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January 2004

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Preface

This work forms part of the Initial Site Investigation stage of the hydrogeochemical evaluation carried out at the Forsmark site leading to a Hydrogeochemical Site Descriptive Model (version 1.1). The work was carried out during the period May 2003 to October 2003 by the SKB's Hydrochemical Analytical Group (HAG) consisting of independent consultants and university personnel. Three separate groups within HAG were involved and the evaluation was conducted independently using different approaches ranging from expert knowledge to geochemical and mathematical modelling. During regular HAG meetings the results were presented and discussed. The lack of analytical data to depths below 200 m restricted the modelling to shallow groundwater systems. Despite different modelling approaches the similarities obtained gave added confidence to the modelling results.

Summary

Siting studies for SKB's programme of deep geological disposal of nuclear fuel waste currently involves the investigation of two locations, Forsmark and Simpevarp, on the eastern coast of Sweden to determine their geological, geochemical and hydrogeological characteristics. Present work completed has resulted in model version 1.1 which represents the first evaluation of the available Forsmark groundwater analytical data collected up to May 1st, 2003 (i.e. the first "data freeze"). The HAG group had access to a total of 456 water samples collected mostly from the surface and sub-surface environment (e.g. soil pipes in the overburden, streams and lakes); only a few samples were collected from drilled boreholes. The deepest samples reflected depths down to 200 m. Furthermore, most of the waters sampled (74%) lacked crucial analytical information that restricted the evaluation. Consequently, model version 1.1 focussed on the processes taking place in the uppermost part of the bedrock rather than at repository levels.

The complex groundwater evolution and patterns at Forsmark are a result of many factors such as: a) the flat topography and closeness to the Baltic Sea resulting in relative small hydrogeological driving forces which can preserve old water types from being flushed out, b) the changes in hydrogeology related to glaciation/deglaciation and land uplift, c) repeated marine/lake water regressions/transgressions, and d) organic or inorganic alteration of the groundwater caused by microbial processes or water/rock interactions. The sampled groundwaters reflect to various degrees modern or ancient water/rock interactions and mixing processes.

Based on the general geochemical character and the apparent age two major water types occur in Forsmark: fresh-meteoric waters with a bicarbonate imprint and low residence times (tritium values above detection limit), and brackish-marine waters with Cl contents up to 6000 mg/L and longer residence times (tritium values below detection limit). The meteoric water is found at the surface and at shallow depths and the marine water is found closer to the coast and at depths affected by Baltic Sea water and probably old Litorina Sea water.

The present state of knowledge of the reactive system is that the main water-rock interaction processes that affects the chemistry in the fresh meteoric waters are: 1) decomposition of organic matter, 2) calcite, plagioclase, biotite and sulphide dissolution, 3) Na-Ca ion exchange, and 4) phyllosilicate precipitation probably extremely slow in the present environment. For the brackish-saline groundwaters in contrast, the water/rock interaction processes seem to be less important although this has not been established because of a lack of data. At the moment multiple end-member mixing between marine water, glacial meltwater and a deeper saline water seem to play a significant role.

Based on presently available data, the groundwater sample at 115 m depth, i.e. not representative of repository depths, met the groundwater criterion established by SKB concerning the measured Eh, pH, TDS and Ca+Mg values. The redox system at this depth is controlled by the presence of iron oxides, hydroxides or by sulphide minerals.

In this evaluation the post glacial groundwater scenario model has been updated, the salinity distribution, mixing processes and the major reactions altering the groundwaters have been modelled down to a depth of 200 m and a new Hydrogeochemical Site Descriptive Model version 1.1 has been produced. A 3D groundwater description of the site was not produced at this stage due to a lack of observations reflecting spatial variations. The possibilities to compare and integrate future hydrochemical modelling with hydrogeological modelling has improved due to major development in constructing hydrogeological site models. The salinity distribution in fractures and the rock matrix together with mixing proportions can be compared from two independent models.

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1 Introduction

1.1 Background

SKB is conducting thorough investigations at two candidate sites for the eventual disposal of spent nuclear fuel. These sites are located in the municipalities of Forsmark and Simpevarp and the main objective is aimed at providing detailed proposals of how a deep repository can be constructed and operated. The investigations at Forsmark commenced in 2002 and will take between four and eight years to complete. The programme will include, among other things, drilling down to repository depths.

The site selection and investigation phases encompass a sufficiently large scale in terms of time, space and content to make a breakdown into different stages necessary. During the initial selection phase the site that is considered most suitable for a deep repository is chosen. A few boreholes are drilled as part of an Initial Site Investigation stage and the data they generate enables a decision to be made as to whether the site is still deemed suitable. The site and its immediate surroundings should be between 5 and 10 km^2 in areal extent

Provided that the preconditions set are still good, a Complete Site Investigation stage follows. The main aim is to collate sufficient knowledge about the rock and its properties to enable SKB to produce both a site description and a construction plant description, and also to conduct a safety analysis.

The area's ecosystem is inventoried from ground surface surveys. A decision is also taken as to the major rock types present and the thickness of the soil layer above the bedrock. The surface/near-surface hydrological and groundwater chemistry studies include charting water courses, measuring the water supply and taking water samples.

Drilling is the most extensive activity conducted during the site investigations and also has the biggest environmental impact. Some 10–20 percussion boreholes will be made to a maximum depth of 200 m, and an equal number of cored boreholes between 500–1000 m in depth. Most of the boreholes will be 76 mm in diameter. Numerous different kinds of investigations and measurements are performed during the drilling work.

1.2 Scope and Objectives

The aim of the site modelling is to develop a Hydrogeochemical Site Descriptive Model according to the Strategy for the Development of a Hydrogeochemical Site Descriptive Model /Smellie et al, 2002/. The first such model for Forsmark was the "version 0" model /SKB, 2002/. For groundwater chemistry there were no samples available from the actual site so the conceptual model was based on data from nearby sites and interpretation of the post-glacial events.

This model version (version 1.1) represents the first evaluation of the available Forsmark groundwater analytical data collected up to May 1st, 2003 (i.e. the so called "data freeze"). The HAG group had access to a total of 456 water samples mostly collected from the surface and sub-surface environment (e.g. soil pipes in the overburden, streams and lakes); only a few samples were collected from drilled boreholes. The deepest samples reflected depths down to 200 m. When sampled most of the waters (74%) lacked crucial analytical information that restricted their evaluation. Consequently, model version 1.1 focussed on the processes taking place in the uppermost part of the bedrock rather than at repository levels.

The work presented here forms part of the Initial Site Investigation stage and the derived model represents the first model based on measured data from the site investigation programme. As the investigations progress over the next months and years, several updated models will be derived based on groundwater samples from new boreholes and repeated sampling from existing boreholes.

1.3 Setting

The Forsmark site is situated about 150 km north of Stockholm and is located within the confines of the Forsmark nuclear power plant facility. Located in the same area is the world's first underground storage (SFR) for low and medium active radioactive waste. The facility was constructed by SKB 50 m below the seafloor in crystalline bedrock during 1983–1988, and has a storage capacity of 63,000 m^3. The waste is from the nuclear power plants, from industrial and research applications of radioactive materials and from hospitals. The candidate area selected for the site investigations is located close to SFR (see Figure 1-1 and Figure 4-1).

1.4 Methodology and organisation of work

1.4.1 Methodology

The main objectives of the Hydrogeochemical Site Descriptive Model for the Forsmark site are to describe the chemistry and distribution of the groundwater in the bedrock and overburden and the processes involved in its origin and evolution. The SKB hydrogeochemistry programme /Smellie et al, 2002/ is intended to fulfil two basic requirements: 1) to provide representative and quality assured data for use as input parameter values in calculating long-term repository safety, and 2) to understand the present undisturbed hydrogeochemical conditions and how these conditions will change in the future. Parameter values for safety analysis include pH, Eh, S, SO_4, HCO_3, PO_4 and TDS (mainly cations), together with colloids, fulvic and humic acids, other organics, bacteria and nitrogen. These values will be used to characterise the groundwater environment at, above and below repository depths. When the hydrogeochemical environment has been fully characterised, this knowledge, together with an understanding of the past and present groundwater evolution, should provide the basis for predicting future changes. The site investigations will therefore provide important source material for safety analyses and the environmental impact assessment for the Forsmark site.

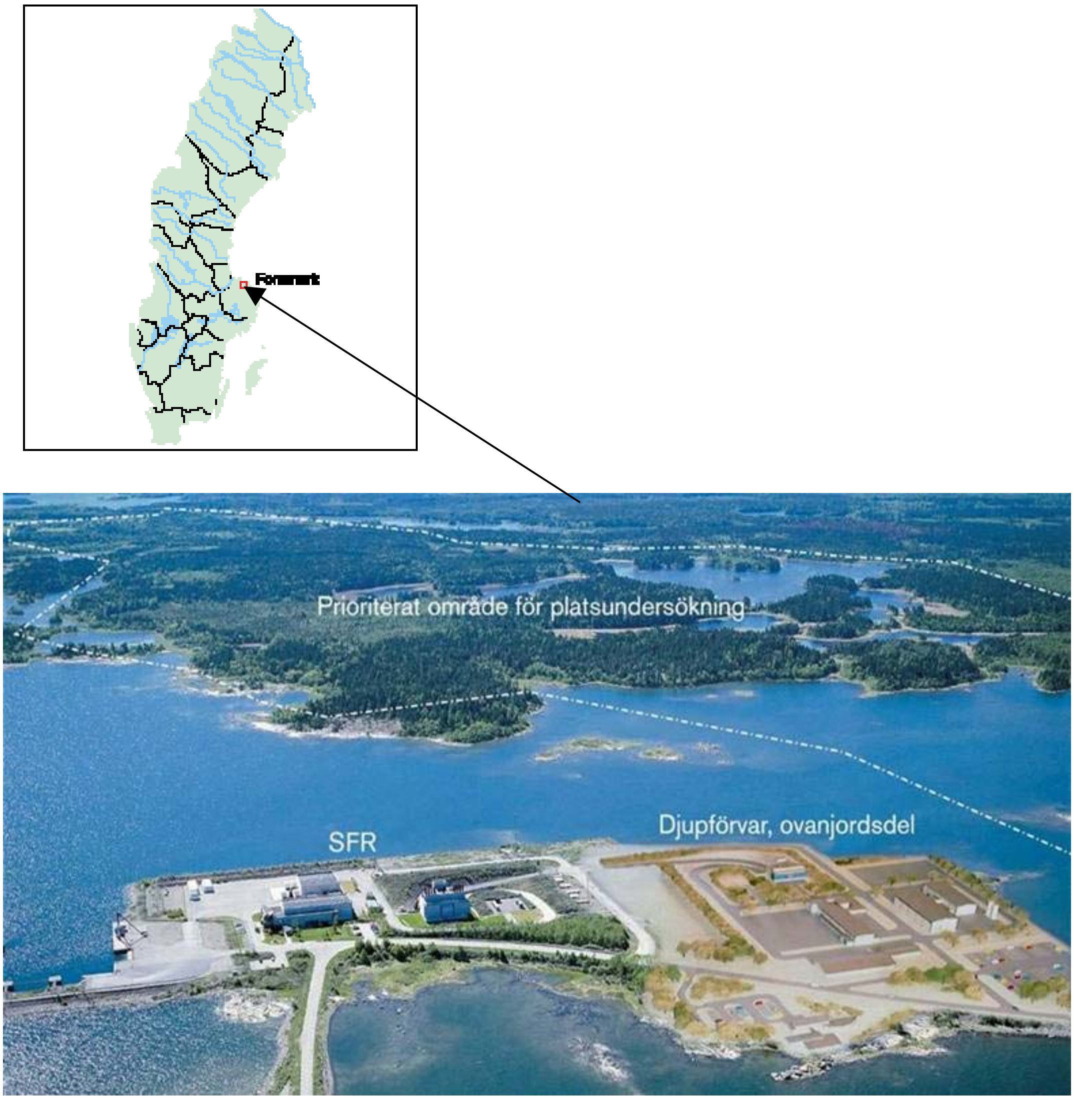

***Figure 1-1.** Location and overview of the Forsmark area showing the candidate area for site investigation (dotted area) and the SFR.*

1.4.2 Organisation of work

This work forms part of the Initial Site Investigation stage (model version 1) of the hydrogeochemical evaluation carried out at the Forsmark site leading to a Hydrogeochemical Site Descriptive Model (version 1.1). Evaluation of the work was carried out during the period May 2003 to October 2003 by the SKB's Hydrochemical Analytical Group (HAG) consisting of independent consultants and university personnel. Three separate groups within HAG were involved and the evaluation was conducted independently using different approaches ranging from expert knowledge to geochemical and mathematical modelling. During regular HAG meetings the results were presented and discussed. The lack of analytical data to depths below 200 m restricted the modelling to shallow water systems. Despite different modelling approaches the similarities obtained gave added confidence to the modelling results presented in this report.

1.5 This report

Chapters 1–7 of this report summarise the hydrogeochemical results collated and interpreted by HAG. These results will serve as input for the final Site Descriptive Model report which will integrate collectively the results from all the geoscientific disciplines. The format and structure of this present report follows that established for the final report.

The main aim of this report is to attempt to integrate the different approaches of the three HAG groups to arrive at an overall interpretation of the presently available Forsmark hydrogeochemical data. Chapter 2 presents an overview of available information prior to this Initial Site Characterisation Stage. This information, presented as Hydrogeochemical Site Descriptive Model version 0, is an integrated result from the site selection studies. Chapter 3 describes the present updated ideas concerning the palaeoevolution of the Forsmark region. Chapter 4 covers the integrated evaluation of the primary hydrogeochemical data and therefore constitutes the main conceptual descriptive input of the Forsmark site. Chapter 5 focuses on the quantitative modelling use of the hydrogeochemical data covering the different modelling approaches attempted, the assumptions made, an evaluation of the uncertainties involved, and how such modelled results can best be visually presented. Chapter 6 summarises the hydrogeochemical description of the Forsmark site and Chapter 7 presents the main conclusions.

The detailed contributions of the three HAG modelling groups are presented in Appendices 1–3. With respect to surface waters, a preliminary modelling has been carried out on Drainage Area 1 and this work is presented as Appendix A at the end of Appendix 2. These results will be included in the ecological description of the site and are therefore not described further in this report. Appendix 4 lists all the groundwater analytical data available at the 'data freeze' point. Appendix 5 shows how the HAG modelling groups utilised the Forsmark data.

2 Available investigations and other prerequisites for the modelling

2.1 Overview

The evaluation of the hydrogeochemical data has been carried out by considering not only the samples from Forsmark site, but in some cases also related to the whole Fennoscandian hydrochemical dataset. For example, selecting the water end-members describing other Fennoscandian sites in order to see how well they compare with the general Forsmark trend and whether or not Forsmark can be interpreted as part of the regional hydrogeochemical system. Consequently, information from hydrogeochemical model versions based on previously investigated sites in Sweden and elsewhere, and information from ongoing geological and hydrogeological modelling at Forsmark, where included in the evaluation.

2.2 Previous model versions

The first model of the Forsmark site was the Site Descriptive Hydrogeochemical Model version 0 /SKB, 2002/. Although there were few data from the Forsmark regional modelled area to support a detailed hydrogeochemical site descriptive model, post-glacial events believed to have affected the groundwater evolution and chemistry at Forsmark show similarities with other Fennoscandian sites. Hence, the major post-glacial stages, all of which have been identified at the Äspö, Finnsjön, Gideå, Hästholmen and Olkiluoto sites, are considered relevant for the hydrogeochemical evolution of the Forsmark area (Figure 2-1). The major stages were:

- The continental ice melted and retreated and glacial melt water flushed the bedrock (> 13,000 BP). At great depths (> 800 m) glacial melt water was mixed with ancient brine groundwater in the bedrock. A saline groundwater with a glacial signature was formed at the interface and fresh glacial water was present in the upper part of the bedrock.

- The flushing on the mainland started directly after the deglaciation commenced. However, since the sites were below the prevailing sea level, the post-glacial marine transgression stages of the Baltic Sea and the Litorina Sea affected the groundwater composition. The continuous shoreline displacement has elevated the site to its present-day altitude above the sea level. The increasing hydraulic flushing has created a mixture of existing groundwater types, i.e. glacial, brine, marine and meteoric groundwaters.

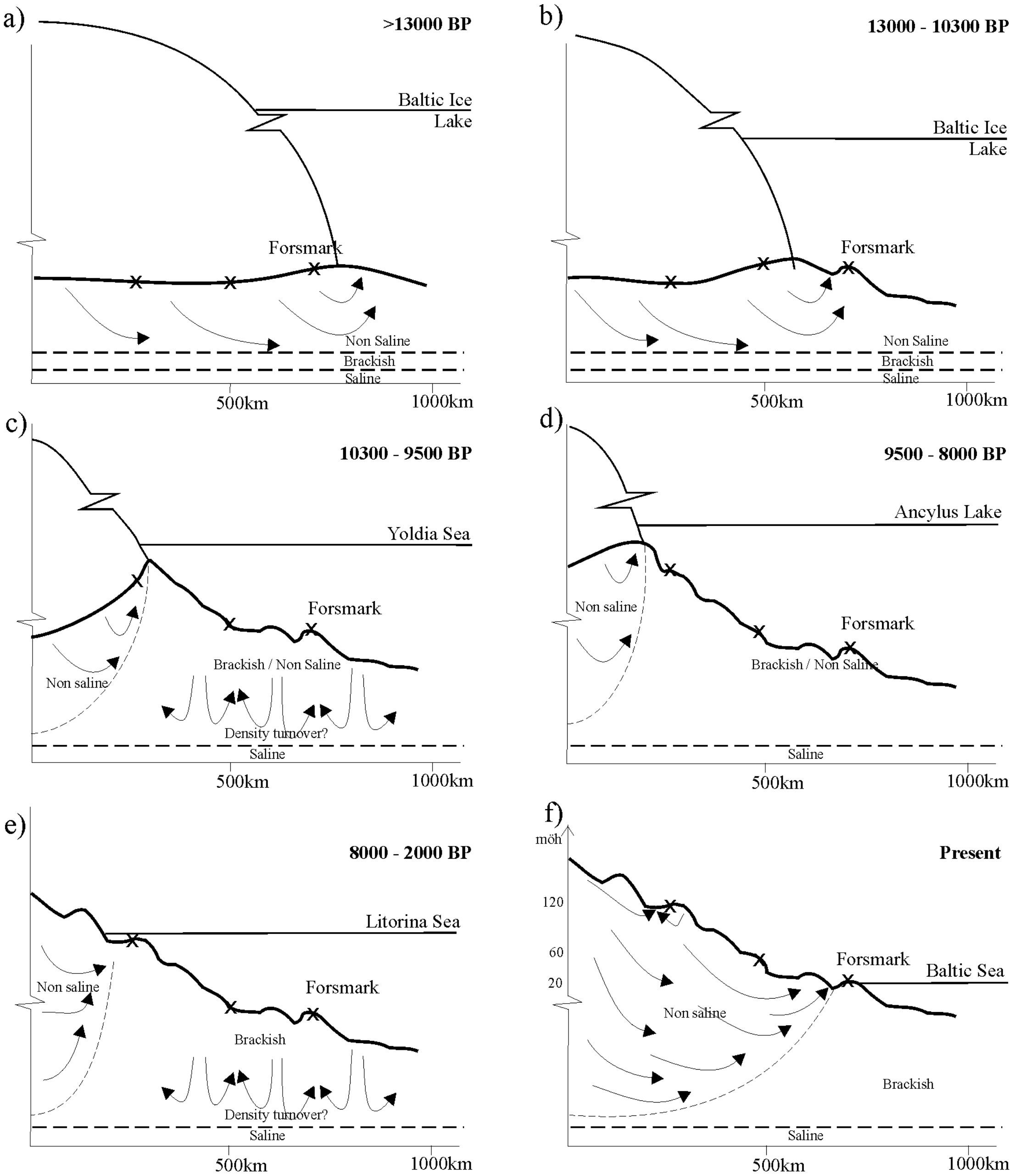

__Figure 2-1.__ Postglacial scenario model for Forsmark was used as the hydrochemical version 0 model for the site /SKB, 2002/.

A more detailed model was presented of the SFR site /Laaksoharju and Gurban, 2003/. Groundwaters have been sampled regularly at SFR and hydrodynamic issues have been addressed. These have been documented and described in, for example, /Nilsson, 2002; Holmén and Stigsson, 2001a,b; Jerling et al, 2001; Kautsky, 2001; Kumblad, 1999; Lindgren et al, 2001; Moreno et al, 2001; Riggare and Johansson, 2001; Stigsson et al, 1999; Andersson et al, 1998a,b; Axelsson and Mærsk Hansen, 1998/.

The modelled present-day groundwater conditions of the SFR site consist of a variable mixture of different water types (see Figure 2-2). The data indicate that all the groundwater at SFR is strongly affected by marine water of different origin and ages. The meteoric (0–1000 BP) portion is located at shallow depths under the land. The marine portion consisting of Litorina Sea water (7000–5000 BP) and Baltic Sea water (0–2000 BP), and Biogenic water (i.e. modern modified sea water) is located in bedrock under the seabed. Underlying this water at a depth of 100–200 m is a mixture of glacial water (> 10,000 BP) and older saline water /Laaksoharju and Gurban, 2003/.

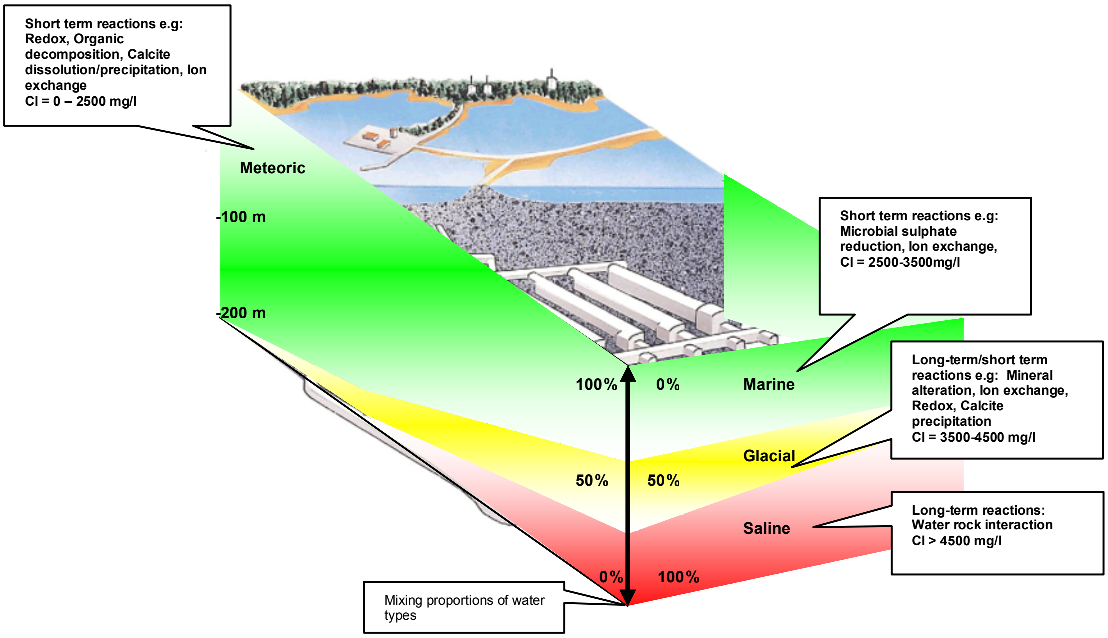

Figure 2-2. *A schematic site descriptive model for SFR based on M3 modelling. The dominating water types, their mixing proportions and the major reactions are indicated. The water types are: Meteoric, Marine (Baltic Sea and Litorina Sea), Glacial and Saline /Laaksoharju and Gurban, 2003/. Note: In reality the groundwater flow is fracture controlled such that the model is restricted in visually representing only a potential map of the distribution of the various water types.*

2.3 Geographical data

The co-ordinates used and made available for the data freeze are listed in Appendix 4. These data were used in the visualisation work.

2.4 Surface investigations

Available QA data reflecting the surface water sampled from lakes, streams, Baltic Sea and soil pipes are listed in Appendix 4.

2.5 Borehole investigations

Available QA data reflecting the groundwater sampled from percussion and core drilled boreholes are listed in Appendix 4.

2.6 Other data sources

Available QA data from the SICADA database reflecting the groundwater conditions at other Swedish sites and Finland /Pitkänen et al, 1999/ were used as background information in the modelling. Information from ongoing geological and hydrogeological investigations at Forsmark was included also in the evaluation.

2.7 Databases

The use of the data in the different modelling work is listed in Appendix 5.

2.8 Model volumes

2.8.1 Regional model volume

The regional model area (Figure 2-3) forms an area 15 km long and 11 km wide (165 km^2) extending in a NE-SW direction. Around 100 km^2, or 60% of the area, is covered by the sea. This regional model area is considered to capture both the upstream and downstream hydrogeological conditions.

2.8.2 Local model volume

The local model area and the candidate area for site investigation is shown in Figure 2-3. The motivation for selection of the local model area is described by /Andersson et al, 2002/.

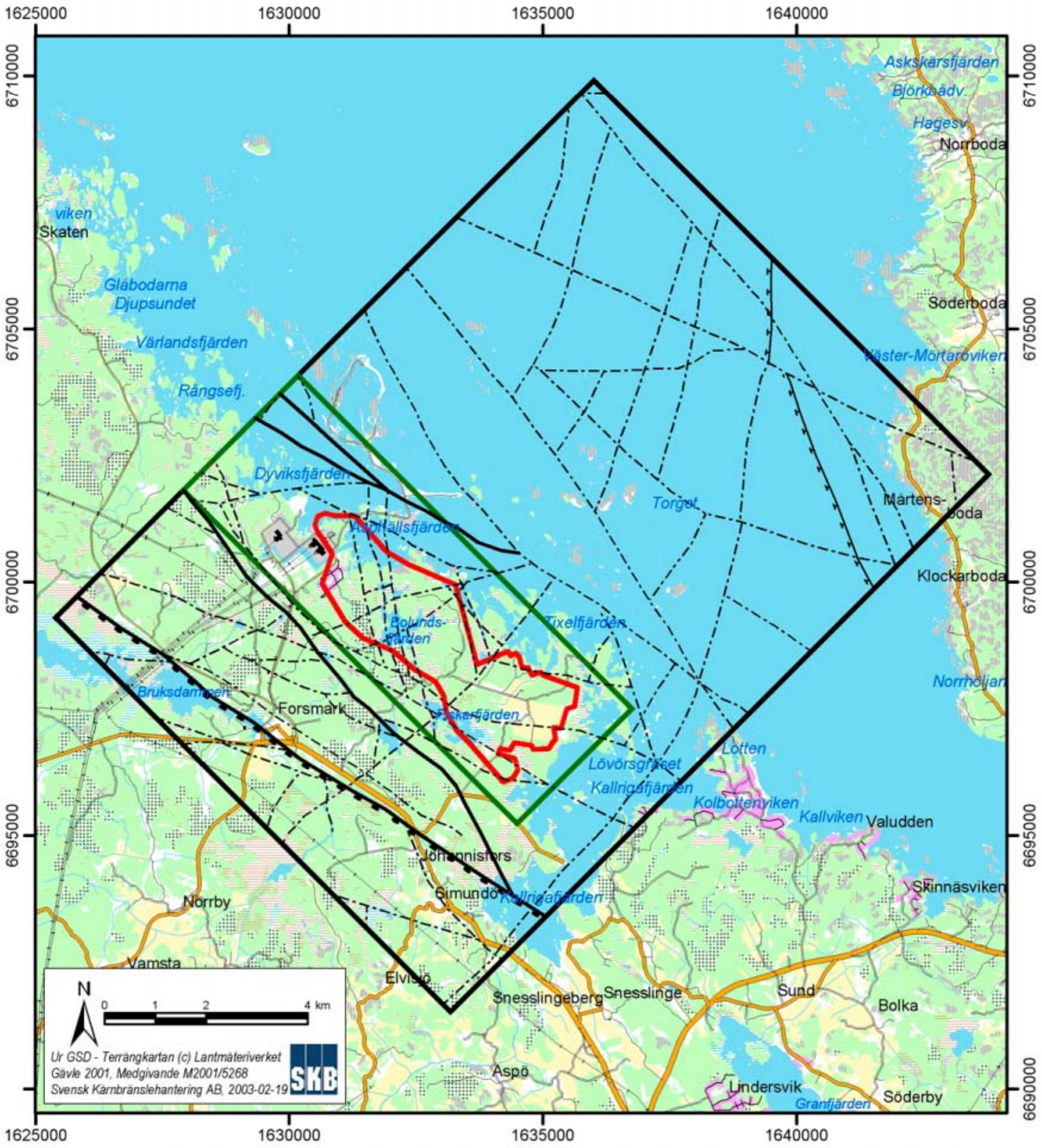

Figure 2-3. *Diagram showing the Forsmark regional model area (in black), the local model area (in green) and the candidate area for site investigations (in red).*

3 Evolutionary aspects of the Forsmark site

3.1 Premises for surface and ground water evolution

The first step in the groundwater evaluation is to construct a conceptual postglacial scenario model (Figure 3-1) for the site. This is based on known palaeohydrogeological events based indiacted by quaternary geological investigations. This model can be helpful when evaluating data since it provides constraints on the possible groundwater types that may occur. The glacial/post-glacial events that might have affected the Forsmark site are based on information from various sources including /Sveriges National Atlas (Berg och Jord) third edition, 2001; Hedenström and Risberg, 2003; Westman et al, 1999; SKB 2002/.

When the continental ice sheet was formed 100,000 BP permafrost formation ahead of the advancing ice sheet probably extended to depths of several hundred metres. According to /Bein and Arad, 1992/ the formation of permafrost in a brackish lake or sea environment (e.g. similar to the Baltic Sea) produced a layer of highly concentrated salinity ahead of the advancing freeze-out front. Since this saline water would be of high density, it would subsequently sink to lower depths and potentially penetrate into the bedrock where it would sink and eventually mix with formational groundwaters of similar density. Where the bedrock was not covered by brackish lake or sea water similar freeze-out processes would occur on a smaller scale within the hydraulically active fractures and fracture zones, again resulting in formation of a higher density saline component which would gradually sink and eventually mix with existing saline groundwaters. Laboratory experiments at the University of Waterloo, Canada, indicate that the volume of high saline water produced from brackish waters by this freeze-out process would be much less than initially considered by Bein and Arads (op cit) and would tend to form restricted pockets of high density saline water rather than a continuous horizon of high salinity in the case of a lake or sea environment.

With continued evolution and movement of the ice sheet, areas previously subject to permafrost would be eventually covered by ice accompanied by a rise in temperature and a slow decay of the underlying permafrost layer. Hydrogeochemically, this decay may have resulted in distinctive signatures being imparted to the groundwater and fracture minerals.

During subsequent melting and retreat of the ice sheet the following sequences of events are thought to have influenced the Forsmark area:

- When the continental ice melted and retreated, glacial meltwater was hydraulically injected under considerable head pressure into the bedrock (> 11,500 BP) close to the ice margin. The exact penetration depth is still unknown, but depths exceeding several hundred metres are possible according to hydrodynamic modelling /e.g. Svensson, 1996/. Some of the permafrost decay groundwater signatures may have been disturbed or destroyed during this stage.

- Different non-saline and brackish lake/sea stages then transgressed the Forsmark site during the period ca. 11,000–500 BP. Of these, two periods with brackish water can be recognised; Yoldia Sea (11,500 to 10,800 BP) and Litorina Sea (9500–2000 BP (continuing to the present)), with Baltic Sea from 2000 to the present. The Yoldia period has probably resulted in only minor contributions to the subsurface groundwater since the water was very dilute and brackish from the large volumes of glacial meltwater it contained. Furthermore this period lasted only for 700 years. The Litorina period in contrast had a salinity maximum of about twice the present Baltic Sea and this maximum prevailed at least from 7000 to 5000 BP; during the last 2000 years the salinity has remained almost equal to the present Baltic Sea values /Westman et al, 1999 and references therein/. Dense brackish seawater such as the Litorina Sea water was able to penetrate the bedrock resulting in a density turnover which affected the groundwater in the more conductive parts of the bedrock. The density of the intruding seawater in relation to the density of the groundwater determined the final penetration depth. As the Litorina Sea stage contained the most saline groundwater, it is assumed to have had the deepest penetration depth eventually mixing with the glacial /brine groundwater mixtures already present in the bedrock.

- When the Forsmark region was subsequently raised above sea level 1000 to 500 years ago, fresh meteoric recharge water formed a lens on top of the saline water because of its low density. As the present topography of the Forsmark area is flat and the time elapsed since the area raised above the sea is short, the out flushing of saline water has been limited and the freshwater lens remains at shallow depths (from the surface down to 25–100 m depending on hydraulic conditions).

Many of the natural events described above may be repeated during the lifespan of a repository (thousands to hundreds of thousands of years). As a result of the described sequence of events, brine, glacial, marine and meteoric waters are expected to be mixed in a complex manner at various levels in the bedrock, depending on the hydraulic character of the fracture zones, groundwater density variations and borehole activities prior to groundwater sampling. For the modelling exercise which is based on the conceptual model of the site, groundwater end-members reflecting, for example, Glacial meltwater and Litorina Sea water composition were added to the data set (cf Appendix 3).

The uncertainty of the updated conceptual model increases with modelled time. The largest uncertainties are therefore associated with the stage showing the flushing of glacial melt water. The driving mechanism behind the flow lines in Figure 3-1 is the shore level displacement which is, in turn driven by the land uplift.

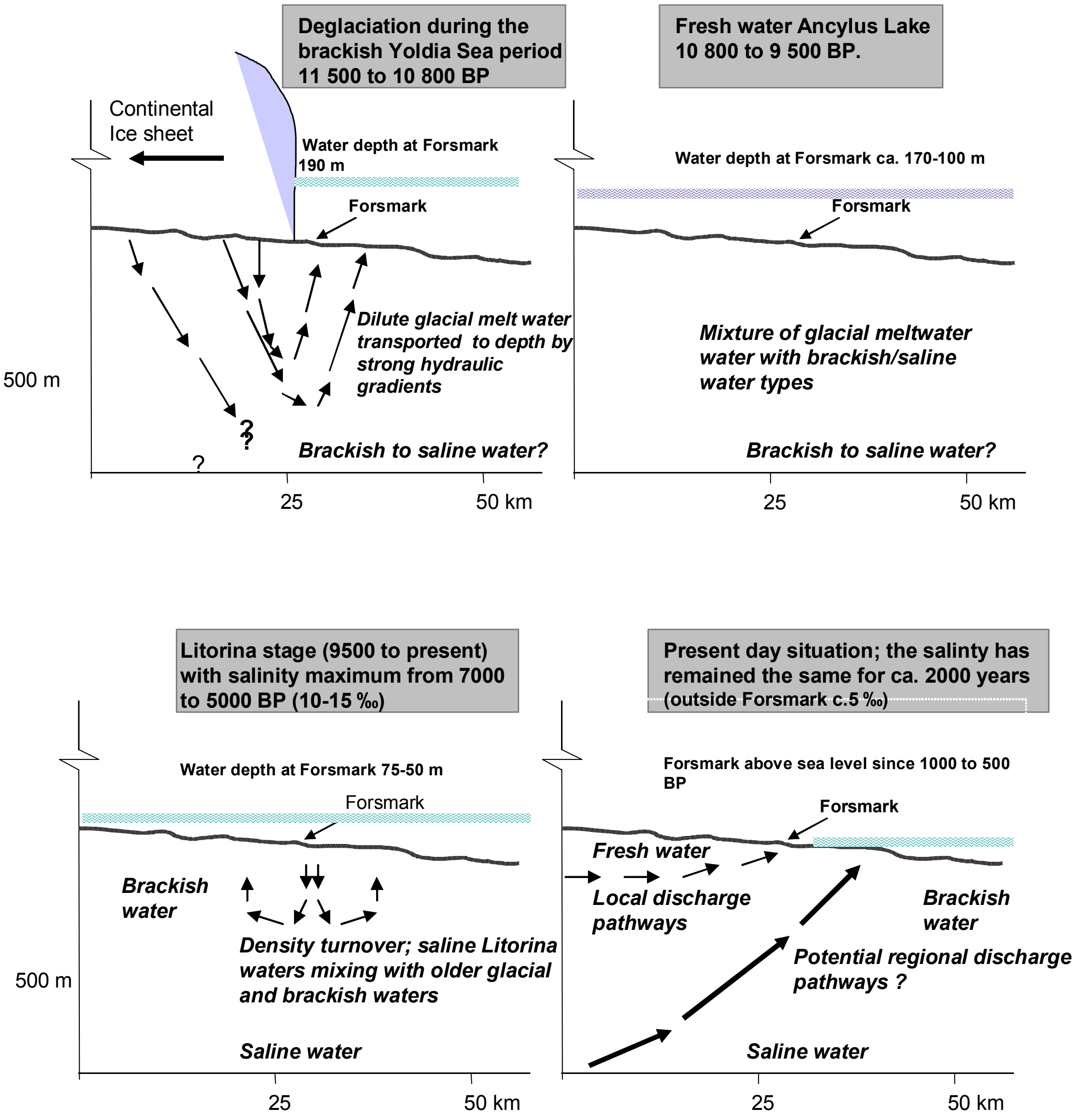

Figure 3-1. An updated conceptual postglacial scenario model for the Forsmark site. The figures show possible flow lines, density driven turnover events and non-saline, brackish and saline water interfaces. Possible relation to different known post-glacial stages such as land uplift which may have affected the hydrochemical evolution of the site is shown: a) Yoldia Sea stage including deglacialtion, b) Ancylus Lake stage, c) Litorina Sea stage, and d) present day Baltic Sea stage. From this conceptual model it is expected that glacial meltwater and deep and marine water of various salinities have affected the groundwater. Based on information from /Sveriges National Atlas (Berg och Jord) third edition, 2001; Hedenström and Risberg, 2003; Westman et al, 1999; SKB, 2002/.

4 Evaluation of primary data

This section describes the evaluation of the primary hydrogeochemical data. Most of these data are waters sampled at various surface locations and in a few boreholes. The evaluation essentially aims at identifying representative datasets which are used for further analysis and providing a first conceptualisation of the origin and evolution of the Forsmark groundwaters.

4.1 Hydrogeochemical data evaluation

The dataset available consists in total of 456 water samples (Appendix 4). Samples reflecting the surface/near-surface conditions (precipitation, streams, lakes, sea water and shallow soil pipe waters) comprise a total of 422 samples. Of the remainder, 21 samples are from percussion drilled boreholes and 13 samples from core drilled boreholes; some of these borehole samples represent repeated sampling from the same isolated location. In conclusion, there is a heavy bias at this stage in the site characterisation of water samples from the surface and near-surface environments. Consequently, hydrochemical evaluation at greater depths is restricted to only a few borehole sampling points which do not achieve expected repository levels.

The sampling locations at the Forsmark site are shown in Figure 4-1 and the sampling and analytical data have been reported by /Nilsson, 2003a,b,c,d/. In the total dataset only 112 surface samples, 5 percussion borehole samples and 2 core-drilled samples were at the time of the “data freeze” analysed for all the major elements, stable isotopes and tritium. This means that 26% of the samples could be used for more detailed evaluation concerning the origin of the water. How the dataset was used in the different models is listed in Appendix 5.

4.1.1 Surface chemistry data

A total of 261 surface water samples were analysed sufficiently and could be used in the detailed evaluation. Analysed data include: major cations and anions (Na, K, Ca, Mg, Si, Cl, HCO_3^- SO_4^{2-}, S^{2-}), trace elements (Br, F, Fe, Mn, Li, Sr, DOC, N, PO_4^{3-}, U, Th, Sc, Rb, In, Cs, Ba, Tl, Y and REEs) and stable (^{18}O, ^{2}H, ^{13}C, ^{37}Cl, ^{34}S, ^{10}B) and radiogenic (^{3}H, ^{14}C, ^{226}Ra, ^{228}Ra, ^{222}Rn, ^{238}U, ^{235}U, ^{234}U, ^{232}Th, ^{230}Th and ^{228}Th) isotopes, but only for some samples. Additionally, for some samples there are nutrients and organics data including NH_4, NO_2, NO_3, N_{Tot}, P_{Tot}, PO_4, poP (particulate organic P), poN (particulate organic N), poC (particulate organic C), Chlorophyll A, Chlorophyll C, Pheopigment, TOC, DOC, DIC and O_2. Water temperature, pH, conductivity, salinity, turbidity and oxygen concentration values were determined in the field. There are no measured Eh values.

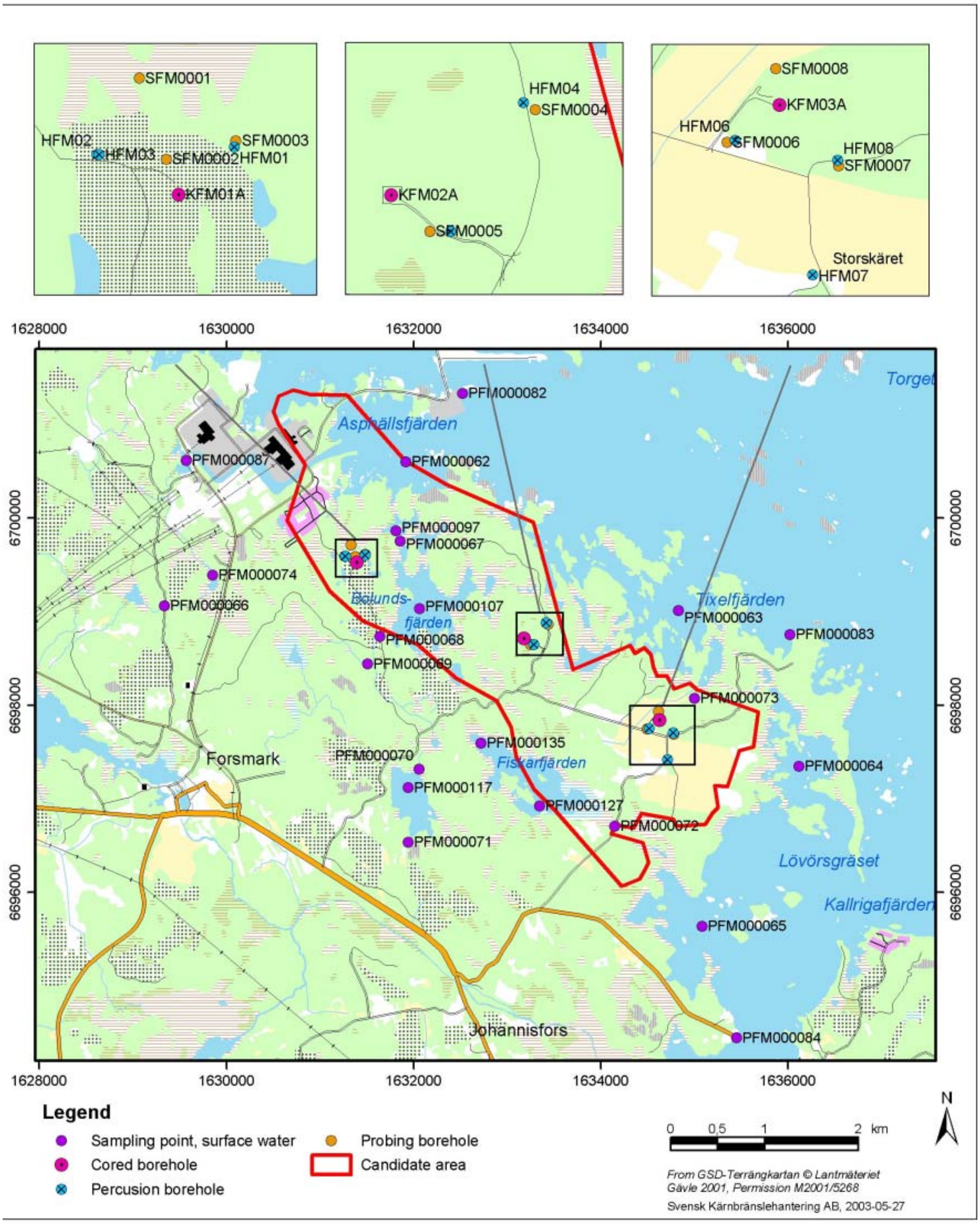

Figure 4-1. *The surface and groundwater sampling locations at the Forsmark site.*

4.1.2 Chemistry data sampled in boreholes

In the data evaluation 45 groundwater samples have been used. The analytical program include: major cations and anions (Na, K, Ca, Mg, Si, Cl, HCO_3^- SO_4^{2-}, S^{2-}), trace elements (Br, F, Fe, Mn, Li, Sr, DOC, N, PO_4^{3-}, U, Th, Sc, Rb, In, Cs, Ba, Tl, Y and REEs) and stable (^{18}O, ^{2}H, ^{13}C, ^{37}Cl, ^{10}B, ^{34}S) and radiogenic (^{3}H, ^{226}Ra, ^{228}Ra, ^{222}Rn, ^{238}U, ^{235}U, ^{234}U, ^{232}Th, ^{230}Th and ^{228}Th) isotopes. Note: The samples were not anlysed for all these elements at the time for the "data freeze" (see Appendix 4).

The different analytical results obtained with contrasting analytical techniques for Fe and S have been confirmed with speciation-solubility calculations and checking their effects on the charge balance. The values selected for modelling were those obtained by ion chromatography (SO_4^{2-}) and spectrophotometry (Fe) assuming that they have no colloidal contribution (as it could be with ICP measurements). The selected pH values correspond to laboratory measurements since no downhole data were available. There is only one measured Eh and temperature value, which have been used in the detailed modelling of one borehole section.

4.1.3 Representativeness of the data

By definition, a high quality sample is considered to be that which best reflects the undisturbed hydrological and geochemical in situ conditions for the sampled section. A low quality sample may include in situ, on-line, at-line, on-site or off-site errors such as contamination from tubes of varying compositions, air contamination, losses or uptake of CO_2, long storage times prior to analysis, analytical errors etc. The quality may also be influenced by the rationale in locating the borehole and selecting the sampling points. Some errors are easily avoided, others are difficult or impossible to avoid. Furthermore, chemical responses to these influences are sometimes, but not always, apparent.

A sampling and analytical protocol is established prior to a sampling campaign. This protocol is based on established sampling routines or special requirements associated with the sampling campaign. The sampling and analytical protocols used in the various sampling campaigns at Forsmark are described by /Nilsson, 2003a,b,c,d/. The analytical precision for the major components: Na, K, Ca, Mg, HCO_3, Cl and SO_4 were checked by ion-balance calculation, where the difference between the anions and cations was calculated. The charge balance calculated for 306 water samples (made both manually and through speciation-solubility calculations with PHREEQC) indicates that only seven samples show percent errors higher than 10%: four surface water samples, one sample from a percussion boreholes (sample 4170 from 50.05 m depth in borehole HFM02) and two samples from soil pipes (sample 4220 from 5.75 m depth in borehole SFM0002 and sample 4221 from 11 m depth in borehole SFM0003).

The pre-sampling Chemac on-line monitoring data concerning pH, Eh, O_2, conductivity and temperature were not available to evaluate the quality and representativeness of the sampled groundwaters. What are available are the percentage flushing water contents for boreholes KFM01A and KFM02. During the sampling period for borehole KFM01A at section 110.00–120.67 m a flushing water content of 7.73% was recorded when sampling commenced; this decreased to less than 1% when the last 5 samples were taken from the same borehole section. From this evidence, therefore, only the first sample collected can be considered doubtful. Borehole KFM02, in contrast, recorded flushing water values of 43.47%, 20.3% and 89% from borehole sections 105.1–159.3 m, 250.00–291.45 m and 248.75–395.88 m respectively, during initial sampling. These high levels of flushing water contamination require great caution when the groundwater data are evaluated, even to the extent of these data being omitted completely.

The drilling event is considered to be the major source for contamination of the formation groundwater. During drilling large hydraulic pressure differences can occur due to uplifting/lowering of the equipment, pumping and injection of drilling fluids.

These events can facilitate unwanted mixing and contamination of the groundwater in the fractures, or the cutting at the drilling head itself can change the hydraulic properties of the borehole fractures. It is therefore of major importance to analyse the drilling events in detail. From this information not only the spiked drilling water can be traced, but also the major risk of contamination and disturbances from foreign water volumes can be directly identified. Too low or excessive extraction of water from a fracture zone prior to sampling can be calculated by applying the DIS (Drilling Impact Study) modelling /Gurban and Laaksoharju, 2002/.

Two sections in KFM01 were the subject of the DIS modelling: 110.1–120.67 m and 176.8–183.9 m. The modelling carried out for these fracture zones was based on the DIFF (differential flow meter logging) measurements and the main aim was to model the amount of the contamination (Figure 4-2) for each fracture zone. Unfortunately, for the first groundwater section sampled (110.1–120.67 m), the drilling data records were erroneous. The labelled water ‘out’ is higher than the labelled volume water ‘in’ and therefore the calculations could not be conducted. The DIS calculations thus were carried out only for the second section in KFM01 (176.8–183.9 m). The DIS calculations showed that this section was contaminated with 2.9 m^3 water of which a maximum of 19.4% consisted of drilling water; the actual results from the sampling showed 17.8% drilling water in the first sample. After removing 2 m^3 of water during sampling the remaining amount of drilling water was still around 4.8%. The DIS calculations indicate that by removing an additional 0.9 m^3 the contaminated water could have been removed from the section. In future the DIS calculations should be performed prior to sampling in order to support and guide the on-going sampling programme.

One fundamental question in modelling is whether the uncertainties lead to a risk of misunderstanding the information in the data. Generally the uncertainties from the analytical measurements are lower than the uncertainties caused by the modelling but the variability during sampling is generally higher than the model uncertainties.

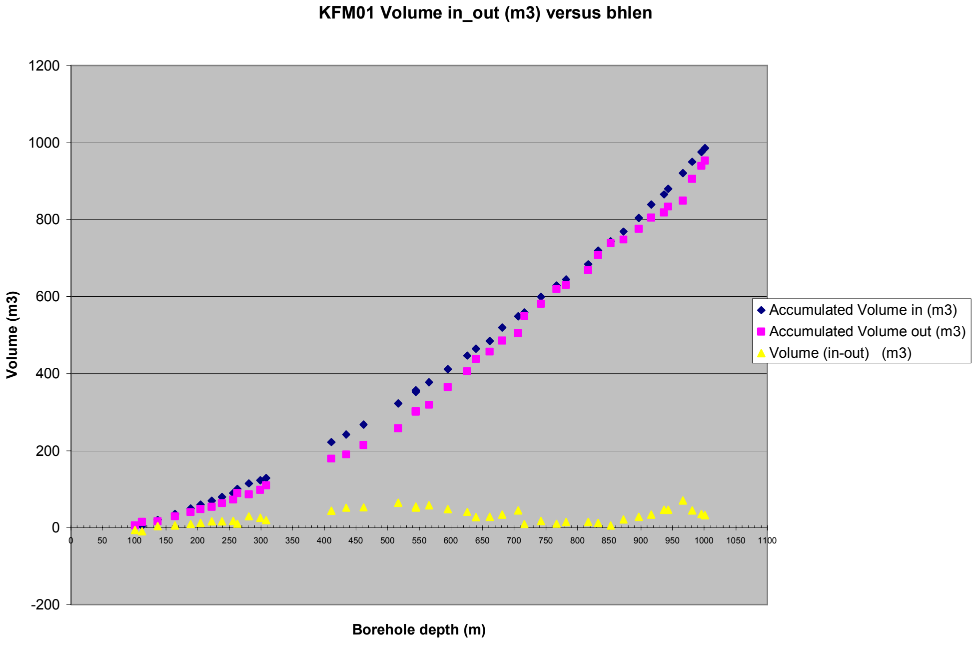

***Figure 4-2.** Drilling water volume pumped in and out from KFM01 (176.8–183.9 m) during drilling.*

4.1.4 Explorative analysis

A commonly used approach in groundwater modelling is to start the evaluation by explorative analysis of different groundwater variables and properties. The degree of mixing, the type of reactions and the origin and evolution of the groundwater can be indicated by applying such analyses. Also of major importance is to relate, as much as possible, the groundwaters sampled to the near-vicinity geology and hydrogeology.

Because of either incomplete data or below detection or suspect values at the time of the 'data freeze', evaluation of, for example the radiogenic isotopes, ^{87}Sr, ^{10}B and REEs and other trace elements, have not been included in this model version 1.1 stage.

Borehole properties

Figure 4-3 illustrates the relation of the borehole KFM01A to the known major structures and hydraulic parameters, and indicates the groundwater sampling location in red. Borehole mapping of drillcore material and downhole BIPS-imaging measurements show that both sub-vertical and sub-horizontal fractures occur but the latter structures are dominant, at least on the scale of the borehole (note that this is a near vertical borehole that underestimates the frequency of steep structures). Fracture minerals consist of quartz, prehnite, laumonite, calcite, analcime, albite, low temperature K-feldspar, chlorite (some very Fe-rich) and pyrite. Clay minerals, although not common, include corrensite (chlorite/smectite mixed layer) ± illite. Some barite and allanite are also sporadically present.

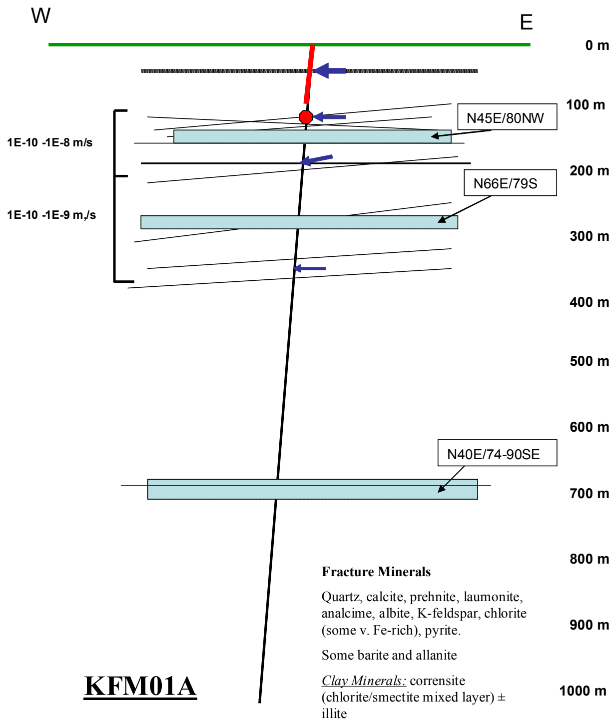

Figure 4-3. *Relation of Borehole KFM01A to the known major structures and hydraulic parameters; groundwater sampling location is indicated in red.*

The sub-horizontal fractures are especially frequent in the upper 350 m of the borehole showing variable dips and strikes and with hydraulic conductivities derived from differential flow meter logging (DIFF); ranging from 10^{-10}–10^{-8} ms^{-1} in the upper 200 m to 10^{-10}–10^{-9} ms^{-1} from 200–350 m. From 350 m to the borehole bottom at 1001.5 m there is only one major sub-horizontal fracture at around 700 m; hydraulic conductivities through this hydraulically tight bedrock length are very low. Borehole KFM01A is cased to 100 m depth which excludes BIPS and DIFF data from this borehole length.

Figure 4-4 shows that one or more of the hydraulically active subhorizontal zones in the upper 100 m of borehole KFM01A can be traced to percussion boreholes HFM03, HFM02 and HFM01, a distance of approx 100 m. Flow rates are exceedingly high at the 50 m level with 1000 L/min recorded in HFM02 and 700 L/min in KFM01A; this decreases to 60 L/min in HFM01. At shallower depths (15–25 m) in HFM02, HFM03 and KFM01A flow rates range from 40 to 200 L/min. Apart from a value of approx 10 L/min at 65 m depth in HFM01, only seepage points characterise greater depths (50–100 m). Since sub-horizontal fracture zones are a common feature of this region, having been documented from nearby Finnsjön some 15 kilometres to the SW /Ahlbom and Smellie, 1991/, similar features should probably be expected at varying depths at the Forsmark site.

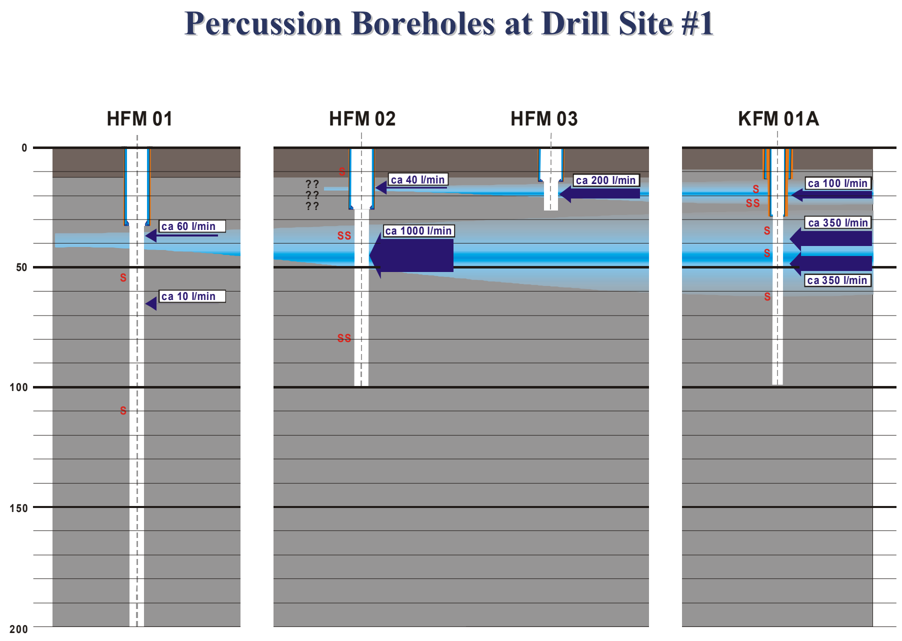

Figure 4-4. *Extrapolation of hydraulically sub-horizontal zones in the upper 100 m from Drilling Site 1. Groundwater flow in L/min is given in blue and seepage points (S and SS) are shown in red.*

Evaluation of scatter plots

The hydrochemical data have been expressed in several X-Y plots to derive trends that may facilitate interpretation. Since chloride is generally conservative in normal groundwater systems its use is appropriate to study hydrochemical evolution trends when coupled to ions, ranging from conservative and non-conservative, to provide information on mixing, dilution, sources/sinks etc. Many of the X-Y plots therefore involve chloride as one of the variables. The following is a preliminary evaluation of the various geochemical and isotopic trends apparent in the Forsmark groundwaters.

The laboratory analytical error in the data plotted is estimated to be ± 5% /cf Smellie et al, 2002/; this is illustrated in Figure 4-8. Note, however, that the very dilute surface and near-surface waters show a misleadingly small error when compared to the more highly mineralised borehole groundwaters.

At this juncture it is useful to define 'Baltic Sea water' since it features prominently in many of the plotted data. As the plots reveal, some of the Baltic Sea data show a large spread to more dilute mixing compositions, and extreme examples exist where only small amounts of Cl are present. Whilst these diluted waters clearly do not represent typical Baltic Sea compositions in the Forsmark area which average around ~ 2600 mg/L Cl, they do represent some coastal Baltic Sea bay localities where there is a large fresh meteoric water input. According to /Samuelsson, 1996/ the salinity of the upper 50 m of open Baltic Sea equivalent to the latitude of Forsmark is ~ 3000 mg/L Cl, therefore the Baltic Sea close to the Forsmark coast (~ 2600 mg/L Cl) represents a somewhat diluted composition. However, since this diluted composition more accurately represents the 'Baltic Sea' composition at the site area, it should be used as the reference or end-member.

General comparison of Cl vs depth with other sites

A general depth comparison of the Forsmark chloride data has been made with the Laxemar (Oskarshamn) and Olkiluoto (Finland) datasets (Figure 4-5). It may be argued that such a comparison should be treated with caution since particularly Laxemar is geographically distant, represents a different hydrogeological regime and involves greater depths; Olkiluoto at least is also located at the coast and appears to have had a similar palaeoevolution to the Forsmark region. However, at great depths (> 1000 m) the Fennoscandian basement hydrogeochemistry probably shares general similarities to the other described sites irrespective of geographic location and therefore Figure 4-5 can serve a useful purpose.

The Laxemar data show dilute groundwaters extending to around 1000 m before a rapid increase in salinity to maximum values of around 47 g/L Cl at 1700 m. Olkiluoto shows an initial sharp increase in chloride at around 150 m which levels off at 5 g/L Cl and continues to 450 m; here there is a relatively steady increase to maximum values of around 20 g/L Cl at 900 m depth (one maximum value of 44 g/L Cl was recorded).

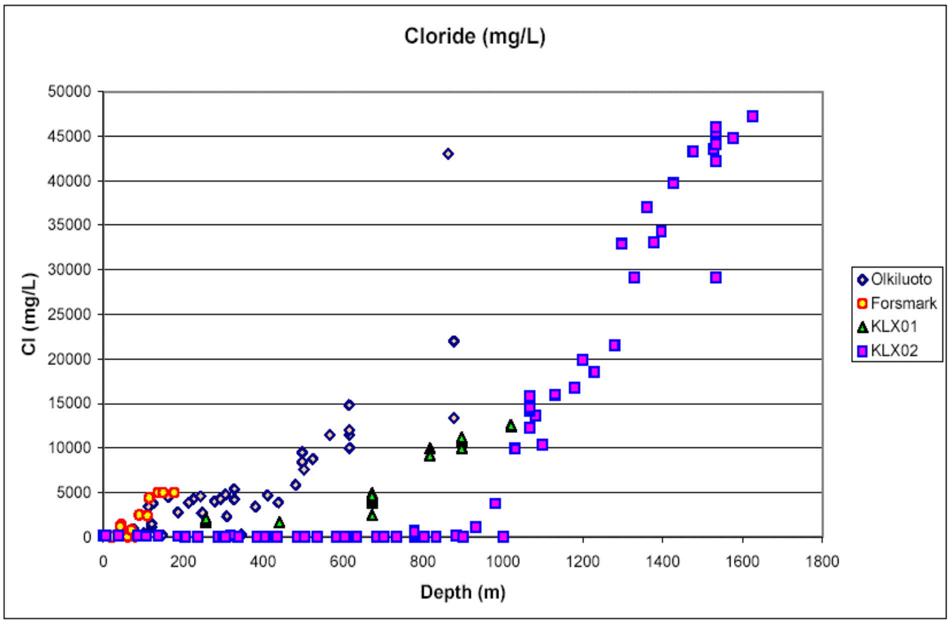

***Figure 4-5.** Depth comparison of chloride between the Forsmark site and the Laxemar (KLX01 and KLX02) and Olkiluoto localities. /Sven Follin, written comm, 2003/.*

The Forsmark data show a close similarity to the initial Olkiluoto trends. It will be interesting to see if this levelling out at around 5 g/L Cl continues with increasing depth. An initial observation at this juncture is that the levelling out at 5 g/L Cl at Olkiluoto has been interpreted as possibly reflecting a Litorina seawater component. This may also be the case at Forsmark due to similarities in palaeoevolution at the two sites.

pH vs Cl

Superficial fresh waters show a wide range of pH values as a consequence of their multiple origin (Figure 4-6). The lowest values are lower than in any other water in the Forsmark area due to the influence of atmospheric and biogenic CO_2. However, pH can also exceed 9 in some superficial waters, as in lake waters, mainly due to photosynthetic activity.

Groundwater samples from core-boreholes and percussion-boreholes show a slightly decreasing trend with chloride, obscured by the dispersion in pH values. Some of the less saline groundwaters have very high pH values, reflecting a superficial imprint. However, the broad scatter of pH values in these groundwaters, especially in the brackish and saline members, can be an artefact consequence of the late measurement of pH in the laboratory instead of in situ. In Appendix 2 the reader can find an analysis of the uncertainties associated with pH values.

Broadly speaking, the main features of the pH trend can be correlated with other Scandinavian sites with similar waters (e.g. Äspö and Olkiluoto; /Laaksoharju and Wallin, 1997; Pitkänen et al, 1999/), also affected by great uncertainties in pH /e.g. Pitkänen et al, 1999/.

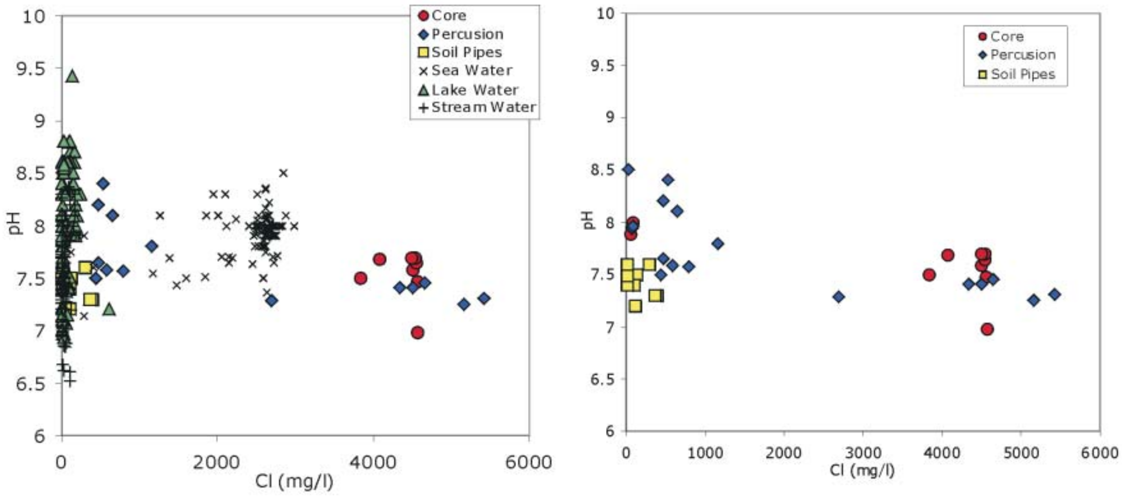

***Figure 4-6.** pH vs chloride content (increasing with depth) in Forsmark waters.*

Alkalinity vs Cl for all Forsmark data

Alkalinity (HCO_3^-) is, together with chloride and sulphate, the other major anion in the system being the most abundant in the non saline waters. Its concentration increases in the surface waters as a result of weathering of e.g. calcite dissolution and the contribution of biogenic CO_2, up to equilibrium with calcite, then, it decreases dramatically with depth (Figure 4-7) Mg vs Cl for all Forsmark data and comparison with other Swedish sites.

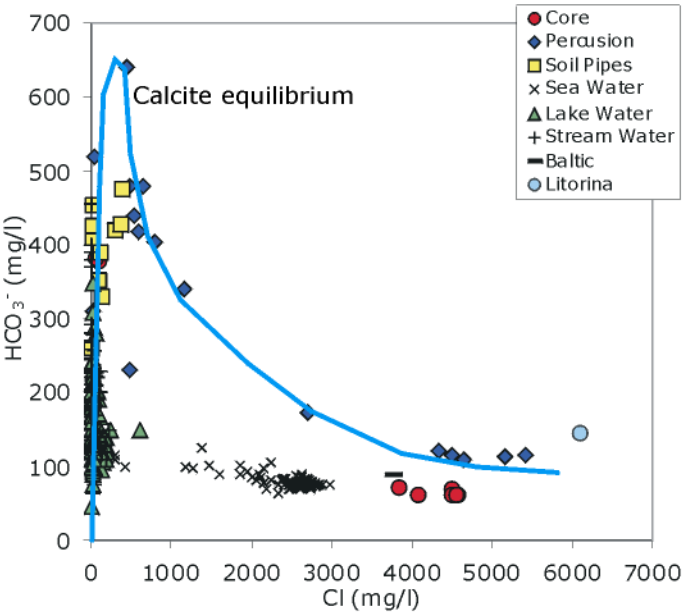

***Figure 4-7.** Plot of alkalinity vs Cl for all Forsmark data.*

Mg vs Cl for all Forsmark data and comparison with other Swedish sites

Figure 4-8 shows two clear trends: a) an obvious modern Baltic Sea water dilution line, and b) a clear borehole saline dilution line distinct from (a).

The Baltic Sea values cluster around 2600 mg/L Cl which is recommended to represent the Baltic Sea end-member composition at the Forsmark site (see discussion above). The plotted data show a large spread to more dilute mixing compositions, and extreme examples exist where only small amounts of Cl are present. These dilute samples represent some coastal Baltic Sea bay localities where there is a large fresh meteoric water input.

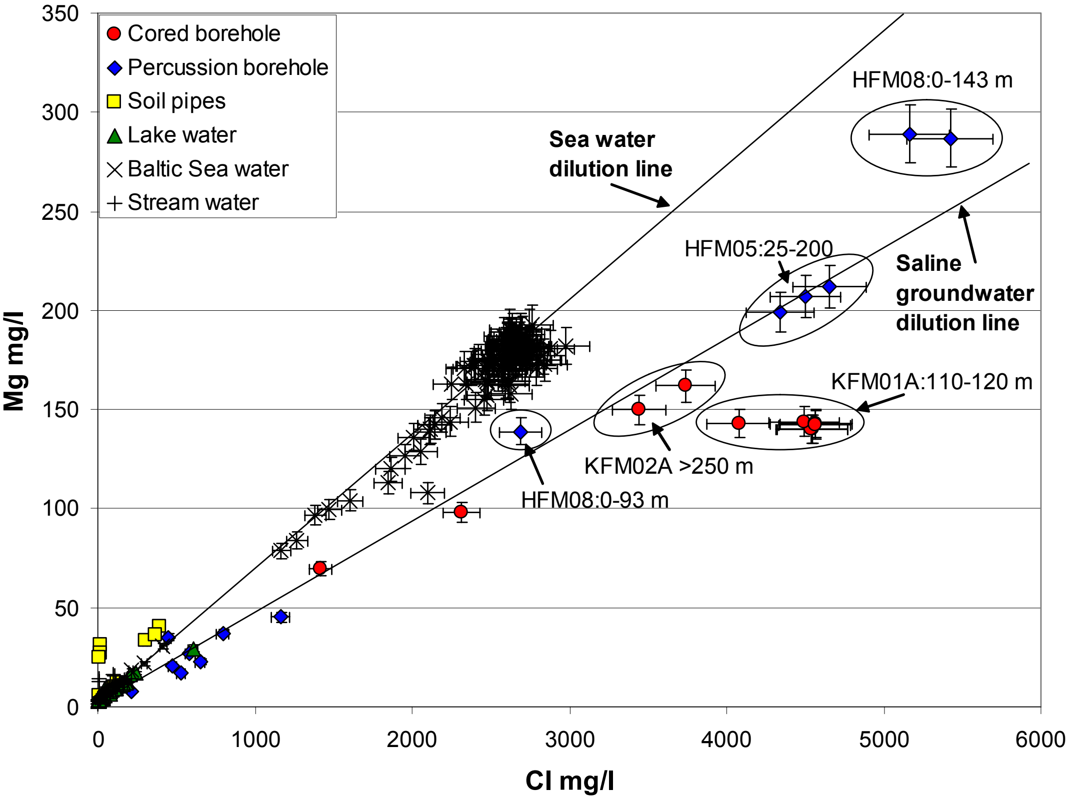

Figure 4-8. Plot of Mg vs Cl for all Forsmark data showing analytical error bars (± 5%).

The borehole data generally plot along a separate saline dilution line with some important exceptions. It is not the case for the KFM01A cored borehole section at 110–120.67 m and for the percussion borehole HFM08 (0–93 m). HFM08 (0–93 m) shows some affiliation to the Baltic Sea water trend, whilst KFM01A shows a greater deviation from the rest of the borehole data by plotting even further away from a Baltic Sea influence. Of particular interest is the Mg and Cl difference between HFM08 (0–93 m) and HFM08 (0–143 m) which can be explained only by the greater depth sampled (some 50 m) in the latter. HFM08 (0–143 m) appears to have penetrated a horizon/pocket/lens of more highly saline water of marine origin where the Mg (~ 290 mg/L) and Cl (~ 5300 mg/L) contents are approaching those estimated values for the Litorina Sea composition (Mg ~ 448 mg/L; Cl ~ 6500 mg/L) as derived by /Pitkänen et al, 1999/. Mixing with a Litorina Sea component may explain the deviation of KFM1A (110–120.67 m), but a deeper, perhaps non-marine saline source, cannot be ruled out at this stage.

A further comment on Figure 4-8 is the close association of some of the Soil Pipe samples to the modern Baltic Sea water dilution line; the other three samples show very little Cl but significant Mg. This may suggest: a) contact with an older marine water followed by cation exchange reactions and later flushing out of chloride, or b) simply water/rock interaction of recharge with minerals in the soil.

Figure 4-9, comparing the Forsmark data with other Swedish sites, underlines the greater Mg contents (> 200 mg/L) associated with the sampled boreholes at Forsmark (e.g. KFR7A) when compared with, for example, the maximum content (~ 175 mg/L) at Äspö (borehole SA2240). This suggests that either Forsmark has better retained its high initial marine-derived Mg than the other Swedish sites, or indicates a greater influence from a later marine component (e.g. Litorina).

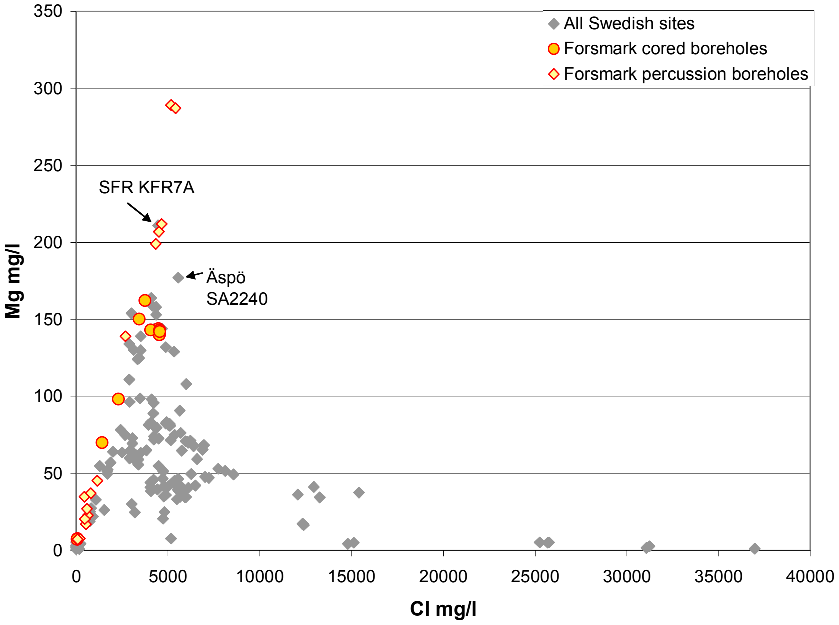

Figure 4-9. *Plot comparing all Forsmark Mg vs Cl data with other Swedish sites.*

Ca vs Cl for all Forsmark data

Figure 4-10, showing Ca vs Cl, differentiates between the Baltic Sea dilution line and a borehole saline dilution line. In common with Figure 4-8 both HFM08 (0–143 m) and KFM01A (110–120.67 m) are anomalous. The generally high Ca contents of the borehole groundwaters (> 500 mg/L) may be explained partly by the influence of ion exchange processes resulting from water-rock reactions in the bedrock. It is unlikely that a Litorina Sea component has contributed since its composition has been calculated to around 150 mg/L Ca /Pitkänen et al, 1999/.

Plots of Ca vs Na and Ca vs Mg (not shown) show similar trends to those described for Figure 4-9.

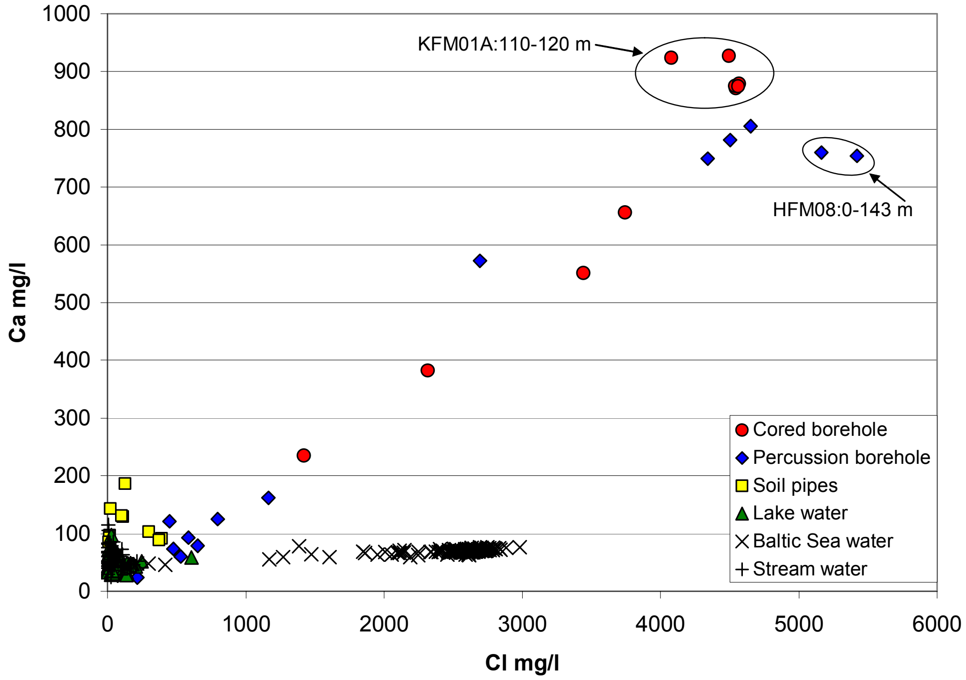

Figure 4-10. *Plot of Ca vs Cl for all Forsmark data.*

SO_4 vs Cl for all Forsmark data

Figure 4-11, showing SO_4 vs Cl, indicates three possible trends: a) an obvious modern Baltic Sea water dilution line, b) a clear borehole saline groundwater dilution trend moving away from (a), and c) a possible low chloride-low sulphate dilution trend incorporating Soil Pipe samples and some Lake/Stream water and shallow percussion borehole samples.

Once again percussion borehole HFM08 (0–143 m) is anomalous recording the highest sulphate content (~ 520 mg/L SO_4) which again suggests some Litorina influence. /Pitkänen et al, 1999/ have estimated a Litorina Sea composition of 890 mg/L SO_4.

The greater scatter of sulphate at lower chloride levels may partly reflect some modern Baltic Sea water influence, some near-surface oxidation of sulphides, and also the variable effects of microbially mediated reactions (e.g. effect of sulphate-reducing bacteria) below and above the geosphere/biosphere interface.

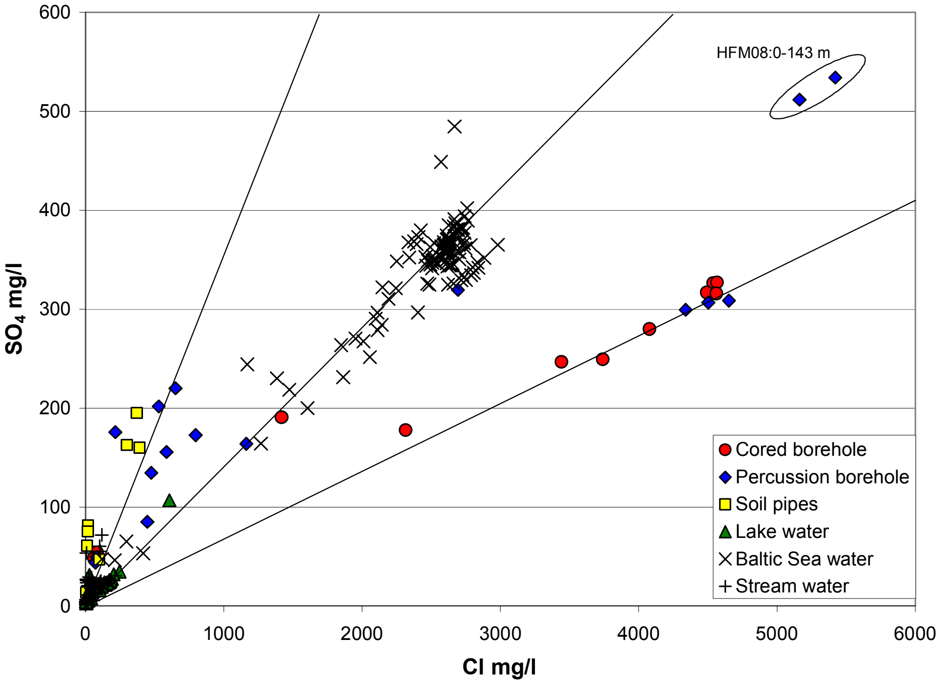

Figure 4-11. *Plot of SO_4 vs Cl for all Forsmark data (SWDL = Sea Water Dilution Line).*

Ca/Mg vs Br/Cl comparing all Forsmark data with other Fennoscandian sites

Plotting Ca/Mg vs Br/Cl (Figure 4-12) indicates those data of marine origin compared to a non-marine or a non-marine/marine mixing origin. For comparison the Forsmark data have been grouped with other Fennoscandian sites (Finnsjön, SFR, Simpevarp, Äspö, Laxemar, Olkiluoto and Stripa); the Yellow Knife-Thompson data have been included since they represent highly evolved basement brines in Canada where a significant marine component is unlikely.

The figure shows clearly the clustering of modern Baltic Sea water values; these can be compared to the other extreme, the Stripa groundwaters, which are considered to be more representative of a non-marine origin since this area was not transgressed by the Litorina Sea or subsequent marine transgressions /Nordstrom et al, 1985/. Between these two extremes fall the range of Finnsjön and Äspö groundwaters considered to have a marine component of varying amount /Smellie and Wikberg, 1991; Laaksoharju et al, 1999c/, and the Olkiluoto groundwaters which lean to a less marine component at greater depths /Pitkänen et al, 1999/. The Simpevarp cored borehole groundwater data plot within the range of the Äspö samples. The Laxemar data, of deep basement origin, plot off the diagram further emphasising their non-marine character.

Collectively the Forsmark borehole groundwaters cluster towards a dominant marine component, more similar to the SFR than the Finnsjön groundwaters, although some Forsmark cored borehole samples do extend towards a slightly less marine component which is significant.

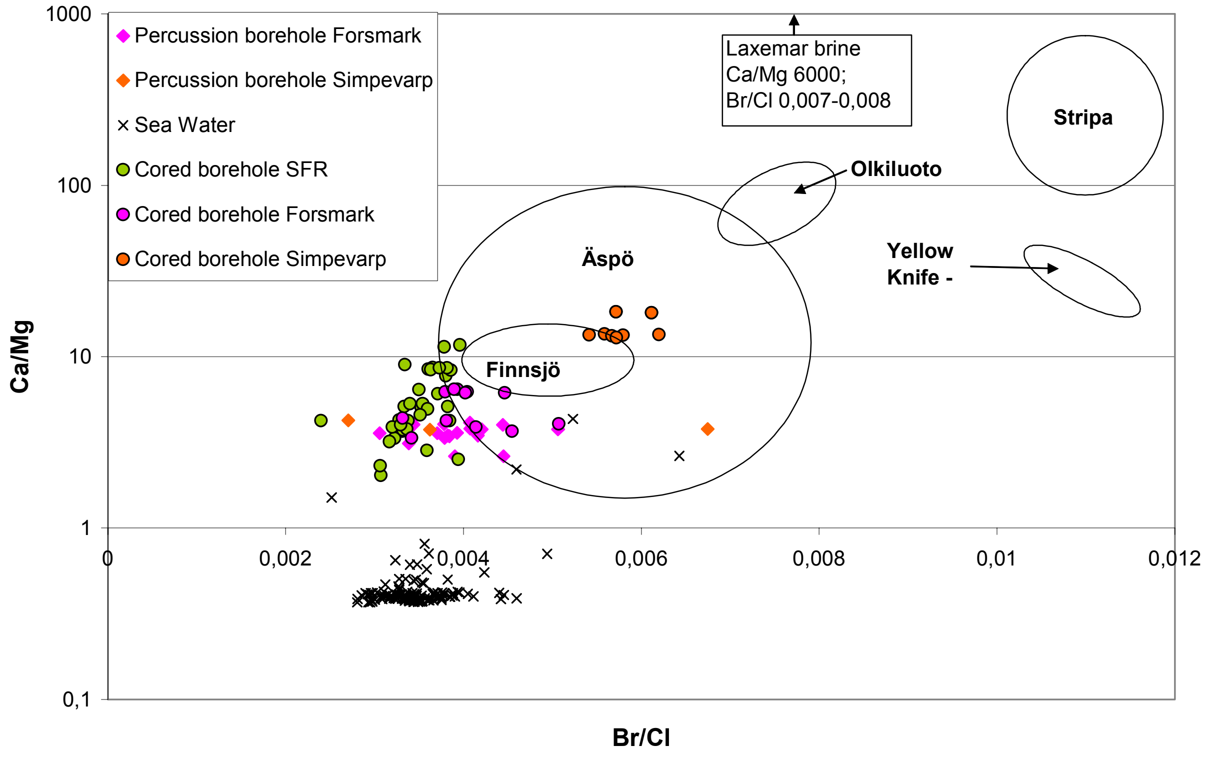

Figure 4-12. Plot comparing all Forsmark Ca/Mg vs Br/Cl data with other Fennoscandian sites and deep Canadian brines.

Ca and Sr vs Cl for all Forsmark data

Ca and Sr vs Cl (Figure 4-13) show a positive correlation with increasing chloride concentration which reflects a common hydrogeochemical source for both cations (similarly for Na). The linear behaviour suggests that mixing is the main process controlling the Ca and Sr contents. The dispersion in Cl values in the groundwaters could be the result of heterogeneous reactions (cation exchange with Na or dissolution/precipitation reactions).

The trend for strontium shows a high correlation with Ca (Figure 4-14) in the groundwaters (but low correlation for superficial waters), suggesting a possible co-precipitation of Sr with calcite as the main reaction process affecting this element.

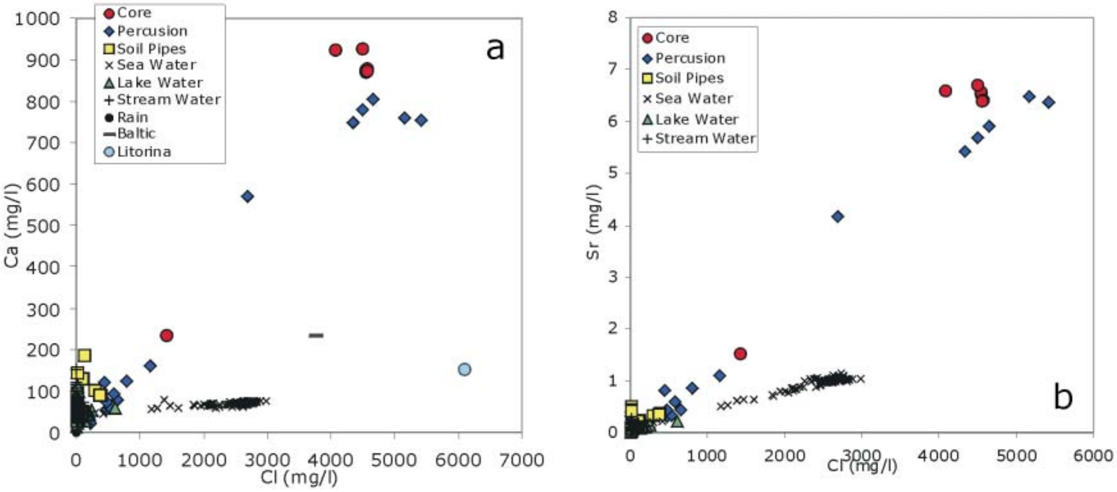

Figure 4-13. Plots of Ca and Sr vs Cl for all Forsmark data.

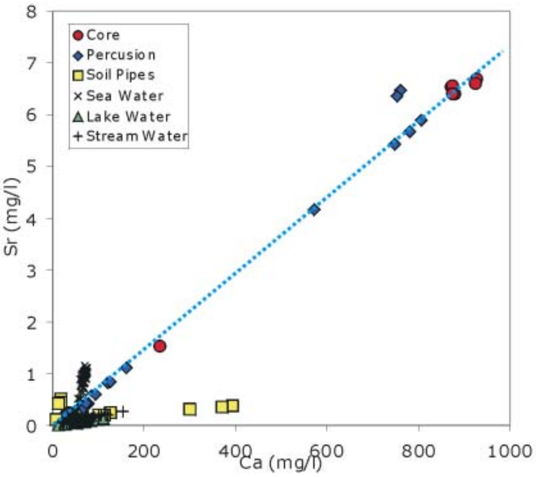

Figure 4-14. Plot of Sr vs Ca for all Forsmark data.

Na vs Cl for all Forsmark data

Sodium shows a positive correlation with chloride concentration, which reflects that mixing is the main process controlling Na contents. In Figure 4-15 two different trends can be seen: 1) an initial trend of weathering followed by mixing with a saline source, and 2) the deviation of groundwaters from the Baltic Sea water dilution line and from the line joining the origin with the Litorina end-member (Figure 4-15). This deviation can be interpreted as a smaller influence of the saline end-member or as a Na removal due to cation exchange reactions.

Si vs Cl for all Forsmark data

The content of dissolved SiO_2 in surface waters indicates a typical trend of weathering, while in groundwaters it has a narrow range of variation indicative of a steady state (Figure 4-16). These two trends are commonly interpreted as the consequence of a reequilibrium process as the residence time of waters increases and water-rock interaction becomes controlled by secondary fracture filling minerals. The general process evolves from an increase in dissolved SiO_2 by dissolution of silicates in surface waters and shallow groundwaters to a progressive decrease related to the participation of silica polimorphs and aluminosilicates in the control of dissolved silica as the residence time of the waters increases.

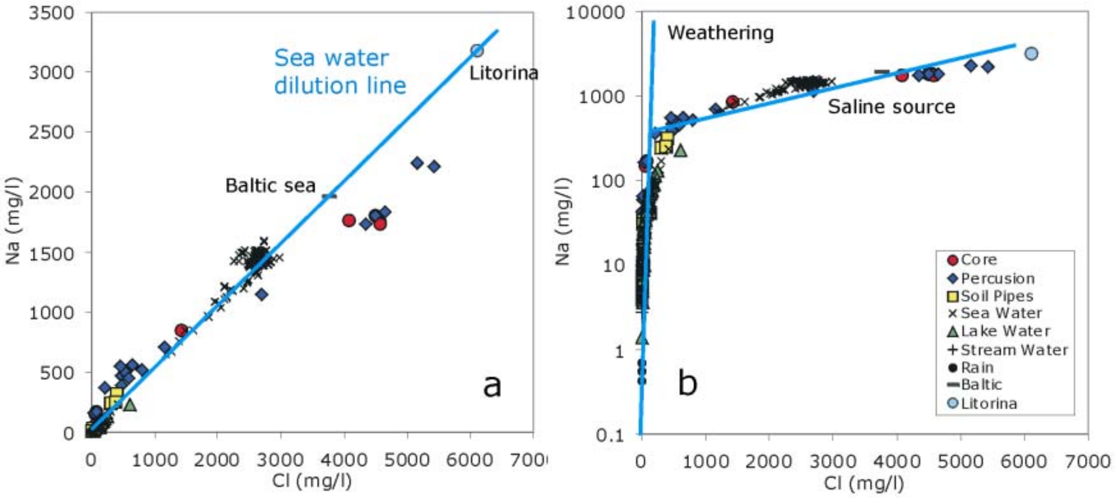

Figure 4-15. *Plot of Na vs Cl for all Forsmark data.*

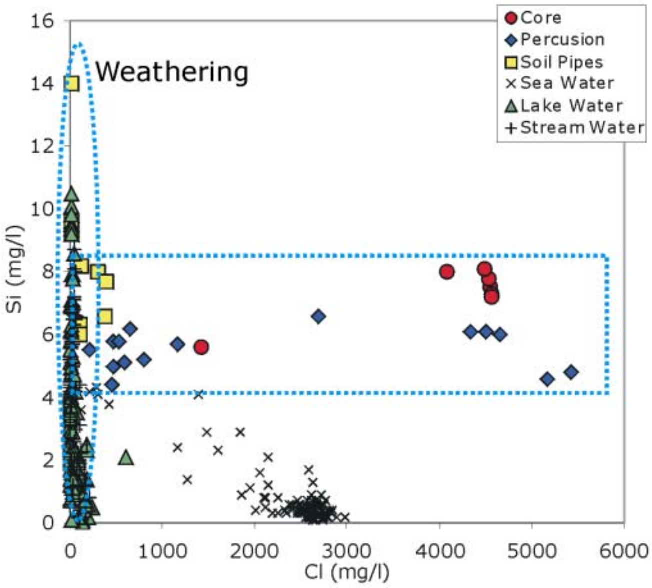

Figure 4-16. *Plot of Si vs Cl for all Forsmark data.*

δD vs δ^{18}O for all Forsmark data and comparison with the Finnsjön and SFR sites

Samples from Forsmark range from δ^{18}O = –14.5 to –4.5‰ SMOW and δD = –102.1 to –44.3‰ SMOW (Figure 4-17). This total range also represents the Lake Waters; the boreholes form a tighter grouping as do the Baltic Sea waters. The majority of the plotted data show a close correlation with the GMWL (Global Meteoric Water Line: δ^2H = 8*δ^{18}O + 10; /Craig, 1961/) generally indicating a meteoric origin. However, much of the Forsmark data, particularly the Lake Water but also some Stream, Soil Pipe and Baltic waters, plot below the GWML. This, according to /Frape and Fritz, 1980/, is due to depleted δD values which suggest surface evaporation; this is supported by the surface origin of the plotted Forsmark samples showing depleted δD. Many of the Lake and Stream water samples show even greater δD depletion values.

Contrastingly, the deeper borehole samples plot close to or on the GMWL with the exception of borehole HFM05 (δ^{18}O = –10.2‰ SMOW; δD = –78‰ SMOW). The reason for this exception is not quite clear but the chemistry of the groundwater suggests mixing with a marine water component.

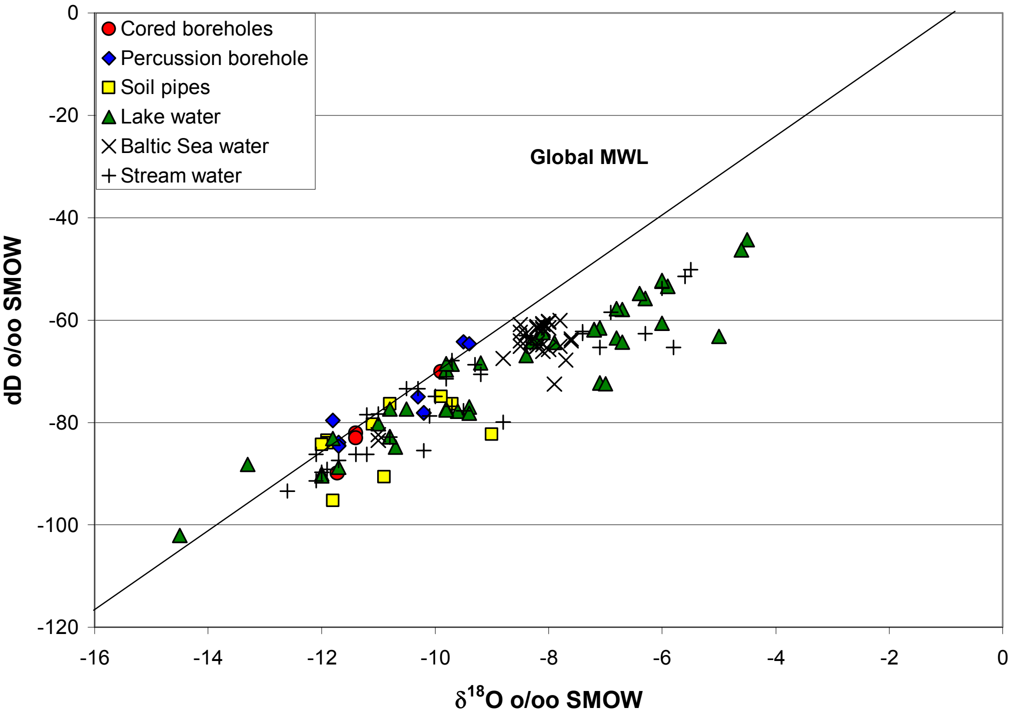

Figure 4-17. *Plot of δD vs δ^{18}O for all Forsmark data (Global MWL = Global Meteoric Water Line).*

Figure 4-18, comparing Forsmark with SFR and Finnsjön data, further illustrates the regional extent of deuterium depletion (i.e. probable surface evaporation effects) at Forsmark. According to /Pitkänen et al, 1999/ similar observations were also noted at Olkiluoto.

δ^{18}O vs Cl for all Forsmark data and comparison with the Finnsjön and SFR sites

Figure 4-19 shows a wide variation of δ^{18}O values at low chloride contents; this is thought to reflect a combination of seasonal fluctuations and mixing of local groundwater discharge (of varying residence times and recharge character) with modern Lake and Stream water sources. With only one exception the Soil Pipe samples tend to cluster at lighter δ^{18}O values (–12 to –11‰ SMOW) which is close to the annual mean precipitation between –11 to –12‰ SMOW. The Baltic Sea water samples typically cluster around 2600 mg/L Cl and –8‰ SMOW.

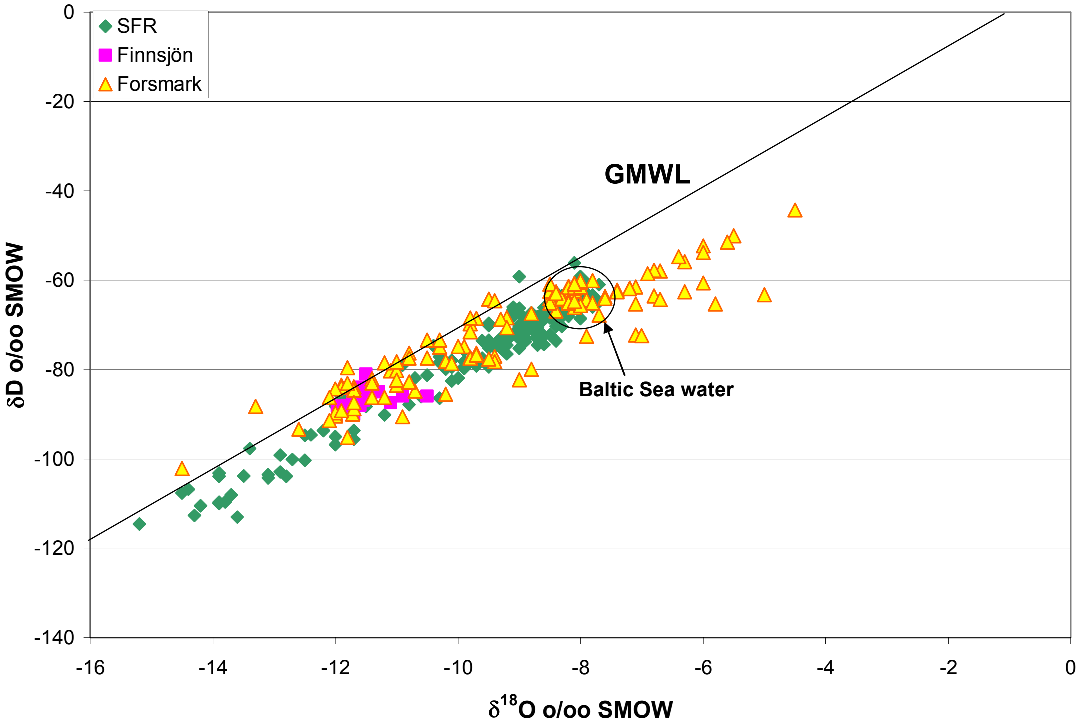

***Figure 4-18.** Plot of δD vs $\delta^{18}O$ comparing Forsmark with Finnsjön and SFR. (GMWL = Global Meteoric Water Line.)*

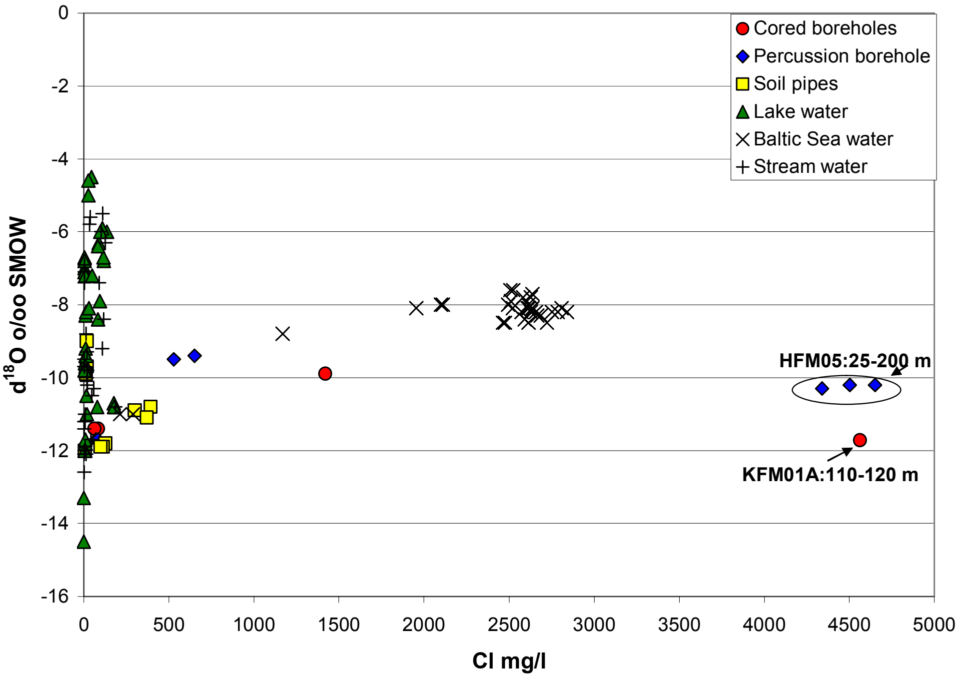

***Figure 4-19.** Plot of $\delta^{18}O$ vs Cl for all Forsmark data.*

The borehole groundwater data show two concentrations; one high chloride (> 4000 mg/L) with δ^{18}O values within the range of –12 to –10‰ SMOW (boreholes HFM05 and KFM01A) and one low chloride (< 1500 mg/L) with δ^{18}O ranging from –12 to –9‰ SMOW. The latter represent mixing with more dilute, surface-derived waters.

The significance of these plotted distributions at Forsmark becomes more apparent when compared to the nearby Finnsjön and SFR data in Figure 4-20. This figure shows two clear clusters representing present meteoric and present Baltic Sea waters; there is a small degree of mixing between the two. The present Baltic Sea water dilution line intercepts the 'x' axis at approx –11.7‰ SMOW, i.e. the average present-day recharge. The remaining data appear to be a scatter, but a dilution line linking a calculated Litorina Sea chloride content (6500 mg/L) with fresh glacial meltwater (δ^{18}O = –25‰ SMOW) does suggest a degree of linear alignment of the SFR data including some of the present Forsmark borehole data which earlier have been identified as potentially containing a significant Litorina Sea component. An increasing brine composition (i.e. more non-marine component) will plot more to the right of the Litorina Sea line as shown by the deeper derived borehole groundwaters from Finnsjön. The scatter between the modern Baltic Sea, Litorina Sea and increasing brine components probably reflects variable mixing processes. Figure 4-20 supports therefore earlier suggestions that there are four main water types or end-members; present Meteoric, present Baltic Sea, an old Litorina Sea component and a deeper, more saline, increasingly non-marine component (Brine). Variable mixing is apparent between all four types.

A (significant?) in-mixing of a cool climate meteoric water (e.g. glacial meltwater) is a probable explanation for the saline water with low δ^{18}O (< 13‰ SMOW) and chloride values around 3500 mg/L. This 'Glacial' component therefore represents the fifth major water type or end-member.

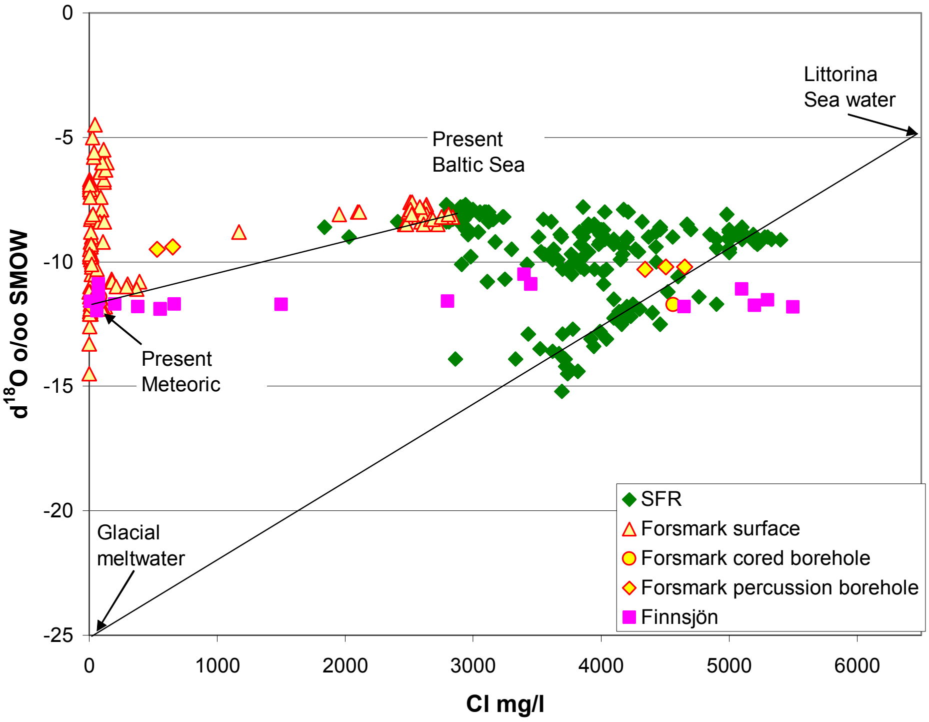

Figure 4-20. *Plot of δ^{18}O vs Cl comparing Forsmark with Finnsjön and SFR.*

δ^{18}O vs tritium for all Forsmark data

Figure 4-21 shows a wide range of δ^{18}O and tritium; the highest tritium value (~ 25 TU), compared to the present-day precipitation average of 10–15 TU, is associated with one of the Soil Pipe samples (SFM0003) and might be interpreted as reflecting a residual high bomb fall-out signature. Two Soil Pipe waters have very low tritium (below detection limit) which might suggest an area of groundwater recharge. Unfortunately there are no corroborative ^{14}C data available for these samples.

The Lake and Stream water samples reflect modern waters of meteoric origin; widespread mixing with waters/groundwaters from different sources has resulted in the observed scatter. Deeper borehole groundwaters (KFM01A; HFM01; HFM05) are older (> 5 TU); shallower borehole groundwaters (10–13 TU) have been influenced by variable mixing with waters that are younger and also with waters with a lighter δ^{18}O signature (present meteoric water).

Generally, the δ^{18}O ranges measured in the surface and near-surface waters may simply represent the seasonal range of present-day precipitation. Long-term seasonal precipitation records are not yet available to help resolve this issue.

The borehole groundwaters analysed record significant tritium (3–12 TU) indicating variable mixing (contamination?) with younger (years) meteoric waters (i.e. probably residual drilling water).

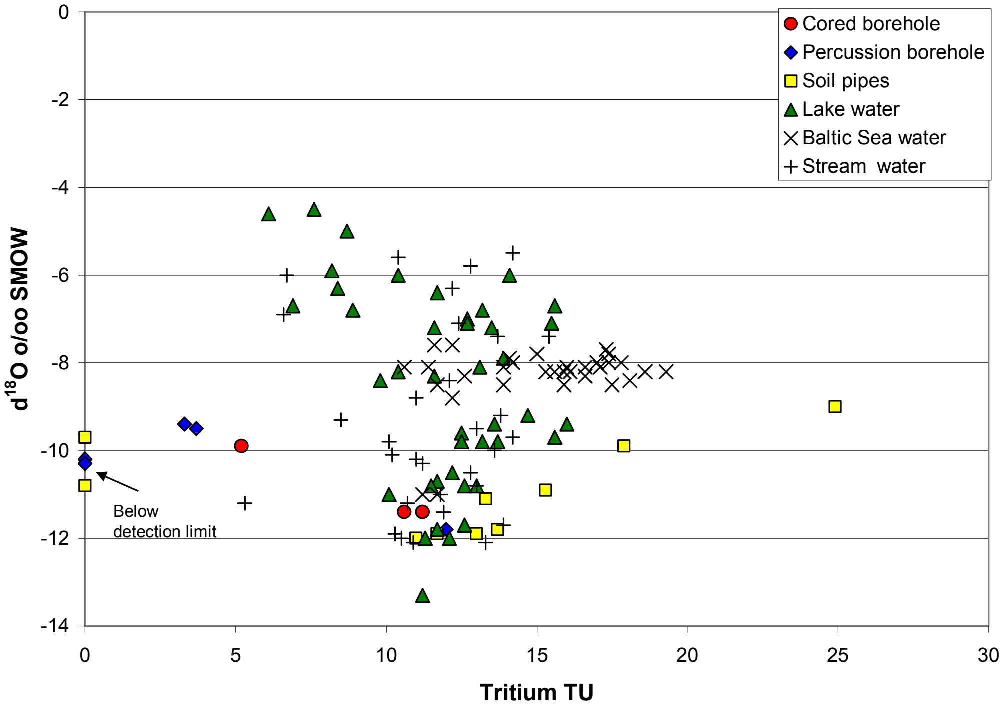

Figure 4-21. *Plot of δ^{18}O vs 3H for all Forsmark data.*

Tritium vs pmC for all Forsmark data

Figure 4-22 shows that almost all of the plotted data fall between 100–120 pmC indicating a modern origin (years); tritium shows a wide scatter of values. Exceptions which plot separately from the main group by virtue of lower tritium contents include the Soil Pipe samples (SFM0001 at 90.2 pmC/15.3 TU; SFM0002 at 85.3 pmC/13.7 TU; SFM0003 at 69.1 pmC/24.9 TU) and the low tritium, low pmC borehole groundwaters (KFM01A at 50.7 pmC/5.2 TU; HFM01 at 46.3 pmC/3.7 TU; HFM01 at 45.2 pmC/3.3 TU). Such values are to be expected from deeper borehole groundwaters, but the Soil Pipe samples are somewhat anomalous. As mentioned above, however, these Soil Pipe samples may be influenced by older discharging groundwaters, or that they have evolved by dissolving some dead carbon from the carbonates in the soil.

Figure 4-22 also indicates a degree of separation in tritium between the three groups of surface waters: a) mostly Baltic Sea water (15–20 TU), b) mostly Lake Water (5–10 TU) and c) Stream water plus overlapping Baltic Sea and Lake waters (10–15 TU). The reason for this is not readily apparent at the moment unless it is the effect of variable surface evaporation.

δ^{13}C vs pmC for all Forsmark data

In Figure 4-23 the δ^{13}C values in the surface waters show that the carbon input ranges from atmospheric (–2 to –5‰) in the Baltic Sea water to biogenic values (around –10‰) for the Lake and Stream waters. Three of the borehole samples analysed (HFM01: 0–71 m and 0–200 m; KFM01A: 0–100 m), all open-hole samples and one Soil Pipe sample, show significantly lower pmC values when compared with the surface waters. This can be explained by dissolution of old calcite, oxidation of old organic material or simply mixing of different waters.

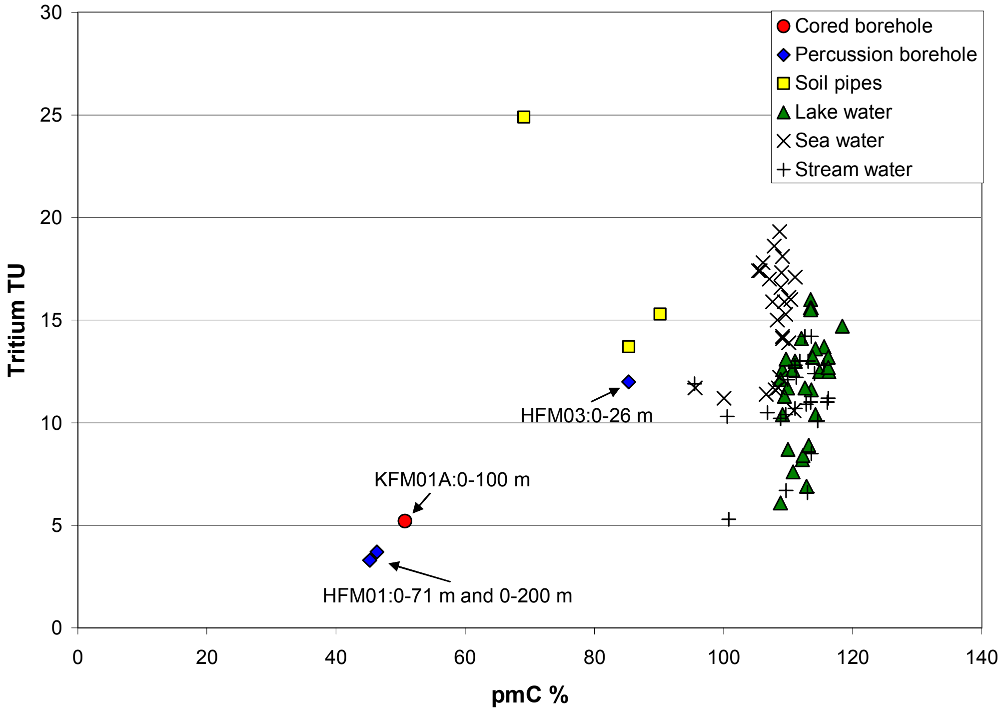

Figure 4-22. *Plot of tritium vs pmC for all Forsmark data.*

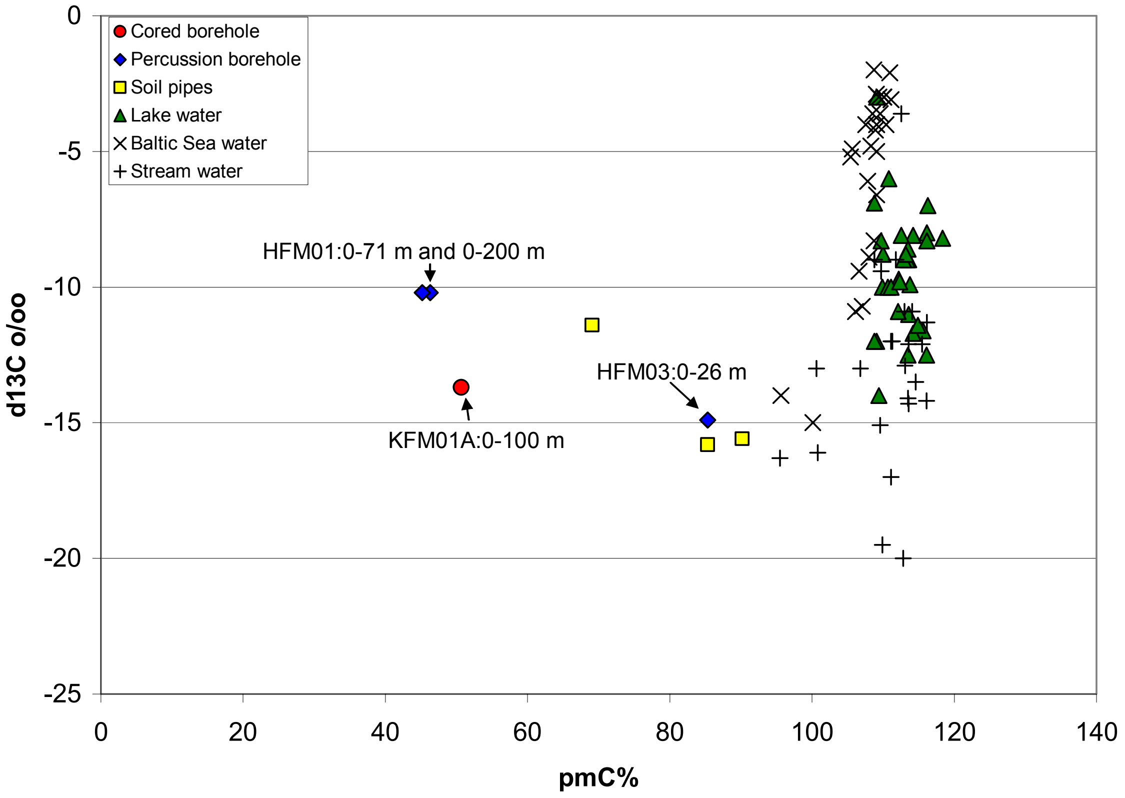

Figure 4-23. *Plot of $\delta^{13}C$ vs pmC for all Forsmark data.*

SO_4 vs $\delta^{34}S$ for all Forsmark data

Figure 4-24 shows a clear distinction between Baltic Sea water values (high SO_4 and $\delta^{34}S$) and Lake/Stream water values (low SO_4 and $\delta^{34}S$). The Soil Pipe samples plot depending on their locality, i.e. possible influence by Baltic Sea water or surface Lake/Stream waters (e.g. KFM02A and HFM04; both these are shallow, open hole samples). The low $\delta^{34}S$ values in the surface waters and the boreholes are in agreement with atmospheric input of SO_4 and possibly with some contribution from oxidation of sulphides. Compared to the Baltic Sea water samples, the decrease in SO_4 and increase in $\delta^{34}S$ indicated in borehole HFM05 might suggest activity of sulphate-reducing bacteria.

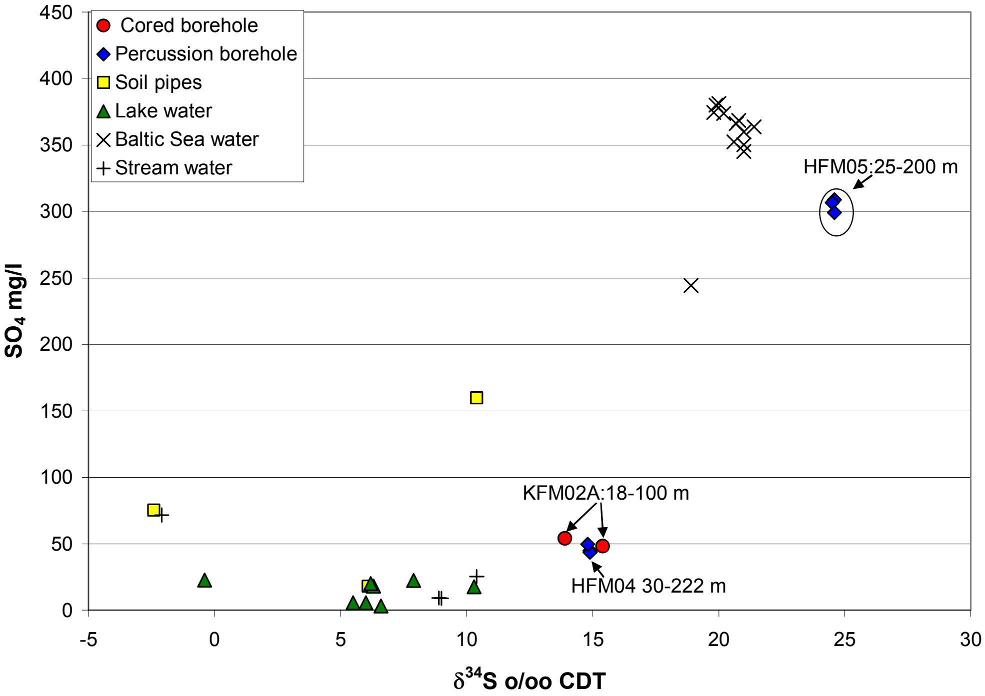

Figure 4-24. *Plot of SO_4 vs $\delta^{34}S$ for all Forsmark data.*

δ^{37}Cl vs Cl for all Forsmark data

Figure 4-25 plots Cl vs δ^{37}Cl for all Forsmark data. According to /Frape et al, 1996/ modern Baltic and possibly palaeo-Baltic waters should be recognised by negative δ^{37}Cl signatures related to salt leachates from Palaeozoic salt deposits south of the Baltic Sea; influence by water-rock interaction tends to result in positive δ^{37}Cl signatures. Taking into consideration the analytical uncertainty of around ± 0.2‰, Figure 4-25 shows that most of the Baltic Sea water data plot around zero; there is however, some emphasis of a negative signature in the remaining data around the 2500 mg/L Cl concentration (i.e. modern Baltic). The large spread of δ^{37}Cl values for the Lake/Stream water samples may be attributed largely to analytical uncertainty at these very low chloride concentrations. Of potential interest are the Lake/Stream water samples and one Soil Pipe sample which plot at –0.5 to –0.3‰ possibly indicating some influence from modern Baltic or palaeo-Baltic waters. Some δ^{37}Cl enrichment may be suggested for the borehole sample (HFM01) at around 500 mg/L Cl; this would be line with water/rock interaction processes.

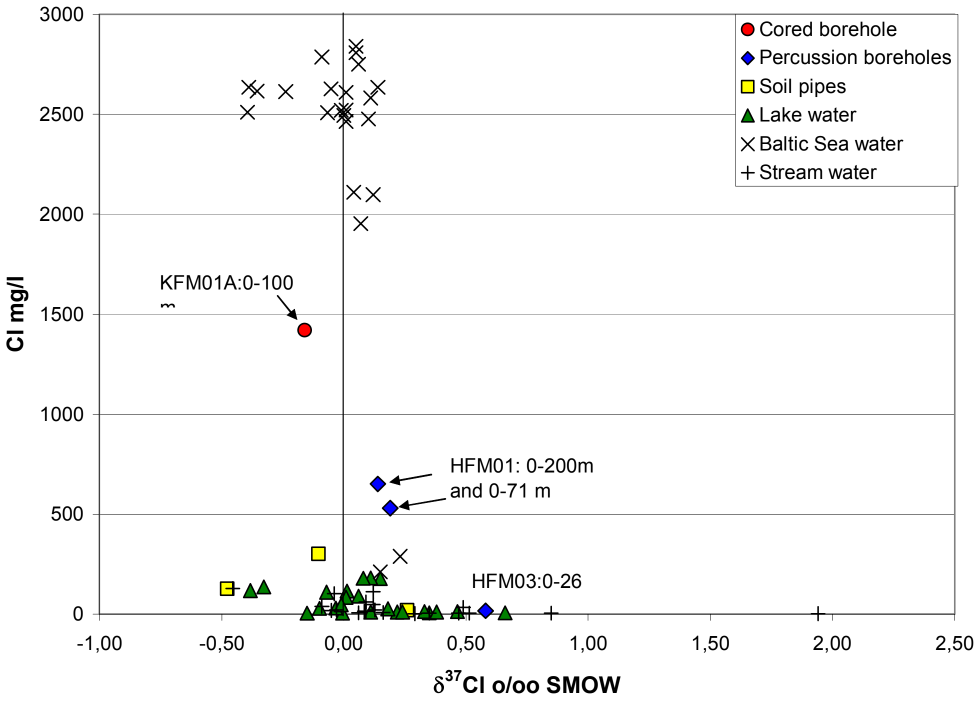

Figure 4-25. *Plot of Cl vs δ^{37}Cl for all Forsmark data.*

Water classification

The aim of water classification is to simplify the groundwater information. First the data set was divided into different salinity classes. Except for sea waters, most surface waters and some groundwaters from percussion boreholes are fresh, non-saline waters according to the classification used for Äspö groundwaters[1]. The rest of the groundwaters are brackish (Cl < 5000 mg/L), except for two samples from percussion boreholes which are saline. Most surface waters are of Ca-HCO3 or Na-Ca-HCO3 type and naturally the sea water is of Na-Cl type. The deeper groundwaters are mainly of Na-Ca-Cl or Na-Cl-HCO3 type. The results of the water type classification of the Forsmark samples are shown in Figure 4-26 and the results are listed for all samples in Appendix 3.

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[1] The Äspö groundwaters were classified into three groups according to the site specific chloride concentrations (Laaksoharju and Wallin, 1997; Laaksoharju et al, 1999c): non-saline groundwater (< 1000 mg/L), brackish groundwater (1000–5000 mg/L) and saline groundwater (> 5000 mg/L).

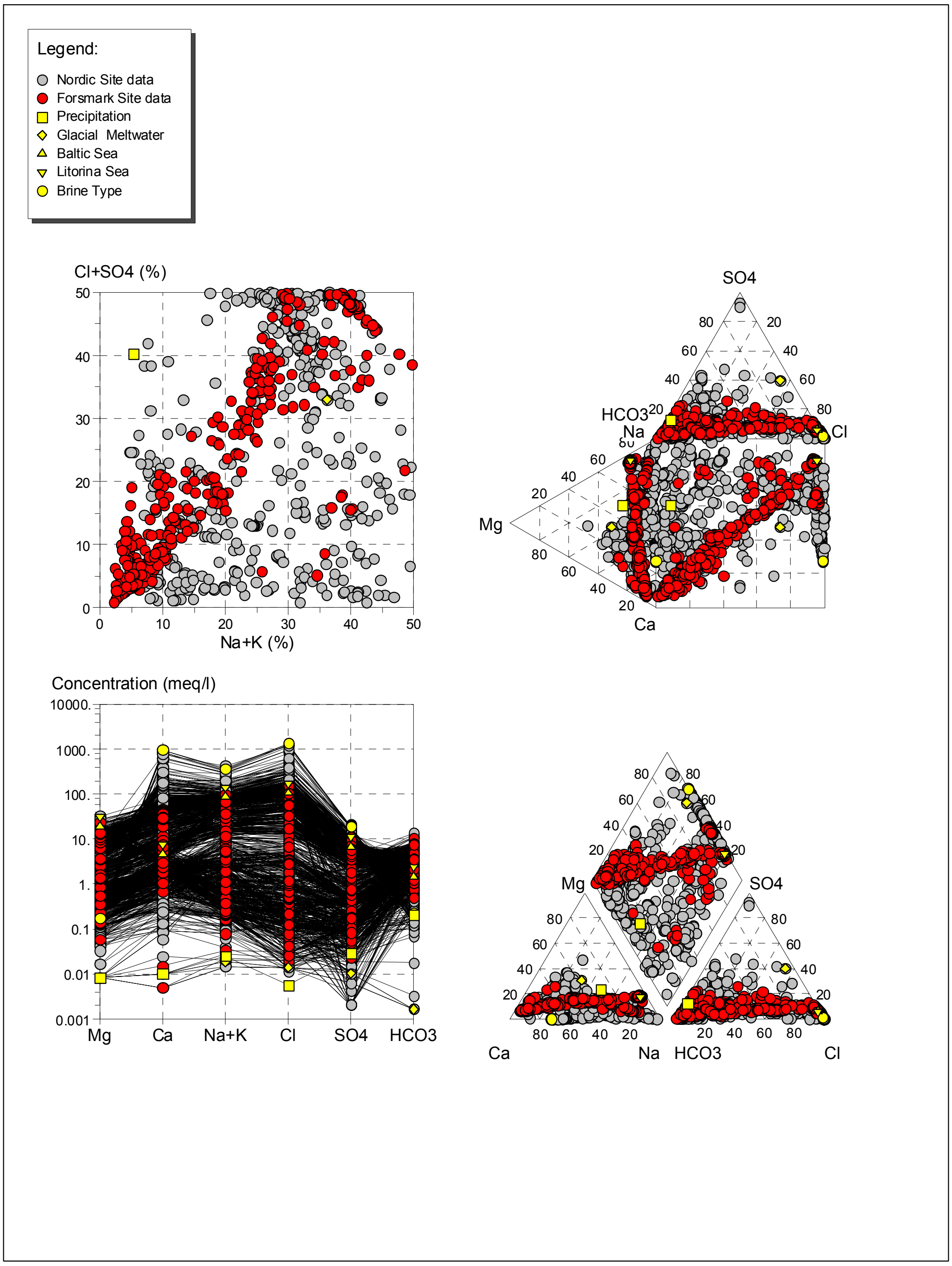

Figure 4-26. Multicomponent plots used for classification of the groundwater data. From top left to top right to bottom left and bottom right: Ludwig-Langelier plot, Durov plot, Shoeller plot and Piper plot applied on all Forsmark data using AquaChem.

5 Descriptive and quantitative modelling

5.1 Hydrogeochemical modelling

The data evaluation and modelling becomes a complex and time-consuming process when the information has to be decoded. Manual evaluation, expert judgment and mathematical modelling must normally be combined when evaluating groundwater information. A schematic presentation of how a site evaluation/modelling is performed and its components are shown in Figure 5-1. The methodology applied in this report is described in detail by /Smellie et al, 2002/.

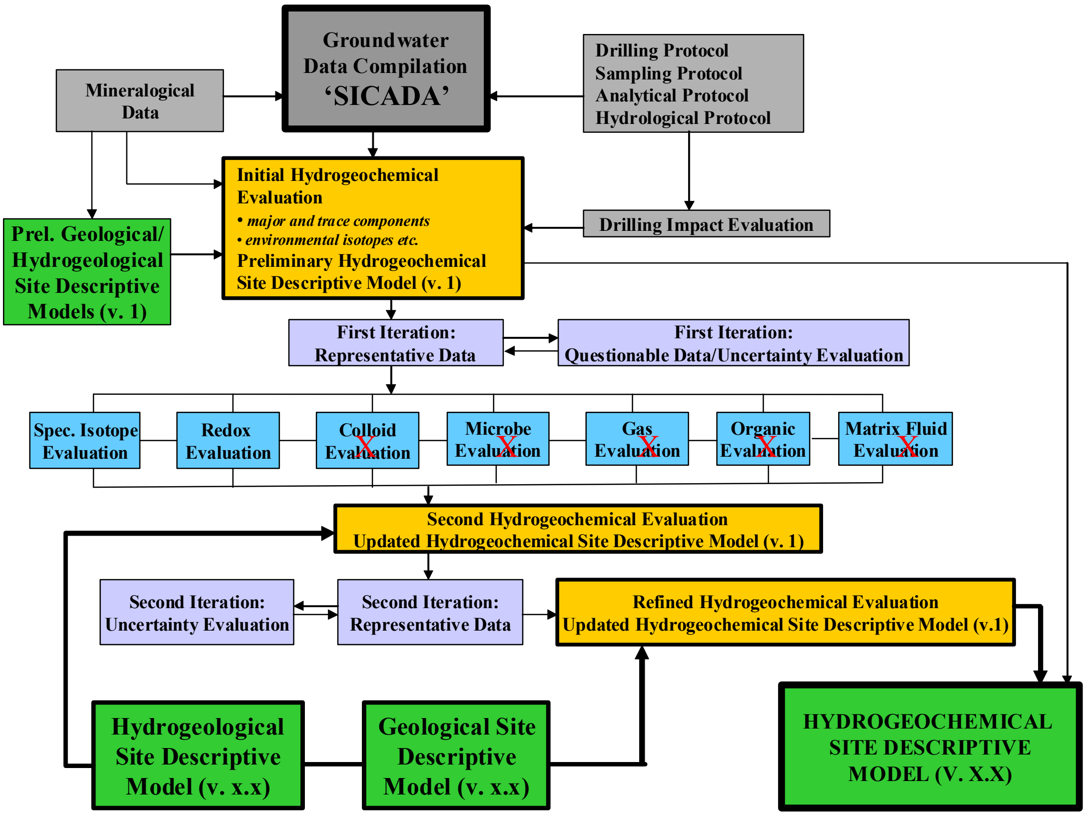

Figure 5-1. The evaluation and modelling steps used in this report. The crossed over evaluation steps were not performed due to lack of data /after Smellie et al, 2002/.

For the groundwater chemical calculations and simulations the following standard tools were used:

For evaluation and explorative analyses of the groundwater:

- AquaChem: Aqueous geochemical data analysis, plotting and modelling tool (Waterloo Hydrogeologic).

Mathematical simulation tools:

- PHREEQC with the database WATEQ4F: Chemical speciation and saturation index calculations, reaction path, advective-transport and inverse modelling /Parkhurst and Appelo, 1999/.
- M3: Mixing and Massbalance modelling /Laaksoharju et al, 1999b/.

Visualisation/animation:

- TECPLOT: 2D/3D interpolation, visualisation and animation tool (Amtec Engineering Inc).

5.1.1 Modelling assumptions and input

Hydrogeochemical modelling involves the integration of different geoscientific disciplines such as geology and hydrogeology. This information is used as background information, supportive information or as independent information when models are constructed or compared. The following chapters describe how geological information can be used in the modelling and how speciation, mass-balance, coupled modelling and mixing modelling can be used.

Geological information is used in hydrogeochemical modelling as direct input in mass-balance modelling but also to judge the feasibility of the results from, for example, saturation index modelling. For this particular modelling exercise geological data were summarised, the information was reviewed and the relevant rock types, fracture minerals and mineral alterations were identified (see Appendix 1).

The underlying geostructural model provides important information of water-conducting fractures used for the understanding and modelling of the hydrodynamics. The cutting plane used for visualisation of groundwater properties is generally selected with respect to the geological model. The results from the modelling are generally presented by using 2D/3D visualisation tools. Unfortunately the lack of data from the depth at Forsmark precludes a 3D interpolation and production of a 2D cutting plane for this model version.

5.1.2 Conceptual model with potential alternatives

Because of the lack of data from depth few alternative models were tested. Those tested included different reference waters and local and regional models, and various modelling tools and approaches were applied on the data set.

5.1.3 Speciation, mass-balance and coupled modelling

Speciation modelling

Speciation-solubility modelling has been carried out with PHREEQC /Parkhurst and Appelo, 1999/ and the WATEQ4F thermodynamic database.

In this type of calculations, starting from the concentration of a set of elements in a water sample and other relevant parameters (temperature, pH, Eh, total or carbonate alkalinity, and, in some cases, density) the concentration and activity of all the relevant species in the system and the saturation indices with respect to a predefined set of minerals is computed. It is a purely thermodynamic calculation where it is assumed that all dissolved species are in mutual homogeneous equilibrium. This approach define the proximity of a solution to equilibrium with a relevant phase through a saturation index defined as

$$SI = \log \frac{IAP}{K(T)}$$

where *IAP* is the ionic activity product and *K*(*T*) is the equilibrium constant of the dissolution-precipitation reaction of the relevant phase. A positive value indicates that thermodynamically a mineral can precipitate a negative value that it can dissolve. A value close to zero indicates that the mineral is not reacting. The saturation index indicates the potential for the process, not the rate, at which the process will proceed. From this information conclusions concerning possible major reactions taking place and indirect indications of the dynamics of the system can be drawn.

The calculations are used to investigate the processes that control water composition at Forsmark. This chapter is divided into two main sections, the first one concerning the state of non-redox elements and phases and the second focussed on the redox state of the system.

The procedure only deals with plausible minerals in the system, i.e. those which can reach equilibrium with the groundwater. Therefore, clearly undersaturated mineral phases are not included in this description. In addition, only mineral phases actually identified from the Forsmark site were considered.

Carbonate system

A pH sensitivity analysis (Appendix 2) shows that laboratory pH values could have been affected by CO_2 degassing. Because there are no pH values from down-hole continuous logging to compare with, it is difficult to assess the likelihood of the results and therefore this uncertainty will propagate into the speciation-solubility calculations.

Calcite saturation states indicate that surface and subsurface waters can be either undersaturated or oversaturated with respect to calcite, but most groundwater samples are near equilibrium (Figure 5-2a), considering the commonly accepted ± 0.5 uncertainty in the SI of this mineral when uncertainties in pH are evaluated /Pitkänen et al, 1998, 1999/. The computed P_{CO2} values show a roughly decreasing trend with depth (Figure 5-2b), but with scatter. P_{CO2} and SI scatter, are mainly attributable to the above-commented uncertainties in pH, which are propagated to P_{CO2} and calcite SI values during calculations.

Trends of alkalinity, pH and saturation state of calcite are apparently related to water-rock interaction processes (dissolution-precipitation of fracture filling calcite and silicate hydrolysis) in agreement with the model for the Stripa groundwaters /Nordstrom et al, 1989/ and verified in other Swedish and Finnish sites.

The measured initial steep rise in alkalinity (Figure 4-7) and pH affecting superficial waters is related to weathering of the bedrock, causing calcite dissolution and hydrolysis of silicates. Calcite reaches saturation (or oversaturation) at the alkalinity peak and the subsequent depletion in alkalinity can be attributed to calcite precipitation. This precipitation process is induced by calcium enrichment in groundwaters associated with mixing with a saline source.

The pH usually increases slightly beyond the alkalinity peak. As calcite precipitation produces a decrease in pH, it has been assumed that the pH increase is associated with the effect of silicate hydrolysis (as consuming proton reactions) deep in the bedrock. Because the trend observed in the Forsmark groundwaters shows a pH decrease, there is, therefore, apparently minor or no silicate hydrolysis compensation. Nevertheless, this pH decreasing pattern in Forsmark can be magnified (with respect to other Scandinavian sites) by the high alkalinity peak developed in the more recent superficial waters. The existence of older recharge groundwaters with lower pH and/or uncertainties in pH measurements (i.e. actual pH lower than mesaured pH due to degassing) would modify the interpretation of the pH pattern.

Silica system

The weathering of rock-forming minerals is the main source of dissolved silica. Superficial waters have a variable degree of saturation with respect to silica phases (quartz and chalcedony); this is compatible with the weathering hypothesis.

Superficial waters are oversaturated with respect to quartz and close to equilibrium with chalcedony (Figure 5-3). Saturation indices of these phases are relatively constant and independent of the chloride content of the waters; this suggests that the groundwater has already reached a stationary state associated with the formation of aluminosilicates or secondary silica phases like chalcedony, which control the concentration of dissolved silica.

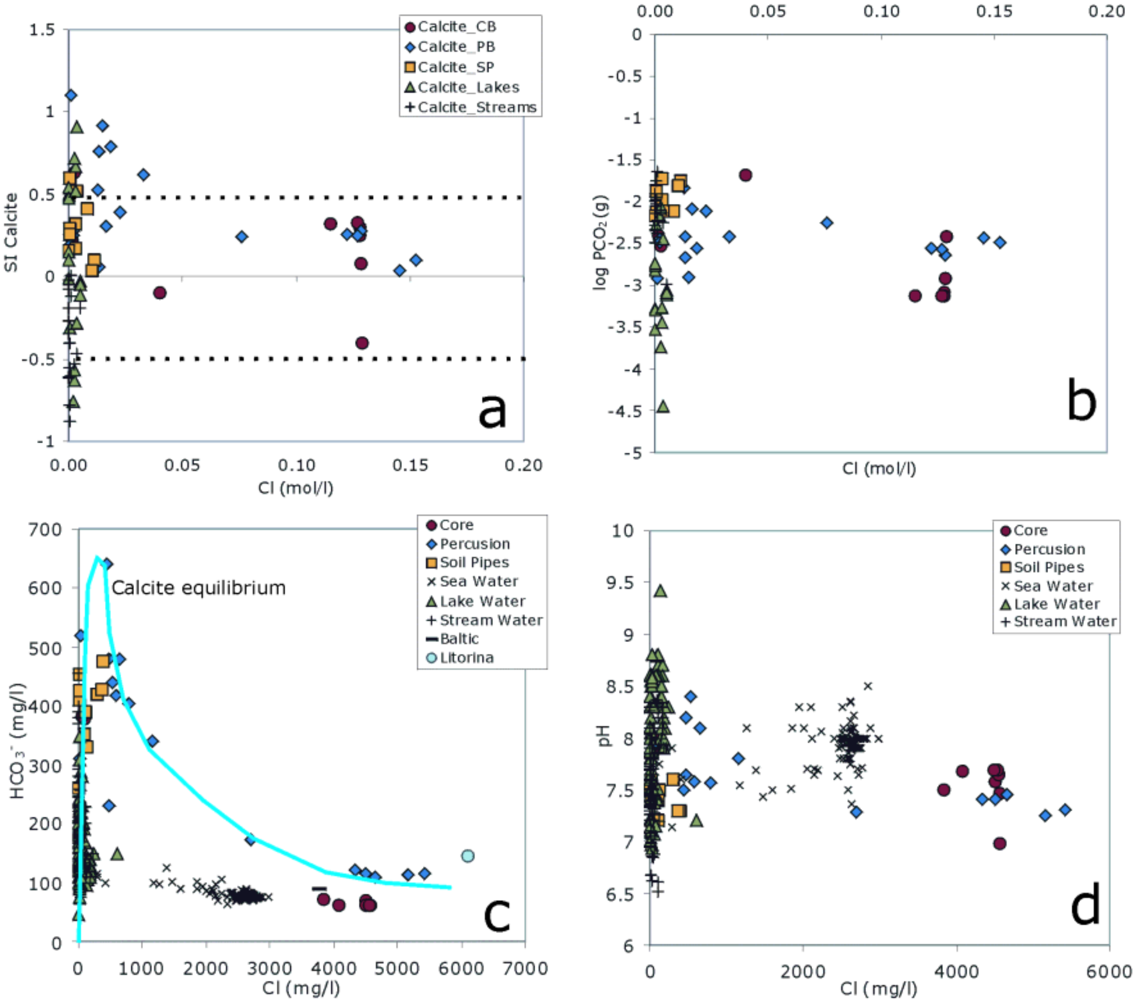

Figure 5-2. *Evolution of the carbonate system in Forsmark waters. (a) and (b) calculated calcite saturation index and partial pressure of* CO_2 *against chloride; (c) and (d) Alkalinity and pH against chloride. The dotted lines in figure (a) represent the uncertainty associated with SI calculations.*

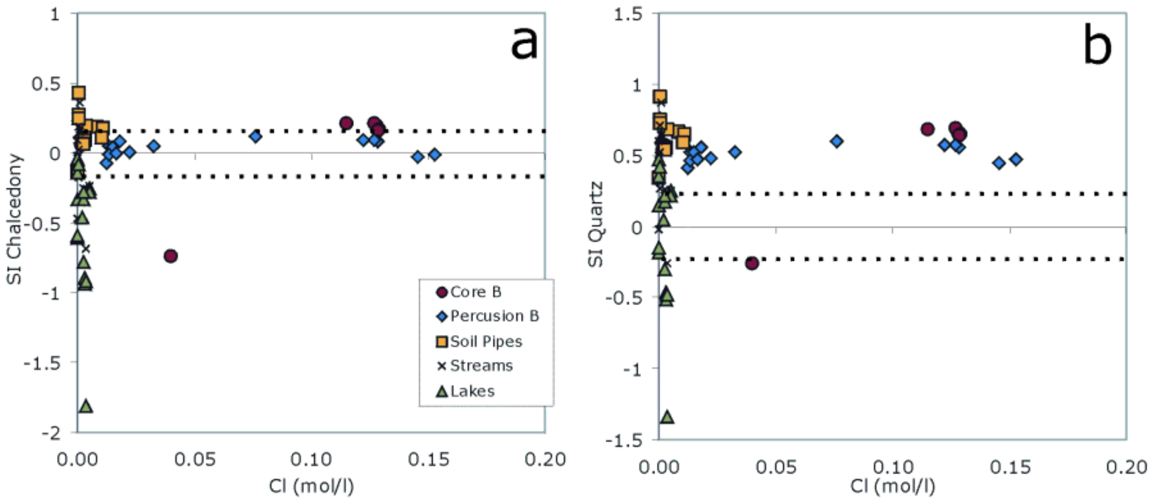

Figure 5-3. *Saturation indices of chalcedony and quartz as a function of Cl. The dotted lines represent the uncertainty associated with SI calculations /Deutsch et al, 1982/.*

The lack of dissolved aluminium data for Forsmark groundwaters precludes the calculation of speciation-solubility diagrams for aluminosilicates Figure 5-4. Therefore, activity diagrams were used to study the stability of silicate minerals in the system. The accuracy of these diagrams depends on pH and they are therefore affected by the uncertainties in the pH measurements at Forsmark. Uncertainties in the equilibrium constants of the aluminosilicates (especially phillosilicates) also affect the conclusions drawn from these diagrams. This last source of uncertainty has been partially removed considering multiple equilibrium constants for the same phase. Nevertheless, the conclusions are preliminary.

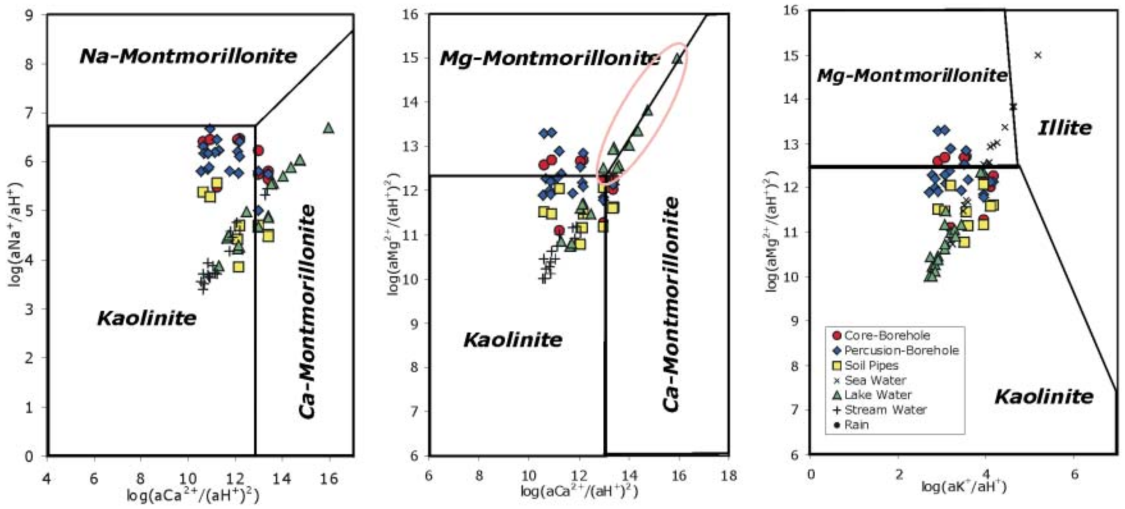

Figure 5-4. *Aqueous activity diagrams for some aluminosilicate minerals at 7°C, 1 bar. The field boundaries were calculated with data from /Helgeson, 1969/ and a logarithmic silica activity of –4.*

Most groundwaters are on or near the stability field of montmorillonite but with no clear trend. Locally, both Mg-montmorillonite and Ca-montmorillonite are favoured and Mg-Ca or Ca-Mg exchange reactions are possible. Some groundwaters fall on or near the Ca-montmorillonite stability field and accordingly Na would be released to solution.

Figure 5-5 shows three additional stability diagrams for other mineral phases identified as filling fracture minerals in the KFM01 borehole: adularia, albite, prenhite, laumontite and chlorite. The diagrams are based on data calculated at 15ºC by /Grimaud et al, 1990/ for the Stripa groundwaters and show that most groundwaters are near or in the albite stability field; samples along the boundary with adularia indicate an equilibrium between albite and adularia. Besides, more saline groundwaters define a trend towards equilibrium with chlorite.

Finally, Figure 5-6 includes illite. Diagram (a) was used in the Cigar Lake natural analogue study /Cramer and Smellie, 1994/, and is based on data from /Helgeson, 1969/ and /Helgeson et al, 1978/. Diagram (b) was constructed with data from /Garrels, 1984/. Both diagrams suggest that illite plays an important role in controlling the groundwater system although the available mineralogical data indicate that the abundance of illite in fracture fillings is low. This, however, may be an underestimation due to the loss of soft and fine grained material during drilling.

Cation exchange processes are probably more important than clay mineral recrystallisation during short-term water-rock interaction at low temperature, but in waters with long residence times these exchange processes may cause irreversible changes in clay minerals as the solubility diagrams suggest /Pitkänen et al, 1999/.

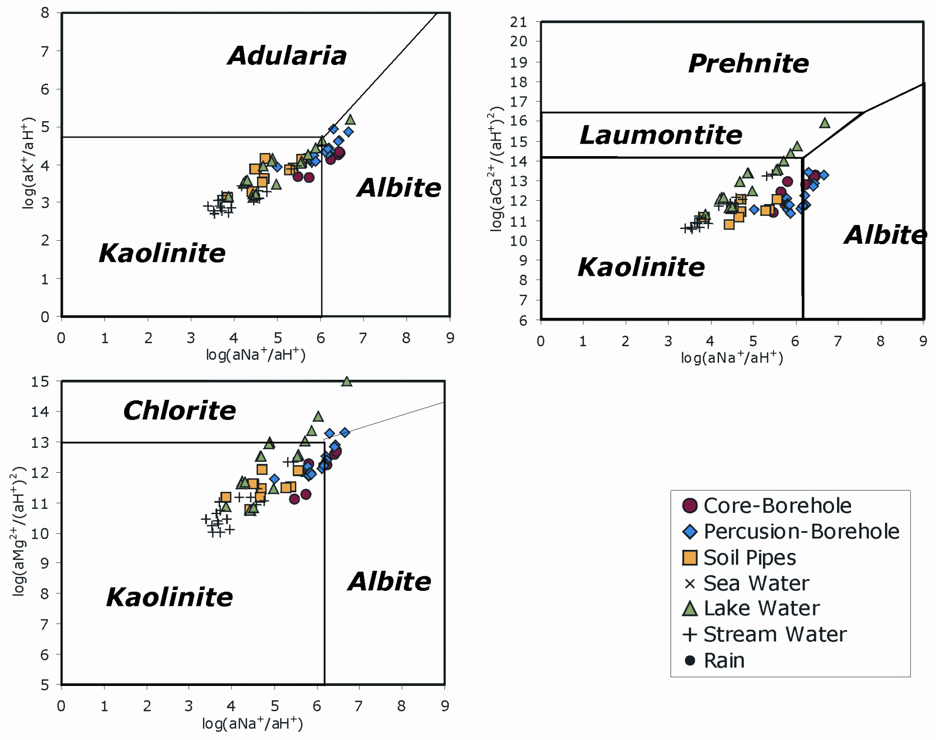

Figure 5-5. *Aqueous activity diagrams for some aluminosilicate minerals at 15°C, 1 bar. The field boundaries have been calculated from the data of /Grimaud et al, 1990/.*

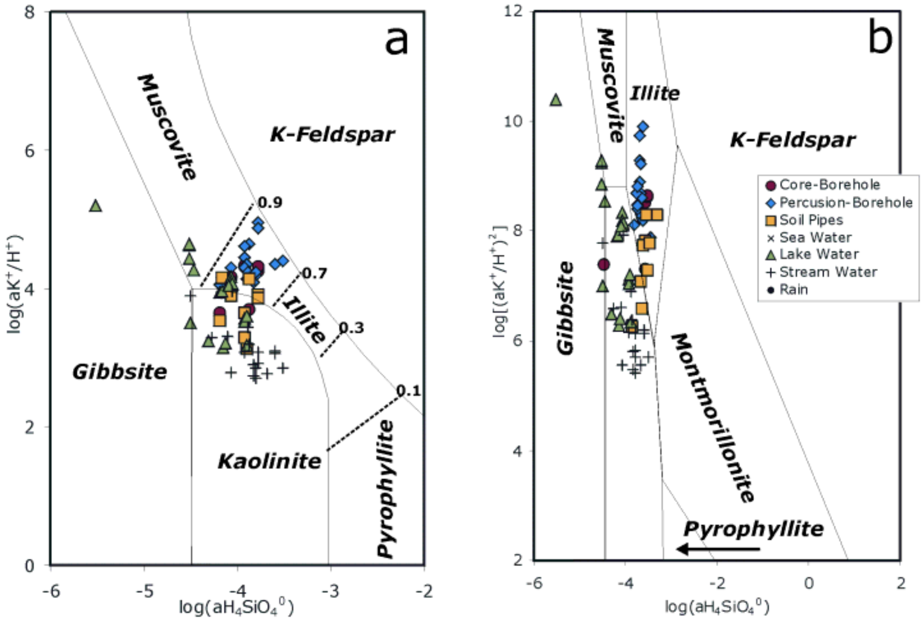

Figure 5-6. *Aqueous activity diagrams for some aluminosilicate minerals at 25°C, 1 bar, including illite. The field boundaries have been calculated with data from /Helgeson, 1969/ and /Helgeson et al, 1978/ in graph (a) and from /Garrels, 1984/ in graph (b). In graph (a) the illite field is contoured to show the stability of different illite fractions in I/S.*

Redox pairs calculations

The available analytical data (dissolved Fe^{2+}, total Fe, total sulphide and sulphate concentrations) allow a standard redox pair calculation only for KFM01A waters at 115.33 m depth (brackish waters). Preliminary values of in situ temperature (7ºC) and Eh (–180 mV) are available for borehole KFM01A at the same depth and will be used as reference values in the following calculations.

The analysed samples (#4480, 4481, 4484, 4520, 4524 and 4538) have a fairly homogeneous chemical composition, as expected from samples taken from the same depth. pH values are also rather constant, between 7.47 and 7.69, except for sample 4525 which has an anomalously low pH value (6.98) and has been omitted from the data set. In the following calculations pH has been varied between 7.4 and 7.7 to take into account the actual uncertainty in this parameter. This range includes the pH value calculated assuming equilibrium with calcite (see Appendix 2).

Previous studies in “granitic” groundwaters from Sweden and Finland /Nordstrom and Puigdomenech, 1989; Smellie and Laaksoharju, 1992; Grenthe et al, 1992; Glynn and Voss, 1999; Bruno et al, 1999/ have found that the iron and sulphur redox pairs/buffers are the most reliable couples to estimate the redox state. In this system, the selected redox couples are dissolved Fe^{3+}/Fe^{2+} and SO_4^{2-}/S^{2-} and the heterogeneous $Fe(OH)_3$ /Fe^{2+}, pyrrhotite/SO_4^{2-} and pyrite/ SO_4^{2-} couples. Results using the Fe^{3+}-clay/Fe^{2+}-clay redox pair as proposed by /Banwart, 1999/ are also tested. Results by using the method suggested by /Grenthe et al, 1992/ with the calibration for $Fe(OH)_{3(s)}/Fe^{2+}$ redox pair, both with and without activity correction /Glynn and Voss, 1999/ provides too low Eh values compared with the measured ones and with the rest of redox pairs (Figure 5-7).

An alternative approach to the computation of the redox potential with the $Fe(OH)_{3(s)}$/ Fe^{2+} pair is that of /Bruno et al, 1999/. They use thermodynamic data for two end members, crystalline and amorphous $Fe(OH)_3$ (Figure 5-7). Using the thermodynamic data from /Bruno et al, 1999/ for amorphous $Fe(OH)_3$, the redox potential calculated by the $Fe(OH)_{3(s)}$/ Fe^{2+} would match the electrochemical measurement.

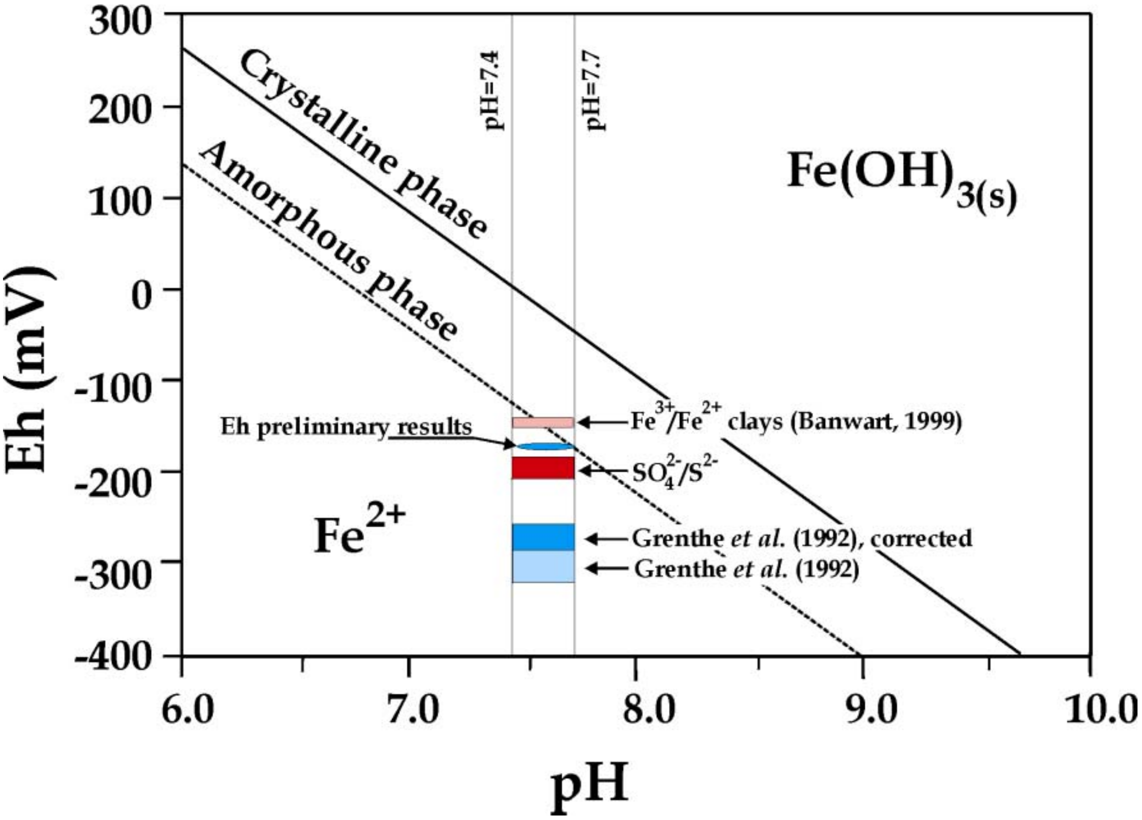

Figure 5-7. *Eh-pH diagram with $Fe(OH)_{3(s)}$/ Fe^{2+} phase boundaries for crystalline (log K=3) and amorphous (log K=5) $Fe(OH)_3$ phases. The diagram has been drawn using data from the Palmottu Natural Analogue study /Bruno et al, 1999/ assuming a concentration of $Fe^{2+} = 3 \cdot 10^{-5}$ M. The vertical lines bracket the uncertainty in pH of the samples. Also shown are the Eh values obtained with the /Grenthe et al, 1992/ calibration of the $Fe(OH)_{3(s)}$/ Fe^{2+} pair (blue squares); the Eh values deduced from the SO_4^{2-}/S^{2-} and Fe^{3+}-clay/ Fe^{2+}-clay pairs (red areas); and the potentiometric value measured in the borehole (blue ellipse).*

The potential calculated with the SO_4^{2-}/S^{2-} pair is between –194 and –210 mV and very close to the measured Eh in the borehole. Redox potentials calculated with the pyrrhotite/SO_4^{2-} redox pair (used by /Bruno et al, 1999/ in the Palmottu system) are around –220 mV, very similar to the values provided by the SO_4^{2-}/S^{2-} couple and close to the measured Eh of –180 mV. Calculated redox potentials assuming equilibrium with pyrite (pyrite/ SO_4^{2-} couple) are also similar.

The Fe^{3+}-clay/Fe^{2+}-clay redox pair proposed by /Banwart, 1999/ is based on the reversible one-electron transfer between oxidised and reduced smectites. For this reaction, the conditional redox potential (Eh, V) as a function of pH at 10ºC is defined by the equation:

$Eh = 0.280–0.056\ pH$.

The results obtained applying this pair, between –138 and –150 mV, are also consistent with the measured ones.

The above results suggest that the redox state of the brackish waters from the shallow depth interval (centred at 115.33 m) in borehole KFM01A could be buffered by the presence of iron oxides and hydroxides and by redox reactions among phyllosilicates. The lack of specific mineralogical data precludes a definitive confirmation of this conclusion.

Nevertheless, the good match between sulphur redox-pairs and between those and electrochemical Eh values points to sulphide minerals as redox buffers. This buffering action, together with the presence of dissolved sulphides, suggests the development of an anoxic-sulphidic state mediated by sulphate reducing bacteria (SRB). Typical precipitation of sulphide minerals associated with the sulphidic environment is suggested by the equilibrium between these waters and several monosulphide phases (e.g. pyrrhotite and amorphous FeS), as deduced from speciation-solubility calculations (see Appendix 2).

Microbial analysis and $\delta^{34}S$ isotopic data are not available for KFM01A waters. However, brackish waters from similar depths and setting in borehole HFM05 show high $\delta^{34}S$ values, between 24.5 and 24.6‰ CDT, substantially higher than the values found in shallower bicarbonate waters from borehole KFMO2A (14–16‰ CDT). These elevated values suggest the existence of a microbially-catalysed reduction of dissolved sulphate. The presence of SRB has been reported at similar depths in studies at sites of the Finnish Programme (Figure 5.5.3.H; /Haveman et al, 1998; Snellman et al, 1998; Pitkänen et al, 1998, 1999/).

The absence of key analytical data (Fe concentration, sulphide, methane) for the rest of the samples in the area rules out a better characterisation of the sequence of redox conditions developed at depth.

Mass balance and mixing calculations

The inverse approach via mass balance and mixing calculations by using PHREEQC /Parkhurst and Appelo, 1999/ to track the hydrogeochemical evolution of the Forsmark area is handicapped by the few groundwater samples used to carry out the study, the absence of key analytical data, the scarcity of mineralogical data and the lack of a hydrogeological model. Consequently, the results summarised in this section should be understood as preliminary, based only on: a) general premises with respect to the type of waters and reactive phases involved, and b) the intercomparison with analogous systems (i.e. similar water end-members).

The evolution paths used in the calculations have been selected taking into account only the most general groundwater hydrogeochemical characteristics and its apparent age. Based on this, two water types were identified: fresh waters with a bicarbonate imprint and low residence times (tritium values above detection limit), and brackish-marine waters with Cl contents up to 6000 mg/L and longer residence times (tritium values below detection limit)

For the analysis of the evolution of the *first water type* (fresh water), which has an *a priori* important water-rock interaction component, simple mass balance calculations with no mixing (to assess the reaction processes occurred between two water samples joined by a hypothetical flow line) and binary mixing with mass balance (to asses the mixing proportions of two water samples and the reaction processes necessary to explain the chemistry of a third water sample) have been performed. For the analysis of the *second water type* (brackish-marine water), only multiple-mixing and mass balance calculations have been carried out. The goal of these calculations is to explain, using heterogeneous reactions between solid phases and the water, the chemistry of a water sample which is the product of the mixing of five or six groundwater end-members. For the calculations with PHREEQC the following chemical and isotopic data have been used: Cl, HCO_3^-, SO_4^{2-}, SiO_2, Ca, Mg, Na, K, Fe, S^{2-}, $\delta^{18}O$ and δ^2H.

Model results for fresh, non-saline waters

From the modelling it was concluded that Ca-Na-HCO_3 waters are little evolved geochemically with a chemistry totally controlled by water-rock interaction processes. Na-HCO_3-Cl waters have a longer residence time and in consequence mass transfer processes are more significant; alternatively, these waters can be explained as a mixing process with a minority marine end-member. Finally, Na-Cl-HCO_3 waters are clearly influenced by a marine component.

The modelling indicates that, in this group of fresh and non-saline waters, water-rock interaction is the main process responsible for the chemistry of the Ca-Na-HCO_3 and Na-HCO_3-Cl waters. However, an increasing contribution of mixing with a marine end-member could explain the observed Cl increase in the more evolved Na-Cl-HCO_3 waters. The reactions that explain the water chemistry are similar in the three cases, the only change being the amount of mass transfer. Decomposition of organic matter, dissolution of calcite, plagioclase, biotite, and sulphides, precipitation of phyllosilicates (mainly smectites and montmorillonites), and Na-Ca ionic exchange, are the main mass transfer processes encountered in most calculations. Smecite may be present in the near-surface fractures but has not been possible to confirm yet.

Model results for brackish-saline waters

Multiple mixing and mass balance calculations performed with PHREEQC for these waters, use the water end members most frequently used in analogous systems: Rain 60, Litorina, Sea Sediment, Glacial Meltwater and Brine. Additionally, the end member Lake Water, used in M3 calculations for Forsmark, has also been included (see below). The set of chosen phases and reactions in shown in Apendix 2.

Modelling results for brackish groundwaters (Cl ≈ 4500 mg/l) indicate the presence of two dominant end members, Litorina and Glacial Meltwater (with near the same proportions) in the mix that produces these waters. The most saline groundwaters considered in the calculations (Cl ≈ 6000 mg/l) is dominated by the Litorina end member (> 80%).

Feasible reactions associated to these mixing models include dissolution of plagioclase and biotite, precipitation of calcite and illite and ionic exchange processes (mainly Na-Ca). The cuasi-conservative behaviour of sulphate in the mixing and the lack of suitable isotopic data precludes a precise description of sulphate-reduction processes.

M3 modelling

A further modelling approach which is useful in helping judge the origin, mixing and major reactions influencing groundwater samples is the M3 modelling concept (Multivariate Mixing and Mass-balance calculations) detailed in /Laaksoharju et al, 1995/ and /Laaksoharju et al, 1999b/.

Introduction and model description

In M3 modelling the assumption is that the groundwater composition is always a result of mixing and reactions. M3 modelling uses a statistical method to analyse variations in groundwater compositions so that the mixing components, their proportions, and chemical reactions are revealed. The method estimates the contribution to hydrochemical variations by mixing of groundwater masses in a flow system by comparing groundwater compositions to identified reference waters. Subsequently, contributions to variations in non-conservative solutes from reactions can be calculated.

The M3 method consists of 4 steps where the first step is a standard principal component analysis (PCA), selection of reference waters, followed by calculations of mixing proportions, and finally mass balance calculations (for more details see /Laaksoharju et al, 1999b; Laaksoharju, 1999d/). The PCA applied to Forsmark data and all Nordic Sites data is illustrated in Figure 5-8. 118 samples from Forsmark site were used in the calculations. The numerical values are presented in Appendix 3.

The reference waters used in the M3 modelling have been identified from previous site investigations (e.g. Äspö and Laxemar) and also from the evaluation of the Forsmark primary data set in Chapter 4 (for groundwater analytical data see Table 5-1):

- **Brine water:** Represents the sampled deep brine type (Cl = 47,000 mg/L) of water found in KLX02: 1631–1681 m /Laaksoharju et al, 1995/. An old age for the Brine is suggested by the measured ^{36}Cl values indicating a minimum residence time of 1.5 Ma for the Cl component /Laaksoharju and Wallin, 1997/.

- **Glacial water:** Represents a possible melt-water composition from the last glaciation > 13,000 BP. Modern sampled glacial melt water from Norway was used for the major elements and the δ^{18}O isotope value (–21‰ SMOW) was based on measured values of δ^{18}O in calcite surface deposits /Tullborg and Larson, 1984/. The δ^{2}H value (–158‰ SMOW) is a modelled value based on the equation ($\delta H = 8 \times \delta^{18}O + 10$) for the meteoric water line.

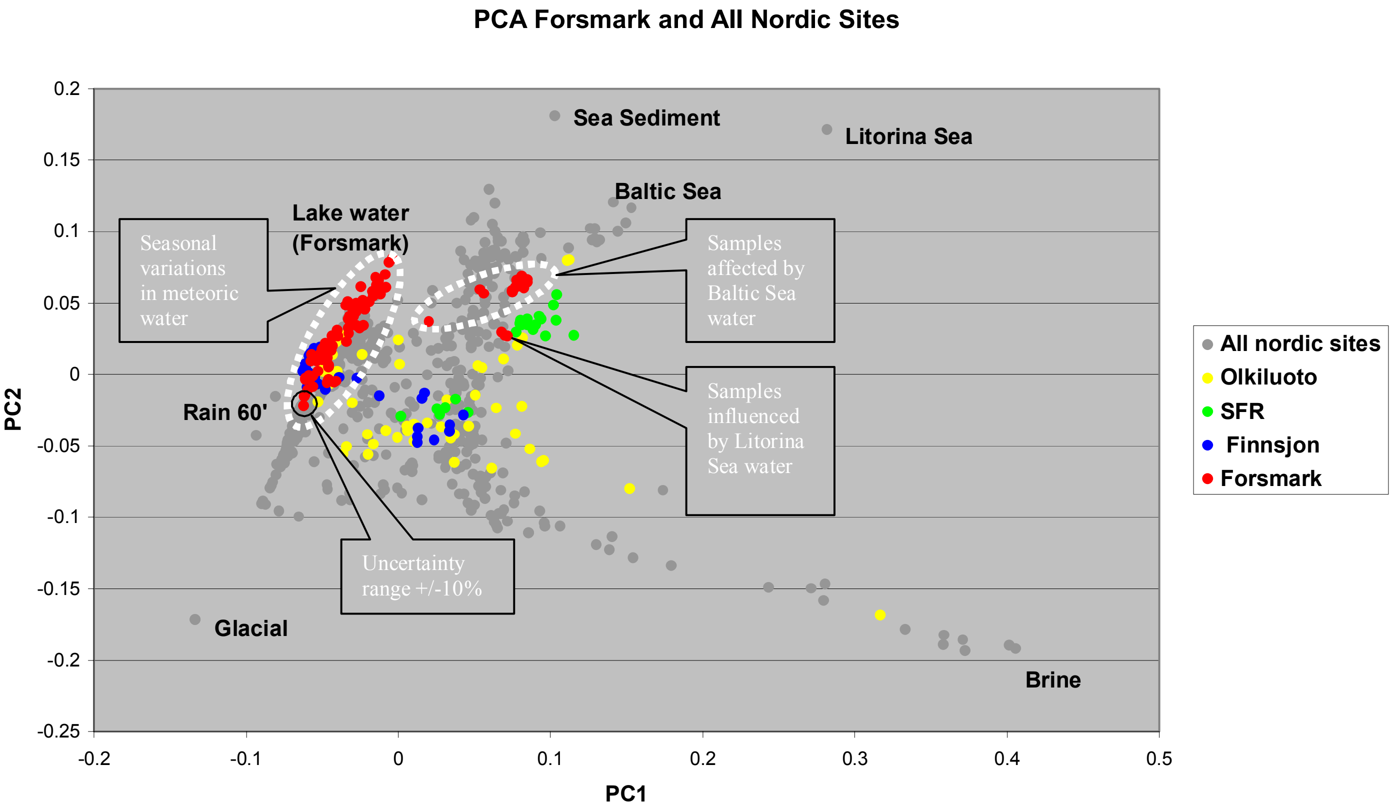

Figure 5-8. *This figure shows the principal components analysis and the location of the identified reference waters. (Variance: First principal component: 0.42236, First and second principal components: 0.6764, First, second and third principal components: 0.78329). The figure shows also the Forsmark data in relation to Nordic samples (e.g. Finnsjön, SFR and Olkiluoto data are indicated). The Lake water (Forsmark), Sea sediment, Marine (Litorina), Brine, Glacial and Rain 60' reference waters were used as reference waters for the modelling The model uncertainty of ± 10% is shown as an error circle for one sample (in black); the analytical uncertainty is ± 5% and represents therefore half the size of the circle.*

- **Litorina Sea:** Represents old marine water and its calculated composition has been based on /Pitkänen et al, 1999/.
- **Sea sediment:** Represents marine water affected by microbial sulphate reduction.
- **Precipitation:** Corresponds to infiltration of meteoric water (the origin can be rain or snow) from 1960. Sampled modern meteoric water with a modelled high tritium (2000 TU) content was used to represent precipitation from that period.
- **Forsmark Lake water:** Corresponds to summer precipitation affected by evaporation indicated by high δ^{18}O values and a slight evaporation modification of the deuterium value.

Table 5-1. Groundwater analytical or modelled data* used as reference waters in the M3 regional modelling for Forsmark.

	Cl (mg/L)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	^3H (TU)	δ^2H ‰	$\delta^{18}O$ ‰
Brine	47200	8500	45.5	19300	2.12	14.1	906	4.2	–44.9	–8.9
Glacial	0.5	0.17	0.4	0.18	0.1	0.12	0.5	0	–158*	–21*
Litorina sea*	6500	3674	134	151	448	93	890	0	–38	–4.7
Sea Sediment	4920	2300	29	730	233	1200	36	14	–50.4	–7.3
Precipitation	0.23	0.4	0.29	0.24	0.1	12.2	1.4	2000*	–80	–10.5
Forsmark Lake water	45.8	21	3.21	30.3	5.9	110	16.18	7.6	–44.3	–4.5

Based on past experience (e.g. Äspö and Laxemar sites), the following six reactions have been considered in the M3 modelling:

Organic decomposition: This reaction is detected in the unsaturated zone associated with Meteoric water. This process consumes oxygen and adds reducing capacity to the groundwater according to the reaction: $O_2 + CH_2O \rightarrow CO_2 + H_2O$. M3 reports a gain of HCO_3 as a result of this reaction.

Organic redox reactions: An important redox reaction is reduction of iron III minerals through oxidation of organic matter: $4Fe(III) + CH_2O + H_2O \rightarrow 4Fe^{2+} + 4H^+ + CO_2$. M3 reports a gain of Fe and HCO_3 as a result of this reaction. This reaction takes place in the shallow part of the bedrock associated with influx of Meteoric water.

Inorganic redox reaction: An example of an important inorganic redox reaction is sulphide oxidation in the soil and the fracture minerals containing pyrite according to the reaction: $HS^- + 2O_2 \rightarrow SO_4^{2-} + H^+$. M3 reports a gain of SO_4 as a result of this reaction. This reaction takes place in the shallow part of the bedrock associated with influx of Meteoric water.

Dissolution and precipitation of calcite: There is generally a dissolution of calcite in the upper part and precipitation in the lower part of the bedrock according to the reaction: $CO_2 + CaCO_3 \rightarrow Ca^{2+} + 2HCO_3^-$. M3 reports a gain or a loss of Ca and HCO_3 as a result of this reaction. This reaction can take place in any groundwater type.

Ion exchange: Cation exchange with Na/Ca is a common reaction in groundwater according to the reaction: $Na_2X_{(s)} + Ca^{2+} \rightarrow CaX_{(s)} + 2Na^+$, where X is a solid substrate such as a clay mineral. M3 reports a change in the Na/Ca ratios as a result of this reaction. This reaction can take place in any groundwater type.

Sulphate reduction: Microbes can reduce sulphate to sulphide using organic substances in natural groundwater as reducing agents according to the reaction: $SO_4^{2-} + 2(CH_2O) + OH^- \rightarrow HS^- + 2HCO_3^- + H_2O$. This reaction is of importance since it may cause corrosion of the copper capsules. Vigorous sulphate reduction is generally detected in association with marine sediments that provide the organic material and the favorable salinity interval for the microbes. M3 reports a loss of SO_4 and a gain of HCO_3 as a result of this reaction. This reaction modifies the seawater composition by increasing the HCO_3 content and decreasing the SO_4 content.

Model results

The modelling indicates two water types, one dominated by meteoric water and the other affected by marine water. The surface meteoric type shows seasonal variations. Some of the samples show possible influences from Litorina Sea water. The deviation calculations in the M3 mixing calculations show potential for organic decomposition/calcite dissolution in the shallow water. Closer to the coast the influence of marine water is detected but also at depth. Indications of ion exchange and sulphate reduction have been modelled.

These M3 results essentially support the initial evaluation of primary data in Chapter 4 and the other modelled results described above in this present chapter.

Model uncertainties

The following factors can cause uncertainties in M3 calculations:

- Input hydrochemical data errors originating from sampling errors caused by the effects from drilling, borehole activities, extensive pumping, hydraulic short-circuiting of the borehole and uplifting of water which changes the in situ pH and Eh conditions of the sample, or as analytical errors.
- Conceptual errors such as wrong general assumptions, selecting wrong type/number of end-members and mixing samples that are not mixed.
- Methodological errors such as oversimplification, bias or non-linearity in the model, and the systematic uncertainty which is attributable to use of the centre point to create a solution for the mixing model.

An example of a conceptual error is assuming that the groundwater composition is a good tracer for the flow system. The water composition is not necessarily a tracer of mixing directly related to flow since there is not a point source as there is when labelled water is used in a tracer test.

Uncertainty in mixing calculations is smaller near the boundary of the PCA polygon and larger near the centre. The uncertainties have been handled in M3 by calculating an uncertainty of 0.1 mixing units (with a confidence interval of 90%) and stating that a mixing portion < 10% is under the detection limit of the method.

Visualisation of the groundwater properties

The 3D/2D visualisation of the Forsmark Cl values was performed with the Tecplot code. Figure 5-9 shows the 3D and the 2D visualisation of Cl in the 118 sampling points (values used in M3 calculations) in Forsmark. The few samples from depth did not allow any 3D interpolation of the Cl distribution or of the M3 mixing calculations.

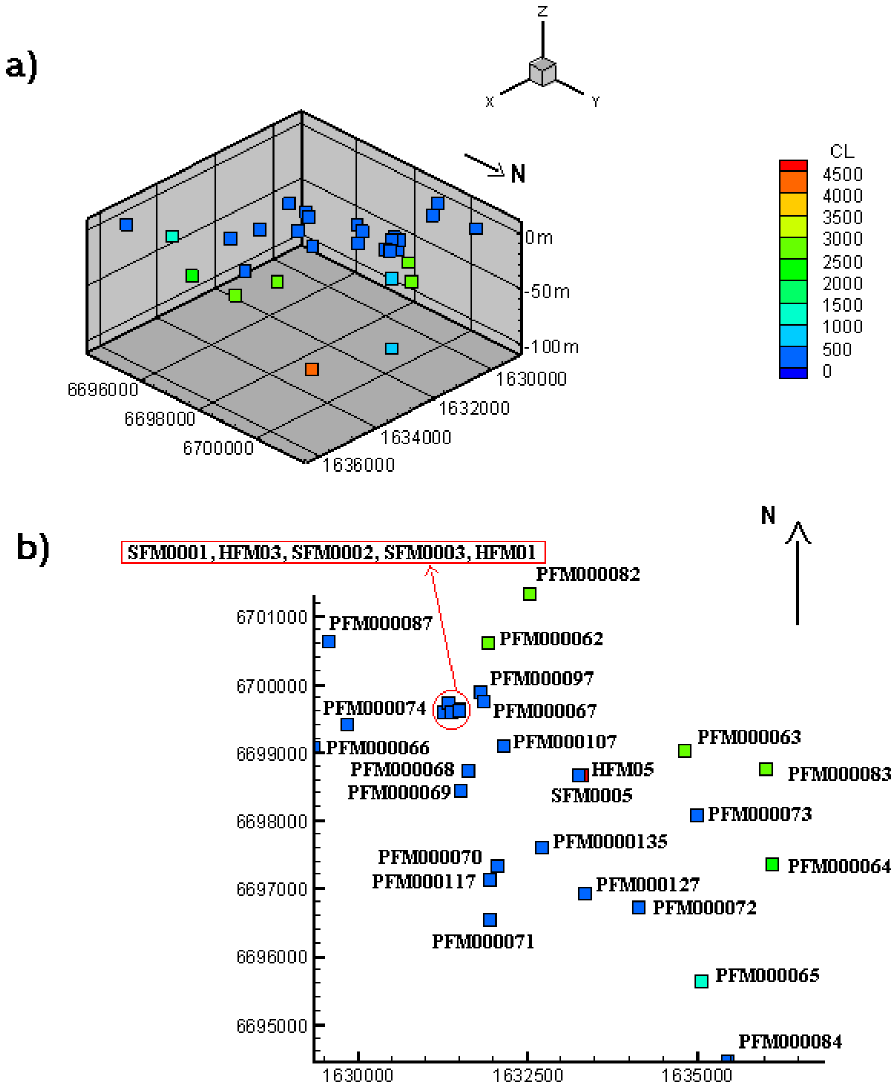

Figure 5-9. *3D (figure a) and 2D (figure b) visualisation of the Cl distribution and sampling points in Forsmark. The x, y, z coordinates represent the Easting, Northing and elevation of the mid sampling section of the location of the sampling points, and are expressed in metres.*

5.1.4 Comparison between the hydrogeological and hydrogeochemical models

Since hydrogeology and hydrogeochemistry deal with the same geological and hydrodynamic media when describing the bedrock groundwater properties, these two disciplines should be able to complement each other when modelling the groundwater system in question. Testing such an integrated modelling approach was the focus of a SKB project (Task 5) based on the Äspö HRL /Wikberg 1998; Svensson et al, 2002; Rhen and Smellie, 2003/. The advantages with such an approach were identified as follows:

- Hydrogeological models will be constrained by a new data set. If, as an example, the model cannot produce any Meteoric water at a certain depth and the hydrogeochemical data indicates that there is a certain fraction of this water type at this depth, then the model has to be revised.
- Hydrogeochemical models generally focus on the effects from reactions on the obtained groundwater rather than on the effects from transport. An integrated modelling approach can describe flow directions and hence help to understand the origin of the groundwater, the turn over time of the groundwater system can indicate the age of the groundwater, and knowing the flow rate can be used to indicate the reaction rate. The obtained groundwater chemistry is a result of reactions and transport, therefore only an integrated description can be used to correctly describe the measurements.
- By comparing two independent modelling approaches a consistency check can be made. As a result a better confidence in processes active, geometrical description and material properties can be gained.

Major recent developments in hydrogeological modelling of the site /S Follin pers comm, 2003/ represents further progress since the TASK#5 exercise /Rhén and Smellie, 2003/. The present modelling should further facilitate future comparison and integration between hydrochemistry and hydrogeology. The hydrogeological model can provide predictions of the salinity in the connected rock matrix, in the flowing groundwater and for dynamic predictions in time for the different water types (meteroric, marine, glacial, and brine) see Figure 5-10. Furthermore, the hydromodel model can, independently from chemistry, predict these salinity features at any point of the modelled rock volume, and the predictions can be checked by direct hydrochemical measurements or calculations. The mixing proportions from the hydrogeological model can in the future, for example, be directly compared with the mixing calculations from the hydrochemical modelling or, conversely, the hydrochemical model can be used to predict the chemistry which results from only transport which, in turn, can be compared with that obtained from reactions. The modelling will increase the understanding of transport, mixing and reactions and will also provide a tool for predicting future chemical changes due to climate changes.

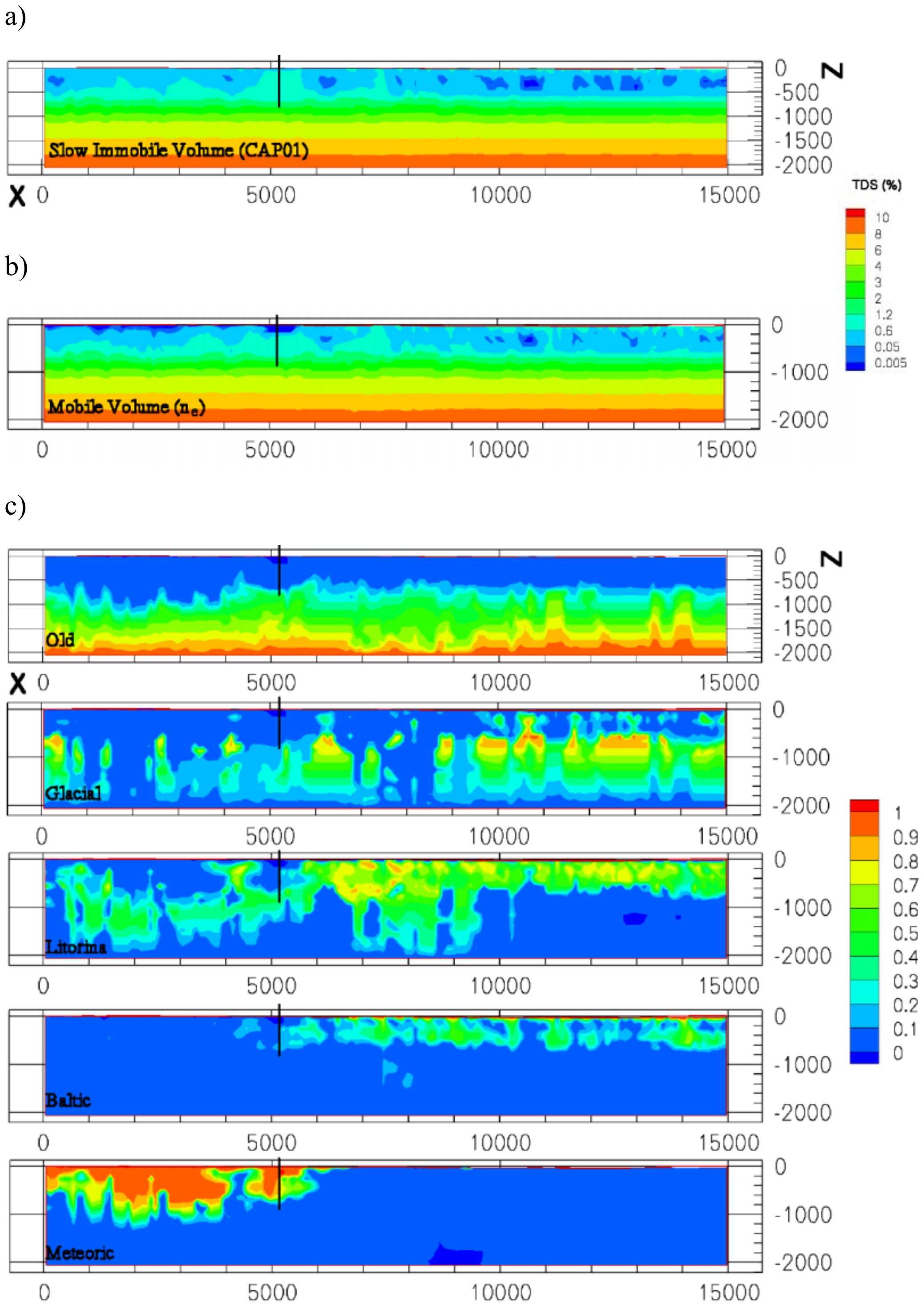

Figure 5-10. *Preliminary results from the hydrochemical modelling of Forsmark /written comm S Follin, 2003/ shown as N-S cutting plane trough the regional model area. The location of the borehole KFM01A (black line), the depth and length in metres are indicated. a) Predicted TDS (mgLl) in the connected rock matrix b) Predicted TDS (mg/L) in the flowing groundwater system. c) Predictions of the present day mixing proportions of the water types old (brine), glacial, Litorina Sea, Baltic Sea and meteoric.*

5.1.5 Evaluation of uncertainties

At every phase of the hydrogeochemical investigation programme – drilling, sampling, analysis, evaluation, modelling – uncertainties are introduced which have to be accounted for, addressed fully and clearly documented to provide confidence in the end result, whether it will be the site descriptive model or repository safety analysis and design /Smellie et al, 2002/. Handling the uncertainties involved in constructing a site descriptive model has been documented in detail by /Andersson et al, 2001, 2002/. The uncertainties can be conceptual uncertainties, data uncertainty, spatial variability of data, chosen scale, degree of confidence in the selected model, and error, precision, accuracy and bias in the predictions. Some of the identified uncertainties recognised during the Äspö HRL modelling exercise are discussed below.

The following data uncertainties have been estimated, calculated or modelled for the data and models used for the Äspö Model Domain:

- disturbances from drilling; may be ± 10–70%,
- effects from drilling during sampling; is < 5%,
- sampling; may be ± 10%,
- influence associated with the uplifting of water; may be ± 10%,
- sample handling and preparation; may be ± 5%,
- analytical error associated with laboratory measurements; is ± 5%,
- mean groundwater variability during groundwater sampling (first/last sample); is about 25%,
- the M3 model uncertainty; is ± 0.1 units within 90% confidence interval.

Conceptual errors can occur from, for example, the paleohydrogeological conceptual model. The influences and occurrences of old water end-members in the bedrock can only be indicated by using certain element or isotopic signatures. The uncertainty is therefore generally increasing with the age of the end-member. The relevance of an end-member participating in the groundwater formation can be tested by introducing alternative end-member compositions or by using hydrodynamic modelling to test if old water types can reside in the bedrock during prevailing hydrogeological conditions.

Uncertainties in the PHREEQC code depend on which PHREEQC code version is being used. Generally the analytical uncertainties and uncertainties concerning the thermodynamic data bases are of importance (in speciation-solubility calculations). Care also is required to select mineral phases which are realistic (even better if they have been positively identified) for the systems being modelled. The errors can be addressed by using sensitivity analyses, alternative models and descriptions. Such analysis was regarded to be outside the scope of this exercise due to lack of groundwater data.

The uncertainty due to 3D interpolation and visualisation depends on various issues, i.e. data quality, distribution, model uncertainties, assumptions and limitations introduced. The uncertainties are therefore often site specific and some of them can be tested such as the effect of 2D/3D interpolations. The site specific uncertainties can be tested by using quantified uncertainties, alternative models, and comparison with independent models such as hydrogeological simulations. Any test concerning Forsmark was not possible because of the lack of groundwater data.

The discrepancies between different modelling approaches can be due to the differences in the boundary conditions used in the models or in the assumptions made. The discrepancies between models should be used as an important validation and confidence building opportunity to guide further modelling efforts.

6 Resulting description of the Forsmark site

6.1.1 Hydrogeochemical description

The main conclusions from the evaluation of scatter plots, traditional geochemical modelling and the M3 statistical modelling approach is that the complex groundwater evolution and patterns at Forsmark are a result of many factors such as: a) the flat topography and closeness to Baltic Sea resulting in relative small hydrogeological driving forces which can preserve old water types from being flushed out, b) the changes in hydrogeology related to glaciation/deglaciation and land uplift, c) repeated marine/lake water regressions/transgressions, and d) organic or inorganic alteration of the groundwater caused by microbial processes or water-rock interactions. The sampled groundwaters reflect in various degrees modern or ancient water/rock interactions and mixing processes.

The detailed evaluation of the observations indicates the following features:

Descriptive observations

- Dilute surface waters, mostly represented by the Lake and Stream samples, are usually characterised by very short residence times (days to some years) and high tritium and ^{14}C.

- Dilute near-surface waters, mostly represented by the Soil Pipe waters, but also some discharging groundwater to the surface Lakes and Streams, are probably characterised by longer residence times (months to some years). Despite this, similarly high tritium values are obtained for the surface-derived waters although ^{14}C (based on only a few data) appears to be a little lower due to dissolution of calcite and/or decomposition of organic material.

- Baltic Sea water which in the coastal bays is mixed with varying amounts of: a) meteoric waters (i.e. direct precipitation run-off), b) stream water input, and c) in places discharge of deeper groundwaters.

- Other marine sources with higher salinity are involved, in particular, Litorina Sea water or Litorina Sea/glacial water mixtures with chloride contents of around 4000–5500 mg/L and δ^{18}O values between –10 and –12‰ SMOW. For example, taking the SFR data into account, a dilution line between a fresh glacial meltwater with a δ^{18}O of –25‰ SMOW and a Litorina Sea water of 6500 mg/L Cl and –4.7‰ SMOW can be calculated, corresponding closely to some of the Forsmark data.

- The Litorina Sea water component (twice as saline as the present Baltic Sea water) has intruded into, and mixed with glacial melt waters, some 7000–5000 years ago. This glacial-Litorina mixture, where preserved in the bedrock, has in some fractures mixed with present Baltic Sea water and, during the last 1000 years, probably also with meteoric water. Only in hydraulically favourable 'pockets' or 'lenses/horizons' (e.g. HFM08 between 93–143 m) has a stronger Litorina signature been recorded.

- At present the indication of a Litorina Sea water is based on the δ^{18}O vs, Cl relationship and also the higher Mg and SO_4 contents when compared with saline waters of brine type. With additional data it is hoped to be able to better differentiate between Baltic, Litorina and deep non-marine saline waters.

- Processes in the bedrock fracture systems such as ion exchange (e.g. with clay fractions) have modified the marine water components causing a decrease in Mg and Na and enrichment of Ca. As shown by the Soil Pipe samples, ion exchange with the sediments may have occurred although the mixing with deeper discharge groundwaters richer in Ca cannot be ruled out.

- In one example (HFM05) the decrease in sulphate content and higher δ^{34}S values might indicate activity of sulphate-reducing bacteria.

Modelled observations

- Based on the general geochemical characteristics and the apparent age two major water types are present in Forsmark: fresh waters with a bicarbonate imprint and low residence times (tritium values above detection limit), and brackish-marine waters with Cl contents up to 6000 mg/L and longer residence times (tritium values below detection limit).

- The chemistry of the first water type is mainly controlled by the chemistry of the recharge waters and, most important, by water-rock interaction processes in the overburden (surface/near-surface). Locally, these waters can mix with marine components changing their chemical composition towards more chloride-rich members. Under these conditions the major water-rock interaction processes are organic matter decomposition, dissolution of the more soluble phases such as calcite and sulphides and the alteration of the upper granitic bedrock.

- Primary and secondary silicates and aluminosilicates are related by incongruent reactions which seem to control silica and aluminium contents and participate in the loss or gain of elements such as K, Mg and, to some extent, Na (through dissolution-precipitation or ion exchange processes).

- Waters from the brackish-marine type representing deeper bedrock groundwaters have a longer residence time and a higher mixing component with older waters with different origins. Heterogeneous reaction processes, although less important than in the first water type, can be described mostly by the same set of minerals; a major difference is that calcite is precipitating instead of dissolving. Also, in some of these waters microbially mediated reactions and dissolution-precipitation of Fe-mineral phases become important at controlling sulphate and iron contents, as well as the redox state of the system.

6.1.2 Visualisation of the Forsmark data

One of the objectives of the Initial Site Investigation stage is to produce a preliminary version of the hydrogeochemical descriptive model on a site scale /Smellie et al, 2002/. Visualisation should be based on modelled approaches and also on a manual approach where expert judgement is schematically illustrated. These preliminary approaches based on presently available Forsmark data are summarised in Figure 6-1.

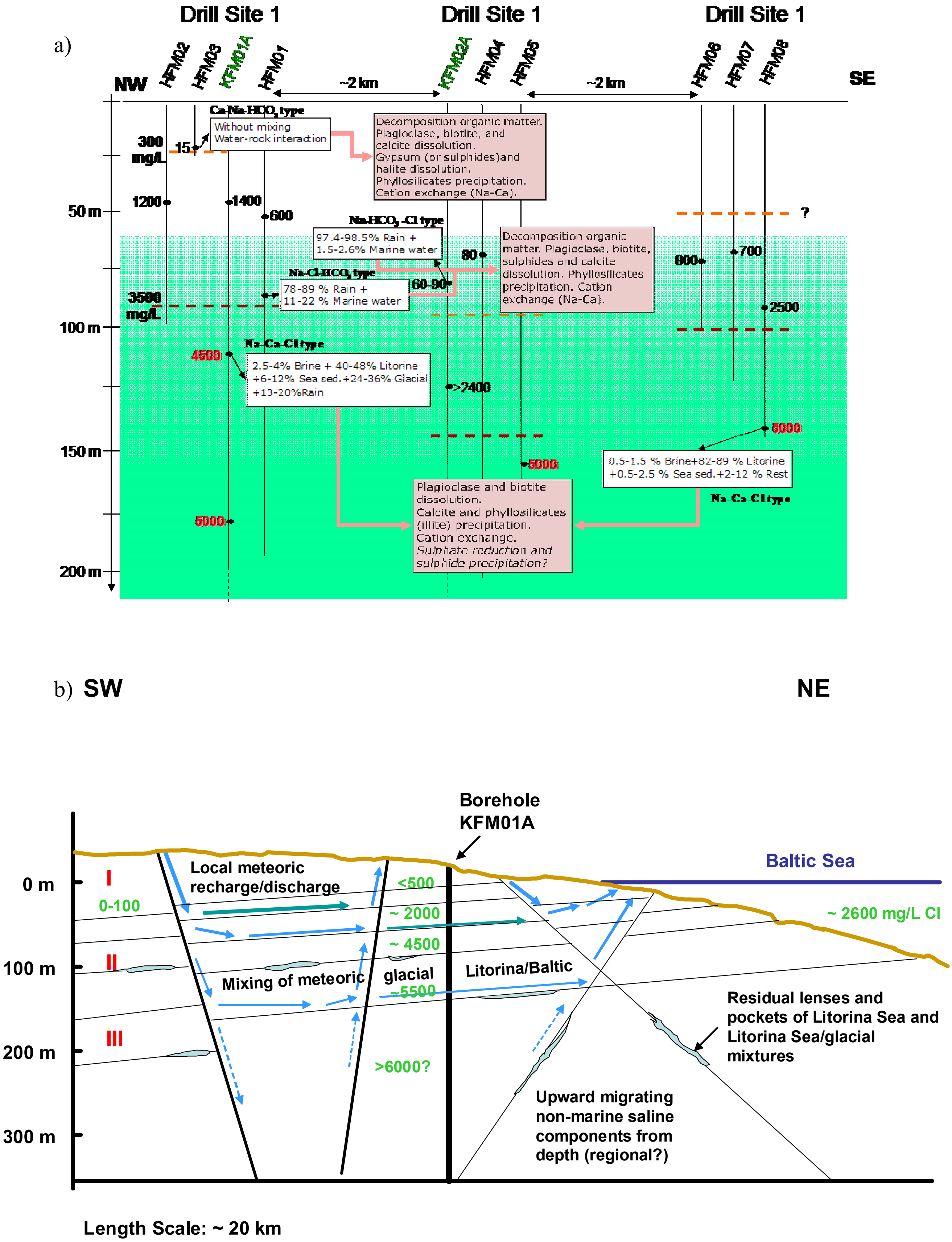

***Figure 6-1.** Preliminary hydrogeochemical site descriptions and visualisations (model version 1.1) interpreted from the Forsmark data.*

a) Integration of: 1) Salinity distributions based on measured Cl concentrations (in red) and electrical conductivity values (in black); the saline interface is at > 5000 mg/L Cl, the non-saline at < 1000 mg/L the brackish water is between 1000–5000 mg/L, Cl, and 2) Modelled evaluation paths of the non-saline and brackish-saline groundwater. For each sample the mixing proportions and the main heterogeneous reaction processes are indicated. Mixing calculations are based on inverse modelling in PHREEQC but uses M3 mixing models and expert judgement for selecting appropriate end-members.

b) Integrated conceptual visualisation of the Forsmark site based partly on measured values from Figure 6-1a, on other hydrochemical and isotopic criteria, and general geological and hydrogeological considerations. Note that the geological structures and groundwater flow directions are not based on measurement but are used only for illustration purposes to fit with present conceptual ideas (for example, when more information is available, the sub-horizontal zones may in reality dip towards the SE). Values in green represent mg/L Cl; I, II and III refer to the modelled reaction boxes illustrated in Figure 6-1a.

Figure 6-1a is based on an integration of :

- Measured salinity variations with depth derived from the percussion and cored boreholes; the measured values are from open boreholes in addition to isolated packed-off borehole sections and lengths. Open hole electrical conductivity logging has been utilised also. Estimations of the high saline interface (> 5000 mg/L), non-saline interface (< 1000 mg/L Cl) and extent of the brackish groundwaters (1000–5000 mg/L Cl) are indicated.
- Modelled calculations integrating the inverse modelling in PREEQEC to explain the evolutionary reaction paths and mixing proportions of the Forsmark groundwaters, with the M3 mixing modelling approach used to select appropriate groundwater end-members. The modelling is preliminary and will be updated when down hole pH and Eh measurements are available for all the samples.

Figure 6-1b is a conceptual visualisation based not only on measured salinity values as shown in Figure 6-1a, but on all relevant hydrochemical and isotopic data (although still very limited), and general geological and hydrogeological considerations. The hydrogeochemical trends described and illustrated in Chapter 4, together with information from the post-glacial scenario illustrated in Figure 3-1 and borehole KFM01A structures in Figure 4-3, have been used to make a first schematic attempt at integrating hydrochemistry with the general hydrostructural character of the Forsmark area. The model will be updated when a more detailed local hydrogeological and geological models become available; for example, the sub-horizontal structures are visualised gently dipping to the NW but may be in reality dip towards the SE.

The present modelled state of hydrogeochemical knowledge of the Forsmark shallow water system is that the main water-rock interaction processes that affects the chemistry are: (i) decomposition of organic matter, (ii) calcite, plagioclase, biotite and sulphide dissolution, (iii) Na-Ca ion exchange, and (iv) phyllosilicate precipitation. The generic reaction model in Figure 6-1b will be refined when more data concerning the mineralogy of the system and its hydrological functioning become available.

The mixing modelling (Figure 6-1a) indicates that two water types dominate. The meteoric water and a marine water affected by Baltic Sea water and possibly Litorina Sea water (see also Figure 6-1b). The meteoric type of water shows typical seasonal variations. Closer to the coast and with depth the influence of marine water is detected.

As for the brackish-saline waters, the modelling points to a mixing process with multiple end-members as the principal control on their chemistry. The main compositional variations between the brackish (< 5000 mg/L Cl) and the saline (6000 mg/L Cl) waters can be explained by an increase in the proportion of the Litorina end-member (see also Figure 6-1b). The role of water-rock interaction processes in these waters is assumed to be much less important than in the fresh waters, and secondary to the mixing process. This circumstance allows the calculation of the mixing proportions even without a precise knowledge of the detailed mineralogy of the system. However, the influence of the sulphate-reduction processes on the final mixing proportions has not been evaluated rigorously enough and it is therefore likely that further detailed studies would produce a refinement of the generic reaction model used in the present calculations.

These mixing processes, schematically visualised in Figure 6-1b, are the result of: a) present-day meteoric recharge/discharge hydraulic gradients of local extent with potentially a more saline regional discharge contribution from depth, b) the forced introduction of glacial melt water to unknown depths during glacial retreat, c) density turnover influences from saline waters introduced during past marine transgressions (e.g. Litorina Sea) since the last glaciation, and d) recent introduction of brackish water when the Baltic Sea covered the Forsmark site area. Because of the generally flat topography close to the coast, the present-day local hydraulic gradients are relatively weak thus preserving the more saline, denser Litorina Sea, Litorina Sea/glacial water and probably brackish Baltic Sea mixtures as pockets and lenses in the bedrock in association with both sub-vertical and sub-horizontal hydraulic structures.

The structural pattern of the area, i.e. a series of vertical and sub-vertical hydraulic fractures which intersect a series of sub-parallel horizontal fracture zones, also hydraulically active, facilitates the groundwater mixing processes. However, this structural system also may partly restrict recharge flow to great depths or, conversely, deep discharge flow to shallow depths by the ‘hydraulic cage’ effect. This may contribute to the existence of a series of hydraulically (and therefore hydrochemically) separated zones or horizons with only limited vertical flow between them. How realistic or widespread this situation may be is presently not known, but earlier studies at nearby Finnsjön /Ahlbom and Smellie, 1991/ would appear to lend some support to these ideas, together with the suggestion that the preserved Litorina Sea waters may be restricted to around 100–200 m depth.

The results from the redox modelling suggest that the redox state of the brackish waters from the shallow depth interval (centred at 115.33 m) at borehole KFM01A could be buffered by the presence of iron oxides and hydroxides and by redox reactions among phyllosilicates. The lack of specific mineralogical data precludes a definitive confirmation of this conclusion. On the other hand, the good match between the sulphur redox-pair and measured Eh values points to sulphide minerals as redox buffers. This buffering action, together with the presence of dissolved sulphides, suggests the development of an anoxic-sulphidic state mediated by sulphate reducing bacteria (SRB). Typical precipitation of sulphide minerals associated with this environment is suggested by the equilibrium between the waters and several monosulphide phases, as deduced from speciation-solubility calculations. Note: Pyrite is a relatively common fracture phase but it has not been possible yet to confirm mineralogically these modelled predictions.

The modelling indicates also that the groundwater composition at shallow depth, i.e. far from repository depth, is such that the representative sample from KFM01A:110–121 m can meet the SKB chemical stability criteria (Table 6-1) for Eh, pH, TDS and Ca+Mg /see Andersson et al, 2000/.

In conclusion, the different first attempt approaches to construct a Hydrogeochemical Site Descriptive Model (version 1.1) have produced fairly good agreement with respect to addressing those issues in common. With additional hydrogeochemical, geological and hydrogeological data linked to model development there are good possibilities of further quantifying the groundwater system and meeting the required modelling objectives.

Table 6-1. The hydrochemical stability criteria defined by SKB are valid for the analysed values of sample KFM01A (110–121 m).

	Eh mV	pH (units)	TDS (g/L)	DOC (mg/L)	Colloids* (mg/L)	Ca+Mg (mg/L)
Criterion	< 0	6–10	< 100	< 20	< 0.5	> 4
KFM01A:110–121 m	–180	7.5	7.8	NA	NA	1016

NA = Not analysed

7 Conclusions

7.1 Overall changes since previous model version

The Hydrogeochemical Site Descriptive Model version 0 presented a conceptual post glacial scenario model for Forsmark to indicate the possible origin of the groundwater In this report the post glacial scenario model has been updated (Figure 3-1), the salinity distribution, mixing processes and the major reactions altering the groundwaters have been modelled down to a depth of 200 m and a new Hydrogeochemical Site Descriptive Model version 1.1 has been produced (Figure 6-1).

7.2 Implication for further modelling

A 3D hydrochemical description of the site was not produced at this stage due to lack of observations reflecting the spatial variations. Such data will be available for the next model version (version 1.2). Comparison and integration between geological and hydrogeological models was in this model version restricted to input concerning the fracture mineralogy, post glacial scenario models and preliminary salinity distributions and mixing proportion calculations.

For the future, the capacity for modelling the surface waters will be increased and coupled hydrogeological and hydrogeochemical modelling will be applied. The use of independent modelling approaches within the HAG group gave a possibility to compare the outcome of the different models and to use discrepancies between models to guide further modelling efforts. The many similarities in the HAG modelling results gave confidence in the obtained results.

7.3 Overall understanding of the site

The overall understanding of the site is restricted to the processes taking place at the surface and down to a depth of 200 m. The confidence in this description is high since independent model approaches were utilised in the work. The origin and the post glacial evolution of the water is fairly well understood. The confidence concerning the spatial variation is low due to few observations at depth. The ongoing sampling programme will provide better spatial information and will increase this confidence.

7.4 Implications for the ongoing site investigation programme

From the HAG modelling work the following suggestions are made for the ongoing site investigation programme (the answers show the response from the site):

- All samples should have x, y, z coordinates in order to be useful in the visualisation work. Answer: The z-coordinates are missing for surface samples such as lakes since the SICADA database can not handle coordinates that varies with time for a sampling point. Answer: A reference level will be used for future sampling so the z-coordinate can be calculated.

- The tube samplings in boreholes with low hydrogeological conductivity are of limited use for reflecting water compositions in fractures. But the information may be useful for reflecting the disturbances in the open borehole. Answer: The electrical conductivity measurements will be used to guide when tube sampling can add more information.

- Much more background information is required to evaluate sample representativeness. For example: a) At which stage during the Chemac monitoring of pH, Eh, O_2 and Temp. is it decided to take samples and why?, b) When there are time constraints and it is not possible to wait for chemical stability – sampling should be planned to cover the complete sampling period, rather than choosing just one time interval. This will give a spread of sampling which should also show up time variations which can be important, c) SICADA only indicates the 'Start' and 'Completion' dates of the sampling. It is necessary to know the actual day of sampling for proper evaluation, and d) Information concerning drilling/sampling protocols (e.g. pump stops; other pauses etc) and the sequences of events carried out in the boreholes are needed. Some of this information (sampling protocol) was forthcoming from Simpevarp but not Forsmark. Answer: Chemac measurements were not included in the "data freeze" and much of the above information will be available for the next model version.

- Analytical questions have been taken up with the site and moves are being made for improvement (e.g. Br data quality; U-series data). Also proper presentation of some data to the required precision (e.g. Sr isotope ratios; B^{11} etc) have been improved in the SICADA data base.

- The flushing/drilling waters should be allocated Class 5 status which is useful to track contamination especially trace elements and isotopic signatures which may be quite sensitive. Answer: The used Class 3 status should be sufficient for tracing contamination since most of the isotopes included in class 5 is optional in the Class 3 program.

- Some data such as REEs are always below detection limits with the result that all granitic waters will show the same range of REE contents. Can other analytical techniques be used so this information can be used in models? Answer: The technique used is ICP-MS and INAA will not provide an improved resolution.

- DIS (Drilling Impact Study) should be made during drilling in order to identify the degree of contamination and guide the sampling strategy. The drilling data should be available earlier concerning: a) the drilling water volume pumped in and out from the borehole, b) the uranine concentration in the drilling water pumped in and out from the borehole, and c) the water pressure along the borehole. The drilling water volume and the uranine records in the water pumped in and out from the borehole should be done simultaneously in time to make a comparision possible. Answer: This is generally a logistic problem and much of the needed information for DIS evaluation is available only after accomplishing the drilling work and processing the data or after performing DIFF measurements.

- The fracture minerals in the drill cores from the Forsmark site (only the first three KFM01A, KFM02A and KFM03A have been sampled so far) are not as well-preserved as expected from triple tube drilling. Instead, many fractures/and fractures zones show loss of loose material, disturbances of surfaces and grinding of fracture coatings. This significantly reduces the possibility of getting good samples for palaeohydrogeological interpretations. For example, low temperature minerals like clays and calcite are the minerals that are most easily destroyed and/or flushed away. It is therefore important to improve further drilling methodology in order to get intact drill cores suitable for hydrogeochemical investigations. Answer: The site will make a test by changing the drilling team and equipment.

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Appendix 1

Explorative analysis, expert judgement and modelling

Contribution to the model version 1.1

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October 2003

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Forsmark Site: Hydrogeochemical Evaluation (Model 1.1 stage).

1. Geological and hydrogeological setting

The Forsmark site is located NE of Forsmark village at the Baltic coast in an area bounded by two regional deformation zones elongated in a NW-SE direction (Fig. 1-1). Outcrops are few, especially away from the coastal margins. The main rock type is a metagranitoid of Svecofennian age; subordinate rock types include metamorphosed sediments, volcanics and gabbros. The site is transversed by local fracture zones mostly trending NNW-SSE and ENE-WSW with a few zones sub-parallel to the regional deformation strike direction. The location of the three drilled borehole sites (KFM01, KFM02 aand KFM03) are indicated in Figure 1-1.

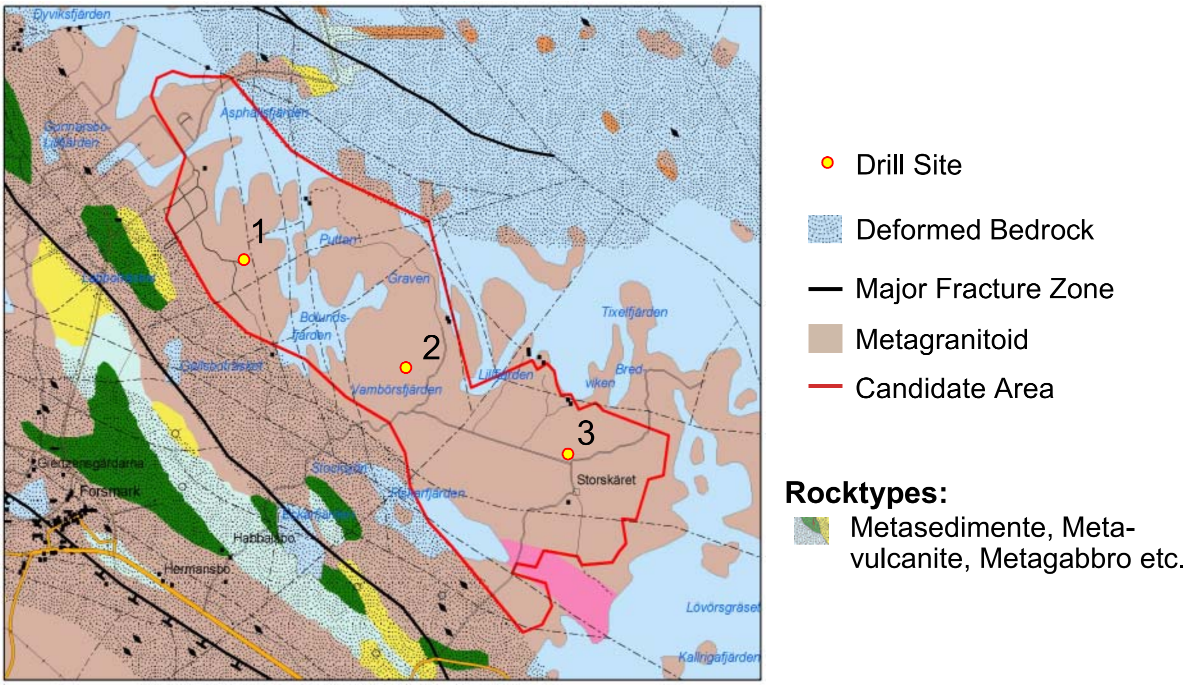

*Figure 1-1. Geology of the Forsmark site showing the location of the three drilled core boreholes***.**

Not a great deal is known about the deep regional hydrogeology of the region hosting the Forsmark site. Being a coastal area an upward discharge of regional groundwater may be expected, driven by high recharge gradients to the west in the western Swedish and central Norwegian upland areas. If this simple recharge/discharge mechanism describes the regional pattern, then old, deep basement saline groundwaters might be expected to be located reasonably close to the surface at the coast (500-1000m).

2. Geological and hydrogeological character of borehole KFM01A

The main rock type penetrated by borehole KFM01A is a medium-grained, reddish-grey to grey metagranodiorite/granite and there is no obvious systematic lithological variation with depth. Figure 2-1 illustrates the relation of the borehole to the known major structures and hydraulic parameters, and indicates groundwater sampling locations in red. Borehole mapping of drillcore material and downhole BIPS-imaging measurements show that both sub-vertical and sub-horizontal fractures occur but the latter structures are dominant, at least on the scale of the borehole (note that this is a near vertical borehole that underestimates steep structures). Fracture minerals consist of quartz, prehnite, laumonite, calcite, analcime, albite, low temperature K-feldspar, chlorite (some very Fe-rich) and pyrite. Clay minerals, although not common, include corrensite (chlorite/smectite mixed layer) ± illite. Some barite and allanite are also sporadically present. It has not been possible so far to establish if a particular paragenesis corresponds to specific fracture types or orientations.

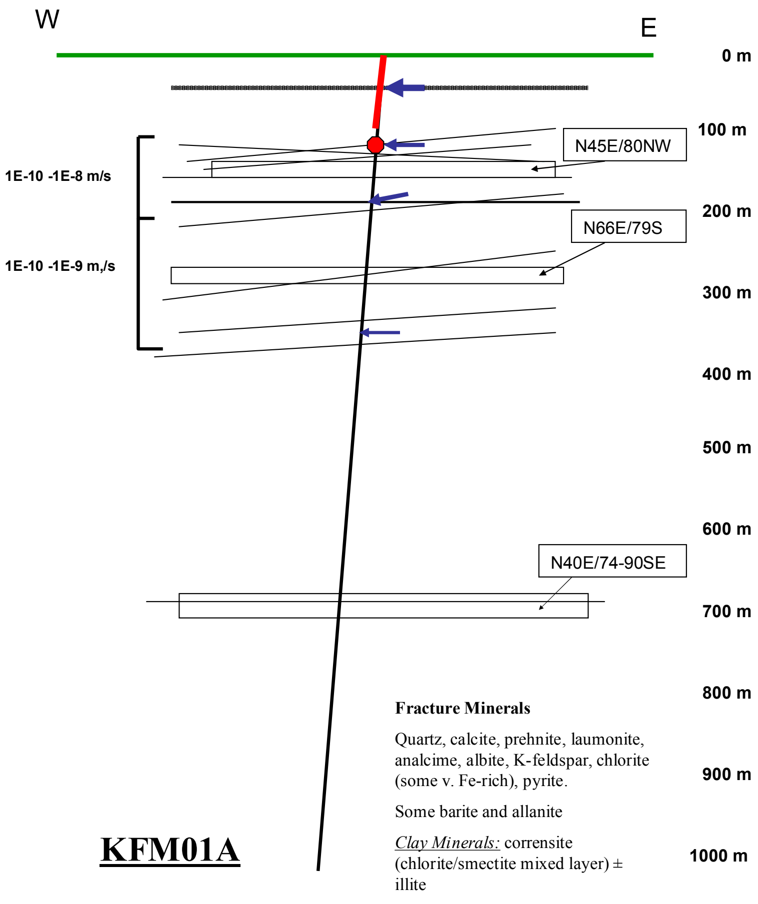

Figure 2-1: *Relation of Borehole KFM01A to the known major structures and hydraulic parameters; groundwater sampling locations are indicated in red.*

The sub-horizontal fractures are especially frequent in the upper 350 m of the borehole showing variable dips and strikes and with hydraulic conductivities (derived from Flow Meter logging; Fig. 2-2) ranging from 10^{-10}-10^{-8} ms^{-1} in the upper 200 m to 10^{-10}-10^{-9} ms^{-1} from 200-350 m. From 350 m to the borehole bottom at 1001.5 m there is only one major sub-horizontal fracture at around 700 m; hydraulic conductivities through this hydraulically tight bedrock length are very low. Borehole KFM01A is cased to 100 m depth which excludes BIPS and Flow Meter data from this borehole length.

As a cautionary note, subsequent drilling of borehole KFM02 suggests that the paucity of fractures below 200-300 m indicated in KFM01A may not be fully representative of the site area.

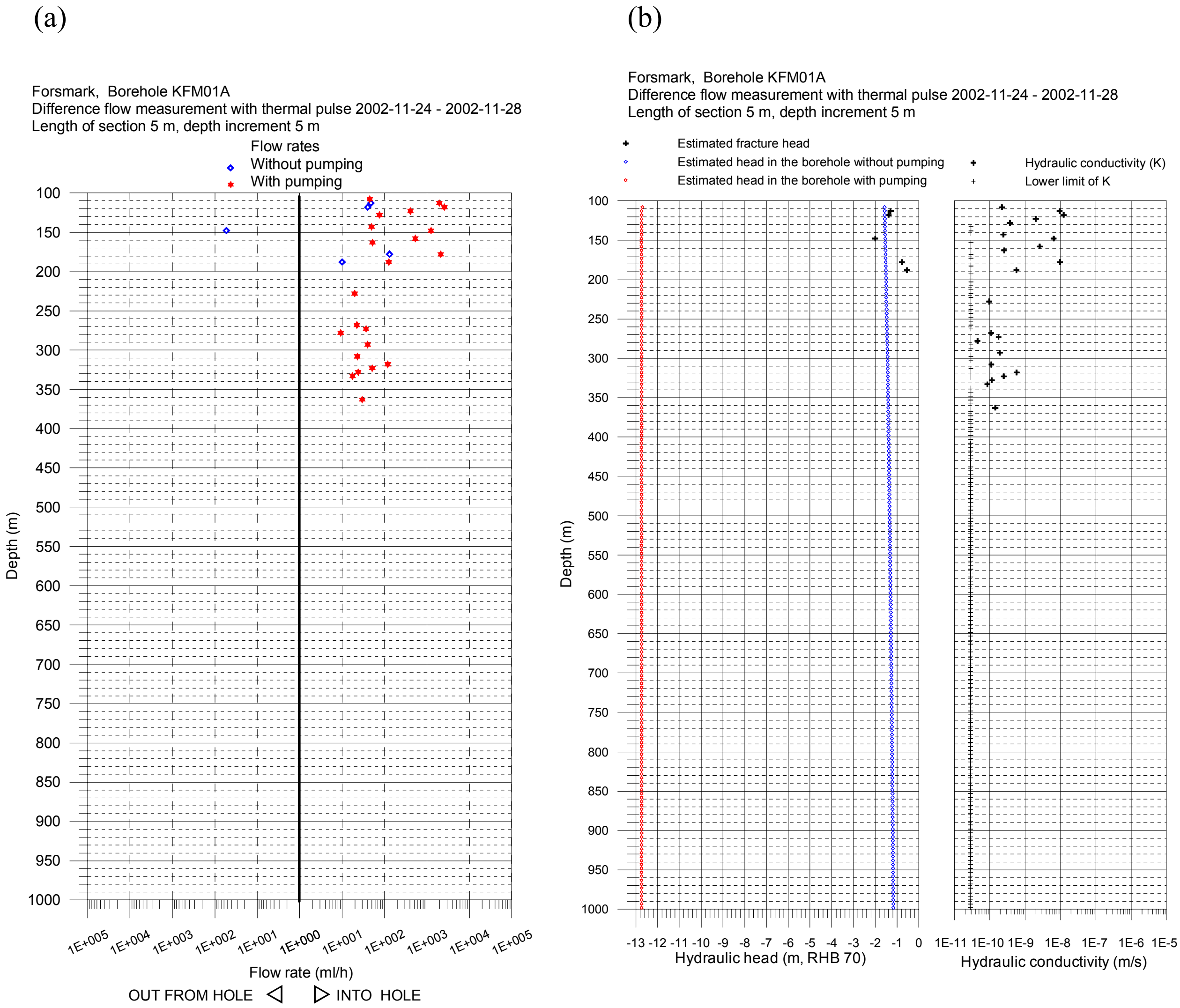

Figure 2-2. *Downhole measurements along borehole KFM01A (105 to 1000 m) of: a) groundwater flow rate (mL/h) into and out of the borehole, and b) hydraulic head and conductivity.*

The recorded rates of groundwater flow under ‘natural’ hydraulic conditions (i.e. no pumping) via fractures into the borehole from the surrounding bedrock, and conversely from the borehole into the bedrock, indicate, with only one exception at approx. 150 m, that water movement is mostly into the borehole (Fig. 2-2a). During pumping all movement of formational groundwater is into the borehole. Under open hole conditions, therefore, formation groundwater would be expected to enter into the borehole with the most hydraulically conducting fractures contributing the greatest volume. Since only at the 150 m level is there a possibility that water is moving from the borehole into the bedrock, any groundwater circulatory movement along the borehole length during open hole conditions would be driven mainly by density differences reflecting different sources (i.e. depths) from the surrounding bedrock.

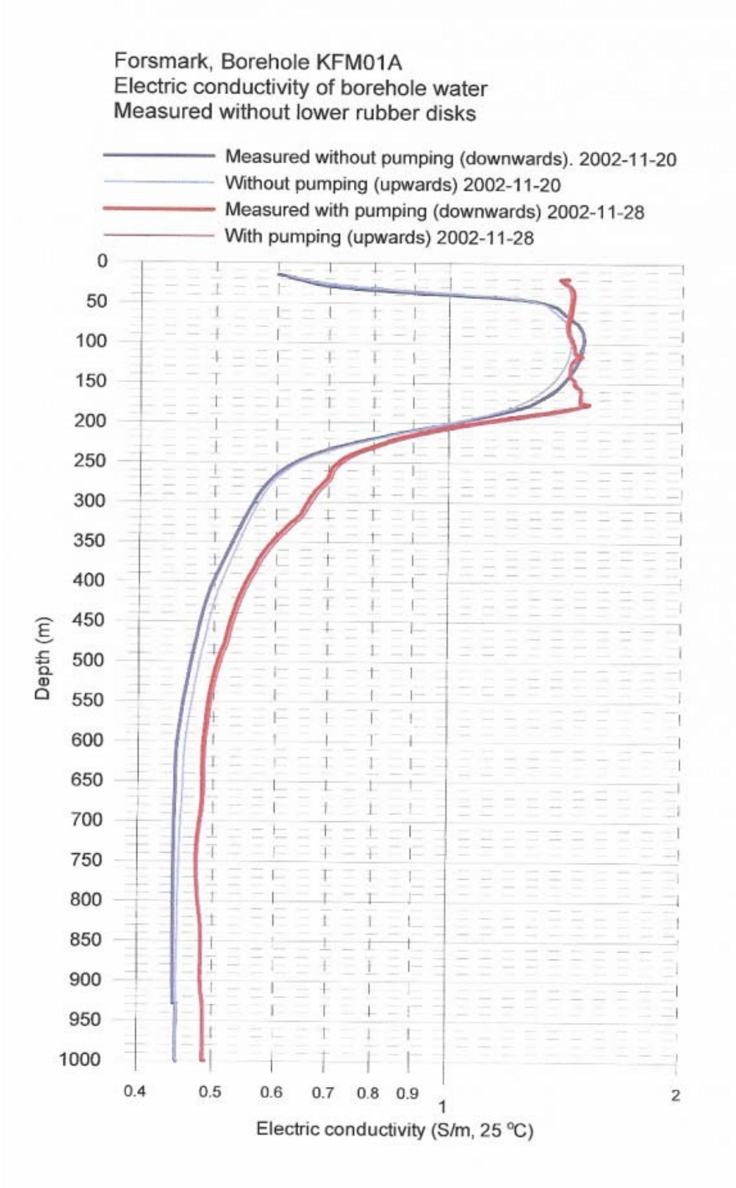

Figure 2-3: *Electrical conductivity log for borehole KFM01A during open hole conditions.*

Figure 2-3 shows an electrical conductivity log of borehole KFM01A during open hole conditions prior to groundwater sampling; differences in salinity trends obtained before and during pumping are very small. The profile shows a high salinity increase between 50-200 m depth corresponding to the most hydraulically conductive part of the borehole. From 200 m to the borehole bottom there is a fairly rapid decrease to below 0.5 S/m at 500 m which continues to 1 000 m. As shown by the low hydraulic conductivity values, little water is entering the borehole over this length. This suggests strongly that the water in the borehole from around 200 m to 1 000 m is mostly residual flushing water taken from percussion borehole HFM01 for drilling purposes. Analysis of the flushing water from HFM01 during a

7 week period following the drilling and sampling of borehole KFM01A showed a variation in electrical conductivity from 0.075-0.320 S/m equivalent to 9-651 mg/L Cl.

Figure 2-4 shows that one or more of the hydraulically active subhorizontal zones in the upper 100 m of borehole KFM01A can be traced to percussion boreholes HFM03, HFM02 and HFM01, a distance of approx. 100 m. Flow rates are exceedingly high at the 50 m level with 1000 L/min recorded in HFM02 and 700 L/min in KFM01A; this decreases to 60 L/min in HFM01. At shallower depths (15-25 m) in HFM02, HMF03 and KFM01A flow rates range from 40 to 200 L/min. Apart from a value of approx. 10L/min at 65 m depth in HFM01, only seepage points characterise greater depths (50-100 m). Since sub-horizontal fracture zones are a common feature of this region, having been documented from nearby Finnsjön some 15 kilometres to the SW (Ahlbom and Smellie, 1991), similar features should probably be expected at varying depths at the Forsmark site (e.g. at 700 m; Fig. 2-1).

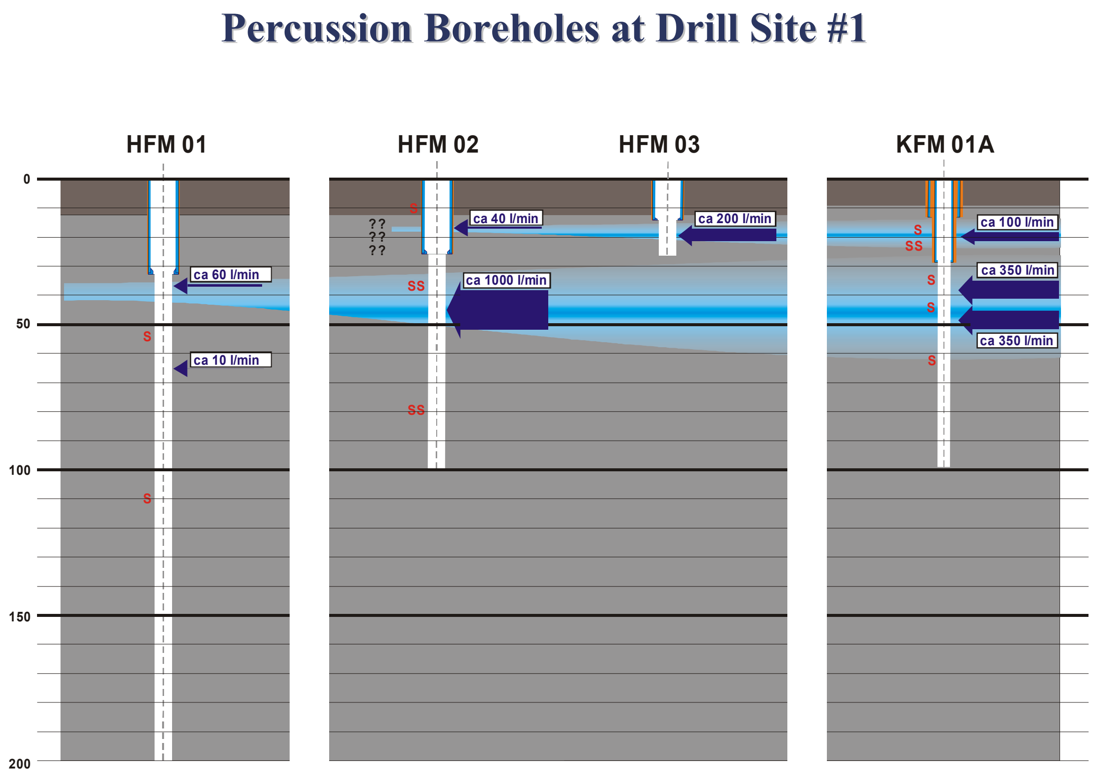

Figure 2-4: Extrapolation of hydraulically sub-horizontal zones in the upper 100 m from Drilling Site 1. Groundwater flow in L/min is given in blue and seepage points are denoted by a red S or SS. (after Sven Follin, written comm., 2003).

3. Groundwater quality and representativeness

The pre-sampling Chemac on-line monitoring data concerning pH, Eh, conductivity and temperature were not available to evaluate the quality and representativeness of the sampled groundwaters. What are available are the percentage flushing water contents for boreholes KFM01A and KFM02. During the sampling period for borehole KFM01A at section 110.00-120.67 m a flushing water content of 7.73% was recorded when sampling commenced; this decreased to less than 1% when the last 5 samples were taken from the same borehole section. From this evidence, therefore, only the first sample collected can be considered doubtful. Borehole KFM02, in contrast, records flushing water values of 43.47%, 20.3% and 89% from borehole sections 105.1-159.3 m, 250.00-291-45 m and 248.75-395.88 m respectively, during initial sampling. These high levels of flushing water contamination require great caution when the groundwater data are evaluated.

4. Hydrogeochemical evaluation

The hydrochemical data have been expressed in several X-Y plots to derive trends that may facilitate interpretation. Since chloride is generally conservative in normal groundwater systems its use is appropriate to study hydrochemical trends in evolution when coupled to ions, ranging from conservative and non-conservative, to provide information on mixing, dilution, sources/sinks etc. Many of the X-Y plots therefore involve chloride as one of the variables. The following is a preliminary evaluation of the various geochemical and isotopic trends apparent in the Forsmark groundwaters.

The laboratory analytical error in the data plotted is estimated to be ± 5% (cf. Smellie et al., 2002); this is illustrated in Figure 4-2. Note however that the very dilute surface and near-surface waters show a misleadingly small error when compared to the more highly mineralised borehole groundwaters.

4.1 General comparison of Cl vs depth with other sites

A general depth comparison of the Forsmark chlorine data has been made with the Laxemar (Oskarshamn) and Olkiluoto (Finland) datasets (Fig.4-1). It may be argued that such a comparison should be treated with caution since particularly Laxemar is geographically distant, represents a different hydrogeological regime and involves greater depths; Olkiluoto at least is also located at the coast and appears to have had a similar palaeoevolution to the Forsmark region. However, at great depths (> 1 000 m) the Fennoscandian basement hydrogeochemistry probably shares general similarities to the other described sites irrespective of geographic location and therefore Figure 4-1 can serve a useful purpose.

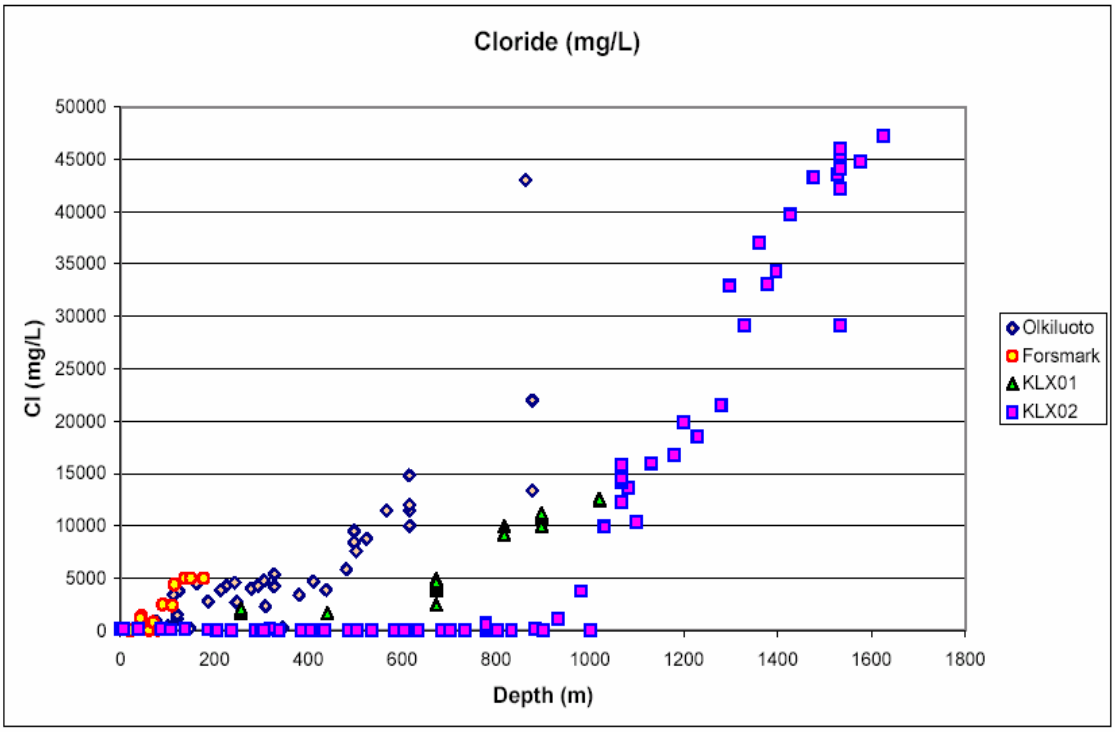

__Figure 4-1:__ Depth comparison of chlorine between the Forsmark site and the Laxemar (KLX01 and KLX02) and Olkiluoto localities. (after Sven Follin, written comm., 2003).

The Laxemar data show dilute groundwaters extending to around 1 000 m before a rapid increase in salinity to maximum values of around 47 g/L Cl at 1 700 m. (Note: The majority of the Laxemar KLX02 dilute waters sampled to approx. 900 m depth represent open hole mixing and do not truly reflect the compositional variation of the formation groundwaters). Olkiluoto shows an initial sharp increase in chlorine at around 150 m which levels off at 5 g/L Cl and continues to 450 m; here there is a relatively steady increase to maximum values of around 20 g/L Cl at 900 m depth (one maximum value of 44 g/L Cl was recorded). The Forsmark data show a close similarity to the initial Olkiluoto trends. It will be interesting to see if this levelling out at around 5 g/L Cl continues with increasing depth. An initial observation at this juncture is that the levelling out at 5 g/L Cl at Olkiluoto has been interpreted as possibly reflecting a Litorina Sea water component. This may also be the case at Forsmark due to similarities in Palaeoevolution at the two sites.

4.2 Plots of Mg vs Cl for all Forsmark data and comparison with other Swedish sites

Figure 4-2 shows two clear trends: a) an obvious modern Baltic Sea water dilution line, and b) a clear borehole saline dilution line quite distinct from (a).

The Baltic Sea values cluster around 2 600 mg/L Cl which is recommended to represent the Baltic Sea end-member composition at the Forsmark site. The plotted data show a large spread to more dilute mixing compositions, and extreme examples exist where only small amounts of Cl are present. These dilute samples represent some coastal Baltic Sea bay localities where there is a large fresh meteoric water input.

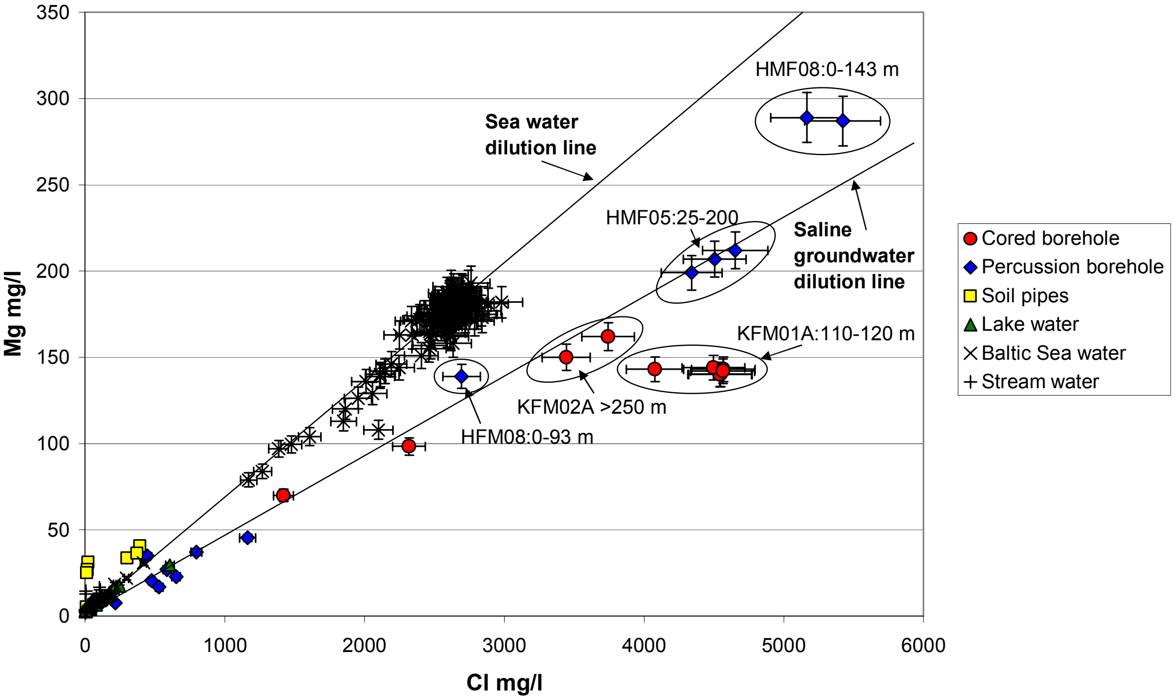

Figure 4-2: *Plot of Mg vs Cl for all Forsmark data showing analytical error bars (±5%)*

The borehole data generally plot along a separate saline dilution line with some important exceptions. It is not the case for the KFM01A cored borehole section at 110-120.67 m and for the percussion borehole HMF08 (0-93 m). HMF08 (0-93 m) shows some affiliation to the Baltic Sea water trend, whilst KFM01A shows an even greater deviation from the rest of the borehole data by plotting even further away from a Baltic Sea influence. Of particular interest is the Mg and Cl difference between HMF08 (0-93 m) and HMF08 (0-143 m), which can only be explained by the greater depth sampled (some 50 m) in the latter. HMF08 (0-143 m) appears to have penetrated a horizon/pocket/lens of more highly saline water of marine origin where the Mg (~290 mg/L) and Cl (~5 300 mg/L) contents are approaching those estimated values for the Litorina Sea composition (Mg ~448 mg/L; Cl ~6500 mg/L) as derived by Pitkänen et al (1999). Mixing with a Litorina Sea component may explain the deviation of KFM1A (110-120.67 m), but a deeper, perhaps non-marine source, cannot be ruled out at this stage.

A further comment on Figure 4-2 is the close association of some of the Soil Pipe samples to the modern Baltic Sea water dilution line; the other three samples show very little Cl but significant Mg. This may suggest: a) contact with an older marine water followed by cation exchange reactions and later flushing out of chloride, or b) simply water-rock interaction of recharge with minerals in the soil.

Figure 4-3**,** comparing the Forsmark data with other Swedish sites, underlines the greater Mg contents (>200 mg/L) associated with the sampled boreholes at Forsmark (e.g. KFR7A) when compared with, for example, the maximum content (~175 mg/L) at Äspö (borehole SA2240). This suggests that either Forsmark has better retained its high initial marine-derived Mg than the other Swedish sites, or indicates a greater influence from a later marine component (e.g. Litorina).

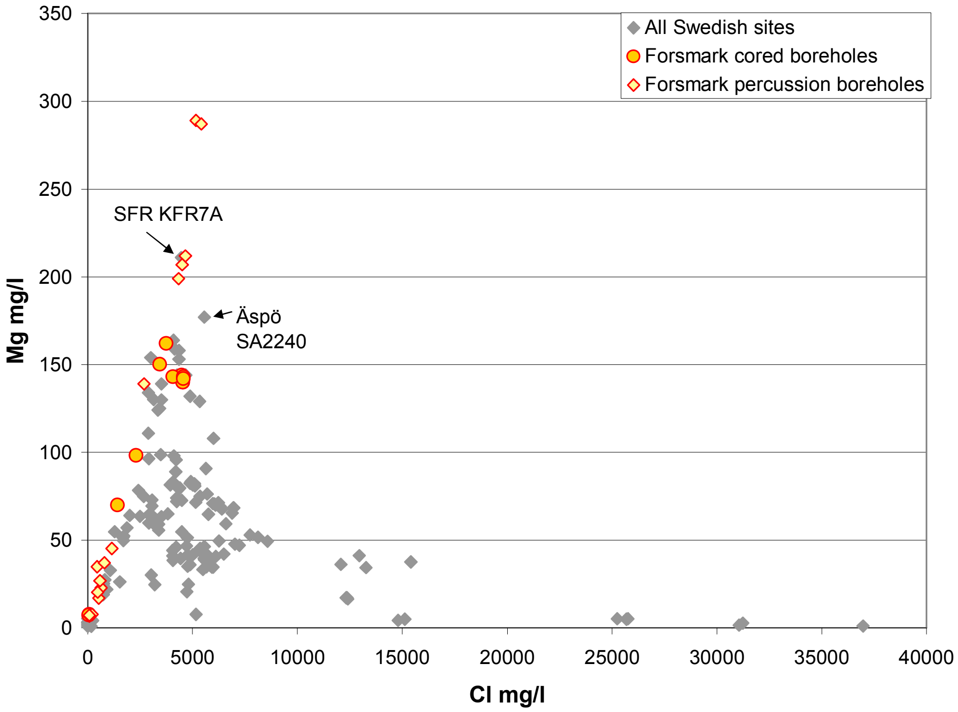

Figure 4-3: *Plot comparing all Forsmark Mg vs Cl data with other Swedish sites.*

4.3. Plot of Ca vs Cl for all Forsmark data

Figure 4-4 showing Ca vs Cl differentiates between the Baltic Sea dilution line and a borehole saline dilution line. In common with Figure 4-3 both HMF08 (0-143 m) and KFM01A (110-120.67 m) are anomalous. The generally high Ca contents of the borehole groundwaters (> 500 mg/L) may be explained partly by the influence of ion exchange processes resulting from water-rock reactions in the bedrock. It is unlikely that a Litorina Sea component has contributed since its composition has been calculated to around 150 mg/L Ca (Pitkänen et al. (1999).

Plots of Ca vs Na and Ca vs Mg (not shown) show similar trends to those described in Figure 4-4.

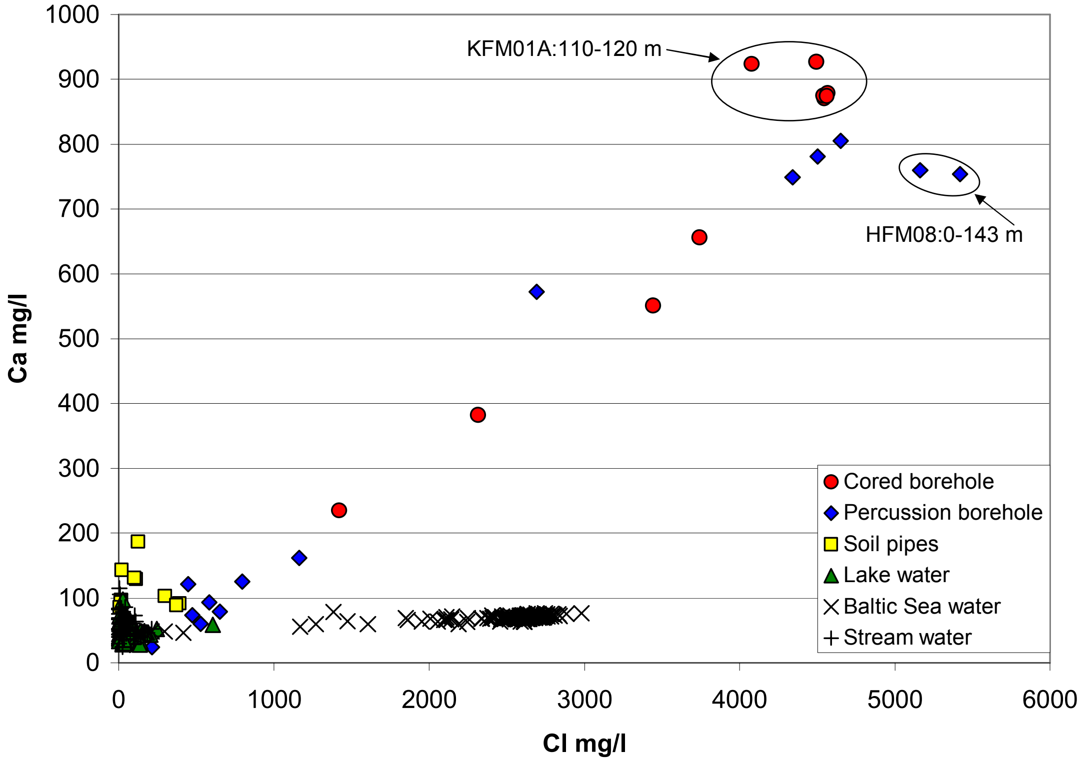

Figure 4-4: *Plot of Ca vs Cl for all Forsmark data*

4.4. Plot of SO_4 vs Cl for all Forsmark data

Figure 4-5, showing SO_4 vs Cl, indicates three possible trends: a) an obvious modern Baltic Sea water dilution line, b) a clear borehole saline groundwater dilution mixing trend moving away from (a), and c) a possible low chloride-low sulphate dilution trend incorporating Soil Pipe samples and some Lake/Stream water and shallow percussion borehole samples.

Once again percussion borehole HMF08 (0-143 m) is anomalous recording the highest sulphate content (~520 mg/L SO_4) which again suggests some Litorina influence. Pitkänen et al. (1999) have estimated a Litorina Sea composition of 890 mg/L SO_4.

The greater scatter of sulphate at lower chloride levels may partly reflect some modern Baltic Sea water influence, some near-surface oxidation of sulphides, and also the variable effects of microbially mediated reactions (e.g. effect of sulphate-reducing bacteria) below and above the geosphere/biosphere interface.

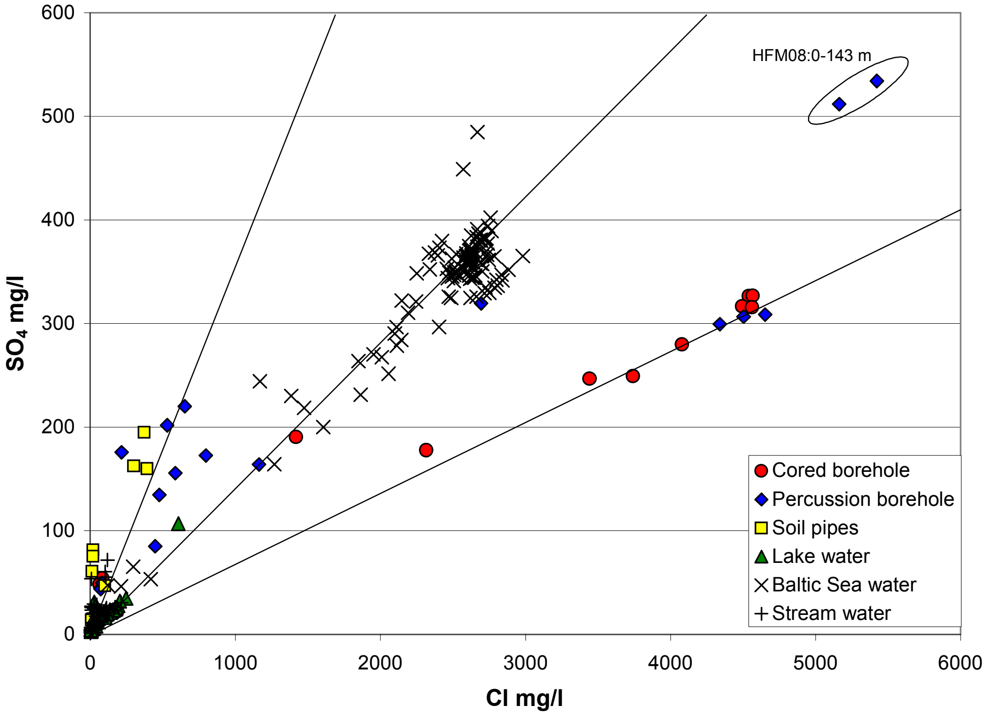

Figure 4-5: *Plot of SO_4 vs Cl for all Forsmark data.*

4.5. Plot of Cl vs Br for all Forsmark data

Excluding the very dilute Lake and Stream water samples, Figure 4-6 shows a clear correlation for all samples except for the deeper groundwaters sampled from the cored and percussion boreholes which deviate significantly. One possibility for this deviation would be a Litorina Sea component. The high Cl and Br contents (up to 5 500 mg/L Cl and 24 mg/L Br) suggest strongly the influence of Litorina Sea water. The observed deviation from the marine Cl/Br trend, however, supports either a modification of the Litorina Sea component or an additional contribution (by mixing) of another saline component. Furthermore, some analytical uncertainty of the Br data should not be discounted (per. comm. Ann-Chatrin Nilsson, 2003).

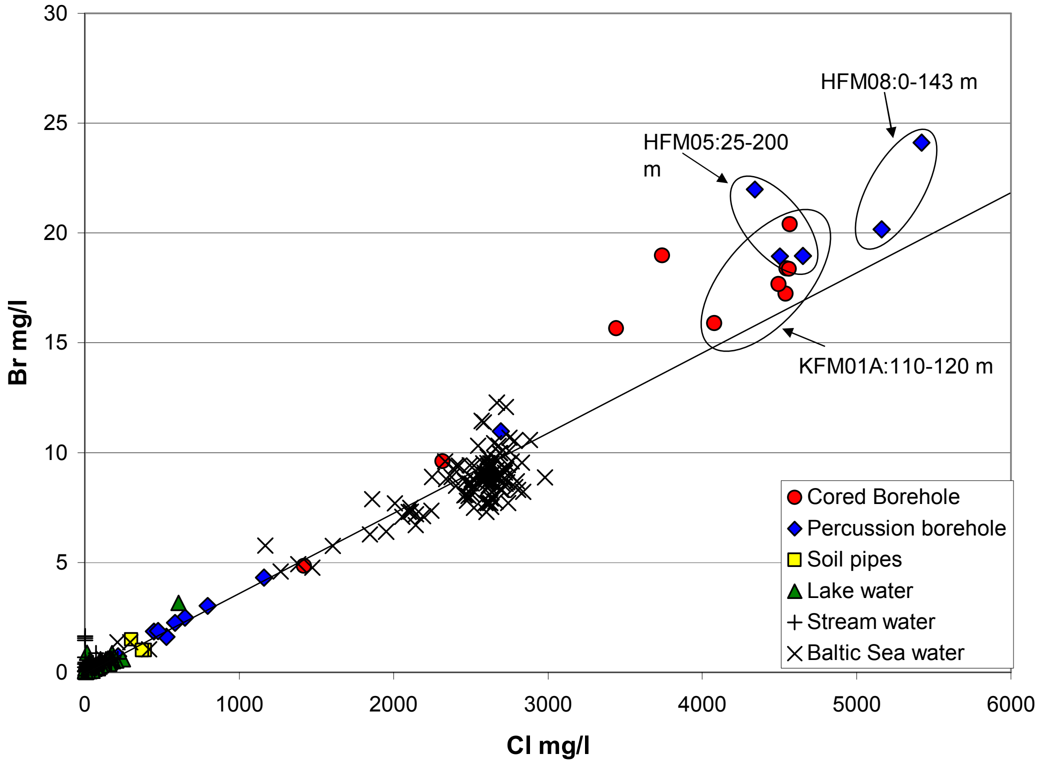

Figure 4-6: *Plot of Br vs Cl for all Forsmark data*

4.6. Plot of Mg vs Ca for all Forsmark data

Figure 4-7 shows little resolution of the surface water data apart from an obvious modern Baltic Sea water cluster; some scattering to lower Mg contents may indicate the input of dilute meteoric waters along the coastline and possibly the influence of ion exchange reactions when in contact with sea bottom or coastal sediments etc. At low Mg contents there is a spread of Ca values which reflects generally the heterogeneity of the sampled locations. Higher values (> 100 mg/L Ca) particularly in the Soil Pipe samples may suggest ion exchange reactions with Baltic Sea water; higher values in some of the Stream Water samples might reflect evidence of discharging groundwaters of deeper origin.

With respect to the borehole samples, Figure 4-7 shows a good correlation apart from HFM08 (0-143 m) and KFM01A (110-120.67 m). As discussed above, the former is anomalous because of the possibility of a significant Litorina Sea component (i.e. estimated 450 mg/L Mg compared to ~190 mg/L Mg for modern Baltic Sea water) and the latter is more indicative of a deep origin with an increased Ca content from water-rock interaction and less influence from a marine component.

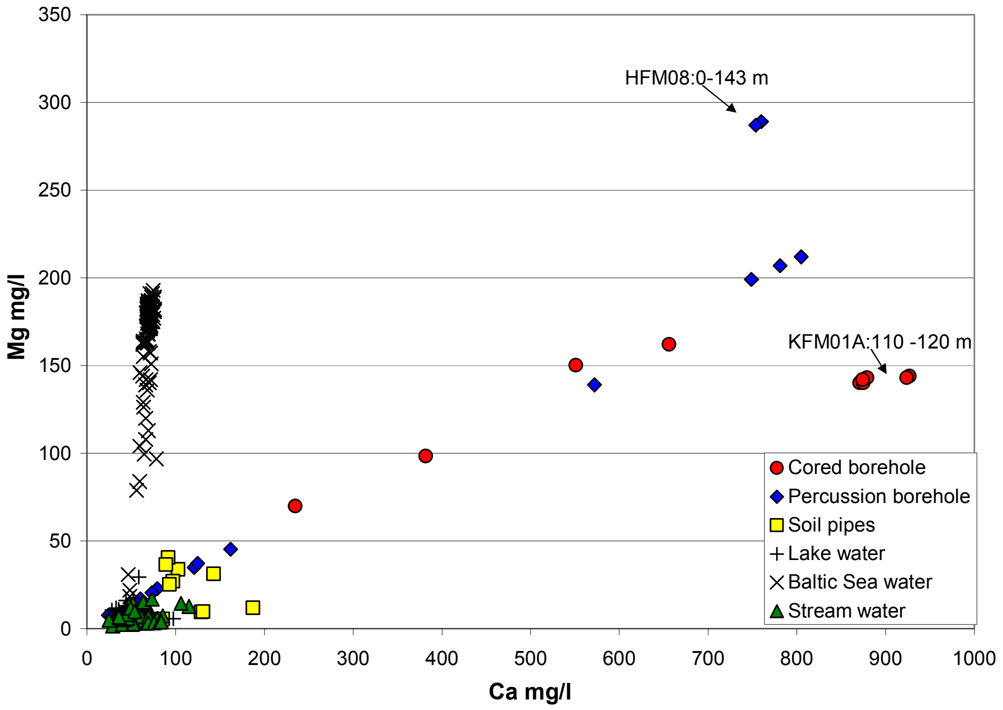

Figure 4-7: *Plot of Mg vs Ca for all Forsmark data*

4.7. Plot of Ca/Mg vs Br/Cl comparing all Forsmark data with other Fennoscandian sites

By plotting Ca/Mg vs Br/Cl, Figure 4-8 provides an opportunity to indicate those data of marine origin versus data with a non-marine or a non-marine/marine mixing origin. For comparison the Forsmark data have been grouped with other Fennoscandian sites (Finnsjön, SFR, Simpevarp, Äspö, Laxemar, Olkiluoto and Stripa); the Yellow Knife-Thompson data have been included since they represent highly evolved basement brines in Canada where a significant marine component is unlikely.

The figure shows clearly the clustering of modern Baltic Seawater values; these can be compared to the other extreme, the Stripa groundwaters, which are considered to be more representative of a non-marine origin since this area was not transgressed by the Litorina Sea or subsequent transgressions (Nordstrom et al., 1985). Between these two extremes fall the range of Finnsjön and Äspö groundwaters considered to have a marine component of varying amount (Smellie and Wikberg, 1991; Laaksoharju et al., 1999), and the Olkiluoto groundwaters which lean to a less marine component at greater depths (Pitkänen et al., 1999). The Simpevarp cored borehole groundwater data plot within the range of the Äspö samples. The Laxemar data, of deep basement origin, plot off the diagram further emphasising their non-marine character.

Collectively the Forsmark borehole groundwaters cluster towards a dominant marine component, more similar to the SFR than the Finnsjön groundwaters, although the Forsmark cored borehole samples do extend towards a slightly less marine component.

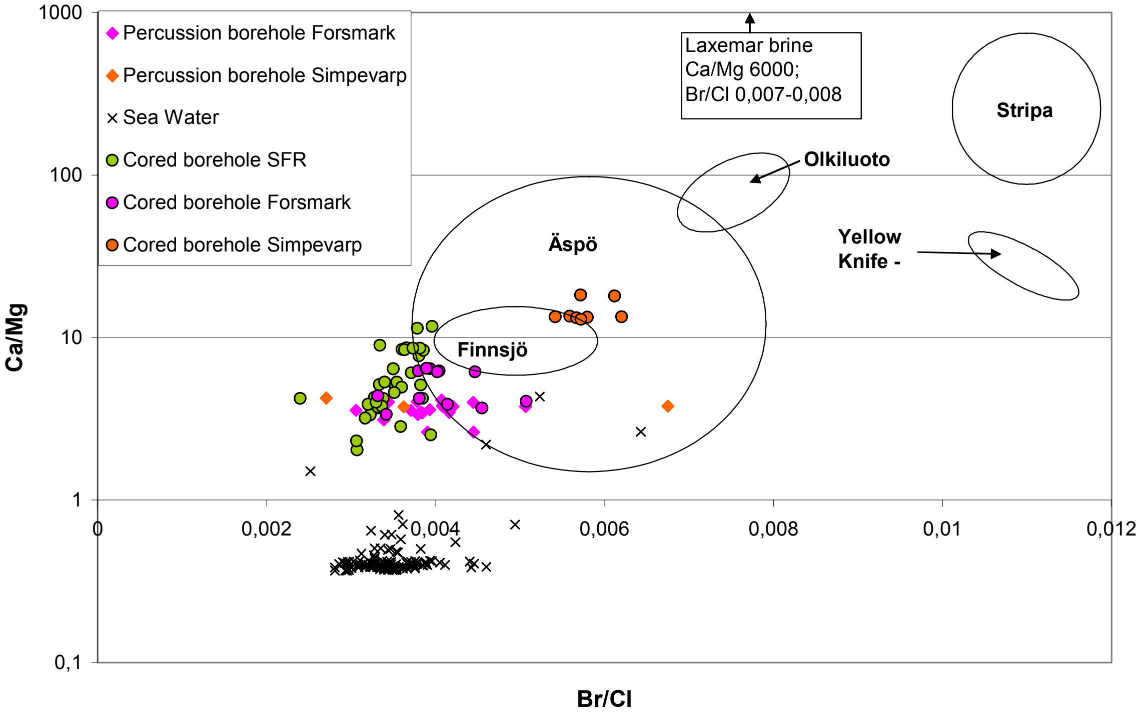

Figure 4-8: *Plot comparing all Forsmark Ca/Mg vs Br/Cl data with other Fennoscandian sites and deep Canadian brines.*

4.8. Plots of δD vs $\delta^{18}O$ for all Forsmark data and comparison with the Finnsjön and SFR sites

Samples from Forsmark range from $\delta^{18}O$ = -14.5 to -4.5 ‰ SMOW and δD = -102.1 to -44.3‰ SMOW (Fig. 4-9). This total range also represents the Lake Waters; the boreholes form a closer grouping as do the Baltic Sea waters. The majority of the plotted data show a close correlation with the GMWL (Global Meteoric Water Line: $\delta^{2}H = 8*\delta^{18}O + 10$; Craig, 1961) generally indicating a meteoric origin. However, much of the Forsmark data, particularly the Lake Water but also some Stream, Soil Pipe and Baltic waters, plot below the GWML. This, according to Fritz and Frape (1980), is due to depleted δD values which suggest surface evaporation; this is supported by the surface origin of the plotted Forsmark samples showing depleted δD. Many of the Lake and Stream water samples show even greater δD depletion values.

Contrastingly, the deeper borehole samples plot close to or on the GMWL with the exception of borehole HMF05 ($\delta^{18}O$ = -10.2‰ SMOW; δD = -78‰ SMOW). The reason for this exception is not quite clear but the chemistry of the groundwater suggests mixing with a marine water component.

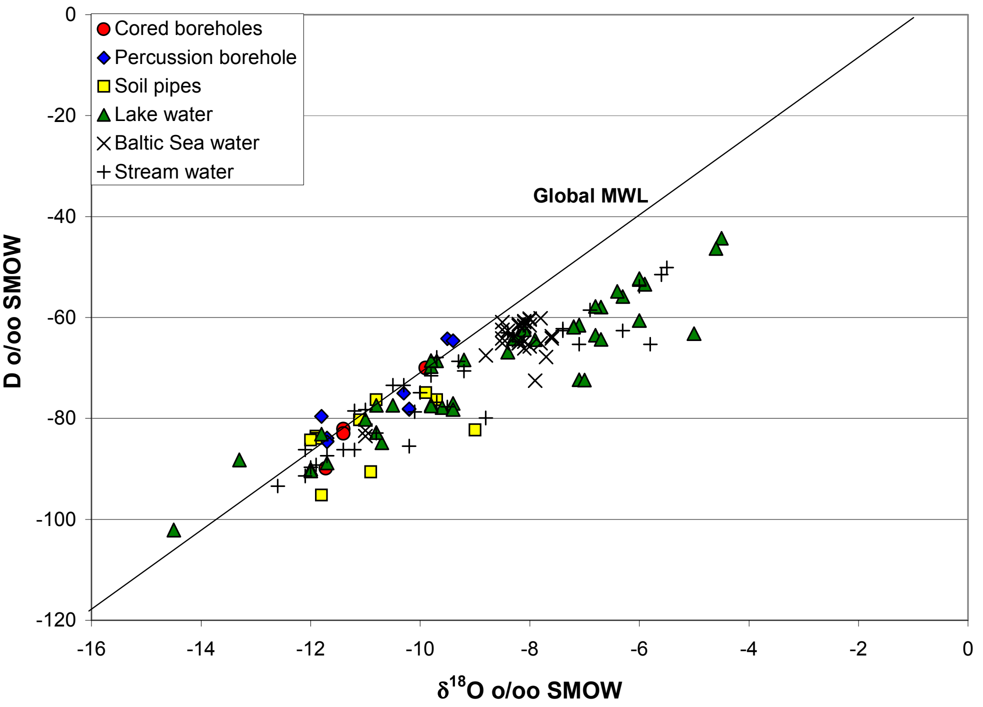

Figure 4-9: Plot of δD vs δ18O for all Forsmark data. (Global MWL = Meteoric Water Line)

Figure 4-10, comparing Forsmark with SFR and Finnsjön data, further illustrates the regional extent of deuterium depletion (i.e. probably surface evaporation effects) at Forsmark. According to Pitkänen et al. (1999) similar observations also were noted at Olkiluoto.

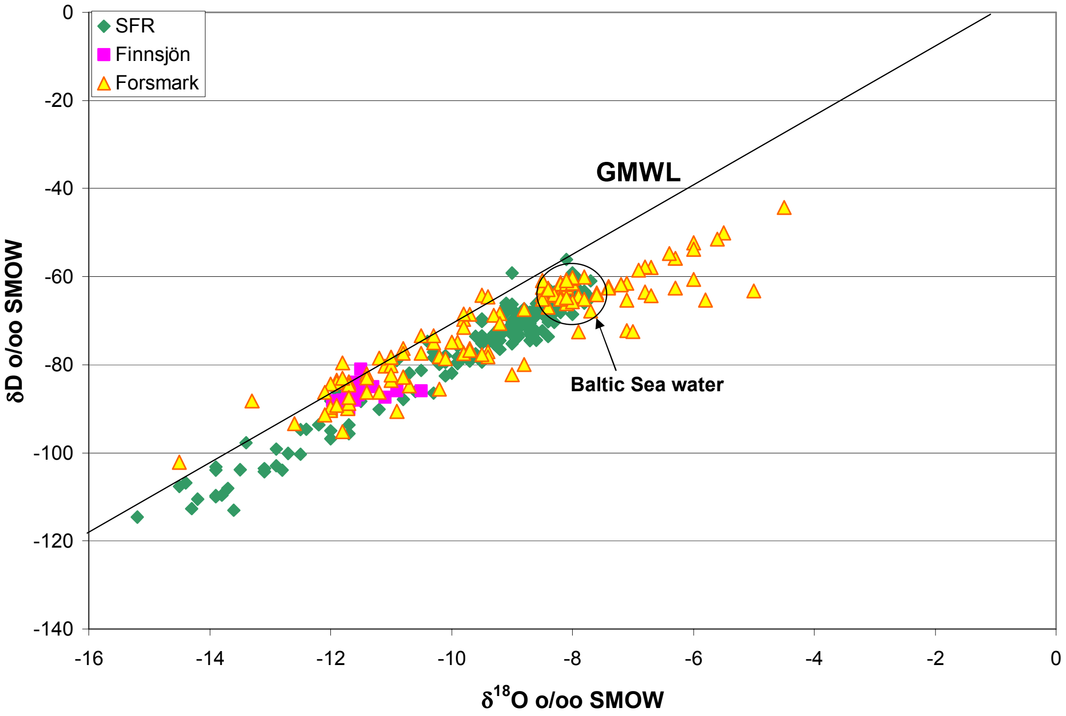

Figure 4-10: Plot of δD vs δ18O comparing Forsmark with Finnsjön and SFR. (GMWL = Global Meteoric Water Line).

4.9. Plots of δ^{18}O vs Cl for all Forsmark data and comparison with the Finnsjön and SFR sites.

Figure 4-11 shows a wide variation of δ^{18}O values at low chloride contents; this is thought to reflect a combination of seasonal fluctuations and mixing of local groundwater discharge (of varying residence times and recharge character) with modern Lake and Stream water sources. With only one exception the Soil Pipe samples tend to cluster at lighter δ^{18}O values (-12 to -11‰ SMOW) which is close to the annual mean precipitation between -11 to -12‰. The Baltic Sea water samples typically cluster around 2 500-3 000 mg/L Cl and -8‰ SMOW.

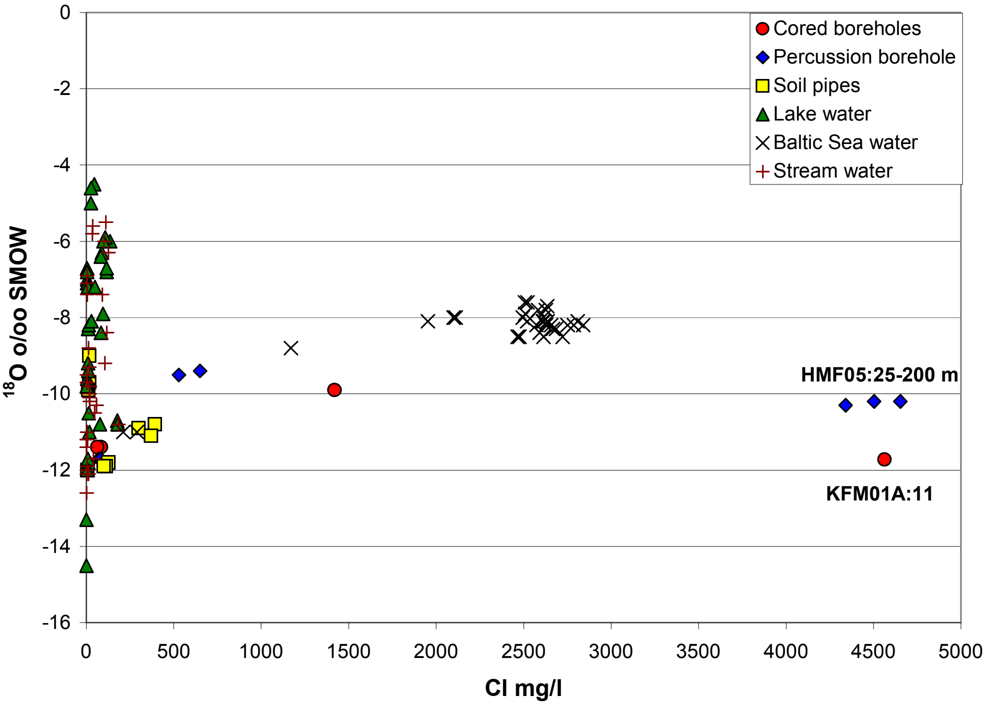

Figure 4-11: *Plot of δ^{18}O vs Cl for all Forsmark data.*

The borehole groundwater data show two concentrations; one high chloride (> 4 000 mg/L) with δ^{18}O values within the range of -12 to -10‰ SMOW (boreholes HMF05 and KFM01A) and one low chloride (< 1 500 mg/L) with δ^{18}O ranging from -12 to -9‰ SMOW. The latter represent mixing with more dilute, surface-derived waters.

The significance of these plotted distributions at Forsmark becomes more apparent when compared to the nearby Finnsjön and SFR data in Figure 4-12. This figure shows two clear clusters representing present Meteoric and present Baltic Sea waters; there is a small degree of mixing between the two. The Baltic Sea water dilution line intercepts the 'x' axis at approx. -11.7‰ SMOW, i.e. the average present-day recharge. The remaining data appear to be a scatter, but a dilution line linking a calculated Litorina Sea chloride content (6 500 mg/L) with fresh glacial melt water (δ^{18}O = -25‰ SMOW) does suggest a degree of linear alignment of the SFR data including some of the present Forsmark borehole data which earlier have been identified as potentially containing a significant Litorina Sea component. An increasing brine composition (i.e. more non-marine component) will plot more to the right of the Litorina Sea line as shown by the deeper derived borehole groundwaters from Finnsjön.

The scatter between the modern Baltic Sea, Litorina Sea and increasing brine components probably reflects variable mixing processes. Figure 4-12 supports therefore earlier suggestions that there are four main water types or end-members; present Meteoric, present Baltic Sea, an old Litorina Sea component and a deeper, more saline, increasingly non-marine component (Brine). Variable mixing is apparent between all four types.

A (significant?) in-mixing of a cool climate meteoric water (e.g. glacial melt water) is a probable explanation for the saline water with low δ^{18}O (<13‰ SMOW) and chlorine values around 3 500 mg/L. This 'Glacial' component therefore represents the fifth major water type or end-member.

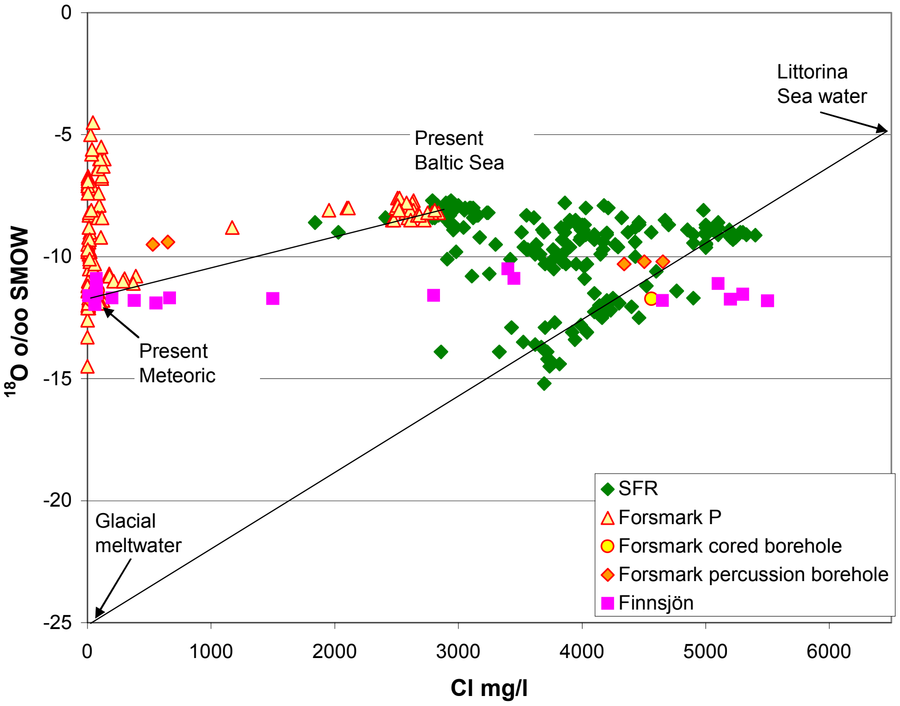

Figure 4-12: *Plot of δ^{18}O vs Cl comparing Forsmark with Finnsjön and SFR.*

4.10. Plot of δ^{18}O vs tritium for all Forsmark data.

Figure 4-13 shows a wide range of δ^{18}O and tritium; the highest tritium value (~25 TU), compared to the present-day precipitation average of 10-15 TU (?), is associated with one of the Soil Pipe samples (SFM0003) and might be interpreted as reflecting a residual high bomb fall-out signature. Two Soil Pipe waters have very low tritium (below detection limit) which might suggest an area of groundwater recharge. Unfortunately there are no corroborative ^{14}C data are available for these samples.

The Lake and Stream water samples reflect modern waters of meteoric origin; widespread mixing with waters/groundwaters from different sources has resulted in the observed scatter. Deeper borehole groundwaters (KFM01A; HMF01; HMF05) are older (> 5 TU); shallower borehole groundwaters (10-13 TU) have been influenced by variable mixing with waters that are younger and also with waters with a lighter δ^{18}O signature (present meteoric water).

Generally, the $\delta^{18}O$ ranges measured in the surface and near-surface waters may simply represent the seasonal range of present-day precipitation. Long-term seasonal precipitation records are not yet available to help resolve this issue.

The borehole groundwaters analysed record significant tritium (3-12 TU) indicating variable mixing (contamination?) with younger (years) meteoric waters (i.e. residual drilling water).

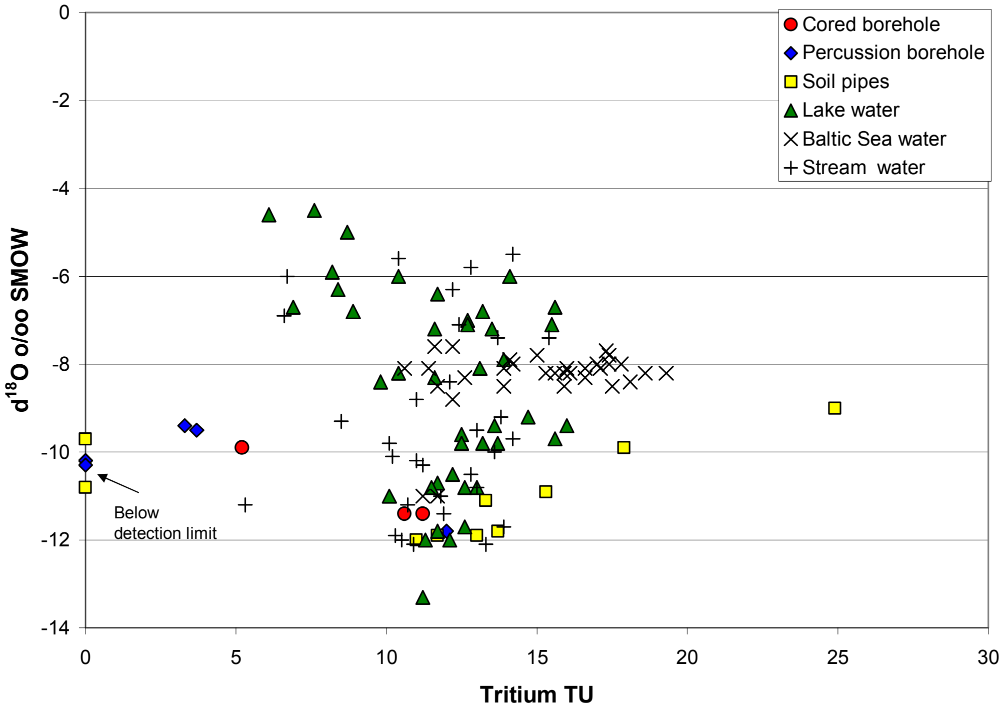

***Figure 4-13**: Plot of $\delta^{18}O$ vs ^{3}H for all Forsmark data.*

4.11. Plot of tritium vs. pmC for all Forsmark data.

Figure 4-14 shows that almost all of the plotted data fall between 100-120 pmC indicating a modern origin (years); tritium shows a wide scatter of values. Exceptions which plot separately from the main group by virtue of lower tritium contents include the Soil Pipe samples (SFM0001 at 90.2 pmC/15.3 TU; SFM0002 at 85.3 pmC/13.7 TU; SFM0003 at 69.1 pmC/24.9 TU) and the low tritium, low pmC borehole groundwaters (KFM01A at 50.7 pmC/5.2 TU; HMF01 at 46.3 pmC/3.7TU; HMF01 at 45.2 pmC/3.3 TU). Such values are to be expected from deeper borehole groundwaters, but the Soil Pipe samples are somewhat anomalous. As mentioned above, however, these Soil Pipe samples may be influenced by older discharge groundwaters or that they have evolved by dissolving some dead carbon from the carbonates in the soil.

Figure 4-14 also indicates a degree of separation in tritium between the three groups of surface waters: a) mostly Baltic Sea water (15-20 TU), b) mostly Lake Water (5-10 TU) and c) Stream Water plus overlapping Baltic Sea and Lake waters (10-15 TU). The reason for this is not readily apparent at the moment unless it is the effect of variable surface evaporation.

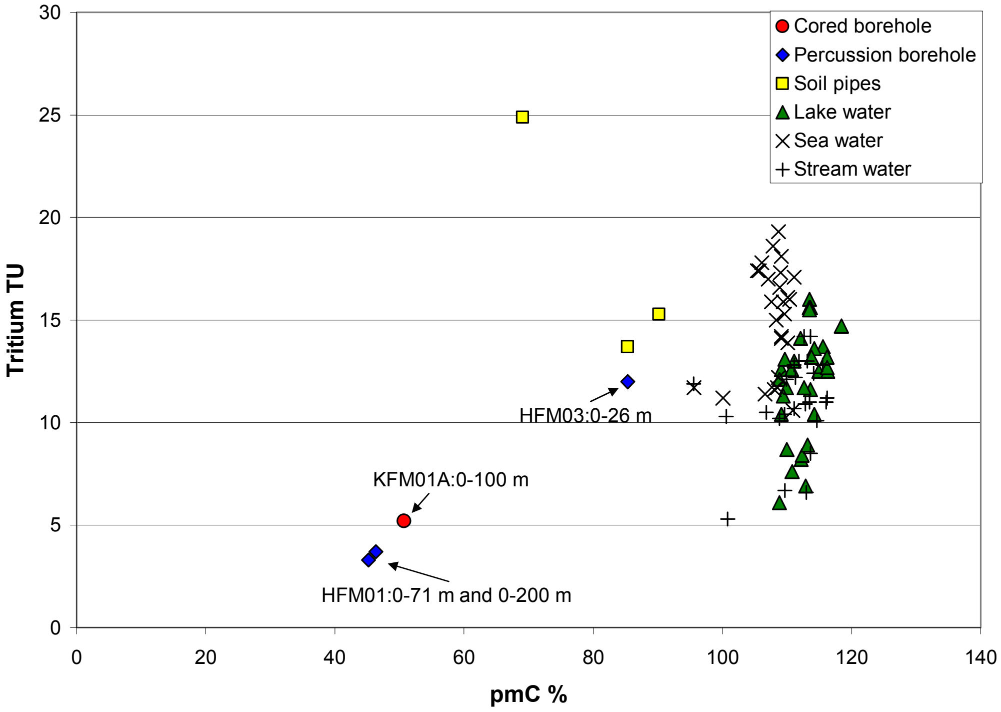

Figure 4-14*: Plot of tritium vs pmC for all Forsmark data*

4.12. Plot of δ^{13}C vs pmC for all Forsmark data.

In Figure 4-15 the δ^{13}C values in the surface waters show that the carbon input ranges from atmospheric (-2 to -5 ‰) in the Baltic Sea water to biogenic values around -10‰ for the Lake and Stream waters.

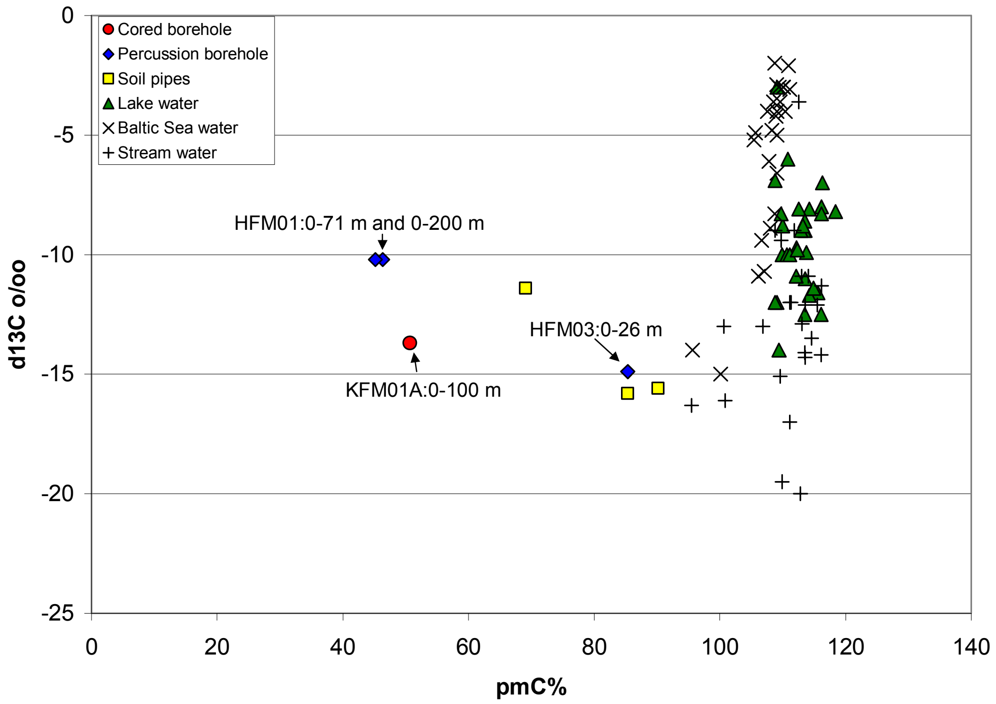

Figure 4-15: *Plot of δ^{13}**C** vs pmC for all Forsmark data*

Three of the borehole samples analysed, (HFM01: 0-71 m and 0-200 m; FFM01A: 0-100 m), all open-hole samples and one Soil Pipe sample, show significantly lower pmC values when compared with the surface waters. This can be explained by dissolution of old calcite, oxidation of old organic material or simply mixing of different waters.

4.13. Plot of SO_4 vs $\delta^{34}S$ for all Forsmark data.

Figure 4-16 shows a clear distinction between Baltic Sea water values (high SO_4 and $\delta^{34}S$) and Lake/Stream water values (low SO_4 and $\delta^{34}S$). The Soil Pipe samples plot depending on their locality, i.e. possible influence by Baltic Sea water or surface Lake/Stream waters (e.g. KFM02A and HFM04; both these are shallow, open hole samples). The low $\delta^{34}S$ values in the surface waters and the boreholes are in agreement with atmospheric input of SO_4 and possibly with some contribution from oxidation of sulphides. Compared to the Baltic Sea water samples, the decrease in SO_4 and increase in $\delta^{34}S$ indicated in borehole HFM05 might suggest activity of sulphate-reducing bacteria.

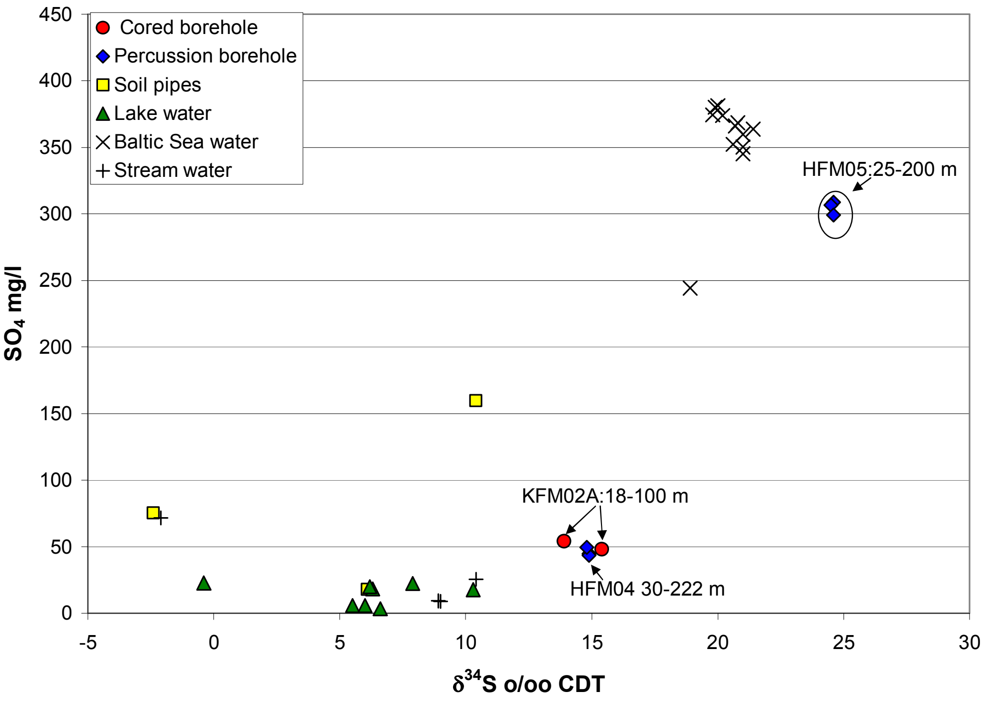

***Figure 4-16**: Plot of SO_4 vs. $\delta^{34}S$ for all Forsmark data*

4.14. Plot of Cl vs $\delta^{37}Cl$ for all Forsmark data.

Figure 4-17 plots Cl vs $\delta^{37}Cl$ for all Forsmark data. According to Frape et al. (1996) modern Baltic Sea and possibly palaeo-Baltic waters should be recognised by negative $\delta^{37}Cl$ signatures related to salt leachate from Palaeozoic salt deposits south of the Baltic Sea; influence by water-rock interaction tends to result in positive $\delta^{37}Cl$ signatures. Taking into consideration the analytical uncertainty of around ±0.2 ‰, Figure 4-17 shows that most of the

Baltic Sea water data plot around zero; there is however, some emphasis of a negative signature in the remaining data around the 2 500 mg/L Cl concentration (i.e. Baltic Sea signature). The large spread of δ^{37}Cl values for the Lake/Stream water samples may be attributed largely to analytical uncertainty at these very low chloride concentrations. Of potential interest are the Lake/Stream water samples and one Soil Pipe sample which plot at -0.5 to -0.3 ‰ possibly indicating some influence from modern Baltic or palaeo-Baltic waters. Some δ^{37}Cl enrichment may be suggested for the borehole samples (HMF01) at around 500 mg/L Cl; this would be line with water-rock interaction processes.

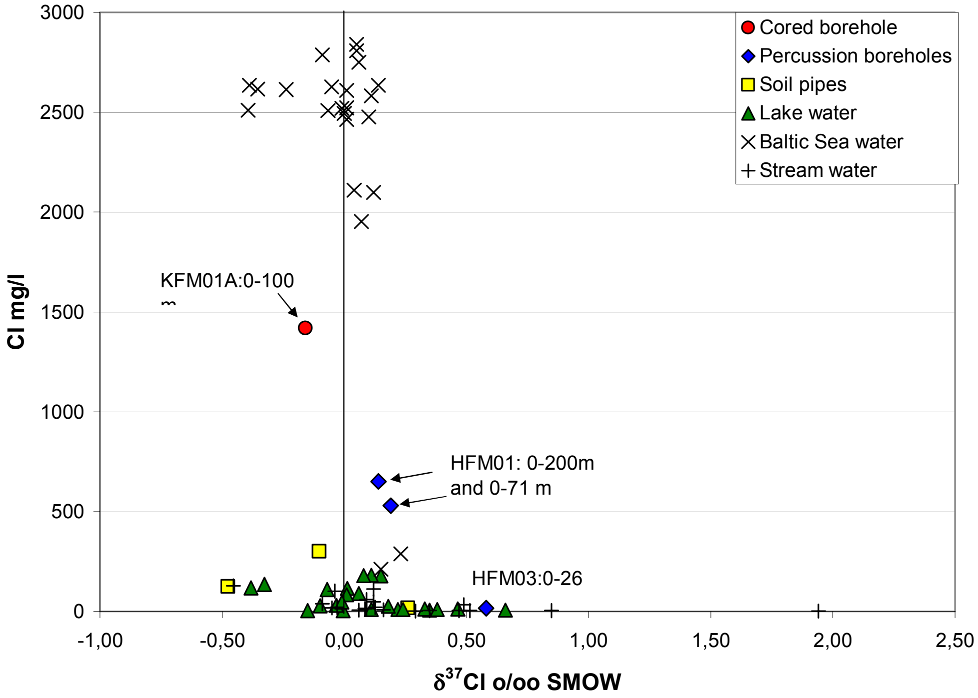

Figure 4-17: *Plot of δ^{37}Cl vs Cl for all Forsmark data*

4.15. Data related to radiogenic isotopes, ^{10}B, ^{87}Sr and trace elements

Because of either incomplete data or below detection or suspect values at the time of the 'data freeze', evaluation of, for example the radiogenic isotopes, ^{87}Sr, ^{10}B and REEs and other trace elements, have not been included in this Model v. 1.1 stage evaluation.

5. Conclusions

An important conclusion from this evaluation is a better definition of what is meant by 'Baltic Sea water' in the Forsmark area. Some of the plotted data in Chapter 4 reveal a large spread of Baltic Sea values showing a trend to more dilute mixing compositions; extreme examples exist where only small amounts of Cl are present. Whilst these diluted waters clearly do not represent typical Baltic Sea compositions in the Forsmark area which average around ~ 2 600 mg/L Cl, they do represent some coastal Baltic Sea bay localities where there is a large fresh meteoric water input. According to Samuelsson (1996) the salinity of the upper 50 m of open Baltic Sea equivalent to the latitude of Forsmark is ~3 000 mg/L Cl, therefore the Baltic Sea close to the Forsmark coast (~2 600 mg/L Cl) represents a somewhat diluted composition. However, since this diluted composition more accurately represents the 'Baltic Sea' composition at the site area, it should be used as the Baltic Sea end-member in all future reference.

The waters of the Forsmark area from available data show the following features:

- Dilute surface waters, mostly represented by the Lake and Stream samples, are usually characterised by very short residence times (days to some years) and high tritium and ^{14}C

- Dilute near-surface waters, mostly represented by the Soil Pipe waters, but also some discharging groundwater to the surface Lakes and Streams, are probably characterised by longer residence times (months to some years). Despite this, similarly high tritium values are obtained to the surface-derived waters although ^{14}C (based on only a few data) appears to be a little lower.

- Baltic Sea water which in the coastal bays is mixed with varying amounts of: a) meteoric waters (direct precipitation run-off, b) stream water input and, c) in places discharge of deeper groundwaters.

- Other marine sources with higher salinity may be involved, in particular, Litorina Sea water or Litorina Sea/glacial water mixtures with chloride contents of around 4 000-5 500 mg/L and δ^{18}O values between -10 and -12‰ SMOW. For example, taking the SFR data into account, a mixing line between a fresh glacial meltwater with a δ^{18}O of -25‰ SMOW and a Litorina Sea water of 6500 mg/L Cl can be calculated, corresponding closely to some of the Forsmark data.

- The Litorina Sea water component (twice as saline as the present Baltic Sea water) has intruded into, and mixed with glacial melt waters, some 7 000 years ago. This glacial-Litorina mixture, where preserved in the bedrock, has in some fractures mixed with present Baltic Sea water and, during the last 1 000 years, probably also with meteoric water. Only in hydraulically favourable 'pockets' or 'lenses/horizons' (e.g. HMF08 between 93-143 m) has a stronger Litorina signature been recorded.

- At present the indication of a Litorina Sea water is based on the δ^{18}O vs, Cl relationship and also the higher Mg and SO_4 contents when compared with saline waters of brine type. With additional data it is hoped to be able to better differentiate between Baltic, Litorina and deep non-marine saline waters.

- Processes in the bedrock fracture systems such as ion exchange (e.g. with clay fractions) have modified the marine water components causing a decrease in Mg and Na and enrichment of Ca. As shown by the Soil Pipe samples, ion exchange with the sediments may have occurred although the mixing with deeper discharge groundwaters richer in Ca cannot be ruled out..

- In one example (HFM05) the decrease in sulphate content and higher $\delta^{34}S$ values might indicate activity of sulphate-reducing bacteria.

- The stable isotope ratios of the Lake and Stream waters show some puzzling values, for example:
    - some high $\delta^{18}O$ values with decreased tritium.
    - some low ^{14}C values in water with 'present-day' tritium.

  These values emphasise the complexity of the origin and mixing of groundwater/surface waters in the region. For example there is the possibility of:

    - input of old (hundreds to thousands of years), deep, locally discharging groundwaters with low ^{14}C values and low to insignificant tritium;
    - input of younger (tens of years) locally discharging groundwaters with higher tritium and ^{14}C values and higher $\delta^{18}O$ values (fall-out from nuclear testing?; evaporation/concentration?);
    - input of modern precipitation/surface flow waters with high present-day ^{14}C, tritium and $\delta^{18}O$ values;
    - input of waters which have reacted with calcite giving a lower ^{14}C content in water characterised by modern tritium values; and
    - input of waters influenced by dissolving some dead carbon from the carbonates in the soil.

- How large is the seasonal variation of tritium in present day precipitation? Unfortunately no data are available at the moment. Two Soil Pipe samples have low tritium values which may suggest contact with discharging deeper groundwaters.

6. Visualisation of the Forsmark data

One of the objectives of the Initial Site Investigation (ISI) stage is to produce a preliminary version of the hydrogeochemical descriptive model on a site scale (Smellie et al., 2002). Visualisation should be based on modelled approaches and also on a manual approach where expert judgement is schematically illustrated. This latter approach is presented in Figure 6-1.

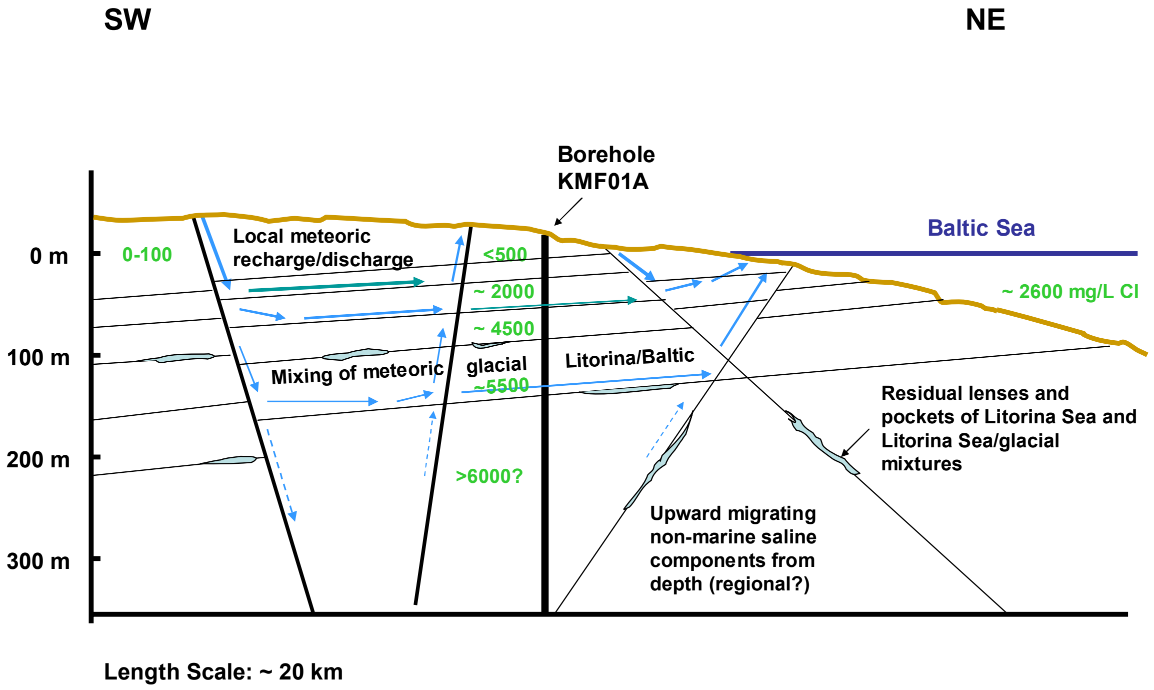

Figure 6-1: *Integrated conceptual visualisation of the Forsmark site based partly on Figure 2-4, on other hydrochemical and isotopic criteria, and general geological and hydrogeological considerations. Note that the geological structures and groundwater flow directions are not based on measurement but are used only for illustration purposes to fit with present conceptual ideas. Values in green represent mg/L Cl.*

Figure 6-1 is a conceptual visualisation based not only on measured salinity values as in Figure 2-4, but on all relevant hydrochemical and isotopic data (although still very limited), and general geological and hydrogeological considerations. The hydrogeochemical trends described and illustrated in Chapter 4, together with information from the postglacial scenario (see Fig. 3-1 in the Main Report; Laaksoharju., 2003) and borehole KMF01A structures in Figure 2-1, have been used to make a first schematic attempt at integrating hydrochemistry with the general hydrostructural character of the Forsmark area.

The mixing processes visualised in Figure 6-1 are the result of: a) present-day meteoric recharge/discharge hydraulic gradients of local extent with potentially a more saline regional discharge contribution from depth, b) the forced introduction of glacial melt water to unknown depths during glacial retreat, c) density turnover influences from saline waters introduced during past marine transgressions (e.g. Litorina Sea) since the last glaciation, and d) recent introduction of brackish water when the Baltic Sea covered the Forsmark site area. Because of the generally flat topography close to the coast, the present-day local hydraulic gradients are relatively weak thus preserving the more saline, denser Litorina Sea, Litorina Sea/glacial water and probably brackish Baltic Sea mixtures as pockets and lenses in the bedrock in association with both sub-vertical and sub-horizontal hydraulic structures.

The structural pattern of the area, i.e. a series of vertical and sub-vertical hydraulic fractures which intersect a series of sub-parallel horizontal fracture zones, also hydraulically active, facilitates the groundwater mixing processes. However, this structural system also may partly restrict recharge flow to great depths or, conversely, deep discharge flow to shallow depths by the ‘hydraulic cage’ effect. This may contribute to the existence of a series of hydraulically (and therefore hydrochemically) separated zones or horizons with only limited vertical flow between them. How realistic or widespread this situation may be is presently not known, but earlier studies at nearby Finnsjön (Ahlbom and Smellie, 1991) would appear to lend some support to these ideas, together with the suggestion that the preserved Litorina Sea waters may be restricted to around 100-200 m depth.

7. References

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Appendix 2

Explorative analysis and Mass balance modelling

Contribution to the model version 1.1

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October 2003

3.8 Hydrogeochemical data evaluation

3.8.1. Surface chemistry data

261 surface water samples have been used in this data evaluation. The analytical results, the sampling methods, analytical procedures and the evaluation of the representativity of the samples are discussed elsewhere.

Analyzed data include: major cations and anions (Na, K, Ca, Mg, Si, Cl, HCO_3^- SO_4^{2-}, S^{2-}), trace elements (Br, F, Fe, Mn, Li, Sr, DOC, N, PO_4^{3-}, U, Th, Sc, Rb, In, Cs, Ba, Tl, Y and REE) and stable (^{18}O, ^{2}H, ^{13}C, ^{37}Cl, ^{34}S) and radiogenic isotopes (^{3}H, ^{14}C, ^{226}Ra, ^{228}Ra, ^{222}Rn, ^{238}U, ^{235}U, ^{234}U, ^{232}Th, ^{230}Th and ^{228}Th), but not in all the samples. Additionally, for some samples there are nutrients and organics data including NH_4, NO_2, NO_3, N_{Tot}, P_{Tot}, PO_4, poP (particulate organic P), poN (particulate organic N), poC (particulate organic C), Chlorophyll A, Chlorophyll C, Pheopigment, TOC, DOC, DIC and O_2.

Water temperature, pH, conductivity, salinity, turbidity, light, and oxygen concentration values were the ones determined in the field. There are no data for Eh.

3.8.2 Chemistry data sampled in boreholes

45 groundwater samples have been used in the data evaluation for this study. The analytical results, the sampling methods, analytical procedures and the evaluation of the representativity of the samples are discussed elsewhere.

The available data set comprises major cations and anions (Na, K, Ca, Mg, Si, Cl, HCO_3^- SO_4^{2-}, S^{2-}), trace elements (Br, F, Fe, Mn, Li, Sr, DOC, N, PO_4^{3-}, U, Th, Sc, Rb, In, Cs, Ba, Tl, Y and REE) and stable (^{18}O, ^{2}H, ^{13}C, ^{37}Cl, ^{34}S) and radiogenic isotopes (^{14}C, ^{3}H, ^{226}Ra, ^{228}Ra, ^{222}Rn, ^{238}U, ^{235}U, ^{234}U, ^{232}Th, ^{230}Th and ^{228}Th). None of the samples has a complete data set and some elements have been analysed only in a few samples (e.g. Fe^{2+}, U, Th, ^{13}C, ^{14}C, etc), especially in samples from core boreholes and percussion boreholes.

The different analytical results obtained with different analytical techniques for Fe and S have been validated with speciation-solubility calculations, checking their effects on the electrical balance. The values selected for modelling were those obtained by ion chromatography (SO_4^{2-}) and spectrophotometry (Fe) assuming that they have no colloidal contribution (as it could be with ICP measurements).

pH values correspond to laboratory measurements (uncertainties associated to these measurements are discussed in section 3.8.4) and there is only one estimated Eh and temperature value, which has been used when necessary.

3.8.3 Representativity of the data

The charge balance calculated for all 306 water samples (both manually and through speciation-solubility calculations with PHREEQC) indicates that only seven samples show percent errors higher than 10%: four surface water samples, one sample from a percussion boreholes (sample 4170 from 50.05 m depth in borehole HFM02) and two samples from soil pipes (no 4220 from 5.75 m depth in borehole SFM0002 and no 4221 from 11 m depth in borehole SFM0003).

3.8.4 Explorative analysis

The evaluation of the hydrogeochemical data has been done both considering only samples from Forsmark and, in some cases, in relation to the whole dataset from different Nordic sites in Sweden and Finland, or to the water end-members describing these sites, in order to see how well they fit in the general trend and whether or not they can be interpreted as part of the whole hydrogeochemical system.

With respect to surface waters, a preliminary study has been done with drainage area 1 and it is described in Appendix A.

Main variables and components

Except for sea waters, most surface waters and some groundwaters from percussion boreholes are fresh, non-saline waters according to the classification used for Äspö groundwaters[1]. The rest of the groundwaters are brackish (Cl<5000mg/l), except two samples from percussion boreholes which are saline (*Figure 3.8.4.A*). Most surface waters are of Ca-HCO_3 or Na-Ca- HCO_3 types, except for sea water, which is of Na-Cl type. Groundwaters are mainly of Na-Ca-Cl or Na-Cl-HCO_3 types.

Chloride

Chloride is treated as a conservative component in mixing and reaction processes; moreover, in Nordic sites it is generally an indicator of depth and, therefore, it has been used as the variable against which the rest of ion concentrations are plotted[2]. In this system, there are few deep samples and, as we can see in *Figure 3.8.4.A*, groundwater Cl values are not very well correlated with depth.

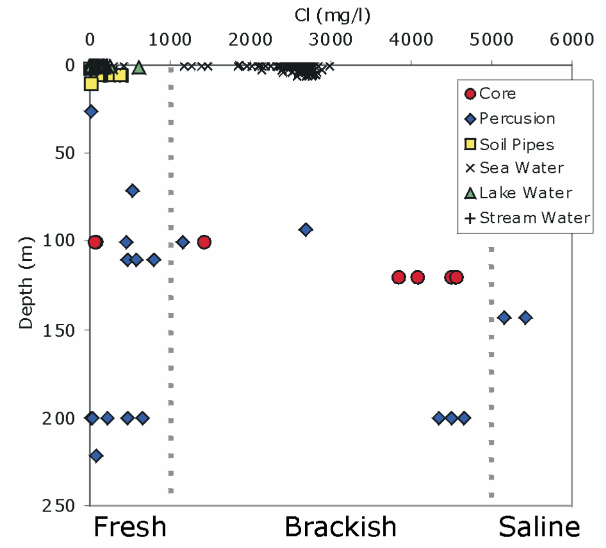

Figure 3.8.4.A. Chloride contents in Forsmark waters as a function of depth.

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[1] The Äspö groundwaters were classified into three groups according to the site specific chloride concentrations (Laaksoharju and Wallin, 1997; Laaksoharju *et al.,* 2000): non-saline groundwater (< 1000 mg/l), brackish groundwater (1000-5000 mg/l) and saline groundwater (> 5000 mg/l).

[2] See figure 3.8.4.A, chloride *versus* depth, and comments in *Appendix 1.*

pH

The influence of atmospheric (and biogeneic) CO_2 is evident in surface waters where pH measurements are not specially problematical. In shallow, diluted HCO_3–type waters with high alkalinity this influence is clear but progressive water-rock interaction processes lead to waters with CO_2 partial pressures higher than atmospheric. These waters are strongly buffered against ingassing of atmospheric CO_2 but the borehole pH measurements could be affected instead by CO_2 outgassing.

As the groundwaters evolve in systems like this, a drop in alkalinity mirrored by an increase in pH takes place which ends in brackish or saline waters weakly buffered against CO_2 ingassing during pH measurement (e.g. Pitkänen *et al*., 1999). As a results and depending on the type of groundwater and its evolutionary state, both ingassing and outgassing processes could occur during pH measurement, modifying its real value at depth.

Water samples from core-boreholes and percusion-boreholes all come from shallow depths (maximum of 200 m) but they show a wide range of salinities, from fresh to brackish to saline waters. This variability could explain the related variability in the measured pH values, from 6.98 to 8.5 (*Figure 3.8.4.B*), but at the same time complicates the evaluation of the samples. There are no continuous logging pH measurements for the sampled depths, which is a handicap as these data are basic to assess the quality of the pH measured in the samples later in the laboratory.

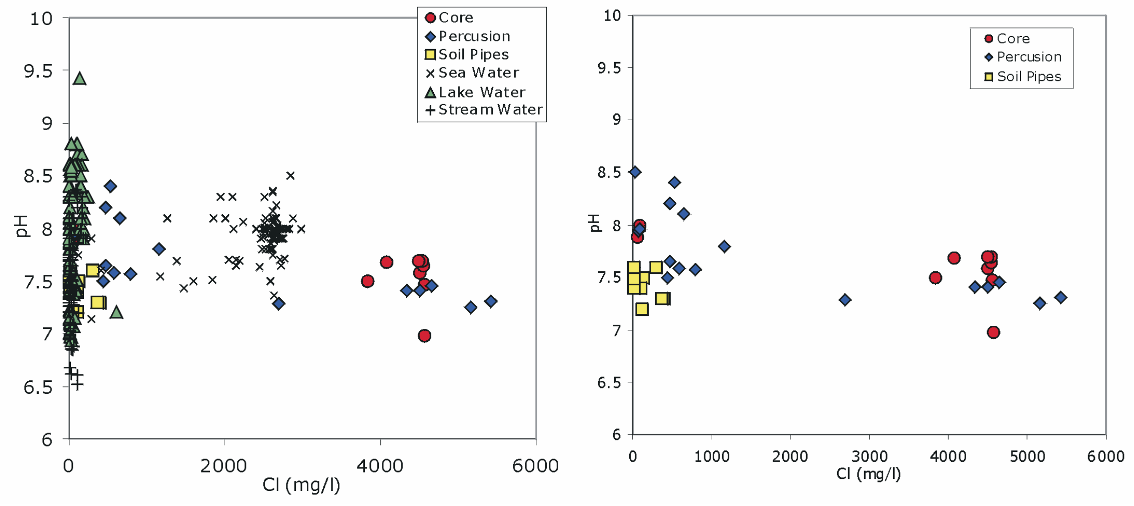

Figure 3.8.4.B. pH vs. chloride content in mg/l (increasing with depth) in Forsmark waters.

Nevertheless, the pH in chemically similar samples from the same depth usually shows variation of up to 0.3 units and, in the case of samples from 115.33 m depth in borehole KFM01A they can reach 0.6 pH units. These variations suggest a CO_2 exchange during pH measurement. The sense of this change can be easily predicted from the calculated CO_2 partial pressure for these samples (table 3.8.4.a) using PHREEQC (Parkhurst y Appelo, 1999).

As can be seen in the table, pCO_2 are always higher than atmospheric (log pCO2 = -3.5; *Figure 3.8.4.C*). Only the brackish waters from borehole KFM01A, with the lowest alkalinity content of all the analysed samples, have a CO_2 partial pressure close to atmospheric.

Table 3.8.4.a. pH values measured in the samples and computed values of total inorganic carbon, calcite saturation index and CO_2 partial pressure using a speciation-solubility code. These data can be compared with those obtained imposing equilibrium with calcite and changing the amount of CO_2 in the samples.

			Measured pH				**Calcite equilibrium**		
Borehole	**Sample**	**Depth (m)**	**pH**	**TIC (mmoles/kg)**	**IS calcite**	**log pCO_2**	**pH**	**TIC (mmoles/kg)**	**log pCO_2**
KFM01A	4480	115.33	7.64	1.027	+0.25	-3.08	7.4	1.066	-2.84
	4481	115.33	7.69	1.035	+0.30	-3.13	7.38	1.086	-2.81
	4484	115.33	7.69	1.035	+0.33	-3.13	7.37	1.088	-2.80
	4520	115.33	7.68	1.036	+0.32	-3.12	7.35	1.092	-2.78
	4524	115.33	6.98	1.196	-0.40	-2.41	7.38	1.069	-2.82
	4538	115.33	7.47	1.053	+0.08	-2.91	7.39	1.068	-2.83
KFM02A	4398	59.20	7.99	6.300	+0.63	-2.53	7.35	6.890	-1.88
	4397	59.20	7.88	6.423	+0.22	-2.40	7.65	6.586	-2.17
HFM01	4114	100.00	8.2	7.877	+0.76	-2.66	7.43	8.560	-1.88
	4115	135.50	8.5	8.385	+1.10	-2.91	7.35	9.486	-1.74
	4116	35.50	8.40	7.121	+0.92	-2.90	7.46	7.796	-1.95
	4172	100.10	8.10	7.914	+0.79	-2.56	7.30	8.794	-1.75
HFM02	4169	50.05	7.80	5.722	+0.62	-2.42	7.17	6.427	-1.79
	4170	50.05	7.50	11.23	+0.53	-1.83	6.97	13.16	-1.30
HFM03	4137	13.00	7.60	5.391	+0.19	-2.21	7.42	5.569	-2.03
HFM04	4399	125.80	7.95	6.537	+0.25	-2.46	7.70	6.699	-2.21
	4400	125.35	7.94	6.542	+0.25	-2.45	7.68	6.715	-2.19
	4401	125.85	7.96	6.497	+0.28	-2.48	7.67	6.689	-2.18
HFM05	4433	112.55	7.45	1.906	+0.28	-2.64	7.17	2.024	-2.35
	4434	112.55	7.41	2.007	+0.25	-2.57	7.16	2.123	-2.32
	4435	112.55	7.41	2.131	+0.26	-2.55	7.15	2.262	-2.28
HFM06	4463	55.35	7.65	3.975	+0.06	-2.41	7.60	4.003	-2.36
	4464	55.35	7.58	7.254	+0.31	-2.09	7.27	7.722	-1.78
	4465	55.35	7.57	7.009	+0.39	-2.11	7.18	7.642	-1.71
HFM08	4521	71.75	7.25	2.033	+0.04	-2.43	7.21	2.053	-2.39
	4522	71.75	7.31	2.042	+0.10	-2.48	7.21	2.089	-2.38
	4535	46.5	7.29	3.115	+0.24	-2.25	7.05	3.342	-2.01

As a result, all the waters are buffered against atmospheric CO_2 contamination during the measurement of pH. But this same circumstance could produced the inverse process: a CO_2 outgassing. One way to verify this possibility is computing the pH and the CO_2 partial pressure when samples are equilibrated with calcite varying only the CO_2 content of the water and comparing then the result with the direct value.

In Table 3.8.4.a it can be seen that the computed pH values are lower than the measured ones and the computed PCO_2 values lower than PCO_2 values assuming calcite equilibrium. This results suggest an outgassing process during pH measurement[3] if waters were in equilibrium with calcite at depth.

However, the computed pH should be use with care because waters used for the calculations have a broad range of compositions and are in different evolutionary stages. Therefore, the assumption of calcite equilibrium could not be valid for some of the samples. On the other hand, there are no downhole continuous logging pH values which could act as a reference to assess the likelihood of the results or point to the existence of other unknown processes affecting pH measurements.

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[3] The only anomalous behaviour, opposite to the already described, is that of sample 4524. Its *in situ* pH in borehole KFM01A is 6.98, sensibly lower than the pH of other samples at the same depth (between 7.47 and 7.69). However, the calculated pH is similar to the other calculated values. This points to additional problems during pH measurement in this sample.

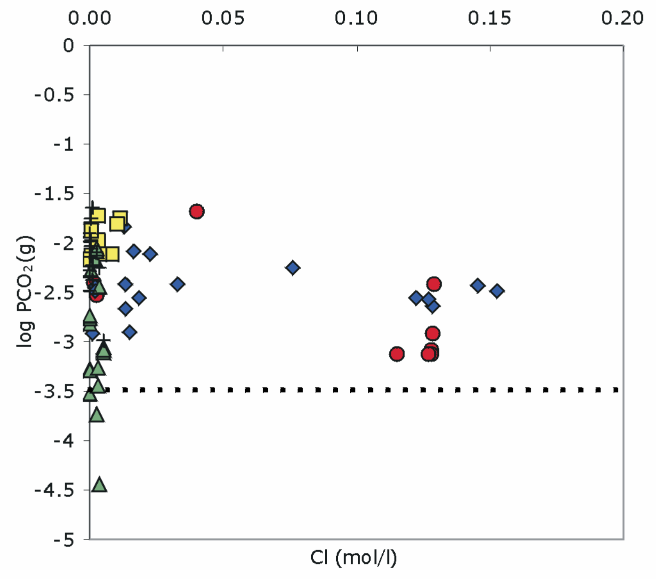

Figure 3.8.4.C. log pCO_2 values with respect to chloride contents in waters from Forsmark. The dotted line represents the atmospheric log pCO_2 value.

Silica vs Cl

The content of dissolved SiO_2 in surface waters indicates a typical trend of weathering, while in groundwaters it has a narrow range of variation indicative of a steady state (*Figure 3.8.4.D*). These two trends are commonly interpreted as the consequence of a re-equilibrium process as the residence time of waters increases and water-rock interaction become controlled by secondary fracture filling minerals. The general process evolves from an increase in dissolved SiO_2 by dissolution of silicates in surface waters and shallow groundwaters to a progressive decrease related to the participation of silica polimorphs and aluminosilicates in the control of dissolved silica as the residence time of the waters increases.

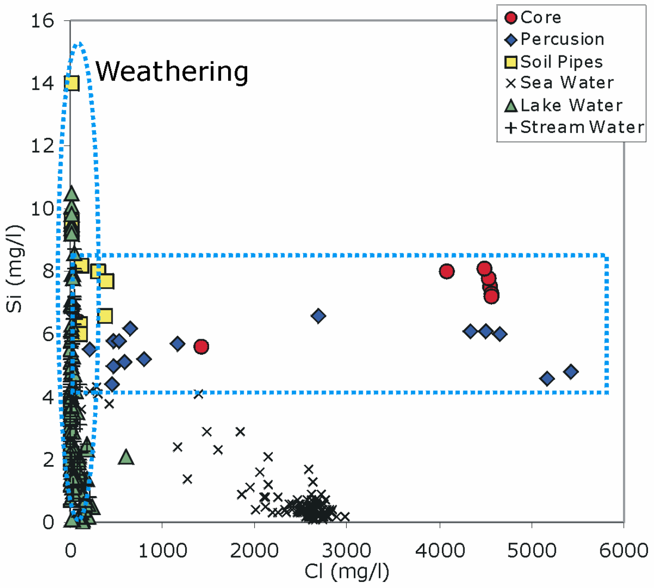

Figure 3.3.4.C. SiO2 vs. chloride in water samples from Forsmark.

Sodium vs Cl

Sodium shows a positive and very good linear correlation with chloride concentration, which reflects that mixing is the main process controlling Na contents. In *Figure 3.8.4.E.b*, two different trends can be seen. An initial trend of weathering followed by mixing with a saline source. The deviation of groundwaters from the sea water dilution line and from the line joining the origin with the Litorina end-member (see *Figure 3.8.4.E.a*) can be interpreted as a smaller influence of the saline end-member or as a Na removal due to cation exchange reactions.

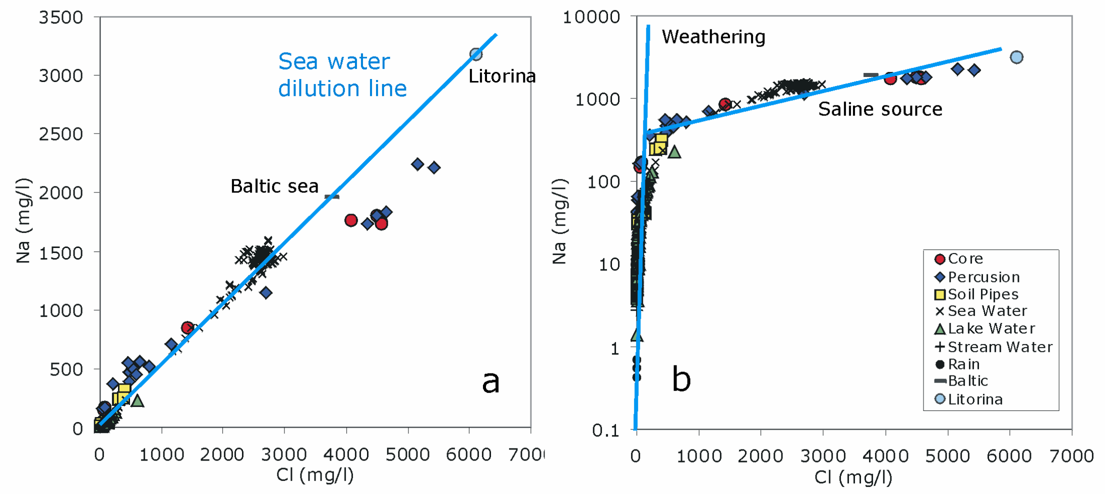

Figure 3.8.4.E. Sodium content in Forsmark waters as a function of chloride. In this figure and in the following, Baltic sea and Litorina represent the concentration of these end members.

Calcium and strontium vs Cl

Ca and Sr (*Figure 3.3.4.F*), also show a very good positive and correlation with increasing chloride concentration, which reflects a common hydrogeochemical source for both of them and for Na. Again, the linear behaviour suggests that mixing is the main process controlling Ca and Sr contents. The dispersion in Cl values in the groundwaters could be originated by heterogeneous reactions (cation exchange with Na or dissolution/precipitation reactions).

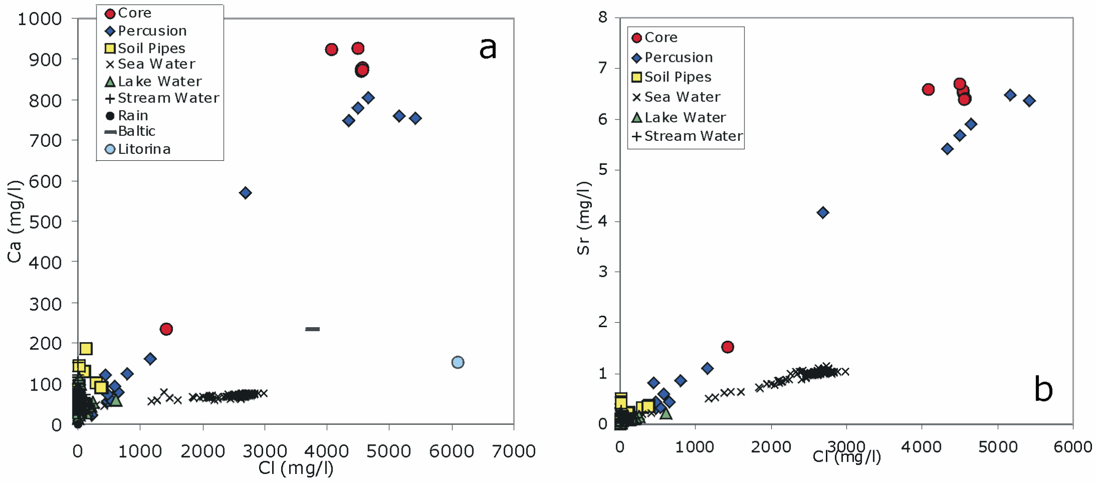

Figure 3.8.4.F. Calcium and Strontium vs. chloride in waters from Forsmark.

The trend for strontium shows a good correlation with Ca (*Figure 3.8.4.G*) in groundwaters (not so good for superficial waters), suggesting a possible co-precipitation of Sr with calcite as the main reaction process affecting this element.

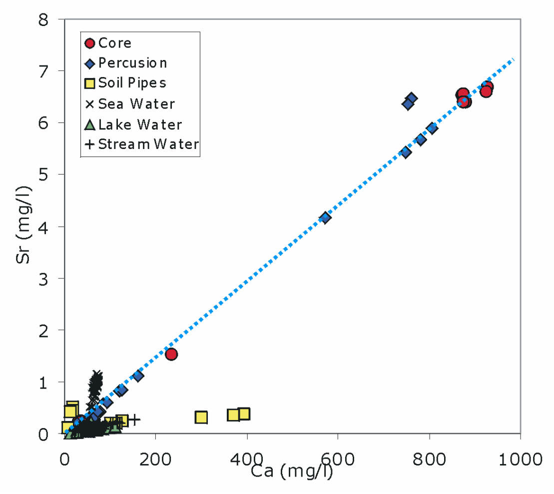

Figure 3.8.4.G. Strontium vs. Calcium in Forsmark waters.

Potassium and Magnesium vs Cl

Potassium and magnesium behave differently to the other major cations as *Figure 3.8.4.H* demonstrate. Potassium content increases with depth but in a non-linear way, staying always below the sea water dilution line. This may reflect additional reaction processes controlling this element (precipitation of clay minerals, like illite in fracture fillings, or cation-exchange). Magnesium also shows an increase with depth but also below the sea water dilution line suggesting a removal due to reactions (involving chlorite, montmorillonite, etc.).

This description is completed in Apendix 1 (Figure 4-2, 4-3 and 4.7).

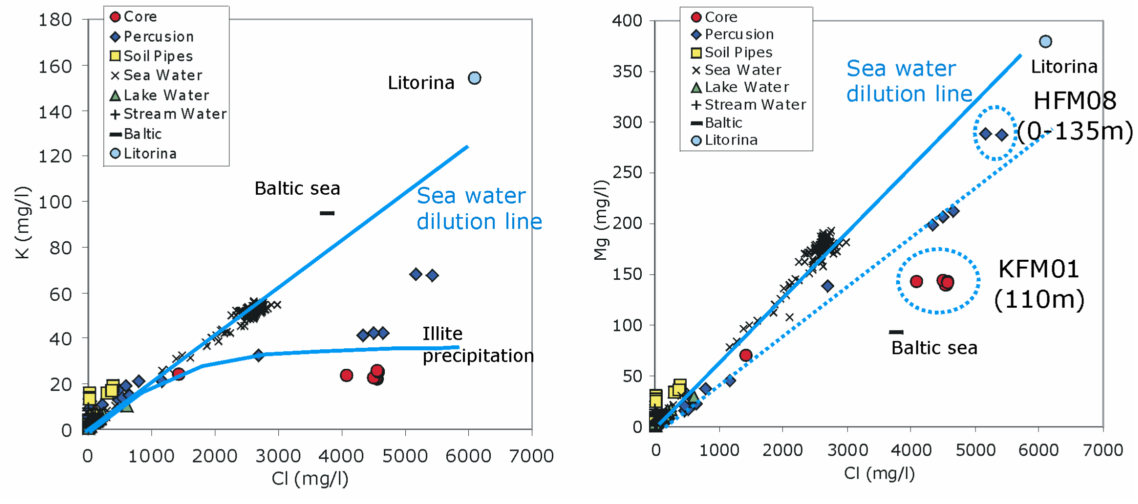

Figure 3.8.4.H. Potassium and magnesium vs. chloride in water samples from Forsmark

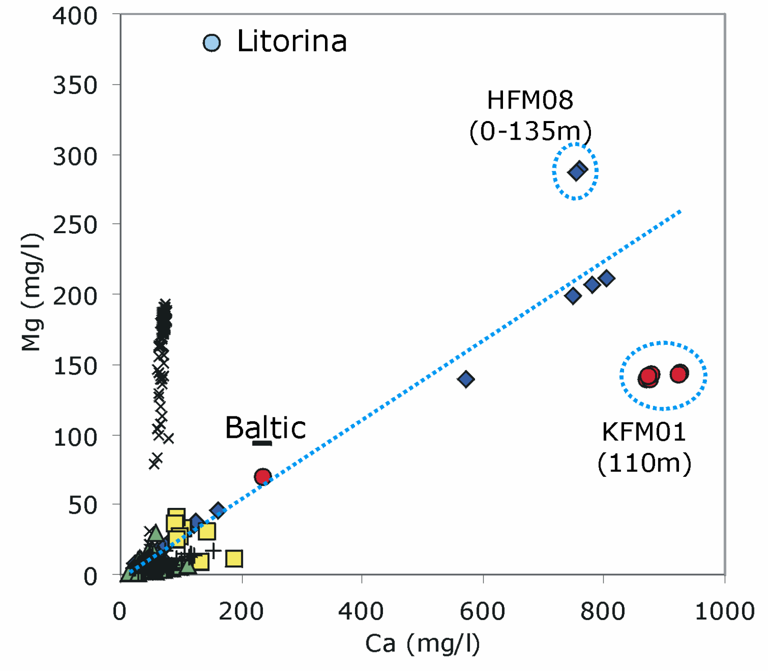

Figure 3.8.4.I. Magnesium vs. calcium in water samples from Forsmark.

Alkalinity vs Cl

Alkalinity (HCO_3^-) is, together with chloride and sulphate the other major anion in the system, being the most abundant in the non saline waters. Its concentration increases in the surface waters as a result of weathering, up to equilibrium with calcite, then, it decreases dramatically with depth (*Figure 3.8.4.J*) as a result of mixing and, probably, calcite precipitation.

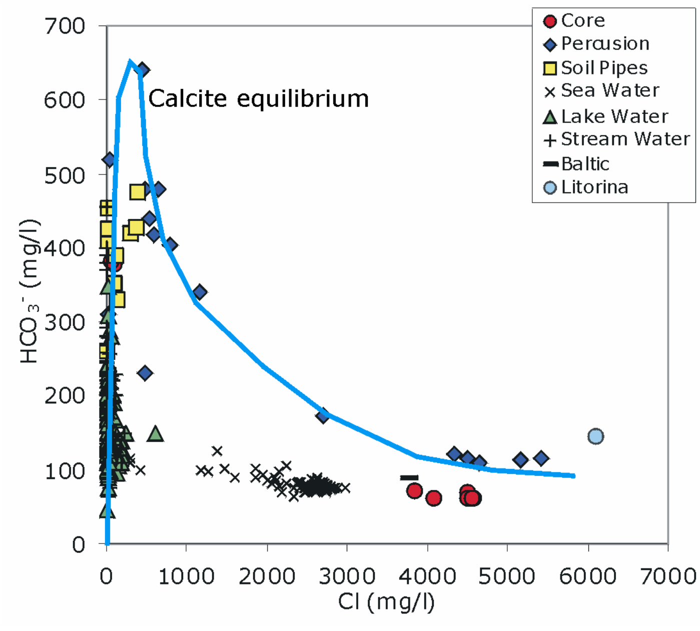

Figure 3.8.4.J. Alkalinity vs. chloride water samples from Forsmark.

Sulphate vs Cl

Sulphate (SO_4^{2-}) increases gradually with depth (i.e., with chloride content) but not in a linear way (*Figure 3.8.4.K*). This non-linear increase can be interpreted as the result of microbially-catalysed reduction reactions of sulphate. This hypothesis should be tested when redox and microbial data become available (see below).

This description is completed in Apendix 1 (Figure 4-5).

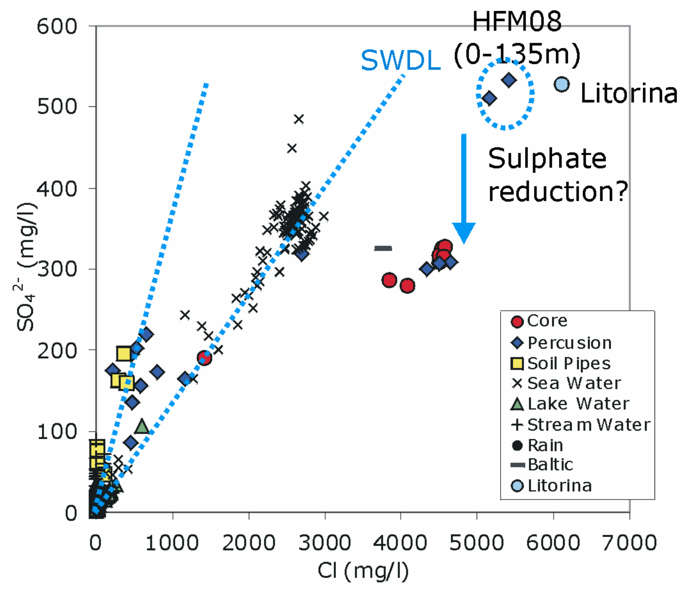

Figure 3.8.4.K. Sulphate vs. chloride in waters from Forsmark.

Bromide and Lithium vs Cl

Bromide and lithium show a linear increase with depth suggesting a common geochemical origin for both (*Figure 3.8.4.L*). The saline groundwaters have higher bromide contents than the present Baltic or estimated Litorina Sea waters. They have rather homogenous Br/Cl ratios (higher than sea water) supporting the non marine origin of the saline groundwaters.

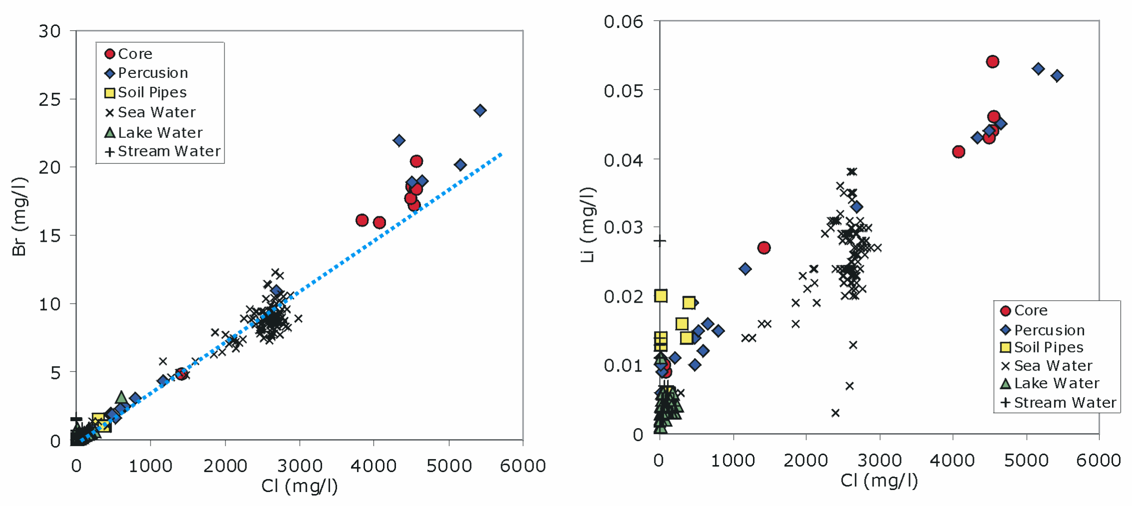

Figure 3.8.4.L. Bromide and lithium vs. chloride in waters from Forsmark.

Lithium can not be considered as good a "conservative" groundwater tracer as chloride and bromide. Its concentration can be affected by ion exchange and dissolution reactions (e.g. biotite dissolution). These processes could be responsible of the wide range of Li concentrations in the superficial waters and, in general, in all waters with less than 500 mg/l Cl.

In groudwaters with higher Cl contents Li defines a roughly linear trend suggesting a mixing component.

This description can be completed with the Eva Lena and John's report: comments in section 3.4 and 3.6.

Fluoride vs. Chloride

In spite of the wide range of fluorine values, there is a general trend of decreasing fluoride with increasing Cl (*Figure 3.8.4.M*). High fluoride concentrations in non saline waters may be associated with the weathering of granite forming minerals (biotite) or to the dissolution of fluorite, whereas low values at depth, where waters are enriched in Ca, may indicate the controlling role of fluorite in F solubility (although this mineral has not been reported as fracture filling phase).

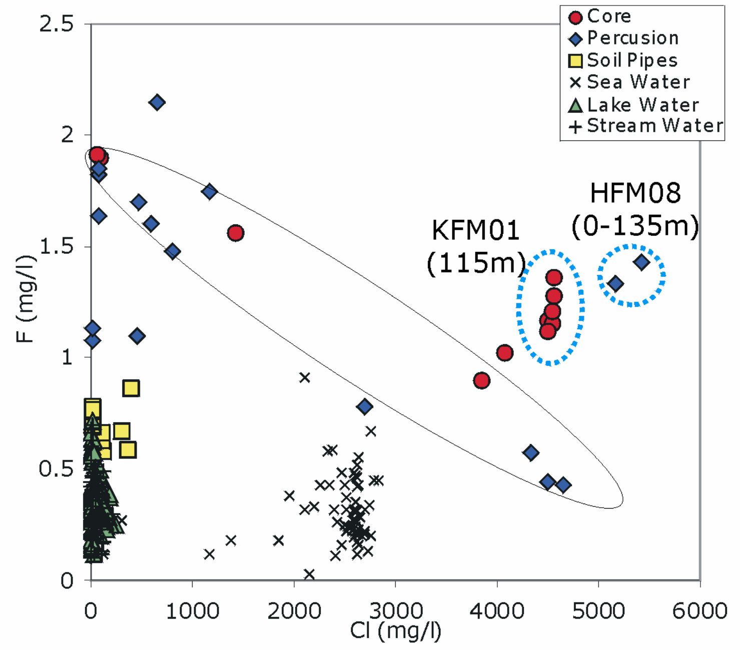

Figure 3.8.4.M. Fluoride vs. chloride in waters from Forsmark.

There are not enough data from redox-active elements (iron, sulphide and uranium) to find significative trends. An analysis of the redox state of some Forsmark groundwaters is presented in chapter 5.5.3.

Stable isotopes

See Appendix 1, sections 4-8 to 4-12.

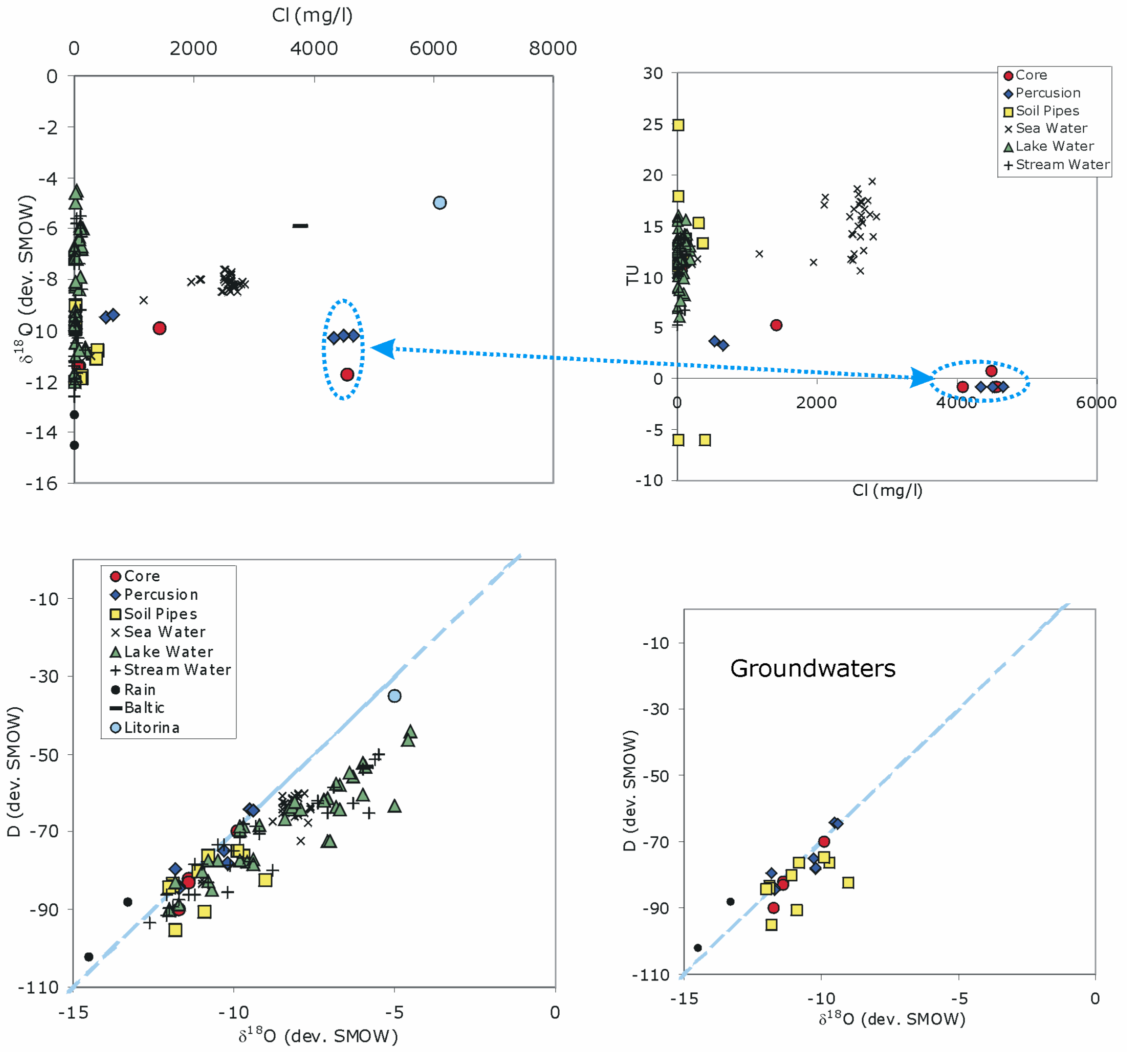

Figure 3.8.4.N. Isotopic plots for Forsmark waters. A.- Plot of δ^{18}O vs. Cl for all Forsmark waters. B.- Plot of tritium vs. Cl for all Forsmark waters. C.- Plot of δD vs. δ^{18}O for all Forsmark waters. D.- Plot of δD vs. δ^{18}O for Forsmark groundwaters and soil pipes.

Stable chlorine isotope results

The following description can follow the one included in Apendix 1, Section 4-14.

In Fig. 3.8.4.O we compare the δ^{37}Cl values in Forsmark groundwaters with values in other Scandinavian sites (Olkilouto and Simpevarp). As it is clear from the figure, Forsmark groundwaters have a very low salinity and a very limited range in chlorine concentrations.

Samples from HFM01 borehole show an enrichment in δ^{37}Cl similar to waters from other sites with the same chlorine concentrations. On the other hand, the only sample from borehole HFM03 (sample # 4137) has the highest δ^{37}Cl enrichment of all the compared waters in Fig 3.8.4.O. The meaning of this enrichment is not clear, as the sample comes from a shallow groundwater (≈ 13 m depth) with very low chlorine contents (15.7 mg/l). One possibility is that the already mentioned large spread of δ^{37}Cl values for the superficial samples (lake and stream waters) is mainly due to analytical uncertainties at these very low chloride concentrations. Other possibility is that the spread of δ^{37}Cl values for superficial waters is related to local maxima of marine aerosols concentration (δ^{37}Cl enrichment up to +2.53 has been observed in ocean aerosols; Pitkänen et al., 1999).

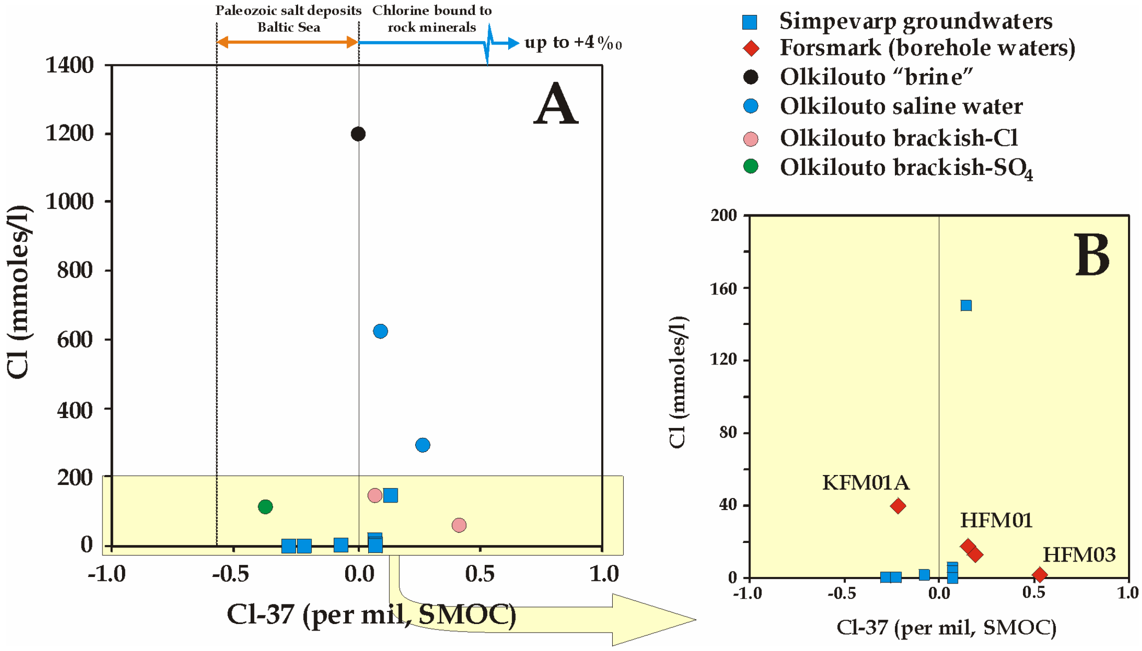

Figure 3.8.4.O. Comparison of δ^{37}*Cl values is Forsmark groundwaters with values in other Scandinavian sites. A.- Plot of* δ^{37}*Cl vs. Cl for Olkilouto and Simpevarp groundwaters. Plot of* δ^{37}*Cl vs. Cl for Simpervarp and Forsmark groundwaters.*

Finally, the sample with the highest Cl content for which there are values of Cl-37 in Forsmark (#4165 of KFM01A borehole) is the only sample with negative δ^{37}Cl (*Figure 3.8.4.O.b*). If we take into account the position of this sample in the above-mentioned ion-ion plots, this negative value is consistent with a recent marine influence.

In any case, chloride isotope interpretations must be considered as preliminary. More data and a better understanding of Cl fractionation are needed (Pitkänen *et al.*, 1999).

5.5 Hydrogeochemical modelling

5.5.1 Modelling assumptions and input from models

The geochemical modelling approach in this study has started with the speciation solubility calculations focused on the saturation indexes of the more relevant mineral phases in the system and the activity calculations for aluminosilicate stability diagrams construction and redox-pairs calculations. Then, in order to define the reaction models that can explain the changes in water chemistry (mixing and water-rock interaction processes), two kinds of inverse modelling simulations have been performed: simple mass balance calculations and more complex mixing and mass balance calculations. All these calculations have been carried out with PHREEQC (Parkhurst and Appelo, 1999) and the WATEQ4F database.

The main goal of the mass balance calculations is to evaluate a set of hypothetical reactions that could happen in a hydrochemical/hydrogeological system, without any thermodynamic control. Starting with the analytical data from an initial point of the system (*initial water*), these calculations define the reaction model that better "explains" the chemistry of a *final water*.

Mixing and mass balance calculations have been performed to analyse the evolution of the two main water types: fresh water and brackish-saline water. For the first group, which has an *a priori* important water-rock interaction component, simple mass balance calculations with no mixing (to assess the reaction processes occurred between two water samples joined by a hypothetical flow line) and binary mixing with mass balance (to asses the mixing proportions of two water samples and the reaction processes necessary to explain the chemistry of a third water sample) have been performed. For the analysis of the *second water type* (brackish-saline water), only multiple-mixing and mass balance calculations have been carried out. The goal of these calculations is to explain, using heterogeneous reactions between solid phases and the water, the chemistry of a water sample which is the product of the mixing of several (more than three) water end-members.

5.5.2 Conceptual model with potential alternatives

From the previous data evaluation analysis some ideas can be drawn to construct an initial conceptual model.

Based on their general geochemical character and the apparent age, we have identified two water types in Forsmark: fresh waters with a bicarbonate imprint and low residence times (tritium values above detection limit), and brackish-saline waters with Cl contents up to 6000 mg/l and longer residence times (tritium values below detection limit).

The chemistry of the first water type is mainly controlled by the chemistry of the recharge waters and, most important, by water-rock interaction processes. Locally, these waters can mix with marine solutions changing their chemical composition towards more chlorine members. Under these conditions the major water-rock interaction processes are organic matter decomposition, dissolution of the more soluble phases such as calcite and sulphides (or gypsum and halite dispersed in the pedogenic zone), and the alteration of the granitic rock.

Primary and secondary silicates and aluminosilicates are related by incongruent reactions which seem to control silica and aluminium contents and participate in the loss or gain of elements like K, Mg and, to some extent, Na (through dissolution-precipitation or ionic-exchange processes).

Waters from the second type have a longer residence time and a higher mixing component with older waters from different origins. Heterogeneous reaction processes are less important than in the first water type and can be described by the same set of minerals, with the only difference that calcite is precipitating instead of dissolving. Also, in some of these waters microbially mediated reactions and dissolution-precipitation of Fe-mineral phases become important at controlling sulphate and iron contents, as well as the redox state of the system.

5.5.3 Speciation-solubility calculations

Speciation-solubility modelling has been carried out with PHREEQC (Parkhurst and Appelo, 1999) and the WATEQ4F thermodynamic database.

In this type of calculations, starting from the concentration of a set of elements in a water sample and other relevant parameters (temperature, pH, Eh, total or carbonate alkalinity, and, in some cases, density) the concentration and activity of all the relevant species in the system and the saturation indices with respect to a predefined set of minerals is computed. It is a purely thermodynamic calculation where it is assumed that all dissolved species are in mutual homogeneous equilibrium. This approach define the proximity of a solution to equilibrium with a relevant phase through a saturation index defined as

$$SI = \log \frac{IAP}{K(T)},$$

where IAP is the ionic activity product and $K(T)$ is the equilibrium constant of the dissolution-precipitation reaction of the relevant phase. A positive value indicates that thermodynamically a mineral can precipitate and a negative value that it can dissolve. A value close to zero indicates an equilibrium state. The saturation index indicates the potential for the process, not the rate, at which the process will proceed. From these information conclusions concerning possible major reactions taking place and indirect indications of the dynamics of the system can be drawn.

These calculations are used to investigate the processes that control water composition at Forsmark. This chapter is divided into two main sections, the first one concerning the state of non-redox elements and phases and the second focused on the redox state of the system.The procedure only deals with plausible minerals in the system, i.e., those which can reach an equilibrium with the groundwater. Therefore, clearly undersaturated mineral phases are not included in this description.

There are no temperature value for groundwaters. Only for the samples used in redox calculations a preliminary in situ value of 7 °C vas available (see *Speciation-solubility calculations for the redox system*). For the rest of the groundwaters a fixed value of 10 °C has been used, which is consistent with the mean temperature of Swedish groundwaters (e.g., Grenthe *et al*., 1992).

The temperature sensitivity analysis has shown that variations up to 5 °C do not appreciably change the results that are summarised below. However, the lack of such a fundamental datum as temperature is an extra source of uncertainty that unnecessarily complicates the calculations and one that must be urgently solved.

Carbonate system

A pH sensitivity analysis (see paragraph in Explorative analysis section) shows that laboratory pH values could have been affected by CO_2 degassing. Because there are no pH values from down-hole continuous logging to compare with, it is difficult to assess the likelihood of the results and therefore this uncertainty will propagate into the speciation-solubility calculations.

Calcite saturation states indicate that surface and subsurface waters can be either undersaturated or oversaturated with respect to calcite, but most groundwater samples are near equilibrium (*Figure 5.5.3.A.c*), considering the commonly accepted ± 0.5 uncertainty in the SI of this mineral when uncertainties in pH are evaluated (Pitkanen *et al.,* 1998, 1999). The computed P_{CO2} values show a roughly decreasing trend with depth (*Figure 5.5.3.A.d*), but with scatter. P_{CO2} and SI scatter, are mainly attributable to the above-commented uncertainties in pH, which are propagated to P_{CO2} and calcite SI values during calculations.

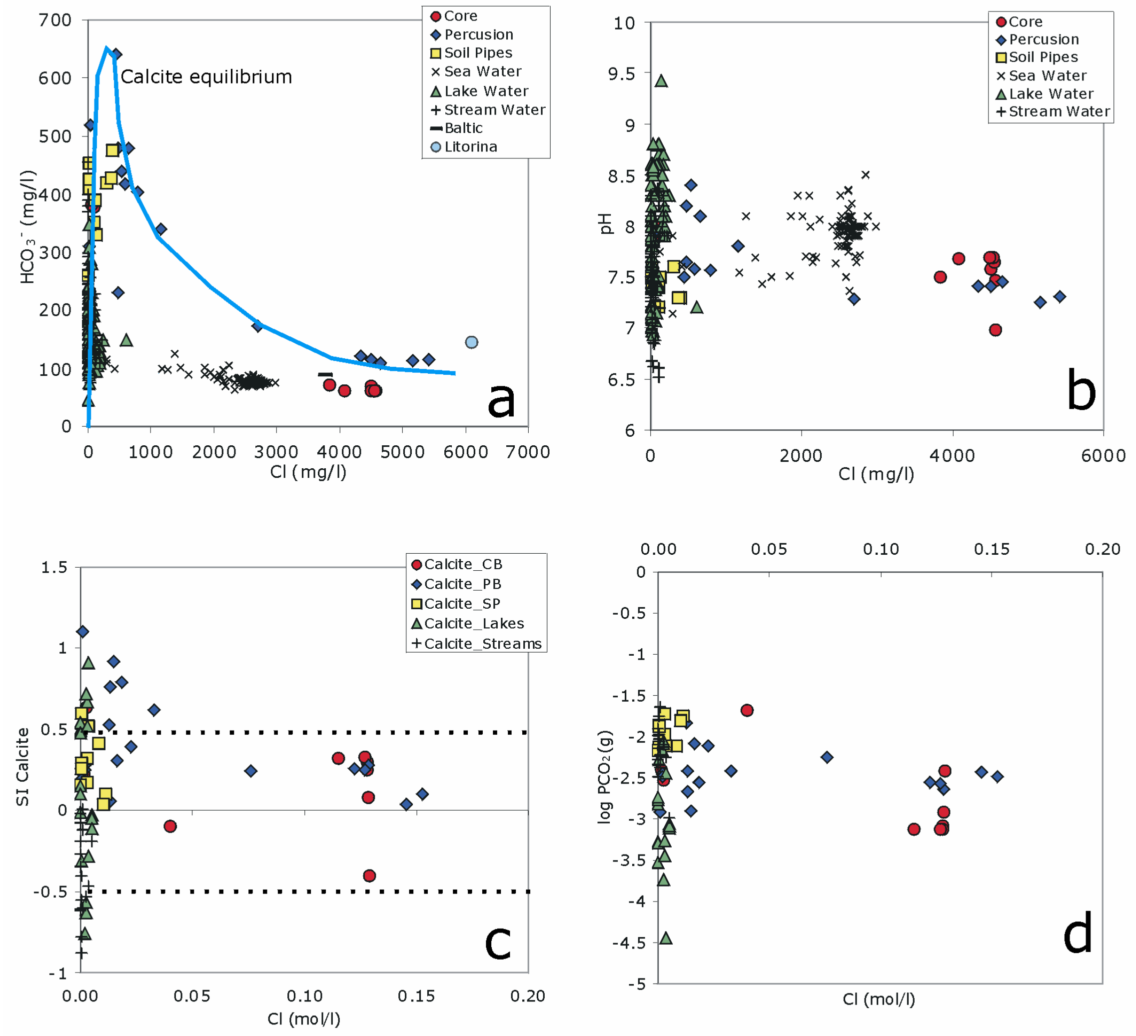

Figure 5.5.3.A: Evolution of the carbonate system in Forsmark waters. (a) and (b) Alkalinity and pH against chloride; (c) and (d) calculated calcite saturation index and partial pressure of CO_2 against chloride. The dotted lines in figure (c) represent the uncertainty associated with SI calculations.

Trends of alkalinity, pH and saturation state of calcite (*Figure 5.5.3.A*) are apparently related to water-rock interaction processes (dissolution-precipitation of fracture filling calcite and silicate hydrolysis) in agreement with Nordstrom *et al.'s* (1989) model for Stripa groundwaters and verified in other Swedish and Finish sites.

The measured initial steep rise in alkalinity and pH affecting superficial waters is related to weathering of the bedrock, causing calcite dissolution and hydrolysis of silicates. Calcite reaches saturation (or oversaturation) at the alkanity peak and the subsequent depletion in alkalinity can be attributed to calcite precipitation. This precipitation process is induced by calcium enrichment in groundwaters associated with mixing with a saline source.

The pH usually increases slightly beyond the alkalinity peak. As calcite precipitation produces a decrease in pH, it has been assumed that the pH increase is associated with the effect of silicate hydrolysis (as consuming proton reactions) deep in the bedrock. The trend observed in the Forsmark groundwaters shows a pH decrease, apparently with minor or no silicate hydrolysis compensation.

Nevertheless, this pH decreasing pattern in Forsmark is magnified (with respect to other Scandinavian sites) by the high-pH peak developed in the recent superficial groundwaters. The existence of older recharge groundwaters with lower pH and/or uncertainties in pH measurements (i.e., actual pH lower than mesaured pH due to degassing) would modify the interpretation of the pH pattern.

Silica and aluminium system

The weathering of rock-forming minerals is the main source of dissolved silica. Superficial waters have a variable degree of saturation with respect to silica phases (quartz and chalcedony); this is compatible with the weathering hypothesis.

Superficial waters are oversaturated with quartz and close to equilibrium with chalcedony (*Figure 5.5.3.B*). Saturation indices of these phases are relatively constant independently of the chlorine content of the waters; this suggests that the groundwater has already reached a stationary state associated with the formation of aluminosilicates or secondary silica phases like chalcedony, which control the concentration of dissolved silica.

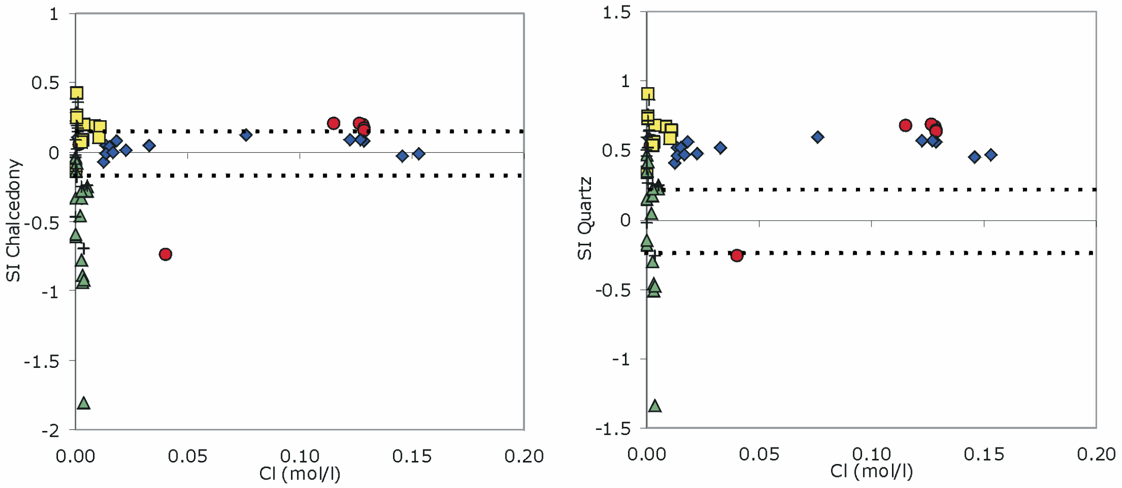

Figure 5.5.3.B. Saturation indices of quartz and chalcedony as a function of Cl. The dotted lines represent the uncertainty associated with SI calculations (Deutsch et al., 1982).

The lack of dissolved aluminium data for Forsmark groundwaters precludes an speciation-solubility analysis of aluminosilicate phases. Therefore, activity diagrams were used to study the stability of silicate minerals in the system. The accuracy of these diagrams depends on pH and are therefore affected by the uncertainties in the pH measurements at Forsmark. Uncertainties in the equilibrium constants of the aluminosilicates (especially phillosilicates) also affect the conclusions drawn from these diagrams. This last source of uncertainty has been partially removed considering more than one equilibrium constant for some phases and different assumptions or mineralogical relations when constructing the diagrams. Nevertheless, the conclusions are preliminary.

Figure 5.5.3.C. shows several activity diagrams based on data from Helgeson (1969) calculated at 7ºC (diagrams used in Olkilouto; Pitkänen et al. 1999). The diagrams plot clay minerals and, apart from the stability of kaolinite, they suggest an association of Ca and Mg to clay minerals in most lake waters, leading to the stabilization of montmorillonite.

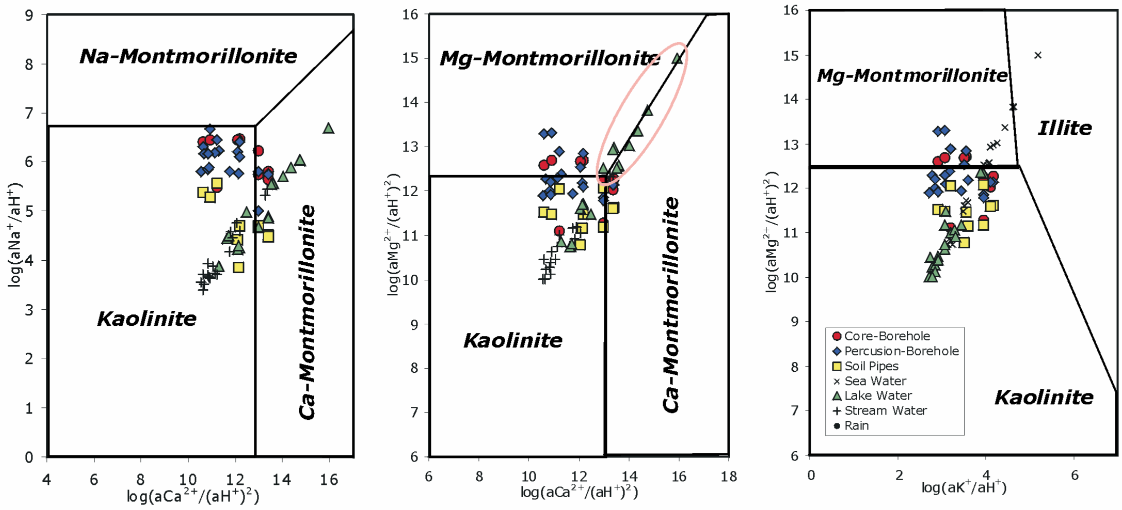

Figure 5.5.3.C. Aqueous activity diagrams for some aluminosilicate minerals at 7ºC, 1 bar. The field boundaries were calculated with data from Helgeson (1969) and a logarithmic silica activity of –4.

Most groundwaters are on or near the stability field of montmorillonites but with no clear trend. Locally, both Mg-montmorillonite and Ca-Montmorillonite are favoured and Mg-Ca or Ca-Mg exchange reactions are possible. Some groundwaters fall on or near the Ca-montmorillonite stability field and accordingly Na would be released to solution.

Figure 5.5.3.D. shows three additional stability diagrams for other mineral phases identified as filling fracture minerals in the KFM01 borehole: adularia, albite, prenhite, laumontite and chlorite. The diagrams are based on data calculated at 15ºC by Grimaud *et al.* (1990) for Stripa groundwaters. These diagrams show that most groundwaters are near or in the albite stability field; samples along the boundary with adularia indicate an equilibrium between albite and adularia. Besides, more saline groundwaters define a trend towards equilibrium with chlorite.

Finally, *figure 5.5.3.E.* includes illite. Diagram (a) was used in the Cigar Lake natural analogue study (Cramer and Smellie, 1994), and is based on data from Helgeson (1969) and Helgeson *et al.* (1978). Diagram (b) was constructed with data from Garrels (1984). Both diagrams suggests that illite plays an important role in controlling the groundwater system although the available mineralogical data indicate that the abundance of illite in fracture fillings is low.

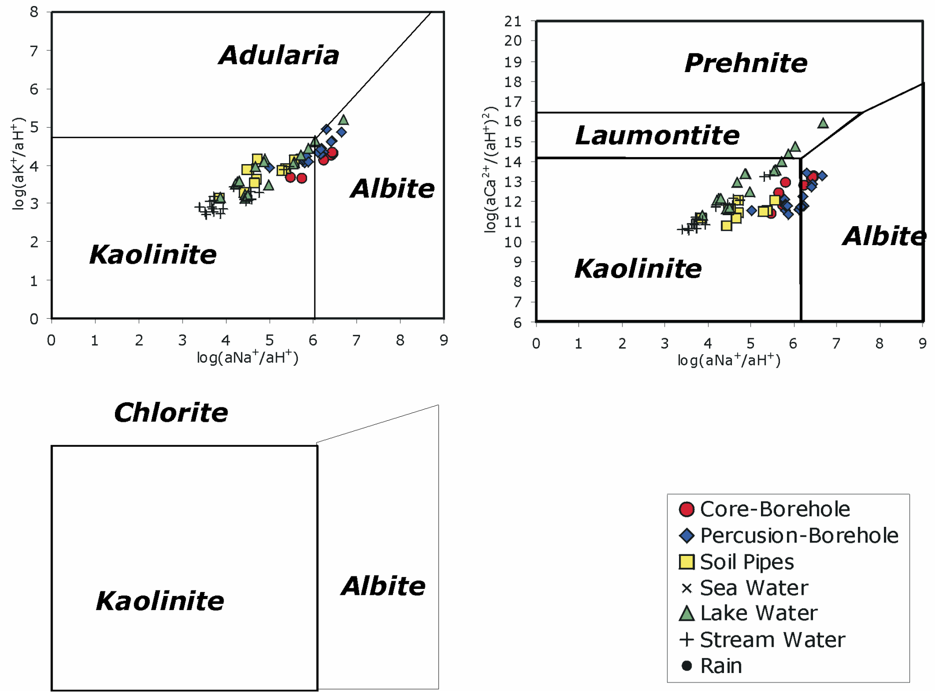

Figure 5.5.3.D. Aqueous activity diagrams for some aluminosilicate minerals at 15°C, 1 bar. The field boundaries have been calculated from the data of Grimaud et al. (1990).

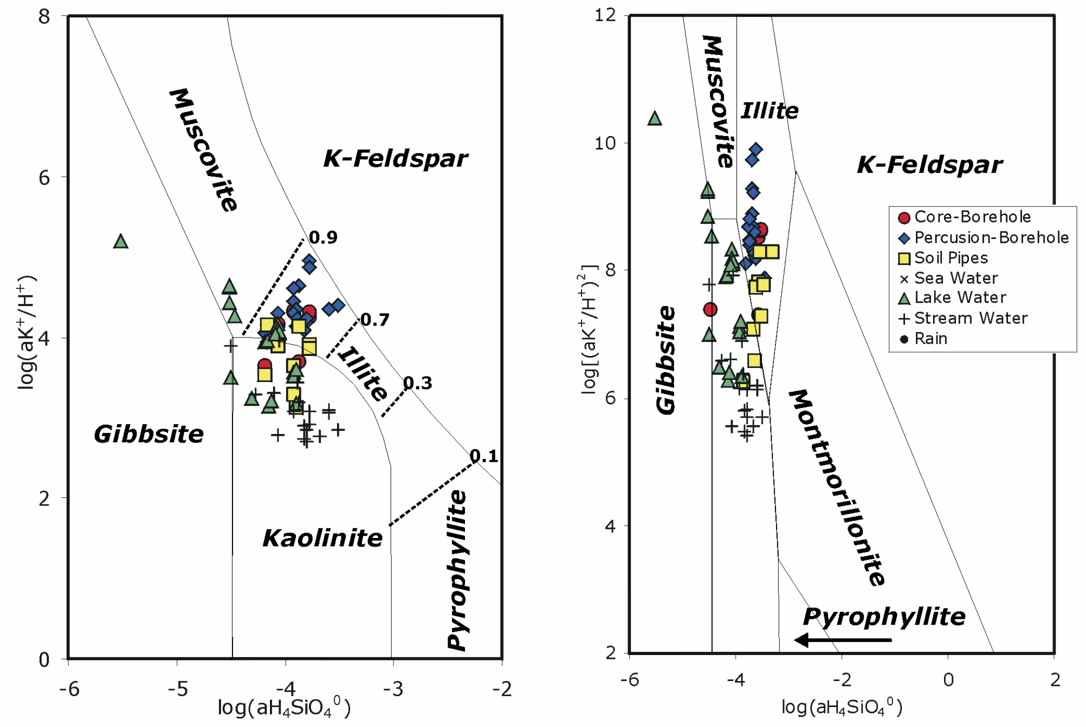

Figure 5.5.3.E. Aqueous activity diagrams for some aluminosilicate minerals at 25°C, 1 bar, including illite. The field boundaries have been calculated with data from Helgeson (1969) and Helgeson et al. (1978) in graph (a) and from Garrels (1984) in graph (b). In graph (a) illite field is contoured to show the stability of different illite fractios in I/S.

Cation exchange processes are probably more important than clay mineral recrystallization during short-term water-rock interaction at low temperature, but in waters with long residence times these exchange processes may cause irreversible changes in clay minerals as the solubility diagrams suggest (Pitkänen et al., 1999).

Other minerals in the system

The SI evolution for fluorite indicates a trend towards equilibrium as chloride concentrations increase. Apparently, fluorite reaches equilibrium in some of the most concentrated groundwaters (*Figure 5.5.3.F*).

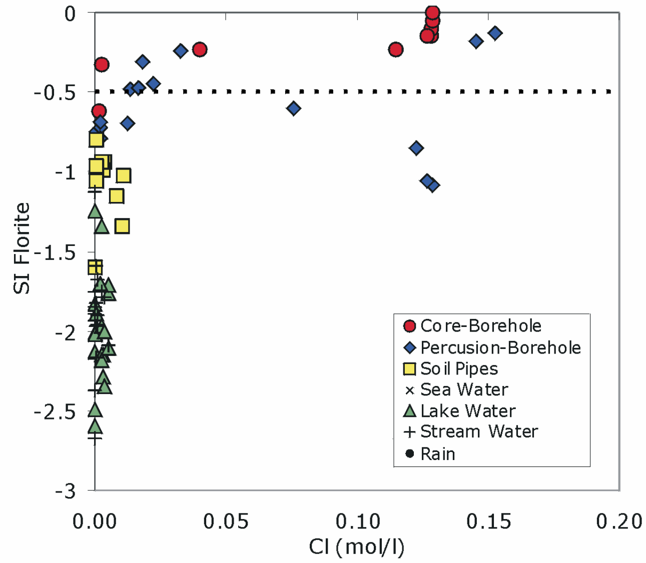

Figure 5.5.3.F. Saturation index of fluorite against Cl concentration. Fluorite seems to reach equilibrium in the most concentrated groundwaters. The dotted lines represent the uncertainty associated with SI calculations (Nordstrom & Jenne, 1977).

Speciation-solubility calculations for the redox system

The available analytical data (dissolved Fe^{2+}, total Fe, total sulfide and sulfate concentrations) allow standard redox pair calculation only for KFM01A waters at 115.33 m depth (brackish waters). There are no continuous *in situ* Eh data and only preliminary temperature (7 ºC) and Eh values (-180 mV) are available, both measured in borehole KFM01A at the same depth of the samples. These values are used as reference values in the following calculations.

The analysed samples (#4480, 4481, 4484, 4520, 4524 y 4538) have a fairly homogeneous chemical composition, as expected from samples taken from the same depth. pH values are also rather constant, between 7.47 and 7.69, except for sample 4525 which has an anomalously low pH value (6.98) and has been omitted from the data set (see sensitivity analysis in section 3.8.4). In the following calculations pH has been varied between 7.4 and 7.7 to take into account the actual uncertainty in this parameter. This range includes the pH value calculated assuming equilibrium with calcite.

All computations have been carried out with PHREEQC (Parkhurst and Appelo, 1999) and the WATEQ4F thermodynamic database if not explicitly said otherwise.

Redox pairs calculations

Previous studies in "granitic" groundwaters from Sweden and Finland (Nordstrom and Puigdomenech, 1989; Smellie and Laaksoharju, 1992; Grenthe *et al.*, 1992; Glynn y Voss, 1999; Bruno *et al.*, 1999), have found that the iron and sulphur redox pairs/buffers are the most reliable couples to estimate the redox state. In this system, the selected redox couples are dissolved Fe^{3+}/Fe^{2+} and SO_4^{2-}/S^2 and the heterogeneous $Fe(OH)_3$ /Fe^{2+}, pyrrhotite/SO_4^{2-} and pyrite/ SO_4^{2-} couples. Results with the Fe^{3+}-clay/Fe^{2+}-clay redox pair proposed by Banwart (1999) are also tested.

Aqueous redox-active species in samples from the 115.33 m depth interval are in sufficient concentration for successful Eh measurement. Total sulphide concentrations are low but above detection limit, with values between $3\cdot10^{-7}$ to $6\cdot10^{-7}$ mol/l; total iron and Fe^{2+} concentrations are between $2.1\cdot10^{-5}$ to $2.7\cdot10^{-5}$ mol/l, above the theoretical lower limit of iron concentration (10^{-6} mol /l) for successful Eh measurement when iron pairs control the redox potential (Grenthe *et al.*, 1992).

In these conditions, the dissolved Fe^{3+}/Fe^{2+} redox couple could be used to estimate an Eh value but because the differences between total iron and Fe^{2+} concentrations are too small the reliability of the result is low. Calculated values for all samples are always oxidizing (Table 5.5.3.a) at variance with the potentiometrically measured value in the borehole (-180 mV).

According to Grenthe *et al.* (1992), Eh values in Swedish groundwaters can be estimated with the $Fe(OH)_{3\,(s)}$/ Fe^{2+} heterogeneous redox couple,

$$Fe(OH)_{3\,(s)} + 3H^+ + e^- \leftrightarrow Fe^{2+} + 3H_2O,$$

by means of the equation

$$Eh = E_0^* - 2.303\, RT/F\, (3\text{ pH} + \log [Fe^{2+}]), \qquad (1)$$

where $E_0^* = 707 \pm 59$ mV at 10 ºC (the average Swedish groundwater temperature), F is Faraday constant (23.061 cal V^{-1} equivalent^{-1}), R is the gas constant (1.98717 cal deg^{-1} mol^{-1}) and T is the temperature (K). Equation (1) is usually employed to estimate Eh values from pH and Fe^{2+} concentration data (e.g. Smellie and Laaksoharju, 1992). The E_0^* value determined by Grenthe *et al.* (1992) is based on a fit of equation (1) to Eh, pH and Fe^{2+} data from a collection of SKB groundwaters sampled at different sites. For the fit, Grenthe *et al.* (1992) use Fe^{2+} concentrations corrected only for the $FeCO_3^0$ ion pair. But Fe^{2+} speciation is usually more complex and, following Glynn and Voss (1999), we have calculated with the aid of equation (1) two sets of Eh values, one considering Fe^{2+} analytical data and the other considering the activities of Fe^{2+} species as obtained from speciation-solubility calculations with WATEQ4F database. The activity results are around 30 mV higher than the Eh obtained with Fe analytical data (Table 5.5.3.a; similar differences are obtained for Simpevarp groundwaters in SITE 94 by Glynn and Voss, 1999).

Samples presented in table 5.5.3.a with the sufficient data to calculate the $Fe(OH)_{3(s)}$/ Fe^{2+} redox potential have a pH near 7.7. Calculations performed with a pH = 7.4 (lower uncertainty limit) provide potential values 50 mV higher than those shown in the table.

Table 5.5.3.a. Calculated redox potentials (Eh, mV) in waters of KFM01A borehole at 115.33 m depth obtained with different redox couples (some samples do not give enough information to use specific redox pairs).

	Fe^{2+}/Fe^{3+}	**Fe^{3+}-clay/ Fe^{2+}-clay**	**$Fe(OH)_3/Fe^{2+}$ (total Fe^{2+} concentration)**	**$Fe(OH)_3/Fe^{2+}$ (calculated aFe^{2+})**	**SO_4/S^{2-}**
4480	+164.1	-147.0	-324.5	-295.0	----
4481	+133.9	-150.0	-330.1	-301.4	-208.0
4484	+148.8	-150.0	-332.2	-302.7	-210.0
4520	+157.7	-149.0	-324.6	-295.5	-208.0
4538	----	-138.0	----	----	-194.0

In any case, Eh values calculated with the $Fe(OH)_{3(s)}$/ Fe^{2+} pair are always lower than the electrochemically measured one and also lower than those provided by the other redox pairs (see below), indicating a more reducing environment. These anomalous results can be related to the original couple calibration (based upon samples with Eh values below –200 mV) and to the effect on the equilibrium constant of the natural variability of $Fe(OH)_3$ (Fe^{3+} oxides and hydroxides) and/or changes in its crystallinity. The equilibrium constant calculated with equation (1) has a value intermediate between the equilibrium constants of amorphous $Fe(OH)_3$ and goethite (Grenthe *et al.* 1992) but other phases with an intermediate crystallinity can also control this redox pair.

An alternative approach to the computation of the redox potential with the $Fe(OH)_{3(s)}$/ Fe^{2+} pair is that of Bruno *et al.* (1999). They use thermodynamic data for two end members, crystalline and amorphous $Fe(OH)_3$ (Figure 5.5.3.G). Using the thermodynamic data from Bruno *et al.* (1999) for amorphous $Fe(OH)_3$, the redox potential calculated by the $Fe(OH)_{3(s)}$/ Fe^{2+} would match the electrochemical measure.

The potential calculated with the SO_4/S^{2-} pair is between –194 and –210 mV (Table 5.5.3.a), very close to the measured Eh in the borehole. Redox potentials calculated with the pyrrhotite/SO_4^{2-} redox pair (used by Bruno *et al.,* 1999, in the Palmottu system) are around –220 mV, very similar to the values provided by the SO_4^{2-}/S^{2-} couple and close to the measured Eh. Calculated redox potentials assuming equilibrium with pyrite (pyrite/ SO_4^{2-} couple) are also similar.

The Fe^{3+}-clay/Fe^{2+}-clay redox pair proposed by Banwart (1999) is based on the reversible one-electron transfer between oxidised and reduced smectites. For this reaction, the conditional redox potential (Eh, V) as a function of pH at 10ºC is defined by the equation

$$Eh = 0.280 - 0.056\ pH. \qquad (2)$$

The results obtained applying this pair, between –138 y –150 mV (Table 5.5.3.a), are also consistent with the measured ones.

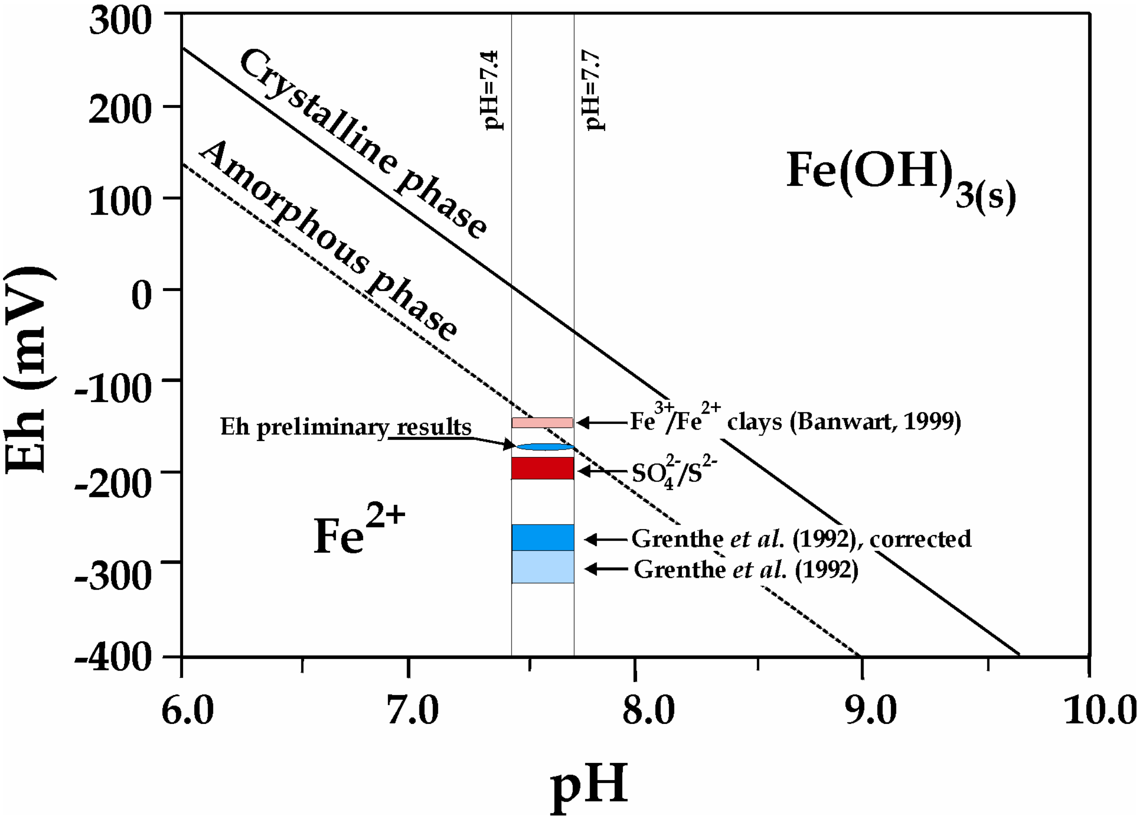

Figure 5.5.3.G. Eh-pH diagram with $Fe(OH)_{3(s)}$/ Fe^{2+} *phase boundaries for crystalline (log K=3) and amorphous (log K = 5)* $Fe(OH)_3$ *phases. The diagram has been drawn using data from Palmottu natural analogue (Bruno et al., 1999) assuming a concentration of* $Fe^{2+} = 3{\cdot}10^{-5}$ *M. The vertical lines bracket the uncertainty in pH of the samples. Also shown are the Eh values obtained with the Grenthe et al.'s (1992) calibration of the* $Fe(OH)_{3(s)}$/ Fe^{2+} *pair (blue squares); the Eh values deduced from the* SO_4/S^{2-} *and* Fe^{3+}*-clay/* Fe^{2+}*-clay pairs (red areas;, and the potentiometric value measured in the borehole (blue ellipse).*

<u>Solubility results for some iron (II) phases</u>

Saturation states of different iron minerals were obtained for the KFM01A waters. For the speciation-solubility calculations the electrochemically measured Eh value has been used. In any case, saturation indexes for iron (II) minerals (such as siderite or iron sulphides) are insensitive to the Eh as long as the values are below + 700 mV and as long as sulphide concentrations are specified (Glynn and Voss, 1999). Therefore, uncertainties in the electrochemical Eh value will not affect the computed saturation states.

Siderite and rodochrosite are near equilibrium although these phases have not been identified in the KFM01A borehole. This equilibrium may be purely coincidental as the redox potential for the iron system is most likely buffered by iron-bearing oxides-oxyhydroxides or sulphides. A similar situation has been reported by Banwart (1999) in the Äspö Large-Scale Redox Experiment.

The calculation of the saturation state of $Fe(OH)_3$ face the same problems already discussed for the redox pairs that include this phase: (i) the equilibrium constant depends on the crystallinity and (ii) even for the same crsytallinity there are differences in the value of the equilibrium constant. The saturation indices obtained with the WATEQ4F database for the amorphous phase suggest an oversaturation of the waters with respect to amorphous $Fe(OH)_3$; on the other hand, the thermodynamic data for amorphous $Fe(OH)_3$ from the NAGRA database (release 26-Aug-2002; Hummel *et al.*, 2002) give a saturation index near equilibrium (NAGRAS's equilibrium constant for $Fe(OH)_3$ is similar to the one used for the amorphous phase in *Figure 5.5.3.G*).

Groundwaters are in equilibrium or near equilibrium with different monosulphides like amporphous FeS, mackinawite or pyrrhotite. This agrees with the good results obtained with the redox pairs based on sulphur phases although none of these phases have been identified in fracture fillings.

Conclusions

The above results suggest that the redox state of the brackish waters from the shallow depth interval (centred at 115.33 m) at borehole KFM01A could be buffered by the presence of iron oxides and hydroxides and by redox reactions among phyllosilicates. The lack of specific mineralogical data precludes a definitive confirmation of this conclusion.

Nevertheless, the good match between the electrochemical and sulphur redox-pair Eh values points to sulphide minerals as redox buffers. This buffering action, together with the presence of dissolved sulphides, suggest the development of an anoxic-sulphidic state mediated by sulphate reducing bacterias (SRB). Typical precipitation of sulphide minerals associated with the sulphidic environment is suggested by the equilibrium between the waters and several monosulphide phases, as deduced from speciation-solubility calculations.

Microbial analysis and δS-34 isotopic data are not available for KFM01A waters. However, brackish waters from similar depths and setting in borehole HFM05 show high δS-34 values, between 24.5 y 24.6 per thousand, substantially higher than the values found in shallower bicarbonate waters from borehole KFMO2A (14-16 per thousand). These elevated values suggest the existence of a microbially-catalysed reduction of dissolved sulphate. The presence of SRB has been reported at similar depths in studies at sites of the Finnish Program (Figure 5.5.3.H; Haveman *et al.,* 1998; Snellman *et al.*, 1998, Pitkanen *et al.,* 1998, 1999).

The absence of key analytical data (Fe concentration, sulphide, methane) for the rest of the samples in the area rules out a better characterization of the sequence of redox conditions developed at depth.

5.5.4 Mass balance and mixing calculations

The inverse approach via mass balance and mixing calculations to track the hydrogeochemical evolution of the Forsmark area is handicapped by the few groundwater samples used to carry out the study, the absence of key analytical data, the scarcity of mineralogical data and the lack of a hydrogeological model.

It is not possible to elaborate a detailed model based upon this small set of hydrogeochemical and hydrological data. Consequently, the results summarised in this section are to be understood as preliminary, based only on (i) general premises with respect to the type of waters and reactive phases involved and (ii) the inter-comparison with analogous systems (similar water end-members).

The evolution paths used in the calculations have been selected taking into account only the most general groundwater hydrogeochemical characteristics and its apparent age.

Based on this, we have identified two water types: fresh waters with a bicarbonate imprint and low residence times (tritium values above detection limit), and brackish-saline waters with Cl contents up to 6000 mg/l and longer residence times (tritium values below detection limit)

For the analysis of the evolution of the *first water type* (fresh water), which has an *a priori* important water-rock interaction component, simple mass balance calculations with no mixing (to assess the reaction processes occurred between two water samples joined by a hypothetical flow line) and binary mixing with mass balance (to asses the mixing proportions of two water samples and the reaction processes necessary to explain the chemistry of a third water sample) have been performed. For the analysis of the *second water type* (brackish-saline water), only multiple-mixing and mass balance calculations have been carried out. The goal of these calculations is to explain, using heterogeneous reactions between solid phases and the water, the chemistry of a water sample which is the product of the mixing of five or six water end-members. For the calculations with PHREEQC the following chemical and isotopic data have been used: Cl, HCO_3^-, SO_4^{2-}, SiO_2, Ca, Mg, Na, K, Fe, S^{2-}, $\delta^{18}O$ and δ^2H.

Selected samples

Fresh, non-saline waters. Three samples have been selected: sample 4137 (HFM03 borehole), with a Ca-Na-HCO_3 tendency; sample 4398 (KFM02A9 borehole), with a Na-HCO_3-Cl tendency; and sample 4172 (HFM01 borehole), with a Na-Cl-HCO_3 tendency. These samples are representative of the steady increase in Cl content (from 15 to 650 mg/l) observed in this water type. All three samples are part of the M3 data set.

Brackish-saline waters. Three samples have been selected, all of them of the Na-Ca-Cl type: samples 4433 (HFM05 borehole), 4538 (KFM01A borehole), and 4521 (HFM08 borehole). The first two a very similar compositionally: sample 4433 has been included in M3 calculations but sample 4538 has not, possibly because tritium was not analysed (although the rest of the samples from this depth in borehole KFM01A do have tritium values, always below detection limit).

Sample 4538 belongs to the only packered sample set in this study (eight samples between 110 and 120.67 m depth) and where most key chemical and physicochemical data have been analysed and measured, e.g., Eh (see section 5.5.3 *Speciation-solubility calculations for the redox system*). This sample has also been analysed for $\delta^{18}O$ y δ^2H isotopic data, which is very useful for performing mixing and mass balance calculations with PHREEQC.

Sample 4521 has not been included in M3 calculations either, because there is no $\delta^{18}O$ value. Nevertheless, it is the sample with the highest Cl content and with the strongest contribution of the Litorina end-member as made evident by a preliminary ion-ion plot analysis. Although the lack of a $\delta^{18}O$ value is a handicap in interpreting the results, PHREEQC is able to perform the computation without this restriction and that is why the sample has been selected.

Fresh, non-saline waters

This type of groundwater, recent and superficial, is *a priori* strongly controlled by water-rock interaction processes. Therefore, its evolution must be conditioned by both the recharge water chemistry *and* the reacting mineral phases.

The recharge waters in Forsmark show a broad compositional variability and include meteoric, soil and lake waters, each one with its own geochemical evolution trend and with very complex interactions between them. The link between these superficial waters and the groundwater is difficult to pinpoint with the current understanding of the system. In consequence, *rain water* has been selected as the initial water for the simple mass balance calculations as representative of a meteoric water at the start of its interaction with the rock. The composition of this rain water has been equated to Rain 60 because at this time there are no complete analysis available on the composition of rain water at Forsmark.

Due to the lack of detailed mineralogical data of the overburden and bedrock, the selection of the feasible reacting solid phases has been made generically, including the most common phases used in similar systems elsewhere: calcite, plagioclase, biotite, halite, gypsum, iron sulphides, organic matter, several phyllosilicates (smectites, montmorillonites), and Ca-Mg-Na-K ionic exchange reactions.

The number of models obtained as a result of the simple mass balance calculations with such a broad type of reactions (especially due to the presence of phyllosilicates and ion exchange) is high. Therefore, only the main qualitative results will be presented here.

The waters than can act as *final waters* in the calculations have a gradual compositional variation (simplistically represented by a progressive increase in Cl concentratrion) due to a mixing with a marine end-member, as the preliminary ion-ion plots suggest. This mixing is an alternative scenario to halite dissolution to explain the Cl content of the final water in the simple mass balance calculations. This alternative could be the most reasonable if the amount of dissolved halite necessary to explain the Cl content of the final water is too big for the rocks involved in the water-rock interaction process. As a consequence, additional mass balance and binary mixings between the Rain 60 and different marine end-members (Baltic Seawater, Sea Sediment and Litorina) have been carried out. For these mass balance+mixing calculations the same feasible solid phases and reactions used in the simple mass balance calculations have been used, excluding gypsum and halite.

Results

Waters represented by sample 4137 (Ca-Na-HCO_3 type) are very superficial and have geochemical characteristics very similar to, or even less evolved than, the soil waters sampled in soil pipes in the Forsmark area. The mass balance models using Rain 60 as an end-member predict an evolution dominated by organic matter decomposition, calcite, plagioclase biotite, gypsum (or sulphides) dissolution, and Na-Ca exchange and precipitation of some phyllosilicate, all of them with very low mass transfers. The change in Cl concentration could be explained by a very small dissolution of halite dispersed in the soil.

The results obtained with simple mass balance calculations for the Na-HCO_3-Cl waters (represented by sample 4398) are similar to the ones already analysed but with somewhat higher mass transfers. Binary mixing calculations with Rain 60 and a marine end-member give similar reaction models with only minor variations due to the low proportion of the marine end-member (between 1.5 and 2.6 % depending on the marine end-member considered: Baltic Seawater, Sea Sediment or Litorina).

Finally, mass balance calculations for Na-Cl-HCO_3 waters (represented by sample 4172) give, as expected, very high halite mass transfer coefficients. Binary mixing with a marine end-member provides a much more reasonable result. The amount of marine end-member is 11% for Baltic Seawater, 20% for Sea Sediment, and 22% for Litorina. In all the cases, the reactions involved include organic matter decomposition, calcite, plagioclase, biotite and sulphide dissolution, precipitation of phillosilicates, and ionic exchange, mainly Na-Ca, very similar to results for the other two water types but with the additional mixing with the marine end-member.

Discussion

From the above results, it can be concluded that Ca-Na-HCO_3 waters are little evolved geochemically with a chemistry totally controlled by water-rock interaction processes. Na-HCO_3-Cl waters have a longer residence time and in consequence mass transfer processes are more significant; alternatively, these waters can be explained as a mixing process with a minority marine end-member. Finally, Na-Cl-HCO_3 waters are clearly influenced by a marine component.

Broadly speaking, water-rock interaction is the main process responsible for the chemistry of most of the waters in this group of fresh and non-saline waters (all the Ca-Na-HCO_3 and Na-HCO_3-Cl waters). However, an increasing contribution of mixing with a marine end-member could explain the observed Cl increase in the more evolved Na-Cl-HCO_3 waters. The reactions that explain the water chemistry are similar in the three cases, the only change being the amount of mass transfer. Decomposition of organic matter, dissolution of calcite, plagioclase, biotite, sulphides, and halite (halite dissolution is only significant in the less evolved superficial waters), precipitation of phyllosilicates (mainly smectites and montmorillonites), and Na-Ca ionic exchange are the main mass transfer processes encountered in most calculations.

Evidently, the selection of rain water as the initial end-member implies that the calculated reactions affecting groundwaters are a kind of average between those taking place in the pedogenic zone and those taking place in the hydrologic circuit itself, as it is impossible to separate both contributions.

Brackish-saline waters

As already mentioned, these waters have a longer residence time and a higher mixing component. Precisely, calculations have given the mixing proportions of the different end-members. To perform them, the inverse capabilities of PHREEQC to compute multiple end-member mixing proportions and reactions have been used. The mixing proportions are computed with respect to end-members of known composition and the reactions with respect to a predefined set of solid phases.

Results obviously depend on the selected end-members and mineral phases or feasible reactions. The chosen water end-members are the most frequently used in analogous systems: Rain 60, Litorina, Sea Sediment, Glacial Meltwater, and Brine. Additionally, the end-member Lake Water, used in M3 calculations for Forsmark, has also been included. The set of phases and reactions includes calcite, plagioclase, biotite, phyllosilicates (especially illite because it has been identified in fracture fillings), and various exchange reactions involving Na, Ca, Mg, and K. Additionally, some more specific phases identified as fracture fillings have been added (e.g. prenhite, laumontite) to assess their incidence in the mixing proportions.

This sensitivity analysis shows that the variations in the reaction set do not produce significant changes in the calculated mixing proportions. Due to this fact, and to simplify the following description, only a qualitative reference to the mass transfer among the initially defined mineral assemblage will be given.

The reduced number of samples and the lack of key data (Eh, Fe^{2+} and dissolved sulphide concentrations, sulphur isotopes, etc) has hindered the quantitative estimation of redox processes in mixing and mass balance calculations. Nevertheless, some provisional calculations were carried out in order to assess their importance, especially in relation to bacterial sulphate-reduction, using the best redox-characterised samples (e.g., sample 4538). Different iron sulphides (pyrite, monosulphides) were selected as representative of the bacterial sulphate-reduction process, which can be represented by the reaction

$$SO_4^{2-} + 2(CH_2O) + OH^- \;--->\; HS^- + 2HCO_3^- + H_2O, \qquad (1)$$

For some calculations, additional iron phases were used (Fe-chlorites and biotites), and also iron ionic exchange processes.

Most results support the actuation of sulphate-reduction processes (reaction 1) and predict the precipitation of sulphides, but with very low mass transfers (10^{-7}-10^{-8} mol/kg of water) and therefore they are not significant. The rest of the calculations suggested a release of iron into the solution through exchange processes and sulphide precipitation (also in negligible amounts), or sulphide dissolution/precipitation, whose likelihood is impossible to ascertain with the present level of knowledge of the system.

Generally speaking, mixing and reaction models obtained with PHREEQC can justify by simple mixing the sulphate concentration in samples. Because the generic end-members are poorly characterised from a redox point of view, the mixing and mass balance calculations strongly depend on the amount of sulphate in the waters. This, together with the quasi-conservative behaviour of sulphate predicted by PHREEQC, explain the minimum values of the mass transfer coefficient for all reactions involving sulphur. In conclusion, a more detailed description of the system (i.e., more samples and better redox-characterised) is essential to gauge the importance of sulphate-reduction reactions in these waters.

Sample 4538

In the set of models obtained with PHREEQC there are cases where Rain 60 is an end-member and cases where Lake Water is an end-member, but not a single one where both end-members appear together. Models that include Rain 60 are divided into those which precipitate calcite (more viable *a priory*) and those which do not. As can be observed in Table 5.5.4.a, this difference does not significantly change the mixing proportions. Models that include Lake Water always produce calcite precipitation, but otherwise the mixing proportions are quite similar to the Rain 60 models.

Table 5.5.4.a. Mixing proportions obtained with PHREEQC for sample 4538. Results with Rain 60 and Lake Water as an initial water end-member have been tabulated separately.

	Rain 60		**Lake Water**
	Calcite precipitation	**No calcite precipitation**	**All with calcite precipitation**
Brine	3.8- 4.0%	3.9-4.2	4.0-4.2
Litorina	40-41.6%	37.6-42.5%	43-44%
Sea Sediment	-----	0-0.2%	-----
Rain 60	18-19.5%	19.3-24.5%	-----
Glacial	35-36%	33.7-37.0	41-42%
Lake water	-----	------	10-10.8%

The net mass transfer results associated to these mixing models indicate the dissolution of biotite and plagioclase, the precipitation of calcite and illite, and the actuation of ionic exchange processes affecting Na and Ca in the 0.1-1 mmol range.

Sample 4433

Results for this sample are summarised in Table 5.5.4.b. The most important differences with respect to the previous sample affect the Sea Sediment end-member, which has a higher weight in the mix (up to 11%), a the Glacial Meltwater end-member, which reduces its contribution in a corresponding amount. Mass transfers are similar qualitatively and quantitatively.

These mild differences could be associated to compositional differences between both samples (overall very similar) and/or to the non-packered status of sample 4433. As a check, the calculations have been repeated with sample 4481 from KFM01A borehole (taken from the same depth as sample 4538) and the results (without redox constraints) are almost identical to the ones obtained for sample 4538.

Table 5.5.4.b. Mixing proportions obtained with PHREEQC for sample 4433 Results with Rain 60,Lake Water, and with neither of them as an initial water end-member have been tabulated separately

	Results with Rain 60	**Results with Lake water**	**Results without fresh waters**
Brine	2.5-3.5%	2.5-3.4	1.5-2.3
Litorina	43.2-48.0	43.6-46.8	54.4-60.2
Sea Sediment	6.3-11.6	6.0-11.0	5.7-11.7
Rain 60	12.6-17.6	-----	-----
Glacial	24.4-26.5	30.7-31.5	31.8-32.7
Lake water	-----	9.5-12.7	------

Sample 4521

As already commented, this sample is the most saline from the Forsmark area. It was not included in M3 calculations because no $\delta^{18}O$ datum was available. This deficiency is also a problem when using PHREEQC because it introduces an extra degree of freedom into the system, increasing the number of feasible models.

In the 21 different models found by PHREEQC, mixtures involve only three or four of the six considered end-members. The Brine and Sea Sediment end-members always appear with a very low weight (< 2.5 %). The rest of the end-members have proportions in the range 3-12%, except for Litorina, which constitutes a 82-89% of the mix. These mixing proportions agree with what was found during the preliminary analysis.

Mass transfers associated to exchange processes are one order or magnitude bigger than in previous samples.

Discussion

In general, brackish water samples (4538 and 4433) do not show great sensitivity to the selected set of feasible phases because the amount of mass transfer involved is low and the process is second order to the most prominent mixing process. This explains why the mixing proportions are so similar irrespective of the water chemistry and the reaction model considered. All models indicate the presence of two dominant end-members, Litorina and Glacial Meltwater, in the mix that produces these waters.

On the other hand, the results obtained by Pitkanen *et al.* (1999) in Olkilouto for waters of the same type and composition are comparable in spite of the different set of feasible phases, the different selection of some end-members, and the different methodology used by these authors. For the brackish waters with a composition most similar to the one studied here, Pitkanen *et al.* (1999) obtain mixing proportions of 57-58% Litorina and 42-43% Glacial waters (Glacial melt + glacial altered waters).

This gives extra trust in the obtained mixing proportions, although it has not been possible to assess the impact of bacterial sulphate reduction. The analysis of $\delta^{34}S$ in some brackish water samples from borehole HFM05, the location of these waters in the Cl-SO_4 correlation diagram, and the speciation-solubility calculations suggest that bacterial sulphate reduction and the corresponding sulphide precipitation is taking place in the system. However, mixing and mass balance calculations carried out with PHREEQC for the selected samples do not allow to obtain conclusions with respect to this point due to the scarcity of samples and complete data (especially sulphur isotopes and a better redox characterization of the end-members and/or reference waters).

As a consequence of the uncertainty introduced by the bacterial sulphate reduction process, it is difficult to assess the incidence of the initial assumptions in the final mixing proportions. The sensitivity analysis carried out increasing the amount of sulphate in the brackish waters (assuming a loss of S by sulphate reduction processes) up to a maximum of 450 mg/l (the concentration of an ideal mixture with Litorina in *figure 3.8.4.K*) shows that the increase raises the weight of the Litorina end-member up to 60%. This is a maximum proportion, because it has been assumed that the Litorina end-member dominantly controls the amount of sulphate in the mixture. However, it gives a good idea of the amount of error introduced in the calculations when ignoring sulphate-reduction processes.

The most saline sample (4125) is less problematic in this respect because its sulphate concentration is very similar to that of the Litorina end-member. The lack of the $\delta^{18}O$ value broadens the range of mixing proportions, but Litorina is always the dominant end-member (82-89%), with a greater weight than in any other analysed brackish water. It is therefore reasonable to think that the transition from low-Cl brackish waters (with Cl concentrations of 4500 mg/l, as in samples 4433 and 4538) to saline waters (represented by sample 4125, with a Cl concentration of 6000 mg/l) is accomplished fundamentally by an increase in the proportion of the Litorina end-member in the mixture.

Final remarks

The results from PHREEQC preliminary modelling for the Forsmark groundwaters are summarised in *Figure 5.5.4.A*. In this model, non-saline fresh waters have a chemistry basically controlled by water-rock interaction processes. However, an increasing contribution of mixing with a marine end-member could explain the observed Cl tendency of these waters.

In the present state of knowledge of the system, the main water-rock interaction processes that control their chemistry are (i) decomposition of organic matter, (ii) calcite, plagioclase, biotite and sulphide dissolution, (iii) phyllosilicate precipitation, and (iv) Na-Ca ion exchange. In the most superficial Ca-Na-HCO_3 waters additional gypsum and halite dissolution takes place. This generic reaction model is susceptible to refinement when more data about the mineralogy of the system and its hydrological functioning becomes available.

As for the brackish-saline waters, the calculations point to a mixing process with multiple end-members as the principal controller of their chemistry. The main compositional variations between the brackish (<5000 mg/l Cl) and the saline (6000 mg/l Cl) waters can be explained by an increase in the proportion of the Litorina end-member.

The role of water-rock interaction processes in these waters is much less important than in the fresh waters, and secondary to the mixing process. This circumstance allows the calculation of the mixing proportions even without a precise knowledge of the detailed mineralogy of the system. However, the incidence of the sulphate-reduction processes in the final mixing proportions has not been evaluated with enough rigor and it is therefore likely that further detailed studies would produce a refinement of the generic reaction model used in the present calculations.

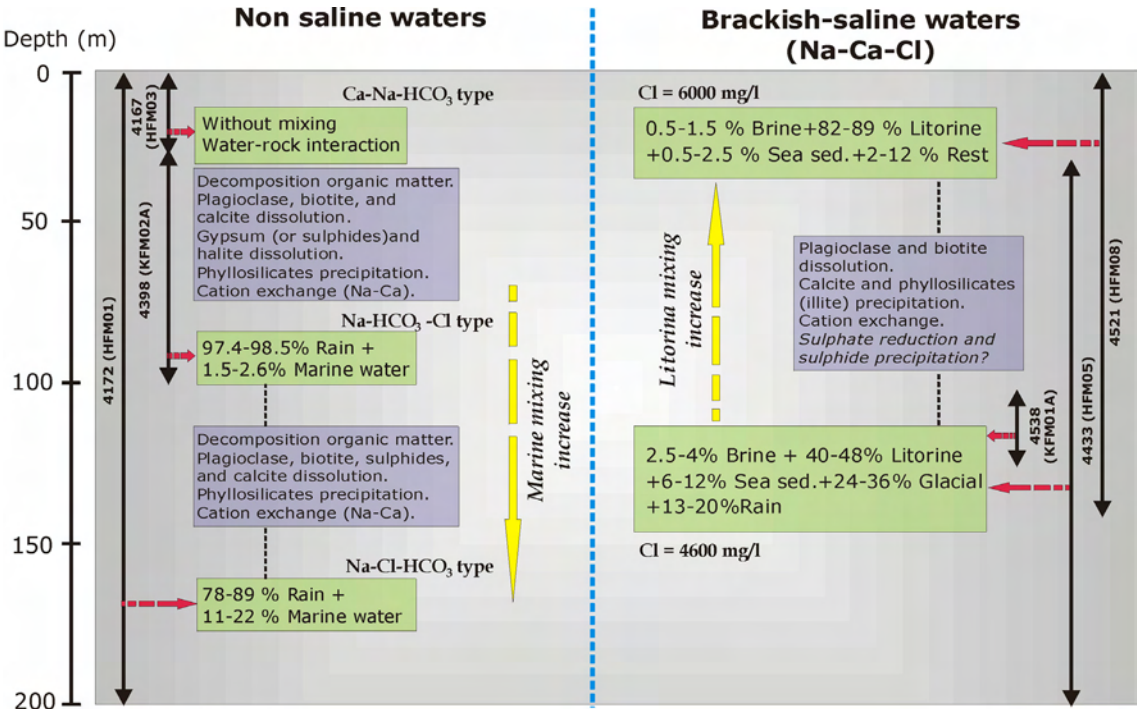

Figure 5.5.4.A. Geochemical conceptual model for Forsmark groundwaters. The possible evolutive paths of the non-saline and brackish-saline groundwaters are summarised, showing the representative sample used in the calculations and the depth interval at which they were taken For each sample, the mixing proportions and the main heterogeneous reaction processes are indicated. The mixing proportions for waters with a Cl content of 4600 mg/l are an average of the values obtained for samples 4538 and 4433 in the models with the Rain 60 end-member (see tables 5.5.4.a and b). Results based on PHREEQC modelling.

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Appendix A: Forsmark's surface waters

Background information

Oligotrophic hardwater lakes in the area are often characterized as "bottomless" because there is no distinct border between the soft sediment and the lake water. The calcareous and highly organogenic sediments are characterized as "algal gyttja" or "cyanophycee gyttja". They are almost free from mineral particles (except for precipitated $CaCO_3$) and show a gelatinous surface sediment.

Preliminary investigation in Lake Hällefjärd (Brunberg and Blomqvist, 1999), indicate high biomass of cyanobacteria (non-nitrogen-fixing) and diatoms.

These studies have also indicated the presence of sulphur bacteria, both in winter and summer (with patchy distributions). Their presence require anoxic environments (microenvironments in summer) with hydrogen sulphide production (high concentrations of free H_2S are in close connection to the rizoids of Chara algae).

It appears that the soft-bottom communities of primary production (photosynthetic activity) in "Chara lakes" are:

- Chara: submersed macroalgae attached to the soft-bottoms
- Cyanobacteria and diatoms.

The photosynthetic activity is mainly due to these soft-bottom communities, and not to "pelagic" microorganisms drifting in open waters.

Explorative analysis

For this study a drainage area composed of several lakes (L2, L6 and L8) and tributaries (S1, S3, S4, S5 and S7) was selected. This area is named "Drainage area 1" in *Figure A.1.* Drainage Area 2 has been only partially characterized.

The whole data set consists of geochemical and physicochemical data for each sampling point at roughly monthly intervals during a year. In order to plot both, spatial and temporal trends, different graphs have been used. *Figure A.2* to *A.5* and *A.13-A.14*, show spatial trends (with sampling points 1 to 8 in the horizontal axis) for different sampling dates (each date plotted as a colour-coded curve; April to August and December, 2002; January and February, 2003).

Figures A.6 to A.12 are parameter-parameter plots including the data from all the sampling points in all the dates. Each sampling point is represented by a different symbol.

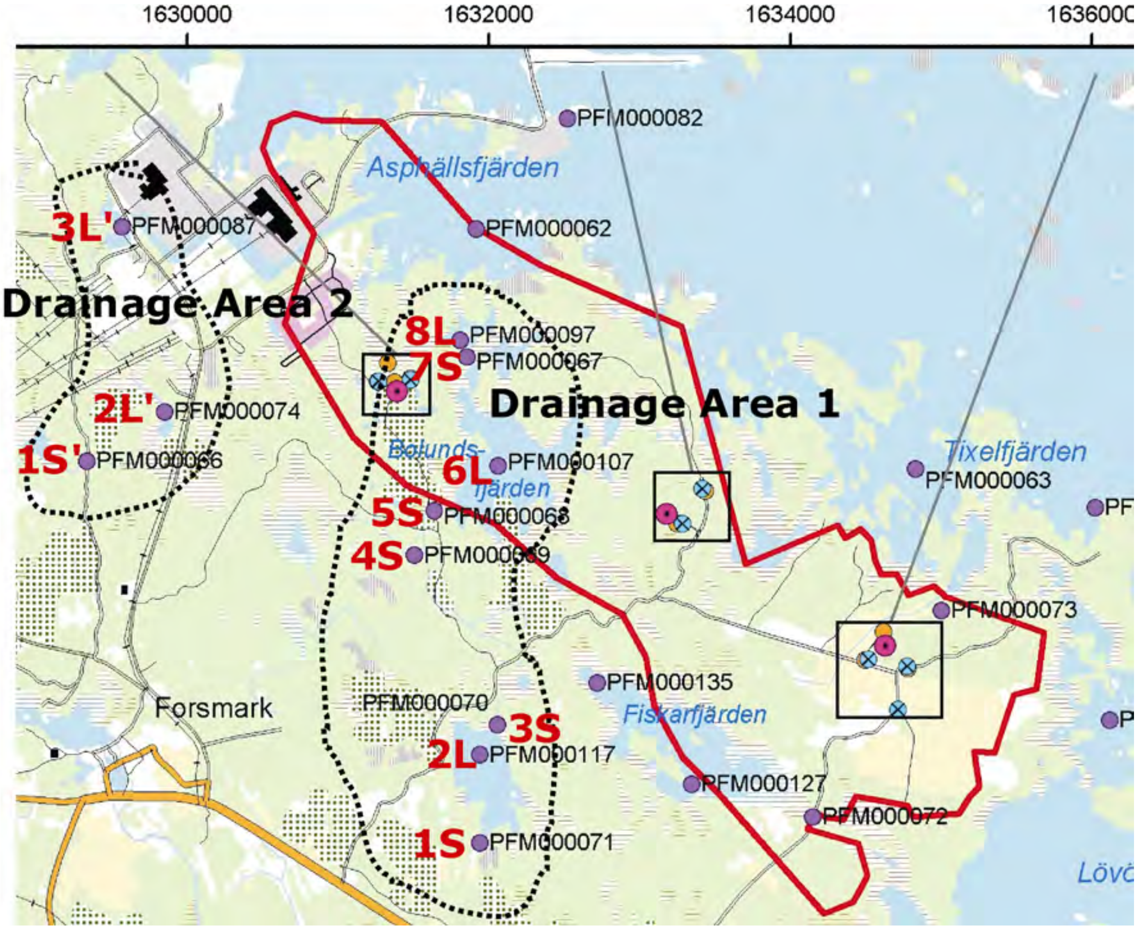

Figure 1: Drainage areas 1 and 2 and location of samples in lakes (L) and streams (S).

Main variables and components

Figure A.2 shows the important increase in conductivity in stream 4 and lake 6, correlated with increases in Cl, Mg, Na, SO_4 and K (these last two are plotted in *Figure A.3*). In L6 there is also a big difference in top-bottom values in winter (February, 2003). A probable explanation is the marine influence: lakes 6 and 8 are close to the coast (closer than L2). The relatively high concentrations in S4 could be the result of its position in the discharge point of a secondary tributary.

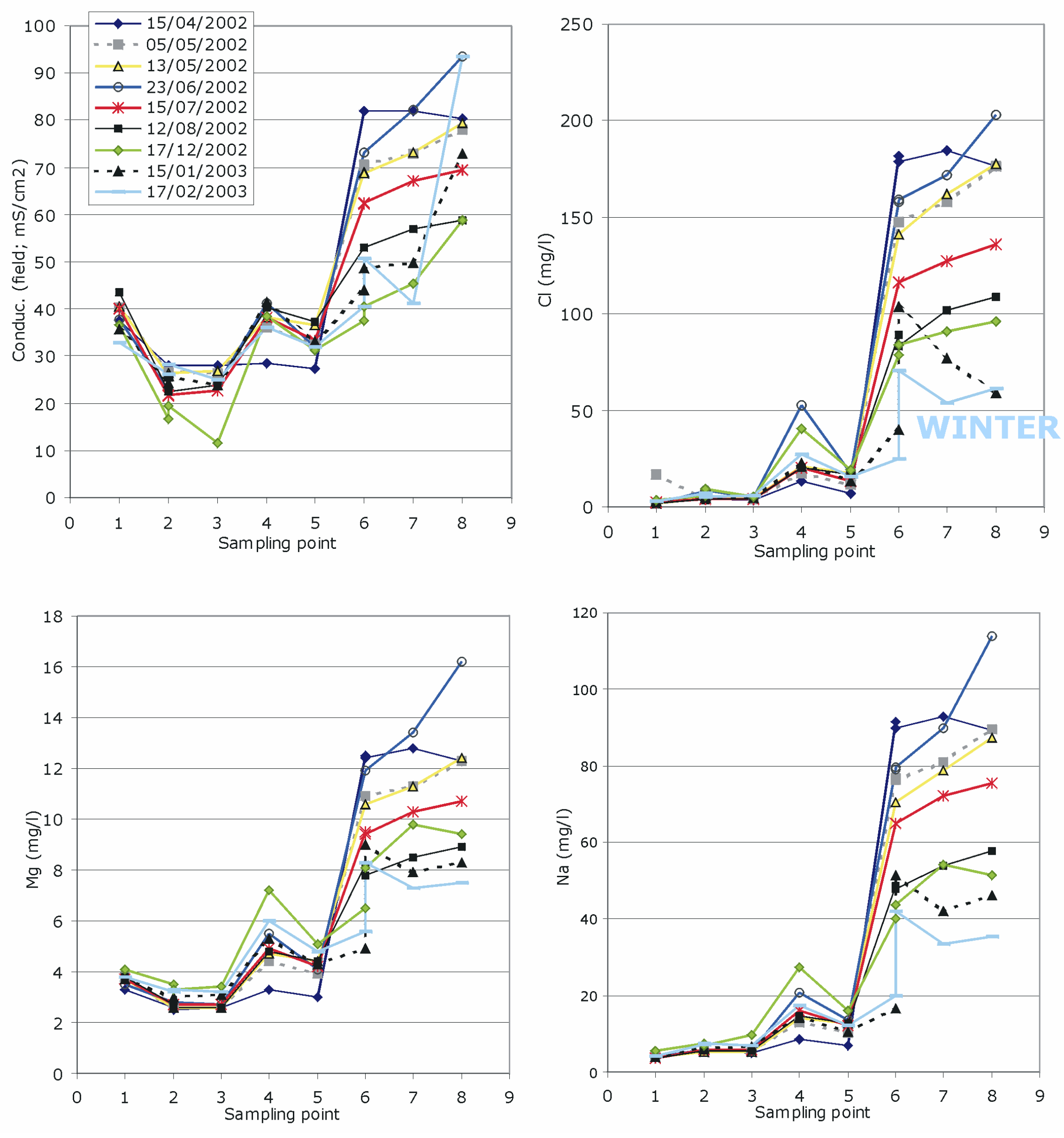

Figure A.2. Conductivity, Cl, Mg and Na evolution along the drainage area 1 (sampling points 1 to 8; see Figure A.1 to locate the points) in different dates.

Potassium behaviour is not as clear-out as Cl, Mg or Na, but it is also possible to observe (*Figure A.3*) smaller concentration increases in the same sampling points (S4 and L6). Sulphate contents (*Figure A.3*) reach maximum in point S4 in winter, even higher than in L6. This behaviour could be related both, to a lack of vegetation cover in the neighbourhood of point S4 enabling a higher weathering rate in the soil and promoting sulphurs (pyrite) oxidation and to the influence of other tributary.

Silica and iron have also very high concentrations in point S4, which are in marked contrast with their low concentrations in lakes. The reason for this depletion in Si and Fe in lakes is explained in the Discussion (silica consumption in the diatoms biosynthesis; Fe removal in particulate matter).

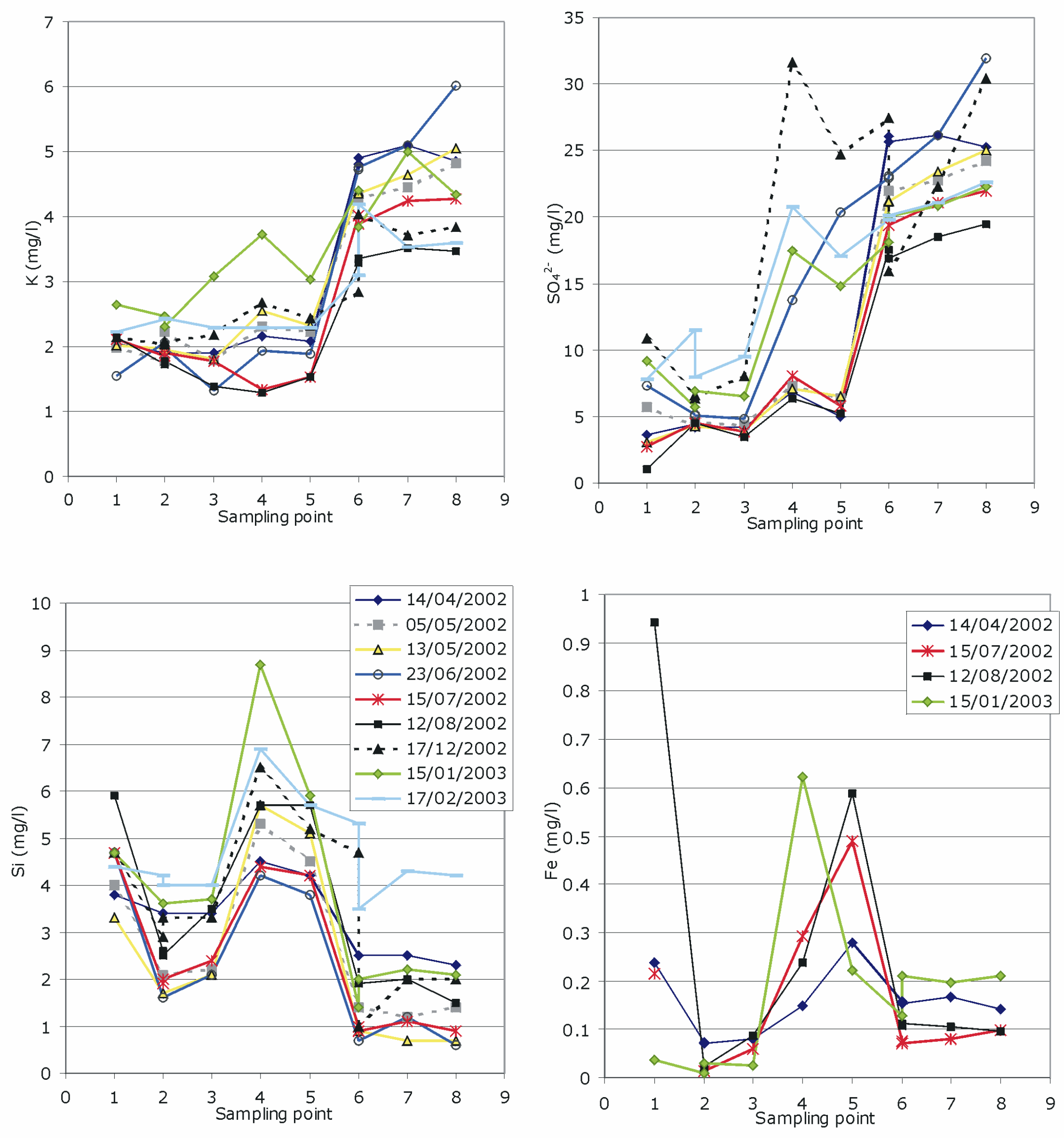

Figure A.3. K, SO_4^{2-}, Si and Fe evolution along the drainage area 1 (sampling points 1 to 8; see Figure A.1 to locate the points) in different dates.

pH, alkalinity and Ca (*Figure A.4*) have a coherent behaviour: when pH increases (as happens in lakes, linked to higher concentration of dissolved oxygen), alkalinity and Ca content decrease, apparently due to calcite precipitation. This precipitation is evident during the summer season, but not in winter, as a result of decreased biological activity during the winter.

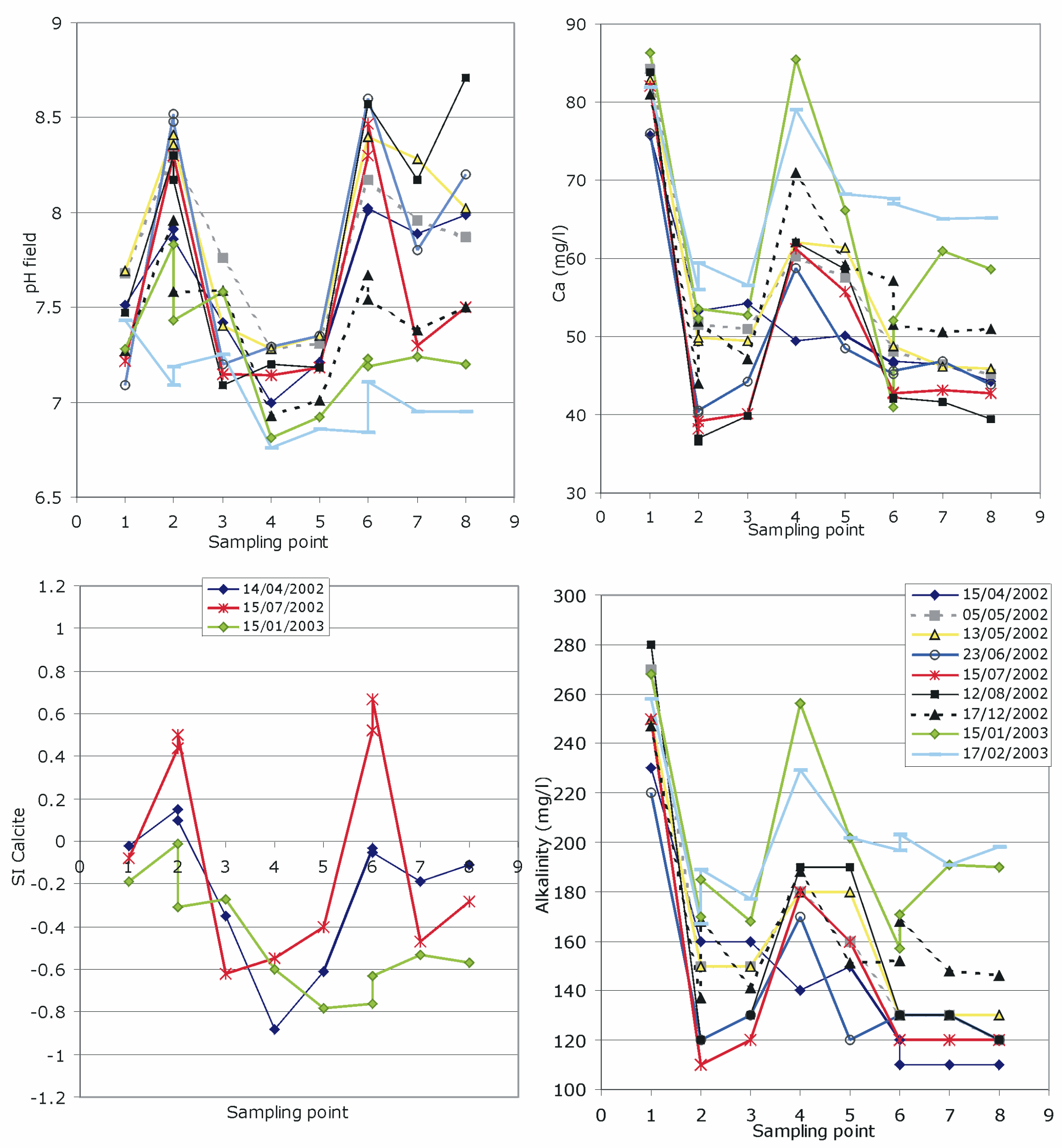

Figure A.4. pH, alkalinity and Ca evolution along the sampling points.

^{18}O, D and ^{13}C values (*Figure A.5*) follow the same general trend of increase in lakes and decrease in streams (even at point S4, which have raised concentration in most elements). L6 shows important top-bottom isotopic differences in cold months, strengthening the stratification hypothesis in spite of their scarce depth (2 m).

Oxygen-pH

The O_2-pH (*Figure A.6*) correlation is particularly good when viewed by dates. The increase in O_2 concentration is related to the photosynthetic activity. This activity consumes CO_2 which causes an increase in pH. The effect is most effective during the summer season when the photosynthetic activity is at a maximum and its correlation with calcite saturation index very good (*Figure A.6*).

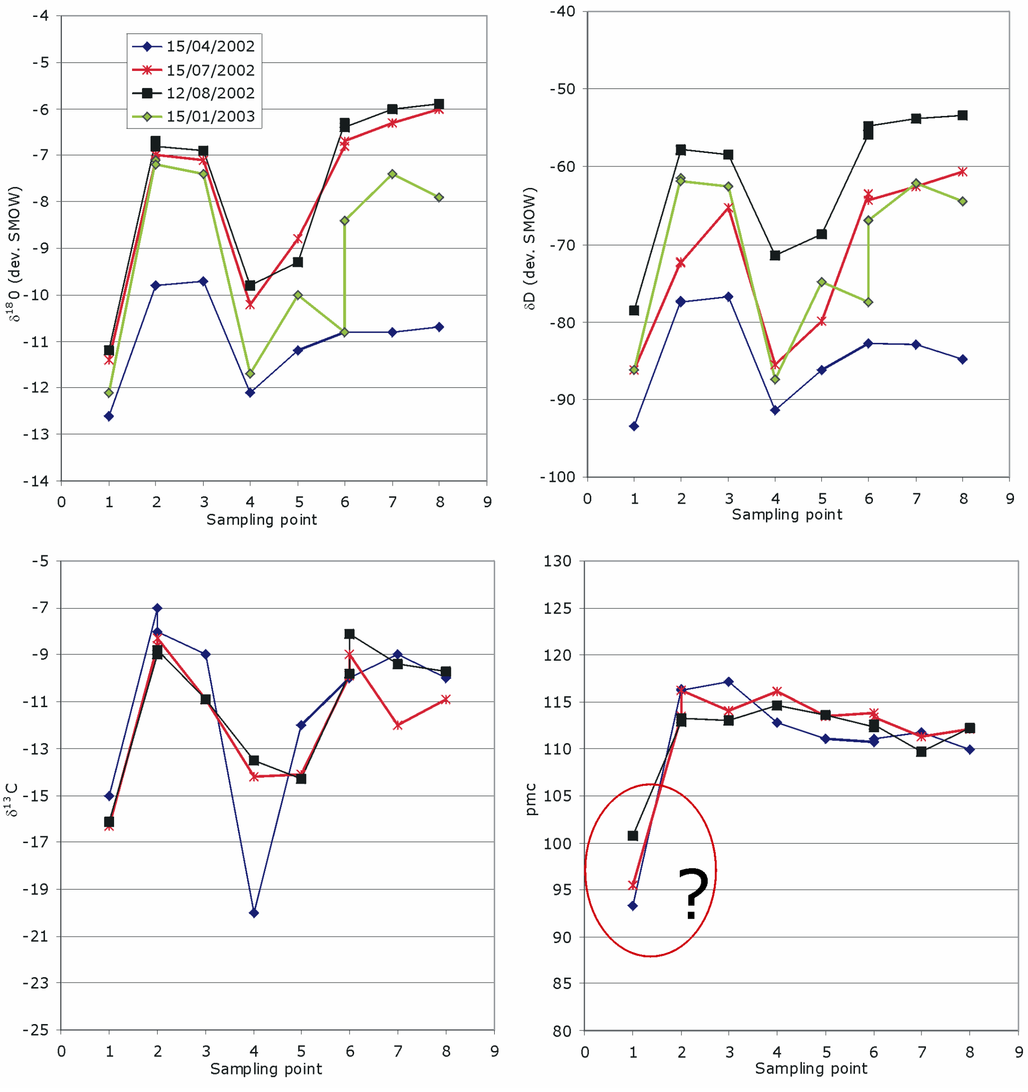

Figure A.5. ^{18}O, D, ^{13}C and percent of modern carbon (pmc) along the drainage area 1 in different dates.

Oxygen-T

Lakes often experience oxygen deficit during the winter season, reaching maximum concentrations in apparent equilibrium with its solubility at the water temperature (*Figure A.7*). During the warmer months, the photosynthetic activity increases O_2 concentrations even above their temperature-controlled solubility. This effect has mainly been observed in lakes, which shows the importance of photosynthesis as a controlling process.

Additional comments

The concentration of dissolved oxygen in lakes is occasionally very low during autumn and winter. This oxygen depletion could is the result of mineralization of dead organic matter, together with the development of an ice cover that prevents oxygen saturation of the water. This partial freezing could, in turn, promote the release of nutrients (or other components) from the sediment, justifying in part some of the high concentrations measured in lakes, and even the stratification of contents, during the cold months. The well developed water stratification in winter results in higher concentrations of inorganic components (like bicarbonate and calcium) and some nutrients (P_{tot} and N_{tot}) in the bottom samples with respect to the top. This could be an indication of the removal of some components from the sediment, either by calcite dissolution (subsaturated samples) or because the oxygen deficit itself releases nutrients.

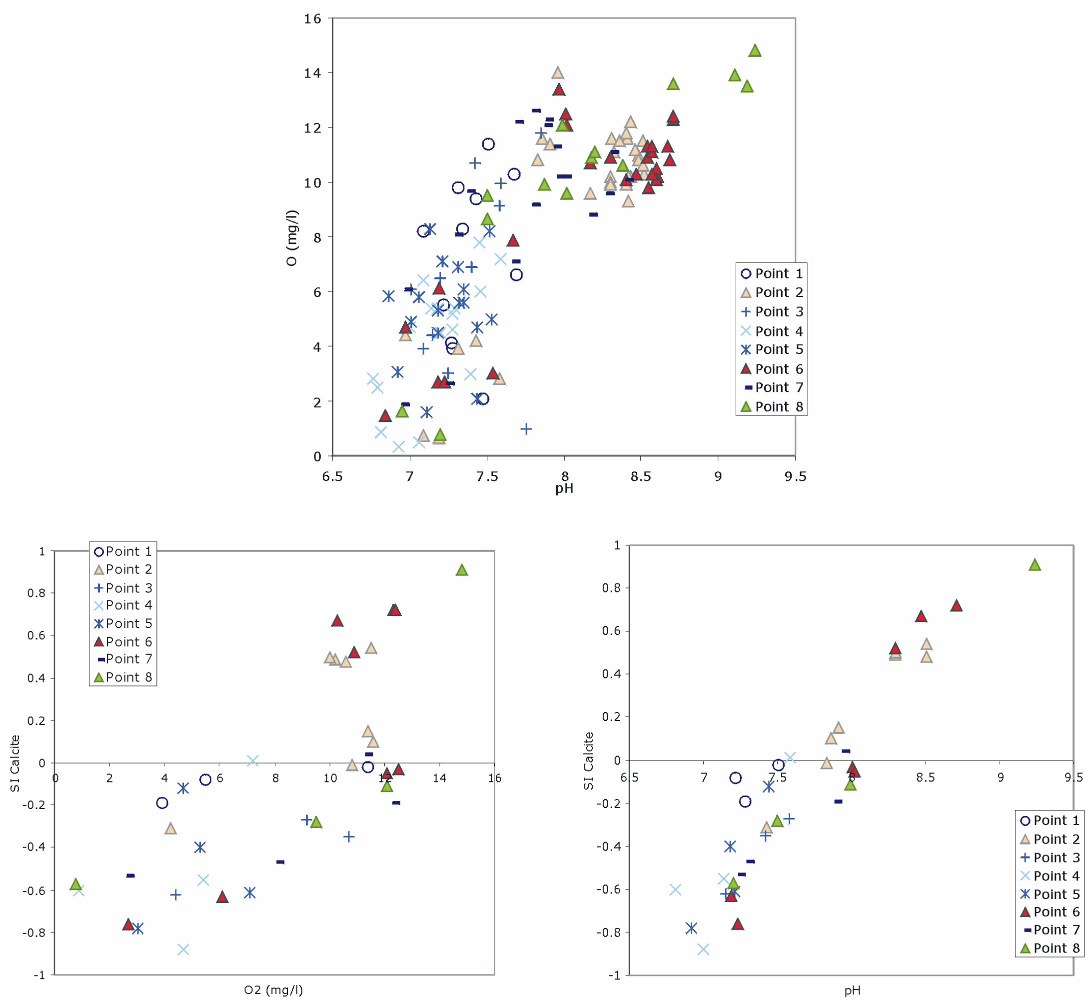

Figure A.6. Relationship between oxygen and pH, and calcite saturation as a function of both.

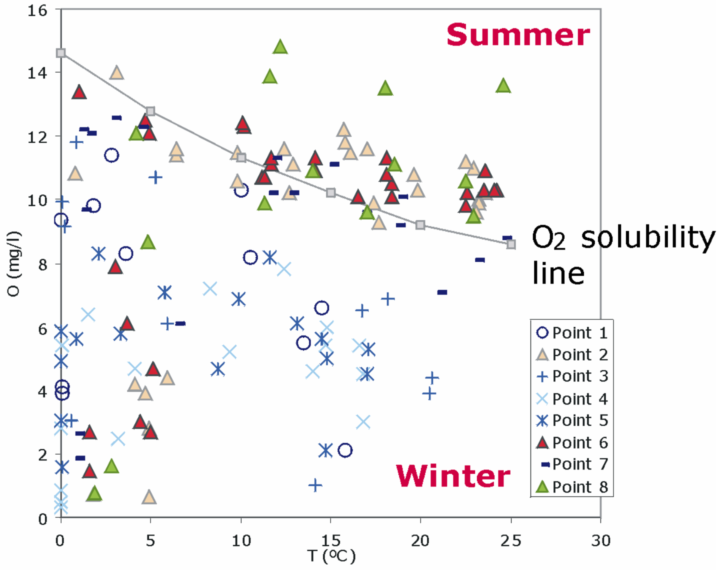

Figure A.7: Oxygen contents as a function of temperature

Carbonate System

As a general rule, alkalinity tends to decrease with increasing pH (*Figure A.8*), trend which is especially well developed in lakes (*Figure A.4*). The increase in pH, conditioned by the photosynthetic activity, can reach values of 9. At this pH, the amount of dissolved CO_2 must be very low, but Charas are able to use HCO_3^- instead of CO_2 for the photosynthesis, reducing the alkalinity even more.

The decrease in alkalinity with an increase in pH is well correlated with the alkalinity-calcium trend (*Figure A.8b*). The nice positive linear correlation is possibly due to calcite precipitation. Surface waters in Forsmark are oversaturated in calcite for pH>7.5 (*Figure A.6c*). *Figure 6a* shows a systematic change in calcite saturation index with dissolved O_2, reaching saturation for oxygen concentration of around 10 mg/l. The coupling between pH and dissolved O_2 with respect to calcite saturation is another indication of the control imposed by biological activity on the precipitation process.

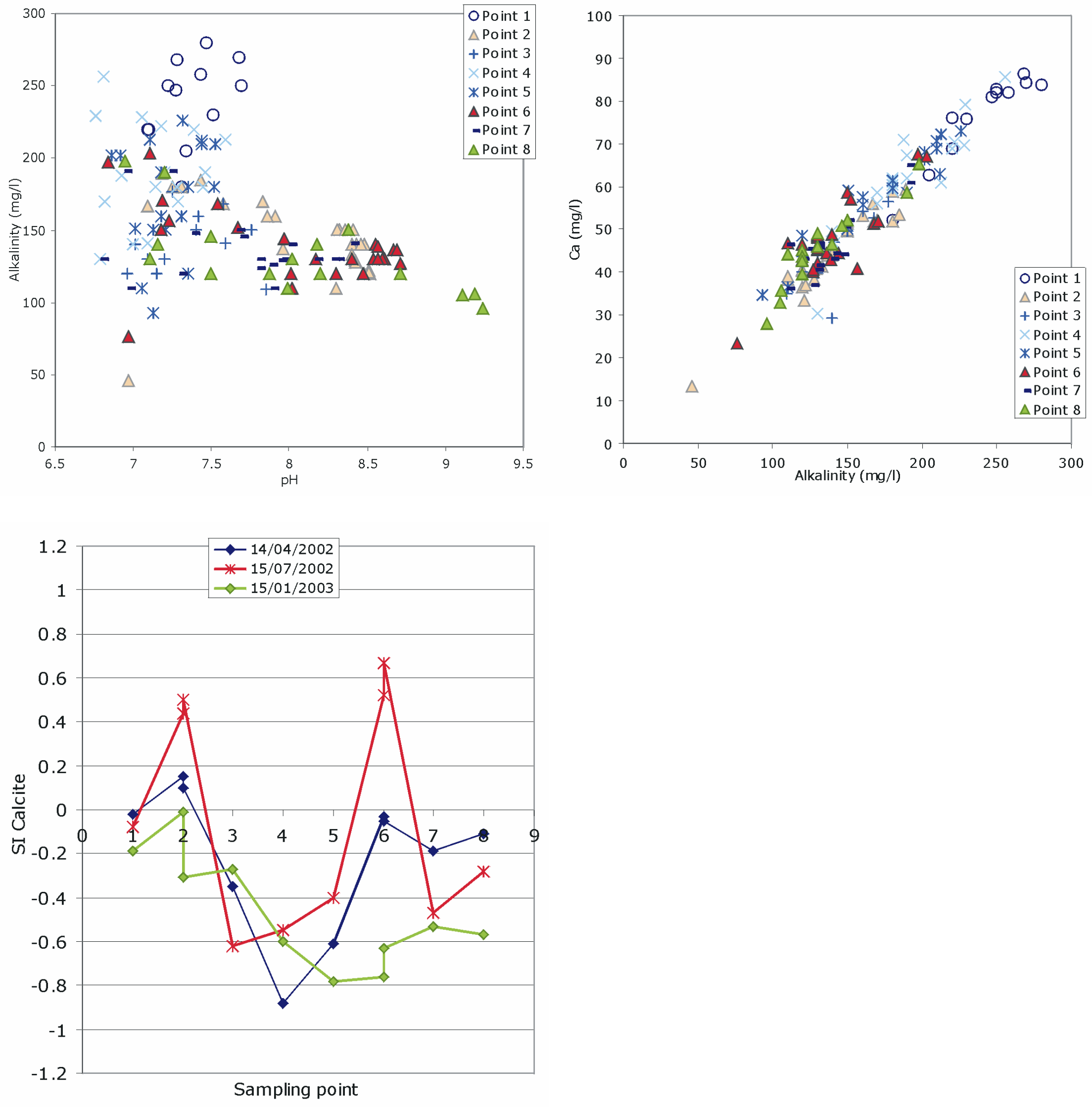

Figure A.8: Alkalinity contents with respect to pH and correlation Ca-alkalinity. Calcite saturation index as a function of date and sampling point.

The seasonality of this process is evident in *Figure A.8c*. In this figure we have superimposed three curves, one for winter (green), other for spring (blue) and the third for summer (red). It is clear that calcite saturation is a summer phenomenon, when biological activity is at its maximum. During winter, although lake waters keep showing less calcium than the average concentration of their inlet streams, it can not be related to calcite precipitation because saturation indices are negative. We can put forward two explanations for this Ca removal in winter:

A dilution effect. Stream waters could be more concentrated, but their volume be low compared with the volume of water stored in lakes. In this way, the oversaturation effect would be inhibited.

Calcite precipitation is only effective in microenvironments where biological activity remains in winter, but this is a local phenomena.

Silica-pH

Si contents decrease with increasing pH up to pH=9 when silica concentrations are almost zero (*Figure A.9*). This trend is the opposite as in an inorganic system and therefore must be related to diatoms activity. These microorganisms use silica for the biosynthesis of their amorphous silica shell (as can be seen in *Figure A.3*, Si concentration decreases abruptly in lakes).

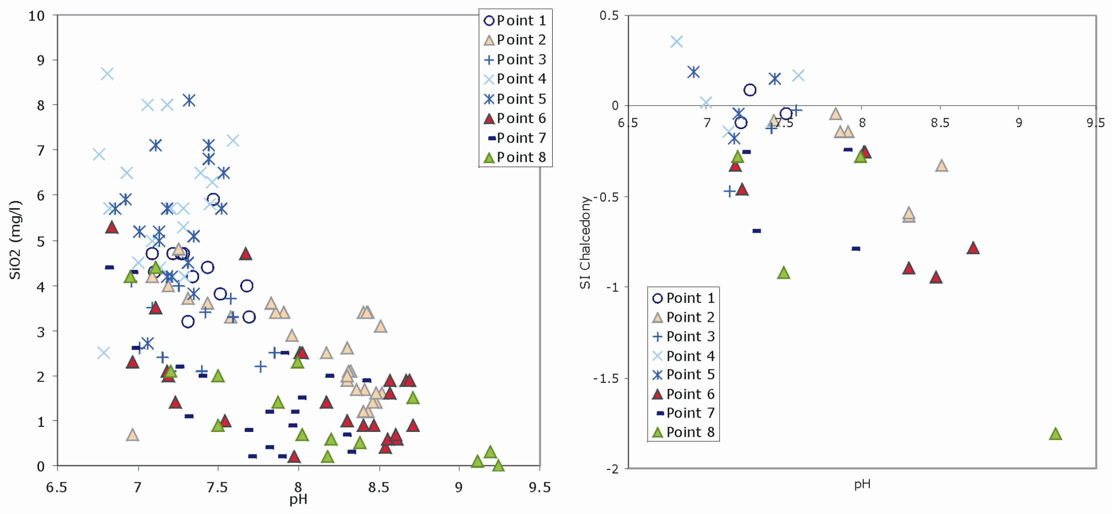

Figure A.9: Silica contents and chalcedony saturation as a function of pH.

Sodium and Sulphate

There is a very good correlation between Na and Cl (*Figure A.10*), but with a slope different from 1, which can be explained by the presence of additional sources of Cl (marine influence? coincident with point 6, 7 and 8, closer to the coast) or by the removal of Na (ionic exchange?).

Sulphate has two different behaviours (*Figure A.10b*): one is typical of stream waters, with a broad range of sulphate concentration for a fairly constant (and low) chloride contents (no clear trend is apparent). This behaviour could be conditioned by seasonal changes in the weathering rate giving rise to pyrite oxidation. The second behaviour is associated to lakes. There is a positive liner correlation between Cl and SO_4, possibly due to evaporation or marine influence (in points 6, 7 and 8).

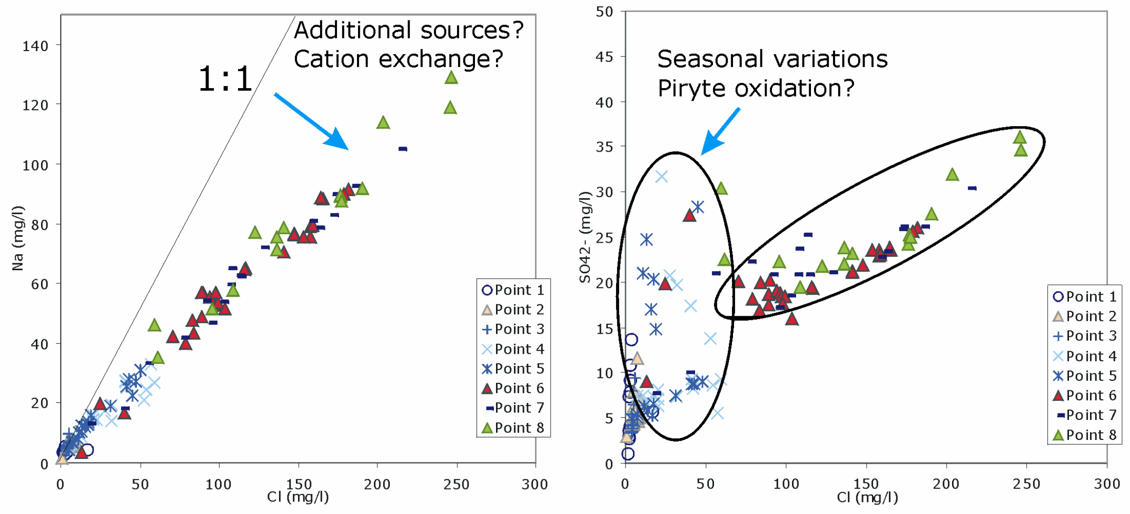

Figure A.10: Correlations between Na and Cl and SO_4 and Cl.

Iron and Uranium

Iron is roughly inversely correlated with oxygen (*Figure A.11*), with low iron contents in well oxygenated waters (>8 mg/l). Poorly oxygenated waters have both, low and high iron contents. The low iron contents in low oxygenated waters could be explained by a removal or iron attached to particulate matter in lakes (this is a very common process in estuaries). A similar behaviour has been observed in REEs.

Uranium is positively correlated with iron, indicating a redox-controlled behaviour.

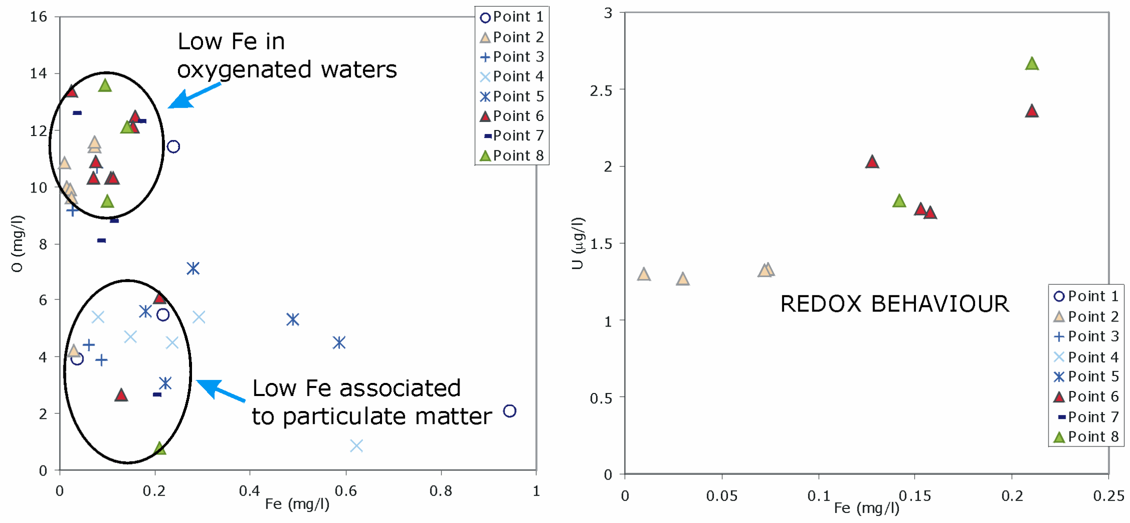

Figure A.11: Oxygen and Uranium contents with respect to iron.

<u>Additional Comments on Fe</u>

It would be very useful to know more about iron behaviour in this system. With the available data it seems that iron is retained in lakes in comparison to streams, but this could be a dilution/concentration effect. There are no clear correlation between iron and any other element involved in retention processes (like calcium), so we can not talk about a coprecipitation phenomenon. It could be simply a process of Fe-oxides/oxyhydroxides formation. Furthermore, iron seems to be also affected by the winter compositional stratification and this would lead to a seasonal change in the phases where iron is retained.

Isotopes

Panel a in *Figure A.12* shows the typical evaporation trend of meteoric waters in a δ^{18}O-D diagram. All Forsmark surface waters (lakes and streams) follow approximately this trend with evaporation. Moreover, in this panel and in the other two, the stratification of values in lake 6 are clearly seen.

Compositional variation in point 4 (crosses in panels b and c) show up in the diagram an abrupt drop in δ^{18}O and D values compared to points 2 and 3, and closer to the typical values of the original recharge water (point 1, open circles). This does not mean that the water in point 4 is the same as in point 1, because other geochemical characteristics are very different.

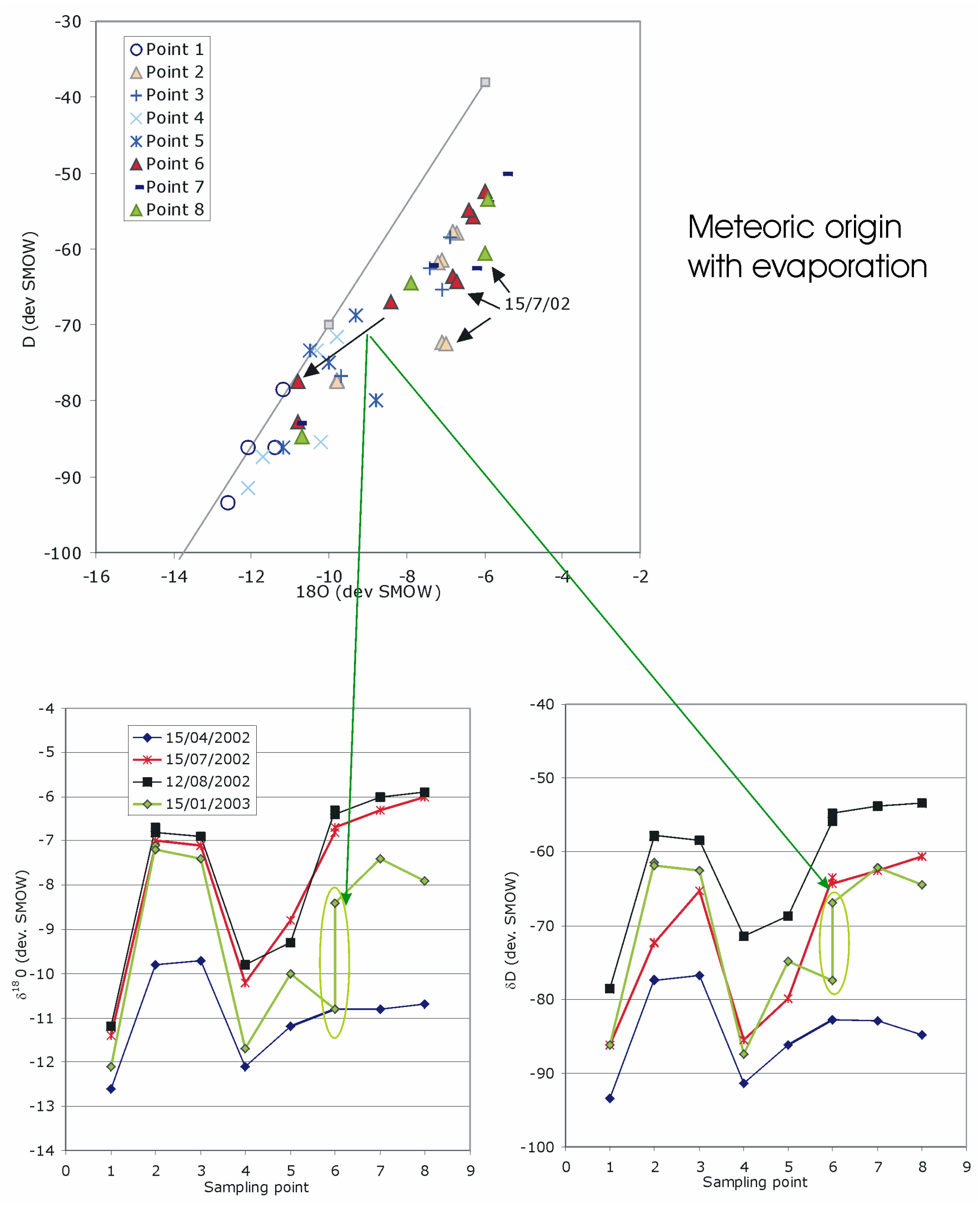

Figure A.12: 18O-D plot and variation of both with time and space.

Nutrients (P and N)

<u>*Dissolved phosphate:*</u>

Dissolved phosphate decreases (*Figure A.13*) both between inlet and lake (detailed balance) and between the first and the last sampling point (net balance), even in winter. This is an indication that dissolved phosphate is the main nutrient (more easily bioavailable).

The positive correlation with calcium is relatively good in warm weather; but during this period there is also a good negative correlation between phosphate and chlorophyll-A, and so, the decrease in dissolved phosphate concentrations in lakes can be interpreted in two ways: (a) as a coprecipitation with calcite; or (b) as a biological intake with photosynthetic activity peaks.

<u>*Particulate Organic P and P_{total}:*</u>

The aforementioned comments about detailed and net balances also apply to these nutrients, although with frequent exceptions, indicating that they are not so strongly conditioned by biological activity.

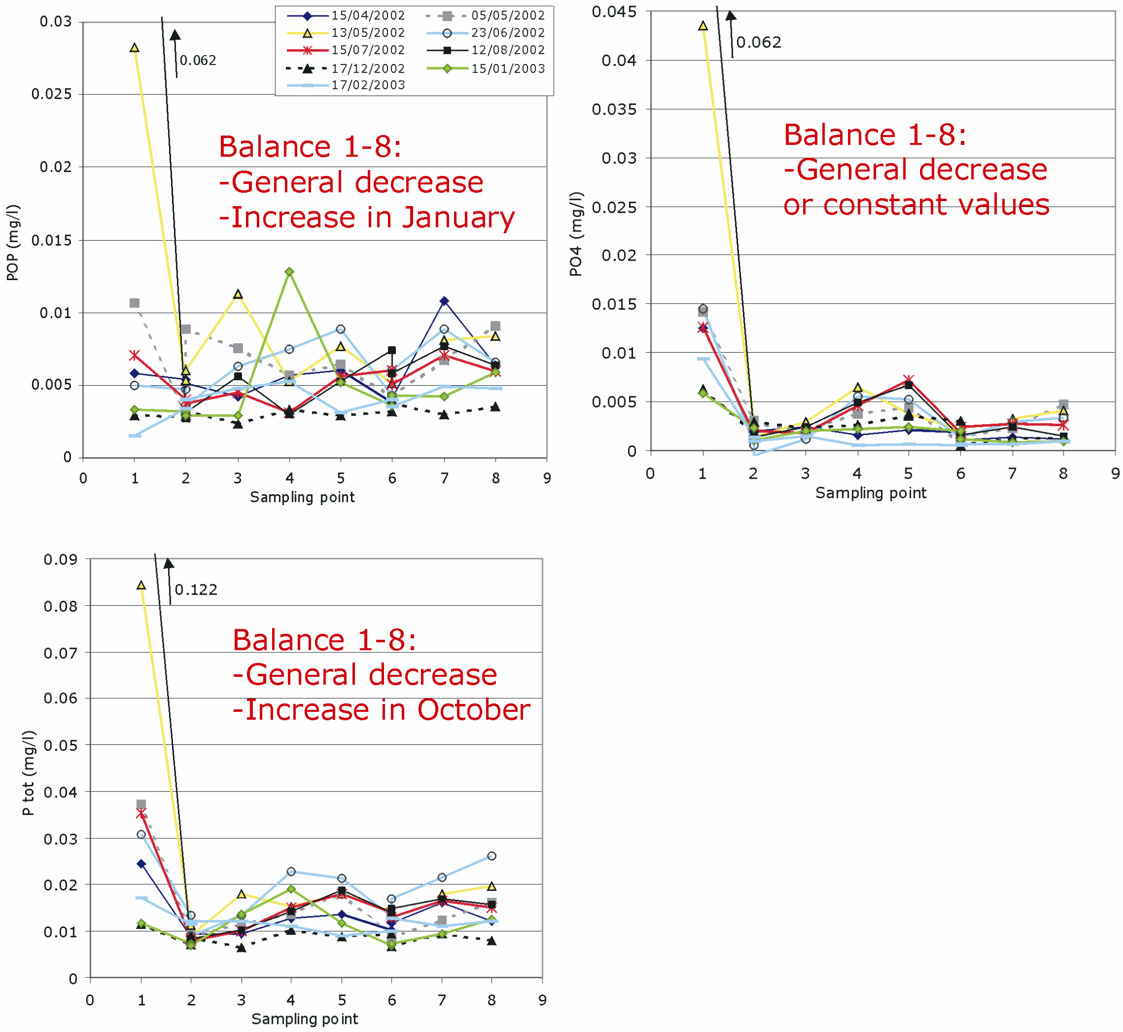

Figure A.13: Variation of different phosphorus forms along the sampling points in different dates.

Nitrogen:

The different species of this element (NH_4, NO_3-NO_2, N_{tot}) show a varied behaviour in the studied lakes (*Figure A.14*):

- In lake 2 we observed a marked increase in NH_4 and N_{tot} and a decrease in NO_3-NO_2 (mainly in winter).

- In lake 6 there is no increase in NH_4 and N_{tot} content (but we do observe a clear winter top-bottom stratification). However, there is a rather big increase in NO_3-NO_2 in winter, together with the top-bottom stratification.

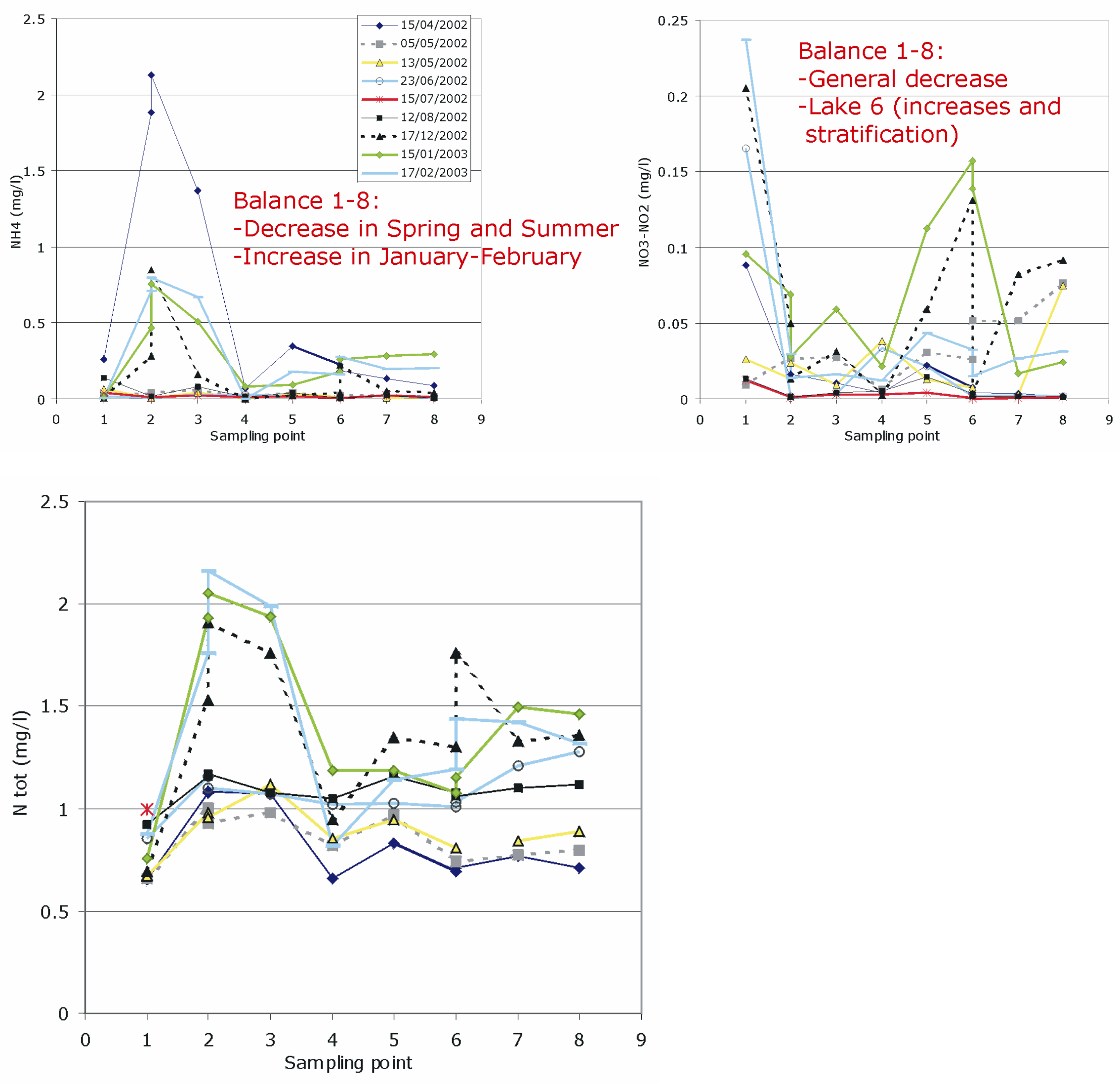

Figure A.14: Variation of different nitrogen forms along the sampling points in different dates.

Charophytes that grow on highly organic bottom sediments are able to release oxygen to the reduced sediment-water interface and this creates favourable conditions for nitrification/denitrification and for nitrogen loss to the atmosphere (nitrogen-cycle bacteria?, indirect effects of charophytes?).

Drainage Area 2

We have carried out a preliminary analysis of drainage area 2. The main results are similar to the ones already summarized for drainage area 1. A remarkable aspect of this area is iron behaviour. Iron reaches its maximum concentration in lake PFM000087 (sample 3L' in *Figure A.1*) in the January 2003 sampling campaign. Top-bottom stratification is well developed, with higher concentration in the bottom sample.

Also in drainage area 2 there is a positive linear correlation between Fe and Ca, especially in the lake 3', maybe indicating a release/retention of these two elements related to calcite precipitation-dissolution.

Discussion

Special features in Lake 6

Lake 6 shows important increases in conductivity, Cl, Mg, Na, SO_4 and K with respect to up-stream sampling point. In lake 2, however, this behaviour is not so well developed and some values actually decrease. The biggest increments coincide with the summer months, with little difference between top and bottom samples. On the other hand, during winter, the increments are smaller but with a strong difference between the top and bottom samples (this difference also affects to the isotopes and to these elements with decreased values like Ca, alkalinity and pH).

These results suggest the onset of a well-developed stratification in winter, despite the shallowness of the lakes. Indeed, top-bottom differences can be bigger than differences between stream 5 and lake 6 itself.

Data needed

This study has highlighted the need of some additional data to better understand the geochemical differences among sampling points. The more important of these are:

- Water flows in streams.
- Seasonal sampling of bottom sediments composition. This sampling could help to elucidate:
- the internal balance of nutrients (e.g. P) related to the interactions with the bottom sediments,
- the dissolution/precipitation and/or release/retention processes associated with the bottom sediments.
- the extent of possible P coprecipitation with calcite.
- It would be quite interesting to have data on the concentration and composition of the colloidal and particulate matter in inlets and lakes. With certainty, both water reservoirs (streams and lakes) would have different contents. It is even possible that flocculation and/or sedimentation processes are taking place in the entrance point of inlets to lakes. These processes could affect the geochemical behaviour of some elements, especially iron and nutrients.
- Redox measurements and S^{2-} contents in different parts of the lakes.
- Data in all the sampling points for each sampling campaign.

- Information about the biological ecosystem in lakes (are there N-cycle bacteria?).
- Information about possible diffuse contribution to lakes (additional to the contribution by streams).

Appendix 3

Explorative analysis, M3 calculations and DIS modelling

Contribution to the model version 1.1

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3D-Terra, Montreal [1)]
Geopoint AB, Stockholm [2)]

October 2003

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1. Conceptual postglacial model of the Forsmark site

The first step in the groundwater evaluation is to construct a conceptual postglacial scenario model for the site based on known paleogeological events. This model can be helpful when evaluating data since it gives constrains to the possible groundwater types that may occur. The glacial/post-glacial events that might have affected the Forsmark site are described below (information compiled from Björck, 1995; Laaksoharju et al., 1999 c, d) and illustrated in Figure 1.

- When the continental ice was formed 100,000BP permafrost formation could take place at a depth of several hundred meters which concentrated the existing groundwater by freezing (Bein and Arad, 1992). The water formed had a higher density and could sink to the depth containing a water with the same salinity and density.
- When the continental ice melted and retreated, glacial meltwater was hydraulically injected under considerable head pressure into the bedrock (>13,000BP). The exact penetration depth is still unknown, but a depth exceeding several hundred metres is possible according to hydrogeological modelling (Svensson, 1996).
- Different non-saline and brackish lake/sea stages then covered the Forsmark site (13,000BP – 4,000BP). Of these only a dense brackish sea water such as Yoldia (Yoldia represents a relative short time period and the effects may be difficult to trace) and Litorina Sea water could penetrate by density overturn and affect the groundwater in the more conductive parts of the bedrock. The density of the intruding sea water in relation to the density of the groundwater determined the final penetration depth of the sea water. The Litorina Sea stage (8,000 to 2,000BP) contained the most saline groundwater (twice the salinity of modern Baltic Sea water) and this water was supposed to have the deepest penetration depth. The result was that the glacial and brine groundwaters in the bedrock were affected by intruding brackish marine water.
- When Forsmark site subsequently rose above sea level a freshwater pillow of meteoric recharge water developed on top of the saline water because of its low density. The continuous land rise increased the hydraulic driving force so that the groundwaters in the upper part of the bedrock were flushed out gradually. This flushing started directly after deglaciation and, since this part of the bedrock had already risen above sea level, the postglacial marine water at these locations did not affect the groundwater composition.

Many of the natural events described above are repeated during a repository lifespan of hundred of thousands of years. As a result of the described sequence of events, brine, glacial, marine and meteoric groundwaters are expected to be mixed in a complex manner at various levels in the bedrock, depending on the hydraulic character of the fracture zones, groundwater density variations and tunnel construction activities prior to groundwater sampling. For the modelling and based on the conceptual model of the site end-members reflecting e.g. glacial meltwater and Litorina Sea water composition were added to the data set.

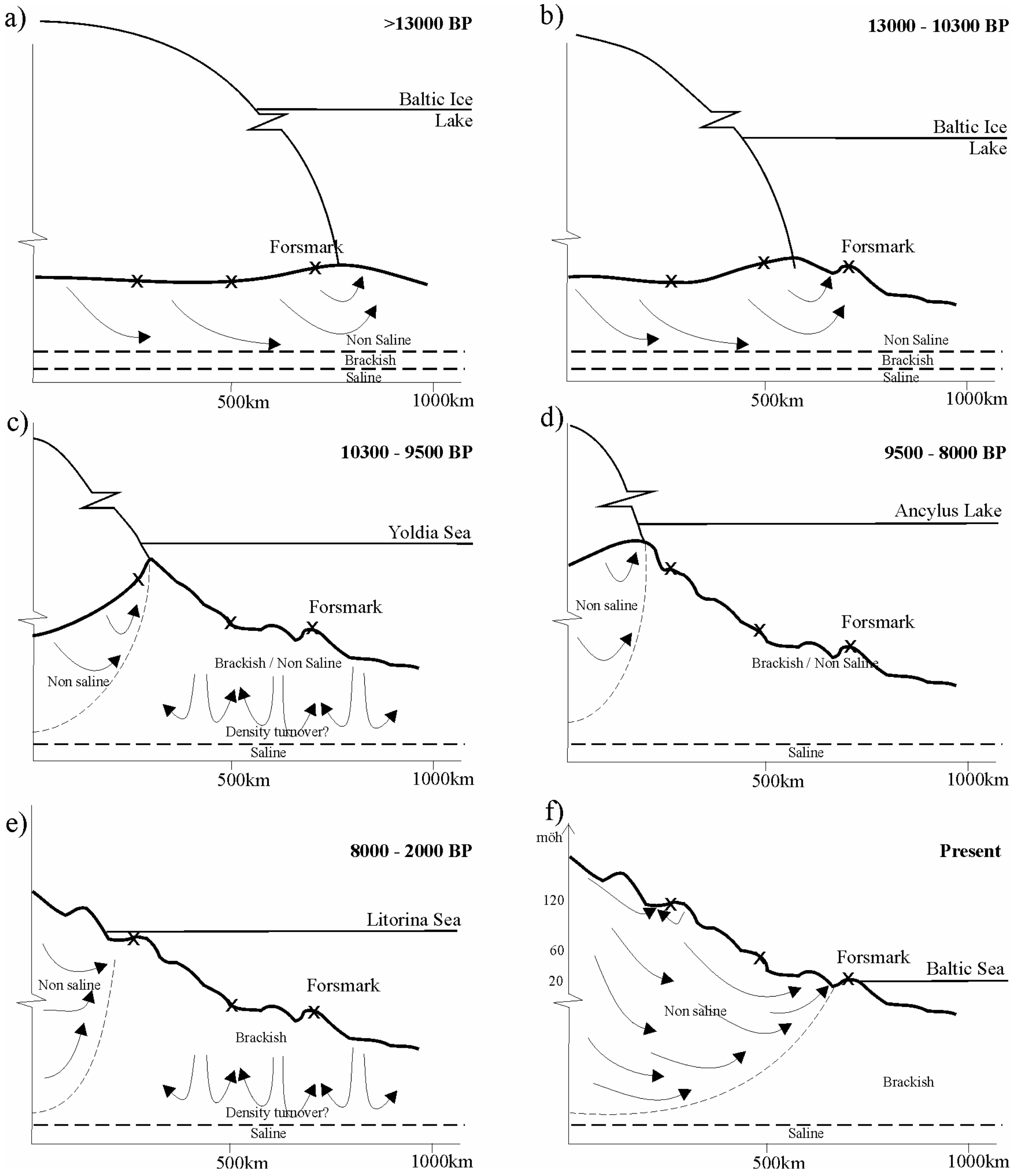


Figure 1: *A conceptual postglacial scenario model for the Forsmark site. Possible relation to different known post-glacial stages and land uplift which may have affected the hydrochemical evolution of the site is shown a) Glacial stage. b) Baltic Ice Lake stage, c) Yoldia Sea stage, d) Ancylus Lake stage, e) Litorina Sea stage and f) present day Baltic Sea stage, after Laaksoharju et al., 1999c. From this conceptual model it is expected that water affected by glacial meltwater and various Sea water stages such as Yoldia Sea, Litorina Sea and modern Baltic Sea water could affect the groundwater at the Forsmark site.*

2. Explorative analysis

2.1 AquaChem evaluation

A commonly used approach in groundwater modelling is to start the evaluation by explorative analysis of different groundwater variables and properties. The next phase often includes a groundwater classification based on the salinity or major constituents of the groundwater. The effects from the major water rock interactions are modelled using some of the standard mass-balance codes.

This section gives examples of how classical geochemical evaluation and modelling can be applied on site data by using the computer code AquaChem. The starting point is scatter plots where the data set is examined see Figure 2 and 3, followed by classification in 4. Water type classification of the Forsmark samples are listed in Appendix1.

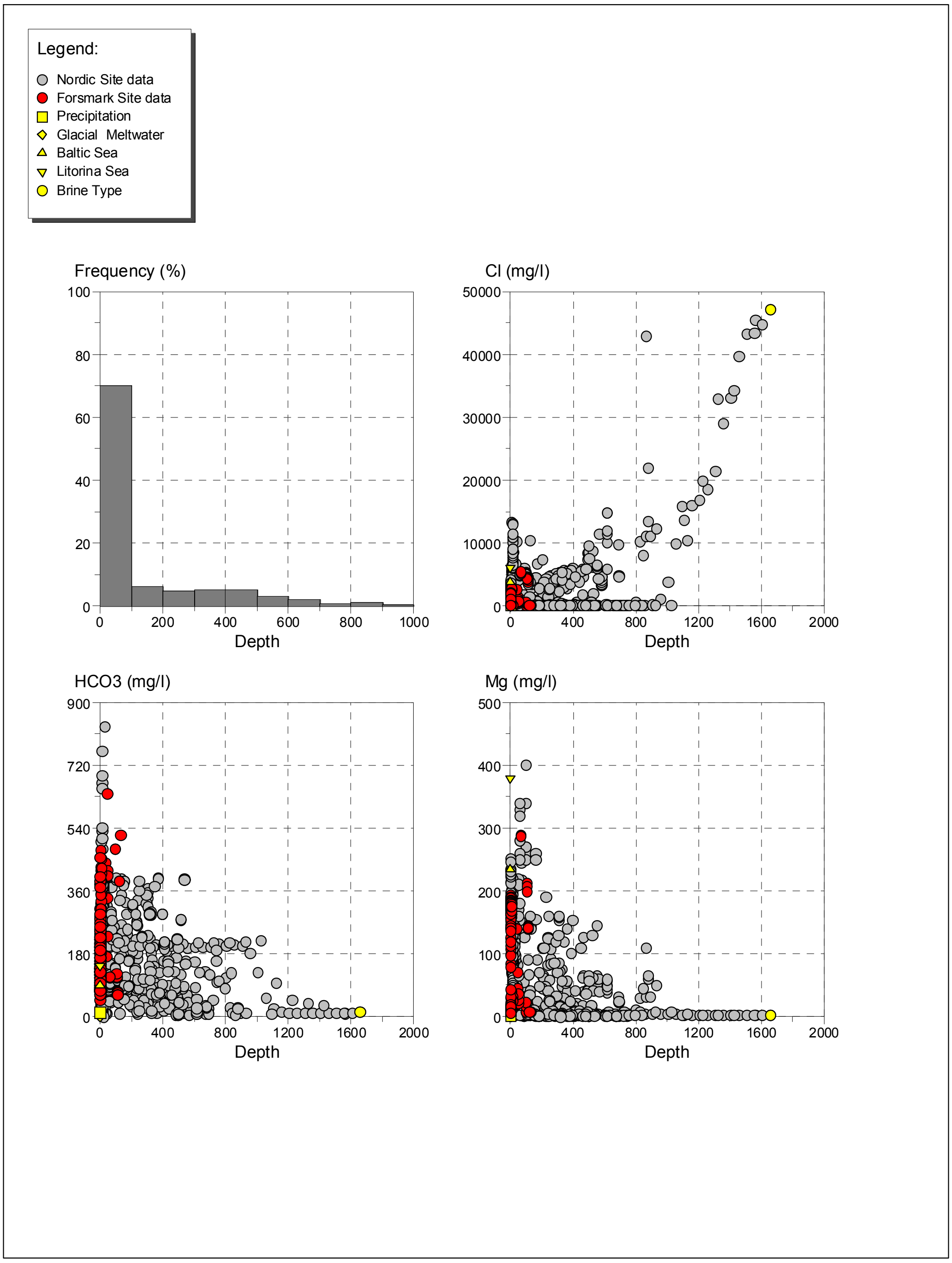


Figure 2: *The frequency of the Cl samples, Cl/depth, HCO_3/Depth and Mg/depth are plotted for the Forsmark data using AquaChem.*

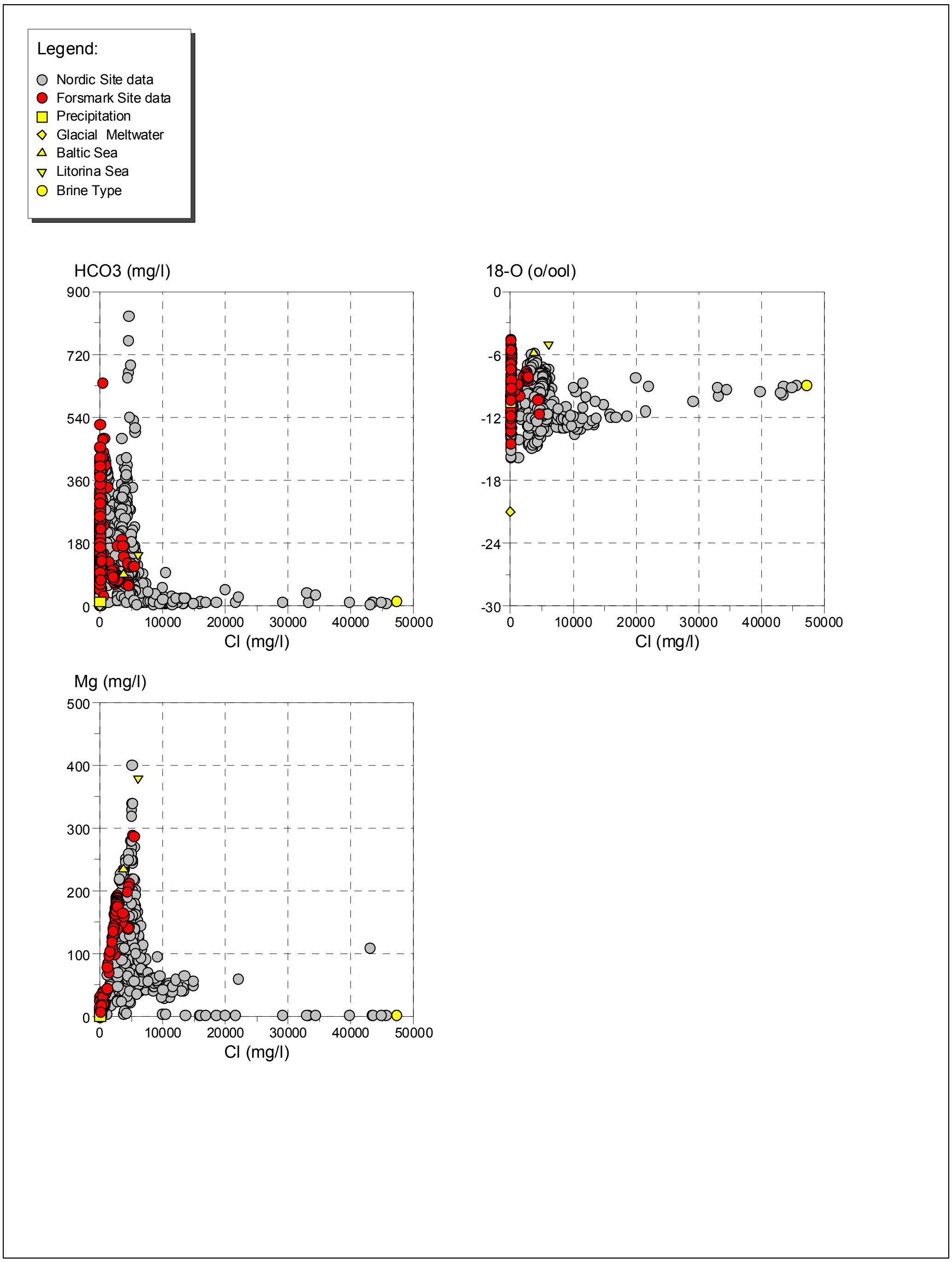


Figure 3*: The HCO_3/Cl, pH/Cl, Oxygen-18/Cl and Mg/Cl are plotted for all Forsmark data using AquaChem.*

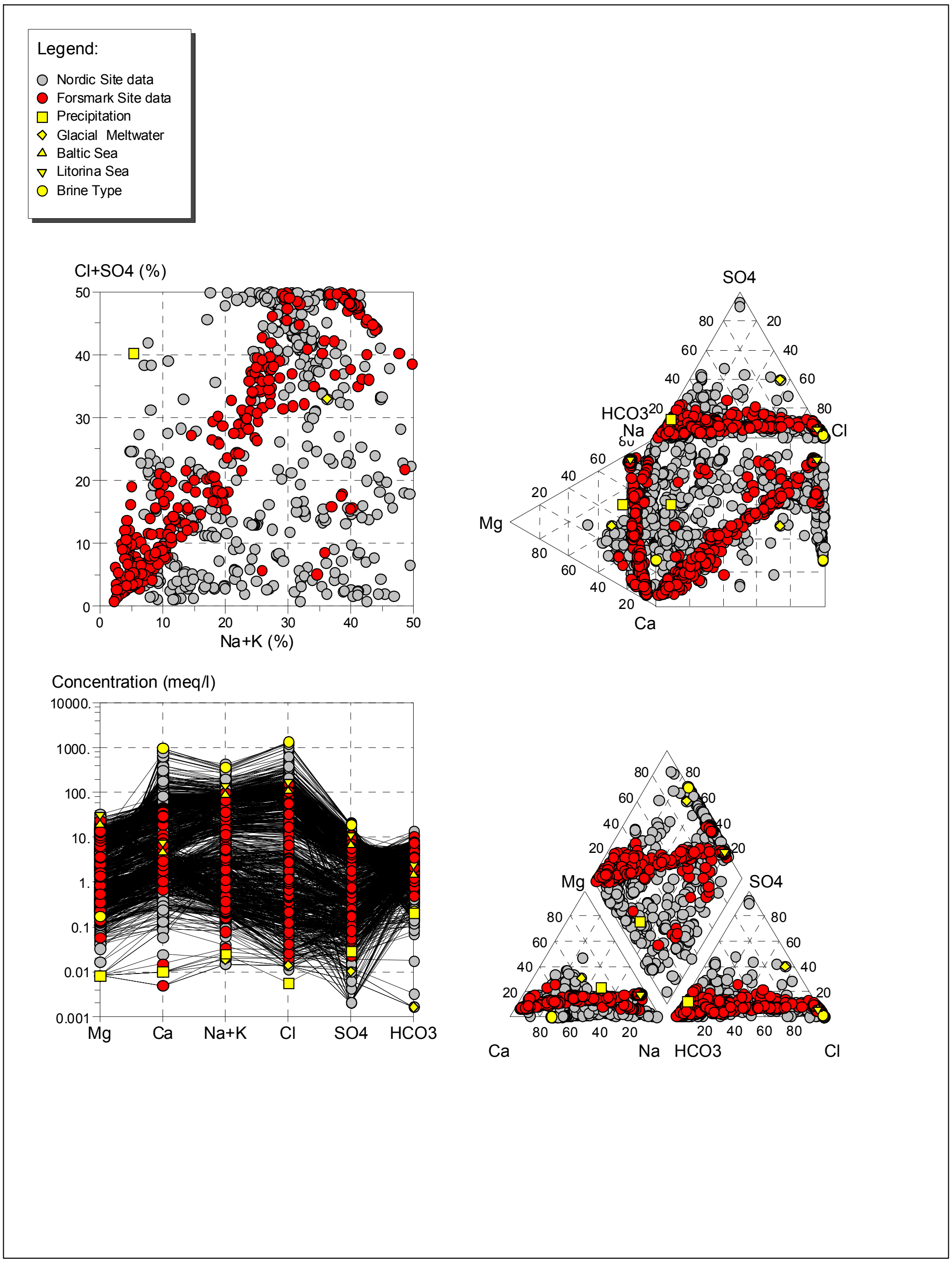


Figure 4: *Multicomponent plots used for classification of the data. From top left to top right to bottom left and bottom right: Ludwig-Langelier plot, Durov plot, Shoeller plot and Piper plot applied on all Forsmark data using AquaChem.*

2. 2 Distribution of the Cl versus depth

The distribution of the Cl versus depth for Forsmark, Finnsjön, SFR, Olkiluoto and all the Nordis sites is presented in Figure 5.

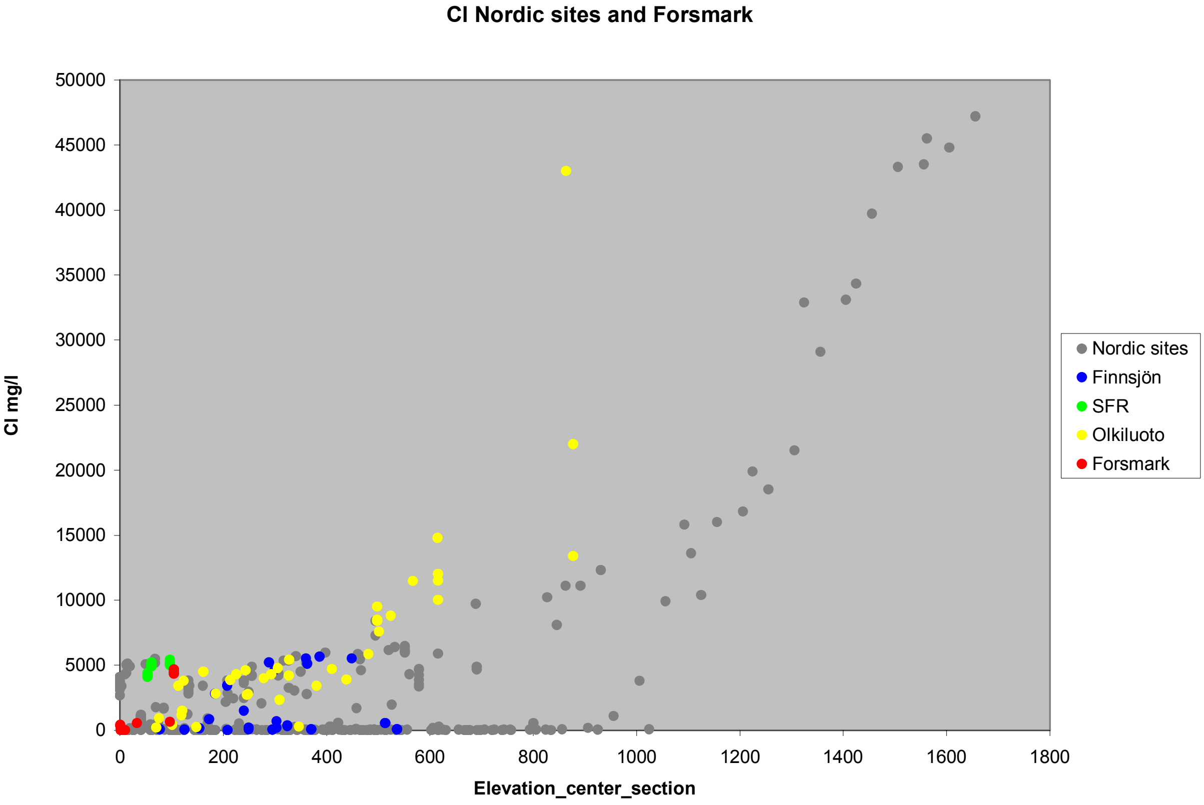


***Figure 5**. The distribution of the Cl (mg/l) with depth in Forsmark, Finnsjön, Olkiluoto, SFR and all the Nordic Sites. The aim was to compare the different sites. This first data set from Forsmark site indicates a shallow groundwater system.*

2.3 Distribution of the Cl at the surface in Forsmark / SURFER visualisation

The computer code SURFER was used for the analyse and visualization of the Cl data distribution at the surface in Forsmark. The result of the SURFER interpolation shows that the Cl distribution of the surface samples (stream samples, soil pipes samples, sea water samples) and the shoreline. The crosses indicate the location of the sampling points.

The interpolation method used was krigging. An interpolation report was produced. The interpolation parameters could thus be checked.
The figure bellow shows the distribution of the Cl (mg/l) at the surface of Forsmark site. In red is indicated schematically the shoreline.

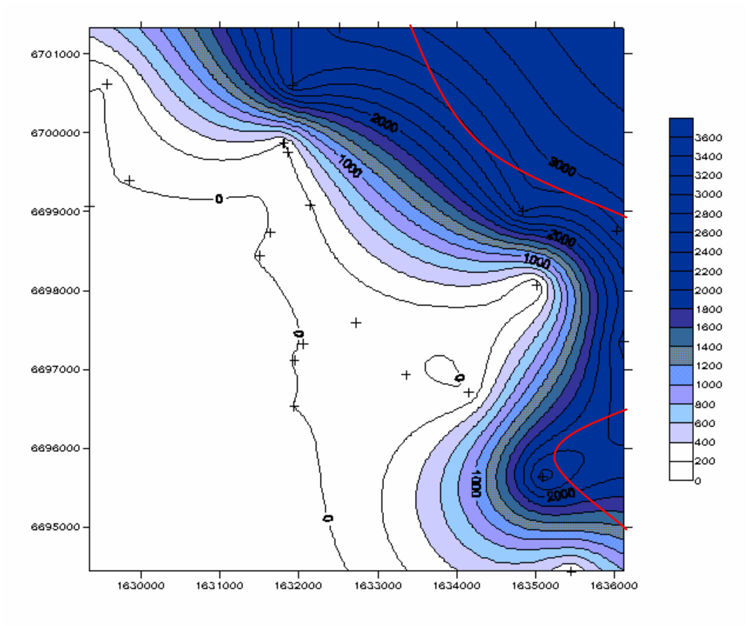


***Figure 6**. The interpolation of the Cl (mg/l) at the surface in Forsmark. The crosses represent the different sampling points. The red line represents schematically the shore line.*

3. Descriptive and quantitative modelling by using M3 code

3.1 M3 modelling

A challenge in groundwater modelling is to reveal the origin, mixing and reactions altering the groundwater samples. The groundwater modelling concept M3 (Multivariate Mixing and Mass-balance calculations) Laaksoharju and Skårman, (1995c); Laaksoharju et al., (1999b,) can be used for making judgment on this.

3.1.1 Introduction and model description

In M3 modelling the assumption is that the groundwater is always a result of mixing and reactions. M3 modelling uses a statistical method to analyse variations in groundwater compositions so that the mixing components, their proportions, and chemical reactions are revealed. The method quantifies the contribution to hydrochemical variations by mixing of groundwater masses in a flow system by comparing groundwater compositions to identified reference waters. Subsequently, contributions to variations in non-conservative solutes from reactions are calculated.

The M3 method has been tested, evaluated, compared with standard methods and modified over several years within domestic and international research programmes supported by the SKB. The main test and application site for the model has been the Äspö HRL (Laaksoharju and Wallin (eds.) 1997; Laaksoharju et al., 1999c). Mixing seems to play an important role at many crystalline and sedimentary rock sites where M3 calculations have been applied such as in different Swedish sites (Laaksoharju et al., 1998), Canada (Smellie and Karlsson, 1996), Oklo in Gabon (Gurban et al., 1998) and Palmottu in Finland (Laaksoharju et al, 1999a).

The features of the M3 method are:

- It is a mathematical tool which can be used to evaluate groundwater field data, to help construct a conceptual model for the site and to support expert judgement for site characterisation.
- It uses the entire hydrochemical data set to construct a model of geochemical evolution, in contrast to a thermodynamic model that simulates reactions or predicts the reaction potential for a single water composition.
- The results of mixing calculations can be integrated with hydrodynamic models, either as a calibration tool or to define boundary conditions.
- Experience has shown that to construct a mixing model based on physical understanding can be complicated especially at site scale. M3 results can provide additional information of the major flow paths, flow directions and residence times of the different groundwater types which can be valuable in transport modelling.
- The numerical results of the modelling can be visualised and presented for non-expert use.

The M3 method consists of 4 steps where the first step is a standard principal component analysis (PCA), selection of reference waters, followed by calculations of mixing proportions, and finally mass balance calculations (for more details see Laaksoharju et al., 1999b; Laaksoharju, 1999d).

For Forsmark, 2 models were built: at regional scale and at local scale. 118 samples from Forsmark met the M3 criteria (data for major elements and isotopes) and were used in the M3 modelling. These samples were from boreholes (core and percussion), soil pipes, lake water and stream water.

3.2 Regional model

The PCA applied to Forsmark data and all Nordic Sites data is illustrated in Fig.7. 118 samples from Forsmark site were used. Numerical values are listed in Appendix 2. Figure 7 shows a surface trend (winter – summer precipitation) and a marine trend showing possible Baltic Sea/ Litorina influences.

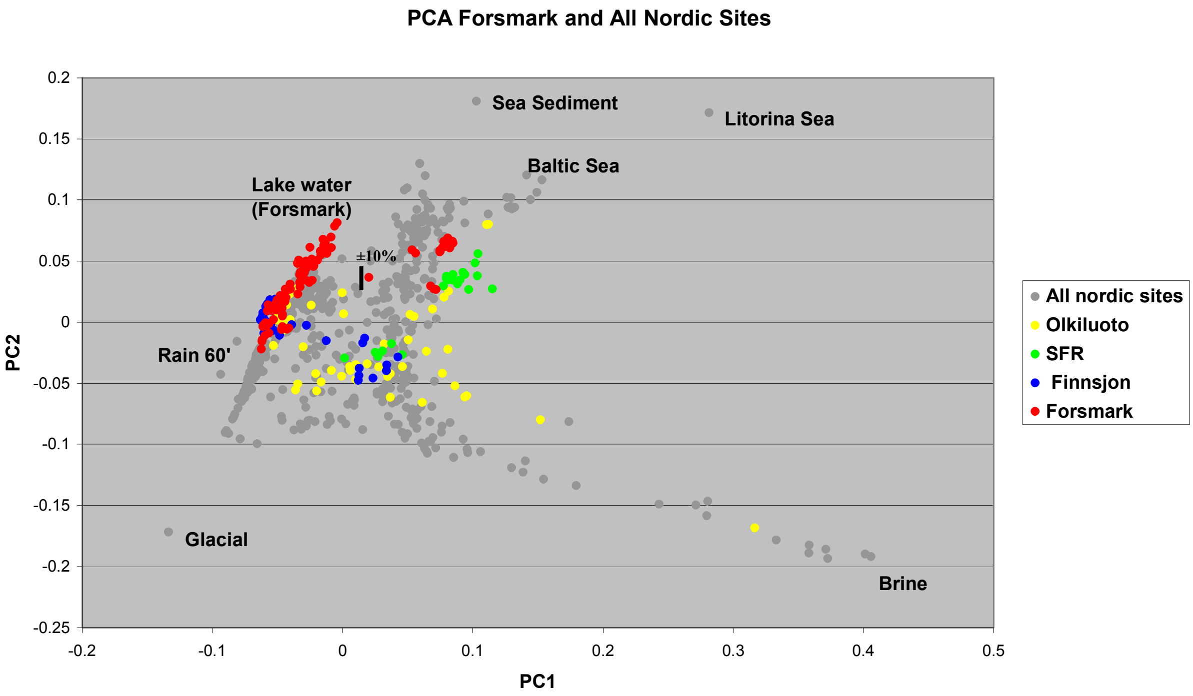


Figure 7. *The picture shows the principal components analysis and the identification of the reference waters. (Variance: First principal component: 0.42236, First and second principal components: 0.6764, First, second and third principal components: 0.78329). The figure shows the Nordic samples, the Forsmark data (in red), Finnsjon (in blue), SFR in green and Olkiluoto data (in yellow). The Lake water (Forsmark), Sea sediment, Marine (Litorina), Brine, Glacial and Rain60' reference waters are used as end members for the modeling. The model uncertainty of ±10% is shown as an error bar (in black); the analytical uncertainty is ±5% and represents therefore half of the error bar.*

The reference waters used are:

- **Brine type of reference water:** Represents the sampled deep brine type (Cl = 47000 mg/L) of water found in KLX02: 1631-1681m (Laaksoharju et al., 1995a). An old age for the Brine is suggested by the measured ^{36}Cl values indicating a minimum residence time of 1.5Ma for the Cl component (Laaksoharju and Wallin (eds.), 1997).

- **Glacial reference water:** Represents a possible melt-water composition from the last glaciation >13000BP. Modern sampled glacial melt water from Norway was used for the major elements and the δ^{18}O isotope value (–21 ‰ SMOW) was based on measured values of δ^{18}O in calcite surface deposits (Tullborg, 1984). The δ^{2}H value (–158 ‰ SMOW) is a modelled value based on the equation ($\delta H = 8 \times \delta^{18}O + 10$) for the meteoric water line.

- **Litorina Water:** Represents modelled Litorina water (see table 3-1).

- **Modified Sea water (Sea sediment):** Represents Baltic Sea affected by microbial sulphate reduction.

- **Precipitation water:** Corresponds to infiltration of meteoric water (the origin can be rain or snow) from 1960. Sampled modern meteoric water with a modelled high tritium (100 TU) content was used to represent precipitation from that period.

- **Local Forsmark lake water:** Corresponds to summer precipitation, with a high content of O^{18}. The water may have undergone evaporation.

For groundwater analytical data see Table 3-1.

Table 3-1: Groundwater analytical or modelled data* used as reference waters in the M3 regional modelling for Forsmark.

	Cl (mg/L)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	^3H (TU)	δ^2H ‰	$\delta^{18}O$ ‰
Brine	47200	8500	45.5	19300	2.12	14.1	906	4.2	-44.9	-8.9
Glacial	0.5	0.17	0.4	0.18	0.1	0.12	0.5	0	-158*	-21*
Litorina sea*	6500	3674	134	151	448	93	890	0	-38	-4.7
Modified Sea	4920	2300	29	730	233	1200	36	14	-50.4	-7.3
Precipitation	0.23	0.4	0.29	0.24	0.1	12.2	1.4	2000	-80	-10.5
Forsmark Lake water	45.8	21	3.21	30.3	5.9	110	16.18	7.6	-44.3	-4.5

The reference waters chosen are identification rows in Appendix 2:

- Brine (identification row 119)
- Marine (identification row 126)
- Sea sediment (identification row 128)
- Rain'60 (identification row 127)
- Glacial (row 125)
- Forsmark lake water (row 55)

The following six reactions have been considered, with comments on the qualitative outcomes of mixing and mass balance modeling with M3:

1. *Organic decomposition:* This reaction is detected in the unsaturated zone associated with Meteoric water. This process consumes oxygen and adds reducing capacity to the groundwater according to the reaction: $O_2 + CH_2O \rightarrow CO_2 + H_2O$. M3 reports a gain of HCO_3 as a result of this reaction.
2. *Organic redox reactions:* An important redox reaction is reduction of iron III minerals through oxidation of organic matter: $4Fe(III) + CH_2O + H_2O \rightarrow 4Fe^{2+} + 4H^+ + CO_2$. M3 reports a gain of Fe and HCO_3 as a result of this reaction. This reaction takes place in the shallow part of the bedrock associated with influx of Meteoric water.
3. *Inorganic redox reaction:* An example of an important inorganic redox reaction is sulphide oxidation in the soil and the fracture minerals containing pyrite according to the reaction: $HS^- + 2O_2 \rightarrow SO_4^{2-} + H^+$. M3 reports a gain of SO_4 as a result of this reaction. This reaction takes place in the shallow part of the bedrock associated with influx of Meteoric water.
4. *Dissolution and precipitation of calcite:* There is generally a dissolution of calcite in the upper part and precipitation in the lower part of the bedrock according to the reaction:

$CO_2 + CaCO_3 \rightarrow Ca^{2+} + 2HCO_3^-$. M3 reports a gain or a loss of Ca and HCO_3 as a result of this reaction. This reaction can take place in any groundwater type.

5. *Ion exchange:* Cation exchange with Na/Ca is a common reaction in groundwater according to the reaction: $Na_2X_{(s)} + Ca^{2+} \rightarrow CaX_{(s)} + 2Na^+$, where X is a solid substrate such as a clay mineral. M3 reports a change in the Na/Ca ratios as a result of this reaction. This reaction can take place in any groundwater type.
6. *Sulphate reduction:* Microbes can reduce sulphate to sulphide using organic substances in natural groundwater as reducing agents according to the reaction: $SO_4^{2-} + 2(CH_2O) + OH^- \rightarrow HS^- + 2HCO_3^- + H_2O$. This reaction is of importance since it may cause corrosion of the copper capsules. Vigorous sulphate reduction is generally detected in association with marine sediments that provide the organic material and the favorable salinity interval for the microbes. M3 reports a loss of SO_4 and a gain of HCO_3 as a result of this reaction. This reaction modifies the seawater composition by increasing the HCO_3 content and decreasing the SO_4 content.

3.3 Local model

The local model was built with only data from the Forsmark site. The PCA applied on Forsmark data is illustrated in Fig.8. Figure 8 shows a similar trend as Figure 7 but with a higher resolution.

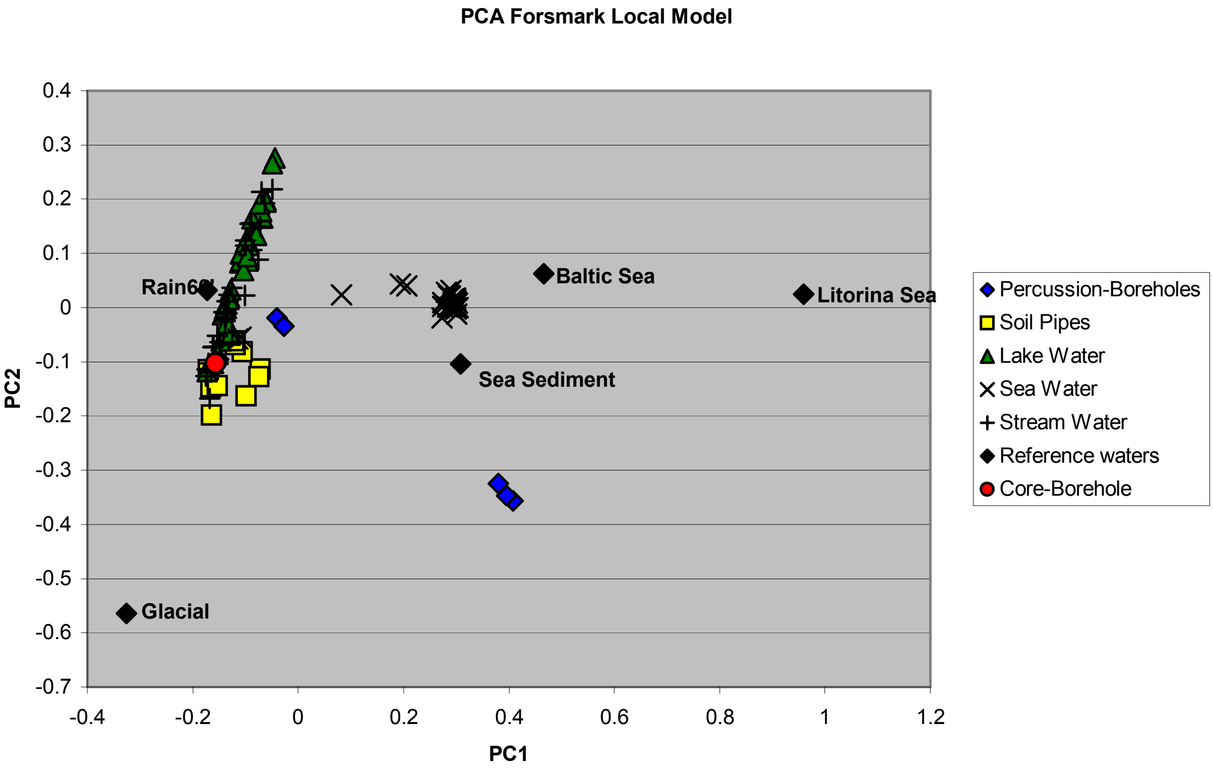


Figure 8. *The picture shows the PCA for the local model for Forsmark. The picture shows the principal components analysis and the identification of the reference waters. (Variance: First principal component: 0.53674, First and second principal components: 0.72016, First, second and third principal components: 0.83182). The Lake water, Litorina, local Groundwater, Glacial and Rain60' are used as reference waters for the modelling.*

The reference waters chosen are identification rows used in Appendix 3:

- Local Groundwater (identification row 6)
- Litorina (identification row 121)
- Rain'60 (identification row 122)
- Glacial (row 120)
- Forsmark lake water (row 55)

For groundwater analytical data see Table 3-2.

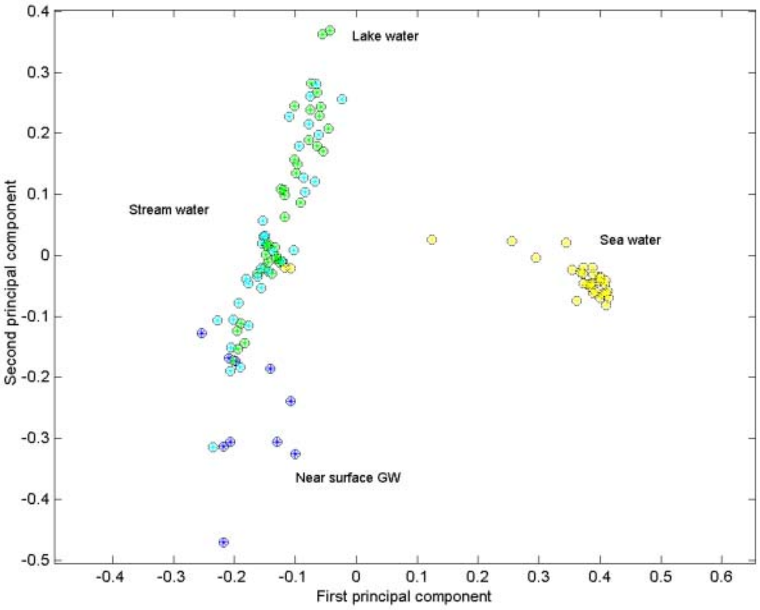
Table 3-2: Groundwater analytical or modelled data* used as reference waters in the M3 local modelling for Forsmark.

	Cl (mg/L)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	^3H (TU)	δ^2H ‰	$\delta^{18}O$ ‰
Local Groundwater	4652.5	1830	42.4	805	212	110	308.66	0.8	-78.2	-10.2
Glacial	0.5	0.17	0.4	0.18	0.1	0.12	0.5	0	-158*	-21*
Litorina sea*	6500	3674	134	151	448	93	890	0	-38	-4.7
Precipitation	0.23	0.4	0.29	0.24	0.1	12.2	1.4	2000	-80	-10.5
Forsmark Lake water	45.8	21	3.21	30.3	5.9	110	16.18	7.6	-44.3	-4.5

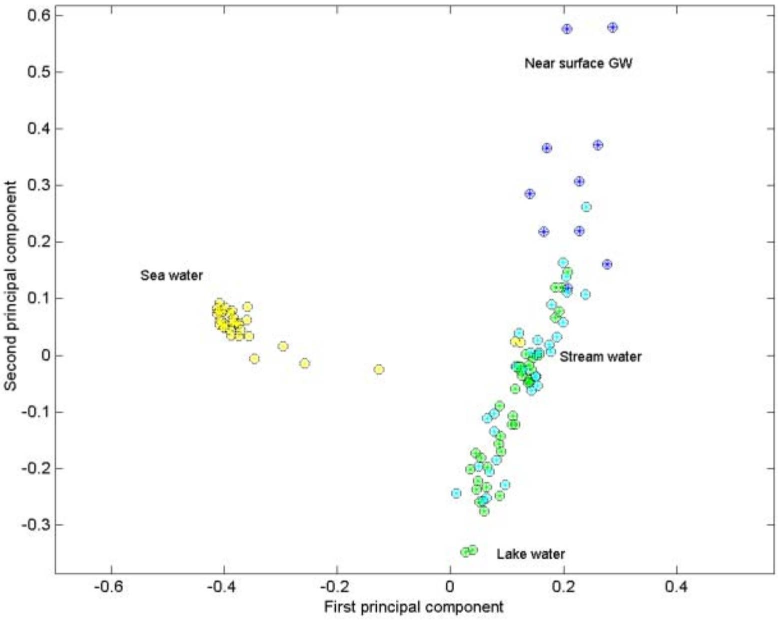
3.4 Alternative models

In order to try to achieve a better resolution, 3 other chemical elements were used together with the major elements and the isotopes. These elements are: Fe, Si and TOC. The three PCA applied on Forsmark data and each of these elements are illustrated in Figures 9-11.

In the Figures 9-11, the top pictures show the M3 calculations based only on major elements and isotopes and the pictures bellow show the major elements, isotopes and Fe, Si or TOC respectively. The Fe, Si and TOC seem to be correlated to one or several major elements and/or isotopes and do not give any new information. In M3 calculations only independent elements could bring new information. The PCA reverses in orientation when using Fe, Si or TOC because M3 code calculates 11 elements instead of 10. The PCA is orientated in a order to achieve highest possible resolution. The following samples were identified: groundwater, near surface groundwater, stream water, lake water and sea water.



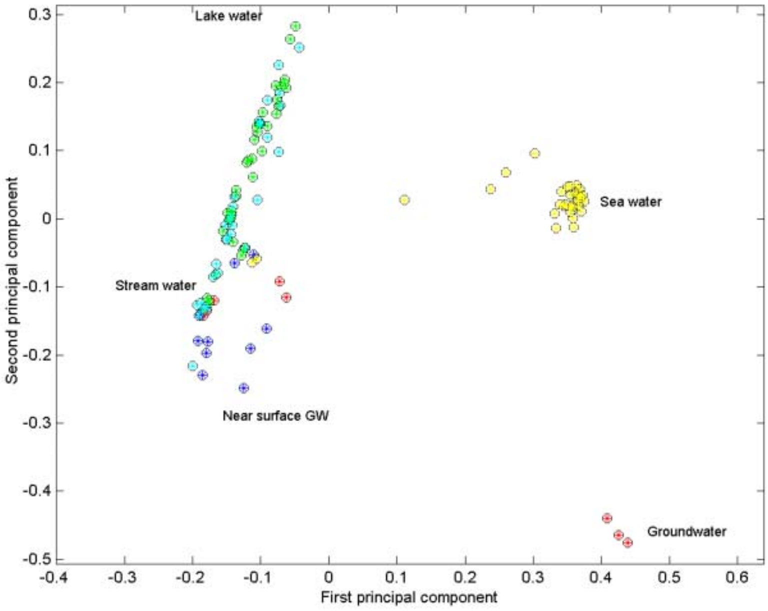
Major elements and isotopes, variance: 0.57607, 0.82817, 0.91367



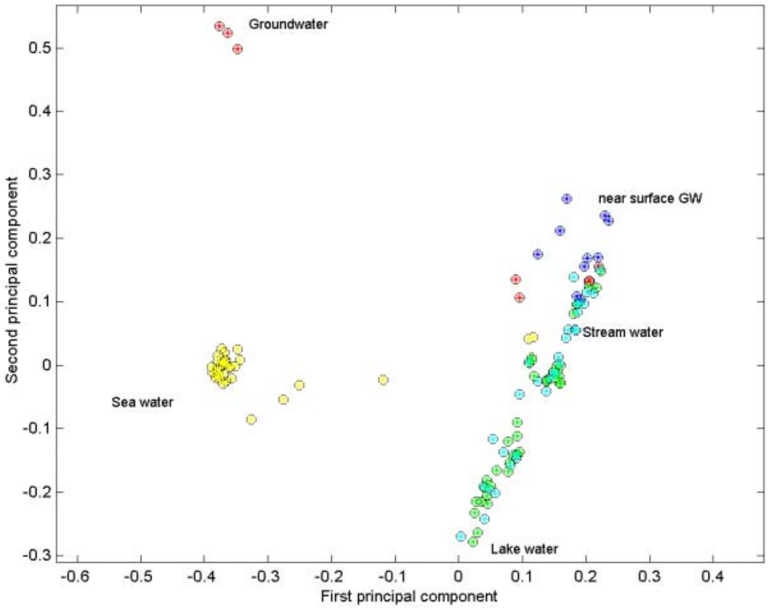
Major elements, isotopes and Fe, variance: 0.53141, 0.79215, 0.8816
Legend: red- groundwater, blue- near surface groundwater, cyan- stream water, yellow- seawater, green- lake water.

Number of samples used in this modeling: 110.

Figure 9: *Local Forsmark PCA, calculated with the major elements, isotopes and Fe.*



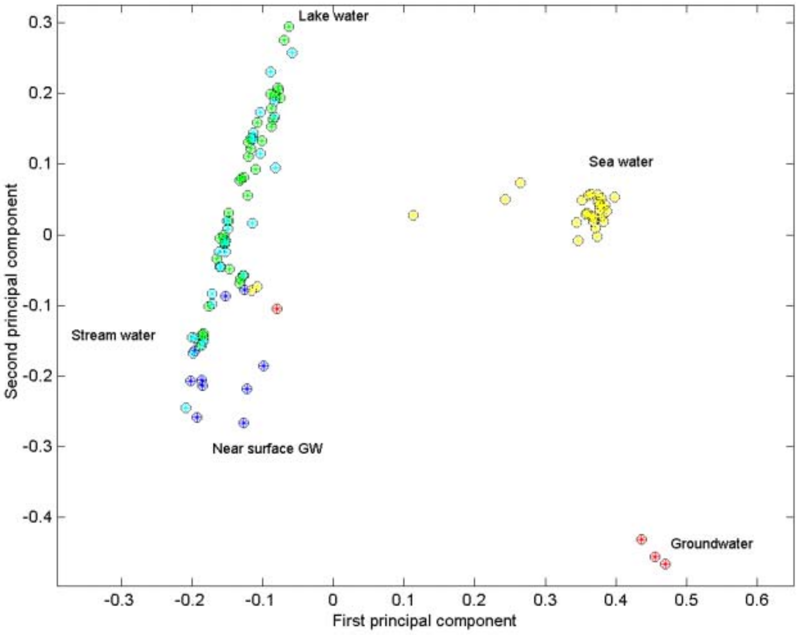
Major elements and isotopes, variance: 0.55165, 0.79947, 0.89681



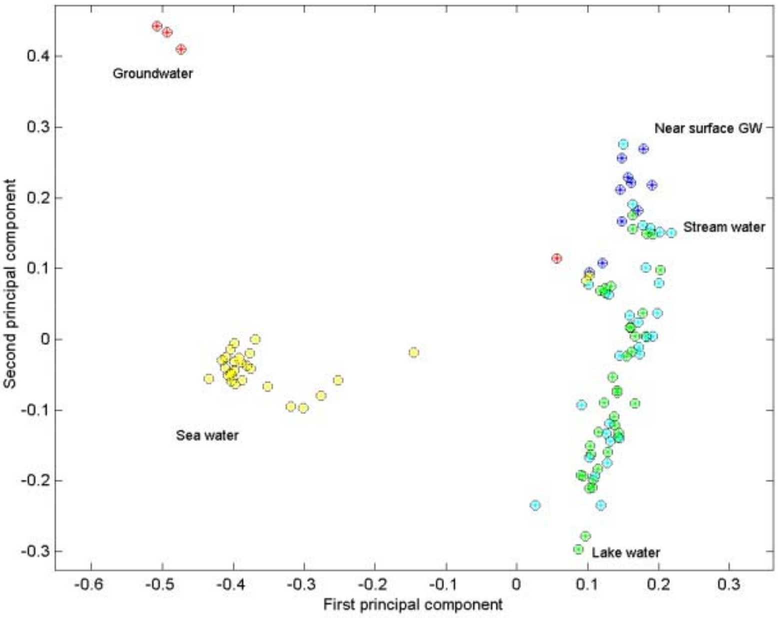
Major elements, isotopes and Si, variance: 0.53325, 0.75805, 0.87393
Legend: red- groundwater, blue- near surface groundwater, cyan- stream water, yellow- seawater, green- lake water.

Number of samples used in this modeling: 118.

Figure 10: *Local Forsmark PCA, calculated with the major elements, isotopes and Si.*



Major elements and isotopes, variance: 0.54612, 0.77219, 0.90145



Major elements, isotopes and TOC, variance: 0.55, 0.75952, 0.8778

Legend: red- groundwater, blue- near surface groundwater, cyan- stream water, yellow- seawater, green- lake water.

Number of samples used in this modeling: 107.

Figure 11: *Local Forsmark PCA, calculated with the major elements, isotopes and TOC.*

4. DIS (Drilling Impact Study) calculations for Forsmark

The Drilling Impact Study (DIS, Gurban I and Laaksoharju M, 2002) was used for evaluation of the borehole data for Forsmark. The DIS evaluates the impact of the drilling on the hydrochemistry. We intended to apply DIS on KFM01 and KFM02 the new-drilled boreholes in Forsmark. The main aim was to evaluate the contamination of the fracture zones, due to drilling activities. The results of the modelling are compared with the hydrochemical data sampled.

The successful implementation of DIS evaluation required the availability of drilling data stored in SICADA and the results from DIFF (Differential Flow measurements). The DIS evaluation involved the compilation, calculation and interpretation of drilling data and DIFF measurements. The following data were analysed:

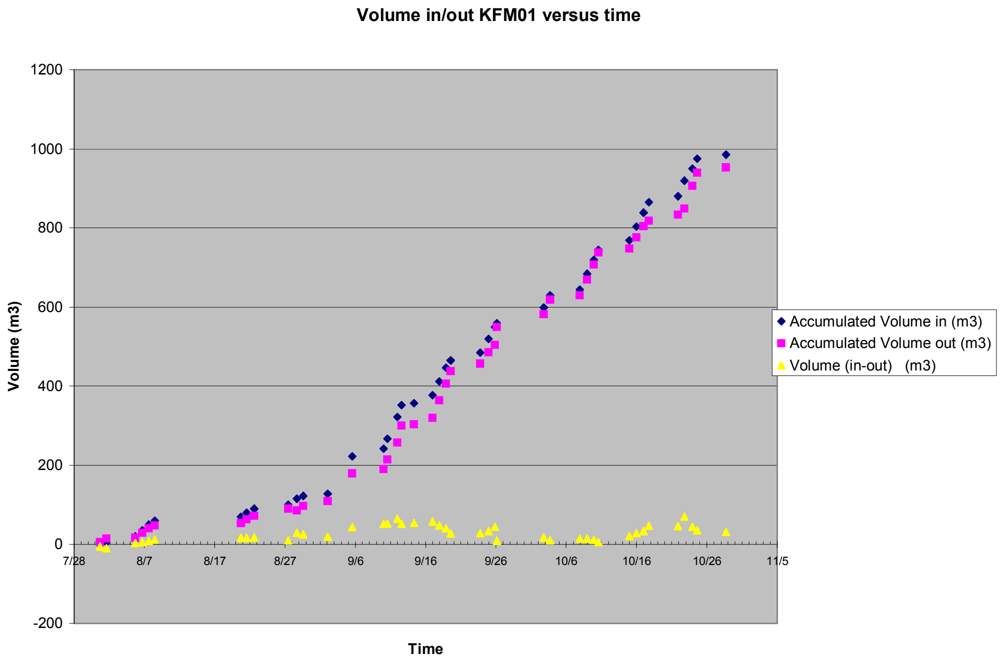
- Drilling water pumped in and out from the borehole during drilling operation;
- The drilled length versus time;
- Water pressure along the borehole during drilling;
- Uranine concentration in the drilling water pumped in and out from the borehole during drilling;
- The DIFF measurements performed in the borehole which measured the hydraulic conductivity along the borehole.

The evaluation work started by collecting data from the drilling and drilling related activities. The representativity of the drilling data and drilling related activities were judged and the data used for the DIS calculations were selected. The DIFF measurements gave the hydraulic conductivity of the fractures zones to be modeled.

At this stage of the site investigation only data for 2 sections in KFM01 were appropriate for the modelling. The data for KFM02 was not complete at this stage, it was possible to investigate only the drilling water volume in and out from the borehole and the uranine content. The water pressure along the borehole and the K values were not available. Therefore the calculations could not be completed.

The data freeze of Forsmark site investigation provided drilling data and groundwater data for the borehole KFM01. The two sections investigated were: 110.1-120.67 and 176.8-183.9. The aim of the DIS calculations was to estimate the amount of the contamination for each fracture zone.

The Figures 12-13 show for exemplification the results of the calculation steps of the methodology applied. The Figures 12-13 show the cumulated drilling water volume in and out from the borehole and the difference between the drilling water volume in and out with time and borehole depth.



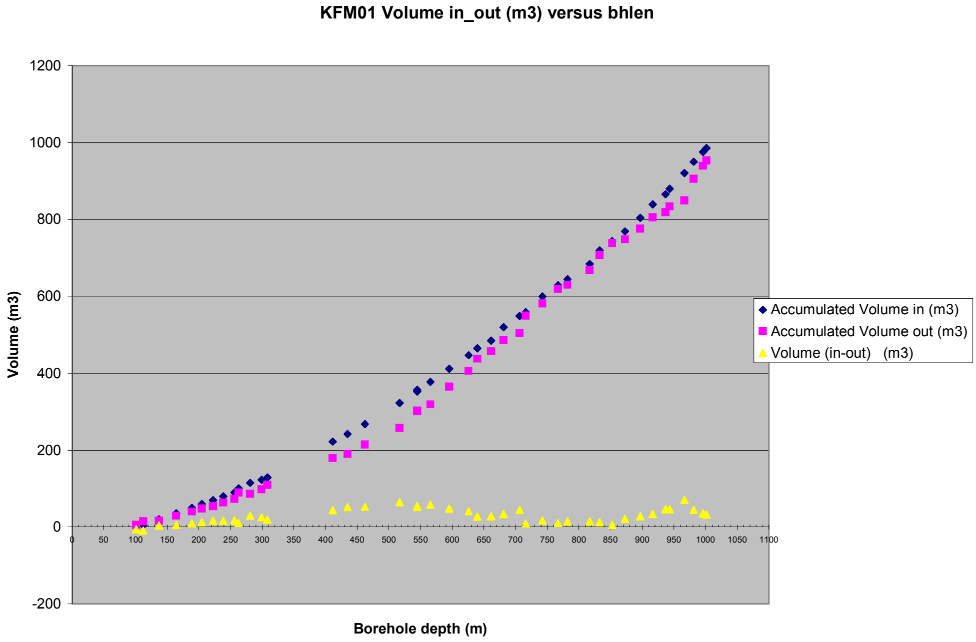
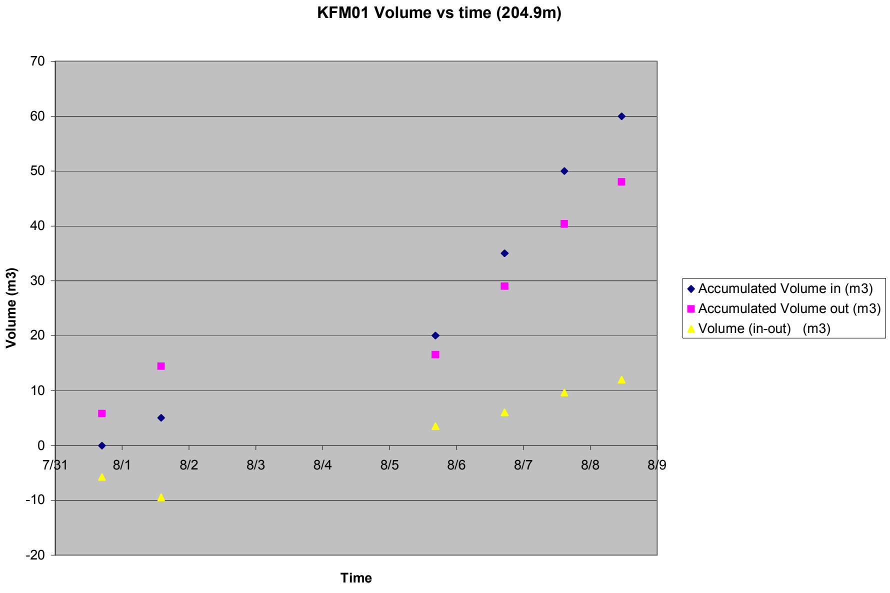


Figure 12: *Drilling water volume pumped in and out in KFM01 during drilling with time and borehole length.*



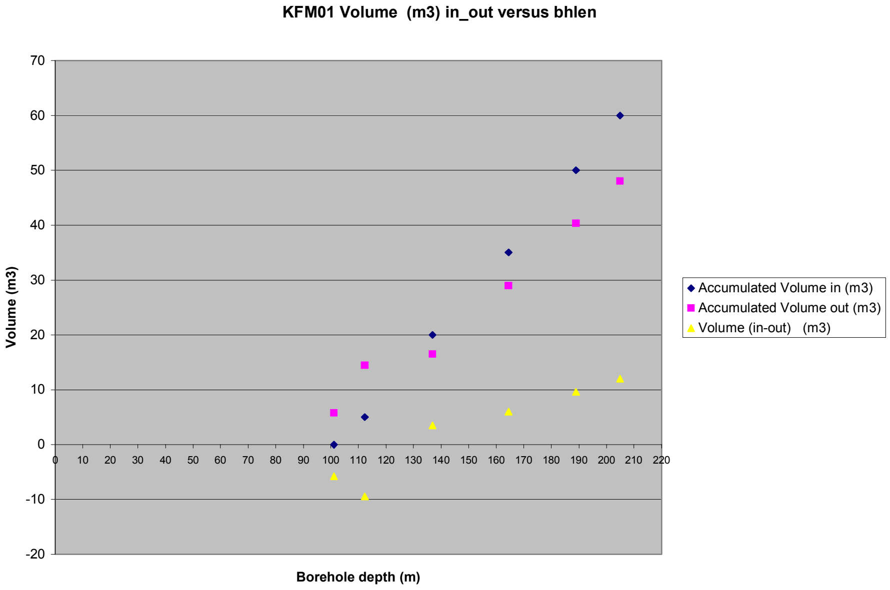


Figure 13: *Detail of the figure 12, showing the accumulated drilling water volume in and out from the borehole, corresponding to the part of the borehole where the two fracture zones analysed are located: 110.1-120.67m and 176.8-183.9 m.*

In a smaller scale, the pictures above (Figure 13) show the drilling water volume in and out from the borehole recorded with time and along the borehole depth. Unfortunately, for the first section the hydrochemical groundwater sampling (110.1-120.67), the drilling data and records are incomplete and biased. The labeled water volume out is higher than the drilling volume water in and the calculations could not be done. This may be an effect of the casing activities down to 100m in the borehole, the borehole being very tight and therefore supposed not to produce water. Therefore, the DIS calculations can be done only for the second section in KFM01 (176.8-183.9).

The uranine concentration in the drilling water was analyzed (Figures 14 and 15). The readings for the drilling water pumped in and out from the borehole are unfortunately not recorded simultaneously. This makes the interpretation more difficult. Therefore an average value of the uranine concentration in the drilling water in and out from the borehole was calculated for each day. These values are then compared and the concentration of the uranine in the drilling water remained in the borehole is calculated.

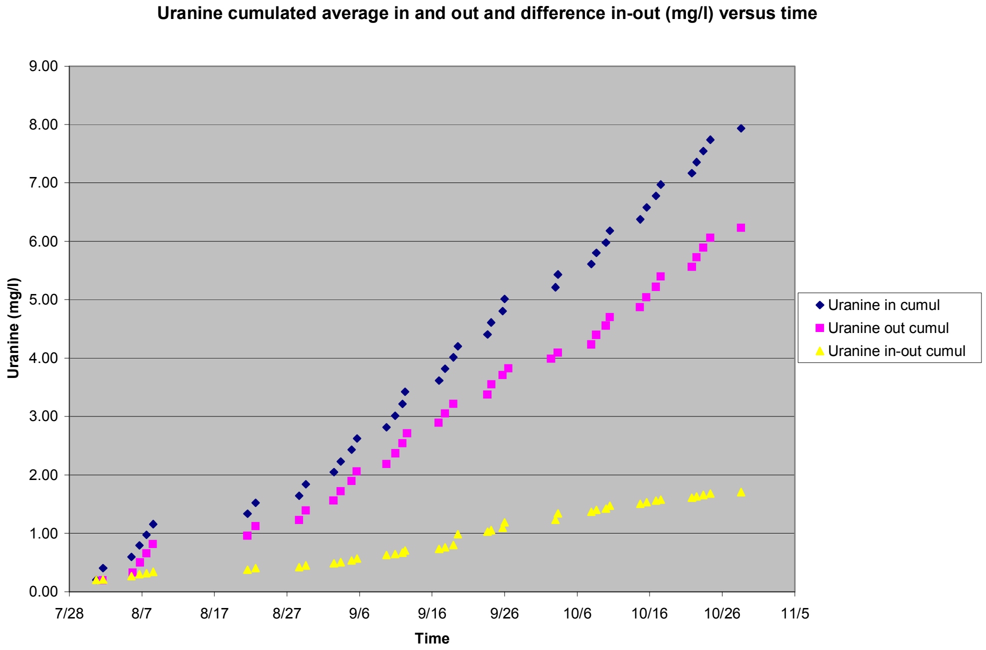


Figure 14: *Average uranine concentration in the drilling water volume pumped in and out from KFM01 during drilling with time.*

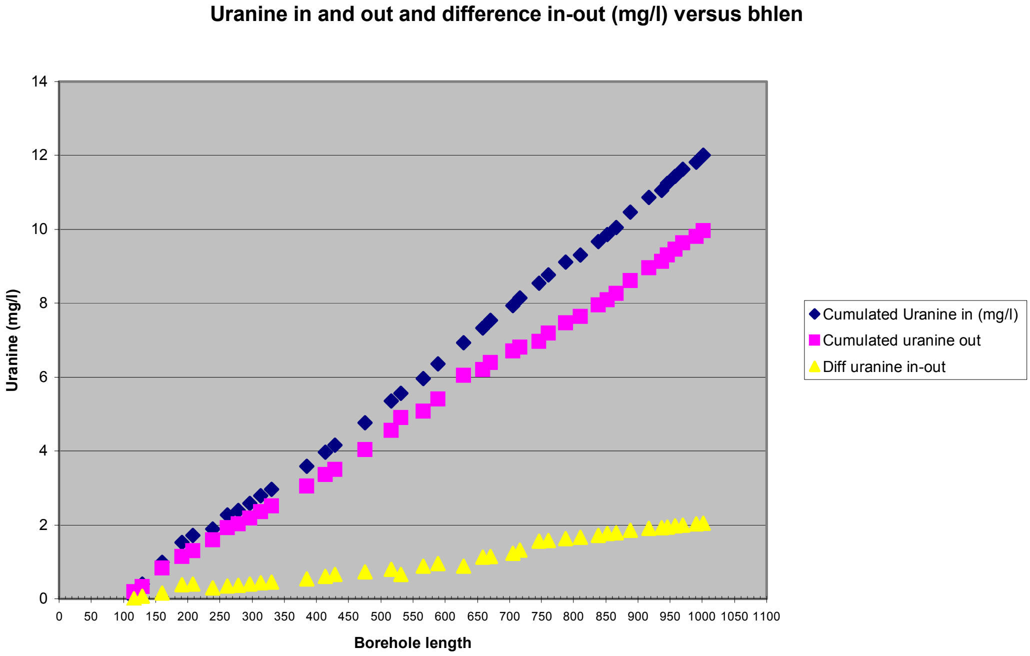


Figure 15: *Average uranine concentration in the drilling water volume pumped in and out from KFM01 during drilling with borehole length.*

The Figures 14-15 show the average uranine concentration in the drilling water volume in and out from the borehole and the difference between the uranine concentration in the volume in and out with time and versus borehole depth.

To a smaller scale, the Figure 16 shows the uranine concentration of the drilling water volume in and out from the borehole recorded versus time and along the borehole depth. The concentration of uranine in the flushing water used for the calculation was 0.20 mg/L.

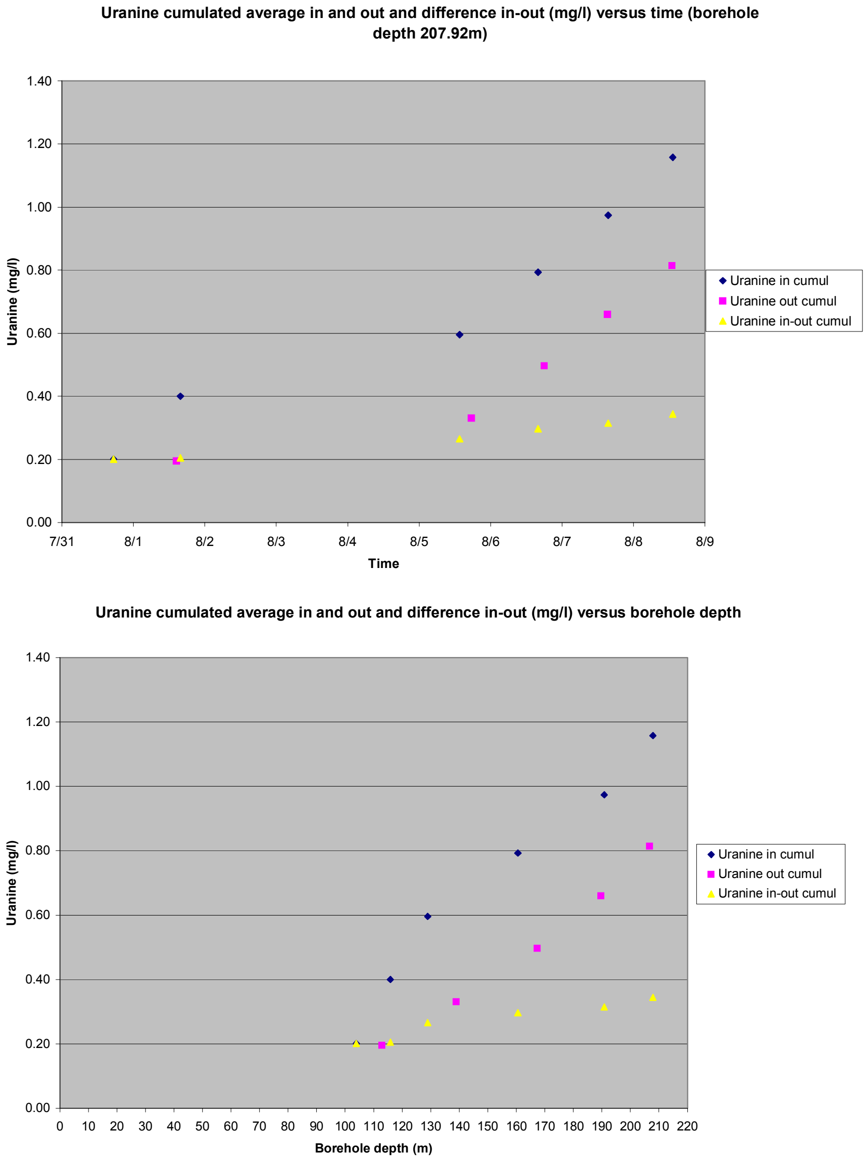


Figure 16: *Detail of the figures 14 and 15, showing the uranine content in the drilling water pumped in and out from the borehole, corresponding to the part of the borehole where the two fracture zones analysed are located: 110.1-120.67 and 176.8-183.9, with time and borehole depth.*

The DIS calculations are made according to the methodology proposed by Gurban and Laaksoharju (2002), as following:

4.1 Calculations of hydraulic permeability for individual fracture zone

This section explains how the hydraulic permeability for individual fracture zones can be calculated.

Calculations of hydraulic permeability for individual fracture zones by using data from KFM01 and comparison with the DIFF measurements:

- Calculation of the pressure:
    1. from the drill rig data: Δp maximum and Δp average
    2. by composing all the different pressures: h-drawdown+friction losses
- Calculation of the thickness of the section (Δe)
- Calculation of the effective drilling time
- Calculation of the flow in the fracture zone (considered the maximum flow which could penetrate the section)

$$Q = \Delta h \times K \times e$$

- Calculation of the drilling water volume lost in the fracture from the on-line measurements

$$V\ lost = Vol\ in - Vol\ out$$

- Calculation of amount of drilling water remained in the fracture
- Calculation of the hydraulic permeability in the fracture Δ e:
    1. $K = \Delta V / \Delta t / (\Delta h * e)$
    2. Comparison of $K_{calculated}$ with K_{DIFF}

By analysing the records from drilling, drilling related activities and DIFF measurements (see figure 13) and by using the above methodology, the following results were obtained in the section 176.8-183.9 m in KFM01:

Δpressure max = 36 bar
Δpressure average= 27.63bar

Note: the drawdown could not be obtained from SICADA; the friction losses along the borehole are very small (around 1 bar per 100m).

The drilling water volume maximum lost in the fracture is Vmax= 2.89m^3.
The time when the fracture was penetrated by the drilling was Δt= 75 minutes.
The uranine lost in the fracture is Δuranine= 0.0182mg/l
The thickness of the section is Δe= 7.1m.

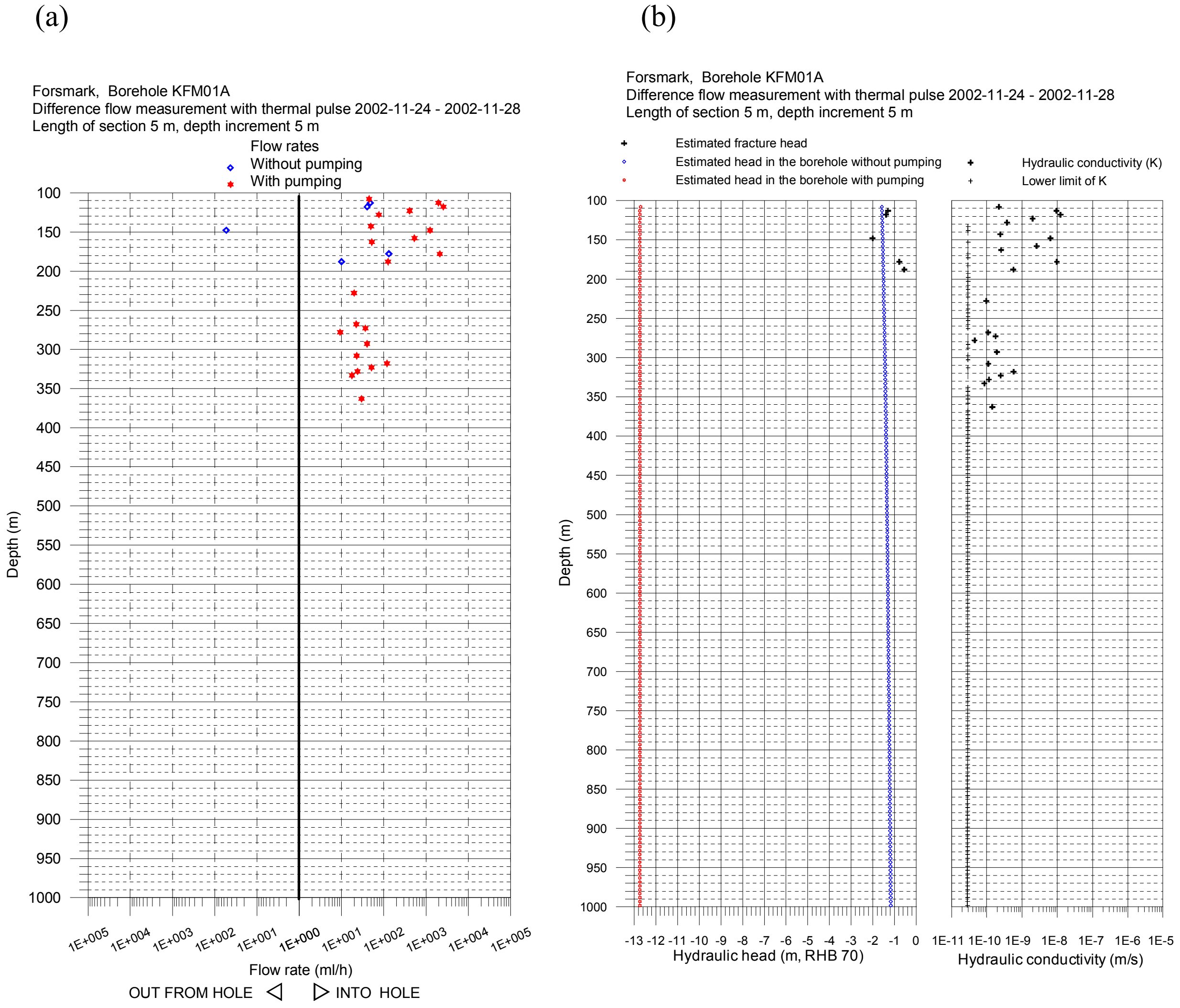


***Figure 17.** Downhole measurements along borehole KFM01A (105 to 1000 m) of: a) groundwater flow rate (mL/h) into and out of the borehole, and b) hydraulic head and conductivity.*

The above DIFF measurements indicate that the hydraulic conductivity of the section 176.8-183.9 m is $K_{DIFF}= 10^{-8}$m/s, see Figure 17.

By using the calculation scheme shown above, the DIS calculations show that the section was contaminated with maximum 2.89m^3 water of which maximum 19.4% consisted of drilling water. The results from the sampling show 17.84% drilling water in the first sample, in the beginning of the pumping. The duration of the pumping was from 26.02.2003 to 1.04.2003, with a flow rate varying from 30 to 63 ml/min.

From the sampling reports (Ann-Chatrin Nilsson, personal communication), the average pumping time was 720 hours with an average flow of 45.95 ml/min. The removed volume was calculated, to be 1.985 m^3. This was compared with the maximum volume of water that contaminated the fracture 2.89 m^3. The average amount of drilling water remaining is 0.9 m^3. The sampling show an amount of 4.8% drilling water, sampled after 720 hours of pumping.

The DIS calculations show that the pumping should have continued in order to remove 0.9 m^3 more.

The DIS calculations can be done during drilling or afterwards. The calculations made during drilling can help to identify the sections for sampling. We recommend to do these calculations during the drilling. The calculations made after drilling can help to determine the amount of contamination and therefore guide the sampling concerning the volume that should be pumped before sampling. We recommend making DIS calculations during drilling and during sampling.

5. Site specific hydrogeochemical uncertainties

At every phase of the hydrogeochemical investigation programme – drilling, sampling, analysis, evaluation, modelling – uncertainties are introduced which have to be accounted for, addressed fully and clearly documented to provide confidence in the end result, whether it will be the site descriptive model or repository safety analysis and design (Smellie et al, 2002). Handling the uncertainties involved in constructing a site descriptive model has been documented in detail by Andersson et al. (2001). The uncertainties can be conceptual uncertainties, data uncertainty, spatial variability of data, chosen scale, degree of confidence in the selected model, and error, precision, accuracy and bias in the predictions. Some of the identified uncertainties recognized during the Forsmark modelling exercise and during the DIS exercise are discussed below.

The following data uncertainties have been estimated, calculated or modelled:

- Drilling; may be ± 10-70%
- Effects from drilling during sampling; is <5%
- Sampling; may be ± 10%
- Influence associated with the uplifting of water; may be ± 10%
- Sample handling and preparation; may be ± 5%
- Analytical error associated with laboratory measurements; is ± 5%
- Mean groundwater variability at Forsmark during groundwater sampling (first/last sample); is about 25%.
- The M3 model uncertainty; is ±0.1units within 90% confidence interval

Conceptual errors can occur from e.g. the paleohydrogeological conceptual model. The influences and occurrences of old water end-members in the bedrock can only be indicated by using certain element or isotopic signatures. The uncertainty is therefore generally increasing with the age of the end-member. The relevance of an end-member participating in the groundwater formation can be tested by introducing alternative end-member compositions or by using hydrodynamic modeling to test if old water types can resign in the bedrock during prevailing hydrogeological conditions.

5.1 Model uncertainties

The following factors can cause uncertainties in M3 calculations:

- Input hydrochemical data errors originating from sampling errors caused by the effects from drilling, borehole activities, extensive pumping, hydraulic short-circuiting of the borehole and uplifting of water which changes the in-situ pH and Eh conditions of the sample, or as analytical errors.

- Conceptual errors such as wrong general assumptions, selecting wrong type/number of end-members and mixing samples that are not mixed.
- Methodological errors such as oversimplification, bias or non-linearity in the model, and the systematic uncertainty, which is attributable to use of the centre point to create a solution for the mixing model.

An example of a conceptual error is assuming that the groundwater composition is a good tracer for the flow system. The water composition is not necessarily a tracer of mixing directly related to flow since there is not a point source as there is when labelled water is used in a tracer test.

Another source of uncertainty in the mixing model is the loss of information in using only the first two principal components. The third principal component gathers generally around 10% of the groundwater information compared with the first and second principal components, which contain around 70% of the information. A sample could appear to be closer to a reference water in the 2D surface than in a 3D volume involving the third principal component. In the latest version of M3 the calculations can also be performed in 3D.

Uncertainty in mixing calculations is smaller near the boundary of the PCA polygon and larger near the center. The uncertainties have been handled in M3 by calculating an uncertainty of 0.1 mixing units (with a confidence interval of 90%) and stating that a mixing portion <10% is under the detection limit of the method.

6. 3D Visualisation of the samples location and Cl distribution with Tecplot

The 3D/2D visualization of the Cl distribution in Forsmark was performed with Tecplot. The x, y, z coordinates represent the Easting, Northing and elevation of the midpoint of the sampling section in meters.

The figure 18 shows the 3D (Figure 18.a) and the 2D (Figure 18.b) visualisation of the 118 Cl values in Forsmark. Figure 18.b shows the locations of the sampling points used for M3 modelling. The z coordinate was not available for the surface samples (sea, lake, streams, soil tubes). Therefore, the z coordinate was assumed to be 0. At the scale of the model, this represents an error smaller than 5%.

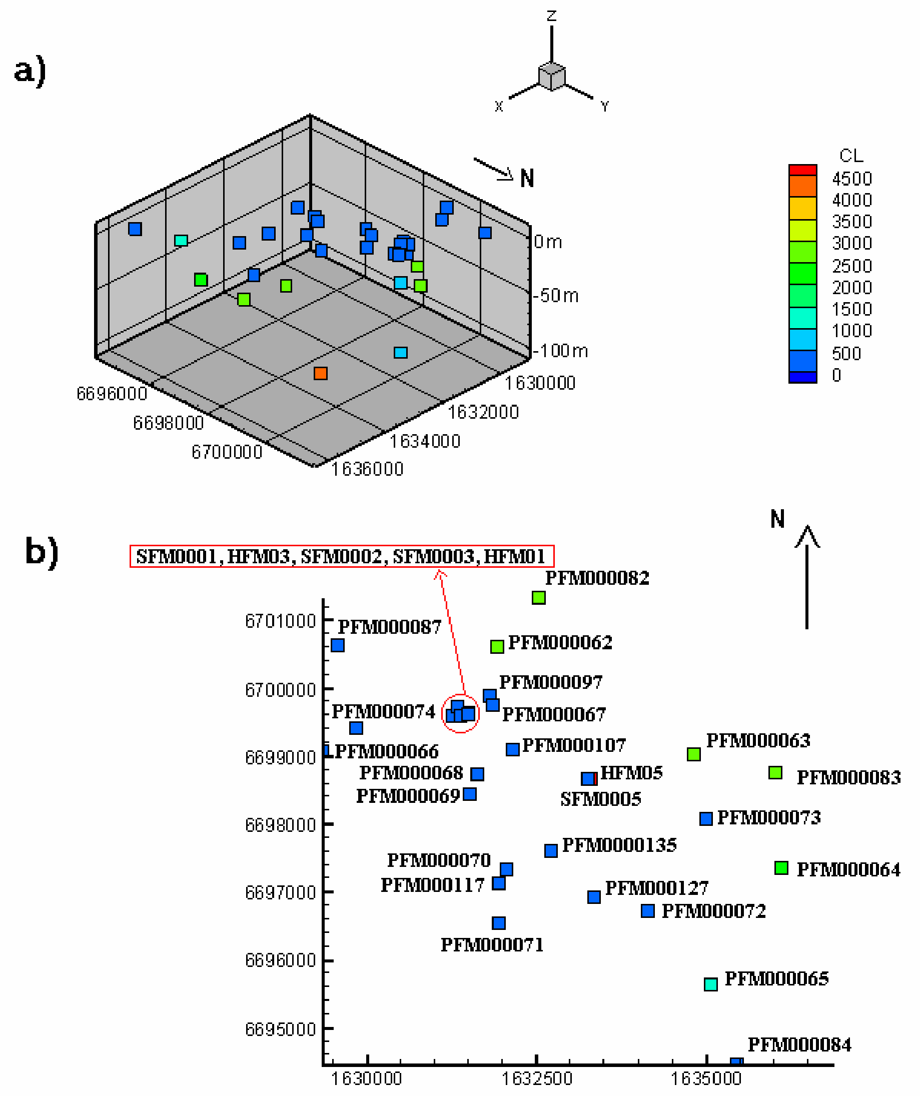


Figure 18: *3D/2D visualisation of the Cl sampling points in Forsmark.*

7. Concluding remarks

This work represents the phase 1 of the hydrochemical evaluation of the Forsmark data. This comprises the explorative analyses (AquaChem, SURFER, Cl distribution), M3 modelling, DIS (Drilling Impact Study) evaluation and 3D/2D visualisation of the data freeze for Forsmark. M3 modelling helped to summarize and understand the data. DIS evaluation helped to judge the representativity of the drilling and sampled data in the cored borehole KFM01. The visualisation helps to understand the distribution of the data at the site.

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Appendix 1: Water type classification of the Forsmark samples by using AquaChem

Borehole	Depth (m)	Cl(mg/l)	Water type
KFM01A	46.9	1419.7	Na-Ca-Cl
KFM01A	111.7	3842.2	Cl
KFM01A	111.7	4504.3	Cl
KFM01A	111.7	4546.8	Na-Ca-Cl
KFM01A	111.7	4541.2	Na-Ca-Cl
KFM01A	111.7	4494.6	Na-Ca-Cl
KFM01A	111.7	4078.2	Na-Ca-Cl
KFM01A	111.7	4567.2	Na-Ca-Cl
KFM01A	111.7	4562.8	Na-Ca-Cl
KFM02A		84.4	Na-HCO3-Cl
KFM02A		63	Na-HCO3
KFM02A		2317.2	Na-Ca-Cl
KFM02A		3741.4	Na-Ca-Cl
KFM02A		3442.5	Na-Ca-Cl
HFM01	96.9	215.7	Na-Cl-SO4
HFM01	96.9	9	Ca-Na-Mg
HFM01	96.9	472.5	Na-Cl-HCO3
HFM01	132	30.8	Na-Ca-HCO3
HFM01	33.1	529.8	Na-Cl-HCO3
HFM01	96.9	651.1	Na-Cl-HCO3
HFM02	46.9	1163	Na-Cl
HFM02	46.9	447	Na-Ca-Cl-HCO3
HFM03	9.8	12.8	Ca-Na-Mg
HFM03	9.8	15.7	Ca-Na-HCO3
HFM04	121.3	72	Na-HCO3-Cl
HFM04	121.3	71.4	Na-HCO3-Cl
HFM04	121.3	81.4	Na-HCO3-Cl
HFM05	104.4	4652.5	Na-Ca-Cl
HFM05	104.4	4503.4	Na-Ca-Cl
HFM05	104.4	4340.3	Na-Ca-Cl
HFM06	48.5	476	Na-Cl
HFM06	48.5	585.8	Na-Cl-HCO3
HFM06	48.5	797.4	Na-Cl-HCO3
HFM08	64.3	5162.8	Na-Ca-Cl
HFM08	64.3	5421.7	Na-Ca-Cl
HFM08	39.2	2694.1	Na-Ca-Cl
SFM0001	5.5	300.6	Na-Ca-Cl-HCO3
SFM0001	5.5	392.4	Na-Ca-Cl-HCO3
SFM0001	5.5	371.1	Na-Ca-Cl-HCO3-S
SFM0002	5.8	126.2	Ca-HCO3-Cl
SFM0002	5.8	113.1	Ca-HCO3-Cl
SFM0002	5.8	100.3	Ca-Na-HCO3-Cl
SFM0003	11	18.6	Ca-Mg-HCO3
SFM0003	11	17.9	Ca-Mg-HCO3
SFM0003	11	12.7	Ca-Mg-HCO3
SFM0005	2.4	7.4	Ca-HCO3
PFM000037			Na-Ca-HCO3

Borehole	**Depth (m)**	**Cl(mg/l)**	**Water type**
PFM000152			Ca-Na-SO4
PFM002457		0.8	Na-SO4-Cl
PFM002457		0.7	Na-K-Ca-Cl
PFM002457		1.1	Na-Ca-Cl
PFM000074	0.5	5.2	Ca-HCO3
PFM000074	0.5	8.6	Ca-HCO3
PFM000074	0.5	7.1	Ca-HCO3
PFM000074	0.5	6.2	Ca-HCO3
PFM000074	0.5	6.1	Ca-HCO3
PFM000074	0.5	20.5	Ca-HCO3
PFM000074	0.5	39.4	Ca-HCO3-Cl
PFM000074	0.5	23.7	Ca-HCO3
PFM000074	0.5	10.3	Ca-HCO3
PFM000074	0.5	7.4	Ca-HCO3
PFM000074	0.5	12.2	Ca-HCO3
PFM000074	0.5	7.9	Ca-HCO3
PFM000086	0.2	2.8	Ca-HCO3
PFM000087	0.5	9.5	Ca-HCO3
PFM000087	1.8	9.4	Ca-HCO3
PFM000087	0.5	13.4	Ca-HCO3
PFM000087	1.8	13	Ca-HCO3
PFM000087	0.5	15.3	Ca-HCO3
PFM000087	1.8	15.2	Ca-HCO3
PFM000087	0.5	15.4	Ca-HCO3
PFM000087	1.8	16.6	Ca-HCO3
PFM000087	0.5	15.1	Ca-HCO3
PFM000087	1.5	15.4	Ca-HCO3
PFM000087	0.5	14.6	Ca-HCO3
PFM000087	1.5	14.5	Ca-HCO3
PFM000087	0.5	12	Ca-HCO3
PFM000087	1.5	12.5	Ca-HCO3
PFM000087	0.5	10.3	Ca-HCO3
PFM000087	1.5	10.4	Ca-HCO3
PFM000087	0.5	12.5	Ca-HCO3
PFM000087	1.5	10.6	Ca-HCO3
PFM000087	1.5	12	Ca-HCO3
PFM000087	0.5	13.3	Ca-HCO3
PFM000087	0.5	12	Ca-HCO3
PFM000087	1.5	11.2	Ca-HCO3
PFM000087	0.5	11.2	Ca-HCO3
PFM000087	1.5	14.6	Ca-HCO3
PFM000087	0.5	11.6	Ca-HCO3
PFM000087	1.5	14.5	Ca-HCO3
PFM000087	0.5	14.9	Ca-HCO3
PFM000087	1.5	17.8	Ca-HCO3
PFM000087	0.5	27.8	Ca-HCO3
PFM000087	1.5	15	Ca-HCO3
PFM000097	0.5	176.7	Na-Ca-Cl-HCO3
PFM000097	0.5	176.4	Na-Ca-Cl-HCO3
PFM000097	0.5	177.6	Na-Ca-Cl-HCO3
PFM000097	0.5	190.7	Na-Ca-Cl-HCO3
PFM000097	0.5	246.5	Na-Ca-Cl-HCO3
PFM000097	0.5	203.3	Na-Ca-Cl-HCO3
PFM000097	0.5	136.2	Na-Ca-Cl-HCO3

Borehole	Depth (m)	Cl(mg/l)	Water type
PFM000097	0.5	108.9	Na-Ca-Cl-HCO3
PFM000097	0.5	122.4	Na-Ca-Cl-HCO3
PFM000097	0.5	141.2	Na-Ca-Cl-HCO3
PFM000097	0.5	136.5	Na-Ca-Cl-HCO3
PFM000097	0.5	59.2	Ca-Na-HCO3-Cl
PFM000097	0.5	95.9	Ca-Na-HCO3-Cl
PFM000097	0.5	61.5	Ca-Na-HCO3-Cl
PFM000107	0.5	13.3	Ca-HCO3-Cl
PFM000107	1.4	606.7	Na-Cl
PFM000107	0.5	182	Na-Ca-Cl-HCO3
PFM000107	1.4	178.8	Na-Ca-Cl-HCO3
PFM000107	0.5	147.5	Na-Ca-Cl-HCO3
PFM000107	1.5	147.8	Na-Ca-Cl-HCO3
PFM000107	0.5	141	Na-Ca-Cl-HCO3
PFM000107	1.5	141.1	Na-Ca-Cl-HCO3
PFM000107	0.5	157.8	Na-Ca-Cl-HCO3
PFM000107	1.5	153.4	Na-Ca-Cl-HCO3
PFM000107	0.5	165.4	Na-Ca-Cl-HCO3
PFM000107	1	164.2	Na-Ca-Cl-HCO3
PFM000107	0.5	158	Na-Ca-Cl-HCO3
PFM000107	1	158.9	Na-Ca-Cl-HCO3
PFM000107	0.5	116.5	Na-Ca-Cl-HCO3
PFM000107	1	116.1	Na-Ca-Cl-HCO3
PFM000107	0.5	88.9	Na-Ca-Cl-HCO3
PFM000107	1	83.2	Ca-Na-Cl-HCO3
PFM000107	0.5	90.1	Na-Ca-Cl-HCO3
PFM000107	1	89.1	Na-Ca-Cl-HCO3
PFM000107	0.5	94.5	Na-Ca-Cl-HCO3
PFM000107	1	96.1	Na-Ca-Cl-HCO3
PFM000107	0.5	97	Na-Ca-Cl-HCO3
PFM000107	1	99.1	Na-Ca-Cl-HCO3
PFM000107	0.5	98.1	Na-Ca-Cl-HCO3
PFM000107	0.5	40.1	Ca-HCO3-Cl
PFM000107	1	103.3	Ca-Na-Cl-HCO3
PFM000107	0.5	78.8	Ca-Na-HCO3-Cl
PFM000107	1	84.2	Ca-Na-HCO3-Cl
PFM000107	0.5	24.7	Ca-HCO3
PFM000107	1	70.5	Ca-Na-HCO3-Cl
PFM000117	0.5	0.9	Ca-HCO3
PFM000117	1.5	4.7	Ca-HCO3
PFM000117	0.5	5.1	Ca-HCO3
PFM000117	1.5	3.9	Ca-HCO3
PFM000117	0.5	4	Ca-HCO3
PFM000117	1.5	5.8	Ca-HCO3
PFM000117	0.5	4.5	Ca-HCO3
PFM000117	1.5	4	Ca-HCO3
PFM000117	0.5	7.9	Ca-HCO3
PFM000117	1.5	4.3	Ca-HCO3
PFM000117	0.5	5.2	Ca-HCO3
PFM000117	1.5	6.5	Ca-HCO3
PFM000117	0.5	8.3	Ca-HCO3
PFM000117	1.5	8.6	Ca-HCO3
PFM000117	0.5	4.1	Ca-HCO3

Borehole	Depth (m)	Cl(mg/l)	Water type
PFM000117	1.5	4.2	Ca-HCO3
PFM000117	0.5	4.3	Ca-HCO3
PFM000117	1.5	4.2	Ca
PFM000117	0.5	4.7	Ca-HCO3
PFM000117	1.5	4.9	Ca-HCO3
PFM000117	0.5	8.3	Ca-HCO3
PFM000117	1.5	4.9	Ca-HCO3
PFM000117	0.5	4.2	Ca-HCO3
PFM000117	1.5	4.1	Ca-HCO3
PFM000117	0.5	5.8	Ca-HCO3
PFM000117	1.5	4.9	Ca-HCO3
PFM000117	0.5	5.5	Ca-HCO3
PFM000117	1.5	9.3	Ca-HCO3
PFM000117	0.5	7	Ca-HCO3
PFM000117	1.5	5.2	Ca-HCO3
PFM000127	0.5	30.2	Ca-Na-HCO3-Cl
PFM000127	1	21.8	Ca-Na-HCO3-Cl
PFM000127	0.5	28.2	Ca-Na-HCO3-Cl
PFM000127	1	28.1	Ca-Na-HCO3-Cl
PFM000127	0.5	25.6	Ca-Na-HCO3-Cl
PFM000127	1	24.9	Ca-Na-HCO3-Cl
PFM000127	0.5	26.6	Ca-Na-HCO3-Cl
PFM000127	1	29.9	Ca-Na-HCO3-Cl
PFM000127	0.5	45.8	Ca-Na-HCO3-Cl
PFM000127	1	27.8	Ca-Na-HCO3-Cl
PFM000127	0.5	33.3	Ca-Na-HCO3-Cl
PFM000127	1.1	31.8	Ca-Na-HCO3-Cl
PFM000127	0.5	36.3	Ca-Na-HCO3-Cl
PFM000127	1	36.4	Ca-Na-HCO3-Cl
PFM000127	0.5	36.4	Ca-Na-HCO3-Cl
PFM000127	1	36.4	Ca-Na-HCO3-Cl
PFM000135	0.5	7.5	Ca-HCO3
PFM000135	0.5	36.5	Ca-Na-HCO3-Cl
PFM000135	0.5	49.3	Ca-Na-HCO3-Cl
PFM000151	0.5	6.1	Ca-HCO3
PFM000151	0.5	4.1	Ca
PFM000151	0.5	6.3	Ca-HCO3
PFM000151	0.5	8.1	Ca-HCO3
PFM000062	0.5	2980.9	Na-Cl
PFM000062	3	2883.3	Na-Cl
PFM000062	3.5	2785.5	Na-Cl
PFM000062	0.5	2747.8	Na-Cl
PFM000062	0.5	2736.1	Na-Cl
PFM000062	3	2729.7	Na-Cl
PFM000062	0.5	2692.1	Na-Cl
PFM000062	3	2694.1	Na-Cl
PFM000062	0.5	2601.9	Na-Cl
PFM000062	3	2609.7	Na-Cl
PFM000062	0.5	2615.6	Na-Cl
PFM000062	3	2635.7	Na-Cl
PFM000062	0.5	2464.7	Na-Cl
PFM000062	3	2476.4	Na-Cl
PFM000062	0.5	2334.6	Na-Cl
PFM000062	3	2395.5	Na-Cl

Borehole	Depth (m)	Cl(mg/l)	Water type
PFM000062	0.5	2610.1	Na-Cl
PFM000062	3	2601.6	Na-Cl
PFM000062	0.5	2631.8	Na-Cl
PFM000062	3	2620.1	Na-Cl
PFM000062	3	2627.6	Na-Cl
PFM000062	0.5	2656.8	Na-Cl
PFM000062	0.5	2667.8	Na-Cl
PFM000062	3	2683.1	Na-Cl
PFM000062	0.5	2590.6	Na-Cl
PFM000062	3	2609.7	Na-Cl
PFM000062	0.5	2668.9	Na-Cl
PFM000062	3	2620.3	Na-Cl
PFM000063	0.5	2800.1	Na-Cl
PFM000063	4.5	2833.7	Na-Cl
PFM000063	0.5	2654	Na-Cl
PFM000063	4.5	2691.1	Na-Cl
PFM000063	0.5	2740.9	Na-Cl
PFM000063	4.5	2731.5	Na-Cl
PFM000063	0.5	2760.4	Na-Cl
PFM000063	4.5	2742.5	Na-Cl
PFM000063	0.5	2587.2	Na-Cl
PFM000063	4.5	2521.6	Na-Cl
PFM000063	0.5	2627.4	Na-Cl
PFM000063	4.5	2612.9	Na-Cl
PFM000063	0.5	2573.1	Na-Cl
PFM000063	4.5	2591.5	Na-Cl
PFM000063	0.5	2375.8	Na-Cl
PFM000063	4.5	2407.9	Na-Cl
PFM000063	0.5	2614.2	Na-Cl
PFM000063	4.5	2628.2	Na-Cl
PFM000063	0.5	2647.5	Na-Cl
PFM000063	4.5	2608.4	Na-Cl
PFM000063	4.5	2636	Na-Cl
PFM000063	0.5	2610.2	Na-Cl
PFM000063	4.5	2626.4	Na-Cl
PFM000063	0.5	2663.9	Na-Cl
PFM000063	0.5	2614.7	Na-Cl
PFM000063	4.5	2613.6	Na-Cl
PFM000063	0.5	2675.6	Na-Cl
PFM000063	4.3	2680.2	Na-Cl
PFM000063	0.5	2613.2	Na-Cl
PFM000063	1	2723.5	Na-Cl
PFM000063	0.5	1474.8	Na-Cl
PFM000063	4.5	2632	Na-Cl
PFM000064	0.5	1268.8	Na-Cl
PFM000064	1.5	2405.1	Na-Cl
PFM000064	0.5	2112.6	Na-Cl
PFM000064	1.5	2470.9	Na-Cl
PFM000064	0.5	2584.8	Na-Cl
PFM000064	1.5	2606.9	Na-Cl
PFM000064	0.5	2703.7	Na-Cl
PFM000064	1	2694	Na-Cl
PFM000064	0.5	2703.5	Na-Cl
PFM000064	1	2633	Na-Cl

Borehole	Depth (m)	Cl(mg/l)	Water type
PFM000064	0.5	2507.5	Na-Cl
PFM000064	1	2522.8	Na-Cl
PFM000064	0.5	2098.5	Na-Cl
PFM000064	1	2111	Na-Cl
PFM000064	0.5	2341.2	Na-Cl
PFM000064	1	2250	Na-Cl
PFM000064	0.5	2629.2	Na-Cl
PFM000064	1	2624.3	Na-Cl
PFM000064	0.5	2612.5	Na-Cl
PFM000064	1	2617.9	Na-Cl
PFM000064	1	2582.4	Na-Cl
PFM000064	0.5	2494.6	Na-Cl
PFM000064	0.5	2512.9	Na-Cl
PFM000064	1	2493.1	Na-Cl
PFM000064	0.5	2191.3	Na-Cl
PFM000064	1	2459	Na-Cl
PFM000064	0.5	1384.1	Na-Cl
PFM000064	1	2147	Na-Cl
PFM000065	0.5	2548.8	Na-Cl
PFM000065	0.5	2633.4	Na-Cl
PFM000065	0.5	2576	Na-Cl
PFM000065	0.5	2509.5	Na-Cl
PFM000065	0.5	1952.9	Na-Cl
PFM000065	0.5	2425.8	Na-Cl
PFM000065	0.5	2595.2	Na-Cl
PFM000065	0.5	2507.1	Na-Cl
PFM000065	0.5	2520.9	Na-Cl
PFM000065	0.5	2564.3	Na-Cl
PFM000065	0.5	2245.6	Na-Cl
PFM000065	0.5	120.4	Na-Ca-Cl-HCO3
PFM000065	0.5	1170	Na-Cl
PFM000065	0.5	296	Na-Ca-Cl
PFM000082		2717.2	Na-Cl
PFM000082	0.5	2662.3	Na-Cl
PFM000082	6.5	2725.7	Na-Cl
PFM000082	0.5	2840.7	Na-Cl
PFM000082	6	2786.8	Na-Cl
PFM000082	0.5	2667.1	Na-Cl
PFM000082	6.5	2685.6	Na-Cl
PFM000082	0.5	1848.9	Na-Cl
PFM000082	6.5	2765	Na-Cl
PFM000083		2056.7	Na-Cl
PFM000083	0.5	2487.2	Na-Cl
PFM000083	6.5	2571.3	Na-Cl
PFM000083	0.5	2751.9	Na-Cl
PFM000083	6	2808.5	Na-Cl
PFM000084		1606	Na-Cl
PFM000084	0.5	417	Na-Cl
PFM000084	2.5	2143.2	Na-Cl
PFM000084	0.5	211.6	Na-Ca-Cl
PFM000084	2.5	289.4	Na-Ca-Cl
PFM000153	0.3	1863.2	Na-Cl
PFM000153	0.5	2009.3	Na-Cl

Borehole	Depth (m)	Cl(mg/l)	Water type
PFM000066	0.2	3.5	Ca-HCO3
PFM000066	0.1	3.3	Ca-HCO3
PFM000066	0.5	3.7	Ca-HCO3
PFM000066	0.1	3.8	Ca-HCO3
PFM000066	0.1	2.8	Ca
PFM000066	0.2	3.1	Ca-HCO3
PFM000066	0.1	3.1	Ca-HCO3
PFM000066	0.5	4.1	Ca-HCO3-SO4
PFM000066	0.1	8.8	Ca-HCO3
PFM000066	0.1	6	Ca-HCO3
PFM000066	0.1	8.5	Ca-HCO3
PFM000067	0.1	17.6	Ca-HCO3
PFM000067	0.2	38.4	Ca-Na-HCO3-Cl
PFM000067	0.5	184.8	Na-Ca-Cl-HCO3
PFM000067	0.1	158	Na-Ca-Cl-HCO3
PFM000067	0.5	161.8	Na-Ca-Cl-HCO3
PFM000067	0.1	170.9	Na-Ca-Cl-HCO3
PFM000067	0.1	213.6	Na-Ca-Cl-HCO3
PFM000067	0.1	172	Na-Ca-Cl-HCO3
PFM000067	0.1	127.2	Na-Ca-Cl-HCO3
PFM000067	0.1	101.6	Na-Ca-Cl-HCO3
PFM000067	0.1	106.6	Na-Ca-Cl-HCO3
PFM000067	0.1	112.7	Na-Ca-Cl-HCO3
PFM000067	0.1		Na-Ca-Mg-HCO3
PFM000067	0.1	111.7	Na-Ca-Cl-HCO3
PFM000067	0.1	105.7	Na-Ca-Cl-HCO3
PFM000067	0.1	94.2	Na-Ca-Cl-HCO3
PFM000067	0.1	76.9	Ca-Na-HCO3-Cl
PFM000067	0.1	90.8	Ca-Na-HCO3-Cl
PFM000067	0.1	54	Ca-Na-HCO3-Cl
PFM000068	0.5	7.1	Ca-HCO3
PFM000068	0.3	4.8	Ca-HCO3
PFM000068	0.5	7	Ca-HCO3
PFM000068	0.1	11.5	Ca-HCO3
PFM000068	0.1	17.3	Ca-HCO3
PFM000068	0.1	31.3	Ca-HCO3-Cl
PFM000068	0	50.4	Ca-Na-HCO3-Cl
PFM000068	0.2	17.6	Ca-HCO3
PFM000068	0.2	13.5	Ca-HCO3
PFM000068	0.1	17	Ca-HCO3
PFM000068	0.2	42.9	Ca-Na-HCO3-Cl
PFM000068	0.1	41.4	Ca-Na-HCO3-Cl
PFM000068	0.5	47.5	Ca-Na-HCO3-Cl
PFM000068	0.5	44.9	Ca-HCO3-Cl
PFM000068	0.5	11	Ca-HCO3
PFM000068	0.1	13.1	Ca-HCO3
PFM000068	0.1	19.2	Ca-HCO3
PFM000068	0.1	15.6	Ca-HCO3
PFM000069	0.2	10.6	Ca-HCO3
PFM000069	0.2	7.1	Ca-HCO3
PFM000069	0.5	13.2	Ca-HCO3
PFM000069	0.1	17.6	Ca-HCO3

Borehole	Depth (m)	Cl(mg/l)	Water type
PFM000069	0.1	20.6	Ca-HCO3
PFM000069	0.1	32.1	Ca-Na-HCO3-Cl
PFM000069	0	56.9	Ca-Na-HCO3-Cl
PFM000069	0.1	52.9	Ca-Na-HCO3-Cl
PFM000069	0.2	20.5	Ca-HCO3
PFM000069	0.1	20.4	Ca-HCO3
PFM000069	0.1	41	Ca-Na-HCO3-Cl
PFM000069	0.1	41.9	Ca-Na-HCO3-Cl
PFM000069	0.1	59.3	Ca-Na-HCO3-Cl
PFM000069	0.1	54.1	Ca-Na-HCO3-Cl
PFM000069	0.1	31.9	Ca-HCO3-Cl
PFM000069	0.1	22.8	Ca-HCO3
PFM000069	0.1	40.6	Ca-Na-HCO3
PFM000069	0.1	27.4	Ca-HCO3
PFM000070	0.1	3.8	Ca-HCO3
PFM000070	0.1	3.5	Ca-HCO3
PFM000070	0.1	3.7	Ca-HCO3
PFM000070	0.1	4.1	Ca-HCO3
PFM000070	0.1	4.6	Ca-HCO3
PFM000070	0	4.7	Ca-HCO3
PFM000070	0.2	4.2	Ca-HCO3
PFM000070	0.1	4.1	Ca-HCO3
PFM000070	0.1	3.9	Ca-HCO3
PFM000070	0.1	4.9	Ca-HCO3
PFM000070	0.1	5.4	Ca-HCO3
PFM000070	0.1	5.6	Ca-HCO3
PFM000071	0.1	2.6	Ca-HCO3
PFM000071	0.2	2.3	Ca-HCO3
PFM000071	0.1	2.1	Ca-HCO3
PFM000071	0.1	16.6	Ca-HCO3
PFM000071	0.2	1.9	Ca-HCO3
PFM000071	0.1	2	Ca-HCO3
PFM000071	0.1	2.3	Ca-HCO3
PFM000071	0.1	1.5	Ca-HCO3
PFM000071	0.5	3.5	Ca-HCO3
PFM000071	0.1	3	Ca-HCO3
PFM000071	0.1	3.2	Ca-HCO3
PFM000071	0.1	2.8	Ca-HCO3
PFM000072	0.5	16.8	Ca-HCO3
PFM000072	0.2	19.8	Ca-Na-HCO3
PFM000072	0.5	17.7	Ca-HCO3
PFM000072	0.2	18.5	Ca-Na-HCO3
PFM000072	0.5	24.5	Ca-Na-HCO3
PFM000072	0.2	47.5	Ca-Na-HCO3-Cl
PFM000072	0.5	74.5	Ca-Na-HCO3-Cl
PFM000072	0.5	24.1	Ca-Na-HCO3-Cl-S
PFM000072	0.2	34.1	Ca-Na-HCO3-Cl
PFM000072	0.5	37.7	Ca-Na-HCO3-Cl
PFM000072	0.1	117.8	Na-Ca-Cl-HCO3-S
PFM000072	0.1	36.7	Ca-Na-HCO3-Cl
PFM000072	0.1	63.3	Ca-Na-HCO3-Cl
PFM000072	0.1	107.7	Ca-Na-HCO3-Cl

Borehole	Depth (m)	Cl(mg/l)	Water type
PFM000072	0.1	102.2	Ca-Na-HCO3-Cl
PFM000073	0.1	6.9	Ca-HCO3
PFM000073	0.1	6.1	Ca-HCO3
PFM000073	0.1	5.9	Ca-HCO3
PFM000073	0.1	6.9	Ca-HCO3
PFM000073	0	7	Ca-HCO3
PFM000073	0.1	5.9	Ca-HCO3-SO4
PFM000073	0.1	7.6	Ca-HCO3
PFM002291	1.5	1171.2	Na-Cl
PFM002292		1166.6	Na-Cl
PFM000155		614.1	Na-Ca-Cl
PFM002564		3744.2	Na-Ca-Cl
PFM002564		3640.7	Na-Ca-Cl
AFM000010		4.9	Ca-HCO3
AFM000048		4.5	Ca-HCO3
AFM000050		244.1	Na-Ca-Cl-HCO3
AFM000073		7.6	Ca-HCO3
AFM000074		245.9	Na-Ca-Cl-HCO3

Appendix 2: M3 mixing calculations for Forsmark regional model

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
1	KFM02A	4398	Ground Water					168	6.46	34.2	7.8	378	84.4	53.92	-82.1	11.2	-11.4	0.00	0.00	0.00	0.00	0.64	0.34
2	KFM02A	4397	Ground Water					148	8.35	30.8	7.3	381	63	48.13	-83	10.6	-11.4	0.00	0.00	0.00	0.00	0.64	0.35
3	HFM01	4116	Ground Water	6699611	1631488	-33.06		498	13.8	60.4	16.9	440	529.8	201.81	-64.2	3.7	-9.5	0.01	0.01	0.01	0.01	0.21	0.73
4	HFM01	4172	Ground Water	6699619	1631495	-96.87		556	15.2	79.1	22.8	480	651.1	220.09	-64.6	3.3	-9.4	0.01	0.01	0.01	0.01	0.16	0.78
5	HFM03	4167	Ground Water	6699593	1631272	-9.84		64.6	9.5	62	14	310	15.7	18.66	-79.6	12	-11.8	0.01	0.01	0.01	0.01	0.66	0.30
6	HFM05	4433	Ground Water	6698656	1633286	-104.44		1830	42.4	805	212	110	4652.5	308.66	-78.2	-0.8	-10.2	0.13	0.13	0.13	0.13	0.13	0.36
7	HFM05	4434	Ground Water	6698656	1633286	-104.44		1800	42.2	781	207	115	4503.4	306.74	-78.1	-0.8	-10.2	0.12	0.12	0.12	0.12	0.13	0.38
8	HFM05	4435	Ground Water	6698656	1633286	-104.44		1740	41.2	749	199	122	4340.3	299.24	-75	-0.8	-10.3	0.12	0.12	0.12	0.12	0.12	0.40
9	SFM0001	4219	Near Surface GW	6699713	1631335	1.22	5.50	242	15.9	103	33.7	420	300.6	162.6	-90.6	15.3	-10.9	0.02	0.02	0.02	0.02	0.54	0.39
10	SFM0001	4316	Near Surface GW	6699713	1631335	1.22	5.50	321	18.9	91.7	40.6	476	392.4	159.79	-76.3	-6	-10.8	0.01	0.01	0.01	0.01	0.33	0.63
11	SFM0001	4403	Near Surface GW	6699713	1631335	1.22	5.50	254	16.9	89.1	36.5	427	371.1	195.08	-80.3	13.3	-11.1	0.02	0.02	0.02	0.02	0.44	0.49
12	SFM0002	4220	Near Surface GW	6699586	1631378	2.01	5.75	40.7	6.19	187	11.8	330	126.2	19.61	-95.2	13.7	-11.8	0.01	0.01	0.01	0.01	0.83	0.13
13	SFM0002	4318	Near Surface GW	6699586	1631378	2.01	5.75	43.1	5.4	129	9.5	390	113.1	18	-83.5	13	-11.9	0.00	0.00	0.00	0.00	0.69	0.30
14	SFM0002	4405	Near Surface GW	6699586	1631378	2.01	5.75	46.7	6.05	131	9.7	351	100.3	46.88	-84	11.7	-11.9	0.01	0.01	0.01	0.01	0.72	0.25
15	SFM0003	4221	Near Surface GW	6699615	1631487	1.93	11.00	33.4	15.8	143	31.2	410	18.6	81.38	-82.3	24.9	-9	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
16	SFM0003	4317	Near Surface GW	6699615	1631487	1.93	11.00	33.5	13.7	97.3	27	453	17.9	75.3	-76.3	-6	-9.7	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
17	SFM0003	4404	Near Surface GW	6699615	1631487	1.93	11.00	31.1	13.6	93	25.2	426	12.7	60.83	-74.9	17.9	-9.9	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
18	SFM0005	4432	Near Surface GW	6698648	1633252	6.80	2.40	5.8	1.87	85.6	5.4	260	7.4	13.63	-84.3	11	-12	0.01	0.01	0.01	0.01	0.82	0.13
19	PFM000074	4202	Lake Water	6699393	1629854		0.50	6.7	1.6	69.1	3.2	210	6.2	3.7	-77.8	12.5	-9.6	0.01	0.01	0.01	0.01	0.63	0.34
20	PFM000074	4224	Lake Water	6699393	1629854		0.50	6.9	1.55	71.3	3.6	240	6.1	2.75	-69.7	13.7	-9.8	0.00	0.00	0.00	0.00	0.55	0.44
21	PFM000074	4337	Lake Water	6699393	1629854		0.50	10.5	1.75	66.1	4	222	10.3	3.43	-68.4	14.7	-9.2	0.00	0.00	0.00	0.00	0.50	0.48
22	PFM000074	4453	Lake Water	6699393	1629854		0.50	9	2.62	84	4.4	245	12.2	27.33	-83.1	11.7	-11.8	0.01	0.01	0.01	0.01	0.80	0.14
23	PFM000087	4060	Lake Water	6700617	1629574		0.50	8.8	2.69	63.2	3.9	190	9.5	8.33	-88.8	12.6	-11.7	0.02	0.02	0.02	0.02	0.89	0.04
24	PFM000087	4061	Lake Water	6700617	1629574		1.80	8.7	2.77	64.1	4	190	9.4	8.3	-90	12.1	-12	0.02	0.02	0.02	0.03	0.89	0.02
25	PFM000087	4200	Lake Water	6700617	1629574		0.50	12	2.19	64.9	4.4	190	12	6.44	-77	13.6	-9.4	0.01	0.01	0.01	0.01	0.62	0.34
26	PFM000087	4201	Lake Water	6700617	1629574		1.50	12	2.25	66.3	4.5	200	12.5	6.24	-78.2	16	-9.4	0.01	0.01	0.01	0.01	0.62	0.34
27	PFM000087	4203	Lake Water	6700617	1629574		0.50	9.8	2.34	65.4	4.5	220	10.3	5.28	-68.6	15.6	-9.7	0.01	0.01	0.01	0.01	0.54	0.44
28	PFM000087	4222	Lake Water	6700617	1629574		1.50	9.8	2.45	66.2	4.6	230	10.4	5.44	-68.5	12.5	-9.8	0.01	0.01	0.01	0.01	0.54	0.44
29	PFM000087	4327	Lake Water	6700617	1629574		0.50	12.1	2.11	52.5	5.2	180	11.2	5.59	-64.2	11.6	-8.3	0.01	0.01	0.01	0.01	0.42	0.56
30	PFM000087	4331	Lake Water	6700617	1629574		1.50	11.9	2.17	54.5	5.1	189	14.6	5.58	-63.5	10.4	-8.2	0.00	0.00	0.00	0.00	0.40	0.58
31	PFM000087	4442	Lake Water	6700617	1629574		0.50	11.5	3.88	93.9	6.2	309	14.9	33.35	-77.4	12.2	-10.5	0.00	0.00	0.00	0.00	0.60	0.38
32	PFM000087	4449	Lake Water	6700617	1629574		1.50	12.2	3.94	99	6.3	309	17.8	33.36	-80.2	10.1	-11	0.01	0.01	0.01	0.01	0.66	0.31
33	PFM000097	4056	Lake Water	6699868	1631814		0.50	89.2	4.86	44.2	12.3	110	176.7	25.23	-84.8	11.7	-10.7	0.03	0.03	0.03	0.03	0.80	0.08
34	PFM000097	4205	Lake Water	6699868	1631814		0.50	75.5	4.28	42.7	10.7	120	136.2	21.99	-60.6	14.1	-6	0.01	0.01	0.01	0.01	0.24	0.73
35	PFM000097	4245	Lake Water	6699868	1631814		0.50	57.9	3.46	39.5	8.9	120	108.9	19.46	-53.4	8.2	-5.9	0.01	0.01	0.01	0.01	0.17	0.80

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
36	PFM000097	4452	Lake Water	6699868	1631814		0.50	51.4	4.34	58.6	9.4	190	95.9	22.28	-64.4	13.9	-7.9	0.01	0.01	0.01	0.01	0.37	0.61
37	PFM000107	4058	Lake Water	6699083	1632145		0.50	91.6	4.81	46.6	12.5	120	182	26.05	-82.8	12.6	-10.8	0.03	0.03	0.03	0.03	0.78	0.11
38	PFM000107	4059	Lake Water	6699083	1632145		1.40	89.8	4.91	46.9	12.4	110	178.8	25.68	-82.8	13	-10.8	0.03	0.03	0.03	0.03	0.79	0.10
39	PFM000107	4206	Lake Water	6699083	1632145		0.50	65	4.02	42.9	9.5	120	116.5	19.39	-63.5	13.2	-6.8	0.01	0.01	0.01	0.01	0.33	0.63
40	PFM000107	4207	Lake Water	6699083	1632145		1.00	64.9	3.89	42.8	9.4	120	116.1	19.43	-64.3	15.6	-6.7	0.01	0.01	0.01	0.01	0.33	0.63
41	PFM000107	4233	Lake Water	6699083	1632145		0.50	48.8	3.29	42	8.2	130	88.9	17.54	-55.8	8.4	-6.3	0.01	0.01	0.01	0.01	0.22	0.76
42	PFM000107	4234	Lake Water	6699083	1632145		1.00	47.7	3.35	42.2	7.8	130	83.2	16.87	-54.8	11.7	-6.4	0.01	0.01	0.01	0.01	0.22	0.76
43	PFM000107	4328	Lake Water	6699083	1632145		0.50	57.1	4.07	44.4	9.3	144	98.1	17.6	-52.3	10.4	-6	0.00	0.00	0.00	0.00	0.15	0.84
44	PFM000107	4444	Lake Water	6699083	1632145		0.50	40	4.41	41	6.5	157	78.8	18.14	-77.4	11.5	-10.8	0.02	0.02	0.02	0.02	0.72	0.20
45	PFM000107	4447	Lake Water	6699083	1632145		1.00	43.6	3.84	52	8.1	171	84.2	20.03	-66.9	9.8	-8.4	0.01	0.01	0.01	0.01	0.44	0.52
46	PFM000117	4048	Lake Water	6697118	1631946		0.50	5.4	1.9	53.3	2.6	160	5.1	4.41	-77.3	12.5	-9.8	0.01	0.01	0.01	0.01	0.67	0.27
47	PFM000117	4049	Lake Water	6697118	1631946		1.50	5.6	1.9	53.3	2.5	160	3.9	4.15	-77.5	13.2	-9.8	0.01	0.01	0.01	0.01	0.67	0.27
48	PFM000117	4217	Lake Water	6697118	1631946		0.50	5.8	1.86	38.2	2.7	110	4.1	4.53	-72.3	15.5	-7.1	0.01	0.01	0.01	0.01	0.47	0.49
49	PFM000117	4218	Lake Water	6697118	1631946		1.50	5.9	1.91	39.2	2.7	110	4.2	4.53	-72.4	12.7	-7	0.01	0.01	0.01	0.01	0.46	0.50
50	PFM000117	4235	Lake Water	6697118	1631946		0.50	5.4	1.73	36.6	2.7	120	4.3	4.48	-57.9	6.9	-6.7	0.01	0.01	0.01	0.01	0.29	0.68
51	PFM000117	4440	Lake Water	6697118	1631946		0.50	7.4	2.46	52.3	3.5	170	5.5	5.74	-61.5	12.7	-7.1	0.00	0.00	0.00	0.00	0.32	0.67
52	PFM000117	4451	Lake Water	6697118	1631946		1.50	6.8	2.31	53.5	3.3	185	9.3	6.9	-61.8	13.5	-7.2	0.00	0.00	0.00	0.00	0.32	0.67
53	PFM000127	4215	Lake Water	6696924	1633350		0.50	21.5	3.38	29.6	5.6	97	26.6	14.49	-63.2	8.7	-5	0.01	0.01	0.01	0.01	0.22	0.75
54	PFM000127	4216	Lake Water	6696924	1633350		1.00	21.4	3.29	30.2	5.8	97	29.9	14.94	-62.4	13.1	-8.1	0.01	0.01	0.01	0.01	0.44	0.51
55	PFM000127	4232	Lake Water	6696924	1633350		0.50	21	3.21	30.3	5.9	110	45.8	16.18	-44.3	7.6	-4.5	0.00	0.00	0.00	0.00	0.00	1.00
56	PFM000127	4241	Lake Water	6696924	1633350		1.00	21	3	30.6	5.7	110	27.8	14.09	-46.3	6.1	-4.6	0.00	0.00	0.00	0.00	0.03	0.97
57	PFM000135	4443	Lake Water	6697594	1632722		0.50	33.7	5.43	72.2	9	281	49.3	22.79	-61.9	11.6	-7.2	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
58	PFM000062	4198	Sea Water	6700605	1631921		0.50	1455	56	71.7	184	71	2615.6	362.9	-66.1	10.6	-8.1	0.36	0.10	0.10	0.10	0.10	0.24
59	PFM000062	4229	Sea Water	6700605	1631921		0.50	1430	51.57	66.6	165	70	2464.7	343.93	-64.1	15.9	-8.5	0.29	0.10	0.10	0.10	0.10	0.32
60	PFM000062	4230	Sea Water	6700605	1631921		3.00	1410	50.07	66.6	164	70	2476.4	348.84	-62.4	11.7	-8.5	0.29	0.10	0.10	0.10	0.10	0.32
61	PFM000062	4322	Sea Water	6700605	1631921		3.00	1490	51	68.3	180	74	2627.6	363.73	-61.3	15.6	-8.2	0.35	0.10	0.10	0.10	0.10	0.25
62	PFM000062	4333	Sea Water	6700605	1631921		0.50	1490	51.3	68.7	181	83	2656.8	368.61	-61.6	15.3	-8.2	0.36	0.10	0.10	0.10	0.10	0.25
63	PFM000063	4194	Sea Water	6699014	1634833		0.50	1450	55.1	72.2	184	72	2627.4	365.72	-65.1	17.4	-7.8	0.38	0.10	0.10	0.10	0.10	0.23
64	PFM000063	4195	Sea Water	6699014	1634833		4.50	1460	55.95	72.8	186	72	2612.9	370.19	-65.7	17.4	-8	0.37	0.10	0.10	0.10	0.10	0.23
65	PFM000063	4227	Sea Water	6699014	1634833		0.50	1473.3	52.67	68.5	169.7	74	2573.1	363.59	-61.6	18.6	-8.2	0.35	0.10	0.10	0.10	0.10	0.26
66	PFM000063	4228	Sea Water	6699014	1634833		4.50	1513.3	54.03	70.2	174.3	77	2591.5	367.53	-62.6	18.1	-8.4	0.35	0.10	0.10	0.10	0.10	0.25
67	PFM000063	4321	Sea Water	6699014	1634833		4.50	1460	50.4	67.7	178	71	2636	365.98	-61.8	16	-8.1	0.35	0.10	0.10	0.10	0.10	0.26
68	PFM000063	4324	Sea Water	6699014	1634833		0.50	1500	51.2	68.9	181	70	2610.2	359.7	-61.6	17.1	-8.1	0.36	0.10	0.10	0.10	0.10	0.25
69	PFM000063	4445	Sea Water	6699014	1634833		0.50	1410	53	71.3	173	79	2613.2	374.5	-60.9	13.9	-8.5	0.35	0.10	0.10	0.10	0.10	0.26
70	PFM000063	4450	Sea Water	6699014	1634833		1.00	1450	55.2	72.2	179	82	2723.5	381.25	-65.1	17.5	-8.5	0.34	0.10	0.10	0.10	0.10	0.25
71	PFM000064	4196	Sea Water	6697347	1636121		0.50	1385	53.25	73.4	176	79	2507.5	347.03	-63.7	11.6	-7.6	0.37	0.09	0.09	0.09	0.09	0.26
72	PFM000064	4197	Sea Water	6697347	1636121		1.00	1385	53.4	72.9	175.5	77	2522.8	348.38	-64.1	12.2	-7.6	0.37	0.09	0.09	0.09	0.09	0.26

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
73	PFM000064	4225	Sea Water	6697347	1636121		0.50	1203.3	43.47	66.2	107.9	90	2098.5	290.35	-61.5	17	-8	0.19	0.08	0.08	0.08	0.08	0.48
74	PFM000064	4323	Sea Water	6697347	1636121		1.00	1430	49	69.9	175	77	2582.4	352.42	-60.1	15	-7.8	0.36	0.09	0.09	0.09	0.09	0.27
75	PFM000064	4330	Sea Water	6697347	1636121		0.50	1410	48.6	69.5	172	80	2494.6	345.16	-60.2	14.2	-8	0.34	0.09	0.09	0.09	0.09	0.29
76	PFM000065	4212	Sea Water	6695635	1635083		0.50	1375	53.3	71.8	175.5	76	2509.5	349.28	-72.5	14.1	-7.9	0.29	0.10	0.10	0.10	0.10	0.32
77	PFM000065	4231	Sea Water	6695635	1635083		0.50	1090	40.27	63.8	126.3	93	1952.9	270.29	-60.7	11.4	-8.1	0.19	0.08	0.08	0.08	0.08	0.50
78	PFM000065	4325	Sea Water	6695635	1635083		0.50	1430	49.3	68.6	174	74	2520.9	350.17	-60.9	16.6	-8.1	0.34	0.10	0.10	0.10	0.10	0.28
79	PFM000065	4446	Sea Water	6695635	1635083		0.50	652	25.9	55.8	78.9	99	1170	244.19	-67.5	12.2	-8.8	0.06	0.06	0.06	0.06	0.24	0.51
80	PFM000082	4044	Sea Water	6701336	1632528		0.50	1420	53.1	72.1	173	76	2840.7	341.85	-64.5	15.9	-8.2	0.33	0.10	0.10	0.10	0.10	0.28
81	PFM000082	4047	Sea Water	6701336	1632528		6.00	1400	52.7	71.7	171	75	2786.8	334.44	-65.1	19.3	-8.2	0.31	0.10	0.10	0.10	0.10	0.30
82	PFM000082	4438	Sea Water	6701336	1632528		0.50	1430	54.1	70.3	176	75	2667.1	373.88	-64.1	12.6	-8.3	0.34	0.10	0.10	0.10	0.10	0.26
83	PFM000082	4439	Sea Water	6701336	1632528		6.50	1450	54	70.2	177	80	2685.6	380.25	-64.1	16.6	-8.3	0.35	0.10	0.10	0.10	0.10	0.25
84	PFM000083	4053	Sea Water	6698757	1636023		0.50	1430	53.5	72.8	175	74	2751.9	329.54	-65.1	16.1	-8.2	0.32	0.10	0.10	0.10	0.10	0.29
85	PFM000083	4054	Sea Water	6698757	1636023		6.00	1430	53.8	72.9	175	74	2808.5	336.61	-64.8	13.9	-8.1	0.34	0.10	0.10	0.10	0.10	0.27
86	PFM000084	4062	Sea Water	6694442	1635455		0.50	133	6.74	48.5	18.4	110	211.6	46.37	-83.5	11.2	-11	0.03	0.03	0.03	0.03	0.79	0.08
87	PFM000084	4063	Sea Water	6694442	1635455		2.50	136	6.89	49.2	18.7	110	289.4	54.48	-82.4	11.7	-11	0.03	0.03	0.03	0.03	0.77	0.09
88	PFM000066	4045	Streaming Water	6699064	1629343		0.20	3.7	2.15	60.4	2.6	180	3.5	9.03	-89.7	10.5	-12	0.02	0.02	0.02	0.04	0.89	0.02
89	PFM000066	4208	Streaming Water	6699064	1629343		0.20	5	1.52	67.3	3.2	200	3.1	4.16	-77.7	13	-9.5	0.01	0.01	0.01	0.01	0.63	0.33
90	PFM000066	4223	Streaming Water	6699064	1629343		0.05	4.8	1.45	66.6	3.2	210	3.1	3.71	-67.9	14.2	-9.7	0.01	0.01	0.01	0.01	0.55	0.43
91	PFM000066	4454	Streaming Water	6699064	1629343		0.10	7.9	3.15	84.6	4.2	245	6	27.53	-78.3	11.8	-11	0.01	0.01	0.01	0.01	0.70	0.26
92	PFM000067	4057	Streaming Water	6699753	1631859		0.50	92.8	5.09	46.5	12.8	110	184.8	26.13	-82.9	13	-10.8	0.03	0.03	0.03	0.03	0.79	0.10
93	PFM000067	4204	Streaming Water	6699753	1631859		0.10	72.2	4.25	43.1	10.3	120	127.2	21.11	-62.6	12.2	-6.3	0.01	0.01	0.01	0.01	0.28	0.68
94	PFM000067	4242	Streaming Water	6699753	1631859		0.10	53.8	3.52	41.7	8.5	130	101.6	18.51	-53.8	6.7	-6	0.01	0.01	0.01	0.01	0.18	0.80
95	PFM000067	4339	Streaming Water	6699753	1631859		0.05	62.9	4.44	45.4	10.4	124	111.7	25.28	-50.1	14.2	-5.5	0.00	0.00	0.00	0.00	0.10	0.88
96	PFM000067	4459	Streaming Water	6699753	1631859		0.10	54.1	5	60.9	9.8	191	90.8	20.82	-62.2	13.7	-7.4	0.00	0.00	0.00	0.00	0.30	0.68
97	PFM000068	4046	Streaming Water	6698735	1631641		0.50	7	2.08	50.2	3	150	7	4.97	-86.2	10.7	-11.2	0.02	0.02	0.02	0.02	0.86	0.06
98	PFM000068	4213	Streaming Water	6698735	1631641		0.20	12.3	1.54	55.8	4.2	160	13.5	5.79	-79.9	11	-8.8	0.01	0.01	0.01	0.01	0.63	0.33
99	PFM000068	4238	Streaming Water	6698735	1631641		0.10	12.7	1.54	58.6	4.4	190	17	5.24	-68.7	8.5	-9.3	0.01	0.01	0.01	0.01	0.53	0.43
100	PFM000068	4343	Streaming Water	6698735	1631641		0.50	27.1	2.26	73	7.9	226	47.5	9.04	-73.4	12.8	-10.5	0.01	0.01	0.01	0.01	0.63	0.33
101	PFM000068	4457	Streaming Water	6698735	1631641		0.10	15.9	3.04	66.2	5.1	202	19.2	14.79	-74.9	13.6	-10	0.01	0.01	0.01	0.01	0.62	0.33
102	PFM000069	4055	Streaming Water	6698440	1631510		0.50	8.7	2.16	49.5	3.3	140	13.2	6.8	-91.4	10.9	-12.1	0.02	0.02	0.02	0.08	0.84	0.02
103	PFM000069	4211	Streaming Water	6698440	1631510		0.15	15.9	1.34	61.3	4.9	180	20.5	8.07	-85.5	11	-10.2	0.01	0.01	0.01	0.01	0.77	0.17
104	PFM000069	4244	Streaming Water	6698440	1631510		0.05	14.6	1.29	62	4.8	190	20.4	6.34	-71.5	10.1	-9.8	0.01	0.01	0.01	0.01	0.60	0.36
105	PFM000069	4342	Streaming Water	6698440	1631510		0.05	26.7	1.58	70.4	7.6	222	59.3	9.33	-73.4	11.2	-10.3	0.01	0.01	0.01	0.01	0.62	0.34
106	PFM000069	4455	Streaming Water	6698440	1631510		0.10	27.3	3.72	85.5	7.2	256	40.6	17.46	-87.4	13.9	-11.7	0.01	0.01	0.01	0.01	0.82	0.13
107	PFM000070	4210	Streaming Water	6697319	1632061		0.20	5.8	1.77	40.2	2.7	120	4.2	3.88	-65.3	12.4	-7.1	0.01	0.01	0.01	0.01	0.39	0.57
108	PFM000070	4240	Streaming Water	6697319	1632061		0.05	5.5	1.39	39.9	2.6	130	4.1	3.42	-58.5	6.6	-6.9	0.01	0.01	0.01	0.01	0.31	0.67
109	PFM000070	4456	Streaming Water	6697319	1632061		0.10	9.7	3.08	52.8	3.4	168	5.4	6.48	-62.6	15.4	-7.4	0.00	0.00	0.00	0.00	0.35	0.64

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
110	PFM000071	4209	Streaming Water	6696533	1631944		0.10	3.7	2.11	82	3.7	250	2.3	2.73	-86.2	11.9	-11.4	0.01	0.01	0.01	0.01	0.81	0.15
111	PFM000071	4239	Streaming Water	6696533	1631944		0.05	3.6	2.14	83.9	3.8	280	1.5	1.08	-78.5	5.3	-11.2	0.01	0.01	0.01	0.01	0.70	0.28
112	PFM000071	4460	Streaming Water	6696533	1631944		0.10	5.6	2.64	86.3	4.1	268	3.2	9.17	-86.2	13.3	-12.1	0.01	0.01	0.01	0.01	0.84	0.11
113	PFM000072	4042	Streaming Water	6696708	1634151		0.50	14	2.99	47.1	4.8	140	17.7	11.76	-78.7	10.2	-10.1	0.02	0.02	0.02	0.02	0.71	0.22
114	PFM000072	4214	Streaming Water	6696708	1634151		0.20	28.9	1.6	36.1	6.4	130	34.1	7.37	-65.3	12.8	-5.8	0.00	0.00	0.00	0.00	0.29	0.69
115	PFM000072	4243	Streaming Water	6696708	1634151		0.50	28	1.42	36.4	6.5	140	37.7	6.89	-51.5	10.4	-5.6	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
116	PFM000072	4345	Streaming Water	6696708	1634151		0.10	72.8	4.72	49.1	11.8	128	117.8	71.74	-63	12.1	-8.4	0.02	0.02	0.02	0.02	0.42	0.51
117	PFM000072	4458	Streaming Water	6696708	1634151		0.10	70.4	4.87	63.6	15.3	201	107.7	55.24	-70.6	13.8	-9.2	0.01	0.01	0.01	0.01	0.49	0.45
118	PFM000073	4043	Streaming Water	6698073	1635004		0.10	10	6.42	122	13.3	390	5.9	48.36	-89.2	10.3	-11.9	0.00	0.00	0.00	0.00	0.73	0.25
119	SGKLX02	Laxemar						8500	45.5	19300	2.12	14.1	47200	906	-44.9	4.2	-8.9	0.00	0.00	1.00	0.00	0.00	0.00
120	KAS03	Äspö pre						613	2.4	162	21	61	1220	31.1	-125	0.1	-15.8	0.03	0.03	0.03	0.57	0.32	0.03
121	SEA01	Sea						1960	95	93.7	234	90	3760	325	-53.3	42	-5.9	0.49	0.29	0.06	0.06	0.06	0.06
122	HBH02	Redox						11.5	2.3	15.4	1.9	63	5	13.2	-77.1	59	-10.2	0.02	0.02	0.02	0.02	0.76	0.14
123	SA1094A	Tunnel						2140	35.1	504	195	760	4490	111.6	-60.3	17	-7.3	0.54	0.01	0.01	0.01	0.01	0.41
124	KAS03	Äspö pre						3020	7.3	4380	49.5	11	12300	709	-96.4	0.4	-12.7	0.06	0.06	0.31	0.44	0.06	0.06
125	Glacial	Glacial						0.17	0.4	0.18	0.1	0.12	0.5	0.5	-158	0	-21	0.00	0.00	0.00	1.00	0.00	0.00
126	Litorina new	Sea						3674	134	151	448	93	6500	890	-38	0	-4.7	0.00	1.00	0.00	0.00	0.00	0.00
127	Rain'60	Rain						0.4	0.29	0.24	0.1	12.2	0.23	1.41	-80	2000	-10.5	0.00	0.00	0.00	0.00	1.00	0.00
128	SAS48	Sediment						2144	91.8	103	258	793	3383	53.1	-61	0	-7	1.00	0.00	0.00	0.00	0.00	0.00
129	HA0982B	Äspö						1557.1	20.95	427.9	125.2	225	3403.5	299	-54.5	22.8	-7.4	0.22	0.07	0.07	0.07	0.07	0.49
130	HA1327B	Äspö						1850	12	778	158	277	4770	198	-59.2	8	-7.5	0.18	0.07	0.07	0.07	0.07	0.52
131	HA1327B	Äspö						1860	11	746	155	280	4600	208	-57.5	18	-7.6	0.18	0.07	0.07	0.07	0.07	0.53
132	HA1327B	Äspö						1790	12.3	674	153	265	4350	241	-54.5	13	-7.4	0.22	0.07	0.07	0.07	0.07	0.49
133	HA1327B	Äspö						1760	13.7	684	157	259	4310	254.977	-50.6	18	-7.5	0.26	0.07	0.07	0.07	0.07	0.45
134	HA1749A	Äspö						1260	13	726.5	65.9	116	3450	284.639	-69.3	4.2	-10.9	0.09	0.09	0.09	0.09	0.52	0.11
135	HAS02	Äspö						2320	26	818	217	227	5470	162	-57.6	1	-7.5	0.36	0.09	0.09	0.09	0.09	0.28
136	HAS02	Äspö						2250	28	741	244	219	5160	155	-63.7	1	-7.8	0.34	0.09	0.09	0.09	0.09	0.30
137	HAS03	Äspö						335	14	80	36	235	574	98	-76.4	33	-10.8	0.03	0.03	0.03	0.03	0.54	0.34
138	HAS03	Äspö						336	12	87	39	235	608	104	-80.5	35	-10.9	0.03	0.03	0.03	0.03	0.60	0.28
139	HAS05	Äspö						228	4	27	4	373	123	118	-68.7	1	-9.8	0.00	0.00	0.00	0.00	0.42	0.56
140	HAS05	Äspö						237	4	25	6	370	119	118	-73.8	2	-9.9	0.01	0.01	0.01	0.01	0.47	0.50
141	HAS06	Äspö						254	3	44	11	271	280	96	-73.3	24	-10.2	0.02	0.02	0.02	0.02	0.56	0.38
142	HAS06	Äspö						900	12	297	56	155	1760	283	-66.6	11	-9.4	0.07	0.07	0.07	0.07	0.37	0.37
143	HAS07	Äspö						669	5	347	48	102	1650	122	-81.2	1	-11.2	0.06	0.06	0.06	0.08	0.69	0.06
144	HAS07	Äspö						656	5	361	55	106	1740	116	-83.4	1	-11.4	0.06	0.06	0.06	0.10	0.68	0.06
145	HAS13	Äspö						1880	32.8	1040	219	132	5070	136	-69.3	1.2	-7.2	0.28	0.10	0.10	0.10	0.10	0.34
146	HBH01	Äspö						8.6	2.3	41.3	4	137	11.3	24.5	-67.3	34	-8.8	0.01	0.01	0.01	0.01	0.52	0.43

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
147	HBH01	Äspö						487	6.7	257	37.6	222	1200	130.035	-74.7	34	-10	0.04	0.04	0.04	0.04	0.53	0.33
148	HBH01	Äspö						494	5.9	224	34.8	237	1080	131.833	-74.7	42	-10.1	0.03	0.03	0.03	0.03	0.53	0.33
149	HBH01	Äspö						482	5.8	211	34.3	243	1056	126	-75.8	34	-10.3	0.03	0.03	0.03	0.03	0.56	0.31
150	HBH01	Äspö						441	5	180	30.2	260	932	130	-79.3	17	-10.7	0.03	0.03	0.03	0.03	0.62	0.26
151	HBH01	Äspö						426	4.8	166	26.1	270	869	132.732	-78.3	17	-10.3	0.03	0.03	0.03	0.03	0.58	0.31
152	HBH01	Äspö						434	6.4	169	26.8	280	843	142	-77.8	25	-10.2	0.03	0.03	0.03	0.03	0.55	0.34
153	HBH01	Äspö						420	7.1	163	26.5	280	833	137.526	-78.1	17	-9.7	0.03	0.03	0.03	0.03	0.51	0.38
154	HBH01	Äspö						421	5.7	162	27	286	812	134	-76.9	17	-9.8	0.03	0.03	0.03	0.03	0.51	0.39
155	HBH01	Äspö						391	5.6	144	23.7	288	737	136	-76.7	25	-9.6	0.02	0.02	0.02	0.02	0.50	0.41
156	HBH01	Äspö						390	5.7	144	22.8	291	739	138	-73.8	9.3	-9.7	0.02	0.02	0.02	0.02	0.48	0.43
157	HBH01	Äspö						369	5	130	21.4	294	654	140	-72.4	9.3	-9.7	0.02	0.02	0.02	0.02	0.47	0.45
158	HBH01	Äspö						361	3.7	120	19.9	291	610	128	-70.1	15	-9.9	0.02	0.02	0.02	0.02	0.47	0.45
159	HBH01	Äspö						356	5.5	118	19.7	292	598	128.537	-68	14	-10	0.02	0.02	0.02	0.02	0.45	0.47
160	HBH01	Äspö						321	4.3	108	21.3	299	519	129	-71	22	-9.9	0.02	0.02	0.02	0.02	0.47	0.46
161	HBH01	Äspö						304	4	94.3	15.8	305	476	123	-75.1	25	-9.9	0.02	0.02	0.02	0.02	0.52	0.41
162	HBH01	Äspö						312	5	98.2	16.8	311	484	125	-71.4	14	-9.8	0.02	0.02	0.02	0.02	0.46	0.47
163	HBH01	Äspö						349	5.1	115	19.1	309	461	104.747	-71.8	22	-9.7	0.02	0.02	0.02	0.02	0.46	0.48
164	HBH01	Äspö						346	5	113	20.2	310	515	124.642	-73.2	16	-9.5	0.02	0.02	0.02	0.02	0.45	0.48
165	HBH01	Äspö						348	5	115	20.5	311	529	125.84	-63.9	26	-9.5	0.01	0.01	0.01	0.01	0.36	0.58
166	HBH01	Äspö						305	4.6	97.6	17.8	315	450	114.155	-67.8	25	-9.5	0.01	0.01	0.01	0.01	0.41	0.54
167	HBH01	Äspö						260.5	3.29	82.1	14.3	311	352	105.017	-68.5	14.4	-9.8	0.01	0.01	0.01	0.01	0.45	0.50
168	HBH01	Äspö						262.9	3.23	81	14.3	319	348	104.178	-68.6	14.4	-9.8	0.01	0.01	0.01	0.01	0.45	0.51
169	HBH02	Äspö						11.5	2.3	15.4	1.9	63	5	13.1833	-77.1	59	-10.2	0.02	0.02	0.02	0.02	0.76	0.14
170	HBH02	Äspö						11.9	2.6	45	3.6	142	19.1	19.9	-72.9	42	-9.7	0.02	0.02	0.02	0.02	0.63	0.31
171	HBH02	Äspö						21.1	1.7	34.5	3.2	137	13.5	24.2692	-71.7	42	-10	0.02	0.02	0.02	0.02	0.65	0.28
172	HBH02	Äspö						5.3	1.7	16.7	2.4	40	8.3	17.5	-61.6	25	-8.5	0.02	0.02	0.02	0.02	0.51	0.41
173	HBH02	Äspö						6.2	1.3	20.8	3.4	70	10.4	18.4	-63.6	17	-7.9	0.02	0.02	0.02	0.02	0.47	0.47
174	HBH02	Äspö						5.3	1	16.7	4	65	9.6	15.4	-70.8	25	-8.9	0.02	0.02	0.02	0.02	0.61	0.31
175	HBH02	Äspö						5.5	1	17.1	3.1	53	10.6	16.2	-64.9	20	-8	0.02	0.02	0.02	0.02	0.50	0.43
176	HBH02	Äspö						5.6	1	17.9	5.6	65	9.2	15.1	-65.6	12	-9.1	0.02	0.02	0.02	0.02	0.57	0.35
177	HBH02	Äspö						5.4	1.1	16.3	2.2	64	10.3	15.1907	-62.6	23	-9.9	0.02	0.02	0.02	0.02	0.61	0.31
178	HBH02	Äspö						5.4	1.2	20.9	3.7	63	12.4	15.7	-62.5	16	-9.5	0.02	0.02	0.02	0.02	0.58	0.34
179	HBH02	Äspö						6.2	1.4	25.9	3.2	74	12.8	20.9	-71.7	18	-9.4	0.02	0.02	0.02	0.02	0.65	0.27
180	HBH02	Äspö						6.4	1.4	25.1	3.3	70	9.9	20.6	-66	29	-9.2	0.02	0.02	0.02	0.02	0.58	0.34
181	HBH02	Äspö						6.7	1.4	27.5	3.3	77	7.8	18.6663	-64.8	20	-8.6	0.02	0.02	0.02	0.02	0.52	0.41
182	HBH02	Äspö						8	1.3	28.4	4.9	79	17.7	18.2469	-65.7	24	-8.5	0.02	0.02	0.02	0.02	0.52	0.41
183	HBH02	Äspö						6.4	1.2	21.4	2.8	55	12.1	17.7675	-63.3	37	-9.1	0.02	0.02	0.02	0.02	0.56	0.36

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
184	HBH02	Äspö						10.3	1.7	42.5	3.3	114	6	19.1757	-72.9	42	-9.7	0.02	0.02	0.02	0.02	0.65	0.27
185	HBH05	Äspö						15.4	2.6	38.4	4	137	11.2	23	-75.3	25	-9.6	0.02	0.02	0.02	0.02	0.65	0.29
186	HBH05	Äspö						16.6	2.5	39.2	4.3	143	11.7	22.34	-75.8	34	-9.5	0.02	0.02	0.02	0.02	0.64	0.30
187	HBH05	Äspö						19.2	3	38.5	3.8	162	12	21.5	-68.4	22	-9.9	0.01	0.01	0.01	0.01	0.58	0.36
188	HBH05	Äspö						19.4	2.7	40.4	4.5	165	19.9	16.6	-65.1	22	-8.8	0.01	0.01	0.01	0.01	0.47	0.49
189	HBH05	Äspö						25.4	2.6	42.6	8.8	172	27.6	36.5536	-64.7	24	-9.4	0.01	0.01	0.01	0.01	0.50	0.45
190	KA0483A	Äspö						1480	9.1	1250	132	42	4890	60	-85.9	8	-11.3	0.09	0.09	0.09	0.22	0.41	0.09
191	KA1639A	Äspö						2005	6.8	1711	66.7	22	6290	434.449	-89.8	5.1	-12.1	0.10	0.10	0.15	0.44	0.10	0.10
192	KA1639A	Äspö						1995	6.8	1723	67.6	25	6390	437.445	-91.2	8.4	-12.1	0.10	0.10	0.15	0.44	0.10	0.10
193	KA1639A	Äspö						2113	6.8	1900	68.3	23	6950	485	-90.2	4.2	-12.4	0.10	0.10	0.17	0.44	0.10	0.10
194	KA1639A	Äspö						2218	8.2	1967	68.3	23	6960	479.392	-89.1	4.2	-12.4	0.10	0.10	0.17	0.43	0.10	0.10
195	KA1639A	Äspö						1670	6.3	773	38.8	15	4260	123.144	-108	12	-14.6	0.08	0.08	0.08	0.59	0.10	0.08
196	KA1639A	Äspö						1626	6	733	41	17	4060	114.455	-111	7.6	-14.7	0.07	0.07	0.07	0.60	0.10	0.07
197	KA1639A	Äspö						1620	6	774	45.9	19	4230	130	-107	4.2	-14.2	0.08	0.08	0.08	0.56	0.13	0.08
198	KA1750A	Äspö						1907	7.4	1540	76.4	37	6310	431.453	-89.6	4.2	-11.5	0.11	0.11	0.14	0.41	0.11	0.11
199	KA1750A	Äspö						1986	6.9	1607	70.7	33	6030	434.449	-86.2	5.1	-11.4	0.11	0.11	0.14	0.41	0.11	0.11
200	KA1750A	Äspö						2003	7	1630	69	31	6320	449.43	-80	8.4	-11.6	0.12	0.12	0.14	0.39	0.12	0.12
201	KA1750A	Äspö						2062	7.8	1684	71.2	33	6230	461.415	-83.5	4.2	-11.4	0.12	0.12	0.15	0.39	0.12	0.12
202	KA1755A	Äspö						2682.1	9.3	3400.3	40.7	9	10407.2	640.3	-91.9	8.45	-13.1	0.07	0.07	0.26	0.45	0.07	0.07
203	KA2162B	Äspö						2200	15	1260	166	102	5940	311.605	-60.2	4.2	-8.7	0.13	0.13	0.13	0.13	0.13	0.37
204	KA2162B	Äspö						2150	13	1330	153	116	5990	314.601	-61.5	4.2	-8.9	0.12	0.12	0.12	0.12	0.18	0.32
205	KA2162B	Äspö						2130	12	1420	126	96	6070	329.582	-73.5	4.2	-9.6	0.13	0.13	0.13	0.17	0.31	0.13
206	KA2512A	Äspö						1877	10	903	117	196	4750.7	302.017	-63.8	11	-8.1	0.10	0.10	0.10	0.10	0.16	0.46
207	KA2858A	Äspö						2630	9.7	3360	49.7	9	10300	577	-96.6	8.5	-13.1	0.07	0.07	0.25	0.47	0.07	0.07
208	KA2862A	Äspö						3230	13.6	4720	41.4	8	13300	666	-90.8	8.5	-12.7	0.06	0.06	0.33	0.41	0.06	0.06
209	KA2862A	Äspö						3160	13.6	4600	46.5	8	13200	667	-91.3	8.5	-12.5	0.07	0.07	0.32	0.41	0.07	0.07
210	KA3005A	Äspö						1730	12.5	1160	84.9	81	4870	288	-76	15.2	-9.7	0.11	0.11	0.11	0.16	0.40	0.11
211	KA3005A	Äspö						1740	12.7	1310	85.6	57	5400	305	-80.5	8.5	-10	0.12	0.12	0.12	0.24	0.30	0.12
212	KA3005A	Äspö						1730	13.63	1191.4	82.5	93	4878.3	350.6	-75.5	30	-10	0.12	0.12	0.12	0.18	0.36	0.12
213	KA3010A	Äspö						1820	15.5	1530	90.5	56	5770	315	-80.3	8.5	-10.5	0.12	0.12	0.12	0.27	0.24	0.12
214	KA3010A	Äspö						1890	15.1	1820	82.2	43	6600	336	-87.9	8.5	-11.3	0.12	0.12	0.13	0.39	0.12	0.12
215	KA3067A	Äspö						1720	11.8	1510	85.9	53	5650	307	-81.2	8.5	-10.6	0.12	0.12	0.12	0.29	0.24	0.12
216	KA3067A	Äspö						2374.3	12.72	2705.6	49.3	10	8584.9	426.299	-95.2	14	-13	0.08	0.08	0.20	0.47	0.08	0.08
217	KA3067A	Äspö						1880	11.2	1950	66.6	26	6560	350	-91.1	8.5	-11.7	0.11	0.11	0.14	0.43	0.11	0.11
218	KA3105A	Äspö						1400	9.5	856	97.6	102	3960	243	-72.4	22	-9.4	0.09	0.09	0.09	0.09	0.43	0.19
219	KA3105A	Äspö						1260	8	754	101	125	3520	217	-73.5	8.5	-8.7	0.08	0.08	0.08	0.08	0.38	0.29
220	KA3110A	Äspö						1590	26	585	131	164	3820	273	-60.7	27	-7.7	0.18	0.09	0.09	0.09	0.09	0.48

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
221	KA3110A	Äspö						1600	20	656	133	161	3940	286	-64.3	11.8	-9.2	0.10	0.10	0.10	0.10	0.16	0.46
222	KA3191F	Äspö						2128.5	9.51	1722.5	90	61	6691.8	368	-76.7	12.7	-10.4	0.13	0.13	0.13	0.32	0.15	0.13
223	KA3191F	Äspö						2225.3	8.55	2093.1	64.3	29	7409.7	444.666	-81.6	8.4	-11.2	0.11	0.11	0.16	0.38	0.11	0.11
224	KA3385A	Äspö						2080	8.5	1861	60.5	10	6650	443	-79.3	9.3	-10.4	0.12	0.12	0.15	0.36	0.12	0.12
225	KA3385A	Äspö						2090	8.4	1860	63.1	10	6710	450	-81.8	8.5	-10.5	0.12	0.12	0.15	0.37	0.12	0.12
226	KAS02	Äspö						1300	6.6	990	65	71	3820	106	-109	0.3	-13.9	0.07	0.07	0.07	0.48	0.23	0.07
227	KAS02	Äspö						1710	8.8	1480	75	33	5360	291	-99.8	8	-12.7	0.10	0.10	0.11	0.49	0.10	0.10
228	KAS02	Äspö						1150	7.5	671	48.5	138	3250	200	-94.9	8	-13.3	0.07	0.07	0.07	0.32	0.39	0.07
229	KAS02	Äspö						1700	9	1540	72	27	5340	270	-101	8	-12.3	0.10	0.10	0.11	0.49	0.10	0.10
230	KAS02	Äspö						1800	8.1	1580	66	25	5440	290	-99.9	8	-12.8	0.10	0.10	0.12	0.50	0.10	0.10
231	KAS02	Äspö						2100	8.1	1890	42	10	6410	560	-97.2	8	-12.3	0.09	0.09	0.18	0.47	0.09	0.09
232	KAS02	Äspö						2850	13.7	3310	30.1	25	10200	668.153	-99.7	8	-13.6	0.06	0.06	0.27	0.48	0.06	0.06
233	KAS02	Äspö						2850	11.5	3690	31	7	11100	522	-96.8	8	-13	0.07	0.07	0.26	0.47	0.07	0.07
234	KAS02	Äspö						3000	10.9	3830	31	11	11100	519	-96.8	0.2	-13.1	0.06	0.06	0.27	0.47	0.06	0.06
235	KAS03	Äspö						613	2.4	162	21	61	1220	31.1	-125	0.1	-15.8	0.03	0.03	0.03	0.57	0.32	0.03
236	KAS03	Äspö						1200	6.3	472	61	54	2850	31.89	-115	8	-14.6	0.05	0.05	0.05	0.50	0.28	0.05
237	KAS03	Äspö						1290	6.5	490	58	53	2950	39	-118	8	-14.5	0.06	0.06	0.06	0.52	0.25	0.06
238	KAS03	Äspö						1770	5.9	1400	40	12	5180	370	-105	8	-13.3	0.08	0.08	0.13	0.55	0.08	0.08
239	KAS03	Äspö						1550	6.2	1190	40	27	4600	300	-110	8	-13.6	0.08	0.08	0.10	0.57	0.08	0.08
240	KAS03	Äspö						1340	5.8	659	47.8	48	3360	167.398	-116	8	-14.9	0.07	0.07	0.07	0.60	0.13	0.07
241	KAS03	Äspö						1340	5.8	800	42.8	49	3530	175.877	-111	5.1	-14.6	0.07	0.07	0.07	0.57	0.15	0.07
242	KAS03	Äspö						1370	5.5	872	45.7	42	3840	198.049	-108	4.2	-14.4	0.08	0.08	0.08	0.57	0.13	0.08
243	KAS03	Äspö						1626.8	7.1	1263.8	44.3	33	4701.1	274.841	-106	5	-13.9	0.08	0.08	0.10	0.56	0.08	0.08
244	KAS03	Äspö						1450	6.9	964	48.4	38	4230	212.431	-109	4	-14.3	0.08	0.08	0.08	0.58	0.10	0.08
245	KAS03	Äspö						1564	6.7	1162	48.4	38	4637	270	-106	6.8	-13.6	0.09	0.09	0.09	0.56	0.09	0.09
246	KAS03	Äspö						1920	6.2	1740	38	11	5880	470	-103	8	-13.3	0.08	0.08	0.16	0.53	0.08	0.08
247	KAS03	Äspö						2130	6.6	2670	45	11	8080	680	-99.7	8	-13	0.07	0.07	0.22	0.48	0.07	0.07
248	KAS03	Äspö						3020	7.3	4380	49.5	11	12300	709	-96.4	0.4	-12.7	0.06	0.06	0.31	0.44	0.06	0.06
249	KAS04	Äspö						382	2.4	91	6.2	222	508	180	-84.8	4.3	-11	0.04	0.04	0.04	0.04	0.76	0.09
250	KAS04	Äspö						1060	8	597	24.9	69	2760	207	-103	8	-13.6	0.07	0.07	0.07	0.44	0.29	0.07
251	KAS04	Äspö						1180	6.1	740	30	69	3030	220	-99.6	0.5	-13	0.07	0.07	0.07	0.41	0.30	0.07
252	KAS04	Äspö						1890	7.8	1660	61	21	5840	407	-92.3	0.03	-11.9	0.10	0.10	0.14	0.45	0.10	0.10
253	KAS05	Äspö						1490	8.6	1070	53.5	97	4500	116	-100	8	-13.3	0.08	0.08	0.08	0.42	0.27	0.08
254	KAS05	Äspö						2270	7.7	2020	42.7	12	7290	576	-95.6	8	-12.9	0.08	0.08	0.19	0.47	0.08	0.08
255	KAS05	Äspö						2450	10	2560	42.1	5	8402	534	-96.8	8.4	-13	0.08	0.08	0.21	0.48	0.08	0.08
256	KAS06	Äspö						945	5.5	484	48.8	135	2450	117	-94	8	-12	0.06	0.06	0.06	0.21	0.56	0.06
257	KAS06	Äspö						1230	7.4	893	82	89	3630	150	-94.3	3.8	-10.9	0.08	0.08	0.08	0.23	0.45	0.08

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
258	KAS06	Äspö						1820	9.1	1490	119	49	5680	283	-77.8	0.3	-9.2	0.12	0.12	0.12	0.19	0.33	0.12
259	KAS06	Äspö						2070	11.7	1410	153	64	5970	362	-69.2	0.6	-7.4	0.13	0.13	0.13	0.13	0.19	0.29
260	KAS06	Äspö						2000	11	1280	126	52	5670	357	-77.7	8	-9.2	0.13	0.13	0.13	0.19	0.29	0.13
261	KAS06	Äspö						2200	11.1	1570	130	50	6150	459	-70.8	3.5	-8.2	0.15	0.15	0.15	0.17	0.25	0.15
262	KAS07	Äspö						971	8.1	522	39.3	167	2460	205	-87.1	8	-11.2	0.07	0.07	0.07	0.13	0.60	0.07
263	KAS07	Äspö						1540	11	655	126	182	3810	347.559	-65.3	24	-8.1	0.09	0.09	0.09	0.09	0.15	0.49
264	KAS07	Äspö						1479	10.81	559	125	335	3743.8	74.3956	-65.4	22	-8	0.05	0.05	0.05	0.05	0.07	0.74
265	KAS07	Äspö						1940	9.8	1650	50.1	18	6060	486	-94.2	25	-12.1	0.10	0.10	0.15	0.45	0.10	0.10
266	KAS07	Äspö						1980	10.2	1600	51.2	52	6120	452.426	-89.1	9	-11.3	0.11	0.11	0.14	0.41	0.11	0.11
267	KAS07	Äspö						1890	9.5	1610	59.6	13	5960	446	-80.4	12.7	-11.2	0.12	0.12	0.14	0.39	0.12	0.12
268	KAS08	Äspö						450	4	164	18.9	237	918	87	-89.4	8	-11.5	0.03	0.03	0.03	0.03	0.81	0.05
269	KAS08	Äspö						2000	8.3	1670	64.3	27	6300	413	-84.3	8	-10.8	0.12	0.12	0.14	0.39	0.12	0.12
270	KAS08	Äspö						2180	13.3	1522	144.8	63	6452	391	-73.8	13	-9.2	0.14	0.14	0.14	0.19	0.25	0.14
271	KAS09	Äspö						1790	33.2	403	152	396	3820	228	-61.9	25	-7.4	0.34	0.06	0.06	0.06	0.06	0.44
272	KAS09	Äspö						1770	40	291	148	264	3541.8	352	-56.2	35	-7.1	0.42	0.08	0.08	0.08	0.08	0.28
273	KAS09	Äspö						1700	42.5	268	150	240	3390	362.54	-55.8	10	-6.7	0.45	0.08	0.08	0.08	0.08	0.24
274	KAS09	Äspö						1628	38	219	144.8	206	3162	363	-58.8	30	-7.1	0.35	0.08	0.08	0.08	0.08	0.32
275	KAS09	Äspö						1490	39.5	191	141	192	2930	364	-51.5	38	-6.9	0.41	0.08	0.08	0.08	0.08	0.29
276	KAS09	Äspö						1465.1	33.89	198.9	139.7	175	2804.3	298.34	-56.7	33.8	-7	0.31	0.07	0.07	0.07	0.07	0.40
277	KAS12	Äspö						1440	11.3	891	91.5	76	4220	171	-90.7	8	-11.4	0.09	0.09	0.09	0.25	0.39	0.09
278	KAS12	Äspö						1460	12	880	84.4	103	4158.6	168	-86.1	5.1	-11.2	0.09	0.09	0.09	0.20	0.45	0.09
279	KAS12	Äspö						1650	12.5	1070	107	61	4860	232.505	-82	4	-10.5	0.11	0.11	0.11	0.20	0.37	0.11
280	KAS13	Äspö						350	4.6	83	11.4	294	543	112	-83.4	17	-11.1	0.02	0.02	0.02	0.02	0.69	0.22
281	KAS13	Äspö						894	10.9	408	44.2	188	2160	190	-92.2	8	-11.9	0.06	0.06	0.06	0.15	0.60	0.06
282	KAS14	Äspö						1775	46.81	265	156.2	349	3403.5	350	-57.8	29	-6.8	0.50	0.07	0.07	0.07	0.07	0.23
283	KAS14	Äspö						1766	47.36	271	154.8	328	3399.9	361	-56.6	29	-7.1	0.49	0.07	0.07	0.07	0.07	0.23
284	KBH02	Äspö						1870	20.5	692	154	366	4320	212.73	-58.1	14	-7.2	0.29	0.06	0.06	0.06	0.06	0.47
285	KBH02	Äspö						1850	19.4	647	158	354	4350	210	-52	4	-7.3	0.33	0.06	0.06	0.06	0.06	0.44
286	KBH02	Äspö						1800	21	638	160	340	4210	227.412	-52.4	10	-7.3	0.33	0.06	0.06	0.06	0.06	0.42
287	KR0012B	Äspö						352	2	143	15.4	198	695	70	-82.1	34	-11.4	0.03	0.03	0.03	0.03	0.78	0.09
288	KR0012B	Äspö						410	2	200	22	185	915	62	-83.2	25	-11.5	0.03	0.03	0.03	0.03	0.80	0.06
289	KR0012B	Äspö						629	5	280	37.8	243	1360	133.631	-76.4	25	-10.2	0.04	0.04	0.04	0.04	0.55	0.29
290	KR0012B	Äspö						604	4.9	268	37.7	245	1330	134.23	-77.3	25	-10.2	0.04	0.04	0.04	0.04	0.56	0.29
291	KR0012B	Äspö						597	5.1	255	36.9	248	1290	131.234	-80.5	34	-9.9	0.04	0.04	0.04	0.04	0.57	0.29
292	KR0012B	Äspö						591	5.2	252	37.2	250	1300	138.724	-77.6	51	-10.3	0.04	0.04	0.04	0.04	0.57	0.28
293	KR0012B	Äspö						572	4.9	235	34.9	250	1270	125	-76.8	34	-11	0.04	0.04	0.04	0.04	0.62	0.24
294	KR0012B	Äspö						540	4.7	213	31.9	260	1130	147	-77.5	25	-10.2	0.03	0.03	0.03	0.03	0.56	0.30

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
295	KR0012B	Äspö						539	4.9	206	31.1	260	1110	140	-81.1	17	-10.3	0.03	0.03	0.03	0.03	0.60	0.26
296	KR0012B	Äspö						527	4.6	206	31.1	270	1130	139	-79.7	17	-10.4	0.03	0.03	0.03	0.03	0.59	0.28
297	KR0012B	Äspö						526	4.5	200	29.5	280	1070	141	-80.2	8	-10.4	0.03	0.03	0.03	0.03	0.59	0.28
298	KR0012B	Äspö						522	4.5	196	29.6	280	1040	147	-80.5	17	-10.4	0.03	0.03	0.03	0.03	0.60	0.28
299	KR0012B	Äspö						516	5.5	195	28.5	280	1080	143	-78.3	17	-10.3	0.03	0.03	0.03	0.03	0.56	0.31
300	KR0012B	Äspö						513	5.5	191	29.1	280	1000	132	-80.3	17	-9.8	0.03	0.03	0.03	0.03	0.55	0.34
301	KR0012B	Äspö						510	7	187	28	280	1020	148	-79.4	17	-9.9	0.03	0.03	0.03	0.03	0.53	0.34
302	KR0012B	Äspö						503	5.5	187	28.3	292	1010	133	-81.1	17	-9.8	0.03	0.03	0.03	0.03	0.55	0.34
303	KR0012B	Äspö						497	5	186	27.9	292	970	176	-79.9	17	-9.9	0.03	0.03	0.03	0.03	0.54	0.33
304	KR0012B	Äspö						486	4.8	178	27.1	296	934	140	-78.5	25	-9.7	0.03	0.03	0.03	0.03	0.52	0.38
305	KR0012B	Äspö						478	5.3	171	25.7	301	918	141.421	-78.7	17	-9.8	0.03	0.03	0.03	0.03	0.52	0.37
306	KR0012B	Äspö						475	5	168	22.9	299	932	150	-72.4	10	-9.8	0.03	0.03	0.03	0.03	0.47	0.43
307	KR0012B	Äspö						471	5	159	21.7	302	888	148	-72.3	4.2	-9.1	0.02	0.02	0.02	0.02	0.42	0.49
308	KR0012B	Äspö						468	4.3	163	24.7	307	876	137	-72.4	18	-9.7	0.02	0.02	0.02	0.02	0.46	0.45
309	KR0012B	Äspö						452	5.2	155	23.8	306	823	127	-72.9	9.3	-9.8	0.02	0.02	0.02	0.02	0.47	0.44
310	KR0012B	Äspö						452	4.2	153	23.3	304	835	157	-72.9	20	-9.8	0.02	0.02	0.02	0.02	0.47	0.43
311	KR0012B	Äspö						461	4.5	156	23.7	311	840	142	-71.9	11	-9.8	0.02	0.02	0.02	0.02	0.46	0.45
312	KR0012B	Äspö						453	5	144	22.3	306	780	124	-68.1	12	-9.9	0.02	0.02	0.02	0.02	0.43	0.48
313	KR0012B	Äspö						445	5.1	146	22.7	306	789	128	-69.2	15	-9.7	0.02	0.02	0.02	0.02	0.43	0.49
314	KR0012B	Äspö						424	4.3	136	25.1	315	710	142	-72	17	-9.9	0.02	0.02	0.02	0.02	0.46	0.45
315	KR0012B	Äspö						406	4.5	118	18.6	307	662	143	-75.1	18	-9.9	0.02	0.02	0.02	0.02	0.51	0.41
316	KR0012B	Äspö						403	4.8	120	19.1	316	645	130	-74.1	27	-9.9	0.02	0.02	0.02	0.02	0.49	0.43
317	KR0012B	Äspö						411	4.5	126	20.1	317	665	137	-74.1	21	-9.6	0.02	0.02	0.02	0.02	0.47	0.46
318	KR0012B	Äspö						387	4.3	118	20.4	324	619	134.529	-69.6	34	-9.6	0.02	0.02	0.02	0.02	0.42	0.51
319	KR0012B	Äspö						346.6	3.37	100.1	17.4	325	500	125.601	-68.1	25.3	-9.8	0.01	0.01	0.01	0.01	0.43	0.51
320	KR0012B	Äspö						343.9	3.5	100.2	17.9	326	531.8	128.687	-67.9	30.4	-9.6	0.01	0.01	0.01	0.01	0.41	0.53
321	KR0012B	Äspö						381.3	4.5	109.5	21.7	308	608.4	129.825	-68.8	16.9	-9.4	0.02	0.02	0.02	0.02	0.41	0.52
322	KR0012B	Äspö						375.3	4.54	115.9	23.2	295	642.4	119.64	-66.7	42	-9.5	0.02	0.02	0.02	0.02	0.40	0.53
323	KR0013B	Äspö						876	4.8	571	63.7	133	2500	83	-93.3	17	-11.4	0.06	0.06	0.06	0.16	0.61	0.06
324	KR0013B	Äspö						986	4.7	535	71.5	237	2460	148.612	-78.5	25	-10.3	0.06	0.06	0.06	0.06	0.54	0.24
325	KR0013B	Äspö						964	5.1	540	75.5	243	2450	146.814	-81.4	17	-10.4	0.06	0.06	0.06	0.06	0.56	0.22
326	KR0013B	Äspö						926	4.5	502	70.3	245	2340	142.619	-77.8	34	-10.1	0.05	0.05	0.05	0.05	0.52	0.28
327	KR0013B	Äspö						913	6.3	490	71.3	250	2340	148.612	-77.2	34	-10.1	0.05	0.05	0.05	0.05	0.49	0.30
328	KR0013B	Äspö						888	6.4	466	65.7	260	2290	140	-78.9	34	-10.5	0.05	0.05	0.05	0.05	0.54	0.26
329	KR0013B	Äspö						851	4.1	440	64	260	2150	136	-80.1	25	-10.4	0.05	0.05	0.05	0.05	0.56	0.25
330	KR0013B	Äspö						848	4	433	61.9	270	2130	148	-80	8	-10.4	0.05	0.05	0.05	0.05	0.56	0.26
331	KR0013B	Äspö						836	4.1	424	61	270	2110	149	-79.8	8	-10.3	0.05	0.05	0.05	0.05	0.55	0.27

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
332	KR0013B	Äspö						821	4	413	58.2	280	2040	150	-80.6	17	-10.3	0.04	0.04	0.04	0.04	0.55	0.27
333	KR0013B	Äspö						831	4	413	58.8	280	2020	153	-80	17	-10.3	0.05	0.05	0.05	0.05	0.55	0.27
334	KR0013B	Äspö						806	6.3	405	57.7	290	1990	148	-81.3	17	-10.4	0.04	0.04	0.04	0.04	0.55	0.28
335	KR0013B	Äspö						802	4.9	398	59.1	290	1920	146	-81.1	8	-9.9	0.04	0.04	0.04	0.04	0.51	0.32
336	KR0013B	Äspö						795	5.8	386	55.3	290	1900	146	-80	17	-10	0.04	0.04	0.04	0.04	0.51	0.32
337	KR0013B	Äspö						776	4.7	378	55	299	1880	135	-81.9	8	-9.9	0.04	0.04	0.04	0.04	0.53	0.32
338	KR0013B	Äspö						764	4.4	378	54.7	300	1840	148	-80.2	17	-9.9	0.04	0.04	0.04	0.04	0.51	0.33
339	KR0013B	Äspö						749	4	365	52.7	299	1800	147	-80.1	25	-9.8	0.04	0.04	0.04	0.04	0.51	0.34
340	KR0013B	Äspö						742	3.9	359	50.9	305	1750	145	-80	25	-9.7	0.04	0.04	0.04	0.04	0.50	0.35
341	KR0013B	Äspö						793	4.6	384	51.9	293	1920	145.016	-75.7	4.2	-9.9	0.04	0.04	0.04	0.04	0.47	0.37
342	KR0013B	Äspö						745	4.5	360	48	307	1740	143	-74.6	14	-9.9	0.04	0.04	0.04	0.04	0.46	0.40
343	KR0013B	Äspö						740	4.7	353	51.1	308	1740	137	-73.2	5.9	-9.9	0.03	0.03	0.03	0.03	0.44	0.42
344	KR0013B	Äspö						734	4.6	343	50.6	309	1690	127	-74.6	14	-9.9	0.03	0.03	0.03	0.03	0.46	0.41
345	KR0013B	Äspö						736	3.7	342	49.5	313	1680	146	-74.6	14	-9.9	0.03	0.03	0.03	0.03	0.46	0.40
346	KR0013B	Äspö						743	4	347	50.5	310	1790	128	-72.7	26	-9.9	0.03	0.03	0.03	0.03	0.44	0.42
347	KR0013B	Äspö						721	4.5	330	47.7	315	1650	123	-70.8	9.3	-10	0.03	0.03	0.03	0.03	0.43	0.45
348	KR0013B	Äspö						751	4.7	351	51.6	305	1690	126	-67.9	10	-9.9	0.03	0.03	0.03	0.03	0.39	0.47
349	KR0013B	Äspö						740	4	343	53.5	311	1690	134	-72.8	19	-9.9	0.03	0.03	0.03	0.03	0.44	0.43
350	KR0013B	Äspö						735	4.2	328.8	49.8	307	1710	144	-75.9	15	-10	0.04	0.04	0.04	0.04	0.48	0.38
351	KR0013B	Äspö						769	4.7	346	52.2	307	1720	148	-72.2	47	-9.8	0.04	0.04	0.04	0.04	0.43	0.43
352	KR0013B	Äspö						830.6	4.5	384	57	297	1870	147.413	-75.8	19	-9.7	0.04	0.04	0.04	0.04	0.45	0.39
353	KR0013B	Äspö						860	4.8	403	64	298	2010	153.405	-70.7	24	-9.8	0.04	0.04	0.04	0.04	0.40	0.44
354	KR0013B	Äspö						784.8	4.1	339.3	56.5	289	1790	147.173	-68.7	27	-9.7	0.04	0.04	0.04	0.04	0.39	0.46
355	KR0013B	Äspö						737	4.05	324.2	54.5	291	1737.2	147.982	-68.3	21.1	-9.4	0.03	0.03	0.03	0.03	0.37	0.49
356	KR0013B	Äspö						715.7	4.2	308.5	52.2	273	1520.9	142.709	-69.8	17.7	-9.3	0.03	0.03	0.03	0.03	0.39	0.47
357	KR0013B	Äspö						619.5	4	269.9	47.1	267	1458.9	125.53	-70.6	71	-9.5	0.03	0.03	0.03	0.03	0.43	0.44
358	KR0015B	Äspö						1060	5	679	74.2	122	3050	89	-86.8	17	-11.6	0.07	0.07	0.07	0.16	0.58	0.07
359	KR0015B	Äspö						578	3.2	247	30.6	342	1150	129.136	-81.9	25	-10.7	0.03	0.03	0.03	0.03	0.60	0.29
360	KR0015B	Äspö						720	4	345	48.6	320	1500	146.814	-80.7	25	-10.6	0.04	0.04	0.04	0.04	0.56	0.29
361	KR0015B	Äspö						641	3.7	296	40.4	327	1480	133.331	-81.1	25	-10.4	0.03	0.03	0.03	0.03	0.56	0.31
362	KR0015B	Äspö						531	3.3	228	30.4	348	1140	129.436	-83.6	42	-10.5	0.02	0.02	0.02	0.02	0.60	0.30
363	KR0015B	Äspö						504	3.1	207	26.5	360	1020	133	-78.9	34	-10.5	0.02	0.02	0.02	0.02	0.55	0.36
364	KR0015B	Äspö						553	3.1	233	31.5	360	1120	138	-82.2	17	-10.6	0.02	0.02	0.02	0.02	0.58	0.32
365	KR0015B	Äspö						558	3.5	238	32.4	370	1120	140	-82.4	17	-10.7	0.02	0.02	0.02	0.02	0.58	0.32
366	KR0015B	Äspö						635	3.7	279	38.5	360	1300	144	-80.1	17	-10.8	0.03	0.03	0.03	0.03	0.56	0.33
367	KR0015B	Äspö						562	3.2	235	31.8	370	1130	141	-81.3	17	-10.9	0.02	0.02	0.02	0.02	0.59	0.32
368	KR0015B	Äspö						562	3.2	229	31.1	370	1250	145	-82.3	17	-10.6	0.02	0.02	0.02	0.02	0.58	0.33

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
369	KR0015B	Äspö						552	4	229	30.8	380	1120	146	-82.6	25	-10.7	0.02	0.02	0.02	0.02	0.57	0.33
370	KR0015B	Äspö						589	4.1	245	35.2	380	1170	162	-80.6	17	-10.2	0.02	0.02	0.02	0.02	0.51	0.39
371	KR0015B	Äspö						527	4.6	210	28.2	390	1040	145	-81.9	17	-10.2	0.02	0.02	0.02	0.02	0.52	0.39
372	KR0015B	Äspö						520	3.7	205	27.9	393	1040	147	-68.2	8	-7.9	0.01	0.01	0.01	0.01	0.23	0.72
373	KR0015B	Äspö						477	3.3	186	25.1	396	876	140	-82.3	25	-10.1	0.02	0.02	0.02	0.02	0.53	0.40
374	KR0015B	Äspö						491	3.1	190	26	400	924	148	-81	17	-10.3	0.02	0.02	0.02	0.02	0.53	0.40
375	KR0015B	Äspö						490	3.3	185	25.1	404	895	137	-81.4	25	-10.7	0.02	0.02	0.02	0.02	0.56	0.37
376	KR0015B	Äspö						602	4	254	36.9	376	1270	145	-76.3	8.4	-10.1	0.02	0.02	0.02	0.02	0.46	0.44
377	KR0015B	Äspö						487	3.5	190	23.2	400	895	139	-76.4	11	-10.1	0.02	0.02	0.02	0.02	0.47	0.47
378	KR0015B	Äspö						488	3.8	185	25.7	403	895	165	-75.8	15	-10.1	0.02	0.02	0.02	0.02	0.46	0.47
379	KR0015B	Äspö						499	3.8	189	26.4	404	901	142	-75.2	14	-10.1	0.02	0.02	0.02	0.02	0.45	0.49
380	KR0015B	Äspö						496	3	187	26.8	408	878	126	-76.7	21	-10.2	0.01	0.01	0.01	0.01	0.48	0.47
381	KR0015B	Äspö						455	3	169	22.6	415	792	122	-69.6	17	-10.1	0.01	0.01	0.01	0.01	0.40	0.56
382	KR0015B	Äspö						458	3.5	168	22.6	415	760	120	-72.9	8.4	-10.1	0.01	0.01	0.01	0.01	0.43	0.53
383	KR0015B	Äspö						481	3.7	179	25.1	417	755	131.833	-71.4	13	-10.2	0.01	0.01	0.01	0.01	0.42	0.54
384	KR0015B	Äspö						404	2.8	146	23.1	427	646	120	-73.9	7.6	-9.9	0.01	0.01	0.01	0.01	0.42	0.55
385	KR0015B	Äspö						511	3.8	189	27.3	415	805	134	-77.6	19	-10.1	0.01	0.01	0.01	0.01	0.47	0.48
386	KR0015B	Äspö						403.4	3.2	141	19.1	409	729	129	-73.7	19	-10.1	0.01	0.01	0.01	0.01	0.45	0.51
387	KR0015B	Äspö						566	3.9	210	32.9	389	1080	148.312	-71.7	28	-9.8	0.02	0.02	0.02	0.02	0.40	0.53
388	KR0015B	Äspö						481.7	3.01	176.7	27.7	389	851	132.162	-69.7	32.1	-9.8	0.01	0.01	0.01	0.01	0.39	0.55
389	KR0015B	Äspö						357.7	2.46	123.5	19	422	534.6	97	-69.2	28.7	-9.7	0.00	0.00	0.00	0.00	0.38	0.62
390	KR0015B	Äspö						578.5	3.55	207.1	36.8	346	977.1	140.312	-70.8	8.45	-9.6	0.02	0.02	0.02	0.02	0.40	0.52
391	KR0015B	Äspö						452.5	3.18	159	29.2	309	889.9	121.39	-71.8	61.7	-9.7	0.02	0.02	0.02	0.02	0.46	0.46
392	KXTT1	Äspö						1768.9	14.06	1285.5	81.4	91	5084	343.25	-76.9	16	-10.2	0.12	0.12	0.12	0.20	0.33	0.12
393	KXTT2	Äspö						1632.2	11.6	963.7	79.7	124	4389.1	326.92	-68.4	39	-9.3	0.10	0.10	0.10	0.10	0.38	0.20
394	KXTT2	Äspö						1754.3	13.79	1263.3	80.8	91	5119.4	357.71	-78.4	22	-10.2	0.12	0.12	0.12	0.22	0.32	0.12
395	KXTT3	Äspö						1621.3	12.14	947.3	79.9	130	4296.9	295.066	-73.4	20	-9.3	0.10	0.10	0.10	0.10	0.42	0.17
396	KXTT3	Äspö						1775.9	14.33	1301.1	82.3	92	5091.1	347	-78.4	24	-10.2	0.12	0.12	0.12	0.21	0.32	0.12
397	KXTT4	Äspö						1763.7	14.16	1253.8	81.5	98	5013.1	343	-78.6	18	-10.1	0.12	0.12	0.12	0.20	0.34	0.12
398	KXTT4	Äspö						1731.7	14.08	1191.8	83.2	106	4920.9	329.82	-77	25	-9.9	0.11	0.11	0.11	0.16	0.38	0.11
399	SA0158A	Äspö						852.8	15.53	239.9	104.2	245	1942.8	253	-63.1	22.8	-8.8	0.05	0.05	0.05	0.05	0.14	0.65
400	SA0205A	Äspö						1475.8	16.37	511.8	135	197	3376.9	388	-57.3	35.5	-7.6	0.18	0.08	0.08	0.08	0.08	0.48
401	SA0237B	Äspö						1417.7	16.76	418.6	129.5	160	3173	356	-60.5	30.4	-8.2	0.10	0.09	0.09	0.09	0.09	0.55
402	SA0311A	Äspö						1031.3	6.52	508	85.1	221	2655.4	200	-67.8	10.1	-9.3	0.06	0.06	0.06	0.06	0.34	0.42
403	SA0327B	Äspö						1226.8	5.91	724.2	83.1	96	3453.1	177	-81.6	8.4	-10	0.08	0.08	0.08	0.10	0.57	0.08
404	SA0435A	Äspö						1094.6	3.99	509.9	71.2	220	2712.2	163	-71.4	14.4	-9.7	0.06	0.06	0.06	0.06	0.44	0.32
405	SA0452A	Äspö						1464	4.83	770.1	107.3	134	3882.1	227	-68.5	16.9	-8.9	0.09	0.09	0.09	0.09	0.36	0.30

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
406	SA0468A	Äspö						1543.1	5.99	782.7	118.7	129	4098.4	240	-66.8	15.2	-9	0.09	0.09	0.09	0.09	0.32	0.32
407	SA0813B	Äspö						1700	21	364	123	481	3450	194	-59.8	6.8	-7.5	0.25	0.04	0.04	0.04	0.04	0.60
408	SA0813B	Äspö						1670	19	317	124	420	3360	226.812	-58.2	14	-7.5	0.23	0.05	0.05	0.05	0.05	0.59
409	SA0813B	Äspö						1660	20	325	127	326	3300	275.95	-57.6	19	-7	0.25	0.06	0.06	0.06	0.06	0.52
410	SA0813B	Äspö						1640	19.1	310	124	317	3350	261	-50.4	14	-7.3	0.27	0.06	0.06	0.06	0.06	0.50
411	SA0813B	Äspö						1578	11.88	322.1	121.1	302	3272.3	282	-53.7	22.8	-7.2	0.20	0.06	0.06	0.06	0.06	0.57
412	SA0813B	Äspö						1572.7	20.25	318.1	120.8	292	3112.8	298	-53.7	30.4	-7.2	0.25	0.06	0.06	0.06	0.06	0.50
413	SA0813B	Äspö						1551	17.5	282.3	124.3	311	3080.9	273.253	-53.2	19.4	-6.8	0.27	0.05	0.05	0.05	0.05	0.52
414	SA0813B	Äspö						1470.9	16.15	279.8	114.8	318	2979.8	582.07	-58.9	18.6	-7.5	0.24	0.08	0.08	0.08	0.08	0.43
415	SA0850B	Äspö						1920	18	1210	141	170	5440	90.4852	-67.2	6.8	-8.3	0.09	0.09	0.09	0.09	0.16	0.47
416	SA0923A	Äspö						1850	31	746	172	669	4500	90	-63.4	4.2	-7.9	0.38	0.02	0.02	0.02	0.02	0.53
417	SA0923A	Äspö						1800	30	678	162	655	4310	127.638	-59.7	8.4	-7.7	0.40	0.02	0.02	0.02	0.02	0.51
418	SA0958B	Äspö						1829.2	22.4	595.2	137.2	371	4087.9	243	-56	8.4	-7.5	0.29	0.06	0.06	0.06	0.06	0.47
419	SA0958B	Äspö						1803.1	21.5	697.7	139.6	311	4310	225.284	-61.9	14	-7.7	0.20	0.07	0.07	0.07	0.07	0.51
420	SA0958B	Äspö						1810	19.6	657	144	296	4260	241	-57.5	14	-7.4	0.24	0.07	0.07	0.07	0.07	0.47
421	SA0958B	Äspö						1634.1	21.4	477.8	125.1	274	3641	303	-55.6	22.8	-7.2	0.25	0.07	0.07	0.07	0.07	0.47
422	SA0976B	Äspö						2170	20.6	993	203	500	5590	58.7255	-60.4	14	-7.4	0.36	0.05	0.05	0.05	0.05	0.45
423	SA1009B	Äspö						1847.1	26.3	535.3	163.6	300	4125.6	250	-84.8	5.1	-11.1	0.09	0.09	0.09	0.09	0.31	0.32
424	SA1009B	Äspö						1769.8	26.6	506.1	153.1	292	3984.1	250	-58.1	15	-7.3	0.30	0.07	0.07	0.07	0.07	0.42
425	SA1009B	Äspö						1740	25.8	514	164	276	4080	252	-47.3	8	-7.3	0.39	0.07	0.07	0.07	0.07	0.35
426	SA1009B	Äspö						1682.1	23.6	440.5	144.5	242	3672.9	304	-54.2	12.7	-7.3	0.29	0.07	0.07	0.07	0.07	0.41
427	SA1009B	Äspö						1590	27.05	371.7	137.9	234	3390	313	-53.1	36.3	-7.3	0.30	0.07	0.07	0.07	0.07	0.41
428	SA1009B	Äspö						1568	31.15	275.2	151.8	228	3385.8	352.353	-54.3	20.3	-6.7	0.38	0.07	0.07	0.07	0.07	0.33
429	SA1009B	Äspö						1526	30.3	240	145.5	234	3045.4	330.34	-57.4	24.5	-7	0.32	0.07	0.07	0.07	0.07	0.40
430	SA1062B	Äspö						2230	23.5	770	220	531	5320	100.672	-58	8	-7.7	0.42	0.04	0.04	0.04	0.04	0.40
431	SA1062B	Äspö						1930	34	545	177	403	4350	187	-57.6	9.3	-7.3	0.42	0.06	0.06	0.06	0.06	0.36
432	SA1077A	Äspö						2180	32.6	650	200	690	4890	127.339	-58.7	17	-7.5	0.52	0.02	0.02	0.02	0.02	0.38
433	SA1094A	Äspö						2140	35.1	504	195	760	4490	111.459	-60.3	17	-7.3	0.54	0.01	0.01	0.01	0.01	0.41
434	SA1111B	Äspö						2160	18.7	736	200	340	5130	110.859	-60.3	25	-7.7	0.28	0.07	0.07	0.07	0.07	0.46
435	SA1210A	Äspö						1980	30.5	572	208	540	4620	129.136	-61.5	17	-7.4	0.44	0.04	0.04	0.04	0.04	0.41
436	SA1210A	Äspö						1770.3	45.1	255.7	152.4	309	3369.7	328	-55.4	27	-6.9	0.48	0.07	0.07	0.07	0.07	0.25
437	SA1210A	Äspö						1728	45.4	272.4	150.2	278	3450	327.784	-53.9	30	-6.9	0.48	0.07	0.07	0.07	0.07	0.24
438	SA1210A	Äspö						1760	47.3	246	171	256	3450	368.533	-49.6	23	-6.6	0.57	0.07	0.07	0.07	0.07	0.13
439	SA1210A	Äspö						1661	26.97	226.7	147.6	264	3254.6	325	-52.4	30.4	-6.9	0.36	0.07	0.07	0.07	0.07	0.38
440	SA1229A	Äspö						2170	11.2	1060	194	510	5590	100.972	-63.6	17	-8.1	0.24	0.05	0.05	0.05	0.05	0.55
441	SA1229A	Äspö						1847.9	24.5	598.5	156.1	426	4210.9	208.266	-60	16	-7.3	0.32	0.05	0.05	0.05	0.05	0.47
442	SA1229A	Äspö						1810.4	27	579.6	151.4	388	4105.5	209.674	-58.1	14	-7.4	0.32	0.06	0.06	0.06	0.06	0.45

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
443	SA1229A	Äspö						1820	24.7	549	159	378	4140	216	-50.1	14	-6.6	0.42	0.05	0.05	0.05	0.05	0.38
444	SA1229A	Äspö						1735.4	26.05	512.1	151.7	336	3928.2	243	-52.8	16.9	-7	0.36	0.06	0.06	0.06	0.06	0.40
445	SA1229A	Äspö						1707.7	25.85	525.8	147.7	325	3687.1	242	-49.7	27	-7.1	0.37	0.06	0.06	0.06	0.06	0.40
446	SA1229A	Äspö						1732	27.43	456	145	330	3871.5	224	-51.7	16.9	-7.1	0.36	0.06	0.06	0.06	0.06	0.41
447	SA1229A	Äspö						1628.5	24.05	466.9	146.7	310	3674.7	247.636	-46.3	15.2	-6.5	0.41	0.05	0.05	0.05	0.05	0.38
448	SA1229A	Äspö						1620.6	24.39	440.4	136.3	314	3481.5	224.35	-54.7	23.7	-7.3	0.28	0.06	0.06	0.06	0.06	0.49
449	SA1327B	Äspö						1610	9.4	648	128	252	3920	225	-65.3	17	-7.4	0.07	0.07	0.07	0.07	0.07	0.64
450	SA1342B	Äspö						1680	11	950	152	170	4730	148.312	-61.9	5.9	-8.7	0.09	0.09	0.09	0.09	0.15	0.50
451	SA1420A	Äspö						1650	7.6	981	117	830	4610	200	-86.6	4.2	-11.2	0.03	0.03	0.03	0.03	0.20	0.68
452	SA1420A	Äspö						1540	10.2	715	123	170	3930	225.913	-72	17	-8.7	0.08	0.08	0.08	0.08	0.29	0.37
453	SA1420A	Äspö						1610	11	760	126	202	4140	225	-68.8	10	-8.5	0.08	0.08	0.08	0.08	0.21	0.45
454	SA1420A	Äspö						1550	14	482	129	226	3450	335.574	-55.5	32	-7.2	0.20	0.07	0.07	0.07	0.07	0.50
455	SA1420A	Äspö						1484.2	9.7	487.9	124.5	215	3419.9	307	-59	31	-7.5	0.11	0.07	0.07	0.07	0.07	0.59
456	SA1420A	Äspö						1539	15.8	485	127.4	212	3434.5	308.8	-57.6	27	-7.2	0.18	0.08	0.08	0.08	0.08	0.52
457	SA1420A	Äspö						1600	13.7	480	139	214	3530	335	-52.5	22	-7	0.24	0.07	0.07	0.07	0.07	0.46
458	SA1420A	Äspö						1426.5	15.7	395.8	116.8	206	3052.5	303	-57	28.7	-7.5	0.14	0.07	0.07	0.07	0.07	0.57
459	SA1420A	Äspö						1441.8	18.2	368.7	125.2	199	2949.7	304.534	-50.5	32.1	-7.1	0.24	0.07	0.07	0.07	0.07	0.49
460	SA1420A	Äspö						1347.5	20.5	284.4	135.8	199	2900.1	301.418	-60.3	23.7	-7.1	0.19	0.07	0.07	0.07	0.07	0.53
461	SA1420A	Äspö						1334.4	20.28	247.4	129.4	204	2721	267.44	-58.4	33	-7.3	0.17	0.06	0.06	0.06	0.06	0.57
462	SA1614B	Äspö						1570	8.3	1250	80.2	37	5160	308	-103	8	-13.1	0.10	0.10	0.11	0.51	0.10	0.10
463	SA1614B	Äspö						1953.7	5.2	1710.4	65.9	32	6207.3	424	-85.5	4.2	-11.5	0.11	0.11	0.14	0.41	0.11	0.11
464	SA1614B	Äspö						1944.3	7.5	1516.2	84.5	67	5815.5	339	-78.3	4	-10.5	0.12	0.12	0.12	0.29	0.23	0.12
465	SA1614B	Äspö						1880	6.7	1390	90.8	81	5650	350	-77.6	4	-10.4	0.12	0.12	0.12	0.26	0.26	0.12
466	SA1614B	Äspö						1831.3	7.37	1207	98.3	109	5176.1	333	-71.9	8.4	-9.7	0.12	0.12	0.12	0.14	0.40	0.12
467	SA1680A	Äspö						606	5.9	171	26.9	237	1160	166	-77.4	7.6	-10.4	0.04	0.04	0.04	0.04	0.59	0.25
468	SA1680B	Äspö						657	4.9	217	30.6	224	1560	178	-85.5	17	-10.7	0.05	0.05	0.05	0.05	0.70	0.11
469	SA1680B	Äspö						1100	10	583	63.3	137	2790	194	-83.8	5.1	-10.8	0.08	0.08	0.08	0.11	0.59	0.08
470	SA1693F	Äspö						941	5.4	489	38.9	160	2400	219	-90.3	4.2	-12	0.06	0.06	0.06	0.20	0.54	0.06
471	SA1696B	Äspö						693	5.8	285	33.3	213	1560	169	-84	5.1	-11	0.05	0.05	0.05	0.05	0.70	0.10
472	SA1696B	Äspö						1330	9.4	916	74.3	102	3910	266	-93.2	8	-11.5	0.09	0.09	0.09	0.28	0.36	0.09
473	SA1696B	Äspö						1653.4	6.3	1195.8	73.3	68	4828	365	-85.6	8.4	-11.2	0.11	0.11	0.11	0.34	0.23	0.11
474	SA1696B	Äspö						1817	8.9	1400.6	72.3	54	5498.8	419	-82.8	4.2	-11.1	0.12	0.12	0.12	0.37	0.15	0.12
475	SA1696B	Äspö						1880	8	1450	76.2	57	5690	428	-81	7	-11.1	0.12	0.12	0.12	0.36	0.14	0.12
476	SA1696B	Äspö						1932.5	9.14	1740.4	71.4	89	6275.2	459	-81.3	8.4	-11.2	0.13	0.13	0.13	0.37	0.13	0.13
477	SA1713A	Äspö						960	14	602	26.4	25	2730	192	-90.2	4.2	-12	0.08	0.08	0.08	0.29	0.41	0.08
478	SA1730A	Äspö						1740	10	1420	64.8	39	5470	464	-91.6	4.2	-12.4	0.11	0.11	0.13	0.44	0.11	0.11
479	SA1730A	Äspö						1944.4	6.1	1709.4	61.8	39	6062.5	459	-89.2	12	-11.9	0.11	0.11	0.14	0.43	0.11	0.11

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
480	SA1730A	Äspö						2001.9	8.1	1860.8	59	40	6064.5	470.8	-87.2	4	-11.7	0.11	0.11	0.15	0.42	0.11	0.11
481	SA1730A	Äspö						2060	7.6	1830	65.4	32	6890	513	-81.7	4	-12.1	0.11	0.11	0.16	0.40	0.11	0.11
482	SA1730A	Äspö						2149.1	8.24	2160	54.2	45	7329.9	512	-86.4	8.4	-12.2	0.10	0.10	0.17	0.42	0.10	0.10
483	SA1730A	Äspö						2430.5	9.35	2793.3	48.6	31	8499.9	549	-85.1	8.4	-12.4	0.09	0.09	0.21	0.42	0.09	0.09
484	SA1730A	Äspö						2440.3	8.2	2755.1	53.5	32	8671.8	539.316	-90.2	8.5	-12	0.09	0.09	0.21	0.42	0.09	0.09
485	SA1730A	Äspö						2384.2	8.23	2616.5	56.4	36	8650.5	530.46	-88.8	16	-12.1	0.09	0.09	0.20	0.42	0.09	0.09
486	SA1742A	Äspö						1300	8.4	968	41.5	71	3800	286	-98.3	4.2	-12.8	0.09	0.09	0.09	0.43	0.23	0.09
487	SA1828B	Äspö						1700	8.5	1290	92.2	43	5200	302.616	-84.4	4.2	-10.8	0.11	0.11	0.11	0.31	0.25	0.11
488	SA1828B	Äspö						1860	9.6	1250	118	72	5540	340	-71.1	32	-9.3	0.12	0.12	0.12	0.14	0.37	0.12
489	SA1828B	Äspö						1909.2	8	1392.4	113.9	48	5849.7	387	-75.9	4.2	-10.3	0.13	0.13	0.13	0.27	0.22	0.13
490	SA1828B	Äspö						1933.1	11.6	1493.5	107.8	49	6550	362.96	-80.1	4	-10.3	0.13	0.13	0.13	0.30	0.18	0.13
491	SA1828B	Äspö						1930	10	1450	108	48	6010	376	-71.4	4	-10.3	0.13	0.13	0.13	0.24	0.24	0.13
492	SA1828B	Äspö						1861.5	11.67	1063.9	138.8	111	5123	251	-67.8	8.4	-8.9	0.11	0.11	0.11	0.11	0.27	0.29
493	SA1844B	Äspö						1810	9.5	1220	113	62	5250	330	-75.8	4.2	-9.5	0.12	0.12	0.12	0.17	0.35	0.12
494	SA1861A	Äspö						1720	11	1050	112	79	4940	302	-73.9	4.2	-9.2	0.11	0.11	0.11	0.11	0.41	0.13
495	SA2074A	Äspö						1959.4	8.6	992.6	172	47	5282.5	305	-65.2	5.9	-8.5	0.12	0.12	0.12	0.12	0.22	0.29
496	SA2074A	Äspö						1730	11	764	144	79	4670	277	-60	7	-8.4	0.10	0.10	0.10	0.10	0.17	0.41
497	SA2074A	Äspö						1701.7	10.2	723.2	141.5	94	4275.6	275	-63.3	8.4	-8.5	0.10	0.10	0.10	0.10	0.21	0.39
498	SA2074A	Äspö						1521.7	10.28	627	126.4	103	3967.2	263	-61.3	8.4	-8.4	0.09	0.09	0.09	0.09	0.20	0.44
499	SA2074A	Äspö						1454	9.3	560.4	119.3	128	3414.1	261.868	-66.3	8.5	-8.7	0.09	0.09	0.09	0.09	0.26	0.39
500	SA2074A	Äspö						1425	9.11	510.1	111.8	140	3238.6	251.3	-65.1	33	-8.4	0.08	0.08	0.08	0.08	0.24	0.44
501	SA2109B	Äspö						1730	17	884	107	67	4480	302.616	-64.5	5.9	-8.2	0.11	0.11	0.11	0.11	0.22	0.34
502	SA2142A	Äspö						1720	25	581	128	127	3880	367.334	-56.2	21	-7.2	0.24	0.10	0.10	0.10	0.10	0.37
503	SA2175B	Äspö						2030	17.1	1100	172	94	5650	275.95	-61.1	14	-8.3	0.14	0.12	0.12	0.12	0.12	0.39
504	SA2175B	Äspö						1959.5	15.29	1037.1	161.6	127	5442	267	-62	8.4	-8.2	0.12	0.11	0.11	0.11	0.11	0.44
505	SA2240B	Äspö						2150	17.1	1040	177	158	5560	258	-60.7	4	-8	0.19	0.11	0.11	0.11	0.11	0.38
506	SA2240B	Äspö						2110	17.5	1010	180	171	5460	253.479	-57.3	5.9	-8.1	0.22	0.10	0.10	0.10	0.10	0.37
507	SA2273A	Äspö						2070	13.4	1110	172	146	5570	252.879	-61.1	4.2	-8.4	0.13	0.11	0.11	0.11	0.11	0.43
508	SA2273A	Äspö						1932	13.35	900.5	166	201	4998.9	218	-60.5	8.4	-7.8	0.16	0.09	0.09	0.09	0.09	0.48
509	SA2273A	Äspö						1911.1	14.38	848.6	165.3	205	4920.9	203	-56.7	12.7	-7.9	0.19	0.09	0.09	0.09	0.09	0.47
510	SA2273A	Äspö						1866	12.35	852.2	151.1	182	4787.9	240.984	-64	8.5	-7.8	0.10	0.09	0.09	0.09	0.09	0.52
511	SA2273A	Äspö						1778.6	13.18	795.9	140.3	180	4346.5	241.66	-62.8	20.3	-8.1	0.09	0.09	0.09	0.09	0.10	0.54
512	SA2273B	Äspö						1830	8	1280	136	104	5460	231.307	-75.8	5.9	-9.4	0.11	0.11	0.11	0.11	0.43	0.12
513	SA2273B	Äspö						1761.7	7.82	1135.1	127.5	117	5105.2	196	-71.3	8.4	-9.5	0.10	0.10	0.10	0.10	0.40	0.19
514	SA2289B	Äspö						2040	12	1160	164	138	5570	251.98	-66.6	10	-8.4	0.11	0.11	0.11	0.11	0.17	0.39
515	SA2289B	Äspö						1952.7	12.16	968.6	162.1	178	5167.3	219	-60.8	8.4	-8	0.13	0.10	0.10	0.10	0.10	0.49
516	SA2322A	Äspö						2170	8.6	1070	129	152	5340	227	-66	4	-8.8	0.11	0.11	0.11	0.11	0.26	0.32

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
517	SA2322A	Äspö						1910	9.8	998	139	165	5070	231.606	-62.9	7.6	-8.5	0.10	0.10	0.10	0.10	0.17	0.43
518	SA2322A	Äspö						1924	11.6	1024	140	169	5353	223	-68	8.4	-8.6	0.10	0.10	0.10	0.10	0.22	0.38
519	SA2322A	Äspö						1908.3	9.44	977.4	142.5	184	5034.3	213	-63.4	8.4	-8.1	0.09	0.09	0.09	0.09	0.14	0.49
520	SA2355B	Äspö						1959	8.4	1634	68.7	23	6240	443	-83.1	5.9	-10.6	0.12	0.12	0.14	0.37	0.12	0.12
521	SA2583A	Äspö						2099	8.3	1870	56.9	13	6647	508	-85.9	4.2	-10.7	0.11	0.11	0.16	0.39	0.11	0.11
522	SA2583A	Äspö						2170	8.51	1859.6	73.9	44	6895.6	492	-83.5	5.9	-11.1	0.12	0.12	0.16	0.37	0.12	0.12
523	SA2600A	Äspö						2398	9.9	2541	52	17	8349	560	-93.7	9.3	-12.2	0.09	0.09	0.21	0.44	0.09	0.09
524	SA2600A	Äspö						2171.1	7.61	1825.4	72.2	92	6718.3	498	-80.4	4.2	-10.8	0.13	0.13	0.15	0.35	0.13	0.13
525	SA2600A	Äspö						2260	9.06	2180	65	37	7734.7	470	-77.9	8.4	-11.2	0.12	0.12	0.17	0.36	0.12	0.12
526	SA2600A	Äspö						2094	7.55	1499	90.7	90	6023.5	407.333	-70.4	11	-9.4	0.13	0.13	0.13	0.20	0.28	0.13
527	SA2600A	Äspö						2140.2	7.59	1542.4	89.3	95	6183	382.12	-75.5	11	-9.8	0.13	0.13	0.13	0.25	0.24	0.13
528	SA2600B	Äspö						2453	9.9	2681	49	13	8597	575	-94.3	5.9	-12.4	0.08	0.08	0.22	0.44	0.08	0.08
529	SA2634B	Äspö						2273	10.2	1986	91.4	64	7197	414	-86.2	18	-11.3	0.12	0.12	0.15	0.37	0.12	0.12
530	SA2649A	Äspö						2123	8.3	1715	76.1	39	6523	501	-82.7	14	-10.9	0.12	0.12	0.15	0.37	0.12	0.12
531	SA2663B	Äspö						2447	10	2639	53.4	20	8686	589	-92.8	4.2	-12.2	0.09	0.09	0.22	0.43	0.09	0.09
532	SA2664A	Äspö						2124	8.2	1753	75.1	39	6701	515	-83.4	11	-10.9	0.12	0.12	0.16	0.37	0.12	0.12
533	SA2681A	Äspö						2139	8.1	1675	77.8	41	6523	486	-82.1	15	-10.7	0.12	0.12	0.15	0.36	0.12	0.12
534	SA2681B	Äspö						2187	10.6	1772	114	64	6842	406	-80.4	9.3	-10.4	0.13	0.13	0.14	0.32	0.13	0.13
535	SA2703A	Äspö						2694	11	3285	43.2	12	10140	659	-93.2	10	-12.8	0.07	0.07	0.26	0.44	0.07	0.07
536	SA2703A	Äspö						2824	7.79	3581.3	40.3	12	10591.6	683	-93.7	4.2	-13.1	0.07	0.07	0.28	0.45	0.07	0.07
537	SA2718A	Äspö						2707.2	7.91	3360.3	41.9	15	10148.4	648	-93.8	4.2	-12.9	0.07	0.07	0.26	0.45	0.07	0.07
538	SA2734B	Äspö						2071	8.5	1726	94.5	37	6490	436	-83.6	10	-10.7	0.12	0.12	0.14	0.36	0.12	0.12
539	SA2768A	Äspö						2459	9.4	2904	55.1	11	9058	580	-92.6	4.2	-12.9	0.08	0.08	0.23	0.45	0.08	0.08
540	SA2768B	Äspö						2190	7.9	2226	70.3	14	7640	490	-84.2	4.2	-11.8	0.11	0.11	0.18	0.40	0.11	0.11
541	SA2783A	Äspö						2258	8.4	2363	59.6	14	8030	508	-88.3	4.2	-12.2	0.10	0.10	0.19	0.43	0.10	0.10
542	SA2783A	Äspö						2347.6	9.12	2532.4	62.5	20	8411.2	523	-90.5	9.3	-12.1	0.09	0.09	0.20	0.42	0.09	0.09
543	SA2783A	Äspö						2448.4	9.55	2813	57.9	18	9022.8	513	-83.2	8.4	-12.2	0.10	0.10	0.21	0.40	0.10	0.10
544	SA2783A	Äspö						2811.3	10.3	3661.9	53.3	14	10944.3	583.959	-88.6	8.5	-12	0.08	0.08	0.26	0.41	0.08	0.08
545	SA2783A	Äspö						2839.8	11.72	3712.7	50.1	18	10910.7	599.45	-90	22	-12.5	0.08	0.08	0.27	0.42	0.08	0.08
546	SA2834B	Äspö						2522	10.7	2734	95.9	15	9094	571	-86.8	4.2	-12.3	0.10	0.10	0.23	0.39	0.10	0.10
547	SA2880A	Äspö						3156.4	13.64	4378.1	41.1	22	12956.3	625.337	-87.7	17	-12.3	0.07	0.07	0.30	0.40	0.07	0.07
548	SA2880A	Äspö						2846.8	12.07	3812.5	46.4	30	11371.5	609.39	-84.5	21	-12.1	0.09	0.09	0.27	0.39	0.09	0.09
549	HAV04	Ävrö						215	4	14	3	300	108	76	-73.5	8	-10.1	0.01	0.01	0.01	0.01	0.54	0.42
550	HAV04	Ävrö						202	4	13	3	290	106	71	-79.7	1	-9.9	0.01	0.01	0.01	0.01	0.59	0.37
551	HAV05	Ävrö						117	3	14	3	265	14	62	-71.8	11	-9.8	0.01	0.01	0.01	0.01	0.53	0.43
552	HAV05	Ävrö						144	3	12	2	271	15	97	-67.1	1	-9.8	0.01	0.01	0.01	0.01	0.48	0.47
553	HAV06	Ävrö						107	2.6	9.7	1	231	22	45	-73.4	1	-10	0.01	0.01	0.01	0.01	0.59	0.36

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
554	HAV06	Ävrö						127	1.6	11	1.4	228	36	71	-70.1	1	-10.2	0.01	0.01	0.01	0.01	0.58	0.36
555	HAV07	Ävrö						135	2	18	2	258	63	68	-71.2	1	-9.9	0.01	0.01	0.01	0.01	0.55	0.41
556	HAV07	Ävrö						139	2	21	2	257	73	69	-73.3	2	-10.2	0.01	0.01	0.01	0.01	0.59	0.36
557	KAV01	Ävrö						255	4.7	156	21	186	575	43	-78.6	19	-10.6	0.03	0.03	0.03	0.03	0.67	0.22
558	KAV01	Ävrö						750	7.4	440	42	81	1970	118	-80.3	13	-10.9	0.06	0.06	0.06	0.09	0.66	0.06
559	KAV01	Ävrö						1500	6	1100	60	42	4300	220	-86.2	8	-11.7	0.09	0.09	0.09	0.33	0.30	0.09
560	KAV01	Ävrö						3100	8	2900	31	9	9700	400	-92.6	3	-12.8	0.08	0.08	0.22	0.47	0.08	0.08
561	HLX01	Laxemar						32.5	2.2	37.8	4.9	115	18.1	47.8	-81	34	-10.9	0.03	0.03	0.03	0.03	0.81	0.09
562	HLX01	Laxemar						137	2.9	10.7	2.1	232	42.3	59.1	-79	25	-10.8	0.02	0.02	0.02	0.02	0.70	0.24
563	HLX01	Laxemar						141	3	11.5	1.9	233	40.9	63.8	-79	17	-10.9	0.02	0.02	0.02	0.02	0.70	0.23
564	HLX03	Laxemar						76	5.1	15	3.9	210	11	21	-80	25	-10.8	0.01	0.01	0.01	0.01	0.71	0.23
565	HLX03	Laxemar						67	5	17	4.3	204	5.8	21.5	-80	34	-10.9	0.02	0.02	0.02	0.02	0.72	0.22
566	HLX06	Laxemar						56.1	2.8	24.5	4.9	219	5.7	8.7	-77	17	-10.6	0.01	0.01	0.01	0.01	0.68	0.28
567	HLX06	Laxemar						92	2	12.3	2.3	249	12.1	23.5	-77	17	-10.6	0.01	0.01	0.01	0.01	0.66	0.30
568	HLX07	Laxemar						170	5.2	27.5	6.1	151	215	72	-76	25	-10.5	0.03	0.03	0.03	0.03	0.68	0.21
569	HLX07	Laxemar						430	5.6	42	9.2	200	440	260	-78	8.4	-10.8	0.05	0.05	0.05	0.05	0.66	0.16
570	KLX01	Laxemar						1040	6.2	243	28	83	2050	48	-89.9	8	-11.5	0.05	0.05	0.05	0.18	0.61	0.05
571	KLX01	Laxemar						860	6.1	223	18	78	1700	106	-94.5	8	-12.2	0.05	0.05	0.05	0.25	0.55	0.05
572	KLX01	Laxemar						1680	7.1	1400	23	24	4870	351	-102	8	-13.3	0.09	0.09	0.11	0.54	0.09	0.09
573	KLX01	Laxemar						1610	7.3	1330	24	24	4680	390	-98.8	8	-11.8	0.10	0.10	0.11	0.49	0.10	0.10
574	KLX02	Laxemar						137	3.9	54.1	4.4	220	149	61.1225	-74.4	8.4	-9.9	0.02	0.02	0.02	0.02	0.59	0.35
575	KLX02	Laxemar						134	3.9	45.7	4.3	202	146	58.1263	-75.1	5.9	-10.5	0.02	0.02	0.02	0.02	0.65	0.27
576	KLX02	Laxemar						130	3.8	43.4	4.3	200	140	56.6282	-74.6	4.2	-10.7	0.02	0.02	0.02	0.02	0.66	0.26
577	KLX02	Laxemar						120	3.7	39.3	4.3	200	123	52.4335	-76.3	11.8	-10.3	0.02	0.02	0.02	0.02	0.65	0.28
578	KLX02	Laxemar						110	4.3	38.6	4.3	202	109	48.8381	-76.1	15.2	-10.4	0.02	0.02	0.02	0.02	0.65	0.28
579	KLX02	Laxemar						97.4	3.5	33.8	4.3	202	82.5	43.7445	-76.3	12.7	-10.5	0.02	0.02	0.02	0.02	0.67	0.27
580	KLX02	Laxemar						87	3.5	31.5	4.3	205	63.8	40.1491	-75.9	5.1	-10.5	0.02	0.02	0.02	0.02	0.66	0.28
581	KLX02	Laxemar						111	3.1	24	4.6	223	73	43	-73.4	5.9	-10.3	0.01	0.01	0.01	0.01	0.61	0.33
582	KLX02	Laxemar						77	3.5	29.1	4.3	205	45	36.5536	-75.4	7.6	-10.7	0.02	0.02	0.02	0.02	0.67	0.27
583	KLX02	Laxemar						206	3.1	36	5.9	201	235	84	-75.7	13	-10.6	0.02	0.02	0.02	0.02	0.66	0.24
584	KLX02	Laxemar						72.9	3.4	27.4	4.5	205	34.5	33.5574	-76.4	7.6	-10.7	0.02	0.02	0.02	0.02	0.68	0.26
585	KLX02	Laxemar						69.5	3.4	26.2	4.6	204	28	32.0593	-75.5	8.4	-10.6	0.01	0.01	0.01	0.01	0.67	0.28
586	KLX02	Laxemar						67.7	3.5	25.6	4.7	202	26.5	31.1605	-76.2	12.7	-10.6	0.01	0.01	0.01	0.01	0.67	0.27
587	KLX02	Laxemar						67.3	3.5	25.3	4.7	198	26.2	30.5612	-75.3	16.1	-10.6	0.02	0.02	0.02	0.02	0.67	0.27
588	KLX02	Laxemar						67.6	3.4	25.5	4.5	201	25.5	29.7822	-76.5	8.4	-10.4	0.01	0.01	0.01	0.01	0.66	0.28
589	KLX02	Laxemar						67.4	3.4	25.3	4.5	200	28	29.7523	-75.5	8.4	-10.4	0.01	0.01	0.01	0.01	0.65	0.29
590	KLX02	Laxemar						68.2	3.5	25.5	4.5	200	28.3	29.8422	-76	17.7	-10.4	0.01	0.01	0.01	0.01	0.66	0.28

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
591	KLX02	Laxemar						67.6	3.4	25.9	4.5	209	28	29.962	-76.6	19.4	-10.5	0.01	0.01	0.01	0.01	0.67	0.28
592	KLX02	Laxemar						68.8	3.4	28.3	4.5	202	34	31.1605	-75.5	15.2	-10.5	0.01	0.01	0.01	0.01	0.66	0.28
593	KLX02	Laxemar						288	4.5	123	10.6	111	548	105	-78.7	8.4	-10.9	0.04	0.04	0.04	0.04	0.76	0.08
594	KLX02	Laxemar						73.4	3.4	38.9	4.3	205	60	35.3552	-75.1	12.7	-10.7	0.02	0.02	0.02	0.02	0.67	0.27
595	KLX02	Laxemar						103	3.4	82.6	4.5	202	175	48.2388	-76.1	11	-10.4	0.02	0.02	0.02	0.02	0.66	0.27
596	KLX02	Laxemar						327	3.7	397	4.6	181	1080	125.541	-77.8	13.5	-10.7	0.04	0.04	0.04	0.04	0.71	0.14
597	KLX02	Laxemar						1000	5.1	1340	4.7	126	3780	302.616	-81.5	11	-11.3	0.08	0.08	0.08	0.26	0.41	0.08
598	KLX02	Laxemar						2460	8.5	3590	4	53	9910	644.183	-84.5	10.1	-11.9	0.09	0.09	0.24	0.42	0.09	0.09
599	KLX02	Laxemar						3300	11.3	4820	3.2	24	13600	805.978	-85.2	4.2	-12.1	0.07	0.07	0.34	0.39	0.07	0.07
600	KLX02	Laxemar						3800	10.4	5620	2.1	8	15800	1010	-78.6	7.6	-11.7	0.06	0.06	0.42	0.34	0.06	0.06
601	KLX02	Laxemar						3780	10.5	5720	2.5	13	16000	898.86	-83.7	0.23	-12	0.06	0.06	0.40	0.38	0.06	0.06
602	KLX02	Laxemar						3930	10.2	6110	2.2	12	16800	928.822	-82.3	4.2	-12	0.05	0.05	0.42	0.37	0.05	0.05
603	KLX02	Laxemar						4190	12	6810	2.1	11	18500	949.795	-80.7	0.2	-11.9	0.05	0.05	0.46	0.35	0.05	0.05
604	KLX02	Laxemar						4640	14.2	8000	2.6	11	21500	943.803	-77.1	4.2	-11.4	0.04	0.04	0.51	0.31	0.04	0.04
605	KLX02	Laxemar						5750	18.2	11000	2.2	10	29100	949.795	-66	0.2	-10.4	0.03	0.03	0.65	0.22	0.03	0.03
606	KLX02	Laxemar						6520	20.5	12700	2.3	11	33100	955.788	-60.2	4.2	-9.9	0.03	0.03	0.73	0.17	0.03	0.03
607	KLX02	Laxemar						8030	29	18600	2.7	9	45500	832	-47.4	26	-8.9	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#IN	-1.#IND
608	KLX02	Laxemar						7330	25.6	15800	2.6	12	39700	946.799	-53.2	0.2	-9.5	0.01	0.01	0.85	0.11	0.01	0.01
609	KLX02	Laxemar						7740	30.6	17100	3.1	12	43300	925.826	-49.4	4.2	-9.8	0.00	0.00	0.91	0.09	0.00	0.00
610	KLX02	Laxemar						7690	30	16900	2.9	11	43500	913.841	-49.8	0.2	-9	0.01	0.01	0.90	0.07	0.01	0.01
611	KLX02	Laxemar						7860	34.2	17500	2.9	10	44800	913.841	-48.1	4.2	-9.1	0.00	0.00	0.93	0.05	0.00	0.00
612	KLX02	Laxemar						8200	45.5	19200	2.1	14	47200	904.852	-44.9	0.2	-8.9	0.00	0.00	0.99	0.00	0.00	0.00
613	KLX02	Laxemar						61	4.1	29.2	5.9	0	150	6	-76.5	38	-9.5	0.03	0.03	0.03	0.03	0.73	0.14
614	KLX02	Laxemar						62.6	3.8	33.6	6	51	120	6.6	-77.4	24	-9.7	0.03	0.03	0.03	0.03	0.72	0.17
615	KLX02	Laxemar						58	3.8	32.1	6.5	139	66	8.1	-77	25	-9.9	0.02	0.02	0.02	0.02	0.67	0.26
616	KLX02	Laxemar						53.6	3.3	34.4	6.9	182	46	10.5	-77.4	30	-10	0.01	0.01	0.01	0.01	0.66	0.29
617	KLX02	Laxemar						50.8	4.9	37.2	7.4	205	36.1	12.6	-77.7	26	-10	0.01	0.01	0.01	0.01	0.63	0.32
618	KLX02	Laxemar						52	3.1	39.6	7.7	209	35.4	13.5	-77.8	26	-10	0.01	0.01	0.01	0.01	0.64	0.31
619	KLX02	Laxemar						51.2	4.3	39.4	7.6	212	35.4	13.7	-78.1	32	-10	0.01	0.01	0.01	0.01	0.63	0.32
620	KLX02	Laxemar						51.6	3.1	40.1	7.8	212	35.4	13.8	-81.2	32	-10.1	0.01	0.01	0.01	0.01	0.68	0.27
621	KLX02	Laxemar						50.4	4.8	39.1	7.6	213	34.7	13.8	-79.3	32	-10	0.01	0.01	0.01	0.01	0.64	0.31
622	KLX02	Laxemar						50.3	3.2	38.1	7.4	215	35.4	13.3	-82.2	27	-10	0.01	0.01	0.01	0.01	0.68	0.28
623	KLX02	Laxemar						57.5	3.2	53.4	7.4	217	83.4	14.8	-79.3	28	-10	0.01	0.01	0.01	0.01	0.65	0.30
624	KLX02	Laxemar						2277	9.2	3929	4.4	97	10387	489	-76.2	30	-9.5	0.12	0.12	0.20	0.34	0.12	0.12
625	KLX02	Laxemar						4286	18	7733	2.4	47	19908	707	-66	25	-8.2	0.09	0.09	0.43	0.21	0.09	0.09
626	KLX02	Laxemar						6762	28	12550	2	38	32882	862	-63.4	19	-9.1	0.04	0.04	0.71	0.14	0.04	0.04
627	KLX02	Laxemar						6941	26	12800	2.1	32	34341	646	-62.8	25	-9.3	0.03	0.03	0.70	0.17	0.03	0.03

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
628	BFI01	Finnsjön						24	3.2	76	6.3	220	61	8.3	-88.2	36	-11.97	0.02	0.02	0.02	0.02	0.88	0.06
629	BFI01	Finnsjön						420	6.1	170	24	250	830	102	-85.2	5	-11.6	0.03	0.03	0.03	0.03	0.75	0.12
630	BFI01	Finnsjön						650	8.7	320	41	260	1500	140	-85.7	3	-11.72	0.05	0.05	0.05	0.05	0.71	0.11
631	BFI01	Finnsjön						1700	14	1500	120	59	5200	370	-89	3	-11.75	0.12	0.12	0.12	0.36	0.15	0.12
632	BFI01	Finnsjön						1700	16	1500	140	61	5500	390	-86.9	3	-11.54	0.13	0.13	0.13	0.33	0.16	0.13
633	BFI01	Finnsjön						1700	13	1650	110	47	5500	370	-88.7	3	-11.81	0.12	0.12	0.12	0.39	0.12	0.12
634	KFI01	Finnsjön						44	2.5	59	7.5	314	10	1	-87	38	-11.6	0.00	0.00	0.00	0.00	0.78	0.20
635	KFI01	Finnsjön						45	2.5	61	7	320	11	1	-88	40	-11.6	0.00	0.00	0.00	0.00	0.79	0.20
636	KFI01	Finnsjön						50	2.7	60	7	322	13	1	-90	50	-11.6	0.00	0.00	0.00	0.00	0.80	0.18
637	KFI01	Finnsjön						56	2.9	59	7.5	325	18	1	-88	46	-11.6	0.00	0.00	0.00	0.00	0.78	0.20
638	KFI01	Finnsjön						88	2.8	50	6.5	350	37	1	-87	40	-11.6	0.00	0.00	0.00	0.00	0.76	0.24
639	KFI04	Finnsjön						225	3	25	4	386	127	44	-80.4	6	-11.3	0.00	0.00	0.00	0.00	0.64	0.35
640	KFI04	Finnsjön						225	3.1	24	5.5	390	133	48	-80.4	7	-11.3	0.00	0.00	0.00	0.00	0.64	0.35
641	KFI04	Finnsjön						210	3.1	23	9.5	389	124	46	-83	6	-11.3	0.00	0.00	0.00	0.00	0.66	0.33
642	KFI04	Finnsjön						215	3	40	7	360	200	40	-83.6	10	-11.7	0.01	0.01	0.01	0.01	0.72	0.26
643	KFI04	Finnsjön						170	2.8	24	4	390	74	30	-81	11	-11.5	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
644	KFI04	Finnsjön						165	2.8	22	4	397	72	25	-85	13	-11.4	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
645	KFI04	Finnsjön						165	2.7	22	4	395	72	29	-85	14	-10.9	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
646	KFI04	Finnsjön						165	2.9	22	4	395	75	29	-85	13	-11.3	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
647	KFI04	Finnsjön						170	2.8	22	4	393	75	29	-85	14	-11.5	0.00	0.00	0.00	0.00	0.70	0.30
648	KFI04	Finnsjön						170	2.8	22	4	393	75	19	-85	10	-11.4	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
649	KFI04	Finnsjön						170	2.7	22	4	393	75	19	-85	13	-11.6	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
650	KFI05	Finnsjön						1100	10	875	110	85	3400	325	-86	7	-10.5	0.10	0.10	0.10	0.17	0.44	0.10
651	KFI05	Finnsjön						1100	9.4	900	110	83	3450	325	-86	7	-10.9	0.10	0.10	0.10	0.20	0.42	0.10
652	KFI05	Finnsjön						1380	7.2	1500	70	39	4650	300	-88	5	-11.8	0.10	0.10	0.10	0.38	0.21	0.10
653	KFI05	Finnsjön						1500	8.3	1790	100	44	5650	324	-88	3	-12.2	0.11	0.11	0.11	0.42	0.13	0.11
654	KFI07	Finnsjön						94	1.4	36	5.5	333	23	7	-87	13	-11.6	0.00	0.00	0.00	0.00	0.78	0.21
655	KFI07	Finnsjön						164	1.6	57	7.5	314	173	18	-87	10	-11.8	0.01	0.01	0.01	0.01	0.80	0.17
656	KFI07	Finnsjön						390	2.9	114	18	233	665	71	-90	3	-11.7	0.03	0.03	0.03	0.03	0.84	0.04
657	KFI07	Finnsjön						195	1.7	96	13	300	320	32	-88	11	-11.8	0.01	0.01	0.01	0.01	0.81	0.14
658	KFI07	Finnsjön						224	1.8	107	16	292	380	35	-88	11	-11.8	0.02	0.02	0.02	0.02	0.81	0.13
659	KFI07	Finnsjön						280	2.2	145	18	278	545	51	-89	10	-12	0.02	0.02	0.02	0.02	0.83	0.08
660	KFI07	Finnsjön						275	2.1	149	14	277	555	47	-89	11	-11.9	0.02	0.02	0.02	0.02	0.83	0.08
661	KFI07	Finnsjön						275	2	142	17	278	555	49	-89	8	-11.9	0.02	0.02	0.02	0.02	0.83	0.09
662	KFI09	Finnsjön						950	7	370	49	162	2800	210	-84	3	-11.59	0.07	0.07	0.07	0.13	0.60	0.07
663	KFI09	Finnsjön						1600	8	1000	57	34	5100	320	-89.9	3	-11.91	0.10	0.10	0.10	0.41	0.18	0.10
664	KFI09	Finnsjön						1400	8	1000	57	33	5100	300	-87.4	3	-11.1	0.10	0.10	0.10	0.34	0.26	0.10

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
665	KGI02	Gideå						50	2.3	10	2.6	161	4.8	1	-90.9	3	-12.55	0.02	0.02	0.02	0.08	0.84	0.02
666	KGI02	Gideå						48	2.2	10	2.7	161	4.1	0.6	-90.4	3	-12.62	0.02	0.02	0.02	0.08	0.84	0.02
667	KGI02	Gideå						49	2.2	9.5	2.4	163	4.7	0.5	-90.1	3	-12.57	0.02	0.02	0.02	0.08	0.85	0.02
668	KGI02	Gideå						53	2	10	2.4	160	5.4	0.4	-91.4	3	-12.68	0.02	0.02	0.02	0.09	0.83	0.02
669	KGI02	Gideå						51	2.2	9.5	2.3	160	5	0.1	-89.5	3	-12.44	0.02	0.02	0.02	0.07	0.85	0.02
670	KGI02	Gideå						50	2.2	11	1.9	158	4.6	0.1	-92.7	3	-12.73	0.02	0.02	0.02	0.11	0.82	0.02
671	KGI04	Gideå						11	2.5	33	4.4	141	1.5	3.9	-93.4	36	-12.93	0.02	0.02	0.02	0.13	0.80	0.02
672	KGI04	Gideå						49	0.9	9	1	133	7.9	0.3	-89.7	5	-12.55	0.02	0.02	0.02	0.10	0.82	0.02
673	KGI04	Gideå						105	1.9	21	1.1	18	178	0.1	-99.4	8	-13.63	0.02	0.02	0.02	0.30	0.60	0.02
674	KGI04	Gideå						5	2.7	30	4.3	121	2.2	8	-94.1	49	-12.94	0.02	0.02	0.02	0.15	0.77	0.02
675	KGI04	Gideå						145	3	58	1.5	50	260	0.1	-101	10	-13.81	0.02	0.02	0.02	0.29	0.61	0.02
676	KFJ02	Fjällved						26	2.3	19	3.3	144	8	10	-80.5	19	-11.31	0.02	0.02	0.02	0.02	0.82	0.10
677	KFJ02	Fjällved						33	2.6	21	3.4	170	8	0.2	-80.8	3	-11.35	0.02	0.02	0.02	0.02	0.80	0.13
678	KFJ02	Fjällved						130	1	12	0.8	83	170	0.2	-103	3	-14.11	0.02	0.02	0.02	0.30	0.63	0.02
679	KFJ04	Fjällved						65	3	15	2.2	218	6	7	-81.8	9	-11.5	0.01	0.01	0.01	0.01	0.79	0.15
680	KFJ04	Fjällved						38	2.7	28	3.9	196	9	7	-82.6	21	-11.54	0.02	0.02	0.02	0.02	0.81	0.12
681	KFJ04	Fjällved						54	2.4	17	2.3	195	5	3.6	-81.6	12	-11.45	0.02	0.02	0.02	0.02	0.80	0.13
682	KFJ04	Fjällved						62	2	14	2	198	8	3.9	-84.7	6	-11.69	0.02	0.02	0.02	0.02	0.85	0.08
683	KFJ07	Fjällved						55	3.8	11	2.1	160	4	0.5	-80.4	3	-11.28	0.02	0.02	0.02	0.02	0.79	0.13
684	KFJ07	Fjällved						48	3.9	11	2.1	160	3	0.5	-80.3	3	-11.33	0.02	0.02	0.02	0.02	0.79	0.13
685	KFJ07	Fjällved						37	3.3	11	2	160	1	0.5	-80.7	3	-11.34	0.02	0.02	0.02	0.02	0.80	0.12
686	KFJ07	Fjällved						37	3.1	11	2	160	3	1.1	-80.2	3	-11.23	0.02	0.02	0.02	0.02	0.79	0.13
687	KFJ07	Fjällved						47	3.1	11	2.1	150	1	0.5	-80.1	3	-11.24	0.02	0.02	0.02	0.02	0.80	0.12
688	KFJ07	Fjällved						46	3.6	10	2	150	3	0.5	-81.4	3	-11.36	0.02	0.02	0.02	0.02	0.82	0.10
689	KFJ07	Fjällved						53	3.6	11	2.1	150	3	0.8	-81.2	3	-11.39	0.02	0.02	0.02	0.02	0.82	0.10
690	KFJ07	Fjällved						54	3.2	11	2.1	160	4	0.5	-80.3	3	-11.36	0.02	0.02	0.02	0.02	0.80	0.12
691	KFJ07	Fjällved						52	3	11	2	190	4	0.5	-80.6	3	-11.4	0.02	0.02	0.02	0.02	0.79	0.15
692	KFJ08	Fjällved						13	3.2	25	4.6	130	4	6.5	-79.3	8	-11.22	0.02	0.02	0.02	0.02	0.80	0.12
693	KFJ08	Fjällved						14	2.9	26	4	130	4	5	-77.8	10	-10.94	0.02	0.02	0.02	0.02	0.77	0.15
694	KFR01	Forsmark						1900	8.6	940	170	69	4100	300	-88.1	3	-12.26	0.11	0.11	0.11	0.30	0.26	0.11
695	KFR01	Forsmark						1700	9.3	1200	180	71	4400	300	-86.4	3	-12.05	0.11	0.11	0.11	0.27	0.27	0.11
696	KFR01	Forsmark						1700	8.8	1200	210	73	4100	340	-88.3	3	-11.5	0.12	0.12	0.12	0.24	0.28	0.12
697	KFR01	Forsmark						800	9.7	490	65	74	4300	320	-86	3	-11.9	0.09	0.09	0.09	0.26	0.40	0.09
698	KFR01	Forsmark						1500	16	1600	170	77	4200	490	-88.2	3	-12	0.13	0.13	0.13	0.32	0.16	0.13
699	KFR01	Forsmark						1500	7.1	970	160	83	4200	350	-88	3	-11.8	0.11	0.11	0.11	0.27	0.30	0.11
700	KFR10	Forsmark						1200	20	1650	400	80	5100	450	-62.8	3	-9.1	0.36	0.16	0.12	0.12	0.12	0.12
701	KFR10	Forsmark						1800	19	1000	270	90	5400	400	-63	3	-9.12	0.25	0.13	0.13	0.13	0.13	0.24

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
702	KFR10	Forsmark						1800	20	1500	250	88	5000	400	-62.9	3	-9.11	0.23	0.13	0.13	0.13	0.13	0.24
703	KFR10	Forsmark						2000	21	1200	340	89	5100	440	-66.1	3	-8.6	0.33	0.16	0.13	0.13	0.13	0.13
704	KFR10	Forsmark						1800	18	970	260	92	5000	430	-69	3	-8.7	0.22	0.13	0.13	0.13	0.13	0.27
705	KFR10	Forsmark						1600	19	1400	250	98	5200	670	-67.2	3	-9.1	0.25	0.15	0.15	0.15	0.15	0.15
706	KFR10	Forsmark						1500	16	1100	270	105	5000	450	-67.3	3	-8.8	0.22	0.12	0.12	0.12	0.12	0.28
707	KFR7A	Forsmark						1800	21	1250	330	87	5000	440	-67	3	-9.62	0.30	0.14	0.14	0.14	0.14	0.16
708	KFR7A	Forsmark						2300	20	930	260	94	4900	440	-65.5	3.06	-9.44	0.23	0.14	0.14	0.14	0.14	0.22
709	KFR7A	Forsmark						1900	20	1200	320	98	5000	420	-65.6	3	-9.45	0.30	0.13	0.13	0.13	0.13	0.17
710	KFR7A	Forsmark						2100	19	880	280	92	4900	480	-67.7	3.06	-9.1	0.26	0.14	0.14	0.14	0.14	0.19
711	KFR7A	Forsmark						2600	20	1200	340	98	5200	430	-69.1	2.88	-9.2	0.27	0.18	0.14	0.14	0.14	0.14
712	KFR7A	Forsmark						1100	44	760	180	96	5000	480	-69.6	3	-9.5	0.21	0.13	0.13	0.13	0.13	0.29
713	KFR7A	Forsmark						2500	28	1500	280	120	5000	670	-70.2	3	-9.5	0.15	0.26	0.15	0.15	0.15	0.15
714	KFR7A	Forsmark						1800	15	970	250	110	5000	460	-70	3	-9	0.17	0.13	0.13	0.13	0.13	0.31
715	KKA03	Kamlunge						17	2.9	130	12	272	19	170	-59.6	103	-8.7	0.01	0.01	0.01	0.01	0.32	0.64
716	KKA03	Kamlunge						19	2.8	129	7.5	271	21	160	-59.6	99	-8.7	0.01	0.01	0.01	0.01	0.33	0.63
717	KKA03	Kamlunge						17	2.7	127	9.5	265	20	160	-59	77	-8.8	0.01	0.01	0.01	0.01	0.33	0.63
718	KKA04	Kamlunge						53	3.1	75	18	293	37	118	-69	58	-10	0.01	0.01	0.01	0.01	0.48	0.48
719	KKA04	Kamlunge						55	3.3	86	17	295	38	110	-67.6	41	-9.7	0.01	0.01	0.01	0.01	0.44	0.52
720	KKA04	Kamlunge						55	3.2	85	15	290	37	110	-71	48	-9.5	0.01	0.01	0.01	0.01	0.47	0.50
721	KKA04	Kamlunge						54	3.2	85	15	296	36	110	-71	60	-9.8	0.01	0.01	0.01	0.01	0.49	0.48
722	KKA04	Kamlunge						53	3.2	85	16	293	36	110	-70	61	-10	0.01	0.01	0.01	0.01	0.49	0.47
723	KKA04	Kamlunge						57	3.3	78	17	295	37	110	-71	60	-9.9	0.01	0.01	0.01	0.01	0.49	0.47
724	KKA04	Kamlunge						58	3.2	80	17	295	41	112	-71	59	-9.9	0.01	0.01	0.01	0.01	0.49	0.47
725	KKA04	Kamlunge						58	3.2	80	17	295	41	112	-71	58	-9.9	0.01	0.01	0.01	0.01	0.49	0.47
726	KKA04	Kamlunge						58	3.2	80	17	295	41	112	-71	60	-9.9	0.01	0.01	0.01	0.01	0.49	0.47
727	HKM20	Karlsham						8.7	1.6	11	2.4	59	11	2	-99.1	28	-13.64	0.02	0.02	0.02	0.26	0.66	0.02
728	HKM20	Karlsham						8.1	1.7	11	2.6	81	9	3	-99.8	22	-13.72	0.02	0.02	0.02	0.25	0.67	0.02
729	KKM03	Karlsham						5.7	1.2	13	2.8	65	2.5	4	-99.3	49	-13.66	0.02	0.02	0.02	0.26	0.67	0.02
730	KKM03	Karlsham						6.1	1.3	13	2.7	65	2.5	4	-100	39	-13.76	0.02	0.02	0.02	0.27	0.66	0.02
731	KKM03	Karlsham						4.8	1.8	13	3.1	62	3	6	-100	56	-13.78	0.02	0.02	0.02	0.27	0.65	0.02
732	KKM03	Karlsham						5	1.8	13	3.2	66	2.5	6	-100	56	-13.76	0.02	0.02	0.02	0.26	0.66	0.02
733	KKM08	Karlsham						0.8	0.2	2	0.6	8	0.5	5	-107	30	-14.57	0.02	0.02	0.02	0.39	0.53	0.02
734	KKM13	Karlsham						18	1.6	106	0.6	13	6	240	-99.8	9	-13.72	0.04	0.04	0.04	0.37	0.46	0.04
735	KKM13	Karlsham						19	5.8	145	3.9	23	11	300	-97.9	28	-13.49	0.05	0.05	0.05	0.35	0.46	0.05
736	KKM13	Karlsham						1.9	1	5.4	0.8	31	2	7	-98.9	37	-13.61	0.02	0.02	0.02	0.28	0.63	0.02
737	KKM13	Karlsham						1.4	0.8	3.5	0.7	8	5	5	-109	39	-14.9	0.02	0.02	0.02	0.42	0.51	0.02
738	KKM13	Karlsham						1	0.7	3	0.5	9	0.5	6	-110	25	-15.04	0.02	0.02	0.02	0.43	0.50	0.02

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
739	KKL01	Klipperå						48	0.9	14.4	2.3	80	48	1.3	-85.2	6.53	-11.9	0.02	0.02	0.02	0.08	0.82	0.02
740	KKL02	Klipperå						27	1.1	30	1	134	18	0.1	-88.8	3	-12.35	0.02	0.02	0.02	0.09	0.83	0.02
741	KKL02	Klipperå						41	1.5	16	1	99	25	0.11	-80.5	13	-11.31	0.02	0.02	0.02	0.02	0.85	0.05
742	KKL09	Klipperå						16	1	30	2	121	5.5	4	-85.4	2.14	-11.93	0.02	0.02	0.02	0.06	0.85	0.02
743	KKR01	Kråkemål						39	3.2	40	8	223	15	4.2	-78	3	-10.3	0.01	0.01	0.01	0.01	0.65	0.31
744	KKR01	Kråkemål						40	3.1	40	8	224	15	4.2	-78	3	-10.3	0.01	0.01	0.01	0.01	0.65	0.31
745	KKR01	Kråkemål						39	3.2	40	8	224	15	3.6	-78	3	-10.3	0.01	0.01	0.01	0.01	0.65	0.31
746	KKR01	Kråkemål						40	3.1	40	9	224	15	3.6	-78	3	-10.3	0.01	0.01	0.01	0.01	0.65	0.31
747	KKR01	Kråkemål						57	3.3	30	8	231	25	2.7	-77	3	-10.4	0.01	0.01	0.01	0.01	0.65	0.32
748	KKR01	Kråkemål						57	3.1	28	8.5	231	25	2.7	-77	3	-10.4	0.01	0.01	0.01	0.01	0.65	0.32
749	KKR01	Kråkemål						58	3.1	27	9	231	25	3.6	-77	3	-10.4	0.01	0.01	0.01	0.01	0.65	0.32
750	KKR01	Kråkemål						57	3.3	28	9.5	227	23	1.5	-77	3	-10.4	0.01	0.01	0.01	0.01	0.65	0.32
751	KKR01	Kråkemål						235	3.2	25	8.5	210	260	36	-79	3	-10.7	0.02	0.02	0.02	0.02	0.70	0.23
752	KKR01	Kråkemål						250	3.3	29	8.5	215	280	40	-79	3	-10.7	0.02	0.02	0.02	0.02	0.69	0.23
753	KKR01	Kråkemål						250	3.3	29	8	215	280	39	-79	3	-10.7	0.02	0.02	0.02	0.02	0.69	0.23
754	KKR01	Kråkemål						250	3.2	29	7.5	215	280	38	-79	3	-10.7	0.02	0.02	0.02	0.02	0.69	0.23
755	KKR01	Kråkemål						80	3.7	22	6.5	222	44	9.6	-83	3	-10.4	0.01	0.01	0.01	0.01	0.71	0.24
756	KKR01	Kråkemål						80	3.3	22	7	222	44	7.2	-83	3	-10.4	0.01	0.01	0.01	0.01	0.71	0.24
757	KKR01	Kråkemål						82	3.4	22	6.5	223	45	8.1	-83	3	-10.4	0.01	0.01	0.01	0.01	0.71	0.24
758	KKR01	Kråkemål						82	3.5	21	7	222	47	8.1	-83	3	-10.4	0.01	0.01	0.01	0.01	0.71	0.24
759	KLJ01	Lansfjär						11.3	1.52	7.7	1.2	44	0.8	4.4	-109	8	-13.8	0.02	0.02	0.02	0.34	0.59	0.02
760	KSV04	Svartbob						24	1.7	25	3.2	138	2.3	1.9	-90	5	-12.5	0.02	0.02	0.02	0.09	0.83	0.02
761	KSV04	Svartbob						40	0.8	13	1.7	127	9	0.8	-95.3	3	-13.2	0.02	0.02	0.02	0.17	0.76	0.02
762	KSV04	Svartbob						35	0.9	17	2	130	8	1.2	-95	3	-13	0.02	0.02	0.02	0.16	0.77	0.02
763	KSV04	Svartbob						35	0.7	17	1.9	126	7	0.8	-95.4	3	-13.1	0.02	0.02	0.02	0.17	0.76	0.02
764	KSV05	Svartbob						20	1.1	19	1.2	114	2.4	3	-92.2	33	-12.8	0.02	0.02	0.02	0.14	0.78	0.02
765	KSV05	Svartbob						3	0.6	8	1.9	28	7	4.7	-90.8	36	-12.6	0.02	0.02	0.02	0.19	0.72	0.02
766	KSV05	Svartbob						3	0.6	8	1.3	50	7	4.8	-86.8	37	-12.1	0.02	0.02	0.02	0.12	0.78	0.02
767	KSV05	Svartbob						3	0.5	9	1.6	47	10	5.5	-86	36	-12	0.03	0.03	0.03	0.12	0.78	0.03
768	KTA01	Taavinun						3.9	1	6.2	1.4	32	2	6.9	-97.4	145	-13.64	0.02	0.02	0.02	0.27	0.65	0.02
769	KTA01	Taavinun						4.5	0.95	6.7	1.4	33	1	7.6	-101	120	-13.9	0.02	0.02	0.02	0.30	0.62	0.02
770	KTA01	Taavinun						3.9	0.87	6.7	1.4	32	1	6.2	-97.6	123	-13.66	0.02	0.02	0.02	0.27	0.65	0.02
771	KTA01	Taavinun						3.7	0.94	5.4	1.4	26	1	4.8	-98.7	123	-13.61	0.02	0.02	0.02	0.28	0.64	0.02
772	KTA01	Taavinun						3.7	1	5.3	1.4	30	1	5.2	-97.8	160	-13.63	0.02	0.02	0.02	0.27	0.65	0.02
773	KTA01	Taavinun						4.3	0.97	5.3	1.4	28	1	5.3	-97.5	162	-13.67	0.02	0.02	0.02	0.27	0.65	0.02
774	KTA01	Taavinun						4.5	0.99	5.6	1.4	31	1	5.3	-98.5	121	-13.78	0.02	0.02	0.02	0.28	0.64	0.02
775	KTA01	Taavinun						4	0.97	6.2	1.4	32	1	6.3	-98.7	155	-13.76	0.02	0.02	0.02	0.28	0.64	0.02

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
776	KTA01	Taavinun						4.3	0.96	6.4	1.3	32	1	6.4	-97.9	99	-13.78	0.02	0.02	0.02	0.28	0.64	0.02
777	KTA01	Taavinun						4.1	0.93	6.5	1.4	32	1	6.5	-98.6	121	-13.64	0.02	0.02	0.02	0.28	0.64	0.02
778	KTA01	Taavinun						4.1	0.93	6.4	1.4	31	1	7	-98.6	158	-13.76	0.02	0.02	0.02	0.28	0.64	0.02
779	KTA01	Taavinun						4	0.92	5.9	1.3	31	1	6.7	-98	153	-13.78	0.02	0.02	0.02	0.28	0.64	0.02
780	KTA01	Taavinun						4.8	1.3	7.9	1.1	25	1	5.8	-97.4	129	-13.68	0.02	0.02	0.02	0.28	0.64	0.02
781	KTA01	Taavinun						4.5	1.3	6.9	1.2	30	1	5.8	-97.1	115	-13.64	0.02	0.02	0.02	0.27	0.65	0.02
782	Rain old	Precipitation						0.4	0.29	0.24	0.1	12.2	0.23	1.41	-80	0	-10.5	0.03	0.03	0.03	0.04	0.84	0.03
783	Rain	Precipitation						0.4	0.29	0.24	0.1	12.2	0.23	1.41	-80	22	-10.5	0.03	0.03	0.03	0.04	0.85	0.03
784	Rain old, north	Precipitation						0.4	0.29	0.24	0.1	12.2	0.23	1.41	-80	0	-14	0.03	0.03	0.03	0.20	0.69	0.03
785	Rain, north	Precipitation						0.4	0.29	0.24	0.1	12.2	0.23	1.41	-80	22	-14	0.03	0.03	0.03	0.20	0.69	0.03
786	Rain'60, north	Precipitation						0.4	0.29	0.24	0.1	12.2	0.23	1.41	-80	2000	-14	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
787	Glacial	Glacial						0.17	0.4	0.1779	0.1	0.12	0.5	0.5033	-158	0	-21	-1.#IND	-1.#IND	-1.#IND	-1.#IND	-1.#INI	-1.#IND
788	1569_1	Äspö-1						1190	5.78	297	37.1	111.8	2318	62.6206	-126	0.1	-16.6	0.04	0.04	0.04	0.62	0.20	0.04
789	1569_2	Äspö-2						110	1.84	33.8	3.52	12.4	219	10.3968	-121	0.1	-15.5	0.02	0.02	0.02	0.52	0.41	0.02
790	PROV 1b	Norway g						0.12	0.4	0.1	0.1	0.12	0.5	0.29962	-102	0	-14	0.02	0.02	0.02	0.34	0.57	0.02
791	PROV 2b	Norway g						0.17	0.4	0.1779	0.1	0.12	0.5	0.5033	-116	0	-15.8	0.02	0.02	0.02	0.51	0.43	0.02
792	PROV 3b	Norway g						0.1	0.4	0.1	0.1	0.1	0.5	0.29962	-99.6	0	-13.7	0.02	0.02	0.02	0.31	0.60	0.02
793	PROV 4b	Norway g						0.1023	0.4	0.2319	0.1	0.24	0.5	0.55565	-116	0	-15.7	0.02	0.02	0.02	0.50	0.43	0.02
794	PROV 5b	Norway g						0.2748	0.32437	0.4846	0.1	1.1	0.71	0.89128	-111	0	-15.1	0.02	0.02	0.02	0.44	0.48	0.02
795	PROV 6b	Norway g						713.2	26.3258	26.345	85.628	11	1290	176.396	-103	0	-14.1	0.07	0.07	0.07	0.33	0.39	0.07
796	PASSEA01	Sea						1960	95	93.7	234	90	3760	503.362	-53.3	42	-5.9	0.40	0.36	0.06	0.06	0.06	0.06
797	PASSEA01	Sea						1380	58	67.7	168	61	2670	383.514	-54.6	26	-7	0.49	0.09	0.09	0.09	0.09	0.14
798	PASSEA01	Sea						1810	69	88.8	215	84	3380	501	-50.7	36	-6	0.46	0.24	0.08	0.08	0.08	0.08
799	PASSEA02	Sea						1640	66	76.1	197	73	3160	434.449	-54.5	38	-6.9	0.48	0.16	0.09	0.09	0.09	0.09
800	PASSEA02	Sea						1810	69	88	212	83	3320	461.415	-50.8	33	-6	0.47	0.22	0.08	0.08	0.08	0.08
801	PASSEA03	Sea						1820	75	82.6	223	80	3540	491.377	-54.8	29	-6.9	0.42	0.25	0.08	0.08	0.08	0.08
802	PASSEA03	Sea						1920	64	91	227	84	3620	514	-52.3	36	-6.5	0.43	0.24	0.08	0.08	0.08	0.08
803	PASSEA04	Sea						2050	83	93	251	94	4030	548.305	-53	40	-6.5	0.37	0.35	0.07	0.07	0.07	0.07
804	PASSEA04	Sea						1990	66	94	234	89	3680	535	-53.6	58	-6.7	0.40	0.26	0.08	0.08	0.08	0.08
805	PASSEA05	Sea						2030	81	91.8	246	91	4100	536.32	-54.8	30	-6.8	0.37	0.33	0.08	0.08	0.08	0.08
806	PASSEA05	Sea						1935	73	90	231	84	3610	516	-54.1	34	-7	0.40	0.27	0.08	0.08	0.08	0.08
807	Varvinnokka	Olkiluoto						28.8	6.57	25	5.16	98.848	6.56	62.4	-86.6	21.3	-10.4	0.03	0.03	0.03	0.03	0.80	0.08
808	Varvinnokka*	Olkiluoto						9.7	3.6	44	5	152.54	4.7	15	-81.6	12.7	-10.6	0.02	0.02	0.02	0.02	0.76	0.17
809	Helmiranta*	Olkiluoto						76	2.4	19	3.4	201.36	15	23	-84.1	10.5	-11.3	0.02	0.02	0.02	0.02	0.81	0.12
810	PVP1	Olkiluoto						7.2	2.4	13	4.8	26.848	7.3	28	-72.9	55	-9.9	0.03	0.03	0.03	0.03	0.72	0.17
811	PVP2	Olkiluoto						3.1	1.7	4.7	1.4	9.1526	4.8	5.9	-75.6	47	-10	0.03	0.03	0.03	0.03	0.77	0.11
812	PR1	Olkiluoto						3.3	1.8	4.6	2.3	20.136	1.3	5	-84.4	15	-11.1	0.03	0.03	0.03	0.08	0.80	0.03

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
813	PR4	Olkiluoto						31	4	15	5.5	122.03	4.5	25	-81.3	35	-10.2	0.02	0.02	0.02	0.02	0.74	0.17
814	PR2	Olkiluoto						79	4.3	19	5.7	213.56	12	17	-83.5	13.5	-10.7	0.01	0.01	0.01	0.01	0.74	0.21
815	PR3	Olkiluoto						210	4.7	9.6	3.7	414.92	30	110	-85.9	42	-10.7	0.00	0.00	0.00	0.00	0.62	0.37
816	2/T7	Olkiluoto						270	4.9	19	7.3	292.88	210	80	-79.7	10.7	-10.8	0.02	0.02	0.02	0.02	0.64	0.30
817	1/T6	Olkiluoto						270	4.9	32	11	375.26	250	110	-79.3	5.8	-10.8	0.01	0.01	0.01	0.01	0.57	0.39
818	1/T5	Olkiluoto						290	4.8	38	12	372.2	275	109	-77.7	5.5	-10.9	0.01	0.01	0.01	0.01	0.57	0.39
819	1/T7	Olkiluoto						324	6.8	78	25	390.98	413	101	-78.4	6.2	-11.1	0.01	0.01	0.01	0.01	0.54	0.41
820	1/T7	Olkiluoto						330	7.9	83	27	396.61	430	96	-79.2	5.6	-10.9	0.01	0.01	0.01	0.01	0.52	0.44
821	5/T7	Olkiluoto						500	5.4	147	32	274.58	910	190	-77.2	1.7	-10.7	0.04	0.04	0.04	0.04	0.57	0.28
822	4/T6	Olkiluoto						760	18	172	67	212.13	1140	200	-76	1.3	-10	0.05	0.05	0.05	0.05	0.41	0.38
823	2/T6	Olkiluoto						760	5	160	35	164.99	1500	160	-89.2	2.2	-11.9	0.05	0.05	0.05	0.13	0.66	0.05
824	4/T4	Olkiluoto						1010	11	530	86	145.58	2330	150	-76.4	3.2	-10.6	0.07	0.07	0.07	0.07	0.53	0.19
825	2/T4	Olkiluoto						1900	16	750	160	51.298	4600	523	-69.7	0.8	-9.2	0.14	0.14	0.14	0.14	0.25	0.20
826	4/T5	Olkiluoto						1870	20	700	260	80.413	4500	510	-72.4	0.8	-9.5	0.17	0.14	0.14	0.14	0.14	0.28
827	4/T5	Olkiluoto						1900	21	700	250	85.959	4500	500	-73.5	0.8	-10	0.14	0.14	0.14	0.14	0.15	0.30
828	8/P1	Olkiluoto						2030	7	1020	130	38.608	4770	470	-79.7	12	-9.6	0.13	0.13	0.13	0.25	0.23	0.13
829	5/T6	Olkiluoto						1600	15	595	160	69.322	3800	463	-74	0.8	-10	0.12	0.12	0.12	0.12	0.35	0.16
830	5/T5	Olkiluoto						1670	16	700	190	74.868	4300	440	-77.3	1.1	-10.3	0.13	0.13	0.13	0.13	0.35	0.14
831	2/T5	Olkiluoto						1770	10	520	110	47.693	3870	400	-80.9	0.8	-10.8	0.11	0.11	0.11	0.23	0.31	0.11
832	5/T4	Olkiluoto						1900	12	570	86	48.525	4000	320	-89.1	1.2	-11.6	0.11	0.11	0.11	0.32	0.26	0.11
833	3/T7	Olkiluoto						1680	11	340	90	42.148	3420	280	-92.1	0.9	-12.4	0.09	0.09	0.09	0.34	0.29	0.09
834	2/T3	Olkiluoto						1950	6.6	730	33	24.956	4300	225	-81.2	1.3	-11.1	0.10	0.10	0.10	0.31	0.30	0.10
835	3/T6	Olkiluoto						1400	6	350	70	36.047	2800	218	-92.1	0.8	-12.1	0.08	0.08	0.08	0.31	0.37	0.08
836	3/T5	Olkiluoto						1460	4.7	270	26	30.509	2700	2.5	-94.9	0.8	-12.8	0.06	0.06	0.06	0.34	0.43	0.06
837	3/P1	Olkiluoto						1445	5	279	25	17.085	2760	1.4	-98.7	0.8	-12.8	0.06	0.06	0.06	0.37	0.40	0.06
838	3/T3	Olkiluoto						1600	8.8	404	25	28.678	3400	26	-90.6	0.8	-12.1	0.07	0.07	0.07	0.30	0.42	0.07
839	3/T2	Olkiluoto						2100	9.6	380	9.9	24.407	3900	16	-91.5	0.8	-12.2	0.08	0.08	0.08	0.36	0.34	0.08
840	2/T2	Olkiluoto						1990	4.7	720	5.3	9.8437	4200	6.9	-90.8	0.8	-12.4	0.07	0.07	0.07	0.40	0.30	0.07
841	5/T2	Olkiluoto						2230	8.4	960	41	36.61	4700	75	-84.4	0.8	-11.3	0.09	0.09	0.09	0.31	0.31	0.09
842	10/P1	Olkiluoto						1930	8.6	1240	57	15.254	5400	8.3	-89.3	0.8	-11.7	0.09	0.09	0.09	0.36	0.29	0.09
843	3/T1	Olkiluoto						2690	12	890	37	6.1017	5865	31.2	-86.9	0.9	-11.7	0.10	0.10	0.10	0.40	0.20	0.10
844	5/T1	Olkiluoto						3020	15	1940	61	6.1017	8400	4.2	-80.4	2.7	-11.1	0.12	0.12	0.13	0.39	0.12	0.12
845	5/T1	Olkiluoto						3050	13	1940	61	12.478	8500	4.5	-81.2	1.3	-11.2	0.12	0.12	0.13	0.40	0.12	0.12
846	1/T4	Olkiluoto						3300	15	2100	62	34.661	8800	20.6	-75.8	2.1	-10.9	0.13	0.13	0.14	0.36	0.13	0.13
847	5/P1	Olkiluoto						3325	14	2255	65	6.604	9500	3.1	-89.3	0.8	-11.8	0.10	0.10	0.16	0.43	0.10	0.10
848	9/P1	Olkiluoto						4200	14	3250	40	4.064	11480	1.3	-82.2	23	-11	0.10	0.10	0.21	0.39	0.10	0.10
849	1/T3	Olkiluoto						4800	21	3900	50	8.7346	14800	4.4	-73.3	3	-10.7	0.10	0.10	0.26	0.32	0.10	0.10

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
850	1/T3	Olkiluoto						4800	21	4000	56	9.0119	14800	0.84	-72.9	2.8	-10.7	0.11	0.11	0.26	0.32	0.11	0.11
851	4/P1	Olkiluoto						9750	22	15700	110	5.08	43000	1	-56.6	0.8	-9.6	0.02	0.02	0.81	0.12	0.02	0.02
852	1/S2	Olkiluoto						3500	19	2700	43.9	20.746	10000	0.1	-69.5	11	-9.1	0.14	0.14	0.16	0.30	0.14	0.14
853	1/S2	Olkiluoto						3890	19.8	3100	48.1	12.814	11500	0.1	-64.4	8	-8.7	0.14	0.14	0.18	0.26	0.14	0.14
854	1/S2	Olkiluoto						4100	19	3300	59.3	24.407	12000	0.14	-73	8	-10	0.12	0.12	0.20	0.31	0.12	0.12
855	1/S1	Olkiluoto						6622	15.6	6214	59.8	26.848	22000	0.1	-70.3	8	-9	0.09	0.09	0.39	0.25	0.09	0.09
856	1/S1	Olkiluoto						4621	17.4	3575	65.5	21.966	13400	0.1	-73.3	8.5	-10.4	0.11	0.11	0.23	0.32	0.11	0.11
857	5/S1	Olkiluoto						2795	13.9	1654	57	40.515	7580	10.9	-81.2	17	-11.1	0.12	0.12	0.12	0.36	0.18	0.12
858	Puskakari	Olkiluoto						1730	61.4	91	227	99.458	3250	501	-62.8	39.8	-7.2	0.44	0.17	0.10	0.10	0.10	0.10
859	Puskakari*	Olkiluoto						1780	66	80	218	79.322	3030	440	-60.7	16.3	-7.6	0.44	0.17	0.10	0.10	0.10	0.10
860	Eteläriutta*	Olkiluoto						1740	65	84	219	78.102	3020	460	-60.9	14.4	-7.5	0.44	0.17	0.10	0.10	0.10	0.10
861	Vuorimäki	Kivetty						2.5	0.86	3.2	0.76	10.983	1.2	2.8	-94.6	13	-12.5	0.02	0.02	0.02	0.22	0.69	0.02
862	Ylimm.Vuorijä	Kivetty						1.5	0.53	2.4	0.75	7.3221	5.2	1.3	-84.4	18.8	-10.3	0.03	0.03	0.03	0.06	0.83	0.03
863	Kulmala	Kivetty						5.8	0.71	8.3	3.8	27.458	7.2	3.8	-98.4	12.3	-12.9	0.02	0.02	0.02	0.24	0.66	0.02
864	1/T6	Kivetty						14	1.5	24	4.6	128.14	3.5	2.8	-95.3	0.8	-12.7	0.02	0.02	0.02	0.14	0.78	0.02
865	1/T5	Kivetty						40	0.89	10	1.6	81.763	22.2	6.8	-100	0.8	-13.7	0.02	0.02	0.02	0.26	0.67	0.02
866	1/T4	Kivetty						18	0.82	12.7	0.65	86.034	2.05	1.15	-90.4	0.8	-12.6	0.02	0.02	0.02	0.14	0.77	0.02
867	1/T3	Kivetty						33	0.69	15	1.9	103.12	9.7	2.5	-94.9	0.8	-13.2	0.02	0.02	0.02	0.19	0.74	0.02
868	1/T2	Kivetty						27	1.4	15	2.8	125.09	4.5	0.85	-93.2	0.8	-12.4	0.02	0.02	0.02	0.12	0.80	0.02
869	2/T7	Kivetty						4.6	0.52	6.3	2.1	42.712	0.47	0.18	-94.8	17	-12.7	0.02	0.02	0.02	0.20	0.71	0.02
870	2/T6	Kivetty						5.2	0.6	7	2.3	42.102	0.54	1.4	-96.2	1.8	-13.3	0.02	0.02	0.02	0.24	0.67	0.02
871	2/T5	Kivetty						17	0.72	13	1.4	76.882	7.8	2.7	-99.3	0.8	-13.6	0.02	0.02	0.02	0.25	0.67	0.02
872	3/T7	Kivetty						4.7	1.9	18	3.9	74.441	1.21	3.9	-93.9	13.5	-12.8	0.02	0.02	0.02	0.18	0.74	0.02
873	3/T7	Kivetty						4.6	1.5	15	3.4	72	1.5	4.9	-97.2	10.75	-12.8	0.02	0.02	0.02	0.20	0.72	0.02
874	3/T6	Kivetty						5.4	1.1	19	3.4	80.543	0.88	3.9	-96.4	8.5	-12.9	0.02	0.02	0.02	0.19	0.72	0.02
875	3/T3	Kivetty						18	0.55	16	1.7	84.814	6.2	4.3	-99.3	4.7	-13.6	0.02	0.02	0.02	0.24	0.68	0.02
876	4/T7	Kivetty						9.1	1.4	21	5.3	105.56	1.09	0.97	-93.3	0.8	-12.7	0.02	0.02	0.02	0.14	0.77	0.02
877	4/T6	Kivetty						7.5	1.2	13	4.4	81.763	1.38	1.51	-92.4	0.8	-12.8	0.02	0.02	0.02	0.16	0.75	0.02
878	4/T3	Kivetty						8.6	1.3	19	4.1	93.966	1.14	0.55	-95.8	0.8	-12.8	0.02	0.02	0.02	0.17	0.75	0.02
879	4/T2	Kivetty						21	1	10	2	83.593	2.1	1.9	-95	1.2	-13	0.02	0.02	0.02	0.19	0.73	0.02
880	4/T1	Kivetty						9.6	0.99	16	4.4	90.915	1.4	2.3	-96.5	4.6	-12.7	0.02	0.02	0.02	0.18	0.74	0.02
881	5/T7	Kivetty						7.3	1.16	12.6	3.8	73.221	1.68	1.54	-91.3	8.8	-12.8	0.02	0.02	0.02	0.16	0.75	0.02
882	5/T6	Kivetty						8.2	1.7	13.5	4.2	81.763	3.53	2.4	-92.2	2.4	-12.4	0.02	0.02	0.02	0.14	0.77	0.02
883	5/T5	Kivetty						10	1.5	13	3.2	81.153	2.1	1.3	-94.3	8.8	-13.1	0.02	0.02	0.02	0.19	0.73	0.02
884	5/T4	Kivetty						20	2	13.8	1.6	79.322	13.8	5.6	-108	8.1	-14.5	0.02	0.02	0.02	0.34	0.59	0.02
885	5/T3	Kivetty						11	1.1	10	3.7	70.17	4.68	2.78	-94.9	14	-13	0.02	0.02	0.02	0.20	0.72	0.02
886	5/T2	Kivetty						12	1.4	17	3.7	89.085	4.3	1.58	-94.4	11.8	-12.7	0.02	0.02	0.02	0.16	0.75	0.02

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMP LING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
887	5/T1	Kivetty						12	1.2	10	3.5	80.543	2.1	1.2	-90.6	8.1	-12.6	0.02	0.02	0.02	0.14	0.77	0.02
888	KR5	Kivetty						35	3	22	2.1	79.322	48	6.9	-102	1.65	-13.9	0.02	0.02	0.02	0.27	0.65	0.02
889	Patvikonmaa	Kivetty						1.69	1.07	5.62	0.93	22.576	0.7	2.41	-88.6	32.5	-11.7	0.03	0.03	0.03	0.13	0.76	0.03
890	Toimisto	Kivetty						12.3	4.02	18.64	4.14	45.153	22	12	-100	44.1	-12.8	0.02	0.02	0.02	0.23	0.67	0.02
891	Piilola	Kivetty						2	0.96	9.87	0.88	10.373	15.8	3.68	-103	35	-13.2	0.02	0.02	0.02	0.30	0.62	0.02
892	Harakkamäki	Kivetty						2.06	1.16	2.4	0.67	12.814	0.76	2.82	-93.7	31.9	-12.2	0.02	0.02	0.02	0.19	0.71	0.02
893	Lemetyinen	Kivetty						2.08	0.55	3.56	0.78	12.203	0.86	5.67	-95.9	34.1	-12.2	0.02	0.02	0.02	0.21	0.69	0.02
894	P-Ahvenainen	Kivetty						1.47	0.56	1.86	0.47	10.373	0.59	1.49	-95.5	18.5	-12.7	0.02	0.02	0.02	0.23	0.67	0.02
895	Iso-Paskol.	Kivetty						1.41	0.71	1.9	0.67	9.1526	0.43	2.86	-95.9	21	-12.3	0.02	0.02	0.02	0.22	0.69	0.02
896	Liimatainen	Kivetty						5.77	2.75	11.44	5.8	79.932	1.93	1.96	-96.9	3.2	-12.6	0.02	0.02	0.02	0.18	0.74	0.02
897	KA1	Kivetty						3.62	2.54	11.6	3.98	66.509	2.22	1.8	-94.9	31.9	-12.4	0.02	0.02	0.02	0.17	0.74	0.02
898	KA1	Kivetty						3.63	2.54	12.5	4.73	68.339	2.24	1.78	-94	27.1	-12.4	0.02	0.02	0.02	0.16	0.75	0.02
899	KA2	Kivetty						6.23	1.5	14.1	3.23	70.17	2.2	2.03	-94.1	5.5	-12.8	0.02	0.02	0.02	0.18	0.73	0.02
900	TAP	Kivetty						22.65	2.85	9.81	3.64	80.543	8.17	9.89	-94.6	37	-12.4	0.02	0.02	0.02	0.16	0.75	0.02
901	KA2	Kivetty						5.96	1.29	9.15	3.08	58.576	1.77	0.68	-96.4	6	-12.6	0.02	0.02	0.02	0.19	0.72	0.02
902	KA2	Kivetty						5.97	1.44	11.3	3.09	61.017	1.77	1.84	-97.9	6	-12.7	0.02	0.02	0.02	0.21	0.71	0.02
903	KR1	Kivetty						9.3	2.25	28.3	7.3	152.54	1.48	0.71	-96	6.1	-12.4	0.02	0.02	0.02	0.11	0.82	0.02
904	KR1	Kivetty						9.3	2.35	22.5	5.5	115.93	1.48	0.11	-96	6.1	-12.5	0.02	0.02	0.02	0.14	0.78	0.02
905	KR1	Kivetty						9.5	2.44	22.2	5.4	122.03	1.46	0.05	-92.7	6.1	-12.4	0.02	0.02	0.02	0.11	0.81	0.02
906	Takkikangas	Romuvaara						1.6	0.55	4.3	0.53	8.4204	5.8	1.4	-106	15.5	-14	0.02	0.02	0.02	0.36	0.56	0.02
907	Hirvelä	Romuvaara						3	0.84	5.7	1.9	13.18	3.1	7.8	-105	11.9	-13.8	0.02	0.02	0.02	0.34	0.58	0.02
908	Haapanoro	Romuvaara						13	17	16	5.5	43.322	10	20	-94.8	17.2	-12.6	0.03	0.03	0.03	0.16	0.70	0.03
909	Kotikumpu	Romuvaara						7.8	4.2	10	4.1	15.864	11	21	-93.1	15.6	-12.8	0.03	0.03	0.03	0.21	0.67	0.03
910	2/T6	Romuvaara						27	0.47	6.3	0.23	80.543	8.2	2	-93.1	0.8	-12.9	0.02	0.02	0.02	0.18	0.74	0.02
911	2/T5	Romuvaara						15	1.5	18	1.6	100.07	1.7	2.2	-94.9	1.7	-13	0.02	0.02	0.02	0.17	0.74	0.02
912	2/T4	Romuvaara						23	0.92	12	0.92	65.898	17.8	9	-96	3.8	-12.9	0.02	0.02	0.02	0.21	0.71	0.02
913	2/T3	Romuvaara						31	0.92	8.6	0.44	62.237	24.1	8.6	-94.9	5.4	-13.2	0.02	0.02	0.02	0.22	0.69	0.02
914	2/T2	Romuvaara						3.5	2.4	25	2.3	93.966	4.5	3	-96.1	25.4	-13.1	0.02	0.02	0.02	0.19	0.73	0.02
915	3/T6	Romuvaara						4.8	1.8	16	4	89.695	0.74	1.34	-96.5	8	-12.9	0.02	0.02	0.02	0.18	0.73	0.02
916	3/T4	Romuvaara						5.5	1.8	19	5	106.78	0.77	1.2	-96.6	2	-13.1	0.02	0.02	0.02	0.18	0.74	0.02
917	3/T1	Romuvaara						45	2.6	35.6	1.36	61.017	109	1.21	-99.6	1.4	-13	0.02	0.02	0.02	0.23	0.68	0.02
918	4/T6	Romuvaara						38	0.66	2.6	0.17	88.475	7.4	1.54	-94.2	0.8	-13.3	0.02	0.02	0.02	0.20	0.72	0.02
919	4/T6	Romuvaara						39	0.6	1.7	0.13	87.865	7.6	1.99	-99.3	1.1	-12.8	0.02	0.02	0.02	0.20	0.72	0.02
920	4/T5	Romuvaara						22	1.2	15	2.1	107.39	3.3	0.3	-99.4	17.6	-13.1	0.02	0.02	0.02	0.20	0.73	0.02
921	4/T3	Romuvaara						36	0.79	4.2	0.88	67.119	23	1.6	-97.5	10.5	-13.2	0.02	0.02	0.02	0.23	0.69	0.02
922	5/T7	Romuvaara						3.7	2.1	10.9	1.8	51.254	0.75	4.9	-101	24.5	-13.7	0.02	0.02	0.02	0.28	0.64	0.02
923	5/T6	Romuvaara						39	0.5	1.7	0.05	87.254	2	0.5	-97.9	4.5	-13.1	0.02	0.02	0.02	0.21	0.71	0.02

	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18	Sea Sedim	Litorina Sea	Brine	Glacial	Rain 60'	Lake water
924	5/T4	Romuvaara						65	0.4	1.2	0.02	103.73	29	2.6	-97.4	2.3	-13	0.02	0.02	0.02	0.19	0.73	0.02
925	5/T1	Romuvaara						37	0.74	2.7	0.08	97.017	6	5.1	-99.9	3.2	-13.4	0.02	0.02	0.02	0.23	0.70	0.02
926	KA2	Romuvaara						2.66	1.27	13.5	1.75	60.407	0.75	2.03	-102	20.6	-13.2	0.02	0.02	0.02	0.26	0.67	0.02
927	KA2	Romuvaara						2.87	1.06	11.1	1.93	54.915	0.74	2.17	-103	16.6	-13.5	0.02	0.02	0.02	0.28	0.64	0.02
928	KA2	Romuvaara						1.7	0.75	6.1	0.84	25.627	0.65	2.4	-102	36.7	-13.5	0.02	0.02	0.02	0.30	0.62	0.02
929	KA3	Romuvaara						2.97	1.53	7.46	1.4	38.441	0.58	3.22	-105	46.5	-13.7	0.02	0.02	0.02	0.31	0.61	0.02
930	KA3	Romuvaara						3.15	1.65	5.9	1.51	34.17	0.54	2.34	-106	40.4	-13.7	0.02	0.02	0.02	0.32	0.60	0.02
931	KA3	Romuvaara						2.8	1.49	4.9	2.31	29.898	0.53	1.78	-105	36.4	-13.4	0.02	0.02	0.02	0.30	0.61	0.02
932	KFM01A	4538	Ground Water	6699537	1631389	-112		1740.0	25.6	874.0	142.0	61.0	4562.8	315.7	-89.9	0.0	-11.7	0.12	0.12	0.12	0.26	0.26	0.12

Appendix 3: M3 mixing calculations for Forsmark local model

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18
1	KFM02A	4398	Ground Water					168	6.46	34.2	7.8	378	84.4	53.92	-82.1	11.2	-11.4
2	KFM02A	4397	Ground Water					148	8.35	30.8	7.3	381	63	48.13	-83	10.6	-11.4
3	HFM01	4116	Ground Water	6699611.02	1631488.47	-33.06		498	13.8	60.4	16.9	440	529.8	201.81	-64.2	3.7	-9.5
4	HFM01	4172	Ground Water	6699618.66	1631494.92	-96.87		556	15.2	79.1	22.8	480	651.1	220.09	-64.6	3.3	-9.4
5	HFM03	4167	Ground Water	6699592.77	1631271.98	-9.84		64.6	9.5	62	14	310	15.7	18.66	-79.6	12	-11.8
6	HFM05	4433	Ground Water	6698656.28	1633285.64	-104.44		1830	42.4	805	212	110	4652.5	308.66	-78.2	0.8	-10.2
7	HFM05	4434	Ground Water	6698656.28	1633285.64	-104.44		1800	42.2	781	207	115	4503.4	306.74	-78.1	0.8	-10.2
8	HFM05	4435	Ground Water	6698656.28	1633285.64	-104.44		1740	41.2	749	199	122	4340.3	299.24	-75	0.8	-10.3
9	SFM0001	4219	Near Surface GW	6699713.30	1631335.46	1.22	5.50	242	15.9	103	33.7	420	300.6	162.6	-90.6	15.3	-10.9
10	SFM0001	4316	Near Surface GW	6699713.30	1631335.46	1.22	5.50	321	18.9	91.7	40.6	476	392.4	159.79	-76.3	6	-10.8
11	SFM0001	4403	Near Surface GW	6699713.30	1631335.46	1.22	5.50	254	16.9	89.1	36.5	427	371.1	195.08	-80.3	13.3	-11.1
12	SFM0002	4220	Near Surface GW	6699585.84	1631377.73	2.01	5.75	40.7	6.19	187	11.8	330	126.2	19.61	-95.2	13.7	-11.8
13	SFM0002	4318	Near Surface GW	6699585.84	1631377.73	2.01	5.75	43.1	5.4	129	9.5	390	113.1	18	-83.5	13	-11.9
14	SFM0002	4405	Near Surface GW	6699585.84	1631377.73	2.01	5.75	46.7	6.05	131	9.7	351	100.3	46.88	-84	11.7	-11.9
15	SFM0003	4221	Near Surface GW	6699614.57	1631487.33	1.93	11.00	33.4	15.8	143	31.2	410	18.6	81.38	-82.3	24.9	-9
16	SFM0003	4317	Near Surface GW	6699614.57	1631487.33	1.93	11.00	33.5	13.7	97.3	27	453	17.9	75.3	-76.3	6	-9.7
17	SFM0003	4404	Near Surface GW	6699614.57	1631487.33	1.93	11.00	31.1	13.6	93	25.2	426	12.7	60.83	-74.9	17.9	-9.9
18	SFM0005	4432	Near Surface GW	6698647.55	1633252.18	6.80	2.40	5.8	1.87	85.6	5.4	260	7.4	13.63	-84.3	11	-12
19	PFM000074	4202	Lake Water	6699393.00	1629854.00		0.50	6.7	1.6	69.1	3.2	210	6.2	3.7	-77.8	12.5	-9.6
20	PFM000074	4224	Lake Water	6699393.00	1629854.00		0.50	6.9	1.55	71.3	3.6	240	6.1	2.75	-69.7	13.7	-9.8
21	PFM000074	4337	Lake Water	6699393.00	1629854.00		0.50	10.5	1.75	66.1	4	222	10.3	3.43	-68.4	14.7	-9.2
22	PFM000074	4453	Lake Water	6699393.00	1629854.00		0.50	9	2.62	84	4.4	245	12.2	27.33	-83.1	11.7	-11.8
23	PFM000087	4060	Lake Water	6700617.00	1629574.00		0.50	8.8	2.69	63.2	3.9	190	9.5	8.33	-88.8	12.6	-11.7
24	PFM000087	4061	Lake Water	6700617.00	1629574.00		1.80	8.7	2.77	64.1	4	190	9.4	8.3	-90	12.1	-12
25	PFM000087	4200	Lake Water	6700617.00	1629574.00		0.50	12	2.19	64.9	4.4	190	12	6.44	-77	13.6	-9.4
26	PFM000087	4201	Lake Water	6700617.00	1629574.00		1.50	12	2.25	66.3	4.5	200	12.5	6.24	-78.2	16	-9.4
27	PFM000087	4203	Lake Water	6700617.00	1629574.00		0.50	9.8	2.34	65.4	4.5	220	10.3	5.28	-68.6	15.6	-9.7
28	PFM000087	4222	Lake Water	6700617.00	1629574.00		1.50	9.8	2.45	66.2	4.6	230	10.4	5.44	-68.5	12.5	-9.8
29	PFM000087	4327	Lake Water	6700617.00	1629574.00		0.50	12.1	2.11	52.5	5.2	180	11.2	5.59	-64.2	11.6	-8.3
30	PFM000087	4331	Lake Water	6700617.00	1629574.00		1.50	11.9	2.17	54.5	5.1	189	14.6	5.58	-63.5	10.4	-8.2
31	PFM000087	4442	Lake Water	6700617.00	1629574.00		0.50	11.5	3.88	93.9	6.2	309	14.9	33.35	-77.4	12.2	-10.5
32	PFM000087	4449	Lake Water	6700617.00	1629574.00		1.50	12.2	3.94	99	6.3	309	17.8	33.36	-80.2	10.1	-11
33	PFM000097	4056	Lake Water	6699868.00	1631814.00		0.50	89.2	4.86	44.2	12.3	110	176.7	25.23	-84.8	11.7	-10.7
34	PFM000097	4205	Lake Water	6699868.00	1631814.00		0.50	75.5	4.28	42.7	10.7	120	136.2	21.99	-60.6	14.1	-6
35	PFM000097	4245	Lake Water	6699868.00	1631814.00		0.50	57.9	3.46	39.5	8.9	120	108.9	19.46	-53.4	8.2	-5.9
36	PFM000097	4452	Lake Water	6699868.00	1631814.00		0.50	51.4	4.34	58.6	9.4	190	95.9	22.28	-64.4	13.9	-7.9
37	PFM000107	4058	Lake Water	6699083.00	1632145.00		0.50	91.6	4.81	46.6	12.5	120	182	26.05	-82.8	12.6	-10.8

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18
38	PFM000107	4059	Lake Water	6699083.00	1632145.00		1.40	89.8	4.91	46.9	12.4	110	178.8	25.68	-82.8	13	-10.8
39	PFM000107	4206	Lake Water	6699083.00	1632145.00		0.50	65	4.02	42.9	9.5	120	116.5	19.39	-63.5	13.2	-6.8
40	PFM000107	4207	Lake Water	6699083.00	1632145.00		1.00	64.9	3.89	42.8	9.4	120	116.1	19.43	-64.3	15.6	-6.7
41	PFM000107	4233	Lake Water	6699083.00	1632145.00		0.50	48.8	3.29	42	8.2	130	88.9	17.54	-55.8	8.4	-6.3
42	PFM000107	4234	Lake Water	6699083.00	1632145.00		1.00	47.7	3.35	42.2	7.8	130	83.2	16.87	-54.8	11.7	-6.4
43	PFM000107	4328	Lake Water	6699083.00	1632145.00		0.50	57.1	4.07	44.4	9.3	144	98.1	17.6	-52.3	10.4	-6
44	PFM000107	4444	Lake Water	6699083.00	1632145.00		0.50	40	4.41	41	6.5	157	78.8	18.14	-77.4	11.5	-10.8
45	PFM000107	4447	Lake Water	6699083.00	1632145.00		1.00	43.6	3.84	52	8.1	171	84.2	20.03	-66.9	9.8	-8.4
46	PFM000117	4048	Lake Water	6697118.00	1631946.00		0.50	5.4	1.9	53.3	2.6	160	5.1	4.41	-77.3	12.5	-9.8
47	PFM000117	4049	Lake Water	6697118.00	1631946.00		1.50	5.6	1.9	53.3	2.5	160	3.9	4.15	-77.5	13.2	-9.8
48	PFM000117	4217	Lake Water	6697118.00	1631946.00		0.50	5.8	1.86	38.2	2.7	110	4.1	4.53	-72.3	15.5	-7.1
49	PFM000117	4218	Lake Water	6697118.00	1631946.00		1.50	5.9	1.91	39.2	2.7	110	4.2	4.53	-72.4	12.7	-7
50	PFM000117	4235	Lake Water	6697118.00	1631946.00		0.50	5.4	1.73	36.6	2.7	120	4.3	4.48	-57.9	6.9	-6.7
51	PFM000117	4440	Lake Water	6697118.00	1631946.00		0.50	7.4	2.46	52.3	3.5	170	5.5	5.74	-61.5	12.7	-7.1
52	PFM000117	4451	Lake Water	6697118.00	1631946.00		1.50	6.8	2.31	53.5	3.3	185	9.3	6.9	-61.8	13.5	-7.2
53	PFM000127	4215	Lake Water	6696924.00	1633350.00		0.50	21.5	3.38	29.6	5.6	97	26.6	14.49	-63.2	8.7	-5
54	PFM000127	4216	Lake Water	6696924.00	1633350.00		1.00	21.4	3.29	30.2	5.8	97	29.9	14.94	-62.4	13.1	-8.1
55	PFM000127	4232	Lake Water	6696924.00	1633350.00		0.50	21	3.21	30.3	5.9	110	45.8	16.18	-44.3	7.6	-4.5
56	PFM000127	4241	Lake Water	6696924.00	1633350.00		1.00	21	3	30.6	5.7	110	27.8	14.09	-46.3	6.1	-4.6
57	PFM000135	4443	Lake Water	6697594.00	1632722.00		0.50	33.7	5.43	72.2	9	281	49.3	22.79	-61.9	11.6	-7.2
58	PFM000062	4198	Sea Water	6700605.00	1631921.00		0.50	1455	56	71.7	184	71	2615.6	362.9	-66.1	10.6	-8.1
59	PFM000062	4229	Sea Water	6700605.00	1631921.00		0.50	1430	51.57	66.6	165	70	2464.7	343.93	-64.1	15.9	-8.5
60	PFM000062	4230	Sea Water	6700605.00	1631921.00		3.00	1410	50.07	66.6	164	70	2476.4	348.84	-62.4	11.7	-8.5
61	PFM000062	4322	Sea Water	6700605.00	1631921.00		3.00	1490	51	68.3	180	74	2627.6	363.73	-61.3	15.6	-8.2
62	PFM000062	4333	Sea Water	6700605.00	1631921.00		0.50	1490	51.3	68.7	181	83	2656.8	368.61	-61.6	15.3	-8.2
63	PFM000063	4194	Sea Water	6699014.00	1634833.00		0.50	1450	55.1	72.2	184	72	2627.4	365.72	-65.1	17.4	-7.8
64	PFM000063	4195	Sea Water	6699014.00	1634833.00		4.50	1460	55.95	72.8	186	72	2612.9	370.19	-65.7	17.4	-8
65	PFM000063	4227	Sea Water	6699014.00	1634833.00		0.50	1473.3	52.67	68.5	169.7	74	2573.1	363.59	-61.6	18.6	-8.2
66	PFM000063	4228	Sea Water	6699014.00	1634833.00		4.50	1513.3	54.03	70.2	174.3	77	2591.5	367.53	-62.6	18.1	-8.4
67	PFM000063	4321	Sea Water	6699014.00	1634833.00		4.50	1460	50.4	67.7	178	71	2636	365.98	-61.8	16	-8.1
68	PFM000063	4324	Sea Water	6699014.00	1634833.00		0.50	1500	51.2	68.9	181	70	2610.2	359.7	-61.6	17.1	-8.1
69	PFM000063	4445	Sea Water	6699014.00	1634833.00		0.50	1410	53	71.3	173	79	2613.2	374.5	-60.9	13.9	-8.5
70	PFM000063	4450	Sea Water	6699014.00	1634833.00		1.00	1450	55.2	72.2	179	82	2723.5	381.25	-65.1	17.5	-8.5
71	PFM000064	4196	Sea Water	6697347.00	1636121.00		0.50	1385	53.25	73.4	176	79	2507.5	347.03	-63.7	11.6	-7.6
72	PFM000064	4197	Sea Water	6697347.00	1636121.00		1.00	1385	53.4	72.9	175.5	77	2522.8	348.38	-64.1	12.2	-7.6
73	PFM000064	4225	Sea Water	6697347.00	1636121.00		0.50	1203.3	43.47	66.2	107.9	90	2098.5	290.35	-61.5	17	-8
74	PFM000064	4323	Sea Water	6697347.00	1636121.00		1.00	1430	49	69.9	175	77	2582.4	352.42	-60.1	15	-7.8

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18
75	PFM000064	4330	Sea Water	6697347.00	1636121.00		0.50	1410	48.6	69.5	172	80	2494.6	345.16	-60.2	14.2	-8
76	PFM000065	4212	Sea Water	6695635.00	1635083.00		0.50	1375	53.3	71.8	175.5	76	2509.5	349.28	-72.5	14.1	-7.9
77	PFM000065	4231	Sea Water	6695635.00	1635083.00		0.50	1090	40.27	63.8	126.3	93	1952.9	270.29	-60.7	11.4	-8.1
78	PFM000065	4325	Sea Water	6695635.00	1635083.00		0.50	1430	49.3	68.6	174	74	2520.9	350.17	-60.9	16.6	-8.1
79	PFM000065	4446	Sea Water	6695635.00	1635083.00		0.50	652	25.9	55.8	78.9	99	1170	244.19	-67.5	12.2	-8.8
80	PFM000082	4044	Sea Water	6701336.00	1632528.00		0.50	1420	53.1	72.1	173	76	2840.7	341.85	-64.5	15.9	-8.2
81	PFM000082	4047	Sea Water	6701336.00	1632528.00		6.00	1400	52.7	71.7	171	75	2786.8	334.44	-65.1	19.3	-8.2
82	PFM000082	4438	Sea Water	6701336.00	1632528.00		0.50	1430	54.1	70.3	176	75	2667.1	373.88	-64.1	12.6	-8.3
83	PFM000082	4439	Sea Water	6701336.00	1632528.00		6.50	1450	54	70.2	177	80	2685.6	380.25	-64.1	16.6	-8.3
84	PFM000083	4053	Sea Water	6698757.00	1636023.00		0.50	1430	53.5	72.8	175	74	2751.9	329.54	-65.1	16.1	-8.2
85	PFM000083	4054	Sea Water	6698757.00	1636023.00		6.00	1430	53.8	72.9	175	74	2808.5	336.61	-64.8	13.9	-8.1
86	PFM000084	4062	Sea Water	6694442.00	1635455.00		0.50	133	6.74	48.5	18.4	110	211.6	46.37	-83.5	11.2	-11
87	PFM000084	4063	Sea Water	6694442.00	1635455.00		2.50	136	6.89	49.2	18.7	110	289.4	54.48	-82.4	11.7	-11
88	PFM000066	4045	Streaming Water	6699064.00	1629343.00		0.20	3.7	2.15	60.4	2.6	180	3.5	9.03	-89.7	10.5	-12
89	PFM000066	4208	Streaming Water	6699064.00	1629343.00		0.20	5	1.52	67.3	3.2	200	3.1	4.16	-77.7	13	-9.5
90	PFM000066	4223	Streaming Water	6699064.00	1629343.00		0.05	4.8	1.45	66.6	3.2	210	3.1	3.71	-67.9	14.2	-9.7
91	PFM000066	4454	Streaming Water	6699064.00	1629343.00		0.10	7.9	3.15	84.6	4.2	245	6	27.53	-78.3	11.8	-11
92	PFM000067	4057	Streaming Water	6699753.00	1631859.00		0.50	92.8	5.09	46.5	12.8	110	184.8	26.13	-82.9	13	-10.8
93	PFM000067	4204	Streaming Water	6699753.00	1631859.00		0.10	72.2	4.25	43.1	10.3	120	127.2	21.11	-62.6	12.2	-6.3
94	PFM000067	4242	Streaming Water	6699753.00	1631859.00		0.10	53.8	3.52	41.7	8.5	130	101.6	18.51	-53.8	6.7	-6
95	PFM000067	4339	Streaming Water	6699753.00	1631859.00		0.05	62.9	4.44	45.4	10.4	124	111.7	25.28	-50.1	14.2	-5.5
96	PFM000067	4459	Streaming Water	6699753.00	1631859.00		0.10	54.1	5	60.9	9.8	191	90.8	20.82	-62.2	13.7	-7.4
97	PFM000068	4046	Streaming Water	6698735.00	1631641.00		0.50	7	2.08	50.2	3	150	7	4.97	-86.2	10.7	-11.2
98	PFM000068	4213	Streaming Water	6698735.00	1631641.00		0.20	12.3	1.54	55.8	4.2	160	13.5	5.79	-79.9	11	-8.8
99	PFM000068	4238	Streaming Water	6698735.00	1631641.00		0.10	12.7	1.54	58.6	4.4	190	17	5.24	-68.7	8.5	-9.3
100	PFM000068	4343	Streaming Water	6698735.00	1631641.00		0.50	27.1	2.26	73	7.9	226	47.5	9.04	-73.4	12.8	-10.5
101	PFM000068	4457	Streaming Water	6698735.00	1631641.00		0.10	15.9	3.04	66.2	5.1	202	19.2	14.79	-74.9	13.6	-10
102	PFM000069	4055	Streaming Water	6698440.00	1631510.00		0.50	8.7	2.16	49.5	3.3	140	13.2	6.8	-91.4	10.9	-12.1
103	PFM000069	4211	Streaming Water	6698440.00	1631510.00		0.15	15.9	1.34	61.3	4.9	180	20.5	8.07	-85.5	11	-10.2
104	PFM000069	4244	Streaming Water	6698440.00	1631510.00		0.05	14.6	1.29	62	4.8	190	20.4	6.34	-71.5	10.1	-9.8
105	PFM000069	4342	Streaming Water	6698440.00	1631510.00		0.05	26.7	1.58	70.4	7.6	222	59.3	9.33	-73.4	11.2	-10.3
106	PFM000069	4455	Streaming Water	6698440.00	1631510.00		0.10	27.3	3.72	85.5	7.2	256	40.6	17.46	-87.4	13.9	-11.7
107	PFM000070	4210	Streaming Water	6697319.00	1632061.00		0.20	5.8	1.77	40.2	2.7	120	4.2	3.88	-65.3	12.4	-7.1
108	PFM000070	4240	Streaming Water	6697319.00	1632061.00		0.05	5.5	1.39	39.9	2.6	130	4.1	3.42	-58.5	6.6	-6.9
109	PFM000070	4456	Streaming Water	6697319.00	1632061.00		0.10	9.7	3.08	52.8	3.4	168	5.4	6.48	-62.6	15.4	-7.4
110	PFM000071	4209	Streaming Water	6696533.00	1631944.00		0.10	3.7	2.11	82	3.7	250	2.3	2.73	-86.2	11.9	-11.4
111	PFM000071	4239	Streaming Water	6696533.00	1631944.00		0.05	3.6	2.14	83.9	3.8	280	1.5	1.08	-78.5	5.3	-11.2

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	IDCODE	SAMPLE NO	WATER_TYPE	NORTHING center section	EASTING center section	ELEVATION center section	SAMPLING depth	NA	K	CA	MG	HCO3	CL	SO4	D	TR	O18
112	PFM000071	4460	Streaming Water	6696533.00	1631944.00		0.10	5.6	2.64	86.3	4.1	268	3.2	9.17	-86.2	13.3	-12.1
113	PFM000072	4042	Streaming Water	6696708.00	1634151.00		0.50	14	2.99	47.1	4.8	140	17.7	11.76	-78.7	10.2	-10.1
114	PFM000072	4214	Streaming Water	6696708.00	1634151.00		0.20	28.9	1.6	36.1	6.4	130	34.1	7.37	-65.3	12.8	-5.8
115	PFM000072	4243	Streaming Water	6696708.00	1634151.00		0.50	28	1.42	36.4	6.5	140	37.7	6.89	-51.5	10.4	-5.6
116	PFM000072	4345	Streaming Water	6696708.00	1634151.00		0.10	72.8	4.72	49.1	11.8	128	117.8	71.74	-63	12.1	-8.4
117	PFM000072	4458	Streaming Water	6696708.00	1634151.00		0.10	70.4	4.87	63.6	15.3	201	107.7	55.24	-70.6	13.8	-9.2
118	PFM000073	4043	Streaming Water	6698073.00	1635004.00		0.10	10	6.42	122	13.3	390	5.9	48.36	-89.2	10.3	-11.9
119	SEA01		Sea					1960	95	93.7	234	90	3760	325	-53.3	42	-5.9
120	Glacial		Glacial					0.17	0.4	0.18	0.1	0.12	0.5	0.5	-158	0	-21
121	Litorina new		Sea					3674	134	151	448	93	6500	890	-38	0	-4.7
122	Rain'60		Rain					0.4	0.29	0.24	0.1	12.2	0.23	1.41	-80	2000	-10.5
123	SAS48		Sediment					2144	91.8	103	258	793	3383	53.1	-61	0	-7
124	SGKLX02		Laxemar					8500	45.5	19300	2.12	14.1	47200	906	-44.9	4.2	-8.9

	2	19	20	21	22	23
	IDCODE	Lake water	Litorina	Ground water	Glacial	Rain 60'
1	KFM02A	0.03	0.03	0.03	0.22	0.70
2	KFM02A	0.03	0.03	0.03	0.22	0.70
3	HFM01	0.10	0.08	0.08	0.08	0.67
4	HFM01	0.09	0.09	0.09	0.09	0.65
5	HFM03	0.03	0.03	0.03	0.21	0.70
6	HFM05	0.00	0.00	1.00	0.00	0.00
7	HFM05	0.01	0.01	0.96	0.01	0.01
8	HFM05	0.02	0.03	0.90	0.02	0.02
9	SFM0001	0.07	0.07	0.07	0.31	0.49
10	SFM0001	0.07	0.07	0.07	0.23	0.55
11	SFM0001	0.07	0.07	0.07	0.25	0.53
12	SFM0002	0.04	0.04	0.04	0.38	0.51
13	SFM0002	0.03	0.03	0.03	0.29	0.62
14	SFM0002	0.03	0.03	0.03	0.29	0.61
15	SFM0003	0.05	0.05	0.05	0.18	0.67
16	SFM0003	0.04	0.04	0.04	0.16	0.72
17	SFM0003	0.04	0.04	0.04	0.15	0.73
18	SFM0005	0.02	0.02	0.02	0.24	0.69
19	PFM000074	0.02	0.02	0.02	0.07	0.86
20	PFM000074	0.02	0.02	0.02	0.04	0.90
21	PFM000074	0.09	0.02	0.02	0.02	0.85
22	PFM000074	0.02	0.02	0.02	0.22	0.71
23	PFM000087	0.02	0.02	0.02	0.23	0.71
24	PFM000087	0.02	0.02	0.02	0.25	0.69
25	PFM000087	0.02	0.02	0.02	0.05	0.88
26	PFM000087	0.02	0.02	0.02	0.06	0.87
27	PFM000087	0.04	0.02	0.02	0.02	0.89
28	PFM000087	0.03	0.02	0.02	0.02	0.90
29	PFM000087	0.28	0.02	0.02	0.02	0.67
30	PFM000087	0.29	0.02	0.02	0.02	0.66
31	PFM000087	0.03	0.03	0.03	0.15	0.77
32	PFM000087	0.03	0.03	0.03	0.19	0.73
33	PFM000097	0.03	0.03	0.03	0.13	0.77
34	PFM000097	0.62	0.02	0.02	0.02	0.33
35	PFM000097	0.73	0.01	0.01	0.01	0.24
36	PFM000097	0.32	0.02	0.02	0.02	0.61
37	PFM000107	0.04	0.04	0.04	0.12	0.77

	2	19	20	21	22	23
	IDCODE	Lake water	Litorina	Ground water	Glacial	Rain 60'
38	PFM000107	0.04	0.04	0.04	0.12	0.77
39	PFM000107	0.50	0.02	0.02	0.02	0.45
40	PFM000107	0.49	0.02	0.02	0.02	0.45
41	PFM000107	0.64	0.01	0.01	0.01	0.32
42	PFM000107	0.65	0.01	0.01	0.01	0.31
43	PFM000107	0.72	0.01	0.01	0.01	0.25
44	PFM000107	0.03	0.03	0.03	0.09	0.82
45	PFM000107	0.25	0.02	0.02	0.02	0.68
46	PFM000117	0.02	0.02	0.02	0.05	0.88
47	PFM000117	0.02	0.02	0.02	0.05	0.88
48	PFM000117	0.33	0.01	0.01	0.01	0.63
49	PFM000117	0.34	0.01	0.01	0.01	0.62
50	PFM000117	0.57	0.01	0.01	0.01	0.41
51	PFM000117	0.44	0.01	0.01	0.01	0.53
52	PFM000117	0.41	0.01	0.01	0.01	0.55
53	PFM000127	0.68	0.01	0.01	0.01	0.29
54	PFM000127	0.41	0.02	0.02	0.02	0.54
55	PFM000127	1.00	0.00	0.00	0.00	0.00
56	PFM000127	0.96	0.00	0.00	0.00	0.04
57	PFM000135	0.34	0.02	0.02	0.02	0.60
58	PFM000062	0.32	0.34	0.11	0.11	0.11
59	PFM000062	0.35	0.31	0.11	0.11	0.11
60	PFM000062	0.36	0.31	0.11	0.11	0.11
61	PFM000062	0.36	0.34	0.10	0.10	0.10
62	PFM000062	0.35	0.34	0.10	0.10	0.10
63	PFM000063	0.34	0.34	0.11	0.11	0.11
64	PFM000063	0.33	0.34	0.11	0.11	0.11
65	PFM000063	0.36	0.33	0.10	0.10	0.10
66	PFM000063	0.34	0.34	0.11	0.11	0.11
67	PFM000063	0.36	0.33	0.10	0.10	0.10
68	PFM000063	0.36	0.34	0.10	0.10	0.10
69	PFM000063	0.35	0.33	0.11	0.11	0.11
70	PFM000063	0.31	0.34	0.12	0.12	0.12
71	PFM000064	0.37	0.33	0.10	0.10	0.10
72	PFM000064	0.37	0.33	0.10	0.10	0.10
73	PFM000064	0.45	0.24	0.10	0.10	0.10
74	PFM000064	0.39	0.33	0.09	0.09	0.09

	2	19	20	21	22	23
	IDCODE	Lake water	Litorina	Ground water	Glacial	Rain 60'
75	PFM000064	0.39	0.32	0.10	0.10	0.10
76	PFM000065	0.31	0.31	0.13	0.13	0.13
77	PFM000065	0.46	0.23	0.10	0.10	0.10
78	PFM000065	0.38	0.32	0.10	0.10	0.10
79	PFM000065	0.47	0.12	0.12	0.12	0.15
80	PFM000082	0.34	0.33	0.11	0.11	0.11
81	PFM000082	0.34	0.32	0.11	0.11	0.11
82	PFM000082	0.33	0.33	0.11	0.11	0.11
83	PFM000082	0.33	0.34	0.11	0.11	0.11
84	PFM000083	0.34	0.33	0.11	0.11	0.11
85	PFM000083	0.34	0.33	0.11	0.11	0.11
86	PFM000084	0.04	0.04	0.04	0.14	0.73
87	PFM000084	0.05	0.05	0.05	0.13	0.73
88	PFM000066	0.02	0.02	0.02	0.24	0.70
89	PFM000066	0.02	0.02	0.02	0.06	0.87
90	PFM000066	0.06	0.02	0.02	0.02	0.88
91	PFM000066	0.03	0.03	0.03	0.15	0.77
92	PFM000067	0.04	0.04	0.04	0.12	0.77
93	PFM000067	0.56	0.02	0.02	0.02	0.39
94	PFM000067	0.70	0.01	0.01	0.01	0.26
95	PFM000067	0.81	0.01	0.01	0.01	0.15
96	PFM000067	0.40	0.02	0.02	0.02	0.54
97	PFM000068	0.02	0.02	0.02	0.17	0.77
98	PFM000068	0.02	0.02	0.02	0.03	0.90
99	PFM000068	0.11	0.02	0.02	0.02	0.83
100	PFM000068	0.03	0.03	0.03	0.09	0.83
101	PFM000068	0.03	0.03	0.03	0.07	0.86
102	PFM000069	0.02	0.02	0.02	0.24	0.70
103	PFM000069	0.02	0.02	0.02	0.14	0.80
104	PFM000069	0.02	0.02	0.02	0.03	0.90
105	PFM000069	0.03	0.03	0.03	0.08	0.85
106	PFM000069	0.02	0.02	0.02	0.25	0.68
107	PFM000070	0.42	0.01	0.01	0.01	0.54
108	PFM000070	0.53	0.01	0.01	0.01	0.44
109	PFM000070	0.40	0.01	0.01	0.01	0.56
110	PFM000071	0.02	0.02	0.02	0.22	0.72
111	PFM000071	0.02	0.02	0.02	0.17	0.77

	2	19	20	21	22	23
	IDCODE	Lake water	Litorina	Ground water	Glacial	Rain 60'
112	PFM000071	0.02	0.02	0.02	0.26	0.68
113	PFM000072	0.03	0.03	0.03	0.07	0.86
114	PFM000072	0.55	0.01	0.01	0.01	0.43
115	PFM000072	0.76	0.00	0.00	0.00	0.23
116	PFM000072	0.36	0.03	0.03	0.03	0.54
117	PFM000072	0.11	0.04	0.04	0.04	0.78
118	PFM000073	0.03	0.03	0.03	0.33	0.58
119	SEA01	0.34	0.51	0.05	0.05	0.05
120	Glacial	0.00	0.00	0.00	1.00	0.00
121	Litorina new	0.00	1.00	0.00	0.00	0.00
122	Rain'60	0.00	0.00	0.00	0.00	1.00
123	SAS48	0.16	0.32	0.20	0.16	0.16
124	SGKLX02					

Appendix 4

Groundwater data from Forsmark

	GENERAL INFORMATION								
Row number	IDCODE		START_DATE	STOP_DATE	SECUP (m)	SECLOW (m)	CLASS_NO	SAMPLE_NO	WATER_TYPE
1	KFM01A	**Core-Boreholes**	2002-05-25 15:55	2002-05-25 15:56	0	100.57	3	4165	Ground Water
2	KFM01A		2003-01-17 15:30	2003-02-20 15:00	110	120.67	2	4461	Ground Water
3	KFM01A		2003-01-17 15:30	2003-02-20 15:00	110	120.67	3	4466	Ground Water
4	KFM01A		2003-01-17 15:30	2003-02-20 15:00	110	120.67	4	4480	Ground Water
5	KFM01A		2003-01-17 15:30	2003-02-20 15:00	110	120.67	5	4481	Ground Water
6	KFM01A		2003-01-17 15:30	2003-02-20 15:00	110	120.67	4	4484	Ground Water
7	KFM01A		2003-01-17 15:30	2003-02-20 15:00	110	120.67	5	4520	Ground Water
8	KFM01A		2003-01-17 15:30	2003-02-20 15:00	110	120.67	4	4524	Ground Water
9	KFM01A		2003-01-17 15:30	2003-02-20 15:00	110	120.67	5	4538	Ground Water
10	KFM02A		2002-11-29 10:00	2002-11-29 10:15	18	100.4	3	4398	Ground Water
11	KFM02A		2002-11-29 15:50	2002-11-29 16:05	18	100.4	3	4397	Ground Water
12	KFM02A		2003-01-20 20:00	2003-01-20 21:00	105.1	159.3	3	4462	Drilling sample
13	KFM02A		2003-01-27 21:00	2003-01-27 22:00	250	291.45	3	4468	Drilling sample
14	KFM02A		2003-01-29 21:00	2003-01-29 22:00	248.75	395.88	3	4469	Drilling sample
15									
16	HFM01	**Percusion-Boreholes**	2002-05-07 19:31	2002-05-07 19:32	0	200.2	3	4112	Ground Water
17	HFM01		2002-05-14 08:45	2002-05-14 08:46	0	200.2	3	4113	Ground Water
18	HFM01		2002-05-14 11:58	2002-05-14 11:59	0	200.2	3	4114	Ground Water
19	HFM01		2002-05-16 11:40	2002-05-16 11:41	71	200.2	3	4115	Ground Water
20	HFM01		2002-05-16 17:24	2002-05-16 17:25	0	71	3	4116	Ground Water
21	HFM01		2002-06-25 00:00	2002-06-25 00:00	0	200.2	3	4172	Ground Water
22	HFM02		2002-06-04 13:34	2002-06-04 13:34	0	100.1	3	4169	Ground Water
23	HFM02		2002-06-04 21:45	2002-06-04 21:46	0	100.1	3	4170	Ground Water
24	HFM03		2002-05-29 12:35	2002-05-29 12:36	0	26	3	4166	Ground Water
25	HFM03		2002-05-29 17:35	2002-05-29 17:36	0	26	3	4167	Ground Water
26	HFM04		2002-12-10 11:45	2002-12-10 11:55	30	221.7	3	4399	Ground Water
27	HFM04		2002-12-10 15:00	2002-12-10 15:10	30	221.7	3	4400	Ground Water
28	HFM04		2002-12-10 20:45	2002-12-10 20:55	30	221.7	3	4401	Ground Water
29	HFM05		2002-12-19 11:35	2002-12-19 11:40	25	200.1	3	4433	Ground Water
30	HFM05		2002-12-19 15:45	2002-12-19 15:50	25	200.1	3	4434	Ground Water
31	HFM05		2002-12-19 20:25	2002-12-19 20:30	25	200.1	3	4435	Ground Water
32	HFM06		2003-01-21 11:55	2003-01-21 12:05	0	110.7	3	4463	Ground Water
33	HFM06		2003-01-21 16:52	2003-01-21 17:02	0	110.7	3	4464	Ground Water
34	HFM06		2003-01-21 21:50	2003-01-21 22:00	0	110.7	3	4465	Ground Water
35	HFM08		2003-02-18 09:30	2003-02-18 09:50	0	143.5	3	4521	Ground Water
36	HFM08		2003-02-18 18:05	2003-02-18 18:05	0	143.5	3	4522	Ground Water
37	HFM08		2003-02-20 13:40	2003-02-20 13:40	0	93	3	4535	Ground Water
38									
39	SFM0001	**SOIL PIPES**	2002-07-18 11:00	2002-07-18 11:00		5.50	5	4219	Near Surface GW
40	SFM0001		2002-09-20 10:30	2002-09-20 10:52		5.50	5	4316	Near Surface GW
41	SFM0001		2002-12-12 11:15	2002-12-18 11:15		5.50	5	4403	Near Surface GW
42	SFM0002		2002-07-18 10:00	2002-07-18 10:00		5.75	5	4220	Near Surface GW
43	SFM0002		2002-09-20 14:15	2002-09-20 14:45		5.75	5	4318	Near Surface GW
44	SFM0002		2002-12-12 13:50	2002-12-12 13:50		5.75	5	4405	Near Surface GW
45	SFM0003		2002-07-18 13:00	2002-07-18 13:00		11.00	5	4221	Near Surface GW
46	SFM0003		2002-09-20 12:40	2002-09-20 13:00		11.00	5	4317	Near Surface GW
47	SFM0003		2002-12-12 13:20	2002-12-12 13:20		11.00	5	4404	Near Surface GW
48	SFM0005		2002-12-16 11:00	2002-12-16 11:15		2.40	5	4432	Near Surface GW
49									
50	PFM000037	**Geosigmas wells**	2002-05-28 09:20	2002-05-28 09:20	0	60	3	4140	Ground Water
51	PFM000152		2002-05-28 10:15	2002-05-28 10:15			3	4141	Ground Water
52									
53	PFM002457	**Rain**	2002-11-04 10:00	2002-11-04 10:15			3	4352	Precipitation
54	PFM002457		2002-12-05 08:00	2002-12-05 08:15			1	4402	Precipitation

	GENERAL INFORMATION								
Row number	IDCODE		START_DATE	STOP_DATE	SECUP (m)	SECLOW (m)	CLASS_NO	SAMPLE_NO	WATER_TYPE
55	PFM002457		2003-02-11 10:00	2003-02-11 10:15			3	4483	Precipitation
56									
57	PFM000074		2002-03-20 10:00	2002-03-20 10:00			3	4003	Lake Water
58	PFM000074		2002-04-02 12:40	2002-04-02 12:40			3	4033	Lake Water
59	PFM000074		2002-04-02 16:30	2002-04-02 16:30			3	4038	Lake Water
60	PFM000074		2002-04-16 16:31	2002-04-16 16:31			3	4052	Lake Water
61	PFM000074		2002-05-12 19:00	2002-05-12 19:00			3	4090	Lake Water
62	PFM000074		2002-05-26 12:00	2002-05-26 12:00			3	4111	Lake Water
63	PFM000074		2002-05-05 12:00	2002-05-05 12:00			3	4067	Lake Water
64	PFM000074		2002-06-09	2002-06-09			3	4143	Lake Water
65	PFM000074		2002-06-23 19:15	2002-06-23 19:15			3	4168	Lake Water
66	PFM000074		2002-07-14 00:00	2002-07-14 00:00			5	4202	Lake Water
67	PFM000074		2002-08-11 20:00	2002-08-11 20:00			5	4224	Lake Water
68	PFM000074		2002-09-02 07:30	2002-09-02 20:00			3	4251	Lake Water
69	PFM000074		2002-09-15 18:00	2002-09-15 21:30			3	4276	Lake Water
70	PFM000074		2002-10-01 07:30	2002-10-01 16:30			3	4309	Lake Water
71	PFM000074		2002-11-12 08:00	2002-11-12 19:00			5	4337	Lake Water
72	PFM000074		2002-12-17 07:30	2002-12-17 18:00			3	4415	Lake Water
73	PFM000074		2003-01-16 07:30	2003-01-16 19:30			5	4453	Lake Water
74	PFM000074		2003-02-18 07:30	2003-02-18 18:30			3	4507	Lake Water
75	PFM000087		2002-03-19 19:30	2002-03-19 19:30			3	4004	Lake Water
76	PFM000087		2002-04-17 16:00	2002-04-17 16:00			3	4060	Lake Water
77	PFM000087		2002-04-17 16:00	2002-04-17 16:00			3	4061	Lake Water
78	PFM000087		2002-05-05 12:00	2002-05-05 12:00			3	4065	Lake Water
79	PFM000087		2002-05-05 12:00	2002-05-05 12:00			3	4066	Lake Water
80	PFM000087		2002-05-12 19:00	2002-05-12 19:00			3	4088	Lake Water
81	PFM000087		2002-05-12 19:00	2002-05-12 19:00			3	4091	Lake Water
82	PFM000087		2002-05-26 12:00	2002-05-26 12:00			3	4117	Lake Water
83	PFM000087		2002-05-26 12:00	2002-05-26 12:00			3	4118	Lake Water
84	PFM000087		2002-06-09	2002-06-09			3	4135	Lake Water
85	PFM000087		2002-06-09	2002-06-09			3	4142	Lake Water
86	PFM000087		2002-06-23 20:30	2002-06-23 20:30			3	4144	Lake Water
87	PFM000087		2002-06-23 20:30	2002-06-23 20:30			3	4148	Lake Water
88	PFM000087		2002-07-14 23:00	2002-07-14 23:00			5	4200	Lake Water
89	PFM000087		2002-07-14 23:00	2002-07-14 23:00			5	4201	Lake Water
90	PFM000087		2002-08-11 21:30	2002-08-11 21:30			5	4203	Lake Water
91	PFM000087		2002-08-11 21:30	2002-08-11 21:30			5	4222	Lake Water
92	PFM000087		2002-09-02 07:30	2002-09-02 20:00			3	4263	Lake Water
93	PFM000087		2002-09-02 07:30	2002-09-02 20:00			3	4264	Lake Water
94	PFM000087		2002-09-15 18:00	2002-09-15 21:30			3	4279	Lake Water
95	PFM000087		2002-09-15 18:30	2002-09-15 21:30			3	4278	Lake Water
96	PFM000087		2002-10-01 07:30	2002-10-01 16:30			3	4292	Lake Water
97	PFM000087		2002-10-01 07:30	2002-10-01 16:30			3	4295	Lake Water
98	PFM000087		2002-11-12 08:00	2002-11-12 19:00			5	4327	Lake Water
99	PFM000087		2002-11-12 08:00	2002-11-12 19:00			5	4331	Lake Water
100	PFM000087		2002-12-16 08:00	2002-12-16 18:00			3	4407	Lake Water
101	PFM000087		2002-12-16 08:00	2002-12-16 18:00			3	4409	Lake Water
102	PFM000087		2003-01-15 07:30	2003-01-15 18:30			5	4442	Lake Water
103	PFM000087		2003-01-15 07:30	2003-01-15 18:30			5	4449	Lake Water
104	PFM000087		2003-02-18 07:30	2003-02-18 18:30			3	4485	Lake Water
105	PFM000087		2003-02-18 07:30	2003-02-18 18:30			3	4486	Lake Water
106	PFM000097		2002-03-19 12:18	2002-03-19 12:18			3	4001	Lake Water
107	PFM000097		2002-04-17 11:30	2002-04-17 11:30			3	4056	Lake Water
108	PFM000097		2002-05-06 10:00	2002-05-06 10:00			3	4073	Lake Water

	GENERAL INFORMATION								
Row number	IDCODE		START_DATE	STOP_DATE	SECUP (m)	SECLOW (m)	CLASS_NO	SAMPLE_NO	WATER_TYPE
109	PFM000097	**Lake Water**	2002-05-13 12:00	2002-05-13 12:00			3	4099	Lake Water
110	PFM000097		2002-05-27 10:00	2002-05-27 10:00			3	4124	Lake Water
111	PFM000097		2002-06-10 10:15	2002-06-10 10:15			3	4150	Lake Water
112	PFM000097		2002-06-24 10:30	2002-06-24 10:30			3	4181	Lake Water
113	PFM000097		2002-07-15 00:00	2002-07-15 00:00			5	4205	Lake Water
114	PFM000097		2002-08-12 18:05	2002-08-12 18:05			5	4245	Lake Water
115	PFM000097		2002-09-02 07:30	2002-09-02 20:00			3	4260	Lake Water
116	PFM000097		2002-09-16 18:00	2002-09-16 21:30			3	4287	Lake Water
117	PFM000097		2002-09-30 07:30	2002-09-30 19:30			3	4315	Lake Water
118	PFM000097		2002-12-17 07:30	2002-12-17 18:00			3	4426	Lake Water
119	PFM000097		2003-01-15 07:30	2003-01-15 18:30			5	4452	Lake Water
120	PFM000097		2003-02-18 07:30	2003-02-18 18:30			3	4499	Lake Water
121	PFM000107		2002-03-19 09:40	2002-03-19 09:40			3	4002	Lake Water
122	PFM000107		2002-04-01 09:30	2002-04-01 09:30			3	4018	Lake Water
123	PFM000107		2002-04-01 10:00	2002-04-01 10:00			3	4019	Lake Water
124	PFM000107		2002-04-17 09:30	2002-04-17 09:30			3	4058	Lake Water
125	PFM000107		2002-04-17 09:30	2002-04-17 09:30			3	4059	Lake Water
126	PFM000107		2002-05-06 12:00	2002-05-06 12:00			3	4068	Lake Water
127	PFM000107		2002-05-06 12:00	2002-05-06 12:00			3	4069	Lake Water
128	PFM000107		2002-05-13 12:00	2002-05-13 12:00			3	4096	Lake Water
129	PFM000107		2002-05-13 12:00	2002-05-13 12:00			3	4097	Lake Water
130	PFM000107		2002-05-27 08:30	2002-05-27 08:30			3	4121	Lake Water
131	PFM000107		2002-05-27 08:30	2002-05-27 08:30			3	4122	Lake Water
132	PFM000107		2002-06-10 09:00	2002-06-10 09:00			3	4151	Lake Water
133	PFM000107		2002-06-10 09:00	2002-06-10 09:00			3	4152	Lake Water
134	PFM000107		2002-06-24 09:00	2002-06-24 09:00			3	4178	Lake Water
135	PFM000107		2002-06-24 09:00	2002-06-24 09:00			3	4179	Lake Water
136	PFM000107		2002-07-15 00:00	2002-07-15 00:00			5	4206	Lake Water
137	PFM000107		2002-07-15 00:00	2002-07-15 00:00			5	4207	Lake Water
138	PFM000107		2002-08-12	2002-08-12			5	4233	Lake Water
139	PFM000107		2002-08-12	2002-08-12			5	4234	Lake Water
140	PFM000107		2002-09-02 07:30	2002-09-02 20:00			3	4261	Lake Water
141	PFM000107		2002-09-02 07:30	2002-09-02 20:00			3	4262	Lake Water
142	PFM000107		2002-09-16 18:00	2002-09-16 21:30			3	4288	Lake Water
143	PFM000107		2002-09-16 18:00	2002-09-16 21:30			3	4289	Lake Water
144	PFM000107		2002-09-30 07:30	2002-09-30 19:30			3	4302	Lake Water
145	PFM000107		2002-09-30 07:30	2002-09-30 19:30			3	4303	Lake Water
146	PFM000107		2002-11-12 08:00	2002-11-12 19:00			5	4328	Lake Water
147	PFM000107		2002-12-17 07:30	2002-12-17 18:00			3	4420	Lake Water
148	PFM000107		2002-12-17 07:30	2002-12-17 18:00			3	4421	Lake Water
149	PFM000107		2003-01-16 07:30	2003-01-16 19:30			5	4444	Lake Water
150	PFM000107		2003-01-16 07:30	2003-01-16 19:30			5	4447	Lake Water
151	PFM000107		2003-02-17 07:30	2003-02-17 19:30			3	4487	Lake Water
152	PFM000107		2003-02-17 07:30	2003-02-17 19:30			3	4488	Lake Water
153	PFM000117		2002-03-18 12:45	2002-03-18 12:45			3	4008	Lake Water
154	PFM000117		2002-04-01 11:00	2002-04-01 11:00			3	4020	Lake Water
155	PFM000117		2002-04-01 11:45	2002-04-01 11:45			3	4021	Lake Water
156	PFM000117		2002-04-16 09:15	2002-04-16 09:15			3	4048	Lake Water
157	PFM000117		2002-04-16 09:15	2002-04-16 09:15			3	4049	Lake Water
158	PFM000117		2002-05-05 14:40	2002-05-05 14:40			3	4079	Lake Water
159	PFM000117		2002-05-05 14:40	2002-05-05 14:40			3	4082	Lake Water
160	PFM000117		2002-05-13 14:40	2002-05-13 14:40			3	4102	Lake Water
161	PFM000117		2002-05-13 14:40	2002-05-13 14:40			3	4103	Lake Water
162	PFM000117		2002-05-28 08:50	2002-05-28 08:50			3	4129	Lake Water

	GENERAL INFORMATION								
Row number	IDCODE		START_DATE	STOP_DATE	SECUP (m)	SECLOW (m)	CLASS_NO	SAMPLE_NO	WATER_TYPE
163	PFM000117		2002-05-28 08:50	2002-05-28 08:50			3	4138	Lake Water
164	PFM000117		2002-06-11 09:00	2002-06-11 09:00			3	4153	Lake Water
165	PFM000117		2002-06-11 09:00	2002-06-11 09:00			3	4154	Lake Water
166	PFM000117		2002-06-25 08:25	2002-06-25 08:25			3	4190	Lake Water
167	PFM000117		2002-06-25 08:25	2002-06-25 08:25			3	4191	Lake Water
168	PFM000117		2002-07-16 00:00	2002-07-16 00:00			5	4217	Lake Water
169	PFM000117		2002-07-16 00:00	2002-07-16 00:00			5	4218	Lake Water
170	PFM000117		2002-08-13 08:00	2002-08-13 08:00			5	4235	Lake Water
171	PFM000117		2002-08-13 08:00	2002-08-13 08:00			5	4236	Lake Water
172	PFM000117		2002-09-03 07:30	2002-09-03 12:00			3	4265	Lake Water
173	PFM000117		2002-09-03 07:30	2002-09-03 12:00			3	4266	Lake Water
174	PFM000117		2002-09-17 18:00	2002-09-17 21:30			3	4282	Lake Water
175	PFM000117		2002-09-17 18:00	2002-09-17 21:30			3	4283	Lake Water
176	PFM000117		2002-10-01 07:30	2002-10-01 16:30			3	4298	Lake Water
177	PFM000117		2002-10-01 07:30	2002-10-01 16:30			3	4299	Lake Water
178	PFM000117		2002-12-17 07:30	2002-12-17 18:00			3	4412	Lake Water
179	PFM000117		2002-12-17 07:30	2002-12-17 18:00			3	4413	Lake Water
180	PFM000117		2003-01-15 07:30	2003-01-15 18:30			5	4440	Lake Water
181	PFM000117		2003-01-15 07:30	2003-01-15 18:30			5	4451	Lake Water
182	PFM000117		2003-02-18 07:30	2003-02-18 18:30			3	4491	Lake Water
183	PFM000117		2003-02-18 07:30	2003-02-18 18:30			3	4492	Lake Water
184	PFM000127		2002-05-27 17:00	2002-05-27 17:00			3	4132	Lake Water
185	PFM000127		2002-05-27 17:00	2002-05-27 17:00			3	4133	Lake Water
186	PFM000127		2002-06-10 20:08	2002-06-10 20:08			3	4163	Lake Water
187	PFM000127		2002-06-10 20:08	2002-06-10 20:08			3	4164	Lake Water
188	PFM000127		2002-06-24 20:20	2002-06-24 20:20			3	4162	Lake Water
189	PFM000127		2002-06-24 20:20	2002-06-24 20:20			3	4177	Lake Water
190	PFM000127		2002-07-15	2002-07-15			5	4215	Lake Water
191	PFM000127		2002-07-15	2002-07-15			5	4216	Lake Water
192	PFM000127		2002-08-12 19:40	2002-08-12 19:40			5	4232	Lake Water
193	PFM000127		2002-08-12 19:40	2002-08-12 19:40			5	4241	Lake Water
194	PFM000127		2002-09-01 17:00	2002-09-01 20:00			3	4247	Lake Water
195	PFM000127		2002-09-01 17:00	2002-09-01 20:00			3	4248	Lake Water
196	PFM000127		2002-09-16 18:00	2002-09-16 21:30			3	4290	Lake Water
197	PFM000127		2002-09-16 18:00	2002-09-16 21:30			3	4291	Lake Water
198	PFM000127		2002-09-30 07:30	2002-09-30 19:30			3	4296	Lake Water
199	PFM000127		2002-09-30 07:30	2002-09-30 19:30			3	4297	Lake Water
200	PFM000135		2002-03-19 15:30	2002-03-19 15:30			3	4006	Lake Water
201	PFM000135		2002-12-17 07:30	2002-12-17 18:00			3	4414	Lake Water
202	PFM000135		2003-01-15 07:30	2003-01-15 18:30			5	4443	Lake Water
203									
204	PFM000062		2002-05-07 08:51	2002-05-07 08:51			3	4076	Sea Water
205	PFM000062		2002-05-07 08:51	2002-05-07 08:51			3	4081	Sea Water
206	PFM000062		2002-05-14 07:30	2002-05-14 07:30			3	4109	Sea Water
207	PFM000062		2002-05-14 07:30	2002-05-14 07:30			3	4110	Sea Water
208	PFM000062		2002-05-27 13:49	2002-05-27 13:49			3	4120	Sea Water
209	PFM000062		2002-05-27 13:49	2002-05-27 13:49			3	4127	Sea Water
210	PFM000062		2002-06-10 13:00	2002-06-10 13:00			3	4145	Sea Water
211	PFM000062		2002-06-10 13:00	2002-06-10 13:00			3	4146	Sea Water
212	PFM000062		2002-06-24 13:50	2002-06-24 13:50			3	4184	Sea Water
213	PFM000062		2002-06-24 13:50	2002-06-24 13:50			3	4185	Sea Water
214	PFM000062		2002-07-15 13:15	2002-07-15 13:15			5	4198	Sea Water
215	PFM000062		2002-07-15 13:15	2002-07-15 13:15			5	4199	Sea Water
216	PFM000062		2002-08-12 09:04	2002-08-12 09:04			5	4229	Sea Water

	GENERAL INFORMATION								
Row number	IDCODE		START_DATE	STOP_DATE	SECUP (m)	SECLOW (m)	CLASS_NO	SAMPLE_NO	WATER_TYPE
217	PFM000062	**SEA WATER**	2002-08-12 09:04	2002-08-12 09:04			5	4230	Sea Water
218	PFM000062		2002-09-02 07:30	2002-09-02 20:00			3	4253	Sea Water
219	PFM000062		2002-09-02 07:30	2002-09-02 20:00			3	4254	Sea Water
220	PFM000062		2002-09-16 18:00	2002-09-16 21:30			3	4280	Sea Water
221	PFM000062		2002-09-16 18:00	2002-09-16 21:30			3	4281	Sea Water
222	PFM000062		2002-09-30 07:30	2002-09-30 19:30			3	4306	Sea Water
223	PFM000062		2002-09-30 07:30	2002-09-30 19:30			3	4307	Sea Water
224	PFM000062		2002-10-21 13:00	2002-10-21 20:00			5	4322	Sea Water
225	PFM000062		2002-10-21 13:00	2002-10-21 20:00			5	4333	Sea Water
226	PFM000062		2002-11-11 08:00	2002-11-11 17:00			3	4359	Sea Water
227	PFM000062		2002-11-11 08:00	2002-11-11 17:00			3	4360	Sea Water
228	PFM000062		2002-11-25 08:00	2002-11-25 17:00			3	4382	Sea Water
229	PFM000062		2002-11-25 08:00	2002-11-25 17:00			3	4383	Sea Water
230	PFM000062		2002-12-16 08:00	2002-12-16 18:00			3	4418	Sea Water
231	PFM000062		2002-12-16 08:00	2002-12-16 18:00			3	4419	Sea Water
232	PFM000063		2002-05-07 12:00	2002-05-07 12:00			3	4083	Sea Water
233	PFM000063		2002-05-07 12:00	2002-05-07 12:00			3	4084	Sea Water
234	PFM000063		2002-05-14 08:00	2002-05-14 08:00			3	4105	Sea Water
235	PFM000063		2002-05-14 08:00	2002-05-14 08:00			3	4106	Sea Water
236	PFM000063		2002-05-27 14:30	2002-05-27 14:30			3	4130	Sea Water
237	PFM000063		2002-05-27 14:30	2002-05-27 14:30			3	4131	Sea Water
238	PFM000063		2002-06-10 14:15	2002-06-10 14:15			3	4155	Sea Water
239	PFM000063		2002-06-10 14:15	2002-06-10 14:15			3	4156	Sea Water
240	PFM000063		2002-06-24 14:42	2002-06-24 14:42			3	4182	Sea Water
241	PFM000063		2002-06-24 14:42	2002-06-24 14:42			3	4183	Sea Water
242	PFM000063		2002-07-15 14:20	2002-07-15 14:20			5	4194	Sea Water
243	PFM000063		2002-07-15 14:20	2002-07-15 14:20			5	4195	Sea Water
244	PFM000063		2002-08-12 10:30	2002-08-12 10:30			5	4227	Sea Water
245	PFM000063		2002-08-12 10:30	2002-08-12 10:30			5	4228	Sea Water
246	PFM000063		2002-09-02 07:30	2002-09-02 20:00			3	4257	Sea Water
247	PFM000063		2002-09-02 07:30	2002-09-02 20:00			3	4258	Sea Water
248	PFM000063		2002-09-16 18:00	2002-09-16 21:30			3	4274	Sea Water
249	PFM000063		2002-09-16 18:00	2002-09-16 21:30			3	4275	Sea Water
250	PFM000063		2002-09-30 07:30	2002-09-30 19:30			3	4304	Sea Water
251	PFM000063		2002-09-30 07:30	2002-09-30 19:30			3	4305	Sea Water
252	PFM000063		2002-10-21 13:00	2002-10-21 20:00			5	4321	Sea Water
253	PFM000063		2002-10-21 13:00	2002-10-21 20:00			5	4324	Sea Water
254	PFM000063		2002-11-11 08:00	2002-11-11 17:00			3	4357	Sea Water
255	PFM000063		2002-11-11 08:00	2002-11-11 17:00			3	4358	Sea Water
256	PFM000063		2002-11-25 08:00	2002-11-25 17:00			3	4380	Sea Water
257	PFM000063		2002-11-25 08:00	2002-11-25 17:00			3	4381	Sea Water
258	PFM000063		2002-12-16 08:00	2002-12-16 18:00			3	4410	Sea Water
259	PFM000063		2002-12-16 08:00	2002-12-16 18:00			3	4411	Sea Water
260	PFM000063		2003-01-14 07:30	2003-01-14 18:30			5	4445	Sea Water
261	PFM000063		2003-01-14 07:30	2003-01-14 18:30			5	4450	Sea Water
262	PFM000063		2003-02-17 07:30	2003-02-17 19:30			3	4493	Sea Water
263	PFM000063		2003-02-17 07:30	2003-02-17 19:30			3	4494	Sea Water
264	PFM000064		2002-05-07 12:00	2002-05-07 12:00			3	4085	Sea Water
265	PFM000064		2002-05-07 12:00	2002-05-07 12:00			3	4087	Sea Water
266	PFM000064		2002-05-14 11:15	2002-05-14 11:15			3	4107	Sea Water
267	PFM000064		2002-05-14 11:15	2002-05-14 11:15			3	4108	Sea Water
268	PFM000064		2002-05-27 16:00	2002-05-27 16:00			3	4125	Sea Water
269	PFM000064		2002-05-27 16:00	2002-05-27 16:00			3	4126	Sea Water
270	PFM000064		2002-06-10 15:20	2002-06-10 15:20			3	4157	Sea Water

	GENERAL INFORMATION								
Row number	IDCODE		START_DATE	STOP_DATE	SECUP (m)	SECLOW (m)	CLASS_NO	SAMPLE_NO	WATER_TYPE
271	PFM000064		2002-06-10 15:20	2002-06-10 15:20			3	4158	Sea Water
272	PFM000064		2002-06-24 15:30	2002-06-24 15:30			3	4186	Sea Water
273	PFM000064		2002-06-24 15:30	2002-06-24 15:30			3	4187	Sea Water
274	PFM000064		2002-07-15	2002-07-15			5	4196	Sea Water
275	PFM000064		2002-07-15	2002-07-15			5	4197	Sea Water
276	PFM000064		2002-08-12 12:00	2002-08-12 12:00			5	4225	Sea Water
277	PFM000064		2002-08-12 12:00	2002-08-12 12:00			5	4226	Sea Water
278	PFM000064		2002-09-02 07:30	2002-09-02 20:00			3	4255	Sea Water
279	PFM000064		2002-09-02 07:30	2002-09-02 20:00			3	4256	Sea Water
280	PFM000064		2002-09-16 18:00	2002-09-16 21:30			3	4267	Sea Water
281	PFM000064		2002-09-16 18:00	2002-09-16 21:30			3	4268	Sea Water
282	PFM000064		2002-09-30 07:30	2002-09-30 19:30			3	4310	Sea Water
283	PFM000064		2002-09-30 07:30	2002-09-30 19:30			3	4311	Sea Water
284	PFM000064		2002-10-21 13:00	2002-10-21 20:00			5	4323	Sea Water
285	PFM000064		2002-10-21 13:00	2002-10-21 20:00			5	4330	Sea Water
286	PFM000064		2002-11-11 08:00	2002-11-11 17:00			3	4353	Sea Water
287	PFM000064		2002-11-11 08:00	2002-11-11 17:00			3	4354	Sea Water
288	PFM000064		2002-11-25 08:00	2002-11-25 17:00			3	4378	Sea Water
289	PFM000064		2002-11-25 08:00	2002-11-25 17:00			3	4379	Sea Water
290	PFM000064		2002-12-16 08:00	2002-12-16 18:00			3	4416	Sea Water
291	PFM000064		2002-12-16 08:00	2002-12-16 18:00			3	4417	Sea Water
292	PFM000065		2002-05-27 16:45	2002-05-27 16:45			3	4128	Sea Water
293	PFM000065		2002-06-10 16:30	2002-06-10 16:30			3	4147	Sea Water
294	PFM000065		2002-06-24 16:10	2002-06-24 16:10			3	4188	Sea Water
295	PFM000065		2002-07-15	2002-07-15			5	4212	Sea Water
296	PFM000065		2002-08-12 12:15	2002-08-12 12:15			5	4231	Sea Water
297	PFM000065		2002-09-02 07:30	2002-09-02 20:00			3	4249	Sea Water
298	PFM000065		2002-09-16 18:00	2002-09-16 21:30			3	4269	Sea Water
299	PFM000065		2002-09-30 07:30	2002-09-30 19:30			3	4308	Sea Water
300	PFM000065		2002-10-21 13:00	2002-10-21 20:00			5	4325	Sea Water
301	PFM000065		2002-11-11 08:00	2002-11-11 17:00			3	4355	Sea Water
302	PFM000065		2002-11-25 08:00	2002-11-25 17:00			3	4376	Sea Water
303	PFM000065		2002-12-16 08:00	2002-12-16 18:00			3	4408	Sea Water
304	PFM000065		2003-01-13 08:00	2003-01-13 18:00			5	4446	Sea Water
305	PFM000065		2003-02-17 07:30	2003-02-17 19:30			3	4503	Sea Water
306	PFM000082		2002-03-20 13:04	2002-03-20 13:04			3	4007	Sea Water
307	PFM000082		2002-04-02 14:35	2002-04-02 14:35			3	4036	Sea Water
308	PFM000082		2002-04-02 15:20	2002-04-02 15:20			3	4032	Sea Water
309	PFM000082		2002-04-16 13:30	2002-04-16 13:30			3	4044	Sea Water
310	PFM000082		2002-04-16 13:30	2002-04-16 13:30			3	4047	Sea Water
311	PFM000082		2003-01-13 08:00	2003-01-13 18:00			5	4438	Sea Water
312	PFM000082		2003-01-13 08:00	2003-01-13 18:00			5	4439	Sea Water
313	PFM000082		2003-02-17 07:30	2003-02-17 19:30			3	4489	Sea Water
314	PFM000082		2003-02-17 07:30	2003-02-17 19:30			3	4490	Sea Water
315	PFM000083		2002-03-18 16:30	2002-03-18 16:30			3	4000	Sea Water
316	PFM000083		2002-04-01 18:15	2002-04-01 18:15			3	4029	Sea Water
317	PFM000083		2002-04-01 19:00	2002-04-01 19:00			3	4025	Sea Water
318	PFM000083		2002-04-16 19:37	2002-04-16 19:37			3	4053	Sea Water
319	PFM000083		2002-04-16 19:37	2002-04-16 19:37			3	4054	Sea Water
320	PFM000084		2002-03-20 13:49	2002-03-20 13:49			3	4005	Sea Water
321	PFM000084		2002-04-02 10:30	2002-04-02 10:30			3	4035	Sea Water
322	PFM000084		2002-04-02 11:10	2002-04-02 11:10			3	4037	Sea Water
323	PFM000084		2002-04-17 18:30	2002-04-17 18:30			3	4062	Sea Water
324	PFM000084		2002-04-17 18:30	2002-04-17 18:30			3	4063	Sea Water

	GENERAL INFORMATION								
Row number	IDCODE		START_DATE	STOP_DATE	SECUP (m)	SECLOW (m)	CLASS_NO	SAMPLE_NO	WATER_TYPE
325	PFM000153		2002-05-07 12:55	2002-05-07 12:55			3	4086	Sea Water
326	PFM000153		2002-05-14 12:08	2002-05-14 12:08			3	4104	Sea Water
327									
328	PFM000066		2002-03-20 11:05	2002-03-20 11:05			3	4015	Streaming Water
329	PFM000066		2002-04-15 11:40	2002-04-15 11:40			3	4045	Streaming Water
330	PFM000066		2002-05-05 20:20	2002-05-05 20:20			3	4070	Streaming Water
331	PFM000066		2002-05-12 19:00	2002-05-12 19:00			3	4092	Streaming Water
332	PFM000066		2002-05-26 22:00	2002-05-26 22:00			3	4119	Streaming Water
333	PFM000066		2002-06-23 21:10	2002-06-23 21:10			3	4174	Streaming Water
334	PFM000066		2002-07-16 00:00	2002-07-16 00:00			5	4208	Streaming Water
335	PFM000066		2002-08-11 22:00	2002-08-11 22:00			5	4223	Streaming Water
336	PFM000066		2002-11-26 08:00	2002-11-26 20:00			3	4394	Streaming Water
337	PFM000066		2002-12-17 07:30	2002-12-17 18:00			3	4424	Streaming Water
338	PFM000066		2003-01-13 08:00	2003-01-13 18:00			5	4454	Streaming Water
339	PFM000066		2003-02-17 07:30	2003-02-17 19:30			3	4509	Streaming Water
340	PFM000067		2002-03-19 10:16	2002-03-19 10:16			3	4009	Streaming Water
341	PFM000067		2002-04-01 15:15	2002-04-01 15:15			3	4023	Streaming Water
342	PFM000067		2002-04-17 11:00	2002-04-17 11:00			3	4057	Streaming Water
343	PFM000067		2002-05-06 09:30	2002-05-06 09:30			3	4072	Streaming Water
344	PFM000067		2002-05-13 12:00	2002-05-13 12:00			3	4098	Streaming Water
345	PFM000067		2002-05-27 09:15	2002-05-27 09:15			3	4123	Streaming Water
346	PFM000067		2002-06-10 09:40	2002-06-10 09:40			3	4149	Streaming Water
347	PFM000067		2002-06-24 10:00	2002-06-24 10:00			3	4180	Streaming Water
348	PFM000067		2002-07-15 00:00	2002-07-15 00:00			5	4204	Streaming Water
349	PFM000067		2002-08-12 17:50	2002-08-12 17:50			5	4242	Streaming Water
350	PFM000067		2002-09-02 07:30	2002-09-02 20:00			3	4259	Streaming Water
351	PFM000067		2002-09-16 18:00	2002-09-16 21:30			3	4286	Streaming Water
352	PFM000067		2002-09-30 07:30	2002-09-30 19:30			3	4313	Streaming Water
353	PFM000067		2002-10-22 07:30	2002-10-22 17:00			5	4339	Streaming Water
354	PFM000067		2002-11-13 07:00	2002-11-13 15:00			3	4356	Streaming Water
355	PFM000067		2002-11-26 08:00	2002-11-26 20:00			3	4395	Streaming Water
356	PFM000067		2002-12-17 07:30	2002-12-17 18:00			3	4427	Streaming Water
357	PFM000067		2003-01-15 07:30	2003-01-15 18:30			5	4459	Streaming Water
358	PFM000067		2003-02-18 07:30	2003-02-18 18:30			3	4500	Streaming Water
359	PFM000068		2002-03-18 18:20	2002-03-18 18:20			3	4014	Streaming Water
360	PFM000068		2002-04-01 16:10	2002-04-01 16:10			3	4024	Streaming Water
361	PFM000068		2002-04-15 15:10	2002-04-15 15:10			3	4046	Streaming Water
362	PFM000068		2002-05-05 20:00	2002-05-05 20:00			3	4080	Streaming Water
363	PFM000068		2002-05-13 18:00	2002-05-13 18:00			3	4093	Streaming Water
364	PFM000068		2002-05-28 12:00	2002-05-28 12:00			3	4137	Streaming Water
365	PFM000068		2002-06-11 11:00	2002-06-11 11:00			3	4160	Streaming Water
366	PFM000068		2002-06-23 23:15	2002-06-23 23:15			3	4176	Streaming Water
367	PFM000068		2002-07-16 00:00	2002-07-16 00:00			5	4213	Streaming Water
368	PFM000068		2002-08-13 11:40	2002-08-13 11:40			5	4238	Streaming Water
369	PFM000068		2002-09-03 07:30	2002-09-03 12:00			3	4271	Streaming Water
370	PFM000068		2002-10-01 07:30	2002-10-01 16:30			3	4301	Streaming Water
371	PFM000068		2002-10-22 07:30	2002-10-22 17:30			5	4343	Streaming Water
372	PFM000068		2002-11-13 07:00	2002-11-13 15:00			3	4362	Streaming Water
373	PFM000068		2002-11-26 08:00	2002-11-26 20:00			3	4393	Streaming Water
374	PFM000068		2002-12-18 07:30	2002-12-18 16:00			3	4425	Streaming Water
375	PFM000068		2003-01-16 07:30	2003-01-16 19:30			5	4457	Streaming Water
376	PFM000068		2003-02-19 07:30	2003-02-19 13:00			3	4497	Streaming Water
377	PFM000069		2002-03-19 16:30	2002-03-19 16:30			3	4016	Streaming Water
378	PFM000069		2002-04-01 16:45	2002-04-01 16:45			3	4028	Streaming Water

	GENERAL INFORMATION								
Row number	IDCODE		START_DATE	STOP_DATE	SECUP (m)	SECLOW (m)	CLASS_NO	SAMPLE_NO	WATER_TYPE
379	PFM000069	**STREAMING WATER**	2002-04-17 13:45	2002-04-17 13:45			3	4055	Streaming Water
380	PFM000069		2002-05-06 19:30	2002-05-06 19:30			3	4075	Streaming Water
381	PFM000069		2002-05-13 16:30	2002-05-13 16:30			3	4089	Streaming Water
382	PFM000069		2002-05-28 11:40	2002-05-28 11:40			3	4136	Streaming Water
383	PFM000069		2002-06-11 00:00	2002-06-11 00:00			3	4159	Streaming Water
384	PFM000069		2002-06-24	2002-06-24			3	4189	Streaming Water
385	PFM000069		2002-07-16 00:00	2002-07-16 00:00			5	4211	Streaming Water
386	PFM000069		2002-08-13 11:00	2002-08-13 11:10			5	4244	Streaming Water
387	PFM000069		2002-09-03 07:30	2002-09-03 12:00			3	4252	Streaming Water
388	PFM000069		2002-10-01 07:30	2002-10-01 16:30			3	4300	Streaming Water
389	PFM000069		2002-10-22 07:30	2002-10-22 17:00			5	4342	Streaming Water
390	PFM000069		2002-11-13 07:00	2002-11-13 15:00			3	4361	Streaming Water
391	PFM000069		2002-11-26 08:00	2002-11-26 20:00			3	4384	Streaming Water
392	PFM000069		2002-12-18 07:30	2002-12-18 16:00			3	4406	Streaming Water
393	PFM000069		2003-01-16 07:30	2003-01-16 19:30			5	4455	Streaming Water
394	PFM000069		2003-02-19 07:30	2003-02-19 13:00			3	4505	Streaming Water
395	PFM000070		2002-03-18 12:30	2002-03-18 12:30			3	4012	Streaming Water
396	PFM000070		2002-04-02 11:35	2002-04-02 11:35			3	4030	Streaming Water
397	PFM000070		2002-04-16 10:00	2002-04-16 10:00			3	4051	Streaming Water
398	PFM000070		2002-05-06 16:02	2002-05-06 16:02			3	4078	Streaming Water
399	PFM000070		2002-05-13 14:40	2002-05-13 14:40			3	4100	Streaming Water
400	PFM000070		2002-06-25 09:33	2002-06-25 09:33			3	4193	Streaming Water
401	PFM000070		2002-07-16 00:00	2002-07-16 00:00			5	4210	Streaming Water
402	PFM000070		2002-08-13 09:30	2002-08-13 09:30			5	4240	Streaming Water
403	PFM000070		2002-11-26 08:00	2002-11-26 20:00			3	4375	Streaming Water
404	PFM000070		2002-12-18 07:30	2002-12-18 16:00			3	4423	Streaming Water
405	PFM000070		2003-01-16 07:30	2003-01-16 19:30			5	4456	Streaming Water
406	PFM000070		2003-02-18 07:30	2003-02-18 18:30			3	4508	Streaming Water
407	PFM000071		2002-03-18 10:00	2002-03-18 10:00			3	4013	Streaming Water
408	PFM000071		2002-04-01 13:30	2002-04-01 13:30			3	4022	Streaming Water
409	PFM000071		2002-04-16 11:00	2002-04-16 11:00			3	4050	Streaming Water
410	PFM000071		2002-05-05 12:00	2002-05-05 12:00			3	4077	Streaming Water
411	PFM000071		2002-05-13 14:00	2002-05-13 14:00			3	4101	Streaming Water
412	PFM000071		2002-06-25 09:10	2002-06-25 09:10			3	4192	Streaming Water
413	PFM000071		2002-07-16 00:00	2002-07-16 00:00			5	4209	Streaming Water
414	PFM000071		2002-08-13 09:00	2002-08-13 09:00			5	4239	Streaming Water
415	PFM000071		2002-11-26 08:00	2002-11-26 20:00			3	4374	Streaming Water
416	PFM000071		2002-12-18 07:30	2002-12-18 16:00			3	4422	Streaming Water
417	PFM000071		2003-01-15 07:30	2003-01-15 18:30			5	4460	Streaming Water
418	PFM000071		2003-02-18 07:30	2003-02-18 18:30			3	4506	Streaming Water
419	PFM000072		2002-03-18 15:00	2002-03-18 15:00			3	4010	Streaming Water
420	PFM000072		2002-04-01 19:45	2002-04-01 19:45			3	4031	Streaming Water
421	PFM000072		2002-04-15 16:29	2002-04-15 16:29			3	4042	Streaming Water
422	PFM000072		2002-05-06 12:00	2002-05-06 12:00			3	4071	Streaming Water
423	PFM000072		2002-05-13 15:50	2002-05-13 15:50			3	4094	Streaming Water
424	PFM000072		2002-05-27 21:00	2002-05-27 21:00			3	4134	Streaming Water
425	PFM000072		2002-06-10 21:00	2002-06-10 21:00			3	4161	Streaming Water
426	PFM000072		2002-06-23 22:00	2002-06-23 22:00			3	4175	Streaming Water
427	PFM000072		2002-07-15	2002-07-15			5	4214	Streaming Water
428	PFM000072		2002-08-12 20:30	2002-08-12 20:30			5	4243	Streaming Water
429	PFM000072		2002-11-12 08:00	2002-11-12 19:00			5	4345	Streaming Water
430	PFM000072		2002-11-26 08:00	2002-11-26 20:00			3	4392	Streaming Water
431	PFM000072		2002-12-18 07:30	2002-12-18 16:00			3	4428	Streaming Water
432	PFM000072		2003-01-16 07:30	2003-01-16 19:30			5	4458	Streaming Water

	GENERAL INFORMATION								
Row number	IDCODE		START_DATE	STOP_DATE	SECUP (m)	SECLOW (m)	CLASS_NO	SAMPLE_NO	WATER_TYPE
433	PFM000072		2003-02-19 07:3	2003-02-19 13:0			3	4504	Streaming Water
434	PFM000073		2002-03-18 17:4	2002-03-18 17:4			3	4011	Streaming Water
435	PFM000073		2002-04-02 09:2	2002-04-02 09:2			3	4034	Streaming Water
436	PFM000073		2002-04-15 18:1	2002-04-15 18:1			3	4043	Streaming Water
437	PFM000073		2002-05-06 18:3	2002-05-06 18:3			3	4074	Streaming Water
438	PFM000073		2002-05-13 16:3	2002-05-13 16:3			3	4095	Streaming Water
439	PFM000073		2002-11-26 08:0	2002-11-26 20:0			3	4385	Streaming Water
440	PFM000073		2002-12-18 07:3	2002-12-18 16:0			3	4429	Streaming Water
441									
442	PFM002291	**Process control**	2002-09-04 15:0	2002-09-04 15:1			4	4293	Process control
443	PFM002291		2002-10-02 13:3	2002-10-02 13:3			4	4312	Process control
444	PFM002291		2002-10-03 13:0	2002-10-03 13:0			4	4346	Process control
445	PFM002291		2002-10-03 14:4	2002-10-03 14:4			4	4348	Process control
446	PFM002291		2002-11-11 15:1	2002-11-11 15:2			4	4363	Process control
447	PFM002291		2002-11-12 15:1	2002-11-12 15:2			4	4366	Process control
448	PFM002291		2002-11-13 15:1	2002-11-13 15:2			4	4368	Process control
449	PFM002291		2002-11-14 15:1	2002-11-14 15:2			4	4370	Process control
450	PFM002292		2002-09-04 15:0	2002-09-04 15:1			4	4294	Process control
451	PFM002292		2002-10-02 13:3	2002-10-02 13:4			4	4314	Process control
452	PFM002292		2002-10-03 13:0	2002-10-03 13:1			4	4347	Process control
453	PFM002292		2002-10-03 14:4	2002-10-03 14:5			4	4349	Process control
454	PFM002292		2002-11-11 15:2	2002-11-11 15:2			4	4364	Process control
455	PFM002292		2002-11-12 15:2	2002-11-12 15:2			4	4367	Process control
456	PFM002292		2002-11-13 15:2	2002-11-13 15:2			4	4369	Process control
457	PFM002292		2002-11-14 15:2	2002-11-14 15:2			4	4371	Process control
458									
459	PFM000155	**tap water (brandpost)**	2002-05-28 09:10	2002-05-28 09:10	0	40	3	4139	Ground Water
460	PFM002564	**flushing waters (HFM05)**	2003-01-23 16:4	2003-01-23 16:5			3	4467	Ground Water
461	PFM002564		2003-02-10 10:0	2003-02-10 10:2			3	4482	Ground Water
462									
463	AFM000010	ID codes for whole lakes, 10 randomly selected samples from different depths are mixed	2002-03-18 12:4	2002-03-18 12:4			3	4008	Lake Water
464	AFM000048		2002-03-20 10:0	2002-03-20 10:0			3	4003	Lake Water
465	AFM000050		2002-03-19 09:4	2002-03-19 09:4			3	4002	Lake Water
466	AFM000073		2002-03-19 19:3	2002-03-19 19:3			3	4004	Lake Water
467	AFM000074		2002-03-19 12:1	2002-03-19 12:1			3	4001	Lake Water

		COORDINATES								
Row number	Charge Balance (%)	CENTER_OF_SECT	NORTHING_SECUP	NORTHING_SECLOW	NORTHING_CENTER_OF_SECT	EASTING_SECUP	EASTING_SECLOW	EASTING_CENTER_OF_SECT	ELEVATION_SECUP	ELEVATION_SECLOW
1		50.285	6699529.813	6699536.553	6699533.372	1631397.16	1631390.057	1631393.924	3.125	-96.963
2		115.335	6699537.079	6699537.68	6699537.378	1631389.252	1631388.34	1631388.797	-106.344	-116.958
3		115.335	6699537.079	6699537.68	6699537.378	1631389.252	1631388.34	1631388.797	-106.344	-116.958
4		115.335	6699537.079	6699537.68	6699537.378	1631389.252	1631388.34	1631388.797	-106.344	-116.958
5		115.335	6699537.079	6699537.68	6699537.378	1631389.252	1631388.34	1631388.797	-106.344	-116.958
6		115.335	6699537.079	6699537.68	6699537.378	1631389.252	1631388.34	1631388.797	-106.344	-116.958
7		115.335	6699537.079	6699537.68	6699537.378	1631389.252	1631388.34	1631388.797	-106.344	-116.958
8		115.335	6699537.079	6699537.68	6699537.378	1631389.252	1631388.34	1631388.797	-106.344	-116.958
9		115.335	6699537.079	6699537.68	6699537.378	1631389.252	1631388.34	1631388.797	-106.344	-116.958
10		59.2								
11		59.2								
12		132.2								
13		270.725								
14		322.315								
15										
16		100.1	6699605.181	6699628.763	6699618.656	1631484.552	1631509.461	1631494.916	1.731	-195.35
17		100.1	6699605.181	6699628.763	6699618.656	1631484.552	1631509.461	1631494.916	1.731	-195.35
18		100.1	6699605.181	6699628.763	6699618.656	1631484.552	1631509.461	1631494.916	1.731	-195.35
19		135.6	6699615.83	6699628.763	6699621.544	1631491.993	1631509.461	1631499.305	-68.056	-195.35
20		35.5	6699605.181	6699615.83	6699611.024	1631484.552	1631491.993	1631488.465	1.731	-68.056
21		100.1	6699605.181	6699628.763	6699618.656	1631484.552	1631509.461	1631494.916	1.731	-195.35
22		50.05	6699593.212		6699595.334	1631268.674		1631269.168	3.053	
23		50.05	6699593.212		6699595.334	1631268.674		1631269.168	3.053	
24		13	6699592.812	6699592.745	6699592.772	1631272.626	1631271.226	1631271.978	3.148	-22.814
25		13	6699592.812	6699592.745	6699592.772	1631272.626	1631271.226	1631271.978	3.148	-22.814
26		125.85	6698881.729	6698899.371	6698890.55	1633419.554	1633412.02	1633415.787	-25.976	-216.714
27		125.85	6698881.729	6698899.371	6698890.55	1633419.554	1633412.02	1633415.787	-25.976	-216.714
28		125.85	6698881.729	6698899.371	6698890.55	1633419.554	1633412.02	1633415.787	-25.976	-216.714
29		112.55	6698649.275	6698663.28	6698656.277	1633288.813	1633282.457	1633285.635	-17.231	-191.655
30		112.55	6698649.275	6698663.28	6698656.277	1633288.813	1633282.457	1633285.635	-17.231	-191.655
31		112.55	6698649.275	6698663.28	6698656.277	1633288.813	1633282.457	1633285.635	-17.231	-191.655
32		55.35	6697752.012	6697762.424	6697757.218	1634522.188	1634522.631	1634522.41	6.637	-103.571
33		55.35	6697752.012	6697762.424	6697757.218	1634522.188	1634522.631	1634522.41	6.637	-103.571
34		55.35	6697752.012	6697762.424	6697757.218	1634522.188	1634522.631	1634522.41	6.637	-103.571
35		71.75	6697703.275	6697716.898	6697710.086	1634777.502	1634774.777	1634776.14	7.132	-135.694
36		71.75	6697703.275	6697716.898	6697710.086	1634777.502	1634774.777	1634776.14	7.132	-135.694
37		46.5	6697703.275	6697712.104	6697707.689	1634777.502	1634775.736	1634776.619	7.132	-85.431
38										
39					6699713.302			1631335.456		
40					6699713.302			1631335.456		
41					6699713.302			1631335.456		
42					6699585.837			1631377.727		
43					6699585.837			1631377.727		
44					6699585.837			1631377.727		
45					6699614.569			1631487.328		
46					6699614.569			1631487.328		
47					6699614.569			1631487.328		
48					6698647.552			1633252.184		
49										
50					6699768			1630168		
51										
52										
53					6699592			1631351		
54					6699592			1631351		

		COORDINATES								
Row number	Charge Balance (%)	CENTER_OF_SECT	NORTHING_SECUP	NORTHING_SECLOW	NORTHING_CENTER_OF_SECT	EASTING_SEC UP	EASTING_SEC LOW	EASTING_ CENTER_OF_SECT	ELEVATION_SEC UP	ELEVATION_SEC LOW
55					6699592			1631351		
56										
57	3.43									
58	-3.2				6699393			1629854		
59	7.81				6699237			1629852		
60					6699393			1629854		
61	5.65				6699393			1629854		
62	5.27				6699393			1629854		
63	4.83				6699393			1629854		
64	-2.2				6699393			1629854		
65	4.98				6699393			1629854		
66	3.63				6699393			1629854		
67	-0.17				6699393			1629854		
68	-0.76				6699393			1629854		
69	-9.92				6699393			1629854		
70	-2.39				6699393			1629854		
71	0.96				6699393			1629854		
72	2.33				6699393			1629854		
73	-2.44				6699393			1629854		
74	2.01				6699393			1629854		
75	1.5									
76	4.28				6700617			1629574		
77	4.79				6700617			1629574		
78	4.76				6700617			1629574		
79	5.31				6700617			1629574		
80	4.99				6700617			1629574		
81	5.19				6700617			1629574		
82	2.81				6700617			1629574		
83	4.54				6700617			1629574		
84	3.71				6700617			1629574		
85	2.91				6700617			1629574		
86	3.55				6700617			1629574		
87	4.01				6700617			1629574		
88	6.48				6700617			1629574		
89	5.13				6700617			1629574		
90					6700617			1629574		
91	-0.61				6700617			1629574		
92	2.77				6700617			1629574		
93	6.33				6700617			1629574		
94	-0.79				6700617			1629574		
95	-1.7				6700617			1629574		
96	3.06				6700617			1629574		
97	3.32				6700617			1629574		
98	2.62				6700617			1629574		
99	0.57				6700617			1629574		
100	2.32				6700617			1629574		
101	0.52				6700617			1629574		
102	-1.9				6700617			1629574		
103	-0.87				6700617			1629574		
104	-2.31				6700617			1629574		
105	0.84				6700617			1629574		
106	-3.48									
107	-1.08				6699868			1631814		
108	-1.62				6699868			1631814		

						COORDINATES					
Row number	Charge Balance (%)		CENTER_OF_SECT	NORTHING_SECUP	NORTHING_SECLOW	NORTHING_CENTER_OF_SECT	EASTING_SECUP	EASTING_SECLOW	EASTING_ CENTER_OF_SECT	ELEVATION_SECUP	ELEVATION_SECLOW
109	-3.28					6699868			1631814		
110	-4.56					6699868			1631814		
111	-2.15					6699868			1631814		
112	1.03					6699868			1631814		
113	0.48					6699868			1631814		
114	-1.61					6699868			1631814		
115	3.42					6699868			1631814		
116	-0.95					6699868			1631814		
117	-4.36					6699868			1631814		
118	7.18					6699868			1631814		
119	-2.26					6699868			1631814		
120	0.04					6699868			1631814		
121	-5.45										
122	-6.52					6699083			1632145		
123	-14.42					6699083			1632145		
124	-1.57					6699083			1632145		
125	-0.38					6699083			1632145		
126	-0.36					6699083			1632145		
127	-0.93					6699083			1632145		
128	-1.09					6699083			1632145		
129	-1.22					6699083			1632145		
130	-3.38					6699083			1632145		
131	-2.49					6699083			1632145		
132	0.02					6699083			1632145		
133	-0.61					6699083			1632145		
134	-2.43					6699083			1632145		
135	-2.33					6699083			1632145		
136	0.88					6699083			1632145		
137	0.87					6699083			1632145		
138	-0.56					6699083			1632145		
139	0.32					6699083			1632145		
140	2.74					6699083			1632145		
141	2.93					6699083			1632145		
142	0.19					6699083			1632145		
143	-0.32					6699083			1632145		
144	-1.17					6699083			1632145		
145	-1.21					6699083			1632145		
146	0.12					6699083			1632145		
147	-1.92					6699083			1632145		
148	-3.78					6699083			1632145		
149	-7.47					6699083			1632145		
150	-3.25					6699083			1632145		
151	4.21					6699083			1632145		
152	1.23					6699083			1632145		
153	4.1										
154	0					6697118			1631946		
155	-1.51					6697118			1631946		
156	3.98					6697118			1631946		
157	5.15					6697118			1631946		
158	6.51					6697118			1631946		
159	6.19					6697118			1631946		
160	4.43					6697118			1631946		
161	5					6697118			1631946		
162	3.28					6697118			1631946		

		COORDINATES								
Row number	Charge Balance (%)	CENTER_OF_SECT	NORTHING_SECUP	NORTHING_SECLOW	NORTHING_CENTER_OF_SECT	EASTING_SECUP	EASTING_SECLOW	EASTING_CENTER_OF_SECT	ELEVATION_SECUP	ELEVATION_SECLOW
163	5.05				6697118			1631946		
164	3.45				6697118			1631946		
165	2.65				6697118			1631946		
166	4.19				6697118			1631946		
167	4.38				6697118			1631946		
168	7.88				6697118			1631946		
169	8.94				6697118			1631946		
170	2.32				6697118			1631946		
171					6697118			1631946		
172	4.4				6697118			1631946		
173	3.25				6697118			1631946		
174	-0.32				6697118			1631946		
175	1.59				6697118			1631946		
176	2.9				6697118			1631946		
177	-1.8				6697118			1631946		
178	3.33				6697118			1631946		
179	1.39				6697118			1631946		
180	2.6				6697118			1631946		
181	-2.64				6697118			1631946		
182	3.2				6697118			1631946		
183	2.46				6697118			1631946		
184	-1.14				6696924			1633350		
185	5.44				6696924			1633350		
186	1.48				6696924			1633350		
187	3.75				6696924			1633350		
188	6				6696924			1633350		
189	5.62				6696924			1633350		
190	3.95				6696924			1633350		
191	2.96				6696924			1633350		
192	-7.16				6696924			1633350		
193	0.63				6696924			1633350		
194	2.81				6696924			1633350		
195	3.13				6696924			1633350		
196	-0.68				6696924			1633350		
197	1.29				6696924			1633350		
198	-3.67				6696924			1633350		
199	2.65				6696924			1633350		
200	2.61				6697594			1632722		
201	1.06				6697594			1632722		
202	-4.01				6697594			1632722		
203										
204	-5.62				6700605			1631921		
205	-4.43				6700605			1631921		
206	-3.05				6700605			1631921		
207	-2.4				6700605			1631921		
208	1.88				6700605			1631921		
209	1.98				6700605			1631921		
210	0.14				6700605			1631921		
211	0.04				6700605			1631921		
212	0.96				6700605			1631921		
213	-1.21				6700605			1631921		
214	0.39				6700605			1631921		
215					6700605			1631921		
216	1.67				6700605			1631921		

			COORDINATES								
Row number	Charge Balance (%)		CENTER_OF_SECT	NORTHING_SECUP	NORTHING_SECLOW	NORTHING_CENTER_OF_SECT	EASTING_SECUP	EASTING_SECLOW	EASTING_CENTER_OF_SECT	ELEVATION_SECUP	ELEVATION_SECLOW
217	0.88					6700605			1631921		
218	5.54					6700605			1631921		
219	4.77					6700605			1631921		
220						6700605			1631921		
221	1.71					6700605			1631921		
222	-0.75					6700605			1631921		
223	2.17					6700605			1631921		
224	0.83					6700605			1631921		
225	0.36					6700605			1631921		
226	0.86					6700605			1631921		
227	0.1					6700605			1631921		
228	-3.4					6700605			1631921		
229	-3.72					6700605			1631921		
230	-0.09					6700605			1631921		
231	0.73					6700605			1631921		
232	-4.65					6699014			1634833		
233	-4.58					6699014			1634833		
234	-2.46					6699014			1634833		
235	-2.14					6699014			1634833		
236	2.04					6699014			1634833		
237	1.9					6699014			1634833		
238	-0.1					6699014			1634833		
239	-0.09					6699014			1634833		
240	0.13					6699014			1634833		
241						6699014			1634833		
242	0.13					6699014			1634833		
243	0.71					6699014			1634833		
244	1.07					6699014			1634833		
245	1.92					6699014			1634833		
246	5.15					6699014			1634833		
247	4.68					6699014			1634833		
248	0.98					6699014			1634833		
249	1.57					6699014			1634833		
250	-0.93					6699014			1634833		
251	0.36					6699014			1634833		
252	-4.14					6699014			1634833		
253	1.49					6699014			1634833		
254	0.35					6699014			1634833		
255	0.06					6699014			1634833		
256	-4.22					6699014			1634833		
257	-4.16					6699014			1634833		
258	-0.28					6699014			1634833		
259	-0.56					6699014			1634833		
260	-1.23					6699014			1634833		
261	-1.82					6699014			1634833		
262	0.88					6699014			1634833		
263	-5.13					6699014			1634833		
264	-2.3					6697347			1636121		
265	-4.68					6697347			1636121		
266	-2.27					6697347			1636121		
267	-3.98					6697347			1636121		
268	2					6697347			1636121		
269	1.36					6697347			1636121		
270	0.51					6697347			1636121		

			COORDINATES								
Row number	Charge Balance (%)		CENTER_OF_SECT	NORTHING_SECUP	NORTHING_SECLOW	NORTHING_CENTER_OF_SECT	EASTING_SECUP	EASTING_SECLOW	EASTING_CENTER_OF_SECT	ELEVATION_SECUP	ELEVATION_SECLOW
271	0.64					6697347			1636121		
272	-3					6697347			1636121		
273	-2.05					6697347			1636121		
274	0.17					6697347			1636121		
275	-0.11					6697347			1636121		
276	-0.87					6697347			1636121		
277						6697347			1636121		
278	3.78					6697347			1636121		
279	5.2					6697347			1636121		
280	1.42					6697347			1636121		
281	1.52					6697347			1636121		
282	0.29					6697347			1636121		
283	0.62					6697347			1636121		
284	-0.07					6697347			1636121		
285	0.8					6697347			1636121		
286	0.47					6697347			1636121		
287	0.8					6697347			1636121		
288	-1.28					6697347			1636121		
289	-3.83					6697347			1636121		
290	-0.27					6697347			1636121		
291	-2.44					6697347			1636121		
292	1.36					6695635			1635083		
293	0.12					6695635			1635083		
294	-1.4					6695635			1635083		
295	-0.18					6695635			1635083		
296	-0.13					6695635			1635083		
297	4.8					6695635			1635083		
298	1.34					6695635			1635083		
299	0.71					6695635			1635083		
300	0.99					6695635			1635083		
301	1.1					6695635			1635083		
302	-2.75					6695635			1635083		
303	-0.41					6695635			1635083		
304	-0.06					6695635			1635083		
305	0.4					6695635			1635083		
306	-3.53					6701336			1632528		
307	-2.46					6701336			1632528		
308	-3.66					6701336			1632528		
309	-4.61					6701336			1632528		
310	-4.4					6701336			1632528		
311	-1.49					6701336			1632528		
312	-1.32					6701336			1632528		
313	-2.98					6701336			1632528		
314	-2.31					6701336			1632528		
315	-3.99					6698757			1636023		
316	-3.32					6698757			1636023		
317	-2.42					6698757			1636023		
318	-2.84					6698757			1636023		
319	-3.73					6698757			1636023		
320	-2.29					6694442			1635455		
321	0.44					6694442			1635455		
322	-2.02					6694442			1635455		
323	5.53					6694442			1635455		
324	-4.71					6694442			1635455		

		COORDINATES								
Row number	Charge Balance (%)	CENTER_OF_SECT	NORTHING_SECUP	NORTHING_SECLOW	NORTHING_CENTER_OF_SECT	EASTING_SECUP	EASTING_SECLOW	EASTING_ CENTER_OF_SECT	ELEVATION_SECUP	ELEVATION_SECLOW
325	-3.41									
326	-1.38									
327										
328	3.85				6699064			1629343		
329	3.7				6699064			1629343		
330	6.95				6699064			1629343		
331	7.29				6699064			1629343		
332	3.76				6699064			1629343		
333					6699064			1629343		
334	4.89				6699064			1629343		
335	2.41				6699064			1629343		
336	-1.3				6699064			1629343		
337	1.56				6699064			1629343		
338	2.14				6699064			1629343		
339	2.26				6699064			1629343		
340	6.59				6699753			1631859		
341	-1.48				6699753			1631859		
342	-0.55				6699753			1631859		
343	-1.9				6699753			1631859		
344	-3.34				6699753			1631859		
345	-3.05				6699753			1631859		
346	-4.02				6699753			1631859		
347	-0.79				6699753			1631859		
348	1.29				6699753			1631859		
349	-2.36				6699753			1631859		
350	1.04				6699753			1631859		
351	-1.24				6699753			1631859		
352					6699753			1631859		
353	2.6				6699753			1631859		
354	-1				6699753			1631859		
355	-5.47				6699753			1631859		
356	-0.03				6699753			1631859		
357	0.96				6699753			1631859		
358	2.17				6699753			1631859		
359	5.58				6698735			1631641		
360	3.99				6698735			1631641		
361	4.67				6698735			1631641		
362	7.94				6698735			1631641		
363	5.29				6698735			1631641		
364	3.43				6698735			1631641		
365	5.33				6698735			1631641		
366	6.71				6698735			1631641		
367	7.24				6698735			1631641		
368	1.19				6698735			1631641		
369	3.04				6698735			1631641		
370	-0.06				6698735			1631641		
371	2.18				6698735			1631641		
372	-1.48				6698735			1631641		
373	1.44				6698735			1631641		
374	-5.93				6698735			1631641		
375	3.29				6698735			1631641		
376	2.59				6698735			1631641		
377	3.65				6698440			1631510		
378	-14.63				6698440			1631510		

								COORDINATES			
Row number	Charge Balance (%)		CENTER_OF_SECT	NORTHING_SECUP	NORTHING_SECLOW	NORTHING_CENTER_OF_SECT	EASTING_SECUP	EASTING_SECLOW	EASTING_CENTER_OF_SECT	ELEVATION_SECUP	ELEVATION_SECLOW
379	5.36					6698440			1631510		
380	4.37					6698440			1631510		
381	5.4					6698440			1631510		
382	2.96					6698440			1631510		
383	0.94					6698440			1631510		
384	-2.92					6698440			1631510		
385	5.1					6698440			1631510		
386	3.38					6698440			1631510		
387	5.95					6698440			1631510		
388	-1.94					6698440			1631510		
389	-1.78					6698440			1631510		
390	-3.2					6698440			1631510		
391	-4.19					6698440			1631510		
392	2.82					6698440			1631510		
393	3.41					6698440			1631510		
394	2.19					6698440			1631510		
395	9.34					6697319			1632061		
396	-16.06					6697319			1632061		
397	5.56					6697319			1632061		
398	5.1					6697319			1632061		
399	4.45					6697319			1632061		
400	5.67					6697319			1632061		
401	6.34					6697319			1632061		
402	2.21					6697319			1632061		
403	3.91					6697319			1632061		
404	5.05					6697319			1632061		
405	4.75					6697319			1632061		
406	2					6697319			1632061		
407	1.34					6696533			1631944		
408	-1.99					6696533			1631944		
409	4.18					6696533			1631944		
410	-2.32					6696533			1631944		
411	4.69					6696533			1631944		
412	5.08					6696533			1631944		
413	3.96					6696533			1631944		
414	0.33					6696533			1631944		
415	-2.48					6696533			1631944		
416	1.98					6696533			1631944		
417	2.55					6696533			1631944		
418	1.39					6696533			1631944		
419	1.62					6696708			1634151		
420	16.02					6696708			1634151		
421	5.06					6696708			1634151		
422	4.04					6696708			1634151		
423	3.84					6696708			1634151		
424	1.93					6696708			1634151		
425	-3.34					6696708			1634151		
426	3.71					6696708			1634151		
427	4.38					6696708			1634151		
428	0.41					6696708			1634151		
429	-0.84					6696708			1634151		
430	-5.12					6696708			1634151		
431	0.21					6696708			1634151		
432	0.01					6696708			1634151		

			COORDINATES								
Row number	Charge Balance (%)		CENTER_OF_SECT	NORTHING_SECUP	NORTHING_SECLOW	NORTHING_CENTER_OF_SECT	EASTING_SEC UP	EASTING_SEC LOW	EASTING_ CENTER_OF_SECT	ELEVATION_SEC UP	ELEVATION_SEC LOW
433	2.98					6696708			1634151		
434	-0.69					6698073			1635004		
435	-9.18					6698073			1635004		
436	1.3					6698073			1635004		
437	0.53					6698073			1635004		
438	2.22					6698073			1635004		
439	1.36					6698073			1635004		
440	0.79					6698073			1635004		
441											
442											
443											
444											
445											
446											
447											
448											
449											
450											
451											
452											
453											
454											
455											
456											
457											
458											
459											
460											
461											
462											
463	4.1										
464	3.43										
465	-5.45										
466	1.5										
467	-3.48										

Row number	ELEVATION_CENTER_OF_SECT	SAMPLING_DEPTH	SAMPLING_DEPTH_Info	Temp C	Eh (mV)	pH (pH units)	COND (mS/m)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO3 (Alkalinity) (mg/l)
1	-46.929						547	846	24.1	235	69.9	
2	-111.651					7.5						72
3	-111.651					7.58						69
4	-111.651					7.64		1780	22.3	871	140	61
5	-111.651					7.69		1780	22.5	875	140	62
6	-111.651					7.69		1800	22.6	927	144	62
7	-111.651					7.68		1760	23.6	924	143	62
8	-111.651					6.98		1750	25.1	879	143	61
9	-111.651			6.95	-180	7.47		1740	25.6	874	142	61
10						7.99		168	6.46	34.2	7.8	378
11						7.88		148	8.35	30.8	7.3	381
12						7.45		1010	27	382	98.3	72
13						7.4		1520	33.3	656	162	142
14						7.31		1420	34.4	551	150	190
15												
16	-96.868						208	366	10.6	24	7.7	
17	-96.868							42.6	5.7	39.3	7.9	
18	-96.868					8.2	268	470	12.8	56.1	15.5	480
19	-131.975					8.5	86.1	162	12.4	46.3	8	520
20	-33.06					8.4	289	498	13.8	60.4	16.9	440
21	-96.868					8.1	320	556	15.2	79.1	22.8	480
22	-46.949					7.8		703	21.1	162	45.3	340
23	-46.949					7.5		545	16.8	121	34.9	640
24	-9.836						74.7	58.6	8.97	66	12.6	
25	-9.836					7.6	52.7	64.6	9.5	62	14	310
26	-121.345					7.95		169	6.68	27.6	6.9	390
27	-121.345					7.94		167	6.57	28.3	7	390
28	-121.345					7.96		167	6.57	28.9	7.2	388
29	-104.443					7.45		1830	42.4	805	212	110
30	-104.443					7.41		1800	42.2	781	207	115
31	-104.443					7.41		1740	41.2	749	199	122
32	-48.467					7.65		384	17.6	73.3	20.4	231
33	-48.467					7.58		447	19.1	92.9	27	418
34	-48.467					7.57		519	21.4	125	37.2	404
35	-64.281					7.25		2240	68	760	289	113
36	-64.281					7.31		2210	67.8	754	287	115
37	-39.15					7.29		1150	32.6	572	139	173
38												
39	1.221	5.50				7.6	183	242	15.9	103	33.7	420
40	1.221	5.50				7.3		321	18.9	91.7	40.6	476
41	1.221	5.50				7.3		254	16.9	89.1	36.5	427
42	2.012	5.75				7.5	91.7	40.7	6.19	187	11.8	330
43	2.012	5.75				7.2		43.1	5.4	129	9.5	390
44	2.012	5.75				7.4		46.7	6.05	131	9.7	351
45	1.925	11.00				7.6	83.5	33.4	15.8	143	31.2	410
46	1.925	11.00				7.4		33.5	13.7	97.3	27	453
47	1.925	11.00				7.4		31.1	13.6	93	25.2	426
48	6.801	2.40				7.49		5.8	1.87	85.6	5.4	260
49												
50						7.2	36	345	6.25	143	25.1	240
51							47.5	27.7	1.12	25.5	2.1	
52												
53								0.55	0.08	0.17	0.061	
54								0.42	0.16	0.09	0.046	

Row number	ELEVATION_CENTER_OF_SECT		SAMPLING_DEPTH	SAMPLING_DEPTH_Info	Temp C	Eh (mV)	pH (pH units)	COND (mS/m)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO3 (Alkalinity) (mg/l)
55									0.69	0.07	0.26	0.083	
56													
57				Surface			7.5	30	4.6	1.99	55.3	2.8	170
58			0.50	Surface			7.4	19	3.9	1.34	28.7	1.5	100
59			0.20	Surface			7.4	26	5.8	2.07	48.1	2.6	140
60			0.50	Surface					4.8	2.2	59.1	2.8	
61			0.50	Surface			7.9	36.1	6.4	2.53	68	3.3	200
62			0.50	Surface			7.7	38	8.3	2.31	65.9	3.8	200
63			0.50	Surface			7.8	34.6	6.2	2.41	66.5	3.1	200
64			0.50	Surface			7.9	36	9.9	2.18	55.7	3.8	200
65			0.50	Surface			8	34.1	8.3	1.45	62.3	3.7	190
66			0.50	Surface			7.6	37	6.7	1.6	69.1	3.2	210
67			0.50	Surface			7.5	39.6	6.9	1.55	71.3	3.6	240
68			0.50	Surface					10.5	1.44	70.8	4.1	226
69			0.50	Surface					9.9	1.34	63.1	4	218
70			0.50	Surface			7.87		10.1	1.36	62.7	4.1	204
71			0.50	Surface			8.2		10.5	1.75	66.1	4	222
72			0.50	Surface			7.22		6.2	2.5	69.3	3.5	182
73			0.50	Surface			7.09		9	2.62	84	4.4	245
74			0.50	Surface			7		7.8	2.81	83.1	4.1	237
75				Surface			7.4	39	7	2.73	68.7	4.3	220
76			0.50	Surface			8.1	36	8.8	2.69	63.2	3.9	190
77			1.80	Bottom			8.1	36	8.7	2.77	64.1	4	190
78			0.50	Surface			8	40	11.1	2.87	70.7	4.4	210
79			1.80	Bottom			8	40	11.3	2.84	71	4.4	210
80			0.50	Surface			8.1	40.1	12.4	3.17	67.2	4.5	200
81			1.80	Bottom			8.1	40.3	12.1	3.06	67.7	4.5	200
82			0.50	Surface			7.8	39.8	12.9	2.89	61.8	5	200
83			1.80	Bottom			7.8	40.4	12.9	2.82	61.9	5	190
84			0.50	Surface			8.1	34.3	14.8	2.94	51.1	5.3	170
85			1.50	Bottom			7.8	36.3	15	2.96	53.5	5.4	180
86			0.50	Surface			8.2	32.7	13.5	2.45	48.4	5.1	160
87			1.50	Bottom			8.1	32.7	13.5	2.59	48.7	5.2	160
88			0.50	Surface			8	37.7	12	2.19	64.9	4.4	190
89			1.50	Bottom			7.8	39.5	12	2.25	66.3	4.5	200
90			0.50	Surface			8.1	38.8	9.8	2.34	65.4	4.5	220
91			1.50	Bottom			7.7	41.2	9.8	2.45	66.2	4.6	230
92			0.50	Surface					12.3	2.32	65.4	5.1	213
93			1.50	Bottom					12.3	2.29	65.7	5.1	198
94			1.50	Bottom					11.2	2.09	55.5	5	199
95			0.50	Surface					11.1	1.77	55.5	5	200
96			0.50	Surface			8.6		11.5	2.05	50.7	5.1	170
97			1.50	Bottom			8.56		11.4	2.01	50.6	5	170
98			0.50	Surface			8.61		12.1	2.11	52.5	5.2	180
99			1.50	Bottom			8.06		11.9	2.17	54.5	5.1	189
100			0.50	Surface			7.62		10	3.25	77.1	4.7	210
101			1.50	Bottom			7.8		12.5	3.63	79.2	5.8	242
102			0.50	Surface			7.12		11.5	3.88	93.9	6.2	309
103			1.50	Bottom			7.21		12.2	3.94	99	6.3	309
104			0.50	Surface			6.97		11.2	3.52	97.5	5.7	289
105			1.50	Bottom			6.97		13.7	4.38	112	6.5	348
106				Surface			7.7	100	119	6.07	49	17	130
107			0.50	Surface			7.9	80	89.2	4.86	44.2	12.3	110
108			0.50	Surface			7.9	79.5	89.7	4.82	45.2	12.3	120

Row number	ELEVATION_CENTER_OF_SECT		SAMPLING_DEPTH	SAMPLING_DEPTH_Info	Temp C	Eh (mV)	pH (pH units)	COND (mS/m)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO3 (Alkalinity) (mg/l)
109			0.50	Surface			8.2	81.5	87.5	5.05	45.9	12.4	130
110			0.50	Surface			8.1	84.2	91.9	5.25	46.6	13.1	140
111			0.50	Surface			8.3	102	129	6.85	52.3	17.2	150
112			0.50	Surface			8.3	93.5	114	6.02	43.8	16.2	120
113			0.50	Surface			8	69.4	75.5	4.28	42.7	10.7	120
114			0.50	Surface			8.7	58.9	57.9	3.46	39.5	8.9	120
115			0.50	Surface					77.2	4.05	35.7	10.8	106
116			0.50	Surface					78.7	4.32	32.8	11.8	105
117			0.50	Surface			9.43		71.2	3.85	28	10.7	96
118			0.50	Surface			7.38		46.3	3.84	51	8.3	146
119			0.50	Surface			7.44		51.4	4.34	58.6	9.4	190
120			0.50	Surface			7.07		35.4	3.6	65.2	7.5	198
121				Surface			7.8	100	114	5.98	49.5	15.8	140
122			0.50	Surface			7.1	16	3.6	0.94	23.4	1.6	76
123			1.40	Bottom			7.2	230	231	10.5	58.6	29.5	150
124			0.50	Surface			8	81	91.6	4.81	46.6	12.5	120
125			1.40	Bottom			8	80	89.8	4.91	46.9	12.4	110
126			0.50	Surface			8.1	72	76.8	4.31	48.4	10.9	130
127			1.50	Bottom			8.1	72.1	76.3	4.27	48.1	10.9	130
128			0.50	Surface			8.4	70.3	70.6	4.38	48.8	10.6	130
129			1.50	Bottom			8.4	70.4	70.4	4.36	48.7	10.6	130
130			0.50	Surface			8.4	72.7	75.4	4.42	46.3	11.1	130
131			1.50	Bottom			8.4	72.7	75.4	4.43	46.3	11.1	130
132			0.50	Surface			8.7	76.5	88.3	5.04	48.6	12.2	130
133			1.00	Bottom			8.6	76.4	88.7	5.06	48.8	12.3	140
134			0.50	Surface			8.5	73.2	79	4.73	45.2	11.9	130
135			1.00	Bottom			8.5	73.2	79.5	4.76	45.6	11.9	130
136			0.50	Surface			8.6	62.2	65	4.02	42.9	9.5	120
137			1.00	Bottom			8.6	62.5	64.9	3.89	42.8	9.4	120
138			0.50	Surface			8.6	53.1	48.8	3.29	42	8.2	130
139			1.00	Bottom			8.6	53	47.7	3.35	42.2	7.8	130
140			0.50	Surface					56.8	3.64	44.5	8.9	136
141			1.00	Bottom					56.8	3.7	44.5	8.8	136
142			0.50	Surface					55.5	3.67	43	9.3	139
143			1.00	Bottom					55.3	3.7	43	9.3	139
144			0.50	Surface			8.79		52.9	3.46	40	9	127
145			1.00	Bottom			8.8		53.3	3.61	40.5	9	127
146			0.50	Surface			8.33		57.1	4.07	44.4	9.3	144
147			0.50	Surface			7.19		16.6	2.84	57.1	4.9	152
148			1.00	Bottom			7.51		51.4	4.04	51.5	9	168
149			0.50	Surface			7.43		40	4.41	41	6.5	157
150			1.00	Bottom			7.41		43.6	3.84	52	8.1	171
151			0.50	Surface			6.93		19.8	3.09	67.7	5.6	197
152			1.00	Bottom			7.15		42.1	4.2	67	8.3	203
153				Surface			8	33	6.2	2.21	58.9	3.1	180
154			0.50	Surface			7	9	1.4	0.73	13.4	0.7	46
155			1.50	Bottom			7.5	32	5.6	2.22	51.8	3	180
156			0.50	Surface			8.1	28	5.4	1.9	53.3	2.6	160
157			1.50	Bottom			8.1	28	5.6	1.9	53.3	2.5	160
158			0.50	Surface			8.3	27.4	5.2	1.77	51.9	2.6	150
159			1.50	Bottom			8.3	27.4	6.5	2.23	51.5	2.6	150
160			0.50	Surface			8.3	26.8	5.3	1.96	49.5	2.6	150
161			1.50	Bottom			8.3	26.8	5.2	1.95	49.9	2.6	150
162			0.50	Surface			8.4	26.2	5.5	1.84	46.1	2.8	140

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163			1.50	Bottom			8.4	26.2	5.4	1.81	46	2.7	140
164			0.50	Surface			8.4	24.7	6.5	2.14	44	2.9	140
165			1.50	Bottom			8.4	24.7	6.5	1.99	44.2	2.9	140
166			0.50	Surface			8.4	22.6	5.8	2.07	40.3	2.8	120
167			1.50	Bottom			8.4		5.8	1.99	40.6	2.8	120
168			0.50	Surface			8.4	21.6	5.8	1.86	38.2	2.7	110
169			1.50	Bottom			8.4	21.7	5.9	1.91	39.2	2.7	110
170			0.50	Surface			8.4	22.4	5.4	1.73	36.6	2.7	120
171			1.50	Bottom			8.3	22.5	5.4	1.77	37	2.6	
172			0.50	Surface					6.8	1.98	41	2.9	129
173			1.50	Bottom					6.8	2.05	41.4	3	133
174			0.50	Surface					6	1.92	38.3	2.9	128
175			1.50	Bottom					6.1	1.89	38.3	2.9	128
176			0.50	Surface			8.6		5.9	1.91	37	2.9	122
177			1.50	Bottom			8.6		5.5	1.61	33.4	2.6	121
178			0.50	Surface			8.11		6.3	2.04	44	3	137
179			1.50	Bottom			7.87		6.2	2.08	51.9	3	168
180			0.50	Surface			8		7.4	2.46	52.3	3.5	170
181			1.50	Bottom			7.65		6.8	2.31	53.5	3.3	185
182			0.50	Surface			7.14		7.2	2.42	56	3.2	167
183			1.50	Bottom			7.39		7.6	2.44	59.4	3.3	189
184			0.50	Surface			8.5	30.8	18.1	3.13	34.5	5.7	120
185			1.00	Bottom			8.5	30.7	18	3.11	34.3	5.7	110
186			0.50	Surface			8.5	29.7	23.8	3.8	29.6	6.3	110
187			1.00	Bottom			8.6	29.8	23.7	3.78	29.2	6.3	100
188			0.50	Surface			8.6	28.6	20.4	3.37	28.6	5.8	89
189			1.00	Bottom			8.5	28.9	20.4	3.37	29.2	5.8	93
190			0.50	Surface					21.5	3.38	29.6	5.6	97
191			1.00	Bottom			8.6	29	21.4	3.29	30.2	5.8	97
192			0.50	Surface			8.3	30.6	21	3.21	30.3	5.9	110
193			1.00	Bottom			8.8	30.6	21	3	30.6	5.7	110
194			0.50	Surface					27.7	3.68	36.1	6.7	128
195			1.10	Bottom					28.2	3.75	36.3	6.9	133
196			0.50	Surface					28	3.73	34.7	7.2	138
197			1.00	Bottom					28.1	3.76	35	7.2	134
198			0.50	Surface			8.55		25.3	3.17	30.7	6.4	127
199			1.00	Bottom			8.58		28	3.7	34.6	7.2	126
200			0.50	Surface			7	31	7	3.02	52.2	3.8	160
201			0.50	Surface			7.52		27	4.47	58	7.3	193
202			0.50	Surface			7.5		33.7	5.43	72.2	9	281
203													
204			0.50	Surface			8	883	1460	54.7	76	182	75
205			3.00	Bottom			8.1	881	1450	54.5	75.9	181	75
206			3.50	Bottom			8	889	1440	54.6	75.4	181	74
207			0.50	Surface			8	890	1440	54.6	76	182	74
208			0.50	Surface			8	887	1590	51.8	70.4	182	72
209			3.00	Bottom			8	888	1590	52.2	69.9	182	69
210			0.50	Surface			8	882	1490	53.7	73	189	75
211			3.00	Bottom			7.9	880	1490	53.5	72.2	187	76
212			0.50	Surface			7.9	858	1400	52.3	68.3	180	70
213			3.00	Bottom			7.9	858	1400	51.8	67.6	179	70
214			0.50	Surface			8.1	857	1455	56	71.7	184	71
215			3.00	Bottom			8	856	1430	53	75.8	189	
216			0.50	Surface			7.9	807	1430	51.57	66.6	165	70

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217			3.00	Bottom			8	807	1410	50.07	66.6	164	70
218			0.50	Surface					1480	51.9	68.2	171	63
219			3.00	Bottom					1500	52.2	68.4	172	83
220			0.50	Surface					1500	52.7	68.2	185	
221			3.00	Bottom					1490	52.5	67.9	184	80
222			0.50	Surface			8.06		1440	50	67.7	182	72
223			3.00	Bottom			8.05		1520	53.4	71	191	72
224			3.00	Bottom			8.07		1490	51	68.3	180	74
225			0.50	Surface			7.97		1490	51.3	68.7	181	83
226			0.50	Surface			7.97		1500	53.4	69.4	186	74
227			3.00	Bottom			8.01		1480	53.7	69.1	185	75
228			0.50	Surface			7.96		1340	49	63.6	164	74
229			3.00	Bottom			7.95		1340	49.1	63.5	164	74
230			0.50	Surface			8.1		1470	54.3	70.7	182	73
231			3.00	Bottom			8.16		1470	54.4	70.7	182	72
232			0.50	Surface			8	855	1400	52.8	74.5	175	77
233			4.50	Bottom			8	866	1420	53.2	75	177	75
234			0.50	Surface			8	869	1390	52.9	74	175	74
235			4.50	Bottom			8	884	1420	54	74.5	179	74
236			0.50	Surface			8	893	1600	52.6	70.5	183	74
237			4.50	Bottom			7.9	892	1590	52.3	70	181	72
238			0.50	Bottom			8	902	1520	54.8	74.7	193	80
239			4.50	Surface			7.9	898	1510	54.5	73.7	191	80
240			0.50	Surface			7.8	860	1420	53	73.1	187	72
241			4.50	Bottom			7.8	868	1410	52.4	66.9	180	
242			0.50	Surface			8	853	1450	55.1	72.2	184	72
243			4.50	Bottom			7.8	860	1460	55.95	72.8	186	72
244			0.50	Surface			8	834	1473.3	52.67	68.5	169.7	74
245			4.50	Bottom			7.5	843	1513.3	54.03	70.2	174.3	77
246			0.50	Surface					1500	51.8	68.7	171	81
247			4.50	Bottom					1500	52.2	68.7	172	76
248			0.50	Surface					1510	53.9	70.9	174	80
249			4.50	Bottom					1520	52.9	69	187	80
250			0.50	Surface			8.1		1440	50.4	67.9	183	73
251			4.50	Bottom					1460	51.1	68.6	185	73
252			4.50	Bottom			7.88		1460	50.4	67.7	178	71
253			0.50	Surface			7.97		1500	51.2	68.9	181	70
254			4.50	Bottom			7.97		1460	53.2	68.5	182	75
255			0.50	Surface			7.9		1470	53.7	69	183	75
256			0.50	Surface			7.9		1330	48.3	63.2	162	74
257			4.50	Bottom			8.06		1330	48.5	63.3	163	74
258			0.50	Surface			7.94		1470	52.5	71.2	182	78
259			4.30	Bottom			7.92		1460	53.5	72.2	182	80
260			0.50	Surface			7.75		1410	53	71.3	173	79
261			1.00				7.65		1450	55.2	72.2	179	82
262			0.50	Surface			7.43		848	32.4	64.5	99.5	101
263			4.50	Bottom			7.36		1310	49.3	70.1	158	86
264			0.50	Surface			8.1	437	668	26.3	59.6	83.8	98
265			1.50	Bottom			8	747	1200	45.4	72.7	151	83
266			0.50	Surface			8	708	1110	42.8	70.1	140	86
267			1.50	Bottom			7.9	812	1250	47.6	71.8	157	79
268			0.50	Surface			7.8	843	1510	49.7	72	172	82
269			1.50	Bottom			7.8	850	1500	49.5	70.5	171	78
270			0.50	Surface			8	888	1510	54	75.5	188	77

Row number	ELEVATION_CENTER_OF_SECT		SAMPLING_DEPTH	SAMPLING_DEPTH_Info	Temp C	Eh (mV)	pH (pH units)	COND (mS/m)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO3 (Alkalinity) (mg/l)
271			1.00	Bottom			8	887	1510	54	76	189	83
272			0.50	Surface			7.9	852	1390	51.9	69.6	178	76
273			1.00	Bottom			7.9	853	1380	51.7	70.2	179	75
274			0.50	Surface			8	817	1385	53.25	73.4	176	79
275			1.00	Bottom			8.1	824	1385	53.4	72.9	175.5	77
276			0.50	Surface			8.3	706	1203.3	43.47	66.2	107.9	90
277			1.00	Bottom					1213.3	44.07	66.1	139	
278			0.50	Surface					1430	49.9	68.6	163	76
279			1.00	Bottom					1430	49.9	68.7	163	106
280			0.50	Surface					1500	51.6	71.2	186	90
281			1.00	Bottom					1500	51.7	71.1	185	90
282			0.50	Surface			8.34		1460	51	70.6	184	78
283			1.00	Bottom			8.35		1470	51.4	70.7	185	78
284			1.00	Bottom			7.86		1430	49	69.9	175	77
285			0.50	Surface			7.92		1410	48.6	69.5	172	80
286			0.50	Surface			8.05		1400	51.2	68.9	175	77
287			1.00	Bottom			7.95		1400	51	68.7	174	77
288			0.50	Surface			7.69		1190	42.7	59.9	146	70
289			1.00	Bottom			7.63		1260	45.6	63.4	155	76
290			0.50	Surface			7.69		758	31	78.5	96.9	126
291			1.00	Bottom			7.65		1120	42.3	71.7	142	98
292			0.50	Surface			8	836	1470	48.7	69.4	168	88
293			0.50	Surface			8	865	1460	52.6	74	183	87
294			0.50	Surface			8	849	1370	51.7	69.5	178	73
295			0.50	Surface			8.3	820	1375	53.3	71.8	175.5	76
296			0.50	Surface			8.3	648	1090	40.27	63.8	126.3	93
297			0.50	Surface					1520	52.3	70.4	174	84
298			0.50	Surface					1480	51.4	69.2	182	85
299			0.50	Surface			8.01		1410	49.9	68.9	178	77
300			0.50	Surface			7.99		1430	49.3	68.6	174	74
301			0.50	Surface			7.94		1450	52.7	69.7	180	76
302			0.50	Surface			8.06		1180	42.3	62.8	144	82
303			0.50	Surface			7.75		65.6	4.09	43.3	10	106
304			0.50	Surface			7.54		652	25.9	55.8	78.9	99
305			0.50	Surface			7.14		171	8.23	48.4	22	116
306							7.7	830	1390	50.9	70.1	173	73
307			0.50	Surface			7.9	840	1390	51.4	71.8	175	75
308			6.50	Bottom			7.9	840	1390	51	71.2	175	76
309			0.50	Surface			8.5	850	1420	53.1	72.1	173	76
310			6.00	Bottom			8	850	1400	52.7	71.7	171	75
311			0.50	Surface			8.22		1430	54.1	70.3	176	75
312			6.50	Bottom			8.03		1450	54	70.2	177	80
313			0.50	Surface			7.51		968	38.3	69.2	113	101
314			6.50	Bottom			7.71		1460	55.6	71.9	179	78
315							7.7	650	1040	38.6	63.7	129	82
316			0.50	Surface			7.8	810	1270	50.1	67.4	163	75
317			6.50	Bottom			7.8	850	1350	49.7	68.3	168	74
318			0.50	Surface			7.9	860	1430	53.5	72.8	175	74
319			6.00	Bottom			8	860	1430	53.8	72.9	175	74
320							7.5	530	848	31.7	59.7	104	90
321			0.50	Surface			7.6	170	232	10.1	46.5	30.8	100
322			2.50	Bottom			7.7	770	1130	42.3	66.6	142	78
323			0.50	Surface			7.9	110	133	6.74	48.5	18.4	110
324			2.50	Bottom			7.9	110	136	6.89	49.2	18.7	110

Row number	ELEVATION_CENTER_OF_SECT		SAMPLING_DEPTH	SAMPLING_DEPTH_Info	Temp C	Eh (mV)	pH (pH units)	COND (mS/m)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO3 (Alkalinity) (mg/l)
325			0.30	Surface			8.1	602	957	36.6	66.1	120	90
326			0.50	Surface			8.1	687	1080	41.5	68.1	136	85
327													
328			0.20				7.2	32	3.9	2.08	59.1	2.9	180
329			0.20				7.8	31	3.7	2.15	60.4	2.6	180
330			0.10				7.8	34	4.4	2.29	66.4	3	190
331			0.50				7.9	34.7	4.6	2.33	67.4	3	190
332			0.05				7.5	35.5	4.8	2.19	64.8	3.3	200
333			0.10				7.7	31.2	4.5	1.91	60.1	2.9	
334			0.20				7.9	34	5	1.52	67.3	3.2	200
335			0.05				7.6	35.6	4.8	1.45	66.6	3.2	210
336			0.50				7.39		4.2	2.85	49.4	2.6	135
337			0.10				7.36		5.8	2.6	69.2	3.4	186
338			0.10				7.26		7.9	3.15	84.6	4.2	245
339			0.10				6.98		7.5	2.76	81.6	4	232
340			0.10				7.5	32	13	2.5	45.7	4	130
341			0.20				7.2	30	18.2	2.18	36.2	4.1	110
342			0.50				7.9	81	92.8	5.09	46.5	12.8	110
343			0.10				8	74.5	81	4.45	46.4	11.3	130
344			0.50				8.3	76.3	78.7	4.65	46.2	11.3	130
345			0.10				8.2	78	83	4.74	46.6	12	130
346			0.05				7.9	90.5	105	5.6	52.1	14.3	150
347			0.05				8.1	82.2	90	5.09	46.8	13.4	130
348			0.10				7.9	67.2	72.2	4.25	43.1	10.3	120
349			0.10				8.2	57	53.8	3.52	41.7	8.5	130
350			0.10						65	3.91	44.4	9.7	141
351			0.05						62.5	4.02	43.3	10.2	140
352			0.10						58.9	3.73	40.7	9.8	129
353			0.05				7.86		62.9	4.44	45.4	10.4	124
354			0.05				8.33		59.8	4.24	44.1	9.7	146
355			0.05				8.37		46.8	3.37	36.9	7.7	126
356			0.10				7.41		41.9	3.71	50.6	7.9	148
357			0.10				7.41		54.1	5	60.9	9.8	191
358			0.10				7.09		33.5	3.53	65.1	7.3	191
359			0.50				7.6	30	6.5	2.1	50.8	3.3	150
360			0.30				7.4	22	4.3	1.57	36.4	2.4	110
361			0.50				7.7	28	7	2.08	50.2	3	150
362			0.10				7.4	33	10.1	2.22	57.5	3.9	160
363			0.10				7.6	37.4	12.7	2.33	61.4	4.4	180
364			0.10				8	43.1	19	2.17	59.7	5.5	180
365			0.03				8.1	52.1	31.2	2.85	70.7	6.9	210
366			0.20				7.6	31.9	13.5	1.89	48.5	4.1	120
367			0.20				7.8	33.3	12.3	1.54	55.8	4.2	160
368			0.10				7.8	37.3	12.7	1.54	58.6	4.4	190
369			0.20						28	0.69	69	6.6	210
370			0.10				7.64		25.7	1.81	63	7	212
371			0.50				7.43		27.1	2.26	73	7.9	226
372			0.50				7.51		22.4	1.88	72.3	6.8	213
373			0.50				6.68		7.6	2.56	34.7	3.2	93
374			0.10				7.05		10.5	2.44	59.2	4.3	151
375			0.10				6.99		15.9	3.04	66.2	5.1	202
376			0.10				7.02		12.2	2.29	68.2	4.8	202
377			0.20				7.1	34	8.3	2.24	56.1	3.8	170
378			0.20				7.3	26	3.3	0.9	30.3	1.6	130

Row number	ELEVATION_CENTER_OF_SECT		SAMPLING_DEPTH	SAMPLING_DEPTH_Info	Temp C	Eh (mV)	pH (pH units)	COND (mS/m)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO3 (Alkalinity) (mg/l)
379			0.50				7.4	29	8.7	2.16	49.5	3.3	140
380			0.10				7.8	36.9	12.9	2.31	60.3	4.4	180
381			0.10				7.5	39	14.2	2.55	62	4.7	180
382			0.10				7.9	42.8	19.2	2.18	59	5.6	180
383			0.01				8.1	52.2	32.8	2.57	68.8	7.1	220
384			0.10				7.5	41.1	20.8	1.93	58.7	5.5	170
385			0.15				7.7	38.2	15.9	1.34	61.3	4.9	180
386			0.05				7.7	40.2	14.6	1.29	62	4.8	190
387			0.10						27.6	0.63	67.4	6.6	190
388			0.05				7.79		25.1	1.38	60.9	6.8	213
389			0.05				7.27		26.7	1.58	70.4	7.6	222
390			0.05				7.41		24.4	1.34	69.6	6.9	228
391			0.05				7.59		13.8	2.48	46.9	4.3	141
392			0.10				6.96		14.4	2.68	70.9	5.3	188
393			0.10				6.84		27.3	3.72	85.5	7.2	256
394			0.10				6.86		17.4	2.29	79.1	6	229
395			0.10				7.6	24	4.5	1.7	43.7	2.5	120
396			0.10				7.5	34	3.9	1.27	29.2	1.7	140
397			0.10				7.9	28	5	1.91	54.3	2.6	160
398			0.10				8.1	27.2	5.2	1.79	50.9	2.6	150
399			0.05				7.6	27.4	5.3	1.81	49.5	2.6	150
400			0.02				7.5	24	5.5	1.32	44.3	2.7	130
401			0.20				7.6	22.7	5.8	1.77	40.2	2.7	120
402			0.05				7.6	23.8	5.5	1.39	39.9	2.6	130
403			0.10				7.69		5.4	1.91	34.9	2.6	109
404			0.10				7.59		6.6	2.18	47.1	3.1	141
405			0.10				7.72		9.7	3.08	52.8	3.4	168
406			0.10				7.26		6.9	2.29	56.6	3.2	177
407			0.10				8	37	3.5	1.97	68.9	3.3	220
408			0.20				7.5	31	2.8	1.82	52.3	2.8	180
409			0.10				8	37	4	2.05	75.8	3.3	230
410			0.10				8	42.2	4.2	1.99	84.2	3.8	270
411			0.15				7.9	42.1	3.8	2.01	82.9	3.7	250
412			0.05				7.6	37.7	3.8	1.55	76	3.5	220
413			0.10				7.9	40.1	3.7	2.11	82	3.7	250
414			0.05				7.9	43.6	3.6	2.14	83.9	3.8	280
415			0.50				7.51		3.5	2.49	62.7	3.2	205
416			0.10				7.35		3.9	2.15	81	3.7	247
417			0.10				7.43		5.6	2.64	86.3	4.1	268
418			0.10				7.45		4.1	2.23	81.9	3.8	258
419			0.50				7.4	36	15.1	3.34	48.3	5.8	160
420			0.20				7.4	18	14.7	3.06	45.4	5.2	95
421			0.50				7.6	32	14	2.99	47.1	4.8	140
422			0.20				7.6	32.5	16.4	3.04	43.5	5.2	140
423			0.50				7.5	36	19.2	3.66	46.3	5.9	150
424			0.20				7.7	46.3	34.1	4.1	44.8	8.1	170
425			0.50				8	55.9	46	4.8	54.7	9.9	220
426			0.50				7.3	28.3	21.7	2.52	25	4.8	64
427			0.20				7.5	35.6	28.9	1.6	36.1	6.4	130
428			0.50				7.6		28	1.42	36.4	6.5	140
429			0.10				7.19		72.8	4.72	49.1	11.8	128
430			0.10				6.62		21.5	4.16	21.6	4.9	76
431			0.10				6.88		42	5.26	53.8	9.8	193
432			0.10				6.61		70.4	4.87	63.6	15.3	201

Row number	ELEVATION_CENTER_OF_SECT		SAMPLING_DEPTH	SAMPLING_DEPTH_Info	Temp C	Eh (mV)	pH (pH units)	COND (mS/m)	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	HCO3 (Alkalinity) (mg/l)
433			0.10				6.52		76.3	6.41	73.2	16.7	228
434			0.10				8.1	69	8.2	8.17	115	12.7	380
435			0.05				8	67	8	6.76	91.9	11.8	380
436			0.10				8.3	69	10	6.42	122	13.3	390
437			0.10				8.3	69	11.4	6.27	117	14.5	400
438			0.03				8.1	63.7	12.4	6.79	106	14.5	370
439			0.05				8.26		6.7	8.23	101	10.5	293
440			0.10				7.75		12.4	9.53	153	16.8	455
441													
442			1.50						816	21.4	150	43.3	
443													
444													
445													
446													
447													
448													
449													
450									848	21.8	155	44.3	
451													
452													
453													
454													
455													
456													
457													
458													
459								271	266	5.99	138	19.9	30
460							7.19		1530	34.3	608	160	172
461							7.21		1520	35	596	165	173
462													
463							8	33	6.2	2.21	58.9	3.1	180
464							7.5	30	4.6	1.99	55.3	2.8	170
465							7.8	100	114	5.98	49.5	15.8	140
466							7.4	39	7	2.73	68.7	4.3	220
467							7.7	100	119	6.07	49	17	130

Row number	Cl (mg/l)	SO4 (mg/l)	SO4_S (mg/l) (total sulphur by ICP-AES)	Br (mg/l)	F (mg/l)	Si (mg/l) (as Si)	Fe (mg/l) Fetot (ICP-AES)	FeTot (mg/l) (Spectrophotometry)	Fe2+ (mg/l) (spectophotometry)	Mn (mg/l)	Li (mg/l)	Sr (mg/l)
1	1419.7	190.62	76.2	4.85	1.56	5.6					0.027	1.53
2	3842.2	285.82		16.13	0.9							
3	4504.3	309.08		18.57	1.17							
4	4546.8	323.56	105	18.38	1.15	7.5	1.25	1.586	1.531	0.7	0.044	6.53
5	4541.2	326.24	105	17.24	1.21	7.8	1.31	1.428	1.408	0.7	0.054	6.57
6	4494.6	316.62	109	17.67	1.12	8.1	1.33	1.529	1.49	0.73	0.043	6.69
7	4078.2	279.85	109	15.89	1.02	8	1.06	1.207	1.165	0.72	0.041	6.6
8	4567.2	326.83	105	20.4	1.28	7.3	0.831	1.074		0.69	0.046	6.41
9	4562.8	315.65	105	18.35	1.36	7.2	0.79			0.69	0.046	6.4
10	84.4	53.92	17	0.28	1.9	6.4					0.009	0.25
11	63	48.13	13.9	0.24	1.91	6					0.01	0.23
12	2317.2	177.66	55.1	9.6	1.23	4.1					0.031	2.87
13	3741.4	249.13	83.3	18.98	1.1	4.4					0.044	5.35
14	3442.5	246.64	83.1	15.66	2.24	6.2					0.041	3.99
15												
16	215.7	175.7	63.3	0.73		5.5					0.011	0.13
17	9	24.72	5.62			3.8					0.006	0.14
18	472.5	195.93	72.2	1.96		5.8					0.014	0.3
19	30.8	43.69	15.2	-0.2		6.9					0.009	0.14
20	529.8	201.81	75.5	1.62		5.8					0.015	0.33
21	651.1	220.09	76.9	2.49	2.15	6.2					0.016	0.43
22	1163	163.87	63.5	4.31	1.75	5.7					0.024	1.11
23	447	85.14	50.6	1.86	1.1	4.4					0.019	0.82
24	12.8	21.35	8.06		1.08	6.7					0.01	0.27
25	15.7	18.66	8.45	-0.2	1.13	9.8					0.011	0.28
26	72	44.65	16.1	0.32	1.82	6.3					-0.01	0.2
27	71.4	43.7	16	0.27	1.64	6.4					-0.01	0.21
28	81.4	49.61	16	0.28	1.85	6.4					-0.01	0.21
29	4652.5	308.66	101	18.96	0.43	6					0.045	5.9
30	4503.4	306.74	99.5	18.94	0.44	6.1					0.044	5.68
31	4340.3	299.24	97.3	21.98	0.57	6.1					0.043	5.42
32	476	134.65	44.1	1.87	1.7	5					0.01	0.43
33	585.8	155.56	50	2.25	1.6	5.1					0.012	0.6
34	797.4	172.58	55.5	3.02	1.48	5.2					0.015	0.85
35	5162.8	511.67	169	20.15	1.33	4.6					0.053	6.48
36	5421.7	533.97	168	24.12	1.43	4.8					0.052	6.36
37	2694.1	319.35	115	10.97	0.78	6.6					0.033	4.16
38												
39	300.6	162.6	45.6	1.5	0.67	8	2.17			0.19	0.016	0.32
40	392.4	159.79	52.4	1	0.86	7.7	1.79			0.2	0.019	0.38
41	371.1	195.08	51.2	1	0.59	6.6	1.73			0.17	0.014	0.35
42	126.2	19.61	7.34	0.33	0.58	8.2	3.46			0.42	0.006	0.25
43	113.1	18	6.24	0.34	0.63	6.3	2.26			0.24	0.005	0.2
44	100.3	46.88	9.91	0.33	0.66	6	1.1			0.33	0.005	0.21
45	18.6	81.38	25.5	0.01	0.78	14	5.74			0.36	0.02	0.5
46	17.9	75.3	22.8	0.1	0.77	9.6	1.48			0.2	0.013	0.45
47	12.7	60.83	18.2	0.08	0.69	9.2	1.33			0.17	0.014	0.42
48	7.4	13.63	4.84	0.05	0.35	3.8	0.043			0.03	-0.004	0.11
49												
50		10.42	32.4	0.29		6.9					0.015	1.33
51		59.03	15			1.4					0.001	0.08
52												
53	0.753	1.5	0.5	-0.005		0.1	0.017				-0.004	-0.002
54	0.694		0.555	-0.005			0.014					

Row number	Cl (mg/l)	SO4 (mg/l)	SO4_S (mg/l) (total sulphur by ICP-AES)	Br (mg/l)	F (mg/l)	Si (mg/l) (as Si)	Fe (mg/l) Fetot (ICP-AES)	FeTot (mg/l) (Spectrophotometry)	Fe2+ (mg/l) (spectophotometry)	Mn (mg/l)	Li (mg/l)	Sr (mg/l)
55	1.128		0.549	-0.005			0.29					
56												
57	4.5	4.01	1.73	-0.2		4.3						0.06
58	6.1	2.35	1.08	-0.2		2.2						0.03
59	2.8	3.85	2.01	-0.2		3.9						0.05
60	4.1	4.05	1.72	-0.2	0.14	3.9	0.068			0.01	0.002	0.06
61	6.3	4.15	2.05	-0.08		3.5					0.002	0.07
62	8.1	3.83	1.81	-0.2		3.7					0.002	0.08
63	5.2	4.05	2	-0.2		3.7					0.002	0.07
64	8.6	5.04	2.81	0.09	0.72	4.3					0.002	0.08
65	7.1	4.12	1.92	0.02	0.33	3					0.002	0.08
66	6.2	3.7	1.84	-0.2	0.57	4.1	0.071			0.01	0.002	0.08
67	6.1	2.75	1.39	0.07	0.41	5.1	0.05			0.02	0.002	0.09
68	20.5	5.34	1.93	0.09	0.56	7.9					0.003	0.1
69	39.4	7.79	1.91	0.16	0.25	8.6					0.002	0.09
70	23.7	5.71	1.68	0.09	0.31	7.9					0.003	0.09
71	10.3	3.43	1.73	0.09	0.31	7.1	0.026			0.01	-0.004	0.09
72	7.4	33.87	11	-0.2	0.23	5.5					-0.004	0.07
73	12.2	27.33	14.4	-0.2	0.23	7	0.3			0.16	0.002	0.1
74	7.9	26.05	9.36	-0.2	0.24	6.2					-0.004	0.09
75	7.6	8.93	3.52	-0.2		5.3						0.08
76	9.5	8.33	3.31	-0.2	0.4	3.9	0.118			0.02	0.003	0.08
77	9.4	8.3	3.38	-0.2	0.41	3.9	0.121			0.02	0.003	0.07
78	13.4	8.43	3.55	-0.2		2.9					0.002	0.09
79	13	8.23	3.37	-0.2		2.9					0.002	0.09
80	15.3	7.92	3.48	0.11		2.6					0.002	0.08
81	15.2	7.78	3.43	-0.2		2.6					0.002	0.08
82	15.4	7.16	3.06	-0.2		2.6					0.002	0.09
83	16.6	7.47	3.07	-0.2		2.6					0.002	0.09
84	15.1	7.29	3.33	0.1	0.43	3.6					0.003	0.09
85	15.4	7.2	3.35	-0.2	0.6	3.7					0.002	0.09
86	14.6	7.17	3.11	0.04	0.41	4.7					0.002	0.08
87	14.5	7.16	3.07	0.04	0.33	4.7					0.002	0.08
88	12	6.44	3.04		0.62	4.8	0.068			0.01	0.002	0.09
89	12.5	6.24	2.94	-0.2	0.54	5	0.07			0.01	0.002	0.09
90	10.3	5.28	2.34	0.09	0.43	6.1	0.074			0.01	0.002	
91	10.4	5.44	2.29	0.09	0.3	6.3	0.084			0.02	0.002	0.1
92	12.5	6.14	2.78	0.12	0.64	10.1					0.003	0.11
93	10.6	6	2.77	0.09	0.53	10.1					0.003	0.11
94	12	6.25	2.66	0.1	0.35	10.5					0.003	0.1
95	13.3	6.45	2.63	0.11	0.4	10.5					0.003	0.09
96	12	6.34	2.43	0.1	0.31	9.8					0.003	0.09
97	11.2	6.07	2.34	0.1	0.29	9.8					0.003	0.09
98	11.2	5.59	2.53	0.1	0.32	9.5	0.024			0.00004	-0.004	0.1
99	14.6	5.58	2.18	0.88	0.33	9.4	0.042			0.04	-0.004	0.1
100	11.6	34.4	12.1	-0.2	0.3	6.1					-0.004	0.09
101	14.5	29.79	9.86	-0.2	0.4	6.9					-0.004	0.11
102	14.9	33.35	8.66	-0.2	0.34	9.8	0.33			0.64	0.003	0.12
103	17.8	33.36	10.3	-0.2	0.34	9.2	0.41			0.74	0.003	0.12
104	27.8	31.23	10.6	0.06	0.12	7.8					-0.004	0.11
105	15	24.45	9.16	-0.2	0.36	9.2					0.011	0.13
106	245.9	36.14	12.2	0.8		4.4					0.004	0.14
107	176.7	25.23	9.2	0.62	0.25	2.3	0.142			0.01	0.006	0.11
108	176.4	24.24	9.3	0.87		1.4					0.003	0.11

Row number	Cl (mg/l)	SO4 (mg/l)	SO4_S (mg/l) (total sulphur by ICP-AES)	Br (mg/l)	F (mg/l)	Si (mg/l) (as Si)	Fe (mg/l) Fetot (ICP-AES)	FeTot (mg/l) (Spectrophotometry)	Fe2+ (mg/l) (spectophotometry)	Mn (mg/l)	Li (mg/l)	Sr (mg/l)
109	177.6	25.02	9.46	0.56		0.7					0.003	0.11
110	190.7	27.61	9.22	0.65		0.2					0.004	0.12
111	246.5	34.7	13	0.59	0.25	0.5					0.004	0.16
112	203.3	31.92	11.8	0.54	0.25	0.6					0.003	0.14
113	136.2	21.99	8.29	0.43	0.26	0.9	0.099			0.01	0.003	0.11
114	108.9	19.46	6.83	0.41	0.32	1.5	0.095			0.01	0.004	0.1
115	122.4	21.8	8.18	0.41	0.44	0.3					0.004	0.11
116	141.2	23.2	8.5	0.52	0.41	0.1					0.004	0.11
117	136.5	23.8	8.49	0.6	0.27	0					0.005	0.09
118	59.2	30.4	8.83	-0.2	0.24	2					-0.004	0.1
119	95.9	22.28	7.63	0.25	0.5	2.1	0.21			0.05	0.003	0.12
120	61.5	22.57	8.05	0.16	0.28	4.2					-0.004	0.11
121	244.1	34.39	11.5	0.77		4.1						0.13
122	13.3	9.01	1.14	-0.06		2.3					0.001	0.03
123	606.7	106.88	21.5	3.17		2.1						0.22
124	182	26.05	9.22	0.52	0.37	2.5	0.158			0.02	0.004	0.11
125	178.8	25.68	9.25	0.58	0.39	2.5	0.153			0.01	0.004	0.11
126	147.5	21.96	8.25	0.48		1.4					0.003	0.1
127	147.8	21.95	8.72	0.64		1.4					0.003	0.1
128	141	21.24	8.33	0.54		0.9					0.003	0.1
129	141.1	21.14	8.34	0.58		0.9					0.003	0.1
130	157.8	23.63	7.88	0.53		0.4					0.004	0.11
131	153.4	23.57	7.88	0.55		0.4					0.003	0.11
132	165.4	23.62	9.28	0.53	0.29	0.6					0.004	0.12
133	164.2	23.81	9.28	0.48	0.31	0.6					0.004	0.12
134	158	22.93	8.47	0.4	0.24	0.7					0.003	0.11
135	158.9	23.08	8.51	0.4	0.23	0.7					0.003	0.11
136	116.5	19.39	7.61	0.44	0.33	1	0.075			0.01	0.003	0.1
137	116.1	19.43	7.5	0.4	0.28	0.9	0.07			0.01	0.003	0.1
138	88.9	17.54	6.14	0.36	0.2	1.9	0.107			0.01	0.003	0.1
139	83.2	16.87	6.12	0.25	0.32	1.9	0.111			0.01	0.003	0.1
140	90.1	20.28	6.91	0.41	0.29	1.9					0.004	0.11
141	89.1	18.71	6.88	0.39	0.41	1.9					0.004	0.11
142	94.5	19.12	6.95	0.39	0.4	1.6					0.004	0.1
143	96.1	18.82	6.95	0.4	0.36	1.6					0.004	0.1
144	97	18.44	6.57	0.42	0.27	0.9					0.004	0.1
145	99.1	18.46	6.56	0.45	0.26	0.9					0.004	0.1
146	98.1	17.6	6.62	0.36	0.26	0.2	0.025			-0.003	-0.004	0.11
147	40.1	27.45	9.19	0.08	0.26	4.7					-0.004	0.08
148	103.3	15.93	6.43	0.31	0.41	1					-0.004	0.11
149	78.8	18.14	5.34	0.32	0.38	1.4	0.128			0.04	0.002	0.08
150	84.2	20.03	6.75	0.19	0.26	2	0.21			0.05	0.003	0.1
151	24.7	19.83	7.34	-0.2	0.2	5.3					-0.004	0.1
152	70.5	20.12	7.68	0.23	0.43	3.5					-0.004	0.12
153	4.9	5.14	2.44	-0.2		4.8						0.06
154	0.9	3	0.43			0.7						0.01
155	4.7	5.17	2.35	-0.2		3.7					0.001	0.06
156	5.1	4.41	1.88	-0.06	0.58	3.4	0.074			0.05	0.001	0.05
157	3.9	4.15	1.82	-0.2	0.14	3.4	0.072			0.05	0.001	0.05
158	4	4.23	2.08			2.1					0.001	0.05
159	5.8	4.59	2.21			2.1					0.001	0.05
160	4.5	4.35	2.07	-0.2		1.7					0.001	0.05
161	4	4.28	2.06	-0.2		1.7					0.001	0.05
162	7.9	4.7	1.88	-0.2		1.2					0.001	0.05

Row number	Cl (mg/l)	SO4 (mg/l)	SO4_S (mg/l) (total sulphur by ICP-AES)	Br (mg/l)	F (mg/l)	Si (mg/l) (as Si)	Fe (mg/l) Fetot (ICP-AES)	FeTot (mg/l) (Spectrophotometry)	Fe2+ (mg/l) (spectophotometry)	Mn (mg/l)	Li (mg/l)	Sr (mg/l)
163	4.3	4.47	1.9	-0.2		1.2					0.001	0.05
164	5.2	4.7	2.18	0.05	0.22	1.4					0.001	0.05
165	6.5	4.92	2.25	0.05	0.35	1.4					0.001	0.05
166	8.3	5.15	2	0.06	0.36	1.6					0.001	0.05
167	8.6	5.06	2.04	0.03	0.17	1.6					0.001	0.05
168	4.1	4.53	2.17	0.03	0.37	1.9					0.001	0.05
169	4.2	4.53	2.18	0.03	0.36	2	0.014			0.01	0.001	0.05
170	4.3	4.48	1.86	0.04	0.36	2.6	0.021			0.01	0.002	0.05
171	4.2	4.5	1.89	0.04	0.32	2.5	0.024			0.01	0.001	0.05
172	4.7	4.65	2.15	0.09	0.56	3.4					0.001	0.06
173	4.9	5.03	2.18	0.14	0.66	3.4					0.001	0.06
174	8.3	5.14	2.11	0.1	0.27	3.4					0.001	0.05
175	4.9	4.75	2.11	0.06	0.35	3.4					0.001	0.05
176	4.2	4.48	1.96	0.05	0.26	3.1					0.002	0.05
177	4.1	4.33	2.04	0.05	0.16	3.1					0.002	0.05
178	5.8	6.6	2.64	-0.2	0.28	2.9					-0.004	0.06
179	4.9	6.32	2.57	-0.2	0.35	3.3					-0.004	0.06
180	5.5	5.74	2.59	-0.2	0.27	3.6	0.01			0.01	0.001	0.07
181	9.3	6.9	2.67	-0.2	0.27	3.6	0.03			0.05	0.001	0.06
182	7	11.54	4.38	-0.2	0.26	4.2					-0.004	0.06
183	5.2	7.98	3.13	0.2	0.18	4					-0.004	0.06
184	30.2	14.57	5.04	0.06		0.1					0.004	0.07
185	21.8	13.22	5.03	-0.2		0.1					0.004	0.08
186	28.2	16.31	6.71	0.26	0.38	0.9					0.004	0.07
187	28.1	16.39	6.63	0.46	0.5	0.9					0.004	0.08
188	25.6	14.48	5.75	0.11	0.23	1					0.003	0.07
189	24.9	14.66	5.73	0.09	0.29	1.1					0.004	0.07
190	26.6	14.49	5.96	0.18	0.38	1.2	0.06			0.01	0.004	0.07
191	29.9	14.94	5.98	0.15	0.37	1.2	0.037			0.01	0.004	0.07
192	45.8	16.18	5.41	0.2	0.42	2.3	0.062			0.01	0.004	0.08
193	27.8	14.09	5.42	0.18	0.35	2.2	0.066			0.01	0.005	0.08
194	33.3	15.51	6.12	0.2	0.63	2.9					0.005	0.07
195	31.8	15.37	6.18	0.2	0.22	2.9					0.006	0.1
196	36.3	15.09	6.03	0.22	0.41	2.2					0.005	0.1
197	36.4	15.16	5.18	0.2	0.37	2.2					0.005	0.1
198	36.4	14.03	5.64	0.23	0.57	1.1					0.006	0.08
199	36.4	13.85	5.28	0.24	0.35	1.1					0.006	0.09
200	7.5	12.11	4.75	-0.2		5.8						0.07
201	36.5	20.94	7.73	-0.2	0.25	1.4					0.004	0.11
202	49.3	22.79	7.04	0.08	0.29	1.9	0.29			0.13	0.006	0.14
203												
204	2980.9	365.13	132	8.88		0.2					0.027	1.03
205	2883.3	351.81	131	10.58		0.2					0.027	1.03
206	2785.5	364.97	128	10.54		0.2					0.027	1.03
207	2747.8	361.5	129	10.08		0.2					0.027	1.03
208	2736.1	366.37	116	8.66		0.1					0.03	1.15
209	2729.7	369.83	116	12.07		0.1					0.031	1.03
210	2692.1	380.83	126	9	0.21	0.2					0.026	1.09
211	2694.1	380.21	124	9	0.32	0.2					0.026	1.09
212	2601.9	365.44	118	8.8	0.27	0.3					0.023	1.01
213	2609.7	357.34	119	8.9	0.21	0.3					0.022	1
214	2615.6	362.9	124	8.5	0.31	0.2	-0.004			0.01	0.024	1.03
215	2635.7	368.42	125	8.2	0.43	0.1	0.008			-0.003	0.013	1.03
216	2464.7	343.93	112	8.7	0.48	0.7	0.017			0.01	0.032	0.99

Row number	Cl (mg/l)	SO4 (mg/l)	SO4_S (mg/l) (total sulphur by ICP-AES)	Br (mg/l)	F (mg/l)	Si (mg/l) (as Si)	Fe (mg/l) Fetot (ICP-AES)	FeTot (mg/l) (Spectrophotometry)	Fe2+ (mg/l) (spectophotometry)	Mn (mg/l)	Li (mg/l)	Sr (mg/l)
217	2476.4	348.84	111.33	7.8	0.16	0.6	0.013			0.01	0.029	0.98
218	2334.6	367.42	119	9.6	0.58	0.4					0.031	1.03
219	2395.5	365.59	119	9.2	0.32	0.4					0.003	1.04
220	2610.1	362.43	115	7.7	0.47	0.5					0.022	1.02
221	2601.6	361.99	113	7.3	0.26	0.5					0.022	1.01
222	2631.8		128	9.3		0.5					0.035	1
223	2620.1	324.56	126	9.2		0.5					0.035	1.06
224	2627.6	363.73	120	9.5	0.52	0.4	-0.002			-0.003	0.03	1.02
225	2656.8	368.61	119	9.73	-0.2	0.4	-0.002			-0.003	0.027	1.02
226	2667.8	390.88	118	9.2		0.5					0.023	1.05
227	2683.1	385.47	116	9.1		0.5					0.023	1.04
228	2590.6	365	115	9.1	0.19	0.5					0.007	0.98
229	2609.7	360.6	115	8.64	-0.2	0.5					-0.004	0.98
230	2668.9	484.73	118	12.27	-0.2	0.6					0.021	1.04
231	2620.3	371.23	119	9.34	0.12	0.7					0.022	1.04
232	2800.1	342.26	126	8.69		0.2					0.026	1
233	2833.7	347.09	128	9.54		0.3					0.027	1.01
234	2654	346.34	124	10.44		0.1					0.026	1
235	2691.1	358.13	127	9.98		0.2					0.027	1.02
236	2740.9	377.15	117	9.44		0.1					0.024	1.04
237	2731.5	382.18	116	9.24		0.2					0.031	1.03
238	2760.4	402.06	128	9	0.67	0.3					0.028	1.11
239	2742.5	394.04	126	7.7	0.34	0.4					0.027	1.09
240	2587.2	359.27	123	8.8	0.32	0.3					0.024	1.03
241	2521.6	366.78	118	7.5	0.32	0.3					0.02	1.01
242	2627.4	365.72	122	8.8	0.22	0.4	0.028			0.01	0.025	1.02
243	2612.9	370.19	123.5	8.4	0.22	0.4	0.036			0.01	0.024	1.03
244	2573.1	363.59	114.67	8.9	0.27	0.7	0.03			0.01	0.029	1.02
245	2591.5	367.53	118	9	0.48	1.7	0.063			0.05	0.031	1.04
246	2375.8	368.59	119	8.9	0.59	0.6					0.031	1.04
247	2407.9	372.99	118	9.4	0.11	0.6					0.031	1.04
248	2614.2	370.5	130	7.7	0.26	0.6					0.025	1.01
249	2628.2	372.03	129.76	7.7	0.21	0.5					0.024	1.03
250	2647.5	343.99	127	9.1	0.28	0.4					0.038	1
251	2608.4	349.28	128	9.1		0.4					0.038	1.02
252	2636	365.98	119	9.5		0.4	-0.002			-0.003	0.035	1
253	2610.2	359.7	120	9.8	0.35	0.4	-0.002			-0.003	0.028	1.02
254	2626.4	384.84	116	9.3	0.46	0.4					0.023	1.03
255	2663.9	383.4	116	8.9	0.2	0.4					0.024	1.03
256	2614.7	362.72	115	8.69	-0.2	0.4					0.024	0.97
257	2613.6	362.72	115	9.81	0.24	0.5					0.028	0.97
258	2675.6	386.74	119	9.67	-0.2	0.6					0.02	1.04
259	2680.2	380.27	118	10.32	-0.2	0.6					0.022	1.04
260	2613.2	374.5	118	9.01	0.32	0.9	0.02			0.01	0.029	1.02
261	2723.5	381.25	122	9.1	0.13	0.9	0.012			0.01	0.03	1.05
262	1474.8	218.55	77.2	4.77		2.9					0.016	0.65
263	2632	359.35	113	8.63	0.55	1.3					0.02	0.96
264	1268.8	164.15	64.4	4.58		1.4					0.014	0.52
265	2405.1	296.68	111	8.5		0.5					0.024	0.88
266	2112.6	278.73	101	7.32		0.5					0.022	0.82
267	2470.9	325.79	112	8.08		0.4					0.024	0.9
268	2584.8	358.71	112	11.38		0.2					0.029	1
269	2606.9	356.69	111	9.52		0.2					0.03	0.98
270	2703.7	357.35	125	8.6	0.21	0.3					0.026	1.1

Row number	Cl (mg/l)	SO4 (mg/l)	SO4_S (mg/l) (total sulphur by ICP-AES)	Br (mg/l)	F (mg/l)	Si (mg/l) (as Si)	Fe (mg/l) Fetot (ICP-AES)	FeTot (mg/l) (Spectrophotometry)	Fe2+ (mg/l) (spectophotometry)	Mn (mg/l)	Li (mg/l)	Sr (mg/l)
271	2694	371.32	126	8.3	0.22	0.3					0.026	1.05
272	2703.5	350.31	116	8.3	0.32	0.3					0.025	1
273	2633	344.34	117	9	0.23	0.3					0.023	1
274	2507.5	347.03	118	8.59		0.3	0.45			0.02	0.023	0.99
275	2522.8	348.38	117.5	8.77	0.24	0.3	0.06			0.02	0.024	0.99
276	2098.5	290.35	96.17	7.3	0.91	0.8	0.071			0.01	0.024	0.86
277	2111	296.52	96.23	7.5	0.32	0.8	0.067			0.01	0.024	0.87
278	2341.2	352.12	113	8.8	0.43	0.3					0.03	1
279	2250	348.24	113	8.9	0.43	0.3					0.029	1
280	2629.2	370.11	117	7.9	0.21	0.3					0.024	1.03
281	2624.3	360.96	115	8.1	0.42	0.3					0.021	1.02
282	2612.5	346.38	127	8.9		0.2					0.035	1.01
283	2617.9	343.39	124	9	0.17	0.2					0.034	1.03
284	2582.4	352.42	116	9.5	0.22	0.2	0.01			0.01	0.028	0.98
285	2494.6	345.16	114	9.42	0.43	0.4	0.01			-0.003	0.028	0.97
286	2512.9	353.69	113	8.8		0.3					0.022	0.99
287	2493.1	362.55	112	8.6	0.25	0.3					0.023	0.99
288	2191.3	310.36	105	7.11	0.33	0.3					-0.004	0.88
289	2459	352.71	111	8.07	-0.2	0.3					0.036	0.93
290	1384.1	230.15	75.9	4.93	0.18	4.1					0.016	0.62
291	2147	322.15	97.3	7.19	0.03	2.1					0.019	0.83
292	2548.8	345.52	109	10.32		0.2					0.029	0.97
293	2633.4	354.81	122	7.52	0.16	0.2					0.026	1.1
294	2576	351.92	117	8.8	0.23	0.3					0.024	1
295	2509.5	349.28	117.5	8.3	0.37	0.3	0.1			0.01	0.024	0.98
296	1952.9	270.29	87.83	6.4	0.38	1.1	0.056			0.01	0.023	0.79
297	2425.8	379.62	121	9.4	0.26	0.5					0.031	1.06
298	2595.2	357.03	114	7.7	0.31	0.6					0.024	1.01
299	2507.1	341.18	120	8.1		0.5					0.035	0.99
300	2520.9	350.17	115	9.4	0.22	0.4	-0.002			-0.003	0.029	0.98
301	2564.3	361.52	116	8.8		0.5					0.024	1.03
302	2245.6	321.04	103	7.36	-0.2	0.8						0.88
303	120.4	47.5	13.5	0.63	0.12	3.6					-0.004	0.1
304	1170	244.19	58.5	5.78	0.12	2.4	0.16			0.05	0.014	0.51
305	296	65.22	24	1.36	0.27	4.1					-0.01	0.19
306	2717.2	329.21	118	8.84		0.6						1.01
307	2662.3	325.94	118	7.78		0.4						1.02
308	2725.7	334.79	121	8.57		0.4						1.02
309	2840.7	341.85	117	8.23	0.45	0.4	0.09			-0.003	0.03	1.03
310	2786.8	334.44	117	8.44	0.45	0.4	0.072			-0.003	0.03	1.02
311	2667.1	373.88	120	8.94	-0.2	0.7	0.011			-0.003	0.029	1.03
312	2685.6	380.25	121	9.99	-0.2	0.7	0.01			-0.003	0.029	1.04
313	1848.9	263.56	86.2	6.28	0.18	2.9					0.016	0.73
314	2765	389.38	125	9.6	0.2	0.7					0.021	1.07
315	2056.7	251.56	89.2	7.07		1.6						0.77
316	2487.2	324.83	110	8.02		0.6						1.01
317	2571.3	448.72	115	11.45		0.4						0.98
318	2751.9	329.54	119	10.68		0.6	0.135			0.01	0.028	1.04
319	2808.5	336.61	119	8.31		0.4	0.073			-0.003	0.028	1.03
320	1606	199.94	75.3	5.76		2.3						0.64
321	417	53.22	26.6	1.05		3.8						0.22
322	2143.2	284.17	98.2	6.69		1.2						0.84
323	211.6	46.37	17.2	1.36		4.2	0.849			0.09	0.006	0.16
324	289.4	54.48	18	-0.2		4.3	0.838			0.09	0.006	0.16

Row number	Cl (mg/l)	SO4 (mg/l)	SO4_S (mg/l) (total sulphur by ICP-AES)	Br (mg/l)	F (mg/l)	Si (mg/l) (as Si)	Fe (mg/l) Fetot (ICP-AES)	FeTot (mg/l) (Spectrophotometry)	Fe2+ (mg/l) (spectophotometry)	Mn (mg/l)	Li (mg/l)	Sr (mg/l)
325	1863.2	231.31	88.9	7.89		0.9					0.019	0.71
326	2009.3	267.44	99.7	7.68		0.4					0.021	0.8
327												
328	3.3	4.26	1.77	-0.2		4.5						0.06
329	3.5	9.03	1.95	-0.2	0.6	4	0.131			0.01	0.002	0.06
330	3.3	4.65	1.69	-0.04		3.5					0.002	0.07
331	3.7	4.18	2.04	-0.2		3.2					0.002	0.07
332	3.8	4.06	1.79	-0.2		3.1					0.002	0.07
333	2.8	13.23	5.12	-0.02	0.26	3.5					0.002	0.06
334	3.1	4.16	2.08	0.04	0.42	3.9	0.232			0.01	0.002	0.07
335	3.1	3.71	1.82	0.06	0.2	4.3	0.167			0.01	0.001	0.08
336	4.1	32.67	10.9	-0.2	0.21	3.9					0.028	0.06
337	8.8	25.9	9.94	0.13	0.24	5.6					-0.004	0.07
338	6	27.53	9.58	-0.2	0.25	6.7	0.31			0.19	0.002	0.09
339	8.5	23.62	8.59	0.07	0.18	6					-0.004	0.08
340	17.6	7.77	3.41	-0.2		4.4						0.06
341	38.4	10	3.14	-0.2		2.6						0.06
342	184.8	26.13	9.43	0.66	0.25	2.5	0.166			0.01	0.005	0.12
343	158	22.79	8.9	0.56		1.2					0.003	0.11
344	161.8	23.42	8.79	0.49		0.7					0.003	0.1
345	170.9	25.87	8.52	0.64		0.3					0.003	0.11
346	213.6	30.46	11.1	0.61	0.3	0.8					0.004	0.13
347	172	26.17	9.61	0.46	0.27	1.2					0.003	0.12
348	127.2	21.11	8.12	0.44	0.49	1.1	0.081			0.01	0.003	0.1
349	101.6	18.51	7.04	0.4	0.38	2	0.106			0.01	0.004	0.1
350	106.6	23.77	7.66	0.42	0.36	1.9					0.004	0.11
351	112.7	20.86	7.51	0.53	0.39	1.5					0.004	0.11
352			6.96	0.45		0.9					0.005	0.1
353	111.7	25.28	7.5	0.46	0.25	0.4	0.03			-0.003	0.004	0.11
354	105.7	20.93	6.82	0.47	0.36	0.2					-0.004	0.11
355	94.2	17.31	6.23	0.19	0.24	0.2					-0.004	0.09
356	76.9	22.32	7.74	0.2	0.3	2					-0.004	0.1
357	90.8	20.82	7.97	0.3	0.3	2.2	0.196			0.1	0.005	0.12
358	54	21.05	7.92	0.21	0.3	4.3					-0.004	0.11
359	7.1	5.43	2.45	0.2		5.2						0.06
360	4.8	4.58	2.08	-0.2		2.7						0.05
361	7	4.97	2.31	-0.2	0.68	4.2	0.28			0.03	0.002	0.06
362	11.5	6.35	3.15			4.5					0.002	0.08
363	17.3	6.55	3.09	-0.2		5.1					0.002	0.09
364	31.3	7.51	3.15	-0.2		5.7					0.003	0.1
365	50.4		1.22	0.21	0.51	6.8					0.003	0.13
366	17.6	20.39	7.88	0.05	0.26	3.8					0.002	0.08
367	13.5	5.79	2.85	0.07	0.47	4.2	0.49			0.01	0.002	0.08
368	17	5.24	2.5	0.13	0.7	5.7	0.587			0.04	0.003	0.1
369	42.9	8.74	3.86	0.19	0.4	6.5					0.003	0.12
370	41.4	8.74	3.74	0.2	0.26	7.1					0.004	0.11
371	47.5	9.04	3.8	0.12	0.27	8.1	0.18			0.03	0.004	0.12
372	44.9	28.33	9.11	0.2	0.38	7.1					-0.004	0.13
373	11	20.96	7.51	-0.2	0.3	5					-0.004	0.06
374	13.1	24.73	8.67	-0.2	0.24	5.2					-0.004	0.08
375	19.2	14.79	5.5	-0.2	0.26	5.9	0.221			0.06	0.003	0.1
376	15.6	17.04	6.43	-0.2	0.25	5.7					-0.004	0.09
377	10.6	7.47	3.15	-0.2		5.7						0.07
378	7.1	7.49	1.69	-0.2		2.5						0.04

Row number	Cl (mg/l)	SO4 (mg/l)	SO4_S (mg/l) (total sulphur by ICP-AES)	Br (mg/l)	F (mg/l)	Si (mg/l) (as Si)	Fe (mg/l) Fetot (ICP-AES)	FeTot (mg/l) (Spectrophotometry)	Fe2+ (mg/l) (spectophotometry)	Mn (mg/l)	Li (mg/l)	Sr (mg/l)
379	13.2	6.8	2.77	-0.2	0.25	4.5	0.149			0.01	0.002	0.06
380	17.6	7.33	3.41	-0.2		5.3					0.002	0.09
381	20.6	7.11	3.28	-0.2		5.7					0.002	0.09
382	32.1	7.3	3.05	-0.2		5.8					0.003	0.1
383	56.9	5.58	2.79	0.22	0.41	6.5					0.004	0.13
384	52.9	13.74	4.67	0.42	0.36	4.2					0.002	0.1
385	20.5	8.07	3.73	0.1	0.41	4.4	0.292			0.01	0.002	0.09
386	20.4	6.34	2.8	0.14	0.33	5.7	0.237			0.01	0.003	0.1
387	41	9.29	4	0.37	0.44	6.3					0.004	0.12
388	41.9	8.21	3.62	0.21	0.28	7.2					0.004	0.11
389	59.3	9.33	3.38	0.2	0.25	8	0.08			0.02	0.004	0.12
390	54.1	8.69	2.98	0.25	0.48	8					-0.004	0.12
391	31.9	19.71	6.95	-0.2	0.25	5					-0.004	0.08
392	22.8	31.65	10.6	-0.2	0.48	6.5					-0.004	0.1
393	40.6	17.46	6.16	0.22	0.29	8.7	0.623			0.12	0.003	0.13
394	27.4	20.73	7.68	0.2	0.41	6.9					-0.004	0.11
395	3.8	3.49	1.57	0.23		4.1						0.05
396	3.5	3.33	1.38	0.37		2.6						0.03
397	3.7	4.15	1.98	-0.2	0.11	3.4	0.079			0.04	0.002	0.05
398	4.1	4.31	2.21	1.64		2.2					0.001	0.05
399	4.6	3.92	1.98	-0.2		2.1					0.001	0.05
400	4.7	4.82	2.11	0.05	0.3	2.1					0.001	0.05
401	4.2	3.88	2.02	0.03	0.38	2.4	0.06			0.05	0.001	0.05
402	4.1	3.42	1.56	0.04	0.54	3.5	0.088			0.07	0.001	0.07
403	3.9	5.35	2.57	-0.2	0.21	2.5					-0.004	0.05
404	4.9	8.03	3.25	-0.2	0.25	3.3					-0.004	0.06
405	5.4	6.48	2.95	0.07	0.25	3.7	0.026			0.02	0.001	0.06
406	5.6	9.46	3.69	-0.2	0.36	4					-0.004	0.06
407	2.6	4.18	1.78	1.56		4.3						0.07
408	2.3	3.55	1.5	1.47		3.2						0.05
409	2.1	3.65	1.54	0.69	0.13	3.8	0.238			0.05	0.002	0.07
410	16.6	5.71	1.29	0.23		4					0.002	0.08
411	1.9	3.02	1.49	-0.2		3.3					0.002	0.08
412	2	7.36	2.96	-0.2	0.39	4.7					0.002	0.07
413	2.3	2.73	1.34	0.06	0.28	4.7	0.216			0.02	0.002	0.08
414	1.5	1.08	0.55	0.04	0.37	5.9	0.943			0.09	0.002	0.09
415	3.5	13.64	5.1	-0.2	0.27	4.2					-0.004	0.07
416	3	10.86	3.94	-0.2	0.28	4.7					-0.004	0.08
417	3.2	9.17	3.46	-0.2	0.24	4.7	0.036			0.01	0.002	0.09
418	2.8	7.84	3.01	-0.2	0.19	4.4					-0.004	0.08
419	16.8	16.94	6.72	-0.2		4						0.08
420	19.8	14.66	5.66	-0.2		2						0.08
421	17.7	11.76	4.64	-0.2	0.4	1.7	0.047			-0.003	0.003	0.07
422	18.5	11.23	4.92	0.3		0.9					0.003	0.08
423	24.5	10.23	4.69	0.29		1.1					0.004	0.08
424	47.5	7.18	3.15	0.15		1.9					0.005	0.1
425	74.5	12.43	5.17	0.87	0.42	1.9					0.005	0.13
426	24.1	29.08	11.6	0.04	0.12	0.9					0.002	0.06
427	34.1	7.37	3.37	0.47	0.27	1.1	0.238			0.01	0.004	0.08
428	37.7	6.89	3.16	0.31	0.43	1.2	0.323			0.01	0.005	0.1
429	117.8	71.74	22.3	0.33	0.17	2.2	0.441			0.06	0.006	0.13
430	36.7	23.66	8.01	-0.2	0.22	1.8					-0.004	0.05
431	63.3	21.66	7.53	0.08	0.24	3					0.007	0.12
432	107.7	55.24	20.5	0.39	0.13	3.1	1.45			0.1	0.007	0.16

Row number	Cl (mg/l)	SO4 (mg/l)	SO4_S (mg/l) (total sulphur by ICP-AES)	Br (mg/l)	F (mg/l)	Si (mg/l) (as Si)	Fe (mg/l) Fetot (ICP-AES)	FeTot (mg/l) (Spectrophotometry)	Fe2+ (mg/l) (spectophotometry)	Mn (mg/l)	Li (mg/l)	Sr (mg/l)
433	102.2	60.4	22.2	0.59	0.12	4.4					0.006	0.18
434	6.9	53.63	16.4	0.45		3.4						0.2
435	6.1	44.16	14.5	-0.2		1.5						0.16
436	5.9	48.36	16.1		0.44	0.6	0.107			0.03	0.011	0.21
437	6.9	40.52	13.8	-0.2		1.5					0.012	0.22
438	7	27.09	10	0.23		3.2					0.013	0.2
439	5.9	66.81	19.8	-0.2	0.66	3.9					0.011	0.18
440	7.6	89.63	31.2	-0.2	0.63	5.8					0.014	0.26
441												
442	1171.2	230.11	80.9	3.63	2.05	5.8	0.057			0.23	0.024	0.87
443												
444												
445												
446												
447												
448												
449												
450	1166.6	227.74	83	3.69	2.13	6	0.962			0.24	0.019	0.91
451												
452												
453												
454												
455												
456												
457												
458												
459	614.1	88.6	26.2	3.97		5.8					0.013	1.01
460	3744.2	269.44	82.1	14.32	1.31	6.5					0.041	4.48
461	3640.7	269.81	89.6	13.81	1.37	6.4					0.043	4.3
462												
463	4.9	5.14	2.44	-0.2		4.8						0.06
464	4.5	4.01	1.73	-0.2		4.3						0.06
465	244.1	34.39	11.5	0.77		4.1						0.13
466	7.6	8.93	3.52	-0.2		5.3						0.08
467	245.9	36.14	12.2	0.8		4.4					0.004	0.14

Row number	TOC (mg/l)	DOC (mg/l)	S2 (mg/l) (hydrogen sulphide analysed as total sulphide)	I (mg/l)	NH4_N (mg/l) (Ammonium as Nitrogen)	U (µg/l)	Th (µg/l)	Al (µg/l)	ARS	Sc (µg/l)	Cd
1											
2											
3			0.01								
4		4.6	0.01		0.924						
5		2.9	0.01		1.066			2.27			-0.02
6		2.4	0.02		1.065						
7		1.6	0.01		1.009			-60			-20.00
8			0.01		1.062						
9			0.01		1.071						
10											
11											
12	2.5										
13	3										
14	4										
15											
16	11.6										
17	12.7										
18	10										
19	10.9										
20	10.4										
21											
22											
23											
24											
25											
26	9.1										
27	9.4										
28	9.6										
29	2.3										
30	2.5										
31	2.6										
32	5.7										
33	5.8										
34	5.1										
35											
36											
37											
38											
39			0.05	0.009				344	1.61		0.01
40			-0.03	0.008		6.09	0.252	59.8	-0.01	0.103	0.00
41			0.05	0.005				30.3			0.00
42			-0.03	0.008				1020	1.10		0.02
43			-0.03	0.01		4.59	0.251	31.8	0.89	0.155	0.00
44			-0.03	0.007				18.5			0.00
45			-0.03	0.004				2530	8.07		0.02
46			-0.03	0.005		0.55	0.024	31	7.55	0.0202	0.00
47			-0.03	0.004				1.75			0.01
48			-0.03	0.005				39.1			0.02
49											
50	8.1										
51	5.9										
52											
53	2.3							7			
54	1.3							11			

Row number	TOC (mg/l)	DOC (mg/l)	S2 (mg/l) (hydrogen sulphide analysed as total sulphide)	I (mg/l)	NH4_N (mg/l) (Ammonium as Nitrogen)	U (µg/l)	Th (µg/l)	Al (µg/l)	ARS	Sc (µg/l)	Cd
55	1.9							26			
56											
57											
58											
59											
60						2.04	0.026			0.015	
61											
62											
63											
64				0.006							
65			-0.03	0.006							
66								4.9	0.40		0.00
67				0.011							
68				0.009							
69				0.008							
70				0.007							
71				0.007							
72											
73						2.12	-0.02	6.14		-0.05	0.00
74											
75											
76						3.42	0.021			0.019	
77						3.47	0.021			0.016	
78											
79											
80											
81											
82											
83											
84				0.006							
85				0.009							
86			-0.03	0.006							
87			-0.03	0.006							
88								2.3	0.46		0.01
89								2	0.48		0.02
90				0.009							
91				0.008				26.2			
92				0.012							
93				0.008							
94				0.008							
95				0.012							
96				0.007							
97				0.007							
98				0.007							
99				0.007							
100											
101											
102						3.07	-0.02	7.76		-0.05	0.00
103						3.28	-0.02	6.05		-0.05	0.00
104											
105											
106											
107						1.78	0.028	13.1		0.02	
108											

Row number	TOC (mg/l)	DOC (mg/l)	S2 (mg/l) (hydrogen sulphide analysed as total sulphide)	I (mg/l)	NH4_N (mg/l) (Ammonium as Nitrogen)	U (μg/l)	Th (μg/l)	Al (μg/l)	ARS	Sc (μg/l)	Cd
109											
110											
111				0.006							
112			-0.03	0.011							
113				0.006				10			
114				0.008							
115				0.006							
116				0.013							
117											
118											
119						2.67	-0.02	9.67		-0.05	0.00
120											
121											
122											
123											
124						1.7	0.035	14.6		0.019	
125						1.72	0.036			0.016	
126											
127											
128											
129											
130											
131											
132				0.006							
133				0.005							
134			-0.03	0.016							
135			-0.03	0.011							
136				0.007				11.8			
137				0.007				11.6			
138				0.008							
139				0.009							
140				0.009							
141				0.008							
142				0.01							
143				0.01							
144				0.014							
145				0.009							
146				0.009							
147											
148											
149						2.03	-0.02	9.98		-0.05	0.01
150						2.36	-0.02	12.4		-0.05	0.01
151											
152											
153											
154											
155											
156						1.33	0.04			0.028	
157						1.32	0.037			0.016	
158											
159											
160											
161											
162											

Row number	TOC (mg/l)	DOC (mg/l)	S2 (mg/l) (hydrogen sulphide analysed as total sulphide)	I (mg/l)	NH4_N (mg/l) (Ammonium as Nitrogen)	U (µg/l)	Th (µg/l)	Al (µg/l)	ARS	Sc (µg/l)	Cd
163											
164				0.006							
165				0.006							
166				0.006							
167				0.006							
168				0.006				5	0.30		0.00
169				0.006				4.8	0.29		0.00
170				0.007							
171				0.007							
172				0.008							
173				0.008							
174				0.008							
175				0.008							
176				0.009							
177				0.008							
178											
179											
180						1.3	-0.02	5.8		-0.05	0.01
181						1.27	-0.02	2.22		-0.05	0.00
182											
183											
184											
185											
186				0.01							
187				0.01							
188				0.024							
189				0.011							
190				0.01				12.6	0.40		0.00
191				0.009				12.6	0.48		0.00
192				0.011							
193				0.011				12.4			
194				0.013							
195				0.013							
196				0.015							
197				0.012							
198				0.021							
199				0.017							
200											
201											
202						1.11	-0.02	6.02		-0.05	0.00
203											
204											
205											
206											
207											
208											
209											
210				0.006							
211				0.006							
212				0.08							
213				0.014							
214								12.9	1.30		-0.05
215			0.02					5.61	2.00		0.39
216				0.022		0.671	-0.1	4.28	-100.00	-0.01	-0.02

Row number	TOC (mg/l)	DOC (mg/l)	S2 (mg/l) (hydrogen sulphide analysed as total sulphide)	I (mg/l)	NH4_N (mg/l) (Ammonium as Nitrogen)	U (μg/l)	Th (μg/l)	Al (μg/l)	ARS	Sc (μg/l)	Cd
217				0.007		0.69	-0.1	2.65	-100.00	0.14	-0.02
218				0.008							
219				0.009							
220				0.009							
221				0.01							
222				0.007							
223				0.008							
224						0.601	-0.1	1.89		-0.005	0.02
225						0.56	-0.1	32.6		0.0094	0.01
226				0.009							
227				0.01							
228											
229											
230											
231											
232											
233											
234											
235											
236											
237											
238				0.008							
239				0.008							
240				0.015							
241				0.018							
242								13.6	1.20		-0.05
243								20.7	1.40		-0.05
244				0.008		0.733	-0.1	6.56	-100.00	0.015	-0.20
245				0.008		0.604	-0.1	9.41	-100.00	-0.01	-0.02
246				0.09							
247				0.08							
248				0.009							
249				0.01							
250				0.007							
251				0.007							
252				0.007		0.64	-0.1	1.79		-0.005	0.02
253				0.009		0.55	-0.1	1.51		-0.005	0.01
254				0.009							
255				0.009							
256											
257											
258											
259											
260						0.934	-0.1	8.01		-0.3	-0.02
261						0.82	-0.1	2.75		-0.3	0.03
262											
263											
264											
265											
266											
267											
268											
269											
270				0.015							

Row number	TOC (mg/l)	DOC (mg/l)	S2 (mg/l) (hydrogen sulphide analysed as total sulphide)	I (mg/l)	NH4_N (mg/l) (Ammonium as Nitrogen)	U (µg/l)	Th (µg/l)	Al (µg/l)	ARS	Sc (µg/l)	Cd
271				0.009							
272				0.015							
273				0.013							
274								12.1	1.50		-0.05
275								11.3	1.50		-0.05
276				0.011		1.2	-0.1	17.8	-100.00	0.0223	-0.02
277				0.012		1.22	-0.1	17.6	-100.00	0.018	-0.02
278				0.012							
279				0.015							
280				0.012							
281				0.015							
282				0.007							
283				0.01							
284				0.008		0.764	-0.1	3.32		0.0067	0.02
285				0.008		0.715	-0.1	8.91		-0.005	0.02
286				0.009							
287				0.1							
288											
289											
290											
291											
292											
293				0.01							
294				0.008							
295				0.009				9.46	1.60		-0.05
296				0.012		1.24	-0.1	16.2	-100.00	-0.01	-0.02
297				0.009							
298				0.012							
299				0.01							
300						0.647	-0.1	2.67		-0.005	0.01
301				0.009							
302											
303											
304						1.48	-0.1	19.3		-0.3	-0.02
305											
306											
307											
308											
309						0.828	-0.02			0.015	
310						0.745	-0.02			0.02	
311						0.826	-0.1	17.7		-0.3	-0.02
312						0.909	-0.1	12.1		-0.3	-0.02
313											
314											
315											
316											
317											
318						0.754	0.021			0.014	
319						0.721	-0.02			0.006	
320											
321											
322											
323						2.44	0.122			0.076	
324						2.43	0.141			0.068	

Row number	TOC (mg/l)	DOC (mg/l)	S2 (mg/l) (hydrogen sulphide analysed as total sulphide)	I (mg/l)	NH4_N (mg/l) (Ammonium as Nitrogen)	U (µg/l)	Th (µg/l)	Al (µg/l)	ARS	Sc (µg/l)	Cd
325											
326											
327											
328											
329						1.81	0.029			0.033	
330											
331											
332											
333			-0.03	0.005							
334				0.006				28.4			
335				0.008							
336											
337											
338								6.92			0.00
339											
340											
341											
342											
343											
344											
345											
346				0.006							
347				0.009							
348				0.007				11.9			
349				0.008							
350				0.011							
351				0.009							
352				0.009							
353				0.008				5.5	0.27		0.00
354				0.009							
355											
356											
357								12.9			0.00
358											
359											
360											
361											
362											
363											
364											
365				0.019							
366			-0.03	0.005							
367				0.006				17.2			
368				0.01							
369				0.01							
370				0.007							
371								21.8	0.30		0.00
372				0.009							
373											
374											
375								11.9			0.00
376											
377											
378											

Row number	TOC (mg/l)	DOC (mg/l)	S2 (mg/l) (hydrogen sulphide analysed as total sulphide)	I (mg/l)	NH4_N (mg/l) (Ammonium as Nitrogen)	U (μg/l)	Th (μg/l)	Al (μg/l)	ARS	Sc (μg/l)	Cd
379											
380											
381											
382											
383				0.014							
384				0.008							
385				0.005				19			
386				0.008							
387				0.012							
388				0.007							
389								28.3	0.27		0.00
390				0.011							
391											
392											
393								21.7			0.00
394											
395											
396											
397											
398											
399											
400				0.006							
401				0.007				5.5			
402				0.008							
403											
404											
405								3.7			0.00
406											
407											
408											
409											
410											
411											
412				0.006							
413				0.01				31.4			
414				0.021							
415											
416											
417								9.21			0.00
418											
419											
420											
421											
422											
423											
424											
425				0.014							
426			-0.03	0.003							
427				0.008							
428		37.2		0.009							
429				0.003							
430											
431			-0.03								
432								18.9			0.01

Row number	TOC (mg/l)	DOC (mg/l)	S2 (mg/l) (hydrogen sulphide analysed as total sulphide)	I (mg/l)	NH4_N (mg/l) (Ammonium as Nitrogen)	U (µg/l)	Th (µg/l)	Al (µg/l)	ARS	Sc (µg/l)	Cd
433											
434											
435											
436											
437											
438											
439											
440											
441											
442	7.9	6.2									
443	7.6	7.4									
444	7.8	7.9									
445	7.8	7.6									
446	8.3										
447	5.4										
448	4										
449	5.3										
450	9.5	8.3									
451	7.1	7									
452	6.9	8									
453	6.9	6.9									
454	1										
455	2										
456	2.4										
457	2.5										
458											
459	8.3										
460	2.8										
461	2.6										
462											
463											
464											
465											
466											
467											

	CHEMICAL DATA											
Row number	Cr (µg/l)	Cu	Co (µg/l)	Hg	Ni (µg/l)	Zn (µg/l)	Pb	V	Rb (µg/l)	Y (µg/l)	Zr (µg/l)	Mo (µg/l)
1												
2												
3												
4												
5	0.681	-1.00	0.293	2.60E-03	2.87	122	1.10E-01	-5.00E-02				5.98
6												
7	-20	-7.00	-20	-2.00E-03	-20	129	-1.00E+02	-9.00E+00				-20
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
32												
33												
34												
35												
36												
37												
38												
39	1.29	0.72	0.678	-2.00E-03		3.16	7.01E-01	3.02E+00				
40	0.707	0.39	0.254	-2.00E-03	12.8	1.59	2.43E-01	1.96E+00	5.54	2.98	8.48	2.97
41	0.451	0.77	0.229	-2.00E-03	7.33	8.53	1.93E-01	1.38E+00				1.58
42	3.46	1.35	1.74	-2.00E-03		10.1	2.26E+00	3.73E+00				
43	10.9	0.35	0.752	-2.00E-03	42.6	20.4	1.36E-01	2.84E+00	2.47	5	11.3	2.29
44	0.56	1.53	0.626	-2.00E-03	125	56.2	2.28E-01	1.63E+00				2.38
45	3.9	7.90	2.33	-2.00E-03		16.2	2.81E+00	5.89E+00				
46	0.124	0.42	0.215	-2.00E-03	0.595	2.62	9.60E-02	2.97E-01	1.54	0.401	0.443	0.924
47	0.149	0.18	0.129	-2.00E-03	1.28	1.14	7.50E-02	2.75E-01				0.915
48	0.427	3.47	0.191	-2.00E-03	1.79	1.42	1.33E-01	3.13E-01				0.743
49												
50												
51												
52												
53												
54												

	CHEMICAL DATA											
Row number	Cr (µg/l)	Cu	Co (µg/l)	Hg	Ni (µg/l)	Zn (µg/l)	Pb	V	Rb (µg/l)	Y (µg/l)	Zr (µg/l)	Mo (µg/l)
55												
56												
57												
58												
59												
60									1.7	0.179	0.281	
61												
62												
63												
64												
65												
66	0.123	0.50	0.046	-2.00E-03	0.564	0.78	4.30E-02	1.67E-01				0.376
67												
68												
69												
70												
71												
72												
73	0.127	0.24	0.0772	2.80E-03	0.438	1.31	2.16E-01	1.79E-01	2.19	0.144	0.363	0.468
74												
75												
76									2.07	0.198	0.306	
77									2.09	0.203	0.296	
78												
79												
80												
81												
82												
83												
84												
85												
86												
87												
88	0.103	0.46	0.043	-2.00E-03	0.493	0.74	3.70E-02	1.56E-01				0.51
89	0.105	1.42	0.051	6.90E-03	0.522	1.99	8.80E-02	1.72E-01				0.489
90												
91	2.38		0.171		2.82	2.63						0.43
92												
93												
94												
95												
96												
97												
98												
99												
100												
101												
102	0.17	0.16	0.161	-2.00E-03	0.432	0.503	1.40E-02	1.83E-01	3.73	0.182	0.577	0.229
103	0.165	0.33	0.165	2.00E-03	0.448	0.804	1.96E-02	2.11E-01	3.37	0.195	0.599	0.291
104												
105												
106												
107	34.3		0.061		0.434	3.46			2.93	0.266	0.302	0.462
108												

	CHEMICAL DATA											
Row number	Cr (µg/l)	Cu	Co (µg/l)	Hg	Ni (µg/l)	Zn (µg/l)	Pb	V	Rb (µg/l)	Y (µg/l)	Zr (µg/l)	Mo (µg/l)
109												
110												
111												
112												
113	0.119		0.09		0.481	0.76						0.933
114												
115												
116												
117												
118												
119	0.157	0.58	0.0746	1.39E-02	0.436	1.52	8.37E-02	2.19E-01	3.92	0.212	0.497	0.647
120												
121												
122												
123												
124	0.162		0.068		0.41	0.87			2.89	0.267	0.296	0.381
125									2.97	0.271	0.337	
126												
127												
128												
129												
130												
131												
132												
133												
134												
135												
136	0.118		0.092		0.412	0.46						1.01
137	0.114		0.087		0.448	0.71						1.05
138												
139												
140												
141												
142												
143												
144												
145												
146												
147												
148												
149	0.127	0.56	0.0517	-2.00E-03	0.407	12.9	6.39E-01	2.60E-01	2.79	0.155	0.403	0.298
150	0.134	0.68	0.069	-2.00E-03	0.435	2.12	2.56E-01	2.25E-01	3.54	0.204	0.471	0.556
151												
152												
153												
154												
155												
156									1.81	0.242	0.305	
157									1.81	0.242	0.296	
158												
159												
160												
161												
162												

	CHEMICAL DATA											
Row number	Cr (µg/l)	Cu	Co (µg/l)	Hg	Ni (µg/l)	Zn (µg/l)	Pb	V	Rb (µg/l)	Y (µg/l)	Zr (µg/l)	Mo (µg/l)
163												
164												
165												
166												
167												
168	0.09	0.56	0.045	-2.00E-03	0.246	0.38	2.90E-02	2.70E-01				0.262
169	0.077	0.55	0.045	-2.00E-03	0.235	0.47	4.80E-02	2.28E-01				0.25
170												
171												
172												
173												
174												
175												
176												
177												
178												
179												
180	0.0696	0.42	0.0394	-2.00E-03	0.187	3.26	2.38E-01	1.94E-01	2.69	0.0579	0.348	0.247
181	0.0707	0.43	0.0403	-2.00E-03	0.201	0.608	1.93E-02	1.80E-01	2.6	0.0846	0.289	0.235
182												
183												
184												
185												
186												
187												
188												
189												
190	0.085	0.50	0.081	-2.00E-03	0.2	0.44	1.76E-01	4.95E-01				0.612
191	0.096	0.52	0.094	-2.00E-03	0.279	0.45	2.27E-01	5.23E-01				0.625
192												
193	2.05		0.145		1.53	1.81						0.623
194												
195												
196												
197												
198												
199												
200												
201												
202	0.139	0.23	0.107	-2.00E-03	0.279	0.832	9.85E-02	2.16E-01	4.45	0.099	0.377	0.294
203												
204												
205												
206												
207												
208												
209												
210												
211												
212												
213												
214	0.582	24.70	-0.05	-2.00E-03	1.03	23.3	2.82E+00	1.38E-01				1.8
215	0.575	1.41	0.05	-2.00E-03	1.15	4.12	5.01E-01	9.74E-02				1.86
216	0.199	0.81	-0.02	-2.00E-03	1.08	1.19	-1.00E-01	1.54E-01	17.5	0.0236	-10	1.83

	CHEMICAL DATA											
Row number	Cr (µg/l)	Cu	Co (µg/l)	Hg	Ni (µg/l)	Zn (µg/l)	Pb	V	Rb (µg/l)	Y (µg/l)	Zr (µg/l)	Mo (µg/l)
217	0.172	0.94	0.021	-2.00E-02	0.986	1.02	-1.00E-01	1.75E-01	17.9	0.021	-10	1.8
218												
219												
220												
221												
222												
223												
224	0.11	0.91	0.035	-2.00E-03	0.88	4.36	3.03E-01	1.57E-01	18.5	0.026	0.013	1.17
225	0.12	0.73	-0.02	-2.00E-03	0.873	5.09	-5.00E-02	2.07E-01	17.5	0.04	0.095	1.16
226												
227												
228												
229												
230												
231												
232												
233												
234												
235												
236												
237												
238												
239												
240												
241												
242	-0.1	-0.50	-0.05	-2.00E-03	0.68	-2	-3.00E-01	1.61E-01				2.08
243	0.168	2.86	-0.05	-2.00E-03	2.01	106	8.59E-01	2.11E-01				2
244	0.159	0.84	0.03	-2.00E-03	0.944	1.17	1.45E-01	2.96E-01	18.2	0.028	-10	1.89
245	0.162	0.60	0.075	-2.00E-03	1.19	1.51	2.13E-01	3.44E-01	19	0.036	-10	1.91
246												
247												
248												
249												
250												
251												
252	0.092	0.68	-0.02	-2.00E-03	0.585	2.39	6.40E-02	1.93E-01	18.2	0.031	0.045	1.53
253	0.102	0.66	-0.02	-2.00E-03	0.752	3.04	-5.00E-02	1.76E-01	17.1	0.026	0.016	1.17
254												
255												
256												
257												
258												
259												
260	0.155	1.44	0.0364	-2.00E-03	0.908	2.31	-1.00E-01	1.09E-01	17.4	0.072	0.19	1.4
261	0.0885	1.35	-0.02	-2.00E-03	0.94	4.09	-1.00E-01	1.57E-01	17.9	0.0574	0.167	1.38
262												
263												
264												
265												
266												
267												
268												
269												
270												

	CHEMICAL DATA											
Row number	Cr (µg/l)	Cu	Co (µg/l)	Hg	Ni (µg/l)	Zn (µg/l)	Pb	V	Rb (µg/l)	Y (µg/l)	Zr (µg/l)	Mo (µg/l)
271												
272												
273												
274	0.308	0.68	0.118	-2.00E-03	1.11	3	-3.00E-01	2.47E-01				2.08
275	0.484	0.79	0.0789	-2.00E-03	1.06	3.1	-3.00E-01	2.50E-01				2.1
276	0.15	1.04	0.105	-2.00E-03	1.23	-1.19	1.97E-01	4.00E-01	15.5	0.066	-10	1.69
277	0.198	1.29	0.129	-2.00E-03	1.35	1.61	2.23E-01	4.36E-01	16.1	0.071	-10	1.73
278												
279												
280												
281												
282												
283												
284	0.112	0.68	0.046	-2.00E-03	1.05	4.94	-5.00E-02	2.02E-01	16.2	0.046	0.04	1.28
285	-0.05	1.20	0.058	-2.00E-03	0.865	12.6	-5.00E-02	1.39E-01	15.9	0.048	0.054	1.15
286												
287												
288												
289												
290												
291												
292												
293												
294												
295	0.561	0.72	-0.05	-2.00E-03	0.883	2.07	-3.00E-01	2.87E-01				1.87
296	0.212	1.29	0.096	-2.00E-02	1.34	1.3	1.28E-01	4.81E-01	15	0.07	-10	1.64
297												
298												
299												
300	0.069	0.63	0.029	-2.00E-03	0.992	1.4	-5.00E-02	1.76E-01	17.1	0.04	0.023	1.13
301												
302												
303												
304	0.335	1.83	0.109	-2.00E-03	1.07	8.54	2.31E-01	1.86E-01	9.68	0.204	0.387	0.805
305												
306												
307												
308												
309									16.7	0.0941	0.06	
310									16.7	0.1	0.0662	
311	0.14	1.35	-0.02	-2.00E-03	0.954	2.53	1.18E-01	1.25E-01	17.3	0.0625	0.287	1.4
312	0.163	1.38	-0.02	-2.00E-03	0.632	1.7	3.19E-01	1.15E-01	17.5	0.0501	0.168	1.56
313												
314												
315												
316												
317												
318									16.9	0.114	0.0901	
319									16.6	0.0803	0.0602	
320												
321												
322												
323									3.48	0.813	0.689	
324									3.97	0.855	0.709	

	CHEMICAL DATA											
Row number	Cr (µg/l)	Cu	Co (µg/l)	Hg	Ni (µg/l)	Zn (µg/l)	Pb	V	Rb (µg/l)	Y (µg/l)	Zr (µg/l)	Mo (µg/l)
325												
326												
327												
328												
329									1.76	0.2	0.561	
330												
331												
332												
333												
334	0.119		0.07		0.491	2.03						0.404
335												
336												
337												
338	0.129	0.72	0.212	2.40E-03	0.517	1.48	8.94E-02	1.79E-01				0.486
339												
340												
341												
342												
343												
344												
345												
346												
347												
348	0.117		0.091		0.396	0.41						1.01
349												
350												
351												
352												
353	0.1	0.62	0.063	-2.00E-03	0.434	1.28	1.04E-01	3.19E-01				1.04
354												
355												
356												
357	0.227	0.90	0.138	-2.00E-03	0.64	1.37	5.93E-02	2.76E-01				1.21
358												
359												
360												
361												
362												
363												
364												
365												
366												
367	0.197		0.07		0.684	0.55						0.349
368												
369												
370												
371	0.171	0.48	0.1	-2.00E-03	0.41	2.04	6.90E-02	2.40E-01				0.348
372												
373												
374												
375	0.131	0.49	0.0824	3.20E-03	0.484	3.11	6.69E-02	2.05E-01				0.245
376												
377												
378												

	CHEMICAL DATA											
Row number	Cr (µg/l)	Cu	Co (µg/l)	Hg	Ni (µg/l)	Zn (µg/l)	Pb	V	Rb (µg/l)	Y (µg/l)	Zr (µg/l)	Mo (µg/l)
379												
380												
381												
382												
383												
384												
385	0.162		0.073		0.531	0.53						0.362
386												
387												
388												
389	0.166	0.33	0.084	-2.00E-03	0.42	3.29	1.04E-01	2.35E-01				0.261
390												
391												
392												
393	0.207	0.51	0.111	3.30E-03	0.612	4.08	6.83E-02	2.19E-01				0.128
394												
395												
396												
397												
398												
399												
400												
401	0.076		0.052		0.216	0.76						0.221
402												
403												
404												
405	0.0787	0.43	0.0378	-2.00E-03	0.184	1.43	2.51E-02	2.17E-01				0.239
406												
407												
408												
409												
410												
411												
412												
413	0.195		0.138		1.09	0.79						0.914
414												
415												
416												
417	0.105	2.92	0.0659	-2.00E-03	0.689	1.1	-1.00E-02	3.53E-01				0.925
418												
419												
420												
421												
422												
423												
424												
425												
426												
427												
428												
429												
430												
431												
432	0.255	0.42	0.292	3.30E-03	0.725	19.6	3.95E-01	6.01E-01				0.25

	CHEMICAL DATA											
Row number	Cr (µg/l)	Cu	Co (µg/l)	Hg	Ni (µg/l)	Zn (µg/l)	Pb	V	Rb (µg/l)	Y (µg/l)	Zr (µg/l)	Mo (µg/l)
433												
434												
435												
436												
437												
438												
439												
440												
441												
442												
443												
444												
445												
446												
447												
448												
449												
450												
451												
452												
453												
454												
455												
456												
457												
458												
459												
460												
461												
462												
463												
464												
465												
466												
467												

Row number	Indium (µg/l)	Sb (µg/l)	Cs (µg/l)	Ba (µg/l)	La (µg/l)	Hf (µg/l)	Tl (µg/l)	Ce (µg/l)	Pr (µg/l)	Nd (µg/l)	Sm (µg/l)	Eu (µg/l)	Gd (µg/l)
1													
2													
3													
4													
5				91.3									
6													
7				81.4									
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													
31													
32													
33													
34													
35													
36													
37													
38													
39				54									
40	9.73	0.103	0.031	61.5	2.45	0.179	0.005	2.53	0.485	2.03	0.352	0.0488	0.451
41				52.2									
42				105									
43	14.4	0.203	0.0086	101	5.11	0.294	0.006	5.61	0.893	3.86	0.56	0.0796	0.754
44				78.9									
45				63.2									
46	4.27	0.055	0.0102	33.5	0.506	0.0079	0.012	0.289	0.0837	0.347	0.0486	0.0078	0.0582
47				33.3									
48				65.1									
49													
50													
51													
52													
53													
54													

Row number	Indium (µg/l)	Sb (µg/l)	Cs (µg/l)	Ba (µg/l)	La (µg/l)	Hf (µg/l)	Tl (µg/l)	Ce (µg/l)	Pr (µg/l)	Nd (µg/l)	Sm (µg/l)	Eu (µg/l)	Gd (µg/l)
55													
56													
57													
58													
59													
60	15.6		0.0045	19.3	0.0697	0.0114	0.0053	0.068	0.0219	0.0954	0.0203	0.0036	
61													
62													
63													
64													
65													
66				29.1									
67													
68													
69													
70													
71													
72													
73		0.0674	-0.03	34.8		-0.005	-0.03	0.088	0.018	0.0748	0.0164	-0.005	0.0157
74													
75													
76	8.11		0.0062	24.4	0.0573	0.0114	0.0043	0.068	0.0177	0.0831	0.0191	0.0028	
77	7.52		0.0055	24.4	0.0582	0.0127	0.0048	0.0693	0.0187	0.0849	0.0198	0.0033	
78													
79													
80													
81													
82													
83													
84													
85													
86													
87													
88				34.6									
89				36.4									
90													
91				26.3									
92													
93													
94													
95													
96													
97													
98													
99													
100													
101													
102		0.0919	-0.03	59.3		0.0063	-0.03	0.0756	0.0142	0.0595	0.0141	-0.005	0.0147
103		0.0923	-0.03	63.7		0.0067	-0.03	0.0861	0.0162	0.0723	0.0164	-0.005	0.0169
104													
105													
106													
107	8.72	0.0652	0.0084	14.4	0.157	0.0122	0.006	0.219	0.0422	0.169	0.0323	0.0043	
108													

Row number	Indium (µg/l)	Sb (µg/l)	Cs (µg/l)	Ba (µg/l)	La (µg/l)	Hf (µg/l)	Tl (µg/l)	Ce (µg/l)	Pr (µg/l)	Nd (µg/l)	Sm (µg/l)	Eu (µg/l)	Gd (µg/l)
109													
110													
111													
112													
113				22.6									
114													
115													
116													
117													
118													
119		0.0968	-0.03	27.4		0.0053	-0.03	0.165	0.0307	0.121	0.0236	-0.005	0.0223
120													
121													
122													
123													
124	8.8	0.0651	0.0076	15.5	0.16	0.0125	0.0064	0.22	0.0424	0.171	0.0344	0.0045	
125	12.6		0.0081	16.3	0.161	0.0134	0.0066	0.222	0.042	0.167	0.0338	0.0044	
126													
127													
128													
129													
130													
131													
132													
133													
134													
135													
136				20.7									
137				16.5									
138													
139													
140													
141													
142													
143													
144													
145													
146													
147													
148													
149		0.0857	-0.03	20.1		-0.005	-0.03	0.128	0.0236	0.0901	0.0168	-0.005	0.0157
150		0.0937	-0.03	24		0.0056	-0.03	0.171	0.0316	0.121	0.0238	-0.005	0.0223
151													
152													
153													
154													
155													
156	10.4		0.0076	17.1	0.101	0.0122	0.0042	0.11	0.0302	0.128	0.03	0.0042	
157	10.1		0.006	15.7	0.1	0.0135	0.0044	0.111	0.0307	0.129	0.0274	0.0044	
158													
159													
160													
161													
162													

Row number	Indium (µg/l)	Sb (µg/l)	Cs (µg/l)	Ba (µg/l)	La (µg/l)	Hf (µg/l)	Tl (µg/l)	Ce (µg/l)	Pr (µg/l)	Nd (µg/l)	Sm (µg/l)	Eu (µg/l)	Gd (µg/l)
163													
164													
165													
166													
167													
168				10.3									
169				10.6									
170													
171													
172													
173													
174													
175													
176													
177													
178													
179													
180		0.0833	-0.03	19.2		-0.005	-0.03	0.0136	-0.005	0.0197	-0.005	-0.005	-0.005
181		0.0757	-0.03	21.4		-0.005	-0.03	0.0216	0.0073	0.0309	0.0075	-0.005	0.0076
182													
183													
184													
185													
186													
187													
188													
189													
190				16.2									
191				16.8									
192													
193				18.5									
194													
195													
196													
197													
198													
199													
200													
201													
202		0.0977	-0.03	37.8		-0.005	-0.03	0.0517	0.0094	0.0388	0.008	-0.005	0.008
203													
204													
205													
206													
207													
208													
209													
210													
211													
212													
213													
214				17.4									
215				17.5									
216	25.5	0.134	0.0259	19.5		1.05	0.0366						

Row number	Indium (μg/l)	Sb (μg/l)	Cs (μg/l)	Ba (μg/l)	La (μg/l)	Hf (μg/l)	Tl (μg/l)	Ce (μg/l)	Pr (μg/l)	Nd (μg/l)	Sm (μg/l)	Eu (μg/l)	Gd (μg/l)
217	10.9	0.14	0.02	18.9	0.0099	0.943	0.038	0.0131	-0.005	0.0111	-0.005	-0.005	-0.005
218													
219													
220													
221													
222													
223													
224	19.9	0.104	0.025	14.3	0.0101	-0.005	0.0705	0.0124	-0.005	0.0095	-0.005	-0.005	-0.005
225	19.3	0.087	0.018	13.2	0.0117	-0.005	0.0225	0.017	-0.005	0.0108	-0.005	-0.005	-0.005
226													
227													
228													
229													
230													
231													
232													
233													
234													
235													
236													
237													
238													
239													
240													
241													
242				18.2									
243				18.4									
244	12	0.139	0.023	19.9	0.0096	1.33	0.039	0.0112	-0.005	0.0094	-0.005	-0.005	-0.005
245	11.8	0.136	0.023	24.1	0.0087	1.24	0.035	0.014	-0.005	0.009	-0.005	-0.005	-0.005
246													
247													
248													
249													
250													
251													
252	18.8	0.089	0.031	20.4	0.0092	-0.005	0.0497	0.0117	-0.005	0.0089	-0.005	-0.005	-0.005
253	18.4	0.106	0.016	15.1	0.0084	-0.005	0.0385	0.0083	-0.005	0.0097	-0.005	-0.005	-0.005
254													
255													
256													
257													
258													
259													
260		0.0879	-0.1	20		-0.02	-0.1	0.0386	-0.02	0.0293	-0.02	-0.02	-0.02
261		0.0837	-0.1	21.1		-0.02	-0.1	0.0269	-0.02	-0.02	-0.02	-0.02	-0.02
262													
263													
264													
265													
266													
267													
268													
269													
270													

Row number	Indium (μg/l)	Sb (μg/l)	Cs (μg/l)	Ba (μg/l)	La (μg/l)	Hf (μg/l)	Tl (μg/l)	Ce (μg/l)	Pr (μg/l)	Nd (μg/l)	Sm (μg/l)	Eu (μg/l)	Gd (μg/l)
271													
272													
273													
274				21.9									
275				22									
276	16.3	0.153	0.023	21.6	0.0169	2.03	0.05	0.0273	-0.005	0.015	-0.005	-0.005	-0.005
277	16.1	0.151	0.02	21.4	0.0295	1.94	0.053	0.0356	0.0072	0.0271	0.0052	-0.005	0.0054
278													
279													
280													
281													
282													
283													
284	21.1	0.091	0.013	18.1	0.0287	-0.005	0.0548	0.0354	0.0063	0.0242	-0.005	-0.005	-0.005
285	20.9	0.092	0.013	17.3	0.0243	-0.005	0.0269	0.0284	0.0053	0.018	-0.005	-0.005	-0.005
286													
287													
288													
289													
290													
291													
292													
293													
294													
295				20.2									
296	15	0.133	0.02	21	0.0242	1.27	0.046	0.0274	0.0057	0.022	-0.005	-0.005	-0.005
297													
298													
299													
300	18.7	0.095	0.013	16	0.0175	-0.005	0.0293	0.0208	-0.005	0.0158	-0.005	-0.005	-0.005
301													
302													
303													
304		0.116	-0.1	21		-0.02	-0.1	0.162	0.03	0.126	-0.02	-0.02	-0.02
305													
306													
307													
308													
309	15.2		0.0356	15.8	0.0619	0.0031	0.0099	0.09	0.0145	0.0637	0.011	0.0013	
310	15.3		0.0351	14.7	0.0786	0.0031	0.0102	0.104	0.0168	0.0688	0.0123	0.0018	
311		0.0836	-0.1	19.1		-0.02	-0.1	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
312		0.0738	-0.1	19.1		-0.02	-0.1	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
313													
314													
315													
316													
317													
318	14.7		0.0389	15.8	0.0912	0.005	0.0103	0.138	0.0217	0.084	0.0163	0.0022	
319	14.7		0.0322	14.9	0.0482	0.0022	0.0089	0.0687	0.0123	0.0503	0.0098	-0.001	
320													
321													
322													
323	14.3		0.0332	15.2	0.84	0.0308	0.0098	1.26	0.19	0.717	0.135	0.0205	
324	21.1		0.0413	15.4	0.898	0.033	0.0103	1.38	0.206	0.78	0.147	0.0213	

Row number	Indium (µg/l)	Sb (µg/l)	Cs (µg/l)	Ba (µg/l)	La (µg/l)	Hf (µg/l)	Tl (µg/l)	Ce (µg/l)	Pr (µg/l)	Nd (µg/l)	Sm (µg/l)	Eu (µg/l)	Gd (µg/l)
325													
326													
327													
328													
329	10.2		0.0061	19.3	0.0863	0.0228	0.0044	0.108	0.0305	0.113	0.0252	0.0039	
330													
331													
332													
333													
334				26.9									
335													
336													
337													
338				32.4									
339													
340													
341													
342													
343													
344													
345													
346													
347													
348				22.6									
349													
350													
351													
352													
353				21.6									
354													
355													
356													
357				36.2									
358													
359													
360													
361													
362													
363													
364													
365													
366													
367				23.6									
368													
369													
370													
371				28.4									
372													
373													
374													
375				26.6									
376													
377													
378													

Row number	Indium (µg/l)	Sb (µg/l)	Cs (µg/l)	Ba (µg/l)	La (µg/l)	Hf (µg/l)	Tl (µg/l)	Ce (µg/l)	Pr (µg/l)	Nd (µg/l)	Sm (µg/l)	Eu (µg/l)	Gd (µg/l)
379													
380													
381													
382													
383													
384													
385				26.4									
386													
387													
388													
389				27.2									
390													
391													
392													
393				34.6									
394													
395													
396													
397													
398													
399													
400													
401				14.4									
402													
403													
404													
405				19.1									
406													
407													
408													
409													
410													
411													
412													
413				27.9									
414													
415													
416													
417				31									
418													
419													
420													
421													
422													
423													
424													
425													
426													
427													
428													
429													
430													
431													
432				50.7									

Row number	Indium (μg/l)	Sb (μg/l)	Cs (μg/l)	Ba (μg/l)	La (μg/l)	Hf (μg/l)	Tl (μg/l)	Ce (μg/l)	Pr (μg/l)	Nd (μg/l)	Sm (μg/l)	Eu (μg/l)	Gd (μg/l)
433													
434													
435													
436													
437													
438													
439													
440													
441													
442													
443													
444													
445													
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458													
459													
460													
461													
462													
463													
464													
465													
466													
467													

Row number	Tb (µg/l)	Dy (µg/l)	Ho (µg/l)	Er (µg/l)	Tm (µg/l)	Yb (µg/l)	Lu (µg/l)	PMC (pmc)	C13 (permil)	AGE_BP (years)	D (dev, SMOW)	Tr (TU)	O18 (dev, SMOW)	Ra226 (bq/l)
1								50.7	-13.7	5400	-70	5.2	-9.9	
2														
3														
4												-0.8		
5												-0.8		
6												0.8		
7												-0.8		
8												-0.8		
9											-89.9		-11.72	
10											-82.1	11.2	-11.4	
11											-83	10.6	-11.4	
12														
13														
14														
15														
16														
17														
18														
19														
20								46.3	-10.2	6135	-64.2	3.7	-9.5	
21								45.2	-10.2	6325	-64.6	3.3	-9.4	
22														
23														
24														
25								85.3	-14.9	1225	-79.6	12	-11.8	
26											-84.5		-11.7	
27											-83.9		-11.7	
28											-84.6		-11.7	
29											-78.2	-0.8	-10.2	
30											-78.1	-0.8	-10.2	
31											-75	-0.8	-10.3	
32														
33														
34														
35														
36														
37														
38														
39								90.2	-15.6	775	-90.6	15.3	-10.9	
40	0.0547	0.365	0.0815	0.213	0.0347	0.22	0.0358				-76.3	-6	-10.8	1.00E-01
41											-80.3	13.3	-11.1	
42								85.3	-15.8	1225	-95.2	13.7	-11.8	
43	0.0848	0.55	0.125	0.361	0.0587	0.398	0.066				-83.5	13	-11.9	5.00E-01
44											-84	11.7	-11.9	
45								69.1	-11.4	2915	-82.3	24.9	-9	
46	0.0056	0.0368	0.008	0.0223	0.0029	0.0176	0.0032				-76.3	-6	-9.7	-1.00E-01
47											-74.9	17.9	-9.9	
48											-84.3	11	-12	
49														
50														
51														
52														
53											-88.2	11.2	-13.3	
54											-102.1		-14.5	

Row number	Tb (µg/l)	Dy (µg/l)	Ho (µg/l)	Er (µg/l)	Tm (µg/l)	Yb (µg/l)	Lu (µg/l)	PMC (pmc)	C13 (permil)	AGE_BP (years)	D (dev, SMOW)	Tr (TU)	O18 (dev, SMOW)	Ra226 (bq/l)
55														
56														
57														
58														
59														
60			0.006	0.0184	0.0028	0.0183	0.0031	109.4	-14		-90.4	11.3	-12	
61														
62														
63														
64														
65														
66								116.1	-12.5		-77.8	12.5	-9.6	
67								115.6	-11.6		-69.7	13.7	-9.8	
68														
69														
70														
71								118.4	-8.2		-68.4	14.7	-9.2	
72														
73	-0.05	0.0181	-0.005	0.0132	-0.005	0.0131	-0.005				-83.1	11.7	-11.8	0.00E+00
74														
75														
76			0.0059	0.0197	0.003	0.0216	0.0038	109.1	-12		-88.8	12.6	-11.7	
77			0.0062	0.02	0.0032	0.0215	0.0039	108.8	-12		-90	12.1	-12	
78														
79														
80														
81														
82														
83														
84														
85														
86														
87														
88								114.2	-11.7		-77	13.6	-9.4	
89								113.5	-12.5		-78.2	16	-9.4	
90								113.6	-11		-68.6	15.6	-9.7	
91								114.9	-11.4		-68.5	12.5	-9.8	
92														
93														
94														
95														
96														
97														
98								113.6	-9		-64.2	11.6	-8.3	
99								114.2	-8.1		-63.5	10.4	-8.2	
100														
101														
102	-0.05	0.02	-0.005	0.0173	-0.005	0.018	-0.005				-77.4	12.2	-10.5	5.00E-01
103	-0.05	0.0221	0.0052	0.0186	-0.005	0.0203	-0.005				-80.2	10.1	-11	1.00E-01
104														
105														
106														
107			0.0077	0.0241	0.0038	0.0262	0.0038	109.9	-10		-84.8	11.7	-10.7	
108														

Row number	Tb (μg/l)	Dy (μg/l)	Ho (μg/l)	Er (μg/l)	Tm (μg/l)	Yb (μg/l)	Lu (μg/l)	PMC (pmc)	C13 (permil)	AGE_BP (years)	D (dev, SMOW)	Tr (TU)	O18 (dev, SMOW)	Ra226 (bq/l)
109														
110														
111														
112														
113								112.1	-10.9		-60.6	14.1	-6	
114								112.2	-9.7		-53.4	8.2	-5.9	
115														
116														
117														
118														
119	-0.05	0.0256	0.0053	0.0184	-0.005	0.0179	-0.005				-64.4	13.9	-7.9	2.00E-01
120														
121														
122														
123														
124			0.008	0.0249	0.0036	0.0252	0.0039	110.7	-10		-82.8	12.6	-10.8	
125			0.0085	0.0252	0.0036	0.0257	0.0044	111.1	-10		-82.8	13	-10.8	
126														
127														
128														
129														
130														
131														
132														
133														
134														
135														
136								113.8	-9.9		-63.5	13.2	-6.8	
137								113.4	-9		-64.3	15.6	-6.7	
138								112.3	-9.8		-55.8	8.4	-6.3	
139								112.6	-8.1		-54.8	11.7	-6.4	
140														
141														
142														
143														
144														
145														
146								109.1	-3		-52.3	10.4	-6	
147														
148														
149	-0.05	0.0167	-0.005	0.0128	-0.005	0.0119	-0.005				-77.4	11.5	-10.8	0.00E+00
150	-0.05	0.0245	0.0052	0.0172	-0.005	0.0178	-0.005				-66.9	9.8	-8.4	0.00E+00
151														
152														
153														
154														
155														
156			0.0077	0.0229	0.0035	0.0257	0.0042	116.3	-7		-77.3	12.5	-9.8	
157			0.0074	0.0221	0.0038	0.0258	0.0042	116.2	-8		-77.5	13.2	-9.8	
158														
159														
160														
161														
162														

Row number	Tb (μg/l)	Dy (μg/l)	Ho (μg/l)	Er (μg/l)	Tm (μg/l)	Yb (μg/l)	Lu (μg/l)	PMC (pmc)	C13 (permil)	AGE_BP (years)	D (dev, SMOW)	Tr (TU)	O18 (dev, SMOW)	Ra226 (bq/l)
163														
164														
165														
166														
167														
168								113.5	-8.6		-72.3	15.5	-7.1	
169								116.2	-8.3		-72.4	12.7	-7	
170								112.9	-9		-57.9	6.9	-6.7	
171								113.2	-8.8		-57.8	8.9	-6.8	
172														
173														
174														
175														
176														
177														
178														
179														
180	-0.05	0.0061	-0.005	-0.005	-0.005	0.0057	-0.005				-61.5	12.7	-7.1	2.00E-01
181	-0.05	0.0095	-0.005	0.0073	-0.005	0.0084	-0.005				-61.8	13.5	-7.2	0.00E+00
182														
183														
184														
185														
186														
187														
188														
189														
190								110	-8.8		-63.2	8.7	-5	
191								109.7	-8.3		-62.4	13.1	-8.1	
192								110.8	-6		-44.3	7.6	-4.5	
193								108.8	-6.9		-46.3	6.1	-4.6	
194														
195														
196														
197														
198														
199														
200														
201														
202	-0.05	0.0102	-0.005	0.0089	-0.005	0.0096	-0.005				-61.9	11.6	-7.2	2.00E-01
203														
204														
205														
206														
207														
208														
209														
210														
211														
212														
213														
214								110.9	-2.1		-66.1	10.6	-8.1	
215								109	-2.9		-67.8	17.3	-7.7	
216								107.6	-4		-64.1	15.9	-8.5	

Row number	Tb (μg/l)	Dy (μg/l)	Ho (μg/l)	Er (μg/l)	Tm (μg/l)	Yb (μg/l)	Lu (μg/l)	PMC (pmc)	C13 (permil)	AGE_BP (years)	D (dev, SMOW)	Tr (TU)	O18 (dev, SMOW)	Ra226 (bq/l)
217	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	108.5	-3.6		-62.4	11.7	-8.5	
218														
219														
220														
221														
222														
223														
224	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005				-61.3	15.6	-8.2	1.00E-01
225	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	109.6	-3.6		-61.6	15.3	-8.2	-1.00E-01
226														
227														
228														
229														
230														
231														
232														
233														
234														
235														
236														
237														
238														
239														
240														
241														
242								105.4	-5.2		-65.1	17.4	-7.8	
243								105.7	-4.9		-65.7	17.4	-8	
244	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	107.8	-6.1		-61.6	18.6	-8.2	
245	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	109.1	-5		-62.6	18.1	-8.4	
246														
247														
248														
249														
250														
251														
252	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	110.4	-4		-61.8	16	-8.1	
253	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	111.1	-3.1		-61.6	17.1	-8.1	-1.00E-01
254														
255														
256														
257														
258														
259														
260	-0.3	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02				-60.9	13.9	-8.5	1.00E-01
261	-0.3	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02				-65.1	17.5	-8.5	4.00E-01
262														
263														
264														
265														
266														
267														
268														
269														
270														

Row number	Tb (µg/l)	Dy (µg/l)	Ho (µg/l)	Er (µg/l)	Tm (µg/l)	Yb (µg/l)	Lu (µg/l)	PMC (pmc)	C13 (permil)	AGE_BP (years)	D (dev, SMOW)	Tr (TU)	O18 (dev, SMOW)	Ra226 (bq/l)
271														
272														
273														
274								108	-8.9		-63.7	11.6	-7.6	
275								108.7	-8.3		-64.1	12.2	-7.6	
276	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	107.1	-10.7		-61.5	17	-8	
277	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	106.1	-10.9		-60.4	17.8	-8	
278														
279														
280														
281														
282														
283														
284	-0.005	0.0056	-0.005	-0.005	-0.005	-0.005	-0.005	108.3	-4.8		-60.1	15	-7.8	-1.00E-01
285	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	109.1	-4		-60.2	14.2	-8	2.00E-01
286														
287														
288														
289														
290														
291														
292														
293														
294														
295								109.1	-6.6		-72.5	14.1	-7.9	
296	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	106.6	-9.4		-60.7	11.4	-8.1	
297														
298														
299														
300	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	-0.005	108.9	-4.2		-60.9	16.6	-8.1	1.00E-01
301														
302														
303														
304	-0.3	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02				-67.5	12.2	-8.8	1.00E-01
305														
306														
307														
308														
309			0.0037	0.0072	0.0012	0.0076	0.0012	109.4	-3		-64.5	15.9	-8.2	
310			0.0035	0.0079	0.0013	0.0092	0.0027	108.7	-2		-65.1	19.3	-8.2	
311	-0.3	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02				-64.1	12.6	-8.3	1.00E-01
312	-0.3	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02				-64.1	16.6	-8.3	4.00E-01
313														
314														
315														
316														
317														
318			0.004	0.0102	0.0016	0.0095	0.0018	110.1	-3		-65.1	16.1	-8.2	
319			0.0031	0.0073	-0.001	0.0067	0.0012	110.1	-3		-64.8	13.9	-8.1	
320														
321														
322														
323			0.0237	0.0697	0.0099	0.0635	0.01	100.1	-15		-83.5	11.2	-11	
324			0.0256	0.0738	0.0106	0.0666	0.0112	95.6	-14	310	-82.4	11.7	-11	

Row number	Tb (µg/l)	Dy (µg/l)	Ho (µg/l)	Er (µg/l)	Tm (µg/l)	Yb (µg/l)	Lu (µg/l)	PMC (pmc)	C13 (permil)	AGE_BP (years)	D (dev, SMOW)	Tr (TU)	O18 (dev, SMOW)	Ra226 (bq/l)
325														
326														
327														
328														
329			0.0064	0.0197	0.0031	0.0201	0.0034	106.8	-13		-89.7	10.5	-12	
330														
331														
332														
333														
334								113.1	-12.9		-77.7	13	-9.5	
335								113.6	-12.1		-67.9	14.2	-9.7	
336														
337														
338											-78.3	11.8	-11	
339														
340														
341														
342								111.8	-9		-82.9	13	-10.8	
343														
344														
345														
346														
347														
348								111.3	-12		-62.6	12.2	-6.3	
349								109.7	-9.4		-53.8	6.7	-6	
350														
351														
352														
353								112.6	-3.6		-50.1	14.2	-5.5	
354														
355														
356														
357											-62.2	13.7	-7.4	
358														
359														
360														
361								111.1	-12		-86.2	10.7	-11.2	
362														
363														
364														
365														
366														
367								113.5	-14.1		-79.9	11	-8.8	
368								113.6	-14.3		-68.7	8.5	-9.3	
369														
370														
371								115.5	-12.1		-73.4	12.8	-10.5	
372														
373														
374														
375											-74.9	13.6	-10	
376														
377														
378														

Row number	Tb (μg/l)	Dy (μg/l)	Ho (μg/l)	Er (μg/l)	Tm (μg/l)	Yb (μg/l)	Lu (μg/l)	PMC (pmc)	C13 (permil)	AGE_BP (years)	D (dev, SMOW)	Tr (TU)	O18 (dev, SMOW)	Ra226 (bq/l)
379								112.8	-20		-91.4	10.9	-12.1	
380														
381														
382														
383														
384														
385								116.1	-14.2		-85.5	11	-10.2	
386								114.6	-13.5		-71.5	10.1	-9.8	
387														
388														
389								116.2	-11.3		-73.4	11.2	-10.3	
390														
391														
392														
393											-87.4	13.9	-11.7	
394														
395														
396														
397								117.2	-9		-76.8		-9.7	
398														
399														
400														
401								114.1	-10.9		-65.3	12.4	-7.1	
402								113	-10.9		-58.5	6.6	-6.9	
403														
404														
405											-62.6	15.4	-7.4	
406														
407														
408														
409								93.3	-15	505	-93.4		-12.6	
410														
411														
412														
413								95.5	-16.3	315	-86.2	11.9	-11.4	
414								100.8	-16.1		-78.5	5.3	-11.2	
415														
416														
417											-86.2	13.3	-12.1	
418														
419														
420														
421								108.8	-9		-78.7	10.2	-10.1	
422														
423														
424														
425														
426														
427								111.1	-17		-65.3	12.8	-5.8	
428								109.6	-15.1		-51.5	10.4	-5.6	
429								109.9	-19.5		-63	12.1	-8.4	
430														
431														
432											-70.6	13.8	-9.2	

Row number	Tb (µg/l)	Dy (µg/l)	Ho (µg/l)	Er (µg/l)	Tm (µg/l)	Yb (µg/l)	Lu (µg/l)		PMC (pmc)	C13 (permil)	AGE_BP (years)	D (dev, SMOW)	Tr (TU)	O18 (dev, SMOW)	Ra226 (bq/l)
433															
434															
435															
436									100.6	-13		-89.2	10.3	-11.9	
437															
438															
439															
440															
441															
442															
443															
444															
445															
446															
447															
448															
449															
450															
451															
452															
453															
454															
455															
456															
457															
458															
459															
460															
461															
462															
463															
464															
465															
466															
467															

	ISOTOPES											
Row number	Ra228 (bq/l)	Rn222 (bq/l)	U238 (mbq/kg)	U235 (mbq/kg)	U234 (mbq/kg)	Th232 (mbq/kg)	Th230 (mbq/kg)	Th228 (mbq/kg)	B10	S34 (dev, SMOW)	Cl37	Sr87
1											-0.16	
2												
3												
4												
5												
6									0.24			
7									0.23			
8									0.24			
9									0.24			
10										13.9		0.72
11										15.4		0.72
12									0.24			
13									0.24			
14									0.24			
15												
16												
17												
18												
19												
20											0.19	
21											0.14	
22												
23												
24												
25											0.58	
26										14.9		0.72
27										14.9		0.72
28										14.8		0.72
29									0.24	24.6		0.72
30									0.24	24.5		0.72
31									0.24	24.6		0.72
32									0.24			
33									0.24			
34									0.24			
35									0.24			
36									0.24			
37									0.24			
38												
39											-0.10	
40		2.80E+01	100	-30	100	-50	-50		0.19	10.4		0.72
41												
42											-0.48	
43		4.70E+01	400	-30	400	-50	-50		0.19	6.1		0.72
44												
45											0.26	
46		2.60E+01	100	-30	100	-50	-50		0.19	-2.4		0.72
47												
48												
49												
50												
51												
52												
53												
54												

	ISOTOPES											
Row number	Ra228 (bq/l)	Rn222 (bq/l)	U238 (mbq/kg)	U235 (mbq/kg)	U234 (mbq/kg)	Th232 (mbq/kg)	Th230 (mbq/kg)	Th228 (mbq/kg)	B10	S34 (dev, SMOW)	Cl37	Sr87
55												
56												
57												
58												
59												
60												
61												
62												
63												
64												
65												
66											0.66	
67											0.35	
68												
69												
70												
71										6.6		0.72
72												
73		6.00E-01	70	-50	70	-50	-50		0.24	0.2		0.72
74												
75												
76											0.11	
77											0.22	
78												
79												
80												
81												
82												
83												
84												
85												
86												
87												
88											0.33	
89											0.46	
90											0.38	
91											0.24	
92												
93												
94												
95												
96												
97												
98										5.5		0.72
99										6		0.72
100												
101												
102		8.00E-01	60	-50	60	-50	-50		0.24	-1		0.72
103		4.00E-01	-50	-50	-50	-50	-50		0.24	-0.5		0.72
104												
105												
106												
107											0.15	
108												

	ISOTOPES											
Row number	Ra228 (bq/l)	Rn222 (bq/l)	U238 (mbq/kg)	U235 (mbq/kg)	U234 (mbq/kg)	Th232 (mbq/kg)	Th230 (mbq/kg)	Th228 (mbq/kg)	B10	S34 (dev, SMOW)	Cl37	Sr87
109												
110												
111												
112												
113											-0.33	
114											-0.07	
115												
116												
117												
118												
119		0.00E+00	60	-50	60	-50	-50		0.24	7.9		0.72
120												
121												
122												
123												
124											0.11	
125											0.08	
126												
127												
128												
129												
130												
131												
132												
133												
134												
135												
136											-0.38	
137											0.01	
138											0.06	
139											0.01	
140												
141												
142												
143												
144												
145												
146										10.3		0.72
147												
148												
149		1.00E-01	-50	-50	-50	-50	-50		0.24	6.3		0.72
150		0.00E+00	-50	-50	-50	-50	-50		0.28	6.2		0.72
151												
152												
153												
154												
155												
156												
157												
158												
159												
160												
161												
162												

	ISOTOPES										
Row number	Ra228 (bq/l)	Rn222 (bq/l)	U238 (mbq/kg)	U235 (mbq/kg)	U234 (mbq/kg)	Th232 (mbq/kg)	Th230 (mbq/kg)	Th228 (mbq/kg)	B10	S34 (dev, SMOW)	Cl37	Sr87
163												
164												
165												
166												
167												
168												
169											-0.01	
170											-0.15	
171												
172												
173												
174												
175												
176												
177												
178												
179												
180		3.00E-01	-50	-50	-50	-50	-50		0.24	3.4		0.72
181		0.00E+00	50	-50	50	-50	50		0.24			0.72
182												
183												
184												
185												
186												
187												
188												
189												
190											0.18	
191											-0.03	
192											-0.01	
193											-0.10	
194												
195												
196												
197												
198												
199												
200												
201												
202		3.00E-01	-50	-50	-50	-50	-50		0.24	-0.4		0.72
203												
204												
205												
206												
207												
208												
209												
210												
211												
212												
213												
214											-0.36	
215											-0.39	
216											0.01	

	ISOTOPES											
Row number	Ra228 (bq/l)	Rn222 (bq/l)	U238 (mbq/kg)	U235 (mbq/kg)	U234 (mbq/kg)	Th232 (mbq/kg)	Th230 (mbq/kg)	Th228 (mbq/kg)	B10	S34 (dev, SMOW)	Cl37	Sr87
217											0.10	
218												
219												
220												
221												
222												
223												
224		1.00E-01	-50	-50	-50	-50	-50			21.4		0.71
225		3.00E-01	50	-50	50	-50	-50			20.8		0.71
226												
227												
228												
229												
230												
231												
232												
233												
234												
235												
236												
237												
238												
239												
240												
241												
242											-0.05	
243											-0.24	
244												
245												
246												
247												
248												
249												
250												
251												
252			-50	-50	-50	-50	-50		0.19	20.7	0.14	0.71
253		1.00E-01	50	-50	50	-50	-50		0.19	21	0.01	0.71
254												
255												
256												
257												
258												
259												
260		6.00E-01	-50	-50	-50	-50	-50		0.24	19.8		0.71
261		6.00E-01	-50	-50	-50	-50	-50		0.24	20		0.71
262												
263												
264												
265												
266												
267												
268												
269												
270												

	ISOTOPES											
Row number	Ra228 (bq/l)	Rn222 (bq/l)	U238 (mbq/kg)	U235 (mbq/kg)	U234 (mbq/kg)	Th232 (mbq/kg)	Th230 (mbq/kg)	Th228 (mbq/kg)	B10	S34 (dev, SMOW)	Cl37	Sr87
271												
272												
273												
274											-0.07	
275											0.01	
276											0.12	
277											0.04	
278												
279												
280												
281												
282												
283												
284		1.00E-01	100	-50	100	-50	100		0.19	20.6	0.11	0.71
285		2.00E-01	-50	-50	-50	-50	-50		0.19	21	0.00	0.71
286												
287												
288												
289												
290												
291												
292												
293												
294												
295											-0.39	
296											0.07	
297												
298												
299												
300		1.00E-01	-50	-50	-50	-50	-50		0.19	21	-0.01	0.71
301												
302												
303												
304		3.00E-01	-50	-50	-50	-50	-50		0.24	18.9		0.71
305												
306												
307												
308												
309											0.05	
310											-0.09	
311		3.00E-01	-50	-50	-50	-50	-50		0.24	20.2		0.71
312		6.00E-01	-50	-50	-50	-50	-50		0.24	19.9		0.71
313												
314												
315												
316												
317												
318											0.06	
319											0.05	
320												
321												
322												
323											0.15	
324											0.23	

	ISOTOPES											
Row number	Ra228 (bq/l)	Rn222 (bq/l)	U238 (mbq/kg)	U235 (mbq/kg)	U234 (mbq/kg)	Th232 (mbq/kg)	Th230 (mbq/kg)	Th228 (mbq/kg)	B10	S34 (dev, SMOW)	Cl37	Sr87
325												
326												
327												
328												
329												
330												
331												
332												
333												
334											0.85	
335											0.47	
336												
337												
338												
339												
340												
341												
342												
343												
344												
345												
346												
347												
348											-0.45	
349											-0.04	
350												
351												
352												
353									0.19	10.4	0.12	0.72
354												
355												
356												
357												
358												
359												
360												
361											0.16	
362												
363												
364												
365												
366												
367											0.08	
368											-0.05	
369												
370												
371									0.19	9	0.12	0.72
372												
373												
374												
375												
376												
377												
378												

	ISOTOPES											
Row number	Ra228 (bq/l)	Rn222 (bq/l)	U238 (mbq/kg)	U235 (mbq/kg)	U234 (mbq/kg)	Th232 (mbq/kg)	Th230 (mbq/kg)	Th228 (mbq/kg)	B10	S34 (dev, SMOW)	Cl37	Sr87
379											0.09	
380												
381												
382												
383												
384												
385											0.13	
386											-0.03	
387												
388												
389									0.19	8.9	0.09	0.72
390												
391												
392												
393												
394												
395												
396												
397												
398												
399												
400												
401											0.51	
402											0.35	
403												
404												
405												
406												
407												
408												
409												
410												
411												
412												
413											1.94	
414											0.29	
415												
416												
417												
418												
419												
420												
421												
422												
423												
424												
425												
426												
427											0.49	
428											-0.09	
429										-2.1		0.72
430												
431												
432												

	ISOTOPES											
Row number	Ra228 (bq/l)	Rn222 (bq/l)	U238 (mbq/kg)	U235 (mbq/kg)	U234 (mbq/kg)	Th232 (mbq/kg)	Th230 (mbq/kg)	Th228 (mbq/kg)	B10	S34 (dev, SMOW)	Cl37	Sr87
433												
434												
435												
436											0.06	
437												
438												
439												
440												
441												
442												
443												
444												
445												
446												
447												
448												
449												
450												
451												
452												
453												
454												
455												
456												
457												
458												
459												
460									0.24			
461									0.24			
462												
463												
464												
465												
466												
467												

	BIOCHEMISTRY DATA											
Row number	Nh4n (mg/l)	No2n (mg/l)	No3 N No2 N (mg/l)	No3n (mg/l)	N Tot (mg/l)	P Tot (mg/l)	Po4 P (mg/l)	Pop (mg/l)	Pon (mg/l)	Sio2 Si (mg/l)	Chlorophyll A (ug/l)	Chlorophyll C (ug/l)
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
32												
33												
34												
35												
36												
37												
38												
39	0.17		0.0511		1.178	0.0484	0.0174	0.0188	0.0298	4.75		
40												
41	0.17396	0.00278	0.06863		1.25	0.04645	0.01536	7.74965	0.00862	4.746		
42	0.26				0.557	0.118	0.0044	0.0426	0.0398	1.93		
43												
44	0.08998	0.00113	0.00772		0.50876	0.18775	0.00249		0.05468	4.244		
45	0.222				0.711	3.04	0.018	1.07		7.23		
46	0.2		0.028		0.5679	0.0631	0.0109	0.0196	0.0046	3.624		
47	0.14579	0.00204	0.00696		0.55395	0.05387	0.01142	42.23568	0.00813	7.822		
48	0.01253	0.00166	0.03935				0.00516	20.4691	0.03401	2.808		
49												
50												
51												
52												
53	0.27163	0.00023	0.35342		0.71218	0.00593	0.00136			0.002		
54												

BIOCHEMISTRY DATA

Row number	Nh4n (mg/l)	No2n (mg/l)	No3 N No2 N (mg/l)	No3n (mg/l)	N Tot (mg/l)	P Tot (mg/l)	Po4 P (mg/l)	Pop (mg/l)	Pon (mg/l)	Sio2 Si (mg/l)	Chlorophyll A (ug/l)	Chlorophyll C (ug/l)
55												
56												
57	0.006		0.027		0.581	0.008	-0.001	0.034	0.031	4.399	1.1	-0.5
58	0.007		0.006		0.332	0.006	0.001	0.004	0.028	2.161	4.4	0.7
59	0.005		0.007		0.531	0.007	0.002	0.013	0.003	3.758		
60	0.041		0.0027		0.535	0.0069	0.0014	0.0029	0.0112	3.871	-0.5	-0.5
61	0.00287	0.002	0.0266	-0.01	0.727	0.00995	0.00154	0.00431	0.0331	2.88	0.85	-0.5
62	0.00301		0.00337		0.87947	0.01683	0.00229	0.00859	0.07542	3.695	4	0.61
63	0.0031		0.0089		0.684	0.0087	0.0021	0.0047	0.0413	3.595	0.9	-0.5
64	0.00241		0.00368		1.05	0.0161	0.00368	0.00881	0.0871	4.21	4.03	-0.5
65	0.007		0.0039		0.863	0.0115	0.0018	0.004	0.0384	2.85	1.3	-0.5
66	0.00166		0.00064		0.8659	0.00996	0.00182	0.00372	0.02192	3.58	0.59	-0.5
67					0.895	0.0081		0.0025	0.0218		0.9	-0.5
68	0.0024		0.002				0.0018	0.0044		6.88	2.5	-0.5
69	0.0063		0.0006		0.985	0.0092	0.0022	0.0036	0.042	8.78	2.7	-0.5
70	0.0099		0.0008		0.951	0.0092	0.0021	0.00384	0.0369	8.18	1.7	-0.5
71	0.00674	0.00039	0.00995		0.89657	0.00707	0.00198	0.00355	0.0661	7.44	2.2	-0.5
72	0.00468	0.00117	0.09689		0.85235	0.00582	0.00225	0.00162	0.01159	4.796	-0.5	-0.5
73	0.1169	0.0035	0.047		1.2939	0.0122	0.0018	0.0055	0.0464	6.829	5.6	-0.5
74	0.0145		0.0322		0.8118	0.0072	0.0012	0.0013	0.0111	5.996	-0.5	-0.5
75	-0.01		0.028		0.839	0.018	0.002	0.074	0.067	5.591	2.5	-0.5
76	0.068		0.0009		0.551	0.01	0.0011	0.0045	0.0225	3.63	0.9	-0.5
77	0.059		0.0022		0.551	0.0097	0.0013	0.0048	0.0262	3.473	1	-0.5
78												
79	0.0039		0.0036		0.671	0.0113	0.0022	0.0077	0.0502	2.87	3.8	-0.5
80	0.00179	0.002	0.00978	-0.01	0.763	0.0165	0.00246	0.00948	0.0655	2.555	2.13	-0.5
81	0.0117		0.00107		0.752	0.0154	0.0025	0.0096	0.0773	2.828	2.32	-0.5
82	0.00486		0.00309		0.87318	0.0187	0.00338	0.00906	0.06723	2.733	6.64	1.08
83	0.00581		0.00112		0.90893	0.02314	0.00353	0.00952	0.08148	2.717	6.3	0.82
84	0.01086	0.002	0.00177	-0.01	0.97259	0.01538	0.00517	0.00494	0.0458	3.47	0.83	-0.5
85	0.0173		0.00396		1.00017	0.01706	0.00396	0.01182	0.09134	3.56	0.55	-0.5
86	0.011	-0.001	0.0041	-0.01	0.886	0.0133	0.0023	0.0048	0.0416	4.73	1.8	-0.5
87	0.0154		0.0041		0.893	0.0146	0.0022	0.006	0.0451	4.76	1.6	-0.5
88	0.00294		0.0019		0.87597	0.0141	0.00261	0.00806	0.05702	4.22	2.23	-0.5
89	0.01597		0.00092		0.92798	0.01339	0.00231	0.00782	0.05707	4.33	5.73	0.47
90	0.002		0.0018		0.897	0.0101	0.0019	0.0044	0.0414	6.22	2.1	-0.5
91	0.0065		0.0017		0.948	0.0121	0.002	0.0046	0.0578	6.53	2.4	-0.5
92	0.0067		0.0011				0.0021	0.0045		9.99	2.2	-0.5
93	0.0049		0.0002				0.0018	0.0044		10.22	2.1	-0.5
94	0.0093		0.0007		0.939	0.0097	0.0023	0.004	0.047	10.45	2	-0.5
95	0.0108		0.0008		0.957	0.0116	0.003	0.0049	0.051	10.49	1.5	-0.5
96	0.0113		0.0013		0.938	0.0086	0.0019	0.00337	0.0589	9.49	1.3	-0.5
97	0.0104		0.0008		0.921	0.0093	0.0017	0.00374		10.01	2.9	-0.5
98	0.00637	0.0003	0.00326		0.99158	0.00702	0.00125	0.00362	0.04497	9.6	2.5	-0.5
99	0.19925	0.00039	0.00224		1.16	0.00784	0.00246	0.00382	0.04691	9.59	2.1	-0.5
100	0.02043	0.00287	0.0732		0.83742	0.00709	0.00168	0.00372	0.02238	5.393	-0.5	-0.5
101	0.0444	0.00427	0.03937		0.85063	0.00816	0.00207	0.00528	0.04378	6.78	0.78	-0.5
102	0.1678	0.001	0.0059		1.231	0.012	0.0027	0.0052	0.0444	9.325	0.5	-0.5
103	0.1799	0.0014	0.0272		1.1809	0.009	0.0024	0.0055	0.0351	8.827	0.7	0.6
104	0.0373		0.0104		0.9903	0.0104	0.001	0.0042	0.0324	7.499	0.7	-0.5
105	0.2577		0.0039		1.25	0.0112	0.0014	0.0039	0.0358	9.016	1	-0.5
106	0.075		0.031		0.992	0.013	-0.001	0.007	0.089	4.43	0.5	-0.5
107	0.089		0.0016		0.712	0.0122	0.0012	0.0064	0.0333	1.929	0.9	-0.5
108	0.0144		0.0765		0.795	0.0162	0.0047	0.0091	0.0476	1.34	1.7	-0.5

										BIOCHEMISTRY DATA		
Row number	Nh4n (mg/l)	No2n (mg/l)	No3 N No2 N (mg/l)	No3n (mg/l)	N Tot (mg/l)	P Tot (mg/l)	Po4 P (mg/l)	Pop (mg/l)	Pon (mg/l)	Sio2 Si (mg/l)	Chlorophyll A (ug/l)	Chlorophyll C (ug/l)
109	0.00906	0.002	0.0747	-0.01	0.891	0.0196	0.00411	0.00838	0.056	0.671		
110	0.00822		0.00386		0.9754	0.0176	0.00247	0.00646	0.06565	0.231	1.94	-0.5
111	0.01605	0.002	0.00293	-0.01	1.24	0.01776	0.00293	0.00672	0.0552	0.434	1.23	-0.5
112	0.006	-0.001	0.0019	-0.01	1.28	0.0262	0.0033	0.0066	0.0703	0.639	6.1	-0.5
113	0.01147		0.00128		1.12714	0.01509	0.00258	0.00599	0.04732	0.956	1.35	0.48
114	0.0037		0.0014		1.12	0.0156	0.0015	0.0064	0.0539	1.36	2.5	-0.5
115	0.0044		0.0042				0.0013	0.0056		0.277	1.9	-0.5
116	0.0061		0.0014		1.28	0.0133	0.0019	0.0041	0.058	0.102	1.2	-0.5
117	0.0051		0.0013		1.22	0.0129	0.0022	0.00427	0.0582	0.049	1	-0.5
118	0.03823	0.00149	0.09183		1.36	0.00801	0.00125	0.00355	0.03314	1.993	0.57	-0.5
119	0.2929	0.0019	0.0241		1.4625	0.0126	0.0009	0.0059	0.0504	2.054	-0.5	-0.5
120	0.2044		0.0311		1.3203	0.0121	0.0009	0.0048	0.0376	3.4	-0.5	-0.5
121	0.224		0.04		1.1	0.011	-0.001	0.057	0.056	4.16	-0.5	-0.5
122	0.021		0.054		0.486	0.006	0.001	0.003	0.017	2.892	-0.5	-0.5
123	0.206		0.02		1.066	0.012	0.001	0.005	0.041	3.488	-0.5	-0.5
124	0.226		0.0077		0.696	0.0102	0.0019	0.0038	0.0308	2.35	0.7	-0.5
125	0.183		0.0039		0.709	0.0117	0.001	0.0041	0.028	2.239	1	-0.5
126	0.0108		0.0259		0.747	0.0087	0.0009	0.0042	0.0453	0.781	1.5	-0.5
127	0.0214		0.0515		0.739	0.0085	0.0014	0.0042	0.0427	1.297	1.2	-0.5
128	0.00938		0.00762		0.811	0.0143	0.00206	0.00511	0.0466	0.783	0.97	-0.5
129												
130	0.00276	0.001	0.00233	-0.01	0.88999	0.01586	0.00151	0.00696	0.07786	0.416	3.44	0.64
131	0.00319		0.00168		0.89908	0.01601	0.00149	0.00681	0.07608	0.397	2.81	0.61
132	0.00577		0.00182		0.99227	0.01376	0.00182	0.0059	0.0636	0.619	2.69	-0.5
133	0.00399		0.00277		0.98434	0.0133	0.00277	0.00521	0.05328	0.624	1.77	-0.5
134	0.0076		0.0018		1.01	0.0132	0.0013	0.0043	0.0678	0.729	2.7	-0.5
135	0.0076		0.0016		1.03	0.017	0.0014	0.006	0.0709	0.705	2.5	-0.5
136	0.00326		0.00038		1.0532	0.01392	0.00181	0.00602	0.06703	0.99	2.57	-0.5
137	0.00497		0.00015		1.03023	0.01305	0.00237	0.00504	0.05353	0.994	2.14	-0.5
138	0.007		0.0037		1.08	0.014	0.0014	0.0074	0.0806	1.83	3.9	-0.5
139	0.0066		0.0019		1.06	0.0149	0.0016	0.0058	0.0702	1.86	3.9	-0.5
140	0.007		0.0006				0.0012	0.0095		1.92	4.7	-0.5
141	0.0076		0.0005				0.0013	0.0089		1.94	5.3	-0.5
142	0.0056		0.0006		1.19	0.0169	0.0013	0.0103	0.161	1.45	6.1	-0.5
143	0.0067		0.0003		1.18	0.0158	0.001	0.0085	0.126	1.5	4.1	-0.5
144	0.0122		0.0015		1.13	0.0139	0.0014	0.00849	0.0969	0.885	3.3	-0.5
145	0.0126		0.0009		1.12	0.0127	0.0018	0.00652	0.1182	0.881	2.6	-0.5
146	0.01621	0.0003	0.00465		1.1	0.00909	0.00067	0.00431	0.04613	0.235	1.3	-0.5
147	0.03764	0.00283	0.13131		1.3	0.00948	0.00298	0.00316	0.01125	3.999	0.74	-0.5
148	0.22685	0.00039	0.00361		1.76	0.00668	0.00053	0.00376	0.0323	0.541	-0.5	-0.5
149	0.1806	0.0016	0.157		1.0771	0.0069	0.002	0.0036	0.0237	1.281	-0.5	-0.5
150	0.2583	0.0024	0.1387		1.1534	0.0074	0.0012	0.0043	0.0281	1.996	0.5	-0.5
151	0.1588		0.0327		1.19	0.0101	0.0005	0.004	0.0301	4.987	-0.5	-0.5
152	0.2773		0.015		1.44	0.0128	0.0006	0.0035	0.0408	3.276	-0.5	-0.5
153	0.721		0.029		1.761	0.011	0.001			4.89	0.7	-0.5
154	0.068		0.055		0.456	0.008	0.001	0.006	0.042	0.933	-0.5	-0.5
155	0.486		0.026		1.449	0.01	0.001	0.005	0.038	4.613	-0.5	-0.5
156	1.88		0.0141		1.078	0.0088	0.0019	0.0054	0.0336	3.362	1.6	-0.5
157	2.13		0.0161		1.083	0.0095	0.002	0.0051	0.0333	3.388	1.3	-0.5
158	0.037		0.0279		1.006	0.0094	0.003	0.0029	0.0756	2.118	2.4	-0.5
159	0.0387		0.0266		0.929	0.0091	0.0027	0.0089	0.0662	2.128	2.07	-0.5
160	0.00712		0.0131		0.979	0.0113	0.00262	0.00536	0.0841	1.482	3.57	-0.5
161	0.00735		0.024		0.958	0.00904	0.00137	0.006	0.0706	0.377	2.8	-0.5
162	0.00719		0.00194		1.04	0.012	0.00089	0.0044	0.07819	1.276	2.23	-0.5

BIOCHEMISTRY DATA

Row number	Nh4n (mg/l)	No2n (mg/l)	No3 N No2 N (mg/l)	No3n (mg/l)	N Tot (mg/l)	P Tot (mg/l)	Po4 P (mg/l)	Pop (mg/l)	Pon (mg/l)	Sio2 Si (mg/l)	Chlorophyll A (ug/l)	Chlorophyll C (ug/l)
163	0.01245		0.00119		1.08	0.01071	0.00087	0.00469	0.07615	1.256	1.8	-0.5
164	0.01063		0.00276		1.14025	0.01151	0.00276		0.10992	1.37	3.49	0.55
165	0.0145		0.00253		1.131	0.01023	0.00253		0.09667	1.41	2.51	-0.5
166	0.007		0.0018		1.16	0.0135	0.0005	0.0047	0.0932	1.62	1.5	-0.5
167	0.0073		0.0004		1.1	0.0089	-0.0005	0.0036	0.0742	1.62	2.2	-0.5
168	0.01177		0.00099		1.13	0.0083	0.00169	0.00403	0.07869	1.94	3.74	0.52
169	0.01319		0.00104		1.13	0.00796	0.00195	0.00375	0.07604	1.89	3.47	0.5
170	0.0165		0.002		1.16	0.0072	0.0018	0.0027	0.0604	2.59	2.3	-0.5
171	0.0182		0.0014		1.17	0.0084	0.0014	0.0031	0.0568	2.58	2.6	-0.5
172	0.0207		0.001				0.0018	0.0039		3.35	1.9	-0.5
173	0.0227		0.0007				0.0015	0.0047		3.32	1.4	-0.5
174	0.0326		0.0013		1.24	0.009	0.0042	0.0031	0.071	3.35	2.4	-0.5
175	0.032		0.0007		1.2	0.0075	0.0012	0.0033	0.059	3.28	2.3	-0.5
176	0.052		0.005		1.24	0.0077	0.0016		0.0704	3.05	1.1	-0.5
177	0.0502		0.0024		1.25	0.0099	0.0012	0.00518		3.02	0.6	-0.5
178	0.28354	0.00102	0.04983		1.53	0.00712	0.00186	0.00284	0.04772	2.936	1.53	-0.5
179	0.84884	0.00114	0.01361		1.91	0.00851	0.00296	0.00323	0.04539	3.255	0.52	-0.5
180	0.4651	0.0013	0.0693		1.9351	0.0074	0.0023	0.0032	0.038	3.544	1.1	-0.5
181	0.7591	0.0021	0.028		2.0508	0.0069	0.001	0.0029	0.0472	3.709	-0.5	-0.5
182	0.7084		0.0298		1.76	0.0116	0.0014	0.0034	0.0355	3.973	-0.5	-0.5
183	0.7946		0.014		2.16	0.0121	0.0009	0.004	0.0434	3.869	-0.5	-0.5
184	0.00786	-0.001	0.00209	-0.01	1.09	0.01725	0.00315	0.00743	0.07333	0.156	1.07	-0.5
185	0.00778		0.00128		1.07	0.01758	0.00231	0.00536	0.07217	0.155	1.46	-0.5
186	0.00499	0.001	0.00188	-0.01	1.45	0.02461	0.00188	0.01258	0.15628	0.728	3.01	-0.5
187	0.00676		0.0019		1.41	0.02362	0.0019	0.01277	0.15871	0.866	3.33	-0.5
188	0.0116		0.0017		1.36	0.021	0.0019	0.0132	0.2091	1.05	3	-0.5
189	0.0084		0.0036		1.37	0.0211	0.0017	0.0128	0.207	1.082	3.6	-0.5
190	0.01322		0.00086		1.45	0.01953	0.00298	0.01148	0.17392	1.24	6.02	-0.5
191	0.01022		0.00103		1.41	0.01851	0.0032	0.01084	0.15143	1.226	4.35	-0.5
192	0.008	0.002	-0.01	-0.01	1.51	0.0204	0.0016	0.013	0.2142	2.12	7.1	-0.5
193	0.0077		0.0016		1.52	0.0209	0.0019	0.0115	0.1421	2.16	7.3	-0.5
194	0.0196		0.0006				0.0019	0.0131		2.93	14.3	1
195	0.0241	0.002	0.0006	-0.01		0.03	0.0018	0.0141		2.91	10.5	-0.5
196	0.0475		0.0017		2.01	0.0271	0.0036	0.0175	0.257	2.09	13.9	-0.5
197	0.0354		0.0003		2	0.0255	0.0028	0.0154	0.259	2.07	11.9	-0.5
198	0.1316		0.0025		1.93	0.0213	0.002	0.01112	0.1233	1.04	2.8	-0.5
199	0.1476		0.0039		1.92	0.0224	0.002	0.01061	0.1331	1.06	1.3	-0.5
200	0.046		0.044		0.984	0.02	0.001	0.011	0.088	6.04	-0.5	-0.5
201	1.23248	0.00437	0.26065		3.2	0.01559	0.00187	0.00651	0.06768	1.254	13.57	1.9
202	1.4102	0.0004	0.0071		3.7061	0.019	0.0036	0.0114	0.086	2.09	0.5	-0.5
203												
204	0.00215		0.113		0.273	0.0125	0.00085	0.00667	0.0397	2.079	5.2	0.8
205	0.00215	-0.001	0.015	-0.01	0.269	0.0134	0.001	0.00671	0.0483	0.132	4.3	0.7
206	0.00071		0.00809		0.266	0.00759	0.00048	0.00464	0.0457	0.248	1.2	-0.5
207	0.00076		0.00612		0.277	0.00776	0.00045	0.00344	0.0344	0.268	1.02	-0.5
208	0.00121	-0.001	0.00077	-0.01	0.24761	0.00939	-0.0005	0.00401	0.03874	0.098	2.24	-0.5
209	0.00102		0.00087		0.24387	0.00916	-0.0005	0.00304	0.02959	0.132	1.16	-0.5
210	0.00036		0.00046		0.23835	0.00928	0.00046	0.00406	0.02869	0.14	0.68	-0.5
211	0.00046		0.00112		0.23764	0.00821	0.00112		0.03062	0.177	-0.5	-0.5
212	0.0013		0.0003		0.26	0.0112	0.001	0.0063	0.0741	0.26	1.5	-0.5
213	0.0012		0.0003		0.253	0.0105	0.0008	0.0056	0.0385	0.262	1.6	-0.5
214	0.00169		0.00049		0.26786	0.00873	0.00095	0.00498	0.03801	0.313	1.29	-0.5
215	0.00145		0.00032		0.23042	0.00792	0.00085	0.00439	0.02795	0.283	1.03	-0.5
216	0.0028		0.001		0.247	0.0114	0.001	0.0067	0.0351	0.3	1.4	-0.5

BIOCHEMISTRY DATA

Row number	Nh4n (mg/l)	No2n (mg/l)	No3 N No2 N (mg/l)	No3n (mg/l)	N Tot (mg/l)	P Tot (mg/l)	Po4 P (mg/l)	Pop (mg/l)	Pon (mg/l)	Sio2 Si (mg/l)	Chlorophyll A (ug/l)	Chlorophyll C (ug/l)
217	0.0019		0.0008		0.25	0.0104	0.0008	0.0055	0.0341	0.5	2.5	-0.5
218	0.0017		0.0007				0.0009	0.0056		0.45	1.5	-0.5
219	0.002		0.0004				0.0014	0.0076		0.304	1.5	-0.5
220	0.0029		0.0013		0.257	0.0119	0.001	0.0077	0.06	0.438	2.7	-0.5
221	0.003		0.0013		0.262	0.0123	0.0009	0.0079	0.051	0.433	2.7	-0.5
222	0.0047		0.003		0.28	0.0133	0.0015	0.00648	0.0525	0.349	2.3	-0.5
223	0.003		0.0013		0.251	0.0103	0.0012	0.00575	0.0466	0.326	2.2	-0.5
224	0.00717		0.01356		0.00058	0.011	0.00136	0.0342	0.30849	0.267	12.19	1.87
225	0.00723		0.00725		0.00068	0.01034	0.00149	0.04569	0.5447	0.269	8.71	1.67
226	0.00388	0.00104	0.00601		0.25329	0.01005	0.0008	0.00506	0.03625	0.321	2.7	-0.5
227	0.00467	0.00156	0.01183		0.2501	0.00936	0.00113	0.00541	0.03282	0.453	2.7	-0.5
228	0.00739	0.0026	0.02133		0.35586	0.01102	0.00231	0.00421	0.02324	0.523	1.62	-0.5
229	0.00654	0.00151	0.01923		0.26893	0.01033	0.00232		0.01966	0.477	1.99	-0.5
230	0.00429	0.00302	0.04571		0.63838	0.01074	0.00407	0.00337		0.511	1.23	-0.5
231	0.00412	0.00288	0.04419		0.30454	0.01195	0.00406	0.00557	0.031	0.554	1.34	-0.5
232	0.00184		0.0293		0.297	0.0144	0.00137	0.0101	0.0669	0.117	4.5	0.6
233	0.00165	-0.001	0.1237	-0.01	0.326	0.0185	0.00129	0.0125	0.0624	1.059	6.7	0.8
234	0.00007		0.0928		0.305	0.0152	0.00088	0.00855	0.0656	0.141	1.82	-0.5
235	0.00052		0.00227		0.304	0.0167	0.00117	0.00966	0.0758	0.211	1.41	-0.5
236	0.00078		0.00103		0.28862	0.01466	0.0006	0.00756	0.06525	0.127	1.73	-0.5
237	0.0008		0.00044		0.30152	0.02022	-0.0005	0.01176	0.07396	0.155	2.58	-0.5
238	0.00026		0.00101		0.31339	0.0165	0.00101		0.06689	0.242	1.16	-0.5
239	0.00082		0.00274		0.32058	0.02277	0.00274		0.07108	0.338	1.9	-0.5
240	0.0012		0.0007		0.313	0.0173	0.0016	0.008	0.0519	0.323	2.1	-0.5
241	0.0014	-0.001	0.0007	-0.01	0.325	0.0216	0.002	0.0125	0.0679	0.385	2.2	-0.5
242	0.00224		0.00034		0.31545	0.01451	0.00135	0.00765	0.04605	0.343	2.42	-0.5
243	0.00146		0.00104		0.30875	0.01909	0.00163	0.00808	0.0438	0.497	2.93	-0.5
244	0.0026		0.0006		0.326	0.0182	0.0009	0.0091	0.0611	0.46	3	-0.5
245	0.0088		0.0003		0.342	0.0232	0.0021	0.0147	0.0883	1.56	5	0.5
246	0.0022		0.0011				0.0016	0.0191		0.608	5.9	0.5
247	0.0021		0.0006				0.0024	0.017		0.589	7.2	0.7
248	0.0025		0.001		0.317	0.0174	0.0009	0.0119	0.086	0.514	4.2	-0.5
249	0.0034		0.0011		0.327	0.0183	0.0018	0.0122	0.085	0.472	4.1	-0.5
250	0.0029		0.0007		0.276	0.0128	0.0014	0.00785	0.0688	0.387	2.5	-0.5
251	0.004		0.0009		0.27	0.01	0.0014	0.00807	0.0559	0.386	2.5	-0.5
252	0.01034		0.00738		-0.0001	0.01244	0.00129	0.04625	0.28614	0.278	11.01	2.97
253	0.01		0.0074		0.00085	0.01294	0.00127	0.0565	0.28749	0.285	12.8	3.26
254	0.00654	0.0011	0.00634		0.28992	0.01277	0.00087	0.0083	0.04975	0.271	2.6	-0.5
255	0.00817	0.00118	0.00876		0.29173	0.01327	0.00048	0.00705	0.04807	0.359	3.3	-0.5
256	0.01457	0.00191	0.02226		0.29618	0.01178	0.0027	0.004	0.02447	0.45	2.13	-0.5
257	0.0148	0.00142	0.02232		0.27418	0.01005	0.00218	0.00417	0.02012	0.473	1.84	-0.5
258	0.01794	0.00414	0.04664		0.41033	0.01034	0.00281		0.02327	0.505	1.51	-0.5
259	0.0321	0.0034	0.03031		0.32566	0.01232	0.00383	0.00512	0.02789	0.535	2.04	-0.5
260	0.052	0.0034	0.0816		0.3851	0.01	0.0045	0.0034	0.0194	0.887	1.1	-0.5
261	0.0227	0.0039	0.0796		0.3931	0.0092	0.0046	0.0014	0.014	0.848	0.8	-0.5
262	0.0613		0.1296		0.57	0.0132	0.0047	0.0029	0.0158	0.831	0.7	-0.5
263	0.0704		0.5747		1.22	0.0236	0.008	0.0074	0.0226	1.761	-0.5	-0.5
264	0.00188		0.0174		0.486	0.0237	0.00117	0.0156	0.1045	0.468		
265	0.00409		0.00584		0.714	0.0255	0.00249	0.0144	0.105	2.712	10.6	1.2
266	0.00147		0.00373		0.582	0.024	0.00096	0.0143	0.116	0.407	4.76	0.59
267	0.0109	-0.001	0.00194	-0.01	0.428	0.0252	0.00104	0.018	0.136	0.858	4.33	0.55
268	0.00173		0.00068		0.48957	0.0294	-0.0005	0.01982	0.13377	0.199	2.78	0.48
269	0.00169		0.0014		0.60749	0.05099	-0.0005	0.0341	0.19377	0.203	3.46	-0.5
270	0.00141		0.00188		0.44704	0.02556	0.00188		0.06889	0.233	3.44	-0.5

BIOCHEMISTRY DATA

Row number	Nh4n (mg/l)	No2n (mg/l)	No3 N No2 N (mg/l)	No3n (mg/l)	N Tot (mg/l)	P Tot (mg/l)	Po4 P (mg/l)	Pop (mg/l)	Pon (mg/l)	Sio2 Si (mg/l)	Chlorophyll A (ug/l)	Chlorophyll C (ug/l)
271	0.00147	0.002	0.00119	-0.01	0.72419	0.05934	0.00119		0.07586	0.178	2.82	-0.5
272	0.0109		0.0053		0.444	0.0246	0.0018	0.0181	0.1159	0.283	3.8	-0.5
273	0.00173	-0.001	0.001	-0.01	0.458	0.0234	0.0025	0.0148	0.0728	0.279	4.2	-0.5
274	0.00169		0.00023		0.48251	0.02136	0.00208	0.01137	0.05723	0.242	3.87	-0.5
275	0.00141		0.00043		0.48967	0.02625	0.00152	0.01258	0.0779	0.34	4.37	-0.5
276	0.00147		0.001		0.569	0.0264	0.0014	0.0157	0.119	0.67	4.7	-0.5
277	0.0109		0.0006		0.589	0.0297	0.0016	0.0181	0.1177	0.65	5.4	-0.5
278	0.00147		0.0013				0.001	0.0283		0.33	7.4	0.7
279	0.00147		0.0008				0.0018	0.0207		0.326	7.1	0.6
280	0.00173		0.0007		0.531	0.0311	0.0016	0.0208	0.151	0.254	6.9	0.8
281	0.0109		0.0004		0.571	0.0366	0.0014	0.0215	0.176	0.259	6.6	0.7
282	0.01		0.0017		0.441	0.0206	0.0024	0.01251	0.1075	0.208	4.6	0.6
283	0.009		0.0028		0.415	0.0205	0.0023	0.0125	0.1267	0.17	5	0.6
284	0.01455		0.007		0.001	0.02805	0.00196	0.19783	1.02	0.516	11.5	10.18
285	0.00771		0.00733		0.00068	0.01744	0.00123	0.09724	0.75994	0.396	11.31	2.92
286	0.0288	0.00166	0.01482		0.43276	0.02122	0.00071	0.00995	0.10338	0.224	3.7	-0.5
287	0.02586	0.0018	0.01269		0.40359	0.01987	0.00095	0.00964	0.10183	0.204	3.3	-0.5
288	0.05908	0.00211	0.01897		0.43239	0.01856	0.00127	0.00982	0.0545	0.331	4.12	0.56
289	0.07714	0.00272	0.19638		0.43498	0.01467	0.00134	0.00748	0.04762	0.126	3.88	0.6
290	0.06589	0.00367	0.19361		1.42	0.01751	0.00282	0.0092	0.04709	1.143	2.67	0.58
291	0.18492	0.01372	1.47361		2.75	0.0338	0.00331	0.02627	0.11969	3.356	14.49	3.39
292	0.00106		0.00099		0.36218	0.0172	0.00138	0.01103	0.07292	0.147	2.86	-0.5
293	0.00103	0.002	0.00272	-0.01	0.41216	0.02417	0.00272	0.01349	0.12154	0.213	6.48	-0.5
294	0.0011		0.0005		0.33	0.0181	0.0017	0.0124	0.069	0.254	2.5	-0.5
295	0.00222		0.00059		0.35868	0.01706	0.00151	0.00807	0.05382	0.352	1.91	-0.5
296	0.0042		0.0005		0.554	0.0233	0.0009	0.0123	0.085	0.91	3.8	-0.5
297	0.0018		0.0003				-0.0005	0.0073		0.531	3	-0.5
298	0.0025		0.0033		0.32	0.0175	0.0017	0.0143	0.076	0.543	3.6	-0.5
299	0.0081		0.0183		0.37	0.023	0.0037	0.01458	0.104	0.399	4.4	0.5
300	0.00517		0.00352		0.00048	0.02257	0.0014	0.09707	0.55892	0.383	11.82	4.48
301	0.01173	0.00104	0.01157		0.33667	0.01684	0.00108	0.01093	0.08559	0.417	3.8	-0.5
302	0.05169	0.0015	0.07795		0.50135	0.01495	0.00162	0.00864	0.03496	0.725	2.14	-0.5
303	0.03814	0.00647	0.49266		1.41	0.01996	0.00438	0.00979	0.04567	3.349	3.33	1
304	0.0895	0.0052	0.2545		0.9902	0.0225	0.0029	0.0111	0.0707	2.412	17.5	6.5
305	0.1136		0.6006		1.52	0.0278	0.0052	0.0082	0.0314	2.429	6.3	1.9
306	0.005		0.084		0.324	0.012	0.002	0.004	0.024	0.707	2.7	-0.5
307	0.004		0.029		0.39	0.016	0.001	0.009	0.04	0.434	4.8	0.8
308	0.005		0.033		0.297	0.014	0.001	0.007	0.043	0.426	4	0.7
309	0.02		0.0265		0.285	0.0113	0.0007	0.0065	0.0591	0.156	5.5	1.3
310	0.018		0.0281		0.277	0.0115	0.0007	0.006	0.0534	0.164	5.1	1.1
311	0.0096	0.0022	0.1505		0.4081	0.01	0.0051	0.0019	0.0138	0.728	0.6	-0.5
312	0.0053	0.0026	0.0758		0.2941	0.0096	0.0052	0.0047	0.0181	0.677	0.6	-0.5
313	0.0131		0.1749		1.22	0.0269	0.0054	0.0074	0.0242	0.731	-0.5	-0.5
314	0.0042		0.0563		0.2973	0.0113	0.0041	0.0016	0.011	0.613	-0.5	-0.5
315	0.0171		0.244		0.659	0.017	0.0023	0.082	0.044	1.71	2	-0.5
316	0.003		0.077		0.339	0.012	0.001	0.006	0.038	0.671	2.2	-0.5
317	0.005		0.027		0.288	0.011	-0.001	0.007	0.04	0.407	5.2	0.9
318	0.01		0.0012		0.275	0.0122	-0.0007	0.0066	0.0587	0.197	5.1	1.1
319	0.011		0.0105		0.284	0.0124	-0.0007	0.0075	0.0623	0.192	5.6	1.1
320	0.03		0.371		0.84	0.026	0.008	0.098	0.036	2.285	0.6	-0.5
321	0.012		0.596		1.299	0.036	0.004	0.021	0.091	3.521	3.8	0.9
322	0.009		0.15		0.42	0.017	0.003	0.01	0.039	1.044	3.1	0.5
323	0.24		0.361		1.166	0.0379	0.0042	0.0212	0.0869	3.001	4.5	0.6
324	0.243		0.346		1.165	0.039	0.0053	0.0223	0.0897	3.119	4	0.6

BIOCHEMISTRY DATA

Row number	Nh4n (mg/l)	No2n (mg/l)	No3 N No2 N (mg/l)	No3n (mg/l)	N Tot (mg/l)	P Tot (mg/l)	Po4 P (mg/l)	Pop (mg/l)	Pon (mg/l)	Sio2 Si (mg/l)	Chlorophyll A (ug/l)	Chlorophyll C (ug/l)
325	0.00299		0.1611		0.537	0.021	0.00129	0.0129	0.0627	0.633	8.3	1.1
326	0.00283	-0.001	0.0147	-0.01	0.479	0.0202	0.00225	0.0207	0.0983	0.357	4	0.5
327												
328	0.003		0.017		0.588	0.008	-0.001	0.003	0.016	4.611	1.9	-0.5
329	0.067		0.0027		0.564	0.0074	0.0013	0.0023	0.0135	3.643		
330	0.0189		0.0325		0.671	0.00966	0.00226	0.00565	0.0392	3.345	1.1	-0.5
331	0.0321		0.0102		0.739	0.0127	0.00257	0.00573	0.0401	3.733	6.96	-0.5
332	0.01447		0.00819		0.79817	0.01608	0.00333	0.00751	0.05517	3.003	1.44	-0.5
333	0.0333	0.003	0.0096	-0.01	0.873	0.0192	0.0046	0.0089	0.0502	2.96	-0.5	-0.5
334	0.02317		0.00399		0.9057	0.01783	0.00347	0.00814	0.08892	3.68		
335	0.0257	0.005	0.0076	-0.01	0.968	0.0169	0.0031	0.0055	0.0269	4.28		
336	0.00855	0.00239	0.32549		1.01	0.0136	0.00251	0.0086	0.03943	3.5	0.63	-0.5
337	0.00803	0.00259	0.13009		1.14	0.00814	0.00169		0.01627	5.471	-0.5	-0.5
338	0.0475	0.0007	0.0044		0.9155	0.0095	0.0017	0.0048	0.0307	6.471	0.6	-0.5
339	0.0397		0.0121		1.17	0.0077	0.0009	0.0022	0.0164	5.573	-0.5	-0.5
340	0.058		0.038		0.951	0.011	0.001			4.46		
341	0.025		0.026		0.732	0.012	-0.001	0.004	0.033	3.372		
342	0.131		0.0037		0.769	0.0161	0.0014	0.0108	0.11	2.237		
343	0.0216		0.0517		0.775	0.0124	0.0023	0.00672	0.0395	0.996	2.2	-0.5
344	0.00516		0.00319		0.843	0.0179	0.00323	0.00811	0.064	0.304	2.87	-0.5
345	0.01539		0.00247		0.94126	0.01764	0.00222	0.00475	0.04378	0.354	2.09	-0.5
346	0.0461		0.00537		1.15	0.01989	0.00537	0.00575	0.04553	0.804	1.73	-0.5
347	0.0231		0.0023		1.21	0.0216	0.0029	0.0089	0.0888	1.12	2.9	-0.5
348	0.02064		0.0008		1.13249	0.01655	0.00273	0.00709	0.07577	1.06		
349	0.0238		0.0017		1.1	0.017	0.0024	0.0077	0.0626	1.79		
350	0.0237		0.0022				0.0017	0.0144		1.64	6.5	-0.5
351	0.0359		0.0051		1.31	0.0221	0.0035	0.0111		1.45	3.9	-0.5
352	0.0279		0.0066		1.19	0.0172	0.0041	0.00892	0.1019	0.717	3.2	-0.5
353	0.01345		0.00488		0.00098	0.01386	0.00175	0.0864	0.50486	1.18	19.99	4.99
354	0.00683	0.00038	0.00308		1.34	0.0239	0.00144	0.0117	0.12599	0.19	21.8	2
355	0.02027	0.00076	0.04146		1.14	0.01572	0.00205	0.00609	0.11194	0.297	21.26	1.5
356	0.04983	0.00132	0.08218		1.33	0.00948	0.00129	0.00298	0.02825	1.977	0.64	-0.5
357	0.284	0.0018	0.0167		1.4982	0.0095	0.0008	0.0042	0.0321	2.095	-0.5	-0.5
358	0.1956		0.0266		1.42	0.011	0.0006	0.0049	0.0304	4.149	-0.5	-0.5
359	0.028		0.054		0.897	0.01	0.001			5.21		
360	0.013		0.024		0.684	0.01	-0.001	0.004	0.02	3.469		
361	0.344		0.0219		0.83	0.0136	0.0021	0.006	0.034	4.077		
362	0.04		0.0307		0.97	0.0182	0.00443	0.00647	0.0522	4.129	1.5	-0.5
363	0.032		0.0128		0.948	0.0179	0.0038	0.00766	0.0552	1.168	0.98	-0.5
364	0.03044		0.01157		0.90333	0.01674	0.00477	0.00686	0.05016	6.025	0.87	-0.5
365	0.50961		0.0257		1.82	0.06637	0.0257		0.13026	6.61	0.51	-0.5
366	0.0157		0.0217		1.027	0.0214	0.0052	0.0089	0.0585	2.51	0.5	-0.5
367	0.01734		0.00421		1.05454	0.01799	0.00722	0.00559	0.04934	3.68		
368	0.0428		0.0144		1.16	0.0189	0.0067	0.0053	0.0395	5.68		
369	0.0196		0.0295				0.0055	0.0055		6.12	1	-0.5
370	0.0025		0.0008		1.06	0.0157	0.0025	0.00509	0.0355	7.06	1.9	-0.5
371	0.00196		0.00143		0.00096	0.01153	0.0034	0.05167	0.34983	0.972	39.09	-0.5
372	0.01317	0.00115	0.02316		1.04029	0.00876	0.00227	0.00252	0.019	7.15	-0.5	-0.5
373	0.00644	0.00162	0.41401		1.32	0.02519	0.00364	0.01593	0.06813	2.59	-0.5	-0.5
374	0.02484	0.00233	0.05927		1.34963	0.00875	0.00354	0.00294	0.0227	4.059	-0.5	-0.5
375	0.0902	0.003	0.1127		1.1843	0.0118	0.0024	0.0052	0.0382	5.708	-0.5	-0.5
376	0.1792		0.0436		1.14	0.0089	0.0006	0.0031	0.0204	4.139	-0.5	-0.5
377	0.001		0.007		0.793	0.013	0.009			5.921		
378	0.002		0.008		0.654	0.014	0.001	0.006	0.025	4.313		

BIOCHEMISTRY DATA

Row number	Nh4n (mg/l)	No2n (mg/l)	No3 N No2 N (mg/l)	No3n (mg/l)	N Tot (mg/l)	P Tot (mg/l)	Po4 P (mg/l)	Pop (mg/l)	Pon (mg/l)	Sio2 Si (mg/l)	Chlorophyll A (ug/l)	Chlorophyll C (ug/l)
379	0.069		0.0038		0.661	0.0127	0.0016	0.0057	0.025	4.145	0.6	-0.5
380	0.0156		0.00654		0.822	0.0137	0.00378	0.00568	0.0288	4.95	1.1	-0.5
381	0.00312		0.03808		0.855	0.0152	0.00649	0.00527	0.0379	4.511	1.09	-0.5
382	0.02468		0.00442		0.88942	0.01844	0.0056	0.00658	0.04364	6.087	1.64	-0.5
383	0.28757		0.04882		1.7	0.09376	0.04882		0.12695	6.14	1.28	-0.5
384	0.028		0.0336		1.02	0.0228	0.0055	0.0075	0.0467	4.32	0.7	-0.5
385	0.01217		0.00276		0.97805	0.01513	0.0046	0.00315	0.02159	4.07		
386	0.0117		0.005		1.05	0.0142	0.0049	0.003	0.0188	5.64		
387	0.013		0.0082				0.0047	0.0052		5.74	1.8	-0.5
388	0.01		0.0136		1.07	0.0173	0.0037	0.00508	0.0621	6.99	-0.5	-0.5
389	0.02042		0.01283		0.00154	0.01145	0.00272	0.02838	0.14559	1	39.66	0.77
390	0.02225	0.00096	0.00616		1.14	0.01052	0.00346	0.00376	0.03076	8.18	0.7	-0.5
391	0.01055	0.0013	0.1777		1.03014	0.01608	0.00378	0.00811	0.05277	4.1	-0.5	-0.5
392	0.0017	0.00057	0.00219		0.94642	0.0103	0.00263	0.0033	0.01992	4.662	-0.5	-0.5
393	0.0792	0.0014	0.0214		1.1859	0.019	0.0022	0.0128	0.0866	8.161	-0.5	-0.5
394	0.001		0.0123		0.8221	0.0111	0.0005	0.0053	0.0364	6.806	-0.5	-0.5
395	0.171		0.031		1.091	0.01	0.003			4.124		
396	0.02		0.01		0.744	0.007	-0.001	0.003	0.021	2.633		
397	1.37		0.0104		1.072	0.0094	0.0024	0.0042	0.0267	3.575		
398	0.0551		0.0272		0.98	0.0116	0.00214	0.00757	0.0724	2.093	1.9	-0.5
399	0.0415		0.00937		1.116	0.0181	0.00297	0.0113	0.0837	1.608	4.03	-0.5
400	0.0287		0.0036		1.07	0.0135	0.0011	0.0063	0.0692	2.09	1.3	-0.5
401	0.02543		0.00266		1.10078	0.01002	0.00182	0.00448	0.05195	2.34		
402	0.0828		0.0042		1.08	0.0102	0.0024	0.0056	0.0493	3.46		
403	0.17816	0.00129	0.08607		1.36	0.00915	0.00277	0.00378	0.0431	2.67	3.27	0.51
404	0.16336	0.00145	0.03106		1.76	0.00643	0.00234	0.00235	0.03569	3.277	1.01	-0.5
405	0.5107	0.0021	0.0592		1.938	0.0137	0.002	0.0029	0.0423	3.625	0.8	-0.5
406	0.6698		0.0163		1.99	0.0121	0.0015	0.0048	0.0496	3.935	-0.5	-0.5
407	0.025		0.274		0.797	0.021	0.012			4.417		
408	0.015		0.259		0.796	0.022	0.008	0.005	0.017	3.807		
409	0.257		0.0883		0.656	0.0245	0.0125	0.0058	0.0215	3.391		
410	0.0321		0.00954		0.658	0.0372	0.0142	0.0107	0.0349	3.414	-0.5	-0.5
411	0.0657		0.0261		0.672	0.0843	0.0435	0.0283	0.0626	1.547	0.99	-0.5
412	0.0148		0.1654		0.855	0.0307	0.0145	0.005	0.029	4.65	-0.5	-0.5
413	0.04192		0.01209		0.75919	0.03546	0.01263	0.00705	0.0302	4.31		
414	0.1388		0.0132		0.924	0.123	0.0616	0.062	0.0678	6		
415	0.00229	0.00114	0.52712		1.14	0.0246	0.01036	0.00596	0.02259	3.75	-0.5	-0.5
416	0.00654	0.00102	0.20547		0.6946	0.01146	0.00626	0.00293	0.01607	3.92	-0.5	-0.5
417	0.0104	0.0008	0.0956		0.7547	0.0117	0.0058	0.0033	0.0168	4.483	-0.5	-0.5
418	0.008		0.2373		0.8788	0.0171	0.0094	0.0015	0.0087	4.263	-0.5	-0.5
419	0.01		0.003		0.947	0.024	-0.001			4.06		
420	0.004		0.004		0.776	0.015	0.002	0.009	0.041	2.013		
421	0.039		0.0011		0.718	0.0143	0.0024	0.0048	0.0217	1.559		
422	0.00883	-0.001	0.00777	-0.01	0.896	0.0214	0.00482	0.00819	0.0494	0.776	1.3	-0.5
423	0.0115		0.0583		1.068	0.0343	0.00679	0.0102	0.0625	2.797	2.09	-0.5
424	0.07988	0.004	0.01943	0.04	1.51	0.07181	0.02486	0.02119	0.11576	1.774	0.73	-0.5
425	1.08071		0.15204		2.66	0.24775	0.15204		0.16426	1.69	6.26	0.5
426	0.0089		0.0039		0.974	0.0381	0.0047	0.0109	0.0725	0.659	0.8	-0.5
427	0.01011		0.001		1.25	0.03331	0.00517	0.01177	0.10178	1.01		
428	0.045		0.0532		1.36	0.0355	0.0114	0.0129	0.0853	0.95		
429	0.04758	0.0012	0.00653		1.12031	0.07026	0.00805	0.07383	0.27719	2.02	-0.5	-0.5
430	0.00417	0.00107	0.12833		1.74	0.02377	0.00266	0.01299	0.06867	1.41	0.61	-0.5
431	0.02819	0.00099	0.00556		1.64	0.0206	0.00366	0.00799	0.05421	1.93	-0.5	-0.5
432	0.169	0.0025	0.0268		1.4037	0.0729	0.0518	0.016	0.1123	3.255	1.1	-0.5

	BIOCHEMISTRY DATA											
Row number	Nh4n (mg/l)	No2n (mg/l)	No3 N No2 N (mg/l)	No3n (mg/l)	N Tot (mg/l)	P Tot (mg/l)	Po4 P (mg/l)	Pop (mg/l)	Pon (mg/l)	Sio2 Si (mg/l)	Chlorophyll A (ug/l)	Chlorophyll C (ug/l)
433	0.2447		0.0086		1.55	0.0781	0.0463	0.0103	0.0776	4.287	-0.5	-0.5
434	0.073		2.169		3.486	0.21	0.082			3.49		
435	0.01		2.085		2.891	0.036	0.009	0.008	0.024	1.436		
436	0.341		1.359		2.551	0.0419	0.0082	0.0102	0.0363	0.455		
437	0.00207		0.00902		0.747	0.108	0.0314	0.0333	0.0612	1.388	1.8	-0.5
438	0.02924		0.02174		1.18913	0.22657	0.05316	0.14041	0.27283	0.913	19.32	-0.5
439	0.0021	0.01088	5.14		7.98	0.07605	0.03191	0.01195	0.05535	3.18	0.84	-0.5
440	0.00358	0.00177	0.83812		1.36994	0.04432	0.01108	0.00772	0.04056	5.207	0.53	-0.5
441												
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463	0.721		0.029		1.761	0.011	0.001			4.89	0.7	-0.5
464	0.006		0.027		0.581	0.008	-0.001	0.034	0.031	4.399	1.1	-0.5
465	0.224		0.04		1.1	0.011	-0.001	0.057	0.056	4.16	-0.5	-0.5
466	-0.01		0.028		0.839	0.018	0.002	0.074	0.067	5.591	2.5	-0.5
467	0.075		0.031		0.992	0.013	-0.001	0.007	0.089	4.43	0.5	-0.5

Row number	Pheopigment (ug/l)	Poc (mg/l)	Toc (mg/l)	Doc (mg/l)	Dic (mg/l)	O2 (mg/l)	DRILL_WATER (% drilling water residue)	Other measurements	Drainage area	Sampling point order
1										
2							7.73			
3							1.79			
4							1.28			
5							0.87			
6							0.7			
7							0.67			
8							0.54			
9							0.76			
10										
11										
12							43.47			
13							20.3			
14							89			
15										
16										
17										
18										
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33										
34										
35										
36										
37										
38										
39		0.967	22.3	17	45.2	-0.1				
40			21.6	17.2		-0.1				
41		0.55355	27.27	25.2	69.59	-0.2				
42		3.87	15.1	15.8	45.3	0.9				
43			15.3	17.3		3.7				
44		8.78675	12.27	12.22	50.82	0.56				
45			11.1	13.8	66.6	0.3				
46		0.501	11	12		1.1				
47		0.90157	9.55	11.21	69.8	0.34				
48		0.64991	11.96			5.23				
49										
50										
51										
52										
53				1.2	1.1					
54										

Row number	Pheopigment (ug/l)	Poc (mg/l)	Toc (mg/l)	Doc (mg/l)	Dic (mg/l)	O2 (mg/l)	DRILL_WATER (% drilling water residue)	Other measurements	Drainage area	Sampling point order
55										
56										
57	-0.5	0.193	10	11	27				2	2
58	-0.5	0.222	7.3	7.1	17	5.5			2	2
59		0.084	12.7	12.8	2.5	6			2	2
60	-0.5	0.097	10	12	25	7.6			2	2
61	1.01	0.219	11	12	8.5	8.6			2	2
62	0.9	0.60852	19	17.21	15.14	10.2			2	2
63	-0.5	0.252	13.8	14.3	26.9	7.2			2	2
64	2.64	0.6588	19.05	18.4	24.67	14			2	2
65	0.8	0.205	15.8	15.2	21	8.6			2	2
66	0.61	0.18118	19.1	18.59	28.59	10.7			2	2
67	0.5	0.151	20.9	19.8	29.4	7.8			2	2
68	-0.5		20.6	22.2	6.1	9.8			2	2
69	-0.5	0.356	19.6	17.9	4	10.5			2	2
70	0.7	0.308	18.78	18.76	30.6	11.2			2	2
71	0.7	0.38048	17.2	16.8	17.8	11.1			2	2
72	-0.5	0.09902	16.45	14.97	23.82	5.04			2	2
73	4.7	0.1803	19	18.6	47.7	3.08			2	2
74	-0.5	0.0714	18.4	18	28.4	4.65			2	2
75	-0.5	0.393	13	14	33				2	3
76	-0.5	0.161	12.74	12.52	29.86	12.3			2	3
77	-0.5	0.163	12	12.73	27.04	12			2	3
78									2	3
79	0.5	0.342	13.7	13.6	28	9.8			2	3
80	2.53	0.428	11	11	23	11.1			2	3
81	1.61	0.504	13.9	14.11	1.93	11.2			2	3
82	-0.5	0.37141	16.39	13.61	6.94	10.6			2	3
83	1.38	0.34193	16.1	16.19	8.4	10.4			2	3
84	0.84	0.28	16.65	14.64	19.82	13.9			2	3
85	0.62	0.45	16.05	15.82	24.84	11			2	3
86	1.3	0.278	16.3	15.8	19.3	9.4			2	3
87	0.8	0.247	14.9	14.3	20.2	9.1			2	3
88	1.39	0.43841	17.51	16.88	25.42	11.3			2	3
89	0.6	0.4997	17.53	16.69	26.86	12			2	3
90	-0.5	0.265	19.1	16.2	30	11			2	3
91	2.9	0.364	18.6	17.7	23.3	5.8			2	3
92	0.6		17.5	21	1.9	9.8			2	3
93	-0.5		18.66	20.17	2.39	10			2	3
94	-0.5	0.333	17.9	17.7	17.8	10.4			2	3
95	0.5	0.371	18.6	19.3	6.1	9.9			2	3
96	1.3	0.599	18.03	17.95	25.4	12.6			2	3
97	-0.5		8.32	8.99	26.2	12.7			2	3
98	1.1	0.24895	17.6	7.4	20.7	13.9			2	3
99	-0.5	0.28576	17.4	18	25.8	9.8			2	3
100	-0.5	0.15299	18.39	15.06	28.19	4.57			2	3
101	0.64	0.27729	16.51	13.2	25.09	1.55			2	3
102	0.5	0.3379	22.6	22.3	42.3				2	3
103	1.8	0.2398	16.8	22.2	48.8	0.46			2	3
104	-0.5	0.1671	17.8	18.4	45.2	5.44			2	3
105	1	0.2264	17.2	21.6	53.6	-0.2			2	3
106	-0.5	0.697	19	19	23				1	8
107	-0.5	0.205	16.41	16.1	16.65	12.1			1	8
108	1	0.328		12	15	9.9			1	8

Row number	Pheopigment (ug/l)	Poc (mg/l)	Toc (mg/l)	Doc (mg/l)	Dic (mg/l)	O2 (mg/l)		DRILL_WATER (% drilling water residue)	Other measurements	Drainage area	Sampling point order
109		0.365	17.15	16.84	2.52	9.6				1	8
110	-0.5	0.31779	18.32	16.18	6.18	10.9				1	8
111	-0.5	0.397	24	21	22	10.6				1	8
112	7.5	0.542	18.5	17.5	14.7	11.1				1	8
113	-0.5	0.39682	17.97	17.52	19.38	9.5				1	8
114	-0.5	0.459	20.1	20	18.2	13.6				1	8
115	0.5		20.6	19	0.6	13.5				1	8
116	-0.5		21.6	23	8	13.9				1	8
117	0.9	0.332	20.1	19.8	14.1	14.8				1	8
118	0.57	0.26248	21.58	19.06	18.74	8.66				1	8
119	-0.5	0.4032	17.6	22.8	32.2	0.78				1	8
120	-0.5	0.272	22.2	19.4	37.9	1.62				1	8
121	-0.5	0.436	18	18	23						
122	-0.5	0.09	8.7	6.3	8.4	4.7				1	6
123	-0.5	0.307	17.9	17.5	18.1	2.7				1	6
124	0.5	0.201	14.78	15.91	16.96	12.5				1	6
125	-0.5	0.167	15.62	15.41	16.96	12.1				1	6
126	-0.5	0.287	12.5	12	16	10.7				1	6
127	1	0.265	14.3	14.7	16	10.7				1	6
128	1.78	0.281	12.02	10.68	2.14	10.1				1	6
129										1	6
130	0.53	0.37054	13.58	15.46	5.38	11.3				1	6
131	0.55	0.34029	17.48	8.6	3.89	10.9				1	6
132	-0.5	0.396	9.36	11.14	5.39	10.2				1	6
133	-0.5	0.363	16.01	18.33	11.93	9.8				1	6
134	-0.5	0.43	15	16.6	16.1	10.1				1	6
135	-0.5	0.52	16.9	15.5	13.7	10.5				1	6
136	-0.5	0.53181	17.62	17.38	15.83	10.9				1	6
137	-0.5	0.45933	18.33	17.56	16.65	10.3				1	6
138	-0.5	0.624	19.9	19.1	17	10.3				1	6
139	-0.5	0.637	15.6	18.5	16.7	10.3				1	6
140	-0.5		19.8	10.2	7.4	11.3				1	6
141	0.5		19.7	24.2	0.8	10.8				1	6
142	1.3	1.27	16.4	16.4	10.2	11.1				1	6
143	4.4	1.15	16.2	20.2	9.4	11.3				1	6
144	-0.5	0.738	23.99	24.1	17.4	12.3				1	6
145	-0.5	0.65	19.72	19.36	18.7	12.4				1	6
146	-0.5	0.37109	19	17.6	21.5	13.4				1	6
147	0.47	0.25748	23.18	23.71	28.12	7.89				1	6
148	-0.5	0.22164	12.86	15.63	20.7	3.03				1	6
149	-0.5	0.2216	9.7	13.5	21.4	2.68				1	6
150	0.8	0.2471	18.1	14	27.8	6.11				1	6
151	-0.5	0.2286	22.2	21.8	38.3	1.48				1	6
152	-0.5	0.2523	22.6	22.3	37.2					1	6
153	-0.5		23	21	32					1	2
154	-0.5	0.278	6.5	5.9	7.9	4.4				1	2
155	-0.5	0.242	16	16	27	3.9				1	2
156	-0.5	0.252				11.4				1	2
157	1.8	0.279				11.6				1	2
158	-0.5	0.492	17.8	16.1	22.4	11.1				1	2
159	-0.5	0.42	16.8	16	19	11.6				1	2
160	0.69	0.576	18.07	17.82	2.62	11.6				1	2
161	-0.5	0.429	18.17	8.25	0.89	11.5				1	2
162	-0.5	0.35782	17	16.92	3.21	12.2				1	2

Row number	Pheopigment (ug/l)	Poc (mg/l)	Toc (mg/l)	Doc (mg/l)	Dic (mg/l)	O2 (mg/l)	DRILL_WATER (% drilling water residue)	Other measurements	Drainage area	Sampling point order
163	1.1	0.39789	17.82	19.2	2.91	11.8			1	2
164	0.91	0.799	15.53	18.86	9.34	11			1	2
165	-0.5	0.703	15.02	19.59	13.95	11.2			1	2
166	0.9	0.635	18.8	18.7	17.2	10.3			1	2
167	0.5	0.628	16.9	17.6	16.6	10.8			1	2
168	-0.5	0.70061	19.61	17.74	15.53	10.2			1	2
169	-0.5	0.69223	18.7	17.94	16.03	10			1	2
170	-0.5	0.514	18.8	18.6	15.2	9.9			1	2
171	0.7	0.451	19.2	18.4	16.6	9.6			1	2
172	-0.5		19.42	19.46	13.25	9.3			1	2
173	1.1		19.15	16.29	1.34	9.9			1	2
174	-0.5	0.564	19.6	18.2	1.2	10.2			1	2
175	-0.5	0.548	19.2	11.1	1.9	10.2			1	2
176	-0.5	0.488	19.98	19.39	19	11.5			1	2
177	-0.5		19.4	19.65	20.8	10.6			1	2
178	0.91	0.49623	19.11	20.4	19.69	14.02			1	2
179	0.59	0.38224	19.3	18.21	27.9	2.81			1	2
180	-0.5	0.4299	20.4	20.7	25.7	10.83			1	2
181	0.5	0.4113	20.1	21.6	16.8	4.21			1	2
182	-0.5	0.2222	22.8	22.6	27.1	0.75			1	2
183	0.5	0.3428	20.4	22.1	34.1	0.65			1	2
184	-0.5	0.3272	15.91	12.27	0.94	13.6			3	1
185	-0.5	0.33947	15.64	17.06	1.17	14			3	1
186	0.81	1.1	22	19	18	12.9			3	1
187	0.65	1.13	11.33	7.51	8.96	13			3	1
188	-0.5	1.29	14	16.4	10.8	11.3			3	1
189	-0.5	1.25	16.1	17.1	11.6	11.8			3	1
190	1.27	1.61	18.1	16.31	9.8	11.4			3	1
191	1.08	1.46966	17.84	16.47	15.05	11.1			3	1
192	-0.5	1.8	18.3	17.4	14.7	12.2			3	1
193	1.5	1.15	19	15.2	16.5	12.3			3	1
194	-0.5		20.5	18.2	16.1	12.3			3	1
195	2.4		20.6	19.9	17.7	12.4			3	1
196	-0.5	2.54	23	22	18.8	12.3			3	1
197	-0.5	2.56	22.9	22.9	1.7	11.5			3	1
198	-0.5	1.136	17.38	17.65	19.2	12.7			3	1
199	-0.5	1.176	21.72	19.33	16.2	12.3			3	1
200	-0.5	0.712	16	17	25				3	1
201	10.07	0.53305	17.03	17.35	28.26	2.15			3	1
202	-0.5	0.7449	23.8	23.1	43.6				3	1
203										
204	0.6	0.261	2.4	1.9	1.8	13.4				
205	0.8	0.314	3.7	1.8	0.6	13.3				
206	1.07	0.35	1.83	1.62	0.38	15.7				
207	-0.5	0.318	1.86	1.09	0.33	14.9				
208	-0.5	0.13979	3.5	2.64	9.82	13.4				
209	-0.5	0.14278	4.19	1.67	13.14	12.6				
210	-0.5	0.159	2.39	2.25	5.48	11.7				
211	1.26	0.162	2.55	2.24	3.5	11.5				
212	0.9	0.504	4.1	2.7	6.1	11				
213	-0.5	0.331	4.1	2.7	6.8	10.9				
214	-0.5	0.28558	4.4	4.1	13	10.5				
215	-0.5	0.21795	4.09	2.89	6.68	10.6				
216	-0.5	0.215	1.3	2.1	5.6	9.5				

Row number	Pheopigment (ug/l)	Poc (mg/l)	Toc (mg/l)	Doc (mg/l)	Dic (mg/l)	O2 (mg/l)	DRILL_WATER (% drilling water residue)	Other measurements	Drainage area	Sampling point order
217		0.174	2.8	2.1	4.3	9.6				
218	-0.5		3.3	3.9	0.5	9.7				
219	-0.5		3.9	2.3	6.5	9.6				
220	-0.5	0.368	3.9	3.9	10.2	10.8				
221	-0.5		3.9	3.9	4.7	9.9				
222	-0.5	0.395	3.5	3.9	11.36	10.5				
223	-0.5	0.321	3.4	3.1	9.4	10.3				
224	-0.5	0.41172	4.04	3.84	1.97	11.6				
225	-0.5	0.48093	4.72	3.03	3.22	11.6				
226	-0.5	0.19753	3.7	3.4	12	11.9				
227	-0.5	0.18693	3.4	3.6	11.2	11.8				
228	1.15	0.19276	1.76	3.52	11.76	12.9				
229	-0.5	0.17742	1.35	3.88	12.26	13				
230	0.75		3.72	2.98	10.64	13.42				
231	1.12	0.25691	3.52			13.87				
232	0.7	0.489	3.2	2.1	2.4	12.1				
233	2.9	0.393	3.4	2.5	0.8	11.9				
234	-0.5	0.463	1.49	1.73	0.87	12.4				
235	1.64	0.531	1.37	1.72	0.81	13.8				
236	-0.5	0.21575	1.66	2.29	0.6	11.8				
237	-0.5	0.30592	1.77	3.66	0.96	12.1				
238	-0.5	0.296	16.47	12.91	3.66	10.9				
239	0.78	0.383	17.73	5.99	8.72	11.2				
240	0.8	0.267	4.5	4.5	7.9	10.6				
241	-0.5	0.374	4.9	4.9	14	9.7				
242	-0.5	0.28916	4.6	4.2	12	10.1				
243	-0.5	0.29663	4.09	4.08	9.96	9.6				
244	-0.5	0.322	4.4	3.9	3.8	10.3				
245	2	0.485	4.3	4.3	4	3.3				
246	0.7		4.13	4.14	8.62	9.3				
247	0.9		5	4.3	15	8.2				
248	-0.5	0.529	3.6	2.8	5.1	10.1				
249	-0.5	0.498	3.8	1.6	1.1	10.7				
250	-0.5	0.442	2.3	2.4	8.72	10.8				
251	-0.5	0.373	2.5	2.4	6.06	11.3				
252	-0.5	0.43169	6.7	2.22	3.74	13.6				
253	0.5	0.42581	4.3	4.1	15	12.5				
254	1.1	0.29481	3.8	2.4	4	13.4				
255	-0.5	0.27346	3.6	2.3	10.6	13				
256	-0.5	0.17447	2.64	1.46	3.63	12.6				
257	0.8	0.16157	2.69	3.89	12.31	12.9				
258	0.57	0.18195	3.84	2.81	9.66	12.95				
259	0.82	0.19336	3.86	3.82	14.67	11.98				
260	0.7	0.1599	3.4	2.2	8.2	11				
261	-0.5	0.1268	3.6	4	5.5	12.42				
262	0.7	0.0795	2.4	2.4	10.1	10.11				
263	-0.5	0.1549	5.8	9.6	11	11.44				
264		0.581	4	3.2	0.8	12.2				
265	2.1	0.6	7.8	6.3	1.4	12.2				
266	2.68	0.804	3.69	4.67	1.72	11.1				
267	0.65	0.813	3.42	2.29	0.65	11.7				
268	1.26	0.60233	3.44	2.11	8.21	11.8				
269	1.32	0.88232	5.79	4.35	10.45	11.9				
270	0.92	0.351	14.4	12.15	3.67	10.8				

Row number	Pheopigment (ug/l)	Poc (mg/l)	Toc (mg/l)	Doc (mg/l)	Dic (mg/l)	O2 (mg/l)	DRILL_WATER (% drilling water residue)	Other measurements	Drainage area	Sampling point order
271	3.81	0.415	16.03	9.08	3.17	11.1				
272	1.1	0.652	5.3	5.2	11.6	11.1				
273	-0.5	0.401	5.4	2.4	4.9	10.3				
274	1.18	0.32761	4.54	3.71	7.1	10				
275	1.37	0.41961	6.06	3.3	11.27	12.8				
276	1	0.727	8.3	6.2	10.3	10.2				
277	0.9	0.621	4.9	4	5.5	10.1				
278	0.8		5.3	6.1	5.72	10.2				
279	0.9		4.68	5.13	5	9.2				
280	0.8	1.01	3.7	5.7	13.1	10.7				
281	3	1	5.9	5.5	11.7	10.4				
282	-0.5	0.649	3.9	2.9	3.77	11.3				
283	0.6	0.669	2.5	2.2	11.8	11.2				
284	1.45	0.2282	19.68	4.97	4.87	13				
285	-0.5	0.39885	10	4.96	5.07	13.1				
286	1.5	0.64021	4.6	4.6	8.3	13.2				
287	-0.5	0.68712	4.4	4.9	14.3	13.4				
288	0.99	0.34169	4.41	2.83	8.57	11.1				
289	0.95	0.33041	2.39	2.84	8.54	11.2				
290	2.23	0.31759	3.79	6.41	17.22					
291	2.62	0.79875	10.5	6.8	15.5	9.61				
292	-0.5	0.26469	3.29	3.87	0.79	12.1				
293	3.7	0.949	2.47	2.24	7.02	10.9				
294	-0.5	0.422	2.3	4.6	10.3	11.9				
295	1.03	0.30644	5.41	4.82	10.48	11.2				
296	1	0.459	9	6.9	6.5	10.1				
297	-0.5		4.9	5.1	10.3	11.1				
298	1.3	0.479	4.6	4.6	5.4	10.6				
299	1	0.717	3.2	5.9	4.25	10.5				
300	0.82	0.33194	22.85	3.06	4.39	12.7				
301	1	0.59416	3.5	4.3	12.1	13.2				
302	0.83	0.26345	3.96	1.57	2.8	13.3				
303	0.46	0.37583	19.25	18.22	18.83	10.82				
304	2.4	0.4721	5.8	13	15.6	9.11				
305	1	0.2182	17	16.7	19.8	10.25				
306	-0.5		3.3	3.3	11					
307	1.1	0.214	4.2	4.5	10.4	14.7				
308	-0.5	0.272	5.2	3	11.6	14.7				
309	-0.5	0.447				13.8				
310	0.8	0.405				13.7				
311	0.7	0.1313	2.6	1.3	7.1					
312	0.6	0.1613	1.6	1.6	5.6	13.84				
313	-0.5	0.1874	2.3	2.1	11.5	13.53				
314	-0.5	0.1	1.7	1.7	4.2	14.01				
315	-0.5	0.284	6.5	8	15					
316	-0.5	0.234	3	2.7	5.1	14.7				
317	0.8	0.219	4.7	3.7	9.9	14.6				
318	-0.5	0.42	4.53	4.12	8.25	13.3				
319	-0.5	0.411	4.55	4.66	8.56	13.5				
320	-0.5	0.229	7.2	7.7	13					
321	0.5	0.565	13.1	13.4	15.1	11.4				
322	0.5	0.223	3.3	3.2	7.5	13.2				
323	1.3	0.763	13.22	12.56	12.56	11.8				
324	1.5	0.802	13.83	13.9	11.69	12				

Row number	Pheopigment (ug/l)	Poc (mg/l)	Toc (mg/l)	Doc (mg/l)	Dic (mg/l)	O2 (mg/l)	DRILL_WATER (% drilling water residue)	Other measurements	Drainage area	Sampling point order
325	1.4	0.323	5.8	4.9	0.8	12.3				
326	0.58	0.733	5.5	5.6	3.5	11.7				
327										
328	-0.5	0.094	11	12	28				2	1
329		0.141				7.2			2	1
330	-0.5	0.259	13.8	11.8	22	6.7			2	1
331	-0.5	0.303	14.62	7.34	1.67	6.1			2	1
332	0.49	0.21746	16.8	16.57	9.11	7.4			2	1
333	0.7	0.277	17.8	17.3	26.2	5.3			2	1
334		0.66432	15.69	18.95	26.5	4.5			2	1
335		0.184	21	19.9	26.4	3.9			2	1
336	0.59	0.26426	15.73	14.29	26.92	8.1			2	1
337	-0.5	0.11741	16.58	15.62	25.32	6.07			2	1
338	-0.5	0.1922	19.2	18.6	45.6	1.28			2	1
339	-0.5	0.1134	19.4	19.4	46.2	2.73			2	1
340			23	22	23				1	7
341		0.202	16.3	15.9	16.4	6.1			1	7
342		1.121	16.73	15.73	19.15	12.3			1	7
343	0.5	0.272	12.2	14.7	15.2	10.2			1	7
344	-0.5	0.396	9.18	14.01	1.22	9.6			1	7
345	-0.5	0.18009	17.59	11.67	2.75	11.1			1	7
346	-0.5	0.406	2.47	2.91	6	7.1			1	7
347	0.8	0.773	16.3	16.6	16	9.2	-0.03		1	7
348		0.63514	18.26	17.36	16.07	8.1			1	7
349		0.457	19.6	18.3	20.3	8.8			1	7
350	1.1		17.4	23.2	0.9	10.1			1	7
351	-0.5		20.5	20	1.6	10.2			1	7
352	-0.5	0.789	17.69	19.05	20.7	11.3			1	7
353	0.6	0.36117	6.05	20.62	20.31	12.6			1	7
354	6.2	1.06	20.1	15	20.7	12.2			1	7
355	23	0.79246	17.43	6.93	3.66	12.1			1	7
356	0.5	0.25325	21.75	21.21	22.58	9.67			1	7
357	-0.5	0.251	20.6	21	31.9	2.64			1	7
358	-0.5	0.2397	22.7	23	31.4	1.87			1	7
359			20						1	5
360		0.083	14	14	17	5.8			1	5
361		0.385				7.1			1	5
362	0.5	0.37	17.8	14	25.5	6.9			1	5
363	-0.5	0.405	19.57	18.92	20.12	5.6			1	5
364	0.88	0.18308	18.06	20.31	1.68	8.2			1	5
365	0.53	1.15	19.04	9.99	16.35	2.1			1	5
366	-0.5	0.385	22.8	22.3	16.6	6.1			1	5
367		0.52143	22.86	22.72	21.95	5.3			1	5
368		0.321	20.8	23.3	27.2	4.5			1	5
369	0.8		19.33	24.36	22.29	5			1	5
370	2.4	0.228	21.27	22.49	32.1	4.7			1	5
371	-0.5	5.67	25	24	23.87	5.6			1	5
372	-0.5	0.15247	16.6	21	33.4	1.6			1	5
373	-0.5	0.71081	22.06	8.65	5.79	8.3			1	5
374	-0.5	0.14608	23.09	23.31	28.18	4.91			1	5
375	-0.5	0.2794	20.4	20.6	39.1	3.05			1	5
376	-0.5	0.1717	21	20.6	38.4	5.85			1	5
377			17	18	27				1	4
378		0.16	15.4	16.2	20.3	2.5			1	4

Row number	Pheopigment (ug/l)	Poc (mg/l)	Toc (mg/l)	Doc (mg/l)	Dic (mg/l)	O2 (mg/l)	DRILL_WATER (% drilling water residue)	Other measurements	Drainage area	Sampling point order
379	-0.5	0.217	16.15	16.2	18.55	4.7			1	4
380	0.9	0.181	13.7	13.1	18.3	5.2			1	4
381	0.97	0.261	19.06	14.69	14.44	4.6			1	4
382	1	0.19602	19.79	18.88	5.08	7.8			1	4
383	1.31	1.09	16.72	11.22	23.82	3			1	4
384	1.1	0.272	22.3	16.3	17.3	5.4			1	4
385		0.21478	22.98	21.97	23.92	5.4			1	4
386		0.16	24.4	22.4	29.2	4.5			1	4
387	1.1		24.1	22.5	26.7	6			1	4
388	-0.5	0.526	19.47	19.72	36.5	7.2			1	4
389	-0.5	5.97	3.43	23.42	22.92	5.4			1	4
390	-0.5	0.23013	21	22.6	30.5	0.5			1	4
391	-0.5	0.37815	19.16	11.72	1.9	6.4			1	4
392	-0.5	0.12894	21.95	14.84	21.58	0.32			1	4
393	-0.5	0.5457	24.6	18.3	50.4	0.87			1	4
394	-0.5	0.1806	18.8	16.4	41.4	2.82			1	4
395			22	22	18				1	3
396		0.116	13.9	14.2	14	6.1			1	3
397		0.213				10.7			1	3
398	0.6	0.496	15.9	16.8	18.5	1			1	3
399	0.66	0.612	18.19	14.38	1.04	6.9			1	3
400	-0.5	0.399	19.3	19	17.6	6.5			1	3
401		0.46975	17.48	17.61	17.49	4.4			1	3
402		0.453	18.4	16.4	23.3	3.9			1	3
403	-0.5	0.36395	18.22	18.41	20.59	11.8			1	3
404	-0.5	0.27588	21.51	20.58	21.65	9.95			1	3
405	0.6	0.4397	21.6	20.5	23.5	9.16			1	3
406	-0.5	0.353	23.1	22.4	32.2	3.04			1	3
407			11	13	36				1	1
408		0.08	12.7	12.9	30.2	9.8			1	1
409		0.223	9.8	10	30	11.4			1	1
410	-0.5	0.317	11.5	11.7	29.5	10.3			1	1
411	1.73	0.467	13.01	12.26	3.99	6.6			1	1
412	-0.5	0.171	15.5	15.8	27.2	8.2			1	1
413		0.21647	15.94	16.14	26.03	5.5			1	1
414		0.777	17.8	15.6	36.7	2.1			1	1
415	-0.5	0.25275	12.68	8.03	5.06	8.3			1	1
416	-0.5	0.12848	11.84	11.42	33.15	4.13			1	1
417	-0.5	0.108	9.8	8.7	37.2	3.91			1	1
418	-0.5	0.0637	10	9	41.9	9.38			1	1
419			16	19	27				3	2
420		0.221	10	14.6	14.8	6.8			3	2
421		0.181				5.3			3	2
422	-0.5	0.253	13.6	8.5	2.6	5.3			3	2
423	-0.5	0.361	15.95	13.72	1.96	4.3			3	2
424	0.83	0.39602	21.56	22.62	1.75	3.1			3	2
425	1.11	0.985	19.18	10.91	19.7	1			3	2
426	0.6	0.412	16.8	17.6	9.4	4.5			3	2
427		1.01	19.7	18.54	22.68	3.7			3	2
428		0.789	20.4	11.1	8.4	2.2			3	2
429	-0.5	1.4102	16.6	16.7	15.2	0.4			3	2
430	-0.5	0.47053	13.93	4.07	14.61	9.5			3	2
431	0.56	0.46042	21.62	15.45	21.18	1.55			3	2
432	1.2	0.7425	22.2	22.3	36.3	1.02			3	2

Row number	Pheopigment (ug/l)	Poc (mg/l)	Toc (mg/l)	Doc (mg/l)	Dic (mg/l)	O2 (mg/l)	DRILL_WATER (% drilling water residue)	Other measurements	Drainage area	Sampling point order
433	-0.5	0.4438	13.4	22.2	43.6	-0.2			3	2
434			6	7.4	59				4	1
435		0.113	6.9	6.8	53.9	11.3			4	1
436		0.295	5.3	5.1	43	12.5			4	1
437	1.9	0.449	9.1	8.3	47.2	9.9			4	1
438	9.13	1.87911	11.84	14.02	2.67	8			4	1
439	0.69	0.35394	8.86	3.02	9.54	9.5			4	1
440	0.6	0.31644	6.38	6.94	42.5	7.97			4	1
441										
442										
443										
444										
445										
446										
447										
448										
449										
450										
451										
452										
453										
454										
455										
456										
457										
458										
459										
460							0.08			
461							0.6			
462										
463	-0.5		23	21	32					
464	-0.5	0.193	10	11	27					
465	-0.5	0.436	18	18	23					
466	-0.5	0.393	13	14	33					
467	-0.5	0.697	19	19	23					

Appendix 5

The use of the data in the modelling work

Table 1. Available hydrochemical site data handled in the modelling shown in Appendix 1

Available site data		Utilised in model version 1.1		Not utilised in model version 1.1
Data specification	**Reference**	**Analysis/Modelling**	**c.f. section**	**Motivation**
Cored borehole data				
Complete chemical characterisation Borehole name: KFM01A	AP-PF-400-02-38	All hydrochemical modelling and visualisation. Groundwater quality and representativeness.	3.8 and 5.5	
Hydrochemical logging Borehole name: KFM02A	AP-PF-400-03-38	All hydrochemical modelling and visualisation. Groundwater quality and representativeness.	3.8 and 5.5	Will not be used for complete hydrochemical modelling, possibly DIS? Flushing water content is very high (80-90 % in the lower half of the borehole)
Uranine analyses during core drilling Borehole name: KFM01A	AP-PF-400-02-03 P-03-32	DIS (Drilling impact study) Groundwater quality and representativeness.	3.8 and 5.5	
Uranine analyses during core drilling Borehole name: KFM02A	AP-PF-400-02-42 P-03-52	DIS (Drilling impact study) Groundwater quality and representativeness.	3.8 and 5.5	
Percussion hole data				
Samples from: Borehole name: KFM01A, percus. drilled part HFM01-08 SFM01-08	P-03-47 P-03-48 P-03-49	All hydrochemical modelling and visualisation. Groundwater quality and representativeness.	3.8 and 5.5	

Surface based data				
Precipitation	AP-PF-400-02-41	All hydrochemical modelling and visualisation. Groundwater quality and representativeness.	3.8 and 5.5	Draft version
Surface sampling	P-03-27	All hydrochemical modelling and visualisation. Groundwater quality and representativeness.	3.8 and 5.5	

Table 2-X. Available Forsmark site data used in the modeling shown in Appendix 2

Available site data		**Utilized in model version 1.1**		**Not utilized in model version 1.1**
Data specification	**Reference**	**Analysis/Modelling**	**c.f. section**	**Motivation**
Cored borehole data				
KFM01A Complete chemical characterization	All samples	Ion-ion plots	3.8	
	4480, 4481, 4484, 4520, 4524, 4538*	- pH sensitivity analysis	3.8	Samples without pH
		- Speciation-solubility calculations - Redox pairs calculations	5.5	
	4538	Mass balance and Mixing modelling	5.5	
KFM02A Complete chemical characterization	All samples (4398, 4397)	- Ion-ion plots - pH sensitivity analysis	3.8	
	4398	Mass balance and Mixing modelling	5.5	
Percussion hole data				
HFM01 Complete chemical characterization	All samples	Ion-ion plots	3.8	
	4114, 4115, 4116, 4172	-pH sensitivity analysis -Speciation-solubility calculations	3.8 5.5	
	4172	Mass balance and Mixing modelling	5.5	
HFM02 Complete chemical characterization	All samples (4169, 4170)	-pH sensitivity analysis	3.8	
		-Speciation-solubility calculations	5.5	
HFM03 Complete chemical characterization	All samples (4166, 4167)	Ion-ion plots	3.8	
	4167	-pH sensitivity analysis	3.8	
		-Speciation-solubility calculations	5.5	
		-Mass balance and Mixing modelling	5.5	

HFM04 Complete chemical characterization	All samples (4399, 4400, 4401)	- Ion-ion plots - pH sensitivity analysis - Speciation-solubility calculations	3.8 5.5	
HFM05 Complete chemical characterization	All samples (4433, 4434, 4435)	- Ion-ion plots - pH sensitivity analysis - Speciation-solubility calculations	3.8 5.5	
	4433	Mass balance and Mixing modelling	5.5	
HFM06 Complete chemical characterization	All samples (4463, 4464, 4465)	- Ion-ion plots - pH sensitivity analysis - Speciation-solubility calculations	3.8 5.5	
HFM08 Complete chemical characterization	All samples (4521, 4522, 4535)	- Ion-ion plots - pH sensitivity analysis - Speciation-solubility calculations	3.8 5.5	
	4521	Mass balance and Mixing modelling	5.5	
Other borehole data				
Soil Pipes Complete chemical characterization	SFM0001, 0002, 0003, 0005	- Ion-ion plots - Speciation-solubility calculations	3.8 5.5	
Geosigma wells Complete chemical characterization	PFM000037, PFM000152	Ion-ion plots	3.8	
Surface based data				
Rain Complete chemical characterization	PFM002457	Ion-ion plots	3.8	
Lake Water Complete chemical and biochemical characterization	All the samples	Ion-ion plots	3.8	
	4048,4049,4217,4218,4298,4299, 4440,4451,4058,4059,4206,4207, 4302,4303,4444,4447, 4056, 4205, 4315, 4452	Speciation-solubility calculations	5.5	
	Drainage Area 1	Ion-ion plots (mass balance)	Apendix	
Stream Water Complete chemical and biochemical characterization	All the samples	Ion-ion plots	3.8	

Table 1. Available Forsmark site data used in the modeling shown in Appendix 3

Available site data		**Utilized in model version 1.1**		**Not utilized in model version 1.1**
Data specification	**Reference**	**Analysis/Modelling**	**c.f. section**	**Motivation**
Cored borehole data				
KFM01A Complete chemical characterization	Drilling data: drilling water volume in/out, uranine concentration in drilling water volume in/out, water pressure during drilling	DIS modeling (Drilling Impact Study)	§ 4.0	Lack of complete data set of major elements and isotopes
KFM02A	4398, 4397	Explorative analyses, Surfer, Tecplot visualisation M3, AquaChem modelling	§ 2, 3, 5, 6	
Percussion hole data				
HFM01	4116, 4172	Explorative analyses, Surfer, Tecplot visualisation M3, AquaChem modelling	§ 2, 3, 5, 6	
HFM03	4167	Explorative analyses, Surfer, Tecplot visualisation M3, AquaChem modelling	§ 2, 3, 5, 6	
HFM05 Complete chemical characterization	4433, 4434, 4435	Explorative analyses, Surfer, Tecplot visualisation M3, AquaChem modelling	§ 2, 3, 5, 6	
Other borehole data				
Soil Pipes: SFM0001, SFM0002, SFM0003, SFM0005,	4219, 4316, 4403, 4220, 4318, 4405, 4221, 4317, 4404, 4432	Explorative analyses, Surfer, Tecplot visualisation M3, AquaChem modelling	§ 2, 3, 5, 6	

Surface based data				
Lake Water: PFM000074, PFM000087, PFM000097, PFM000107, PFM000117, PFM000127, PFM000135	4202, 4224, 4337, 4453, 4060, 4061, 4200, 4201, 4203, 4222, 4327, 4331, 4442, 4449, 4056, 4205, 4245, 4452, 4058, 4059, 4206, 4207, 4233, 4234, 4328, 4444, 4447, 4048, 4049, 4217, 4218, 4235, 4440, 4451, 4215, 4216, 4232, 4241, 4443	Explorative analyses, Surfer, Tecplot visualization M3, AquaChem modeling	§ 2, 3, 5, 6	
Stream Water: PFM000066, PFM000067, PFM000068, PFM000069, PFM000070, PFM000071, PFM000072, PFM000072, PFM000073	4045, 4208, 4223, 4454, 4057, 4204, 4242, 4339, 4459, 4046, 4213, 4238, 4343, 4457, 4055, 4211, 4244, 4342, 4455, 4210, 4240, 4456, 4209, 4239, 4460, 4042, 4214, 4243, 4345, 4458, 4043	Explorative analyses, Surfer, Tecplot visualization M3, AquaChem modeling	§ 2, 3, 5, 6	
Sea Water: PFM000062, PFM000063, PFM000064, PFM000065, PFM000082, PFM000083, PFM000084	4198, 4229, 4230, 4322, 4333, 4194, 4195, 4227, 4228, 4321, 4324, 4445, 4450, 4196, 4197, 4225, 4323, 4330, 4212, 4231, 4325, 4446, 4044, 4047, 4438, 4439, 4053, 4054, 4062, 4063	Explorative analyses, Surfer, Tecplot visualization M3, AquaChem modeling	§ 2, 3, 5, 6	

Note: Only the samples with major elements and isotopes analyzed can be used in the M3 modeling. Therefore, the samples, which are not listed in this table, didn't meet these criteria and could not be used for the hydrochemical evaluation, modeling and visualization.

	4050,4209,4460,4051,4210,4456, 4055,4211,4300,4455,4046,4213, 4301,4457,4057,4204,4313,4459	Speciation-solubility calculations	5.5	
	Drainage Area 1	Ion-ion plots (mass balance)	Apendix	
Sea Water Complete chemical and biochemical characterization	All the samples	Ion-ion plots	3.8	