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Äspö Hard Rock Laboratory

Compilation of groundwater chemistry data
January 1995 to April 1998

Anna Säfvestad, Svensk Kärnbränslehantering AB

Ann-Chatrin Nilsson, Inorganic Chemistry, KTH, Stockholm

April 1999

Svensk Kärnbränslehantering AB
Swedish Nuclear Fuel
and Waste Management Co
Box 5864
SE-102 40 Stockholm Sweden
Tel 08-459 84 00
+46 8 459 84 00
Fax 08-661 57 19
+46 8 661 57 19

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Ann-Chatrin Nilsson, Inorganic Chemistry, KTH, Stockholm

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Abstract

The present report contains a compilation of groundwater chemistry data collected at the investigation site Äspö between January 1995 and April 1998. The period starts with the change over to the operational phase of the Äspö Hard Rock Laboratory. The report gives a short account on sampling procedures, analytical methods, quality control and data management.

The compiled groundwater data include major components, some minor components (trace metals, nutrient salts) and isotopes (Oxygen, Hydrogen, Uranium, Thorium, Radium and Radon). The data are presented in diagrams from each borehole, showing evolution with time, and compiled in tables. The data originate from monitoring the chemical composition of the groundwater in a number of boreholes in the Äspö HRL access tunnel and in a few of the surface boreholes on Äspö island.

Sammanfattning

Denna rapport innehåller en sammanställning av grundvattenkemi data från Äspö under perioden Januari 1995 till April 1998. Perioden startar vid övergången till driftskede i berglaboratoriet på Äspö. Rapporten redogör kortfattat för provtagning, analysmetoder, kvalitetskontroll och datahantering.

Datasammanställningen inkluderar huvudkomponenter, vissa spårelement och närsalter samt isotoper av Syre, Väte, Uran, Thorium, Radium och Radon. Data presenteras dels borrhålsvis i form av diagram som speglar utvecklingen med tiden och dels i datatabeller. Data härrör från prov som tagits vid monitering/bevakning av grundvattnets kemiska sammansättning i ett flertal borrhål i tillfartstunneln till Äspö berglaboratorium och i några ytborrhål på Äspö.

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1 Introduction

1.1 Background

Groundwater chemical sampling and analyses started with the Pre-investigation Phase at Äspö in 1987. Ten shallow percussion drilled boreholes and thirteen deep core drilled boreholes were sampled, a few of them more carefully than others. A hydrochemical model was developed on the basis of the obtained data. The model also integrated the existing geological model and a qualitative understanding of the general hydrology. At the end of the Pre-investigations, 1990, this understanding of the groundwater system was used to predict conditions during the tunnel construction [1, 2].

During the Tunnel Construction Phase from 1990 to 1994, groundwater was sampled systematically from boreholes drilled into the tunnel wall. On the basis of the first sampling programme in all holes with a water inflow exceeding 0.5 l/min, some boreholes were selected for regular sampling. Thus a time series of groundwater data was obtained. During the Tunnel Construction Phase 68 tunnel boreholes were sampled, out of which 16 were sampled more than twice [3, 4, 5, 6]. Further, the groundwater chemistry was monitored regularly in core drilled surface boreholes. This was done in order to monitor changes in the water composition that might occur due to the construction of the tunnel [3, 7]. Initially, sampling was performed in most of the core drilled surface boreholes, but the number was decreased due to draw down of the groundwater level as the tunnel construction proceeded.

At the beginning of the Operational Phase, a new monitoring programme was introduced, aiming to cover the hydrochemical conditions with respect to time and space within the Äspö HRL. This programme should provide information for determining where, within the rock mass, the hydrochemical changes are taking place and at what time equilibrium conditions are re-established.

A few of the regularly sampled tunnel boreholes were included in the monitoring programme together with a few surface boreholes and some of the boreholes drilled within the programme of selecting experimental sites.

The monitoring programme should provide the data necessary in order to check that the Pre-investigation and the Construction Phase models are valid, as well as it should provide new data for further development of the hydrogeochemical model of Äspö.

1.2 Objectives

The aim of this report is to compile the groundwater analysis data obtained between January 1995 and May 1998 and further to describe the equipment and the methods which were used for sampling, analyses, data management and quality control. The Tritium results obtained during the time period are considered unreliable and are therefore excluded from the report. The report does not discuss any geochemical evaluation or modelling.

Analyses from boreholes with less than 3 sampling occasions are only reported in the data tables in the Appendices 2 and 3.

2 Description of the sampling site, Äspö

2.1 Location

The investigation site of Äspö and the Äspö Hard Rock Laboratory (HRL) is situated a few kilometres north of the nuclear power plant of Simpevarp in south-eastern Sweden (Figure 2-1). The HRL comprises an extensive tunnel system; the tunnel excavation is shown in the Figure 2-1 as a projection on the ground surface. Excavation started in October 1990 and the Construction Phase was completed in 1994.

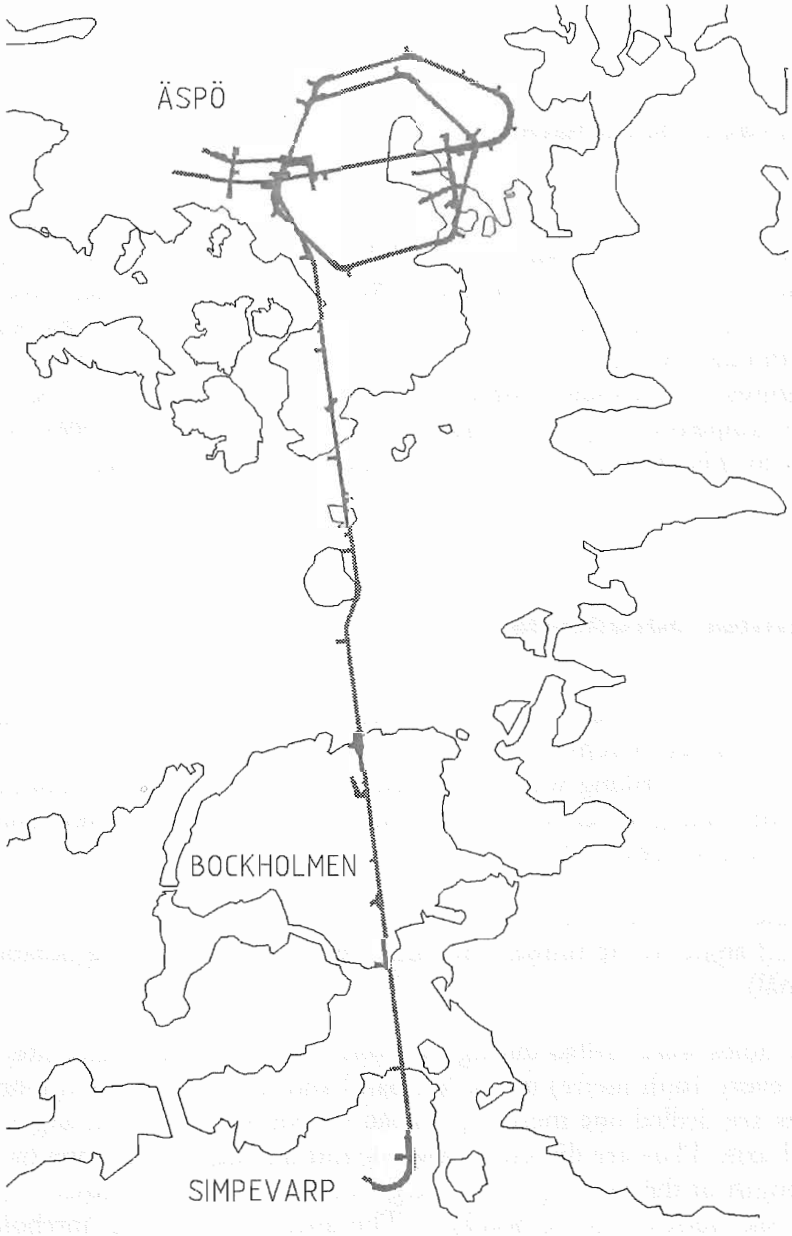


***Figure 2-1** Äspö tunnel, a top view*

A side-view section of the Äspö HRL showing the access ramp, the tunnel spiral and the boreholes is given in Figure 2-2. The HRL is situated at a maximum depth of 460 m below the ground surface of the Äspö island. The tunnel has a total length of about 3.6 km and commences at the ground surface on the mainland close to the nuclear power plant.

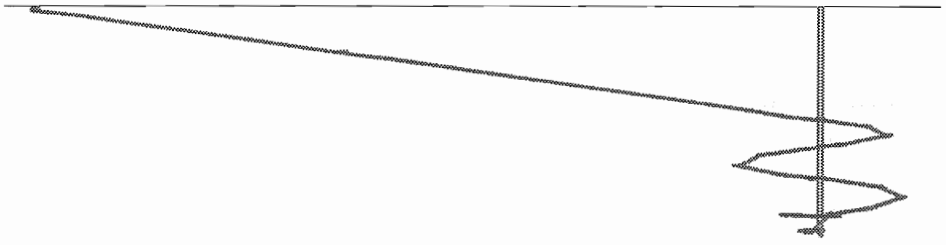


Figure 2-2 Äspö tunnel, a side view

2.2 Surface boreholes

In the Äspö area (i.e. comprising Äspö island and the adjacent area of Ävrö, Laxemar etc) there are 16 core-drilled boreholes and 21 percussion drilled boreholes. The lengths of the boreholes vary between 22 m and 1700 m and most boreholes have been instrumented with rubber packers shortly after drilling. In this way the boreholes are separated hydraulically into two or more sections. The location of the boreholes is shown in Figures 2-3 (KAS09, HBH01, -02, -05) and 2-4 (KAS03). The surface boreholes that were sampled during the considered time period (January 1995 to April 1998), and included in this report, are listed and marked with (S) in Table 2-1.

2.3 Tunnel boreholes

A large number of boreholes have been drilled in the tunnel. There are three types of boreholes; core drilled boreholes, percussion drilled probing holes and other percussion drilled boreholes. All drilling water is tagged by a fluorescent dye, Uranine (0.2 mg/l). The content of drilling water in the water samples (i.e. degree of contamination) can be determined down to about 0.1 %.

The core-drilled boreholes were drilled for special purposes and projects and can be of any length and angle to the tunnel; the initial letter in the borehole notation (idcode) is K (kärnborrhål).

The probing holes were drilled during the construction of the tunnel after each fourth blasting (i.e. every 16:th metre) in the left hand and in the right-hand tunnel walls. The probing holes are drilled one metre up on the tunnel wall and at an angle of 20° to 45° to the tunnel axis. They are directed forwards and parallel to the plane of the tunnel floor. The length of the probing holes are generally around 20 metres and a packer is placed about six metres into the borehole. The initial letter in the borehole notation (idcode) is S (sonderingshål).

The percussion boreholes were drilled for special purposes and projects and can be of any length and angle to the tunnel. The initial letter in the borehole notation (idcode) is H (hammarborrhål).

The tunnel boreholes that have been, and are presently selected and included in the monitoring programme for the operational phase, are given in Table 2-1 together with the boreholes that have been sampled for other projects. The location of the boreholes is shown in Figure 2-3, 2-4 and 2-5.

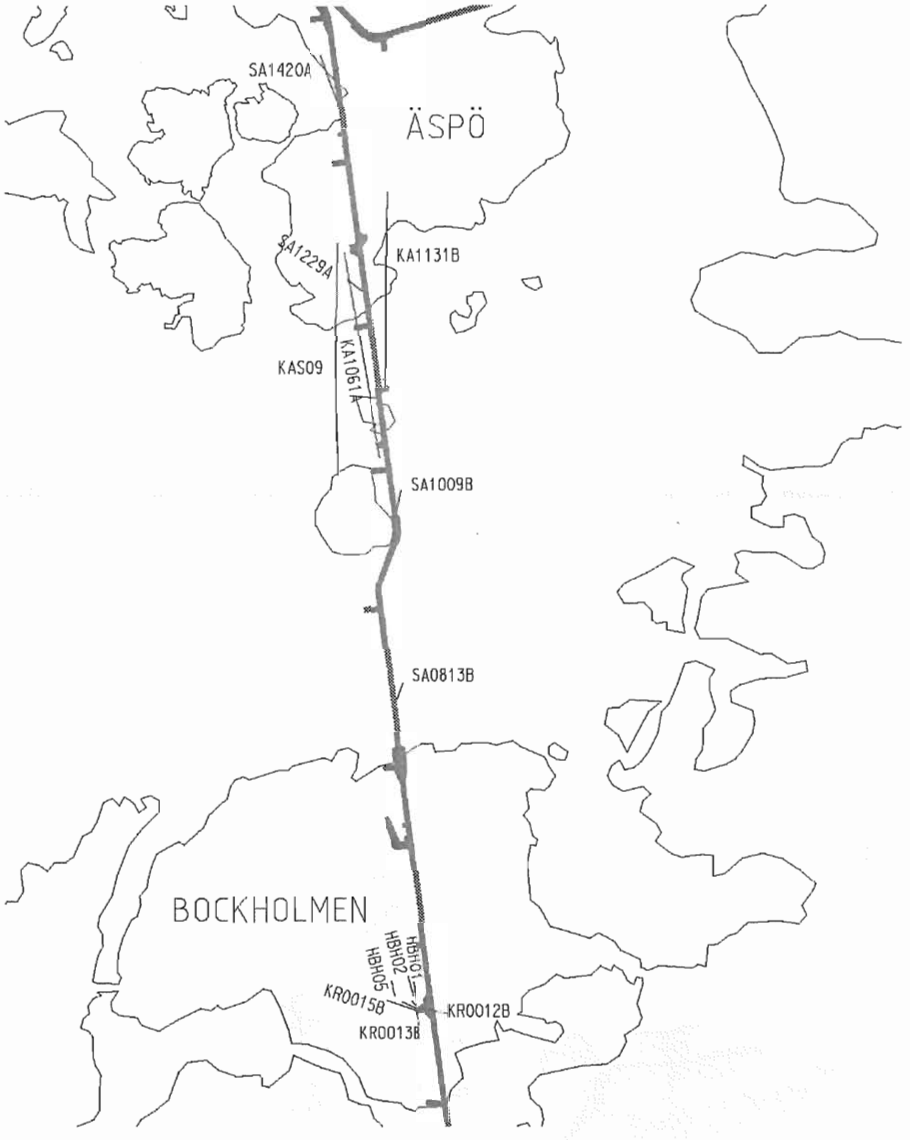


Figure 2-3 *Location of boreholes; access ramp and surface boreholes*

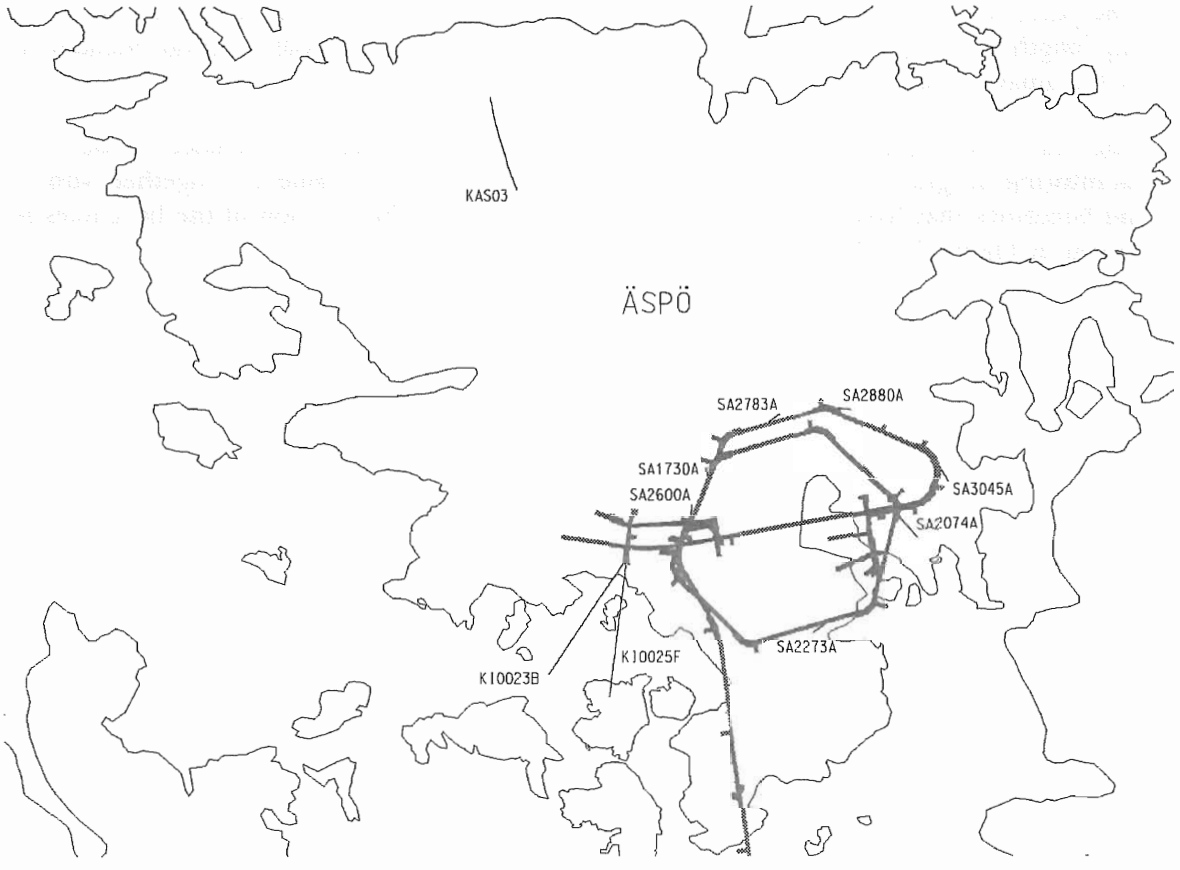


Figure 2-4 *Location of boreholes; spiral and surface boreholes named SA-, KI- and KAS03*

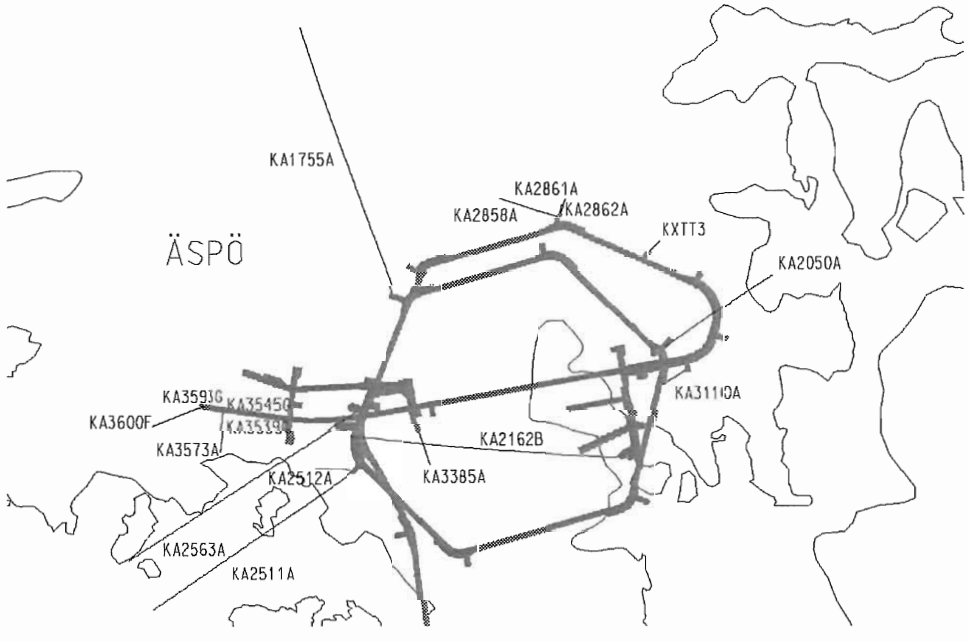


Figure 2-5 *Location of boreholes; spiral boreholes named KA- and KXTT3*

Table 2-1. Boreholes and sections sampled between January 1995 and April 1998

Borehole	Section (m)	Comment on sampling occasions or frequency
HBH01 (S)	31.0 - 50.6	one occasion, 950324
HBH02 (S)	21.0 - 32.4	one occasion, 950324
HBH05 (S)	11.0 - 22.0	one occasion, 950324
HD0025A		March 1998
KA1061A		included March 1998
KA1131B		included Oct. 1997
KA1755A	88.0 - 160.0	included Oct. 1995
KA2050A	No. 1	included Sept. 1997
KA2162B	No. 1	included Sept. 1997
KA2511A	Several sections	included March 1998
KA2512A		Chemlab experiment, March 1997
KA2563A	Several sections	included Sept. 1997
KA2858A	39.8 - 40.8	one occasion, 980310
KA2861A		Feb. 1998, REX
KA2862A	Several sections	Sporadic, REX
KA3110A	20.05 - 28.63	950310, included March 1998, (SELECT)
KA3385A	32.05 - 34.18	950111, included March 1998
KA3539G		March 1998, (PROTOTYPE)
KA3545G		March 1998, (PROTOTYPE)
KA3573A	4.5 – 17	March 1998, (PROTOTYPE)
KA3573A	18 - 40.7	March 1998, (PROTOTYPE)
KA3593G		March 1998, (PROTOTYPE)
KA3600F	4.5 – 21	March 1998, (PROTOTYPE)
KA3600F	22 - 50.1	March 1998, (PROTOTYPE)
KAS03 (S)	107 - 252	included March 1997
KAS03 (S)	553 - 626	included March 1997
KAS09 (S)	116 - 150	951012, included March 1997
KI0023B	Several sections	Oct. 1997 - March 1998, TRUE Block Scale
KI0025F	86 – 88	Sept. 1997, TRUE Block Scale
KI0025F	158 – 168	Sept. 1997, TRUE Block Scale
KI0025F	164 –168	March 1998, TRUE Block Scale
KR0012B	5.0 - 10.57	monitored also during construction phase
KR0013B	7.05 - 16.94	monitored also during construction phase
KR0015B	19.82 - 30.31	monitored also during construction phase
KXTT3	12.42 - 14.42	sampled since April 1996 (TRUE-1)
SA0813B	5.6 -19.7	monitored also during construction phase
SA1009B	6.0 - 19.5	monitored also during construction phase
SA1229A	6.0 - 20.5	monitored also during construction phase
SA1420A	6.0 - 50.0	monitored also during construction phase
SA1730A	5.6 - 20.0	monitored also during construction phase
SA2074A	6.0 - 38.7	monitored also during construction phase
SA2273A	5.8 - 20.0	monitored also during construction phase
SA2600A	5.8 - 19.4	monitored also during construction phase
SA2783A	5,8 - 19.9	monitored also during construction phase
SA2880A	11.92 -13.92	monitored also during construction phase
SA3045A	0 - 20.7	951025, included March 1997

A list of all collected samples from 1995-01-01 to 1998-05-01 is given in Appendix 1.

2.3 Weirs

In order to measure the water flow in different tunnel segments, the inflowing water is collected at certain locations by ditches across the tunnel and then diverted to a gauging box equipped with a v-notch weir. Monitoring of inflowing water to the tunnel includes continuous recording of electrical conductivity in the pump sumps and in a few weirs, as a part of the Hydro Monitoring System (HMS). Water samples for chemical analyses are collected from the v-notch overflow.

Table 2-2. Weirs sampled between January 1995 and May 1998

Gauging box	Tunnel section (m)	Comment
MA0682G	0 – 682	
MA1033G	692 – 1033	
MA1232G	1033 – 1232	
MA1372G	1232 – 1372	
MA1584G	1372 – 1584	
MA1659G		Water from the side tunnel
MA1745G	1584 – 1745	Water from the side tunnel at MA1659G is not included.
MA1883G	1745 – 1883	
MA2028G	1883 – 2028	
MA2178G	2028 – 2178	
MA2357G	2178 – 2357	
MA2496G	2357 – 2496	
MA2587G		Water from the elevator shaft (TH: 220-333 m) and from a sump inside the gate in the side tunnel.
MA2699G	2496 – 2699	
MA2840G	2699 – 2840	Water from side tunnel collected at MA2587G is not included
MA2994G	2840 – 2994	
MA3179G	2994 – 3179	
MA3384G		Water from the elevator shaft (TH: 340-450 m), from the ventilation shaft for incoming air (TV: 220-450 m) and from the ventilation shaft for outgoing air (TW: 0-450 m)
MA3411G	3179 – 3426	Water from the side tunnel collected at MA3384G is not included.
MA3426G	3426 – 3600	Water from parts of tunnel J at approx. 3510 m is included
MF0061G		Water from tunnel F 0 - 61 m and from parts of tunnel J and tunnel G.

A list of all collected samples between 1995-01-01 and 1998-05-01 is given in Appendix 1.

2.5 Projects

Several of the Äspö HRL experiments require groundwater sampling and analyses. The projects, which have been going on during the time period covered in this report, are listed below and a short description is given. Groundwater data reported elsewhere are not included in this report.

- SELECT
  The SELECT Project was an investigation programme to select experimental sites for other planned projects. This included groundwater sampling in a number of core-drilled boreholes drilled especially for the project. The boreholes involved were KA2862A, KA2858A, KA3005A, KA3010A, KA3105A, KA3110A and KA3067A.The sampling was performed from December 1994 to March 1995. The analytical data obtained during 1995 are included in this report.

- Demonstration Repository
  A tunnel branch was constructed to be used for tests and demonstrations of final repository techniques. During the construction work, sampling of groundwater for water and gas analyses was performed in borehole KZ0027A. The main purpose with the sampling was to study if blasting and other activities during the construction of a tunnel effect the groundwater composition and/or gas composition in the adjacent bedrock. The groundwater data are included in report HRL-97-15.

- TRUE
  The objective of the Tracer Retention Understanding Evaluation Project (TRUE) is to further develop the understanding of radionuclide migration and retention processes. The TRUE-1 tests are performed over distances of about 5 m in a fracture at approximately 400 m depth. The boreholes sampled within TRUE are KXTT1, KXTT2, KXTT3, and KXTT4. The groundwater chemistry data obtained between November 1995 and April 1996 are reported as a Technical Note TN-97-08t. More recent data are included in this present report.

- TRUE Block Scale
  The TRUE block scale project aims at studying the tracer transport in a fracture network over distances up to 50 m. The boreholes sampled within TRUE BS are KA2511A, KA2563A, KA3005A, KA3067A and SA2880A. Further, two new boreholes (KI0023B and KI0025F) were drilled during 1997.

- REX
  The Detailed Scale Redox Experiment (REX) focussed on the role of oxygen trapped in the tunnel when the repository is closed. Questions addressed regarding the role of oxygen are: Will oxygen penetrate into the rock matrix during construction and operation and, if so, how much of the rock will be oxidised and how long time will it take before oxygen is consumed? The emphasis of the field experiment is to maintain stagnant groundwater in contact with a fracture surface. The boreholes sampled within the REX project are KA2861A and KA2862A. Some of the analytical data are included in this report.

- Prototype
  A Prototype Repository will be constructed in order to simulate the sequence of deposition starting from detailed characterisation of the host rock to restoration of the backfilled deposition holes and tunnel. The characterisation of the experimental site includes collection of water samples for chemical analysis. The data from the first sampling occasion in March 1998 are presented in this report. The sampled boreholes are KA3539G, KA3545G, KA3593G, KA3573A and KA3600F.

- Radionuclide Retention (with the Chemlab probe)
  The retention of radionuclides in the host rock is the most effective mechanism in the event of the engineering barriers failing. The Chemlab probe was constructed in order to study in situ radionuclide retardation processes in boreholes. The Chemlab experiments are carried out in borehole KA2512A. This borehole was sampled twice and the analytical data are included in this report.

3 Methods

3.1 General

Within the various SKB investigations/projects, water sampling and chemical analyses are performed by following standardised procedures categorised into several classes. The complexity of the sampling (number of bottles, filtering, preservation etc) and the extent of the analysis are defined by the class number (1, 2, 3, 4 or 5).

The sampling and analysis classes are integrated in the site activity database SICADA were each class is an activity type of its own.

The five chemistry classes differ in respect to the number of components/parameters measured.

Class 1, Class 2 and Class 3 are simple procedures. Water samples can be collected in any clean bottle of appropriate volume. Class 4 includes on-line filtering, preservation and special sample bottles. Class 5 includes all class 4 analyses and, in addition, one or more of the so-called special analyses (isotopes, trace elements etc.) performed by external laboratories. These determinations are all optional and can be combined to suit the purpose of the investigation.

3.2 Sampling

3.2.1 Equipment

The equipment used to collect samples from the boreholes located in the tunnels consists of valves, tecalan tubing, Swagelok stainless steel fittings, pressure gauges, on-line filters (Nucleopore, complete with holder and tubing) and high capacity filters (Colly Company). The pore size of the filters is 0.45 μm. Equipment used for sampling from the surface is essentially the same but with the addition of a pump and borehole instrumentation (permanently installed packers).

3.2.2 Preparation

The borehole sections are flushed prior to sampling, such that the quantity of water that is removed from the borehole is equivalent to five times the volume of the test section. This is done in order to collect fresh and representative formation water from the water-bearing fractures, and not a mixture containing residual water that has been in the borehole and the tubing system.

Before the sample is collected, an accurate measure of the sampling flow-rate is obtained using a graduated plastic vessel and a stopwatch.

3.2.3 Sample treatment and preservation

Environmental isotopes: Unfiltered water is collected in a 500 ml glass bottle which is prepared by drying at 105°C for 4 hours. The tecalan tube leading from the borehole is inserted into the bottle and the end is kept near the bottom. The water is allowed to flow. When the volume of the overflow is approximately twice the volume of the bottle, the tecalan tubing is slowly withdrawn, to ensure that all the water is exchanged as the tube is removed.

Ammonium: Two 25 ml portions of unfiltered water are collected directly from the tecalan tubing with a syringe. The sample portions are transferred to 50 ml volumetric flasks which have been cleaned with the analysis reagents. If the ammonium concentration is high, a smaller amount of water is collected.

Hydrogen sulphide: Each water sample is collected in two Winkler bottles, with calibrated volumes, using the same water displacement method as described for the environmental isotopes. The samples are preserved by adding 0.5 ml 1 M ZnAc and 0.5 ml 1 M NaOH.

pH, conductivity, alkalinity, chloride, uranine, sulphate, bromide and DOC: The water is filtered on-line into plastic bottles through high capacity filters. Four 250 ml sample portions are collected. One of the bottles is used for analysis in the Mobile Field Laboratory, two bottles are sent for DOC analysis, and finally one bottle is used as a back-up reference.

Major cations, trace metals, ferrous iron and total iron: The water is filtered on-line with membrane filters (0.45 mm) into acid-cleaned plastic bottles. The bottles are prepared by adding acid (1 ml supra pure HCl per 100 ml water) before the sampling. One 500 ml sample portion is used for the analysis and two 100 ml portions are collected as back-up references.

3.2.4 Possible sampling errors

An inappropriate sampling procedure can result in samples that are not representative for the groundwater in the sampled borehole section. Sampling of the surface boreholes can be more critical in this respect than sampling in the tunnel boreholes where no pumping is required. Too efficient pumping or insufficient flushing of the boreholes are two reasons for such errors.

A second type of error is due to contamination or changes/reactions within the samples; these are described in the list of sensitive components/parameters below.

pH: Errors in the pH-values due to pressure changes and their influence on the carbonate system can be expected. Furthermore, the pH-measurement is carried out after collection and transport to the mobile laboratory. It is often one or two hours between the sampling and the measurement.

Hydrogen carbonate (Alkalinity): Changes in the HCO_3^--concentration can take place if the time between sampling and analysis is excessive. Generally, the alkalinity titration is performed on the sampling day which is considered satisfactory.

Ferrous and total iron: Broken filters (too high pressure) can cause erroneous results if not discovered. Oxidation of ferrous iron will take place if the time between sampling and analysis is excessive. If possible, the spectrophotometric analysis of iron is performed on the sampling day, which is considered satisfactory. Oxidation and precipitation of all the iron present will take place if, by mistake, a sample is collected in a bottle without added acid.

Ammonium: The risk for contamination by the air in the tunnel, or by the syringe used to take the sample portion, is pronounced. There are some difficulties to collect accurate and reproducible volumes with a syringe.

Hydrogen sulphide: It is important to collect the water in such way that no air is enclosed in the bottle or is dissolved in the sample portion. Degassing or oxidation during sampling can lose hydrogen Sulphide.

DOC (Dissolved Organic Carbon): Bacterial growth in the samples will cause errors. Long storage times at room temperature, or long transport times, can cause erroneous results. To combat these problems the samples are kept frozen until transport to the laboratory.

Tritium, Oxygen-18 and Deuterium: There is a risk of contamination by humidity in the air. The water is sometimes collected in 100 ml dried plastic bottles (early samples). These bottles are not completely gas tight and the storage time before transport to the laboratory must therefore be as short as possible.

Radon: If the water flow rate is low, some Radon can be lost during sampling. The container (5 litres) has to be completely filled and sent immediately to the laboratory.

Trace metals: It is very difficult to avoid contamination by common trace metals like Al, Cu, Cr, Co, Ni, Pb and Zn. Sampling for analysis of these elements therefore requires special borehole instrumentation and equipment which generally are not available. These elements are included in the ICP-MS results reported by the consulted laboratory/laboratories, but are reported neither in the present report nor in the database SICADA.

Uranine (drilling water residue): Uneven mixing of uranine in the drilling water or inaccuracy in the uranine addition to the drilling water will give an erroneous initial value for calculation of the drilling water residue in the collected sample. Long storage time of the sample under daylight conditions before performing the fluorescence measurement can cause decomposition of the fluorescent compound.

3.3 Analyses

3.3.1 Laboratories and methods

Analyses are performed in the Mobile Field Laboratory stationed at Äspö HRL and by consulted external laboratories. The Mobile Field laboratory and its equipment are described by Almén et al [10]. The laboratories, methods and measurement uncertainties are listed in Table 3-1. The determination of HCO_3^- (alkalinity titration), ferrous iron, total iron and ammonium and the pH-measurements is performed immediately after sampling.

Table 3-1 List of laboratories, analysis methods, detection limits and measurement uncertainties

Components /Parameters	Laboratory	Method / SIS-Standard no.	Detection limit or range	Measurement Uncertainty
pH	MFL	Potentiometric -	0 - 14	±0.1 pH unit
Conductivity			0 - 10 000	±5%
Cl		Mohr titr. (SIS 028120)	mS/m	±5%
Cl		IC	10 mg/l	±10%
HCO_3		Alkalinity titr. (SIS 028135)	0.5 mg/l 0.6 mg/l	±5%
Na, K,	OOK KTH &	ICP – AES	0.1 mg/l	± 5 %
Ca, Mg, S,	SGAB		< 0.1 mg/l	± 5 %
Mn, Fe, Si, Li,			< 0.03 mg/l	± 5 %
Sr			< 0.005 mg/l	± 5 %
SO_4,	MFL	IC	0.05 mg/l	± 10 %
Br			0.1 mg/l	± 10 %
Fe (tot)	MFL	Spect. (Ferrozine)	0.002 mg/l	± 10 %
Fe(+II)		Spect. (Ferrozine)	0.002 mg/l	± 10 %
HS^-		Spect. (SIS 028115)	0.01 mg/l	± 10 %
NH_4-N		Spect. (SIS 028134)	0.005 mg/l	± 20 %
DOC	IVO HU	UV oxidation, IR	0.2 mg/l	± 0.1 mg/l
^3H	IFE	Natural decay counting	8.4 TU	± 4.2 TU
^2H		MS		± 1.0*
^{18}O		MS		± 0.2 *
^{14}C age	Tandem lab.	Accelerator measurement	-	-
PMC			-	-
^{13}C			-	-
U and Th isotopes	Radiofys, Lund Studsvik	Chem. Sep. and Alfa-spectrometry	-	± 30 %
Ra and Rn isotopes	Studsvik	Chem. Sep. and Alfa-spectrometry, Gamma spectrometry	- -	- -
Trace metals	SGAB Studsvik	ICP-MS** INAA	depending on element	± 15 - 20 %

* The unit is "per mill deviation from SMOW (Standard Mean Oceanic Water)"

** In June 1997 HR ICP-MS was introduced for trace metals at SGAB.

Abbreviations and explanations

titr.	Titrimetric method
IC	Ion Chromatography
ICP-AES	Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma Mass Spectroscopy
DOC	Dissolved Organic Carbon (filtered sample)
UV-oxidation, IR	UV-oxidation and IR-measurement
MS	Mass Spectroscopy
INAA	Instrumental Neutron Activation Analysis

Laboratories

MFL	The Mobile Field Laboratory, Äspö
OOK KTH	Dept. of Chemistry, Inorganic Chemistry, Royal Institute of Technology
SGAB	Svensk Grundämnesanalys AB, Luleå
IFE	Institutt For Energiteknikk, Kjeller, Norge
IVO	IVO Technology Centre, Vantaa, Finland
HU	Dept. of Applied Chemistry and Microbiology, University of Helsinki
Radiofys. Lund	Radiation Physics Department, Lund University
Studsvik	Studsvik Nuclear AB, Nyköping
Tandem	Tandemacceleratorlaboratoriet, Uppsala

3.3.2 Possible sources of analysis errors

Generally, the high concentration levels in many of the groundwater samples can cause difficulties or errors in several analytical methods. Other possible sources of errors are listed below:

pH: The groundwater often maintain a temperature of around 15 centigrade. The gradual warming of the sample and temperature differences between calibration standards and sample, which can be hard to avoid, will cause errors.

Hydrogen Carbonate (Alkalinity): In some cases, foaming samples cause slow mixing which makes it difficult to see the titration end point. Samples from boreholes HBH02 and HBH05 are often of this type.

Bromide: The bromide determinations by ion chromatography are sometimes difficult if the chloride peak is very dominant. Consequently, the samples are normally diluted to a chloride concentration below 300 mg/l. The chloride concentrations of the calibration standards are matched to be similar to the samples.

Total and ferrous Iron: Samples with a colloidal fraction that passes through the filters will cause disagreement between the ICP determination and the spectrophotometric method. The colloids may be excluded, or only partly included in the results of the spectrophotometric method, but are included in the total iron determined by ICP.

Ammonium: There is a high risk for contamination from air, reagents or deionised water. Precipitation causes difficulties in samples with high Calcium and Magnesium concentrations.

Hydrogen Sulphide: Precipitation causes problems in some waters with high Calcium concentrations.

Potassium: The ICP determination has a low sensitivity and furthermore, ionisation effects can cause errors.

3.4 Routines for quality control and data management

As can be seen from Table 3-1, several components are determined by more than one method and/or laboratory. Moreover, control analyses by an independent laboratory are performed routinely on each fifth or tenth collected sample (ICP).

All analytical results are stored in the SICADA database. The applicable hierarchy path Groundwater Chemistry/Analyses/Water in the database contains two types of tables, raw data tables and final data tables.

Data on basic water analyses are inserted in raw data tables for further evaluation. The evaluation results in a final data set for each sample. These data sets are compiled in a final data table named "water_composition". The evaluation is based on:

- Comparison between the results from different laboratories and/or methods. The analyses are repeated if a large disparity is noted (generally more than 10%).
- Calculation of charge balance errors. Relative errors within ±5 % are considered acceptable. The expression for the relative charge balance error is:

$$\text{Rel.error (\%)} = 100 * \frac{(\Sigma\text{cations (equivalents)} - \Sigma\text{anions (equivalents)})}{(\Sigma\text{cations (equivalents)} + \Sigma\text{anions (equivalents)})}$$

- General expert judgement of plausibility based on earlier results and experience.

All results from special analyses of trace metals and isotope ratios are inserted directly in final data tables. In those cases where the analyses are repeated or performed by more than one laboratory, a "best choice" notation will indicate those results which are considered most reliable.

An overview of the data management is given in Figure 3-1.

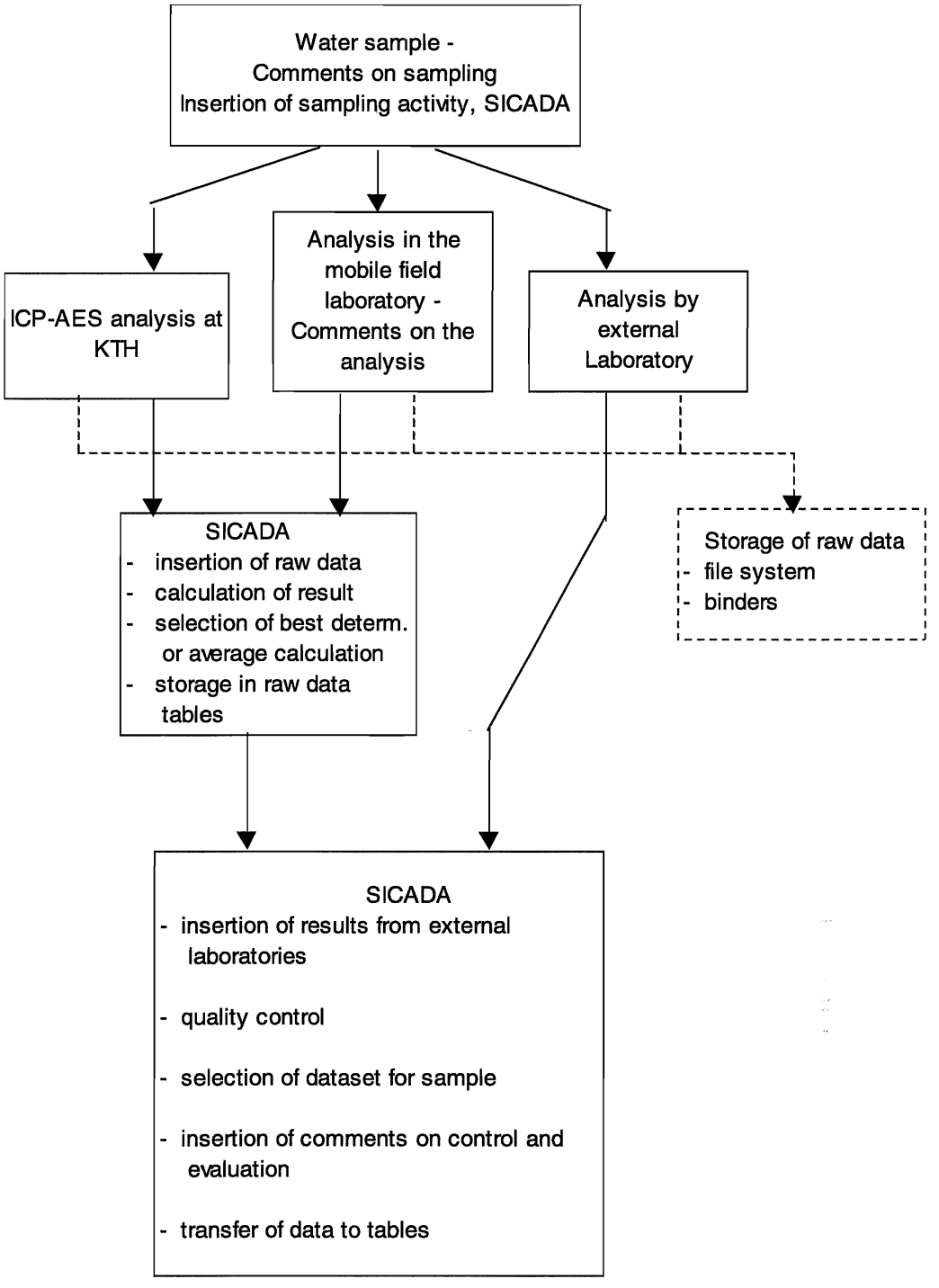


Figure 3-1 *Overview of data management*

4 Results

4.1 General

Chapters 4.2 - 4.4 present the analytical results for boreholes that are sampled at more than three occasions during the time period treated in this report. These boreholes have generally been sampled according to class 4 or class 5 and have more or less complete data sets. The data are divided into three different data groups:

- Basic water analyses together with Tritium, Deuterium and Oxygen-18
- Carbon isotopes and a relative C-14 age
- Special analyses of trace metals and heavy isotopes

Within the first group, the data are presented for each of the 19 boreholes concerned. The amount of data is more limited for the next two groups and only a few boreholes need to bee considered. Complete compilations of the analytical data for all boreholes are given in APPENDIX 2 (samples of class 1 and 2) and APPENDIX 3 (samples of class 3, class 4 and class 5). An explanation to parameter names is given in Appendix 4.

4.2 Analysis quality

4.2.1 Basic water analysis

Comparisons between results from different laboratories show that the agreement is acceptable in most cases. Generally the concentrations of each controlled component agree to within 10 %, although this is to a large extent depending on the element in question and its concentration.

The reported DOC determinations should be considered uncertain since the two contracted laboratories (see Table 3-1) have reported results that differ considerably. The reason for the disagreement can be due to the differences in the analytical methods used. The lower concentrations reported by IVO have been selected throughout the whole monitoring period.
Forty out of 120 samples were analysed by both laboratories. The results from Helsingfors University are plotted against the results from IVO in Figure 4-1.

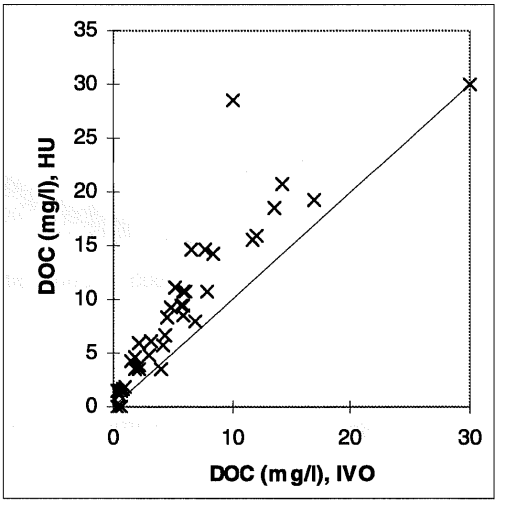


Figure 4-1 Plot of DOC results from Helsingfors University against results from IVO

Figures 4-2 to 4-5 illustrate the consistency of the analysis; Figure 4-6 shows the distribution of the relative charge balance errors. The figures are based on the data compilation in Appendix 2, table 2-1 (only Figure 4-2) and Appendix 3, table 3-1.

The chloride concentrations and the electric conductivity values are plotted in Figure 4-2. As shown, deviation from the regression line is rather small.

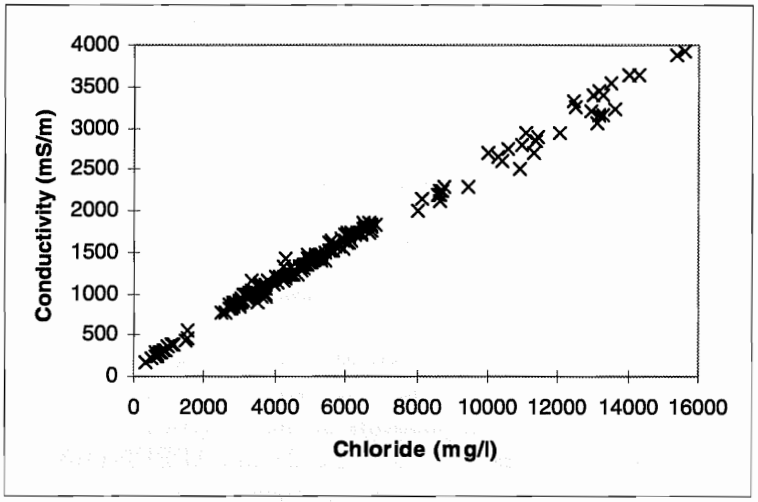


Figure 4-2 *Plot of electric conductivity versus chloride*

The chloride/bromide ratio can be used as an indication to the origin of the groundwater. A plot of bromide versus chloride is also a rough control of the bromide. Points that differ significantly from the linear trend are most probably erroneous. The bromide and the chloride concentrations are plotted in Figure 4-3. As shown, there are no extreme deviations from the regression line. Generally, the chloride/bromide ratio decreases with depth from about 300 to about 120.

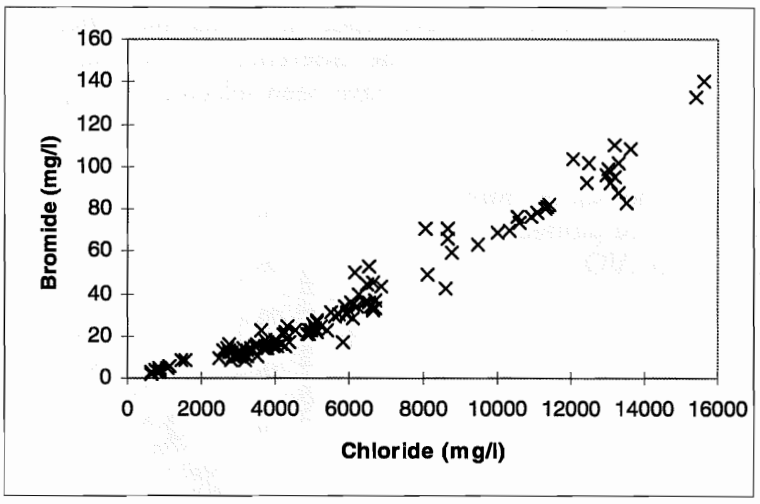


Figure 4-3 *Plot of bromide concentrations versus chloride concentrations*

Sulphate (or Sulphur) and Iron are components which were determined by two different methods. Sulphur concentrations determined by ICP were recalculated to Sulphate concentrations. Any Sulphide present in the water sample was driven off as Hydrogen sulphide, with Nitrogen gas before the ICP measurement. Comparison of the results from ICP and Ion Chromatography is shown in Figure 4-4.

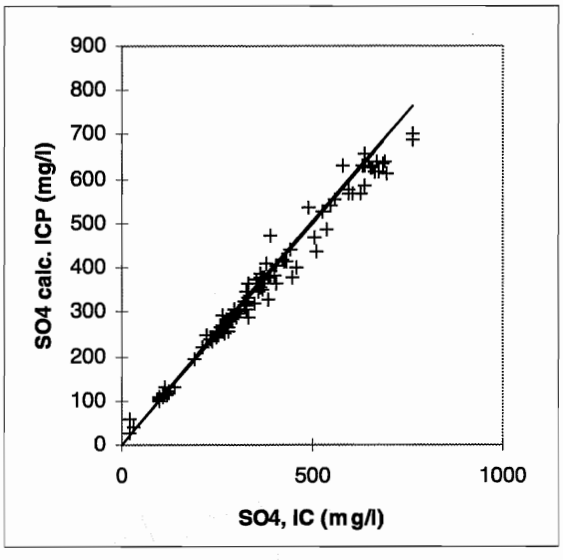


Figure 4-4 *Comparison between Sulphate recalculated from Sulphur determined by ICP and Sulphate determined by Ion Chromatography*

Total Iron determinations by ICP and by spectrophotometry (Ferrozine) are compared in Figure 4-5. The large disparity at some of the high concentrations is probably due to the presence of a colloidal fraction that passes through the filters. The spectrophotometric method will exclude, or only partly include colloids, but the ICP technique makes no distinction between different iron-containing species.

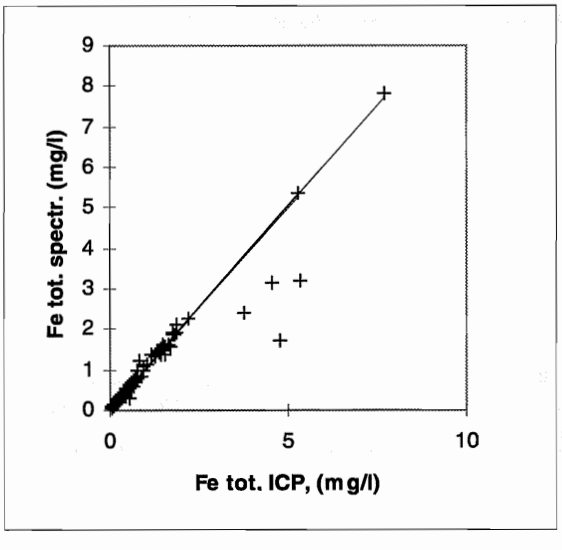


Figure 4-5 *Comparison between total Iron determined by ICP and total Iron by Spectrophotometry*

The charge balance errors give an indication to the quality and precision of the analyses of the major components. The relative charge balance errors are calculated for the selected sets of data (see Appendix 3, table 3-1). The distribution of the errors is presented in Figure 4-6 and each sample representing class 3, class 4 or class 5 is included. Generally the errors do not exceed ± 5 % which is quite good considering the accuracy of the individual concentration values.

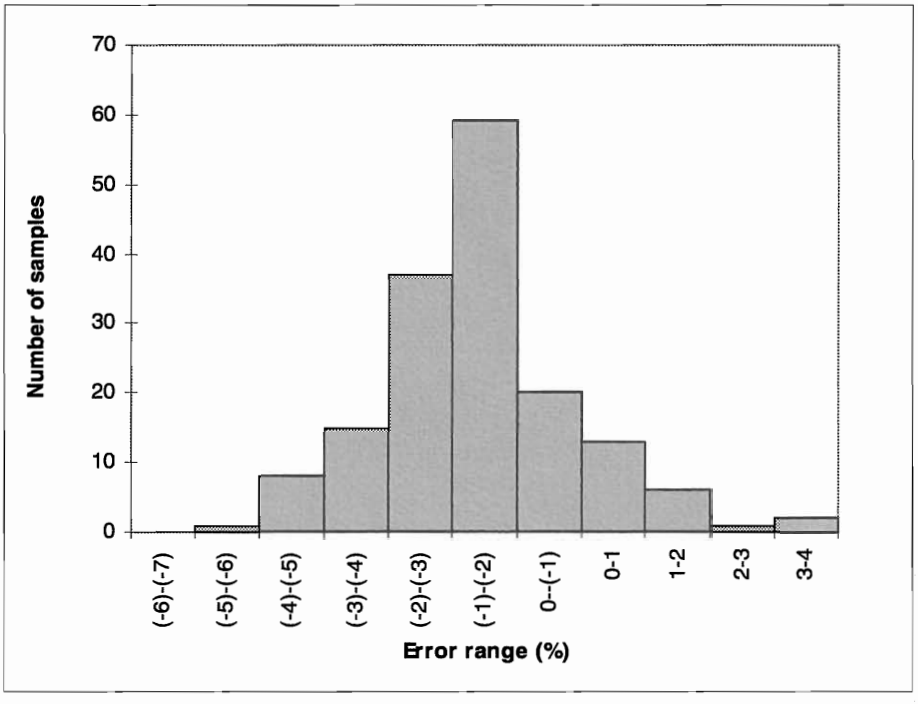


Figure 4-6. Distribution of relative charge balance errors

4.2.2 Tritium, Deuterium and Oxygen-18

The tritium results reported by IFE, for borehole KLX02 (not included in this report), have proved to be erroneous (too high) for samples collected after November 1993. It is most probable that all of, or parts of, the results from the period included in this report are incorrect. Therefore, all tritium results have been rejected. The intention is to re-analyse tritium for a sufficient number of reserve back-up samples to cover the extent of the tunnel and the surface boreholes, and to obtain a reasonable time series for some of the boreholes.

The analytical methods for Deuterium and Oxygen-18 differ completely from Tritium and the analytical data can be considered reliable. The results of Deuterium and Oxygen-18 are reported below (borehole wise) and in Appendix A2-3 and A3-2 (complete compilations).

4.3 Basic water analyses and environmental isotopes

4.3.1 KA1755A

Borehole KA1755A was drilled in April 1994 to supersede borehole KAS04, which intersects southern part of the fracture zone EW-1. It was no longer possible to collect samples in KAS04 due to the draw down from the tunnel. KA1755A was drilled directly into the fracture zone from the tunnel. There are three different packed off sections in the borehole and sampling has been performed in one of the sections since October 1995.

A few general data on the borehole and the sampled section are given below:

Length:	320.58 m
Diameter, 0-2.41 m:	86 mm
Diameter, 2.41–320.58 m:	56 mm
Sampled section:	88.0 - 160.0 m

The local co-ordinates of the section:

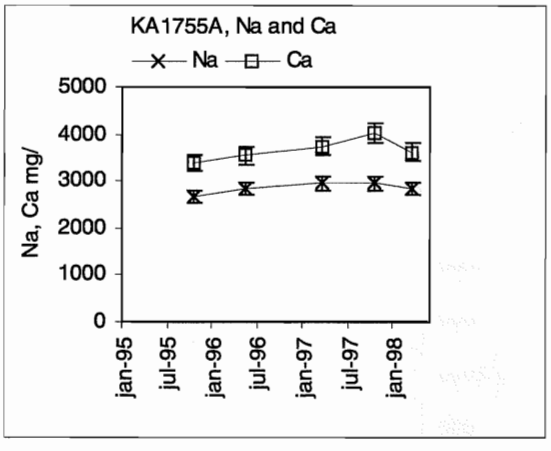
Northing	7492.5
Easting	2022.4
Elevation	-277.6

The co-ordinates are calculated for the centre of the section.

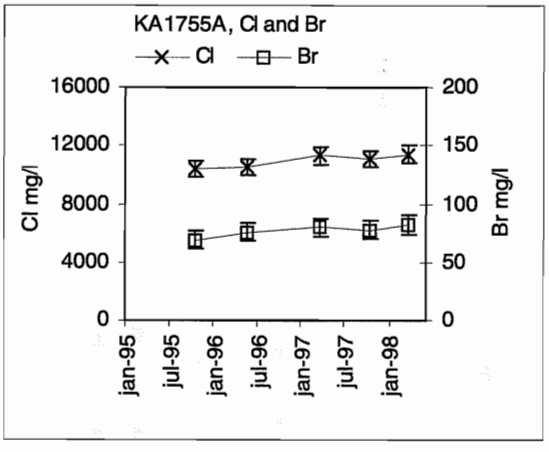
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-7 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-7 *Evolution with time in KA1755A, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

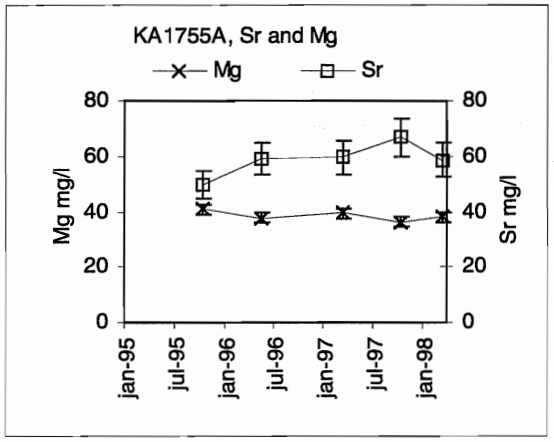
a)



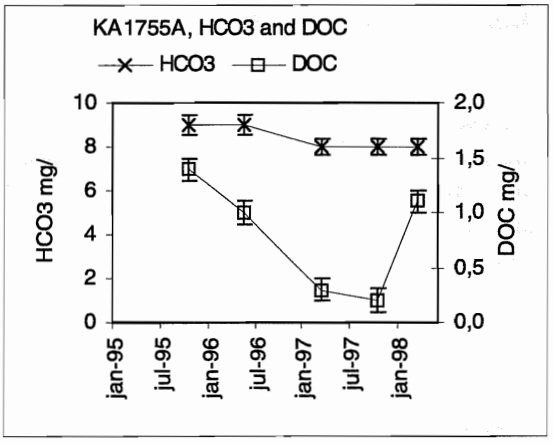
b)



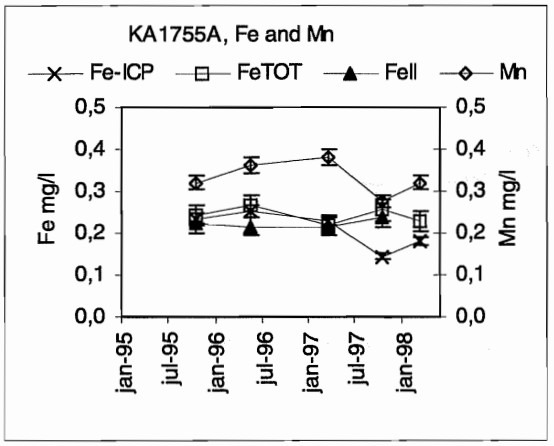
c)


KA1755A, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
0
20
40
60
80
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

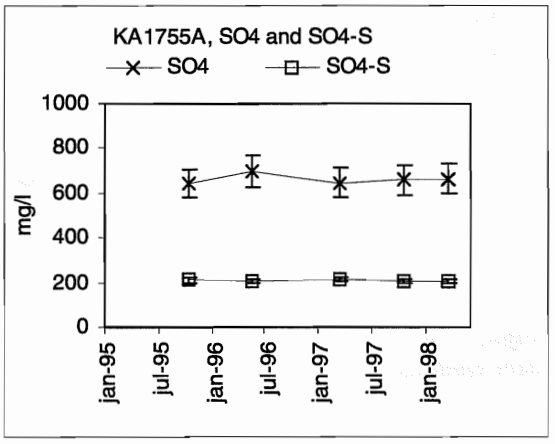
d)


KA1755A, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
0
2
4
6
8
10
0,0
0,5
1,0
1,5
2,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

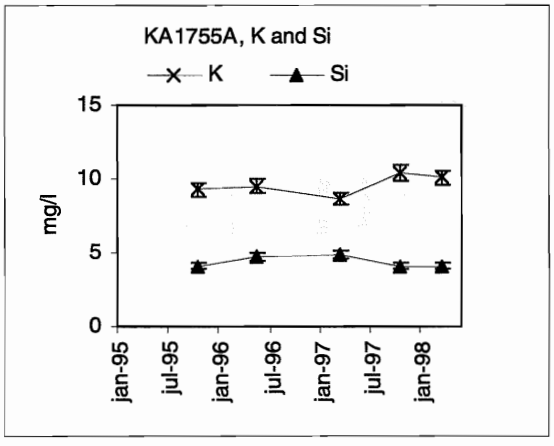
e)


KA1755A, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
0,0
0,1
0,2
0,3
0,4
0,5
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

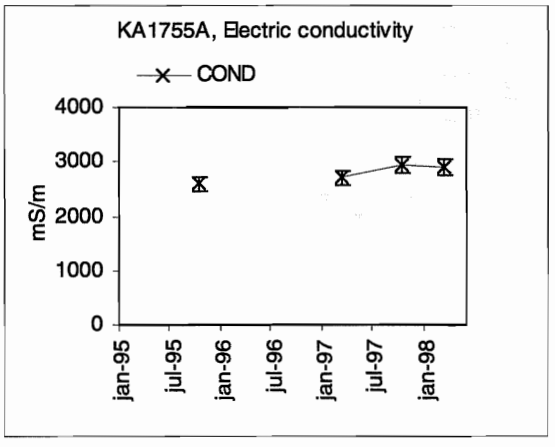
f)


KA1755A, SO4 and SO4-S
SO4
SO4-S
mg/l
0
200
400
600
800
1000
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

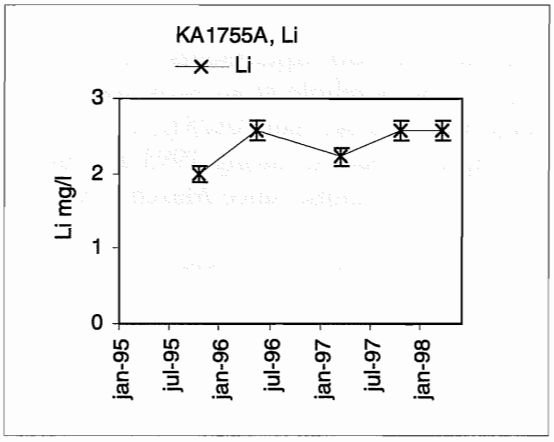
g)


KA1755A, K and Si
K
Si
mg/l
0
5
10
15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

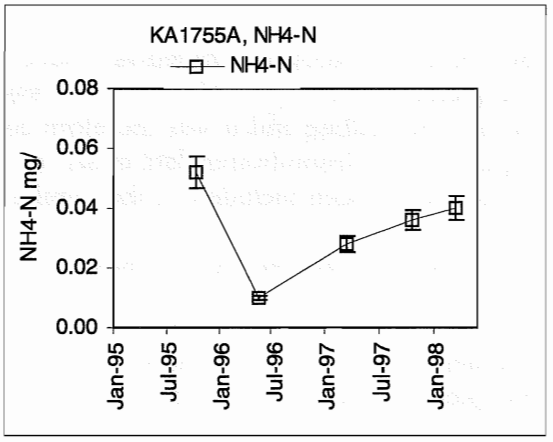
h)


KA1755A, Electric conductivity
COND
mS/m
0
1000
2000
3000
4000
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

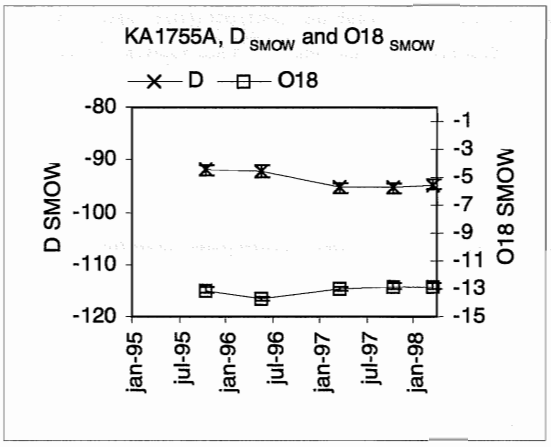
i)


KA1755A, Li
Li
Li mg/l
3
2
1
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


KA1755A, NH4-N
NH4-N
NH4-N mg/
0.08
0.06
0.04
0.02
0.00
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98

k)


KA1755A, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-80
-90
-100
-110
-120
-1
-3
-5
-7
-9
-11
-13
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.2 KA3385A

Borehole KA3385A was drilled as a pilot hole for the Chemlab experiments and was completed in January 1995. It was necessary to grout the borehole at an early stage during the drilling and it was therefore considered less suitable than KA2512A for these experiments. Groundwater data exists for a few samples collected during 1995 and the borehole has been included in the regular monitoring programme since March 1998.

A few general data on the borehole and the sampled section are given below:

Length:	34.18 m
Diameter:	56 mm
Sampled section:	32.05 - 34.18 m

The local co-ordinates of the section:

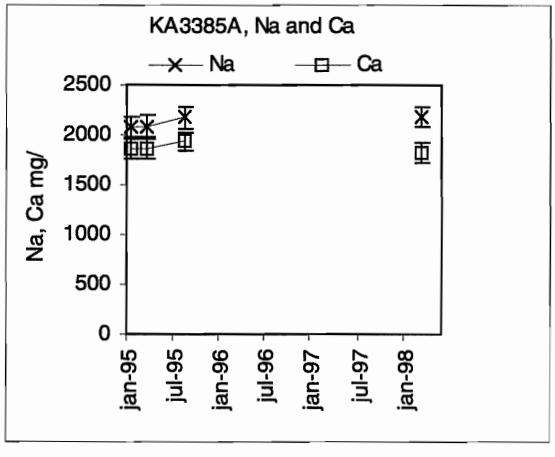
Northing	7234.8
Easting	2091.1
Elevation	–447.5

The co-ordinates are calculated for the centre of the section.

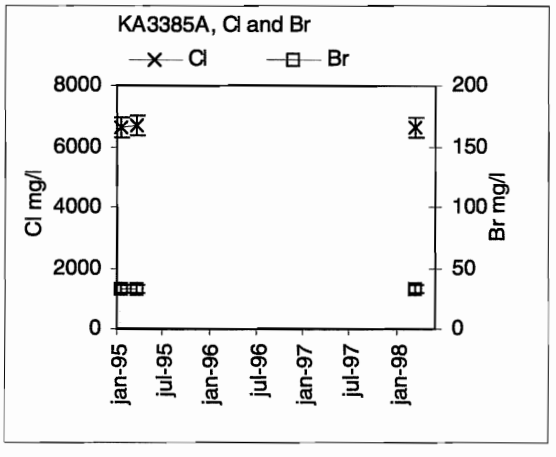
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-8 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-8 *Evolution with time in KA3385A, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

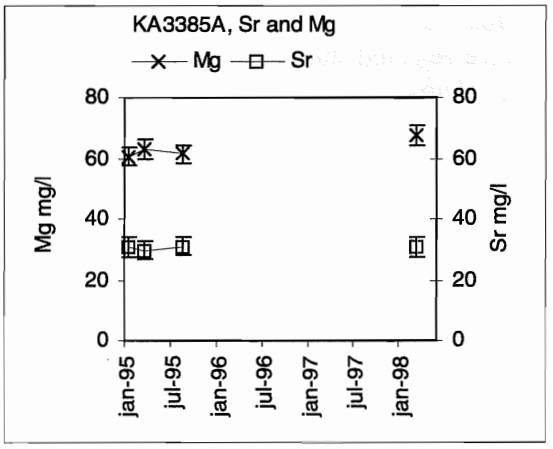
a)



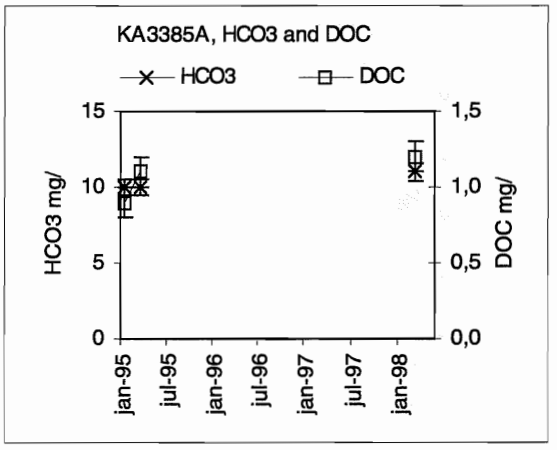
b)



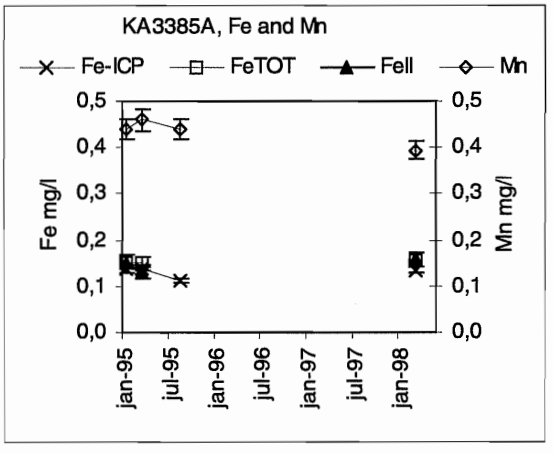
c)


KA3385A, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
0
20
40
60
80
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

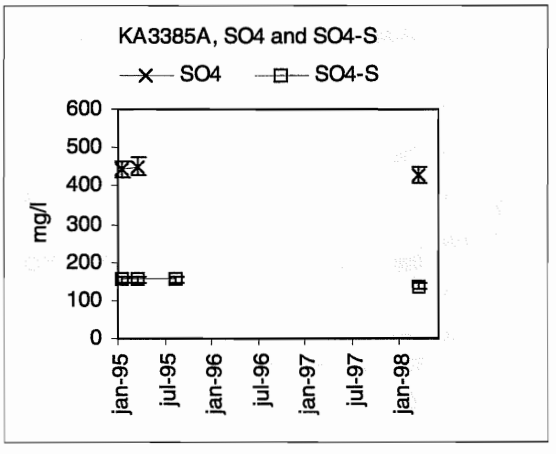
d)


KA3385A, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
0
5
10
15
0,0
0,5
1,0
1,5
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

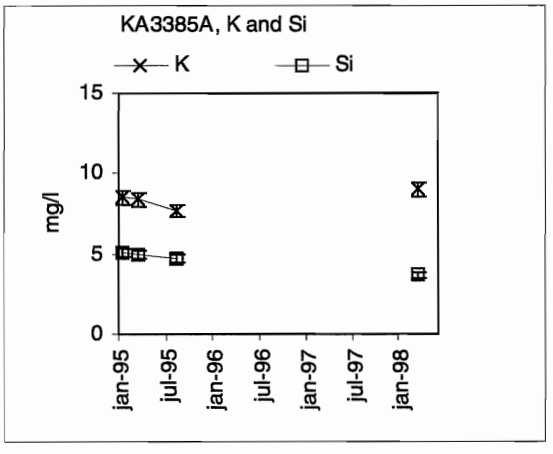
e)


KA3385A, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
0,0
0,1
0,2
0,3
0,4
0,5
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

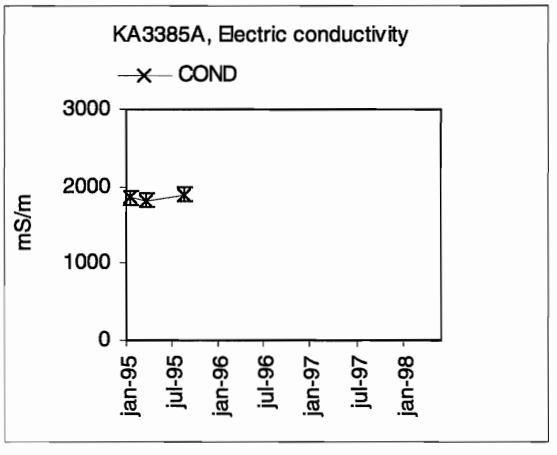
f)


KA3385A, SO4 and SO4-S
SO4
SO4-S
mg/l
0
100
200
300
400
500
600
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

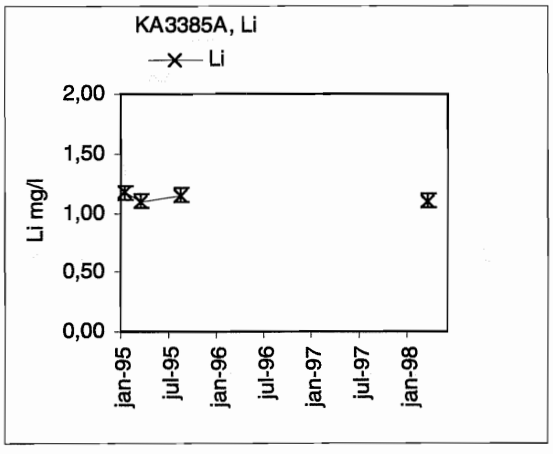
g)


KA3385A, K and Si
K
Si
mg/l
0
5
10
15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

h)


KA3385A, Electric conductivity
COND
mS/m
0
1000
2000
3000
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

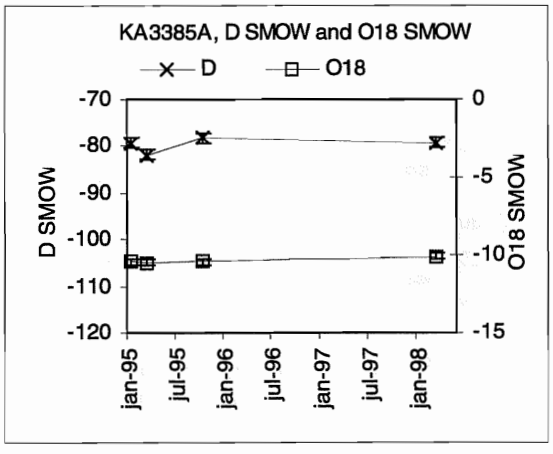
i)



j)

Most Ammonium and Sulphide data were rejected due to precipitation problems.

k)



4.3.3 KAS03

Drilling of the surface borehole KAS03 was completed in October 1987. Extensive water sampling campaigns using the mobile field laboratory were carried out during the pre-investigation phase. Two of six permanently packed-off borehole sections have been sampled more or less continuously within the monitoring programme since 1990. Section no. 5 is interpreted to intersect fracture zone NW-1. Section no. 2 is interpreted to intersect fracture zone NNW-8.

A few general data on the borehole and the sampled sections are given below:

Length:	1002.06 m
Diameter, 0.00 –100.65 m:	164 mm
Diameter, 100.65 - 450.52 m:	56 mm
Sampled sections:	no. 5, 107.00 – 252.00 m
	no. 2, 533.00 – 626.00 m

The local co-ordinates of section no. 5:

Northing	7777.6
Easting	1796.9
Elevation	–169.5

The local co-ordinates of section no. 2:

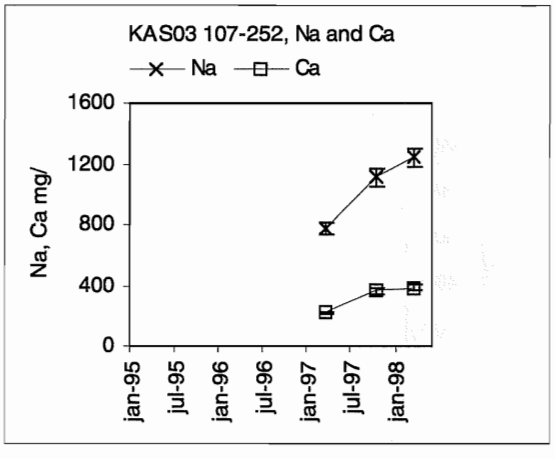
Northing	7825.4
Easting	1781.8
Elevation	–566.3

The co-ordinates are calculated for the centre of the section.

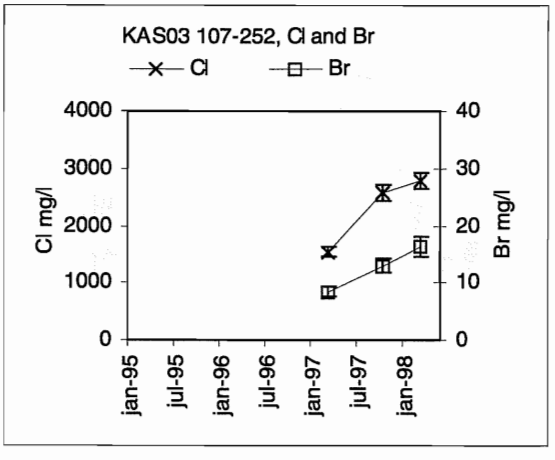
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-9 a) to k) and Figure 4-10 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-9 *Evolution with time in KAS03 section 107-252, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

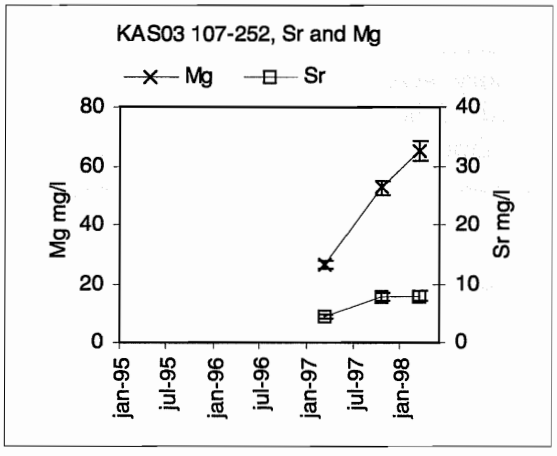
a)



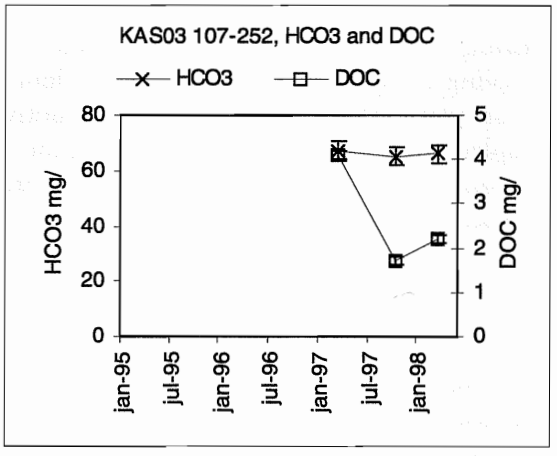
b)



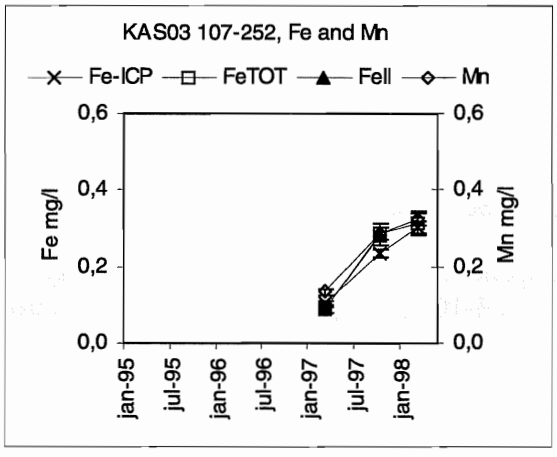
c)


KAS03 107-252, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
0
20
40
60
80
0
10
20
30
40
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

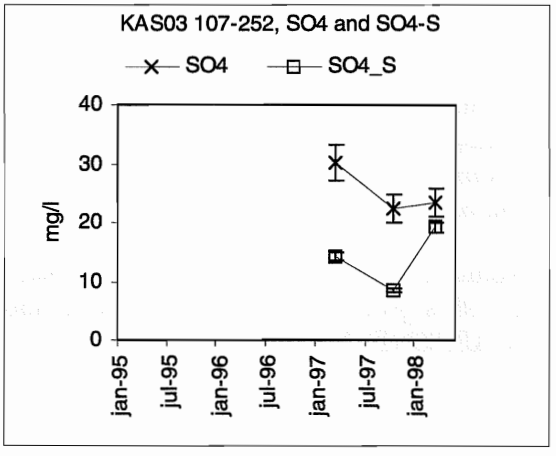
d)


KAS03 107-252, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
0
20
40
60
80
0
1
2
3
4
5
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

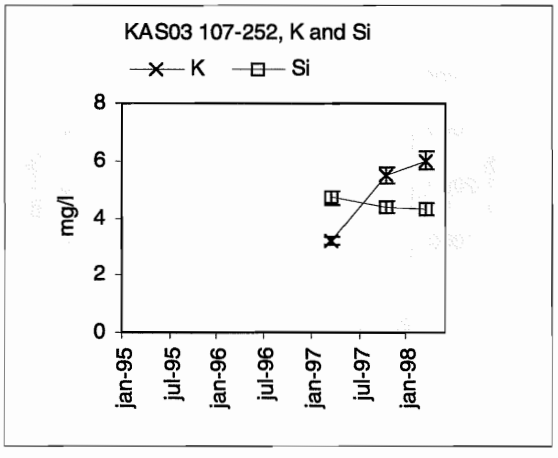
e)


KAS03 107-252, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
0,0
0,2
0,4
0,6
0,0
0,2
0,4
0,6
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

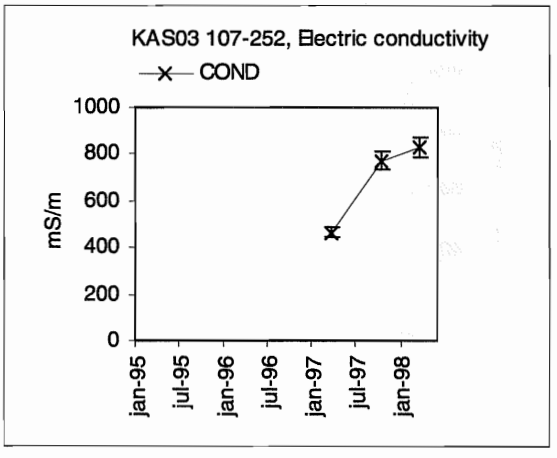
f)


KAS03 107-252, SO4 and SO4-S
SO4
SO4_S
mg/l
0
10
20
30
40
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

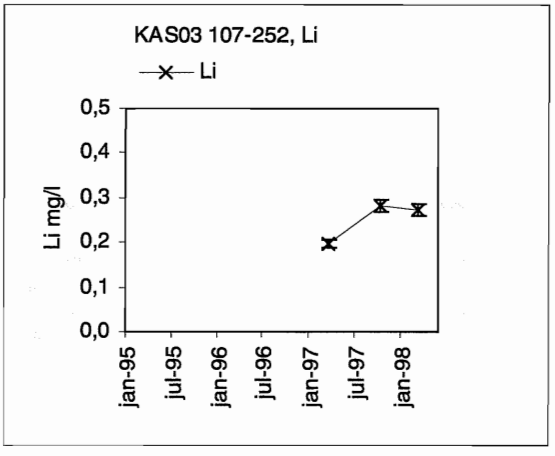
g)


KAS03 107-252, K and Si
K
Si
mg/l
0
2
4
6
8
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

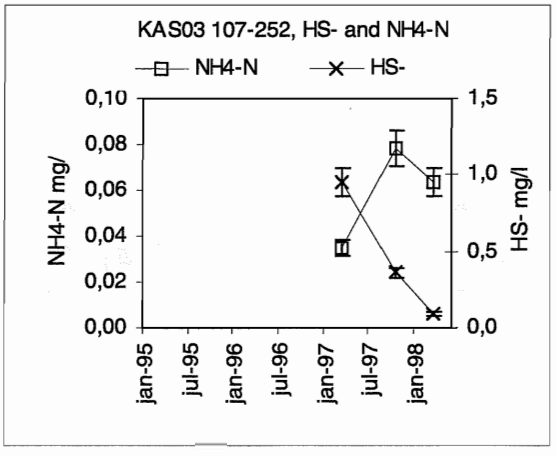
h)


KAS03 107-252, Electric conductivity
COND
mS/m
0
200
400
600
800
1000
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

i)


KAS03 107-252, Li
Li
Li mg/l
0,5
0,4
0,3
0,2
0,1
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


KAS03 107-252, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
0,10
0,08
0,06
0,04
0,02
0,00
1,5
1,0
0,5
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)

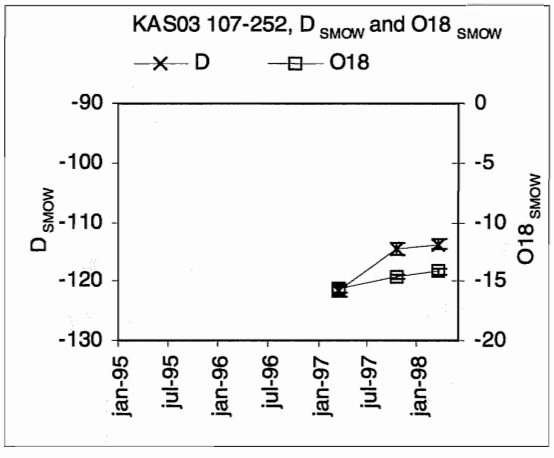
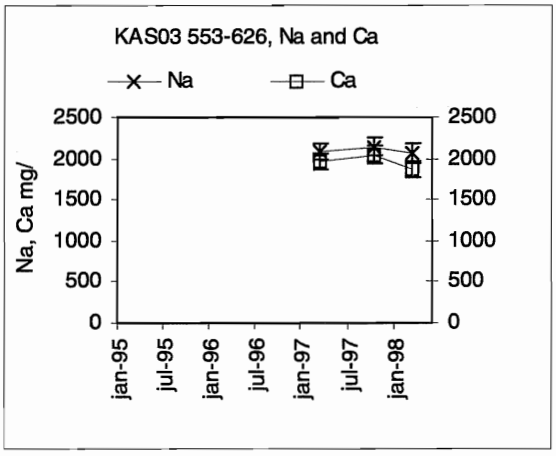
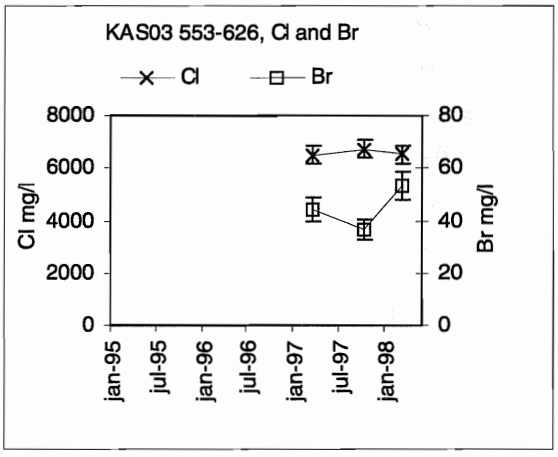

KAS03 107-252, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-90
-100
-110
-120
-130
0
-5
-10
-15
-20
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

Figure 4-10 *Evolution with time in KAS03 section 533-626, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

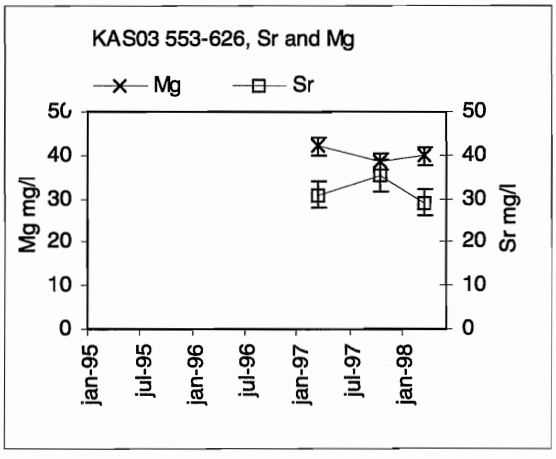
a)



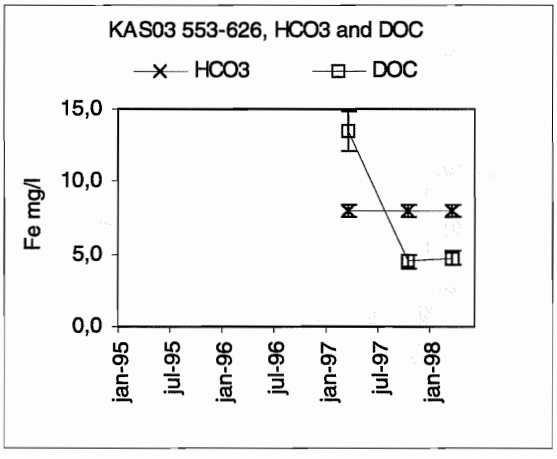
b)



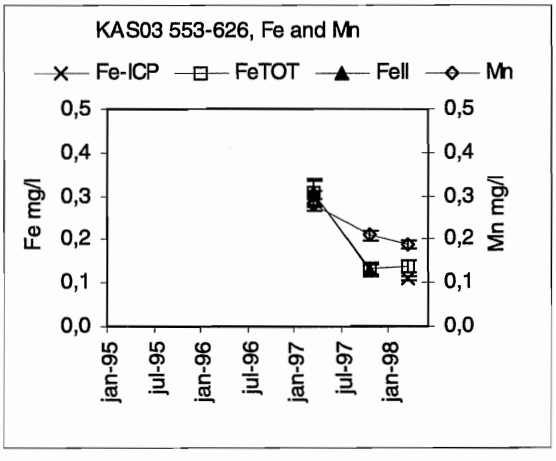
c)



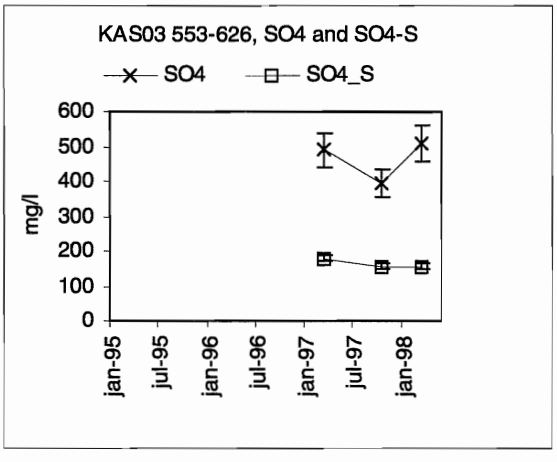
d)



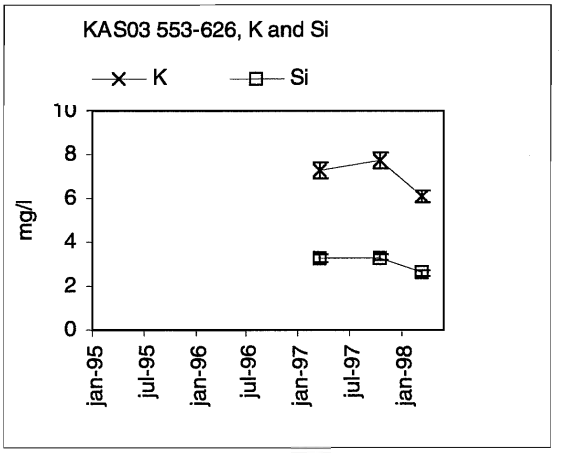
e)



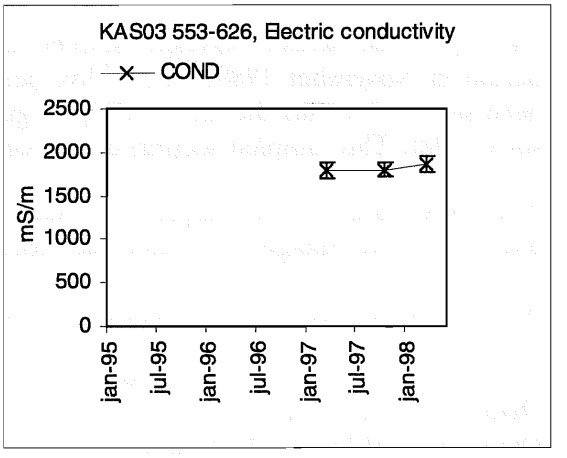
f)



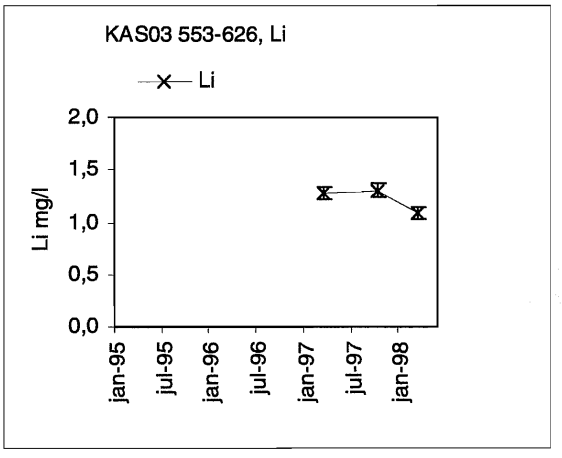
g)


KAS03 553-626, K and Si
K
Si
mg/l
10
8
6
4
2
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

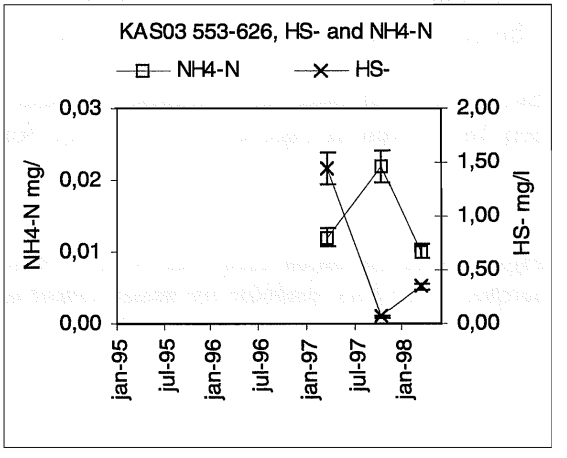
h)


KAS03 553-626, Electric conductivity
COND
mS/m
2500
2000
1500
1000
500
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

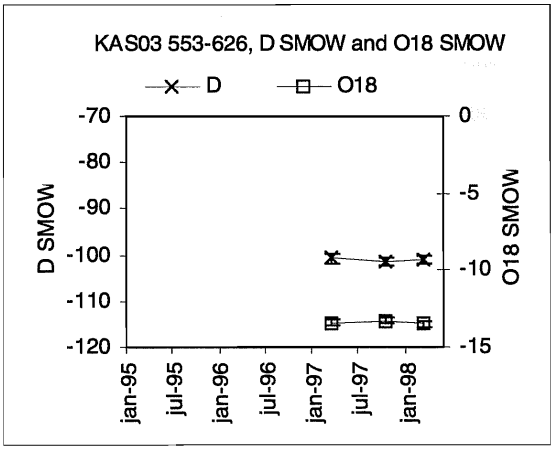
i)


KAS03 553-626, Li
Li
Li mg/l
2,0
1,5
1,0
0,5
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


KAS03 553-626, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
0,03
0,02
0,01
0,00
2,00
1,50
1,00
0,50
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


KAS03 553-626, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-70
-80
-90
-100
-110
-120
0
-5
-10
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.4 KAS09

Drilling of the surface borehole KAS09 was completed during the pre-investigation period in November 1989. One of five permanently packed-off borehole sections has been sampled within the monitoring programme and groundwater data are available since 1990. The sampled section corresponds approximately to the fracture zone NE-1.

The DOC value of the sample collected in March 1998 is higher than expected. This may be due to leakage of a water and alcohol mixture from packers.

A few general data on the borehole and the sampled section are given below:

Length:	450.52 m
Diameter, 0.00 –100.65 m:	167 mm
Diameter, 100.65 - 450.52 m:	56 mm
Sampled section:	116.0 - 150.0 m

The local co-ordinates of the section:

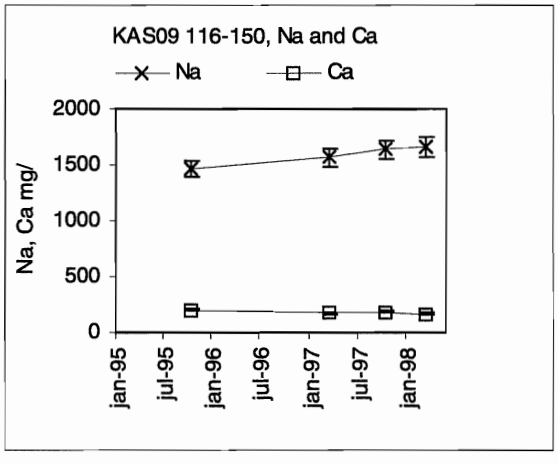
Northing	6857.8
Easting	2089.5
Elevation	–110.6

The co-ordinates are calculated for the centre of the section.

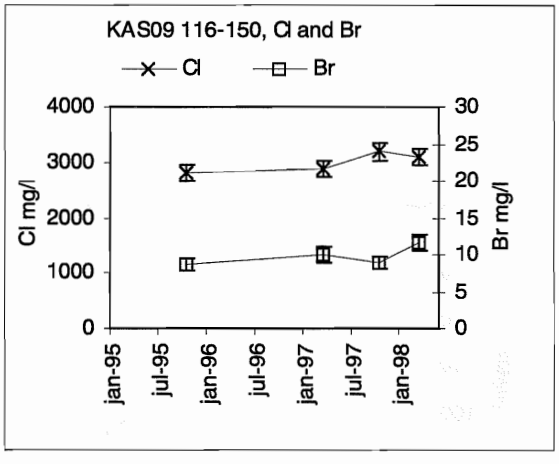
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-11 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-11 *Evolution with time in KAS09 section 116-150, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

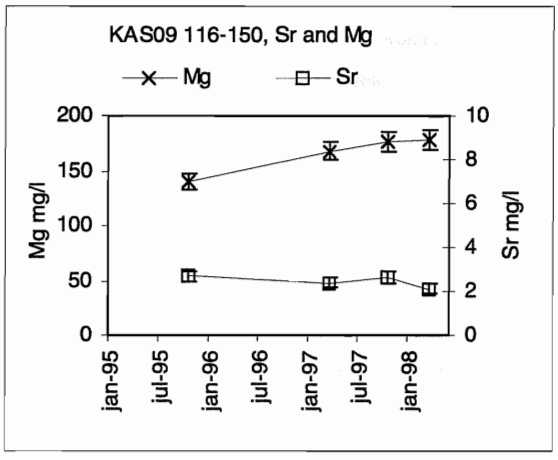
a)



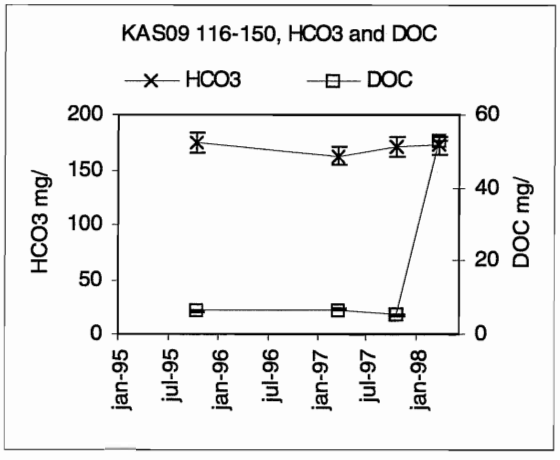
b)



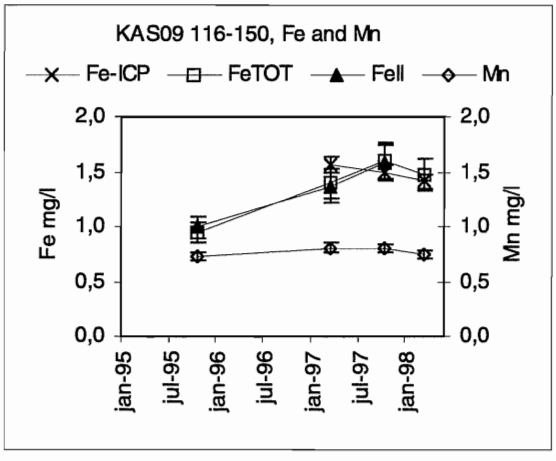
c)


KAS09 116-150, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
200
150
100
50
0
10
8
6
4
2
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

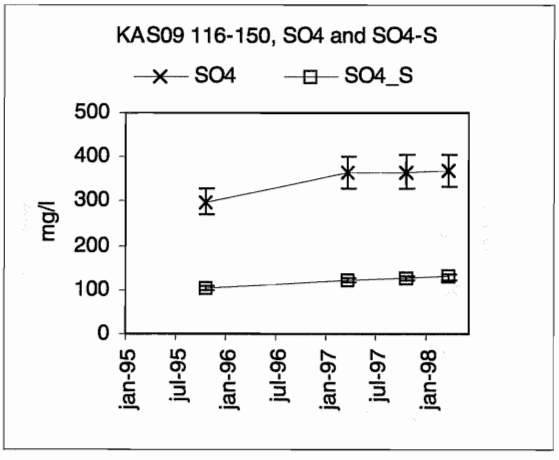
d)


KAS09 116-150, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
200
150
100
50
0
60
40
20
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

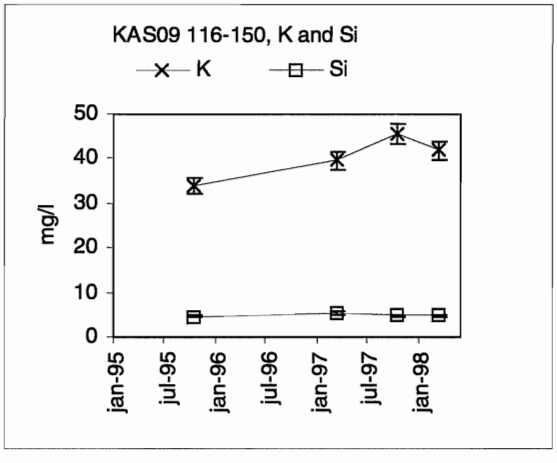
e)


KAS09 116-150, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
2,0
1,5
1,0
0,5
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

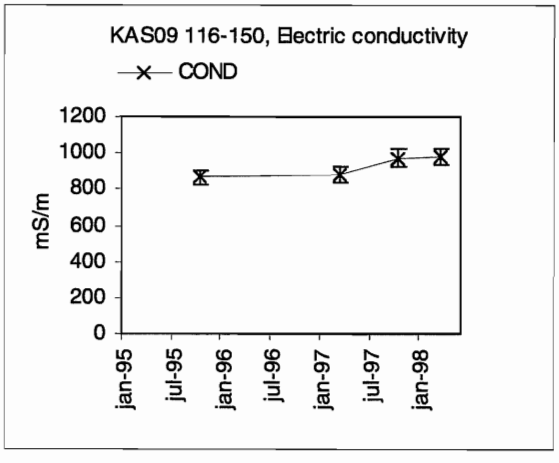
f)


KAS09 116-150, SO4 and SO4-S
SO4
SO4_S
mg/l
500
400
300
200
100
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

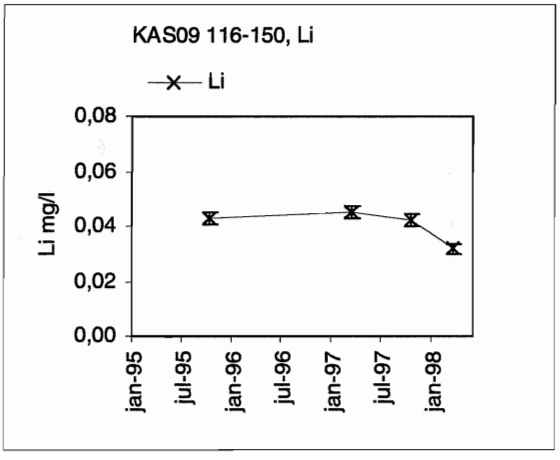
g)


KAS09 116-150, K and Si
K
Si
mg/l
50
40
30
20
10
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

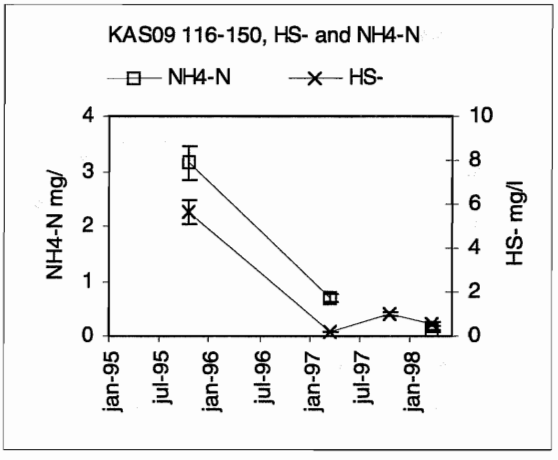
h)


KAS09 116-150, Electric conductivity
COND
mS/m
1200
1000
800
600
400
200
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

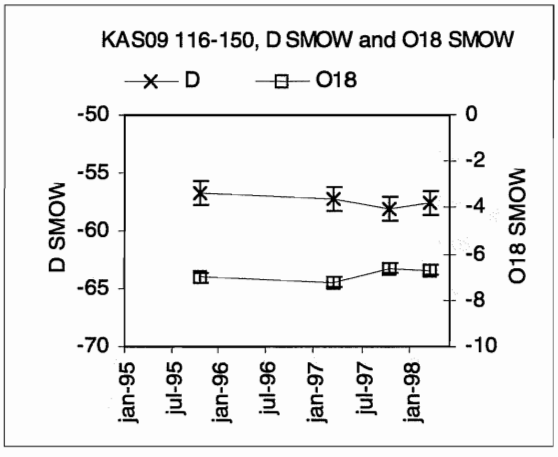
i)


KAS09 116-150, Li
Li
Li mg/l
0,08
0,06
0,04
0,02
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


KAS09 116-150, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
4
3
2
1
0
10
8
6
4
2
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


KAS09 116-150, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-50
-55
-60
-65
-70
0
-2
-4
-6
-8
-10
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.5 KR0012B

KR0012B is one of three boreholes that were drilled for the Large-Scale Redox Project [11]. The borehole is located in the Redox tunnel at an approximate depth of 70 metres. A section is isolated where the borehole intersects the Redox fracture zone. The sampling of the borehole started in May 1991 and has been performed more or less continuously since then. A large number of groundwater data are available.

A few general data on the borehole and the sampled section are given below:

Length:	10.57 m
Diameter:	38 mm
Sampled section:	5.0 - 10.57 m.

The local co-ordinates of the section:

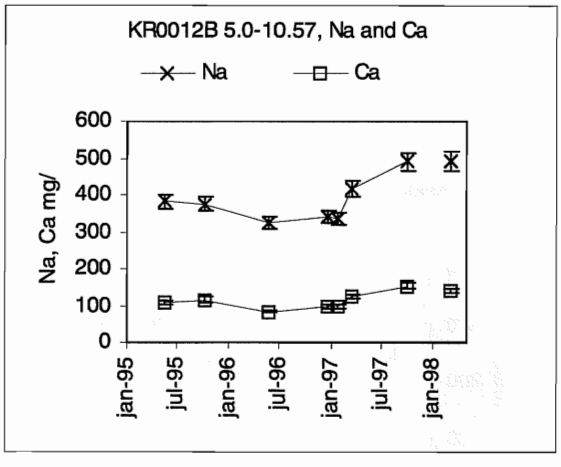
Northing	6167.3
Easting	2165.8
Elevation	–69.2

The co-ordinates are calculated for the centre of the section.

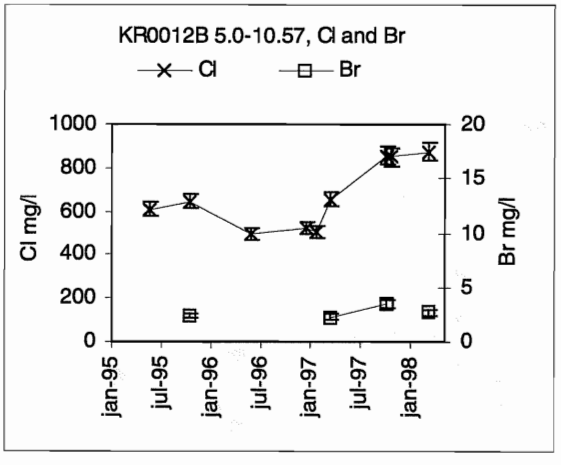
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-12 a) to l). For concentration values see APPENDIX 2 and 3.

Figure 4-12 *Evolution with time in KR0012B, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

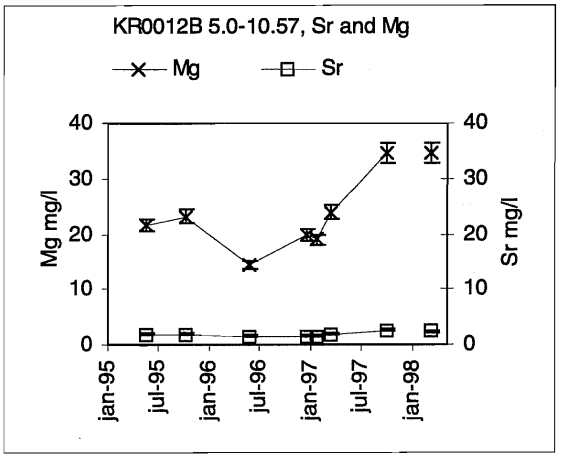
a)



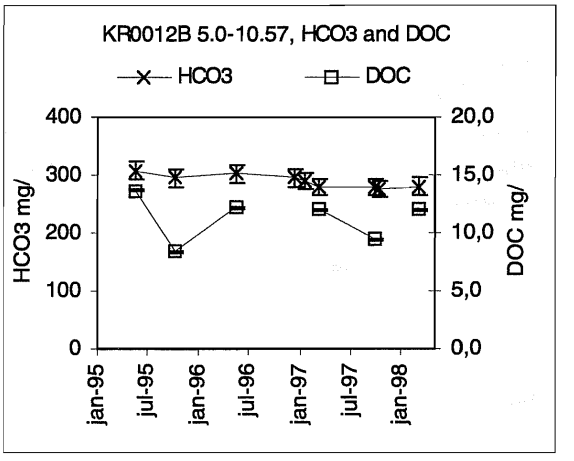
b)



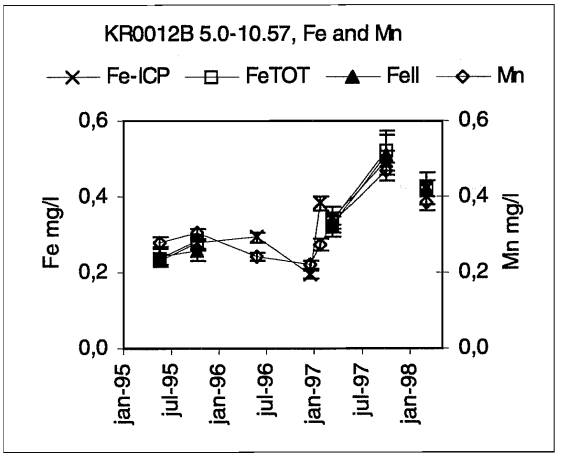
c)


KR0012B 5.0-10.57, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
0
10
20
30
40
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

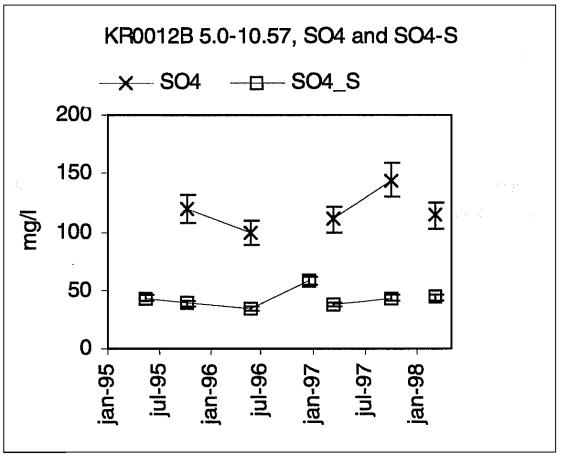
d)


KR0012B 5.0-10.57, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
0
100
200
300
400
0,0
5,0
10,0
15,0
20,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

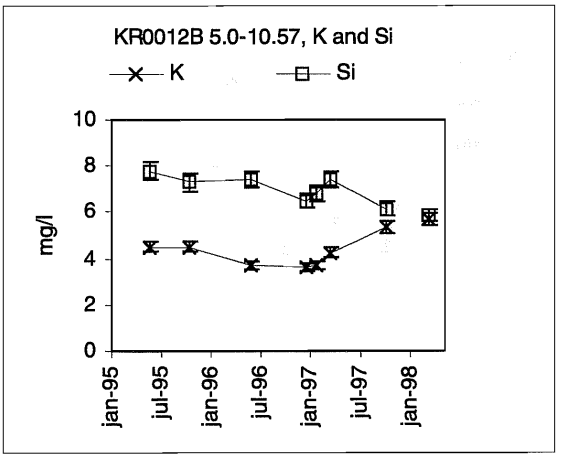
e)


KR0012B 5.0-10.57, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
0,0
0,2
0,4
0,6
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

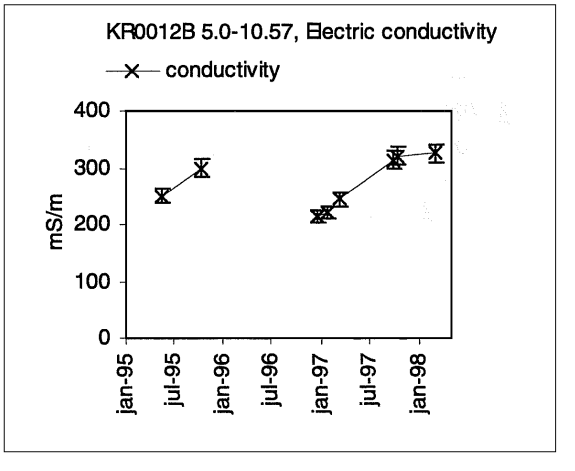
f)


KR0012B 5.0-10.57, SO4 and SO4-S
SO4
SO4_S
mg/l
0
50
100
150
200
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

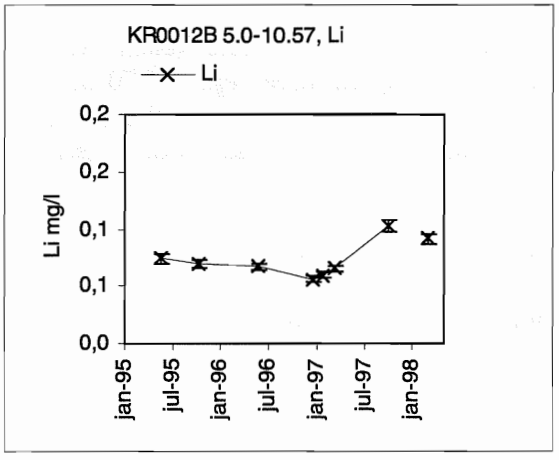
g)


KR0012B 5.0-10.57, K and Si
K
Si
mg/l
0
2
4
6
8
10
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

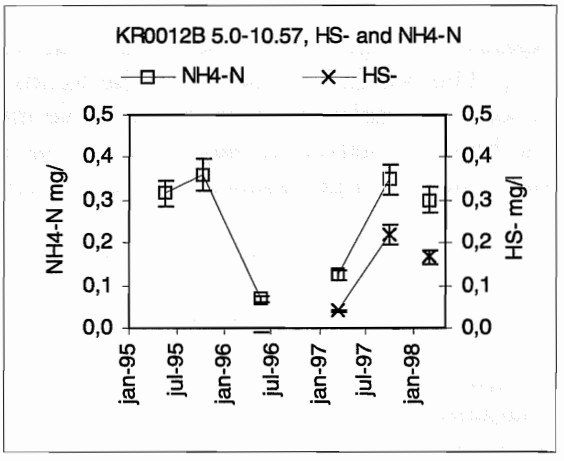
h)


KR0012B 5.0-10.57, Electric conductivity
conductivity
mS/m
0
100
200
300
400
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

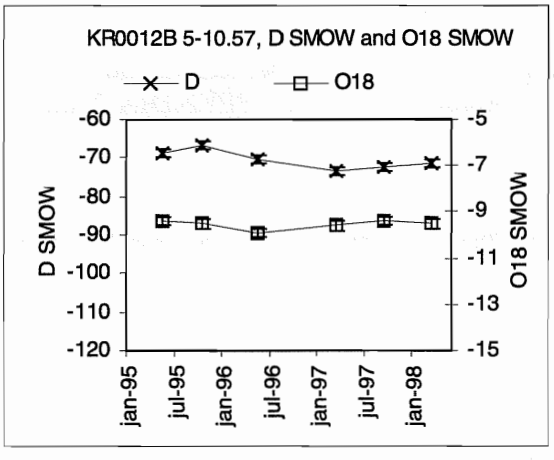
i)


KR0012B 5.0-10.57, Li
Li
Li mg/l
0,2
0,2
0,1
0,1
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

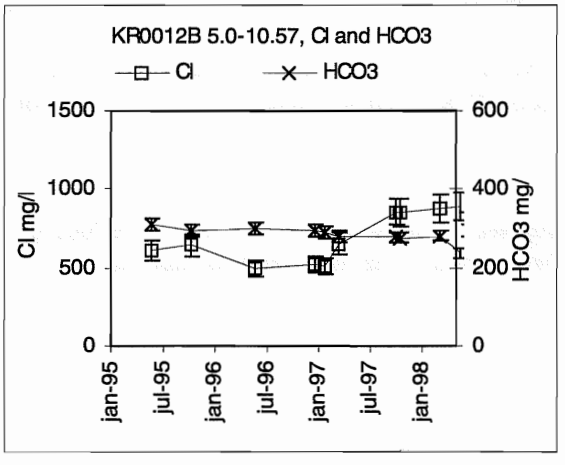
j)


KR0012B 5.0-10.57, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
0,5
0,4
0,3
0,2
0,1
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


KR0012B 5-10.57, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-60
-70
-80
-90
-100
-110
-120
-5
-7
-9
-11
-13
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

l)


KR0012B 5.0-10.57, Cl and HCO3
Cl
HCO3
Cl mg/l
HCO3 mg/
1500
1000
500
0
600
400
200
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.6 KR0013B

KR0013B is one of three boreholes that were drilled for the Large-Scale Redox Project [11]. The borehole is located in the Redox tunnel at an approximate depth of 70 metres. A section is isolated where the borehole intersects the Redox fracture zone. Sampling of the borehole started in May 1991 and has been performed more or less continuously since then. A large number of groundwater data are available.

The borehole is left open since a few years, due to microbial experiments.

A few general data on the borehole and the sampled section are given below:

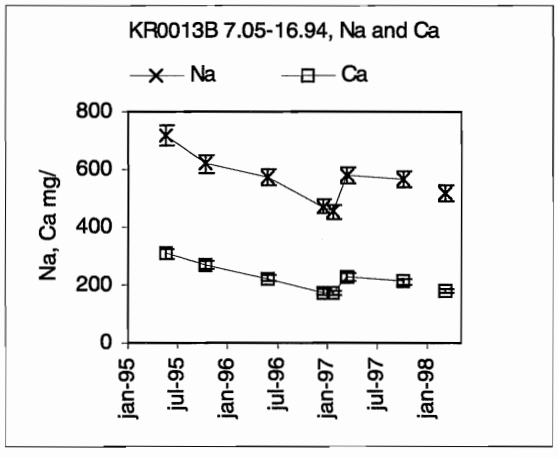
Length: 16.94 m
Diameter: 38 mm
Sampled section: 7.05 - 16.94 m

The local co-ordinates of the section:
Northing 6166.3
Easting 2159.1
Elevation –69.3
The co-ordinates are calculated for the centre of the section.

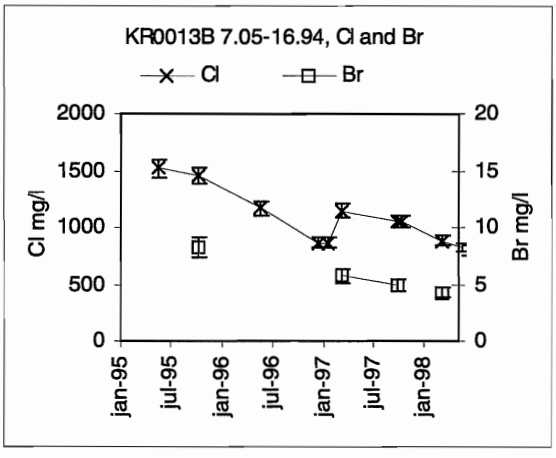
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-12 a) to l). For concentration values see APPENDIX 2 and 3.

Figure 4-13 *Evolution with time in KR0013B, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

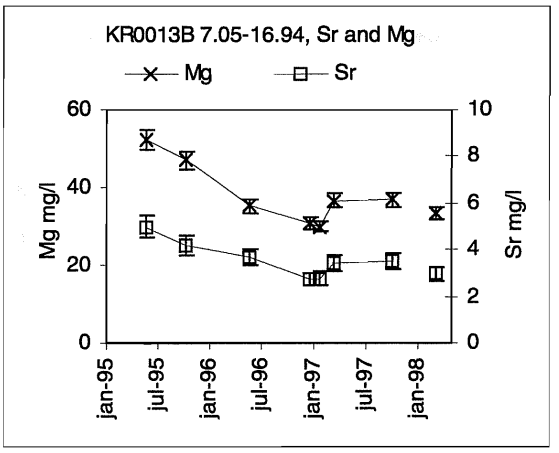
a)



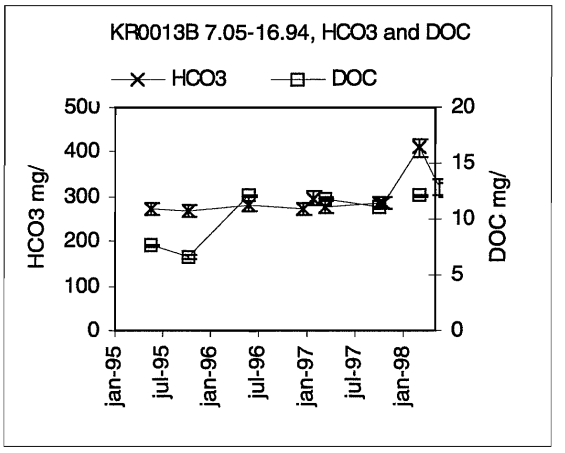
b)



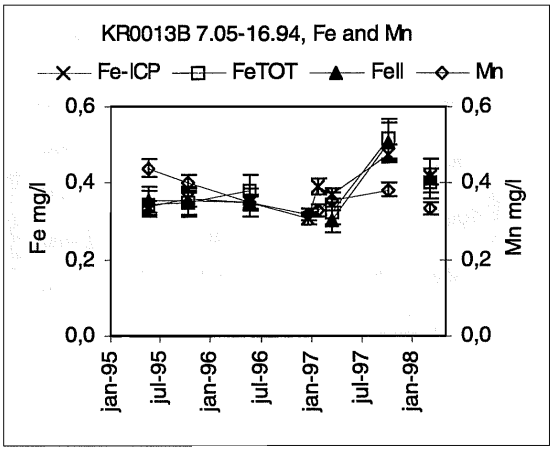
c)


KR0013B 7.05-16.94, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
60
40
20
0
10
8
6
4
2
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

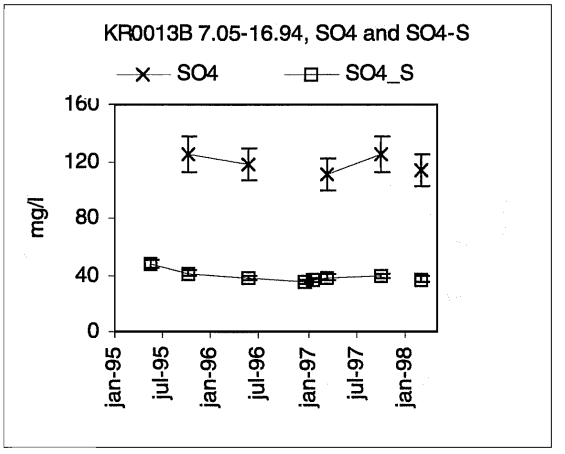
d)


KR0013B 7.05-16.94, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
500
400
300
200
100
0
20
15
10
5
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

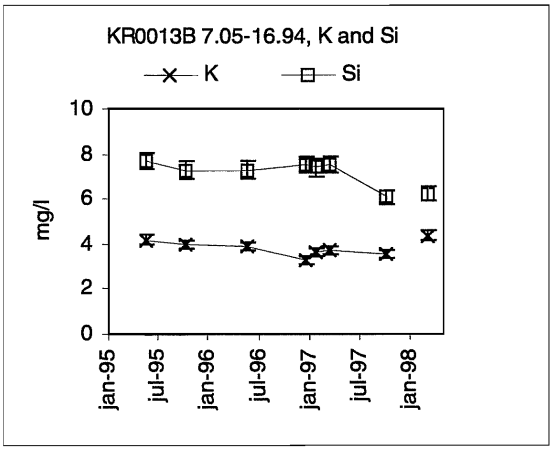
e)


KR0013B 7.05-16.94, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
0,6
0,4
0,2
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

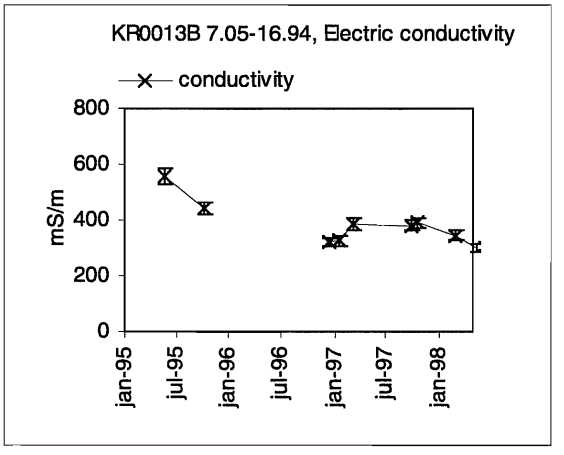
f)


KR0013B 7.05-16.94, SO4 and SO4-S
SO4
SO4_S
mg/l
160
120
80
40
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

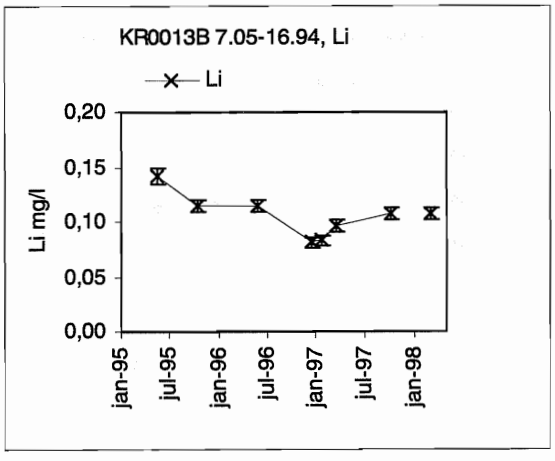
g)


KR0013B 7.05-16.94, K and Si
K
Si
mg/l
10
8
6
4
2
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

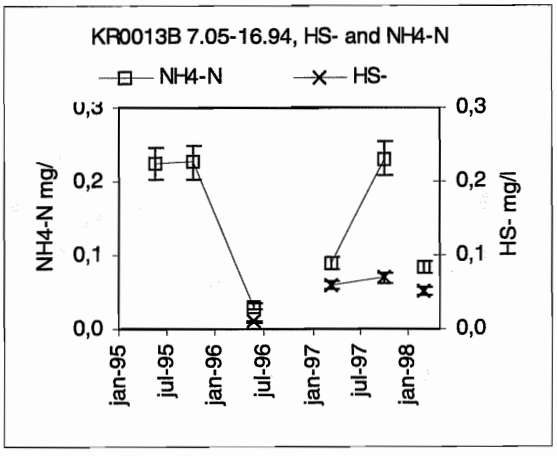
h)


KR0013B 7.05-16.94, Electric conductivity
conductivity
mS/m
800
600
400
200
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

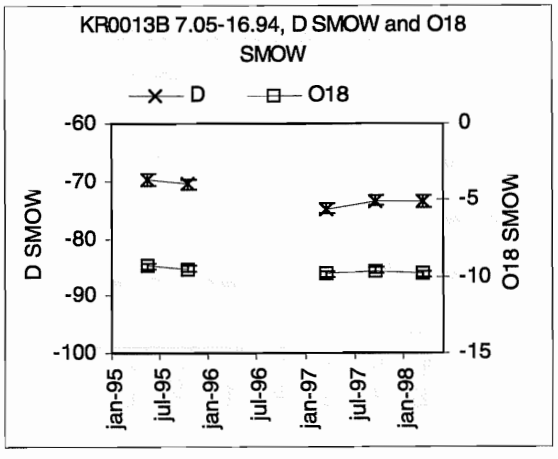
i)


KR0013B 7.05-16.94, Li
Li
Li mg/l
0,20
0,15
0,10
0,05
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

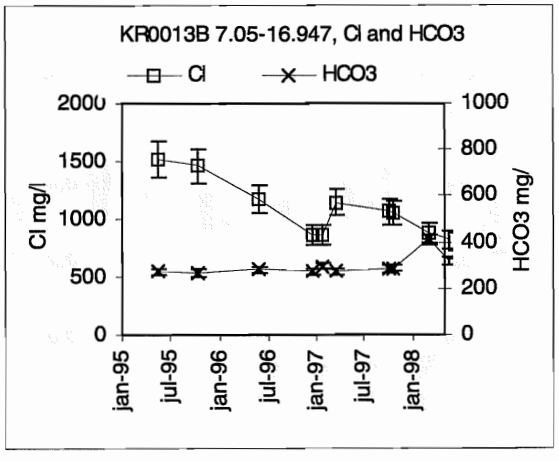
j)


KR0013B 7.05-16.94, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
0,3
0,2
0,1
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


KR0013B 7.05-16.94, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-60
-70
-80
-90
-100
0
-5
-10
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

l)


KR0013B 7.05-16.947, Cl and HCO3
Cl
HCO3
Cl mg/l
HCO3 mg/
2000
1500
1000
500
0
1000
800
600
400
200
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.7 KR0015B

KR0012B is one of three boreholes that were drilled for the Large-Scale Redox Project [11]. The borehole is located in the Redox tunnel at an approximate depth of 70 metres. A section is isolated where the borehole intersects the Redox fracture zone. Sampling of the borehole started in May 1991 and has been performed more or less continuously since then. A large number of groundwater data are available.

A few general data on the borehole and the sampled section are given below:

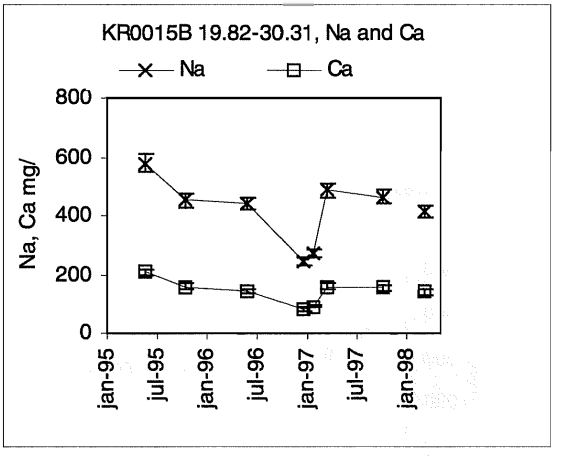
Length: 30.31 m
Diameter: 38 mm
Sampled section: 19.82 - 30.31 m

The local co-ordinates of the section:
Northing 6168.1
Easting 2144.4
Elevation –69.5
The co-ordinates are calculated for the centre of the section.

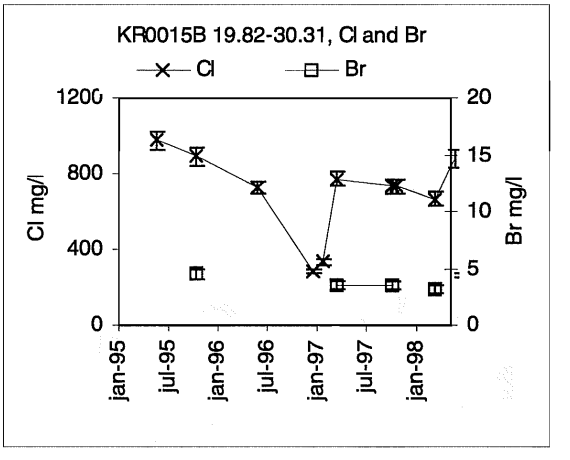
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-14 a) to l). For concentration values see APPENDIX 2 and 3.

Figure 4-14 *Evolution with time in KR0015B, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

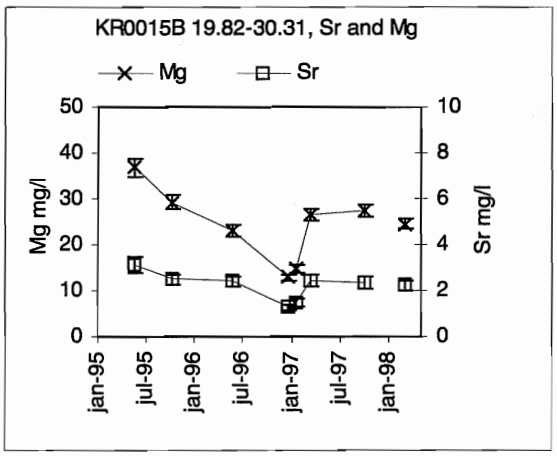
a)



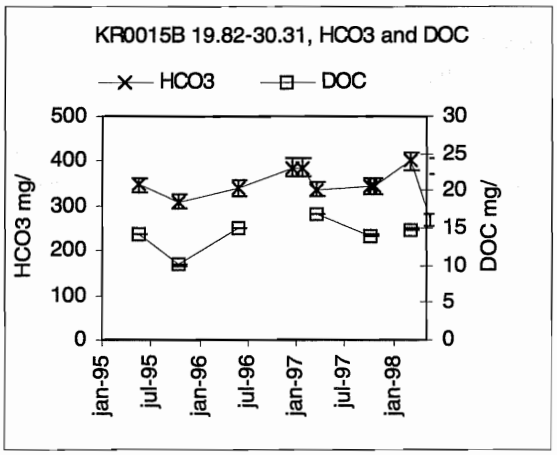
b)



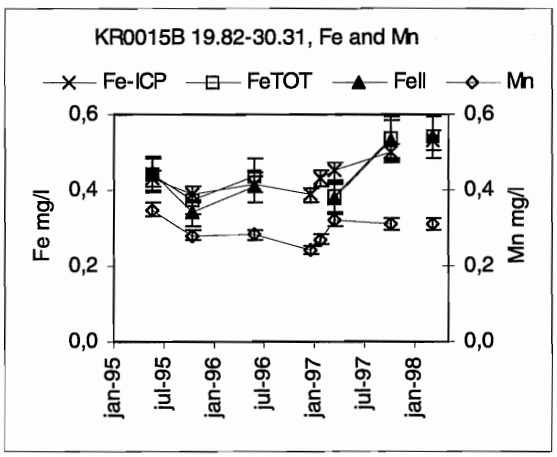
c)


KR0015B 19.82-30.31, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
50
40
30
20
10
0
10
8
6
4
2
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

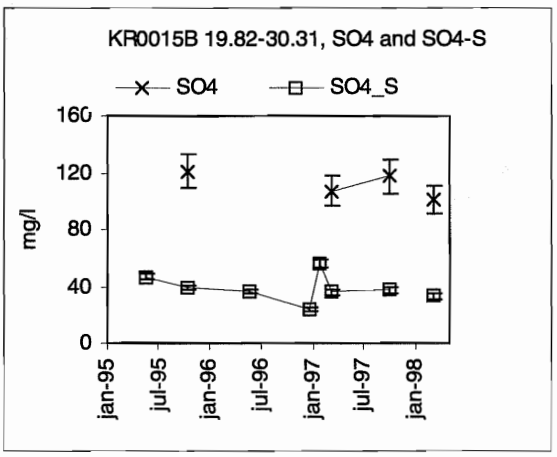
d)


KR0015B 19.82-30.31, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
500
400
300
200
100
0
30
25
20
15
10
5
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

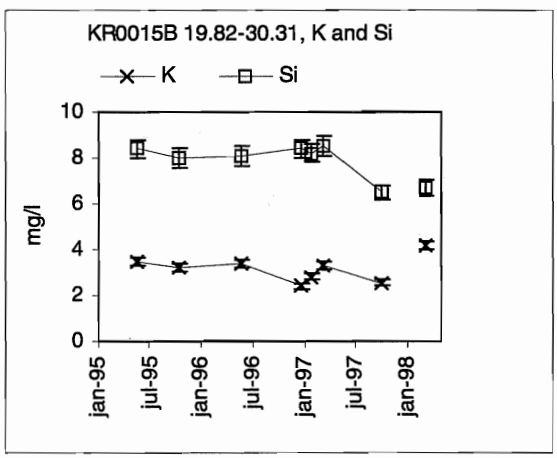
e)


KR0015B 19.82-30.31, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
0,6
0,4
0,2
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

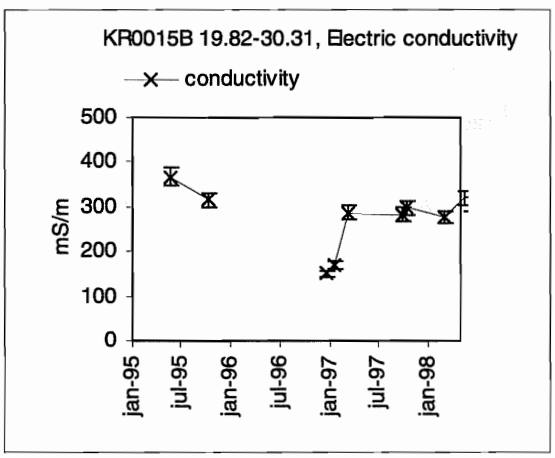
f)


KR0015B 19.82-30.31, SO4 and SO4-S
SO4
SO4_S
mg/l
160
120
80
40
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

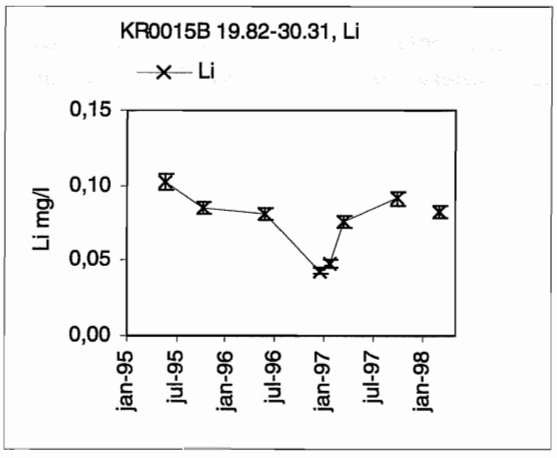
g)


KR0015B 19.82-30.31, K and Si
K
Si
mg/l
10
8
6
4
2
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

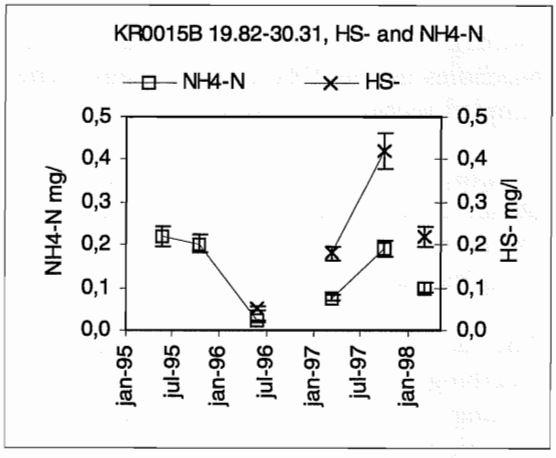
h)


KR0015B 19.82-30.31, Electric conductivity
conductivity
mS/m
500
400
300
200
100
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

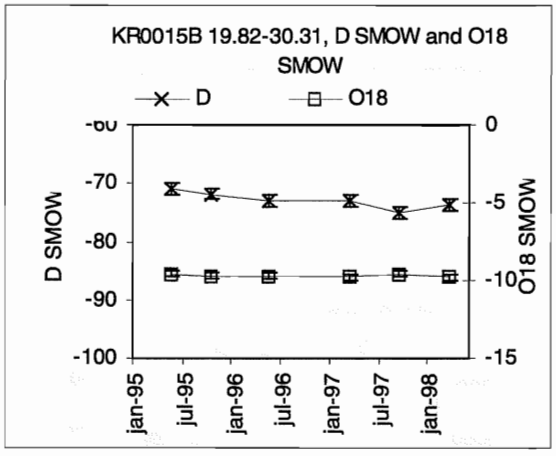
i)


KR0015B 19.82-30.31, Li
Li
Li mg/l
0,15
0,10
0,05
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

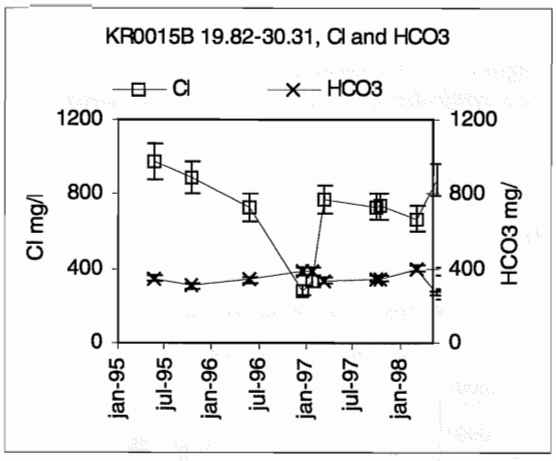
j)


KR0015B 19.82-30.31, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
0,5
0,4
0,3
0,2
0,1
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


KR0015B 19.82-30.31, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
0
-5
-10
-15
-70
-80
-90
-100
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

l)


KR0015B 19.82-30.31, Cl and HCO3
Cl
HCO3
Cl mg/l
HCO3 mg/
1200
800
400
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.8 KXTT3

Drilling of borehole KXTT3 was completed in June 1995 and it constitutes one of four boreholes in the TRUE experiment niche. A few general data on the borehole and the sampled section are given below:

Length:	17.43m
Diameter 0 - 2.00 m:	86 mm
Diameter 2.00 –17.43 m:	56 mm
Sampled section:	12.42 - 14.42 m.

The local co-ordinates of the section:

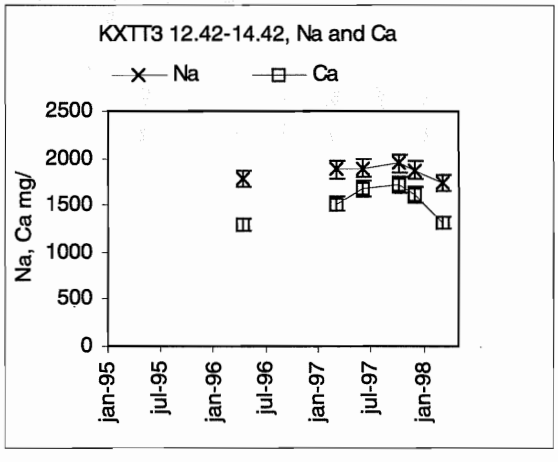
Northing	7437.6
Easting	2321.1
Elevation	–399.1

The co-ordinates are calculated for the centre of the section.

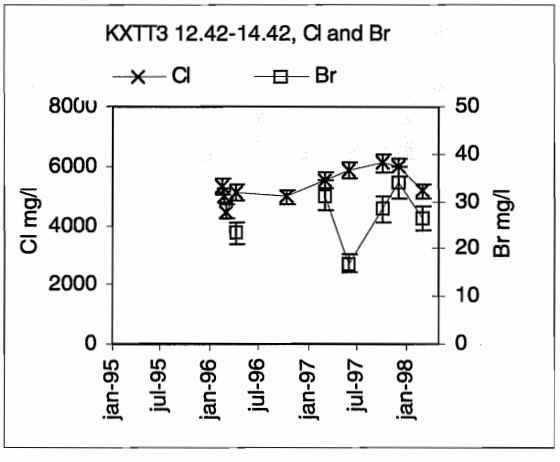
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-15 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-15 *Evolution with time in KXTT3, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

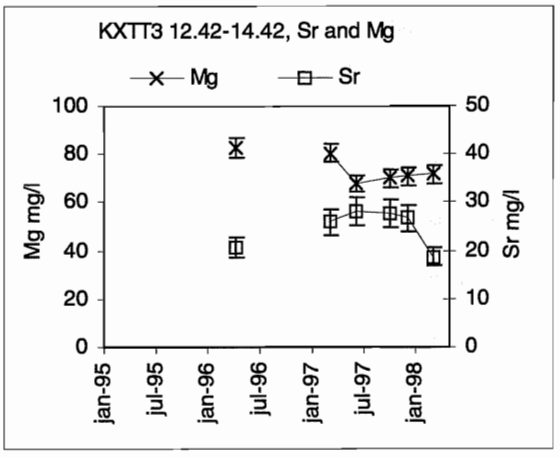
a)



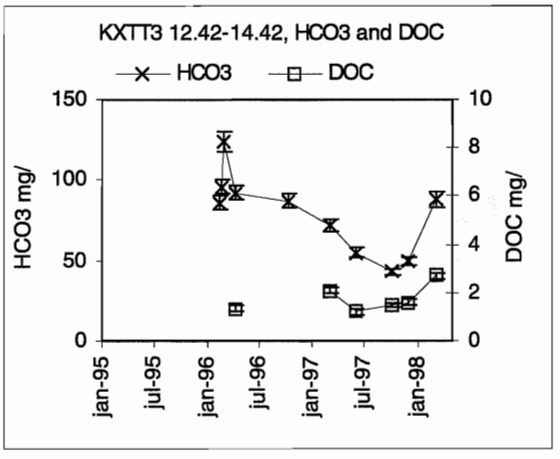
b)



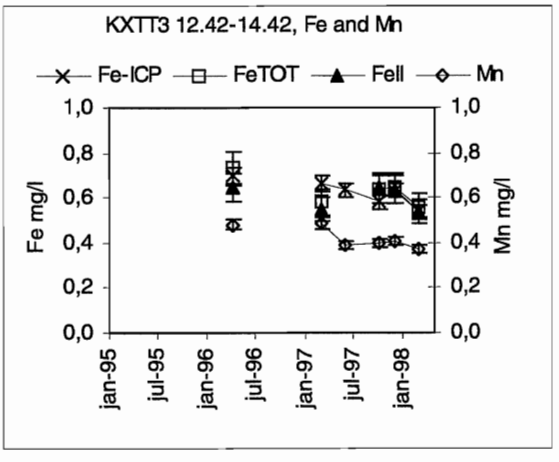
c)


KXTT3 12.42-14.42, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
100
80
60
40
20
0
50
40
30
20
10
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

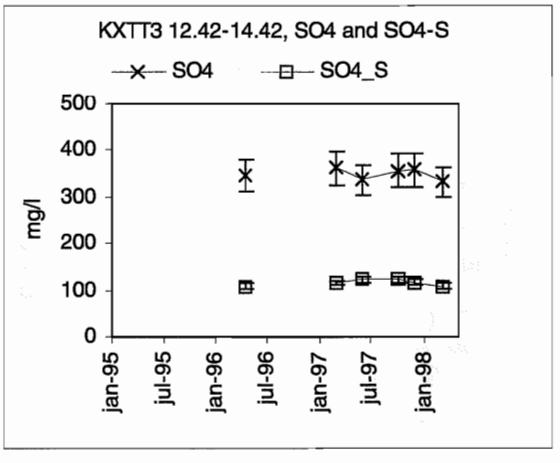
d)


KXTT3 12.42-14.42, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
150
100
50
0
10
8
6
4
2
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

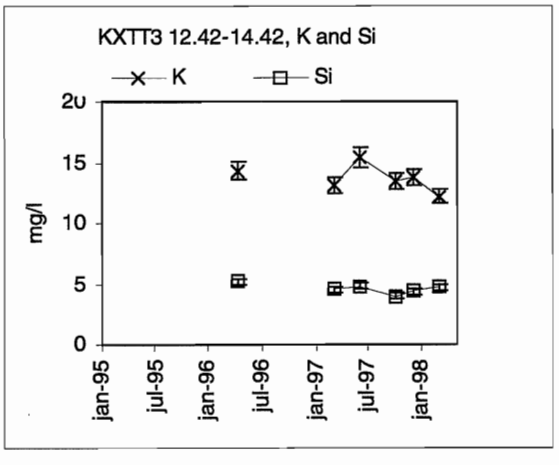
e)


KXTT3 12.42-14.42, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
1,0
0,8
0,6
0,4
0,2
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

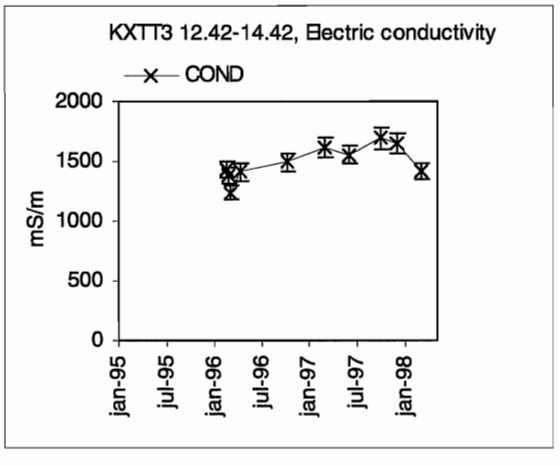
f)


KXTT3 12.42-14.42, SO4 and SO4-S
SO4
SO4_S
mg/l
500
400
300
200
100
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

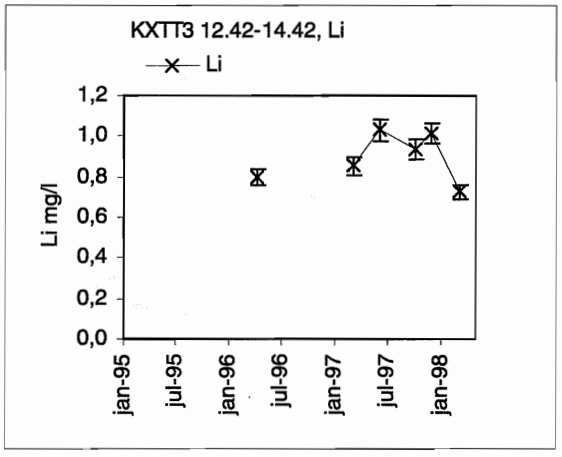
g)


KXTT3 12.42-14.42, K and Si
K
Si
mg/l
20
15
10
5
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

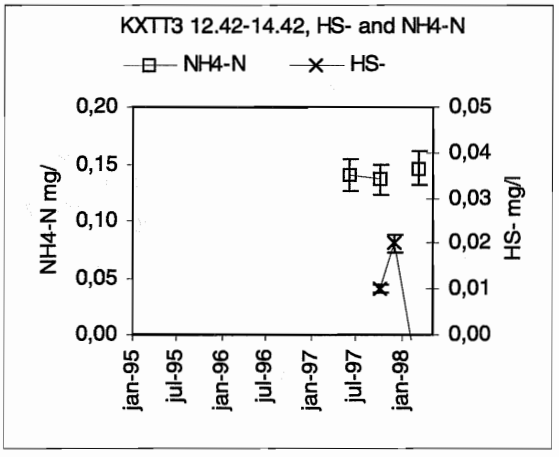
h)


KXTT3 12.42-14.42, Electric conductivity
COND
mS/m
2000
1500
1000
500
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

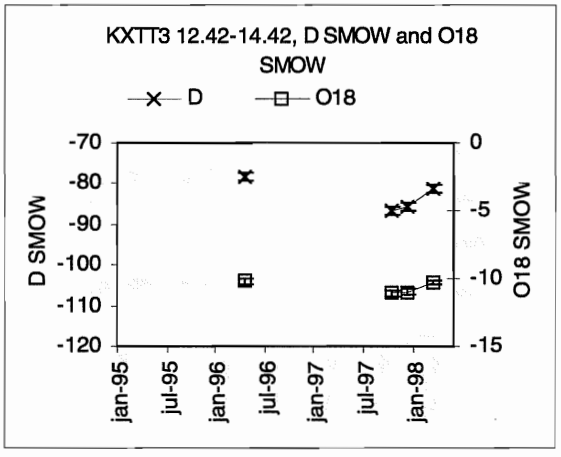
i)


KXTT3 12.42-14.42, Li
Li
Li mg/l
1,2
1,0
0,8
0,6
0,4
0,2
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


KXTT3 12.42-14.42, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
0,20
0,15
0,10
0,05
0,00
0,05
0,04
0,03
0,02
0,01
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


KXTT3 12.42-14.42, D SMOW and O18
SMOW
D
O18
D SMOW
O18 SMOW
-70
-80
-90
-100
-110
-120
0
-5
-10
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.9 SA0813B

Borehole SA0813B is a routinely drilled probing hole and it intersects fracture zone NE-4.

Anomalously high bicarbonate concentrations, low sulphate contents and the existence of sulphate-reducing bacteria, were encountered in the tunnel section 700 –1475 m, i.e. the part of the tunnel that passes under the Baltic Sea. During the construction phase, sampling of this borehole formed part of the Sulphate Reduction Project [12], which aimed at providing detailed knowledge of the processes generating sulphide. Besides the normal analytical protocol, monosulphide determinations in sediments, sulphate determinations in pore water, and studies of bacterial activity, were performed. The borehole has been sampled regularly since August 1991 and is still of interest in the monitoring programme. Studies of bacterial activity have continued during part of the time period covered in this report.

Occasionally, the two analytical methods for iron gave diverging results from this borehole. At these occasions the values obtained by ICP were considerably higher then the corresponding values obtained by spectrophotometry, indicating that there is a colloidal fraction present.

A few general data on the borehole and the sampled section are given below:

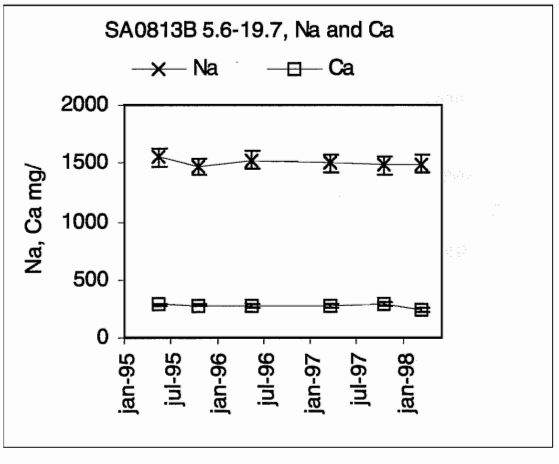
Length: 19.5 m
Diameter: 57 mm
Sampled section: 5.6 - 19.5 m

The local co-ordinates of the section:
Northing 6479.7
Easting 2152.9
Elevation –113.0
The co-ordinates are calculated for the centre of the section.

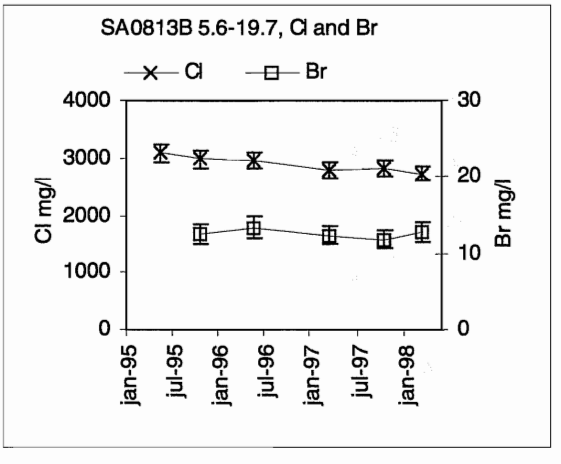
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-16 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-16 *Evolution with time in SA0813B, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

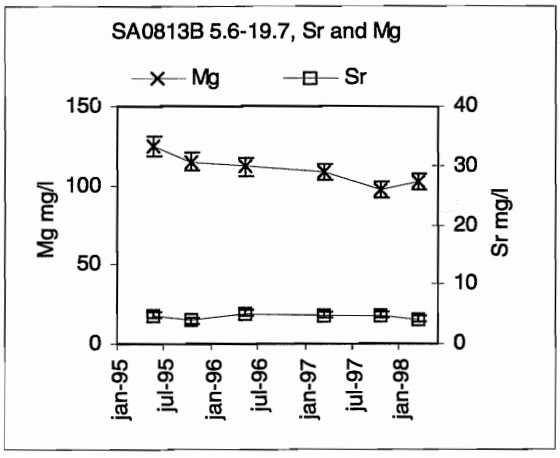
a)



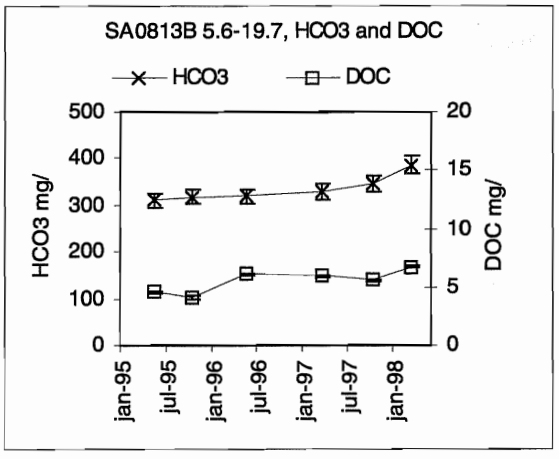
b)



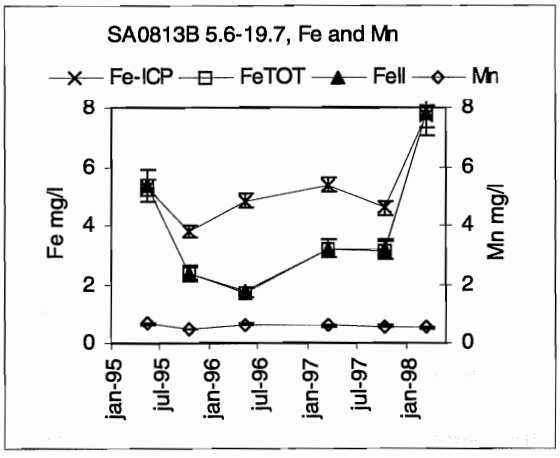
c)


SA0813B 5.6-19.7, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
150
100
50
0
40
30
20
10
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

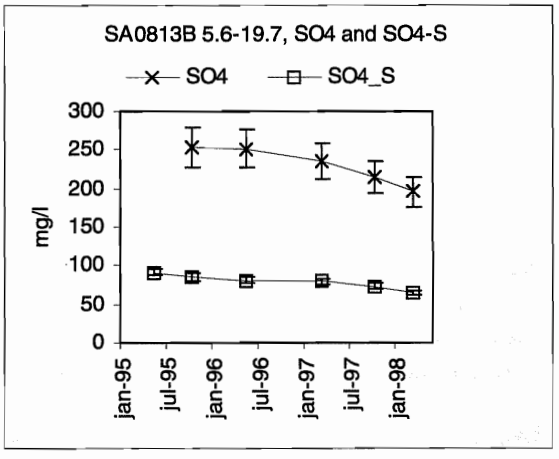
d)


SA0813B 5.6-19.7, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
500
400
300
200
100
0
20
15
10
5
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

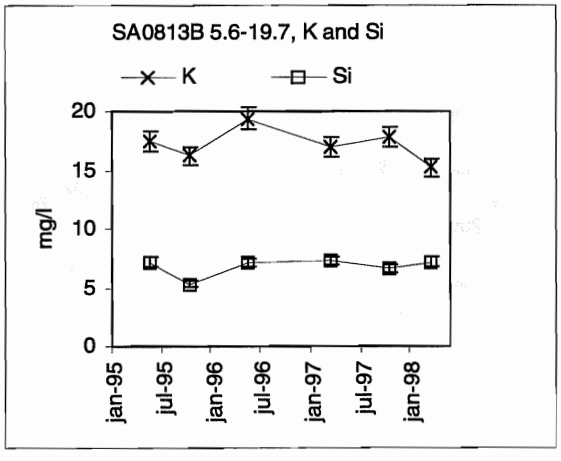
e)


SA0813B 5.6-19.7, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
8
6
4
2
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

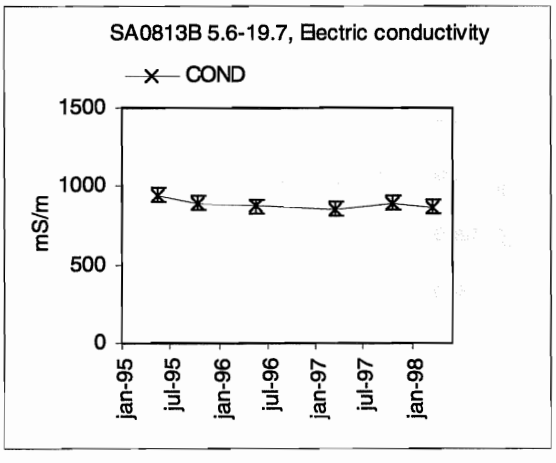
f)


SA0813B 5.6-19.7, SO4 and SO4-S
SO4
SO4_S
mg/l
300
250
200
150
100
50
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

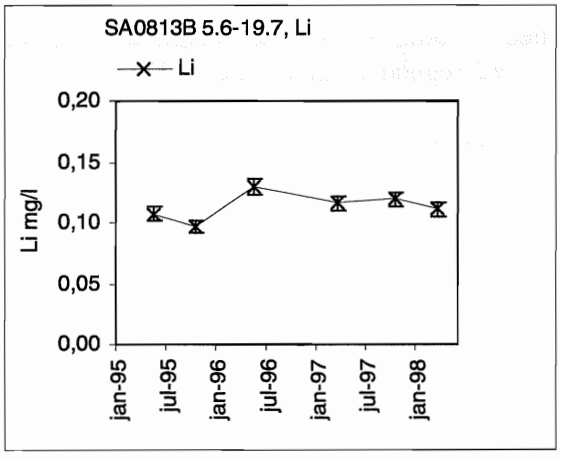
g)


SA0813B 5.6-19.7, K and Si
K
Si
mg/l
20
15
10
5
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

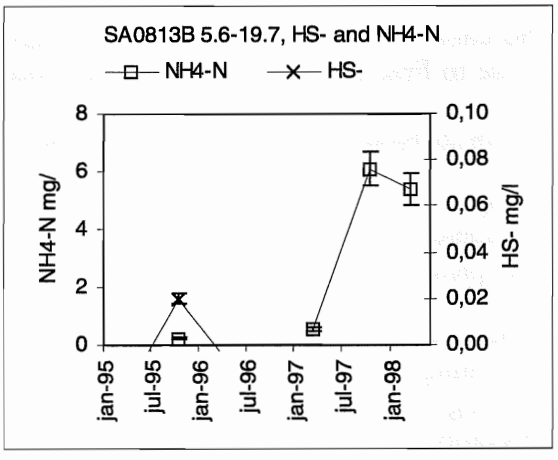
h)


SA0813B 5.6-19.7, Electric conductivity
COND
mS/m
1500
1000
500
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

i)


SA0813B 5.6-19.7, Li
Li
Li mg/l
0,20
0,15
0,10
0,05
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


SA0813B 5.6-19.7, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
8
6
4
2
0
0,10
0,08
0,06
0,04
0,02
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.10 SA1009B

Borehole SA1009B is one of the routinely drilled probing holes. The borehole is located close to Fracture zone NE-3 and has been sampled regularly since June 1993.

A few general data on the borehole and the sampled section are given below:

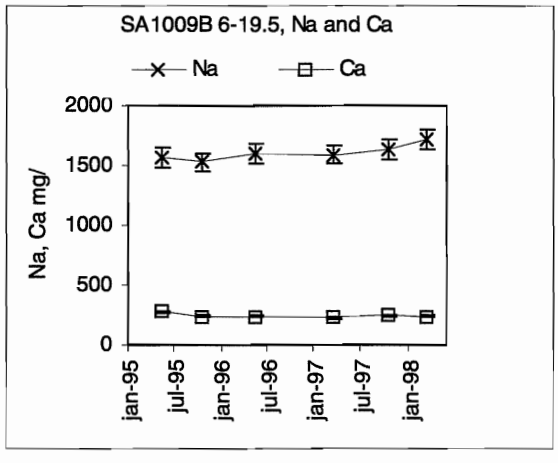
Length: 19.5 m
Diameter: 57 mm
Sampled section: 6.0 - 19.5 m

The local co-ordinates of the section:
Northing 6672.1
Easting 2152.9
Elevation –139.7
The co-ordinates are calculated for the centre of the section.

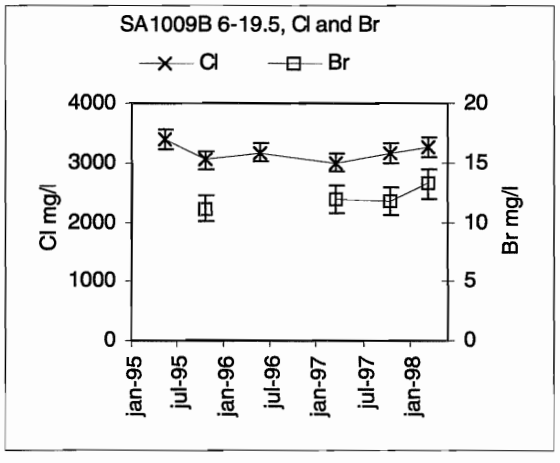
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-17 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-17 *Evolution with time in SA1009B, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

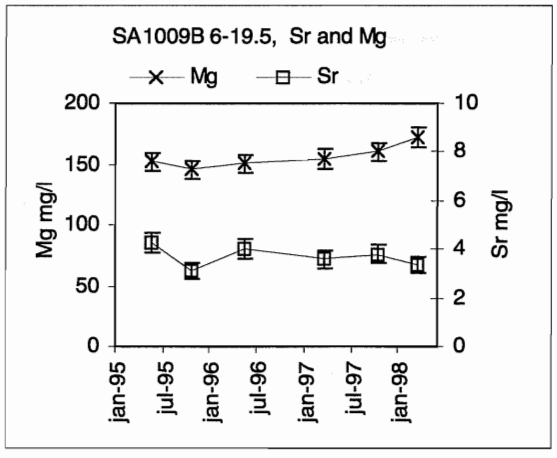
a)



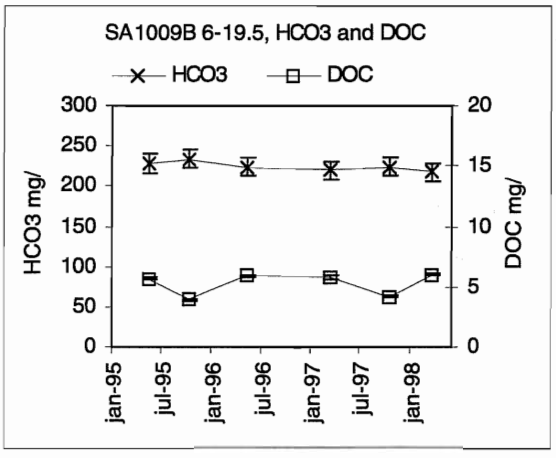
b)



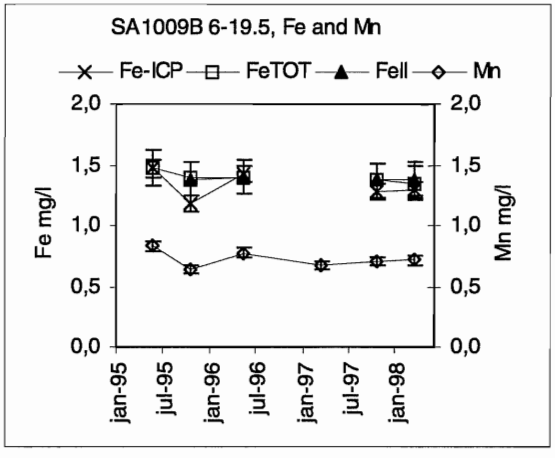
c)


SA1009B 6-19.5, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
200
150
100
50
0
10
8
6
4
2
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

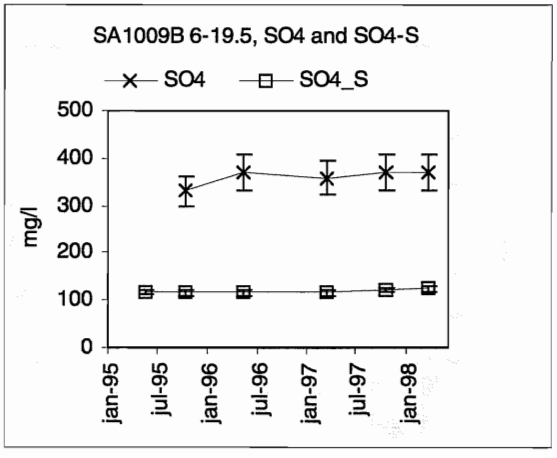
d)


SA1009B 6-19.5, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
300
250
200
150
100
50
0
20
15
10
5
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

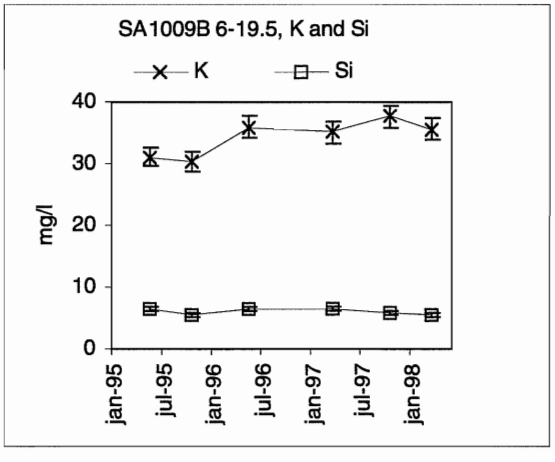
e)


SA1009B 6-19.5, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
2,0
1,5
1,0
0,5
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

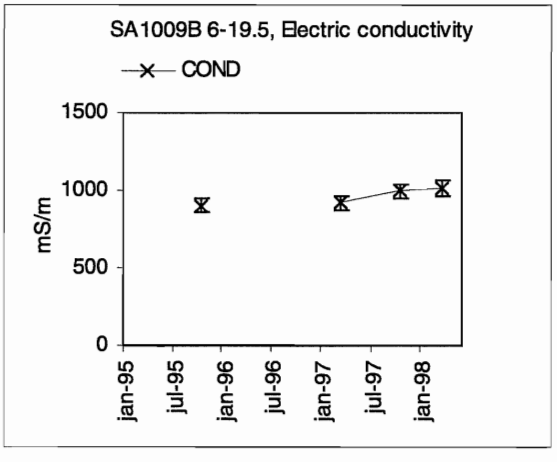
f)


SA1009B 6-19.5, SO4 and SO4-S
SO4
SO4_S
mg/l
500
400
300
200
100
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

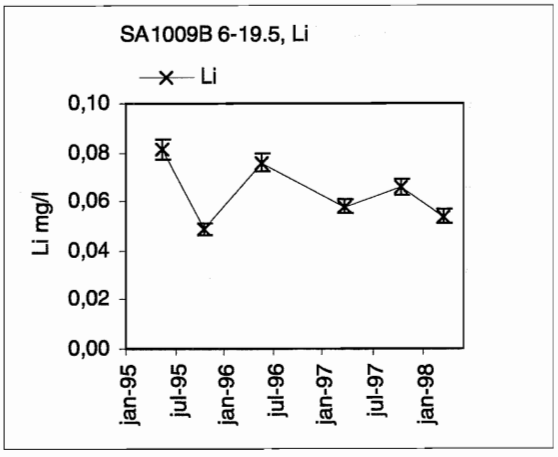
g)


SA1009B 6-19.5, K and Si
K
Si
mg/l
40
30
20
10
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

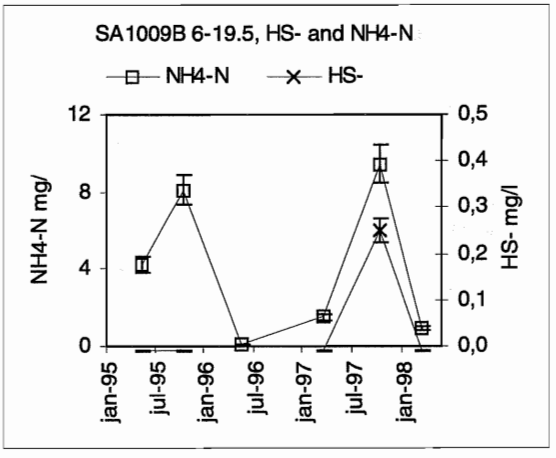
h)


SA1009B 6-19.5, Electric conductivity
COND
mS/m
1500
1000
500
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

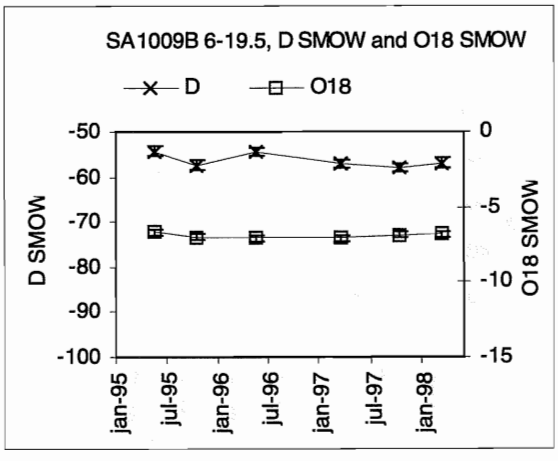
i)


SA1009B 6-19.5, Li
Li
Li mg/l
0,10
0,08
0,06
0,04
0,02
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


SA1009B 6-19.5, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
12
8
4
0
0,5
0,4
0,3
0,2
0,1
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


SA1009B 6-19.5, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-50
-60
-70
-80
-90
-100
0
-5
-10
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.11 SA1229B

The borehole SA1229B is one of the routinely drilled probing holes. The borehole is located south of the fracture zone NE-1 and water samples may possibly be of the same character as water in the fracture zone. The borehole has been sampled regularly since June 1993.

A few general data on the borehole and the sampled section are given below:

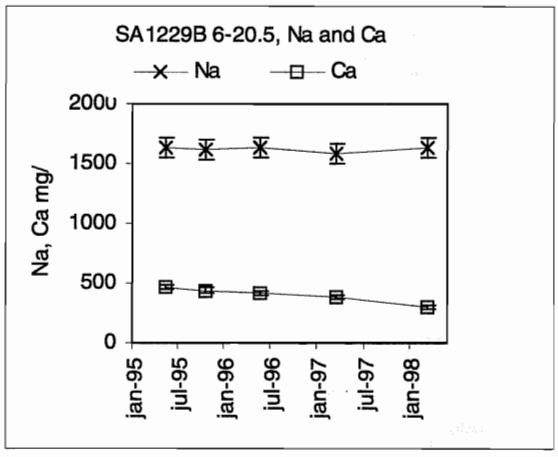
Length: 20.5 m
Diameter: 57 mm
Sampled section: 6.0 - 20.5 m

The local co-ordinates of the section:
Northing 6885.2
Easting 2105.5
Elevation –171.3
The co-ordinates are calculated for the centre of the section.

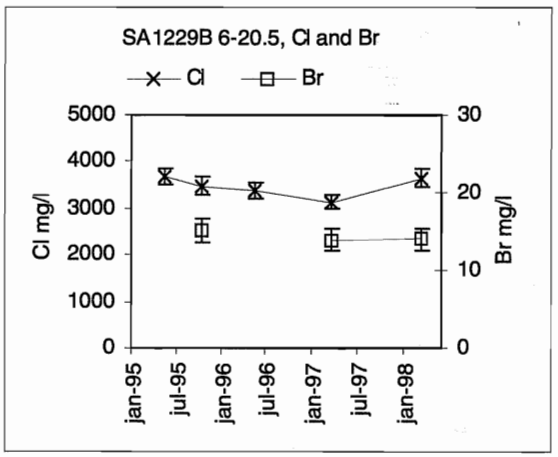
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-18 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-18 *Evolution with time in SA1229B, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

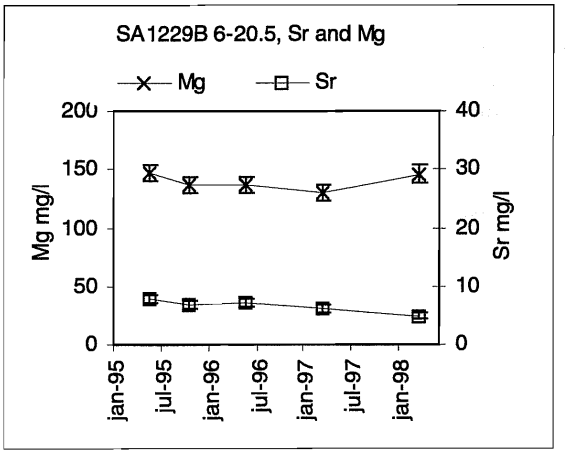
a)



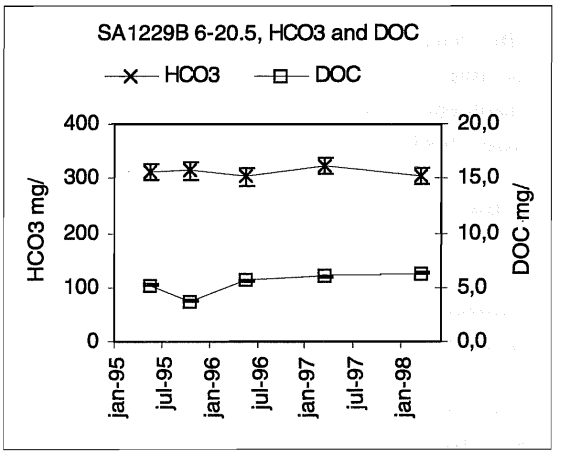
b)



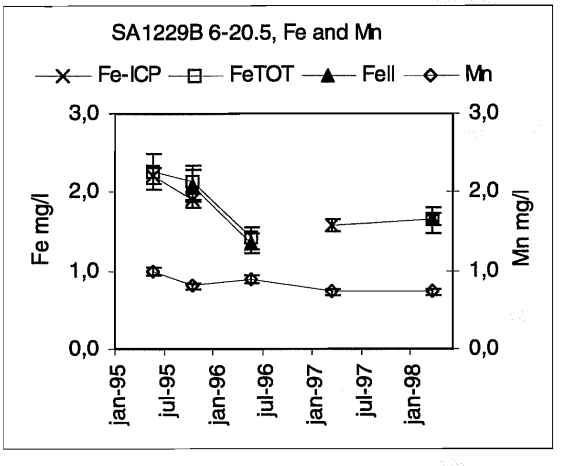
c)


SA1229B 6-20.5, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
200
150
100
50
0
40
30
20
10
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

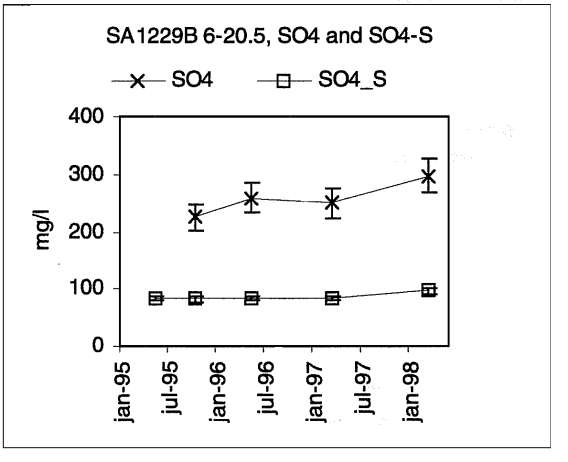
d)


SA1229B 6-20.5, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
400
300
200
100
0
20,0
15,0
10,0
5,0
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

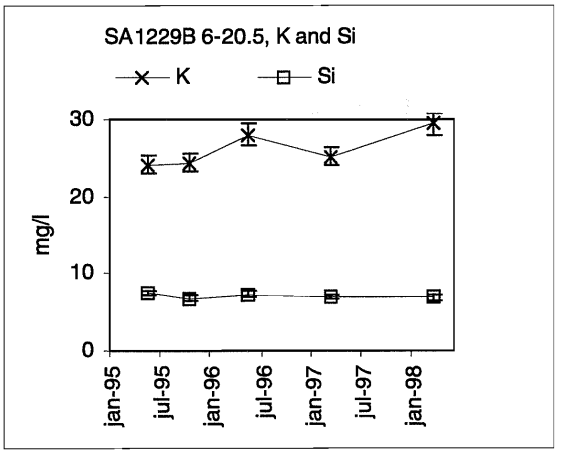
e)


SA1229B 6-20.5, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
3,0
2,0
1,0
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

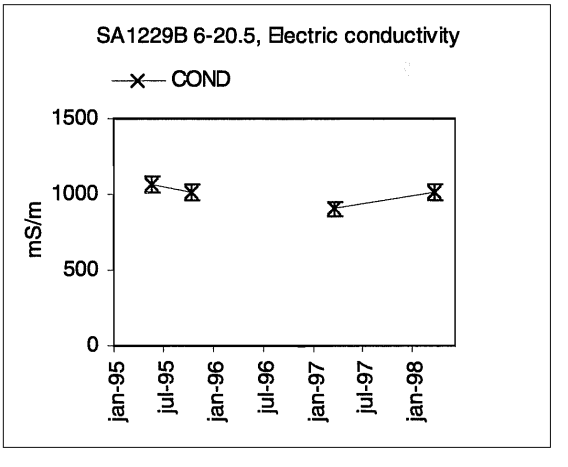
f)


SA1229B 6-20.5, SO4 and SO4-S
SO4
SO4_S
mg/l
400
300
200
100
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

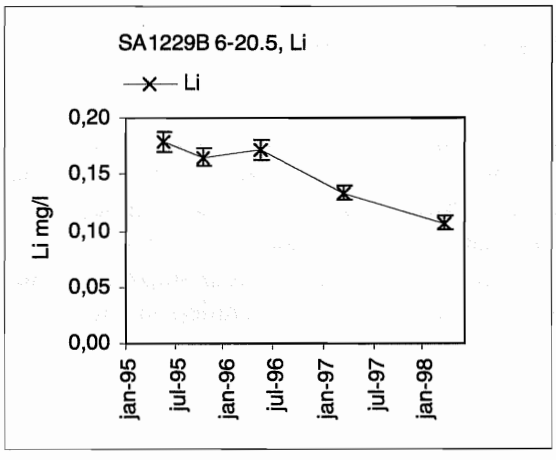
g)


SA1229B 6-20.5, K and Si
K
Si
mg/l
30
20
10
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

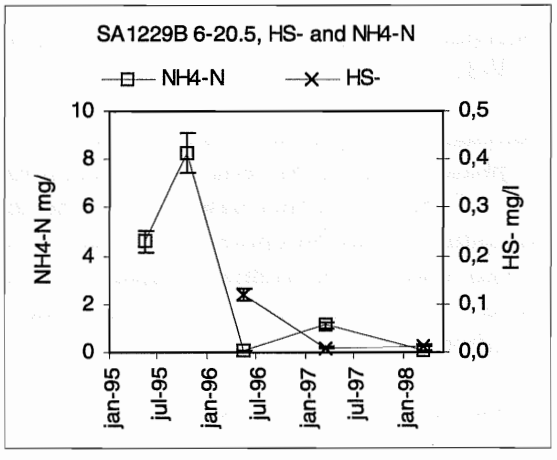
h)


SA1229B 6-20.5, Electric conductivity
COND
mS/m
1500
1000
500
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

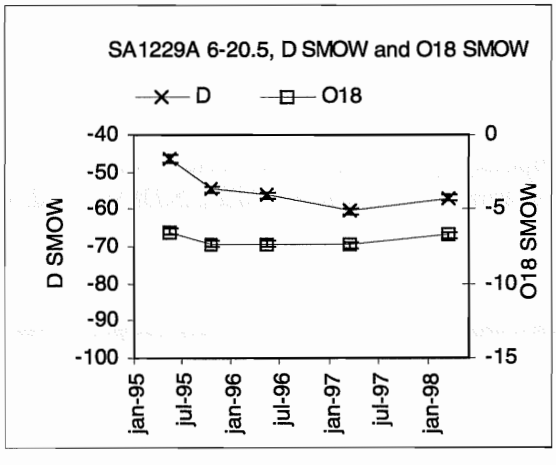
i)


SA1229B 6-20.5, Li
Li
Li mg/l
0,20
0,15
0,10
0,05
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


SA1229B 6-20.5, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
10
8
6
4
2
0
0,5
0,4
0,3
0,2
0,1
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


SA1229A 6-20.5, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-40
-50
-60
-70
-80
-90
-100
0
-5
-10
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.12 SA1420A

Borehole SA1420A is a routinely drilled probing hole and it intersects Fracture zone EW-3.

Anomalously high bicarbonate concentrations, low sulphate contents, and existence of sulphate-reducing bacteria were encountered in the tunnel section 700 –1475 m, i.e. the part of the tunnel that passes under the Baltic Sea. During the construction phase, sampling of this borehole formed part of the so-called Sulphate Reduction Project [12], which aimed at providing detailed knowledge of the processes generating sulphide. The borehole has been sampled regularly since August 1992 and is still included in the monitoring programme.

A few general data on the borehole and the sampled section are given below:

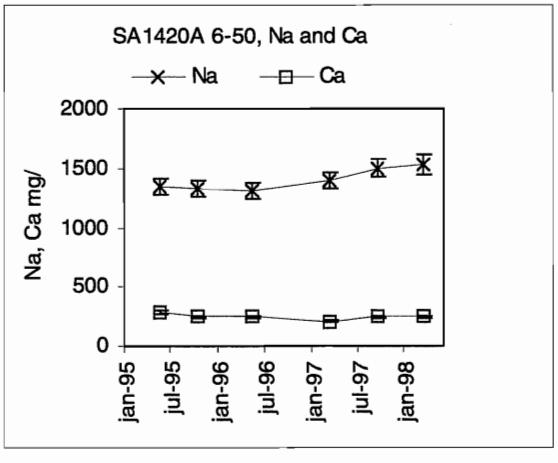
Length: 50.0 m
Diameter: 58 mm
Sampled section: 6.0 - 50.00 m

The local co-ordinates of the section:
Northing 7092.3
Easting 2080.8
Elevation –200.6
The co-ordinates are calculated for the centre of the section.

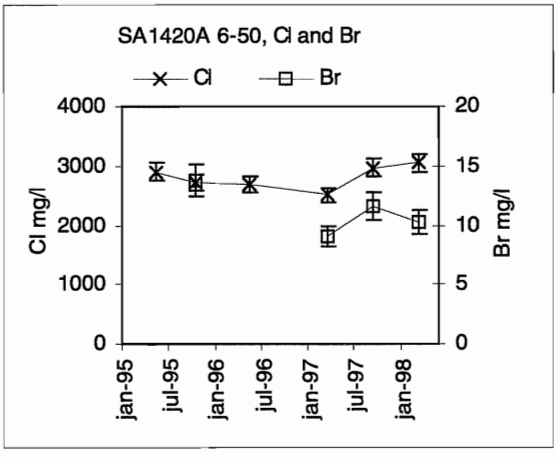
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-19 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-19 *Evolution with time in SA1420A, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

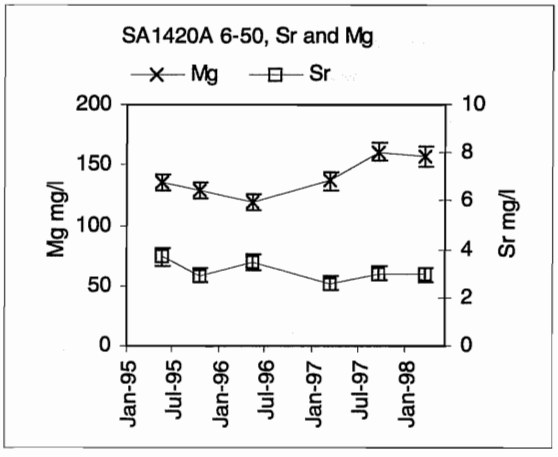
a)



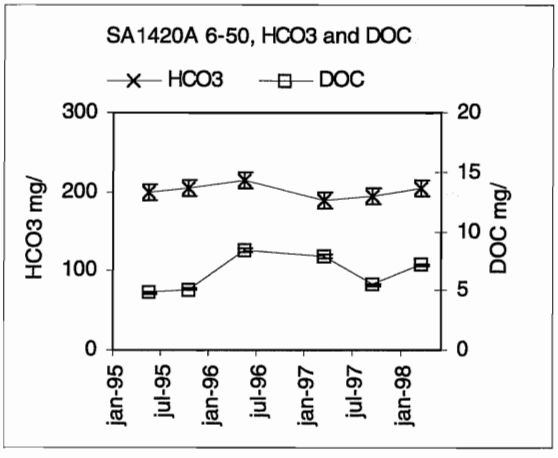
b)



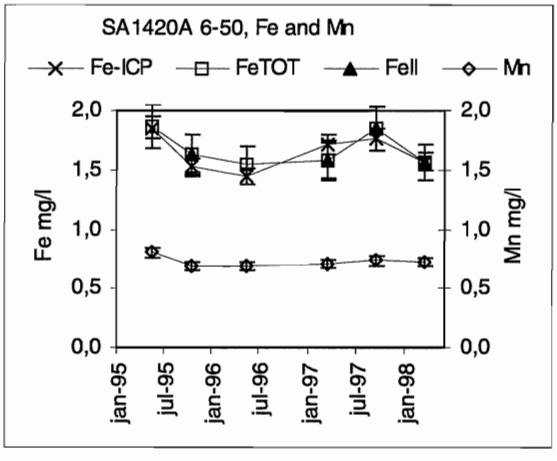
c)


SA1420A 6-50, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
200
150
100
50
0
10
8
6
4
2
0
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98

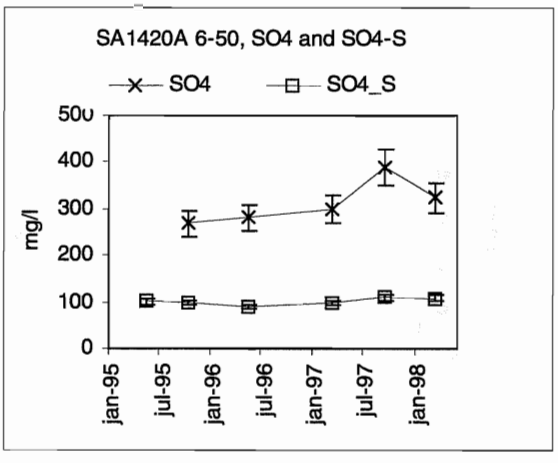
d)


SA1420A 6-50, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
300
200
100
0
20
15
10
5
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

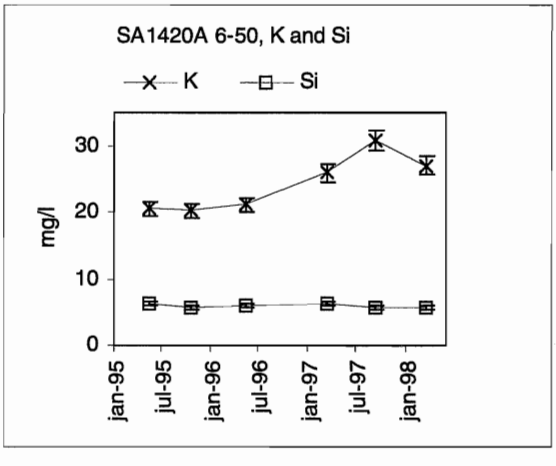
e)


SA1420A 6-50, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
2,0
1,5
1,0
0,5
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

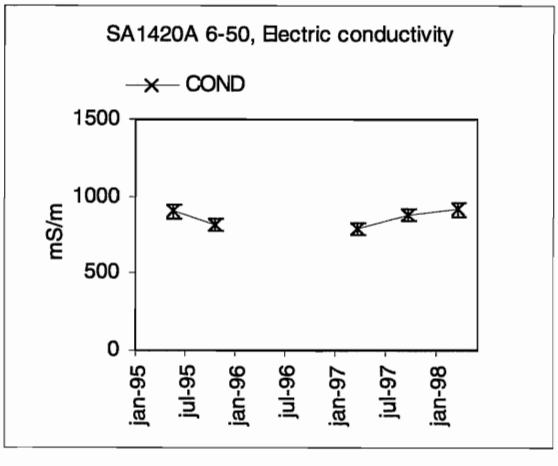
f)


SA1420A 6-50, SO4 and SO4-S
SO4
SO4_S
mg/l
500
400
300
200
100
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

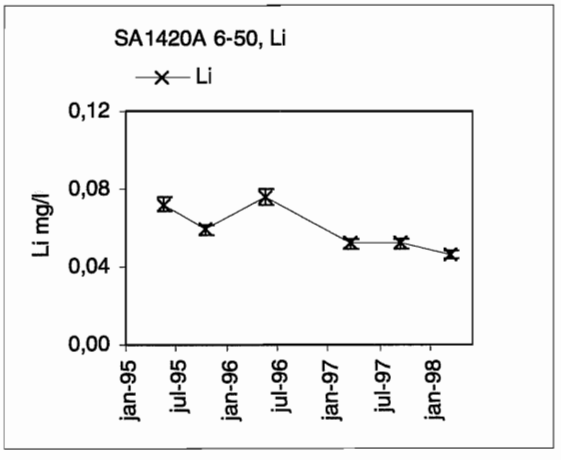
g)


SA1420A 6-50, K and Si
K
Si
mg/l
30
20
10
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

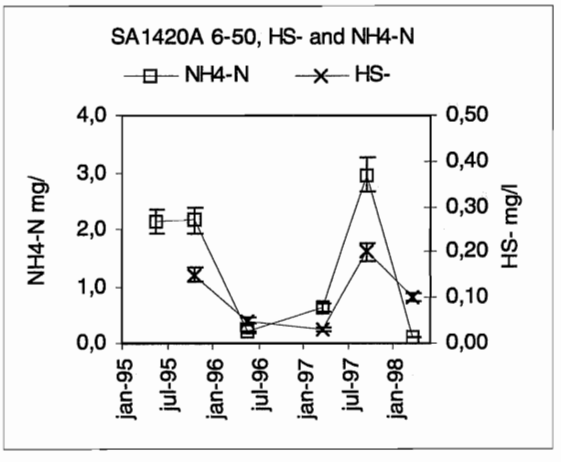
h)


SA1420A 6-50, Electric conductivity
COND
mS/m
1500
1000
500
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

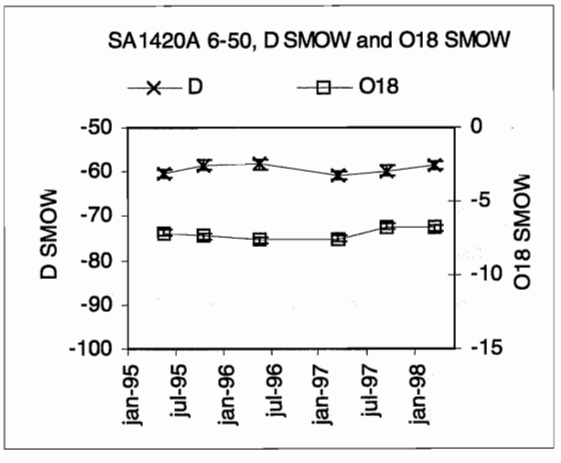
i)


SA1420A 6-50, Li
Li
Li mg/l
0,12
0,08
0,04
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


SA1420A 6-50, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
4,0
3,0
2,0
1,0
0,0
0,50
0,40
0,30
0,20
0,10
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


SA1420A 6-50, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-50
-60
-70
-80
-90
-100
0
-5
-10
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.13 SA1730B

Borehole SA1730B is one of the routinely drilled probing holes. The borehole has been sampled regularly since February 1993.

A few general data on the borehole and the sampled section are given below:

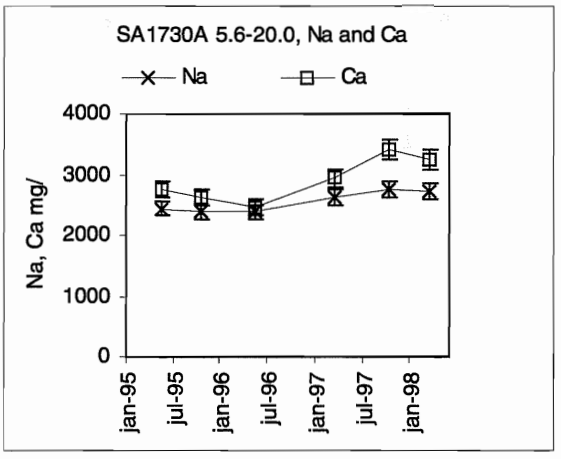
Length: 20.0 m
Diameter: 57 mm
Sampled section: 5.6 - 20.0 m.

The local co-ordinates of the section:
Northing 7369.3
Easting 2065.9
Elevation –237.0
The co-ordinates are calculated for the centre of the section.

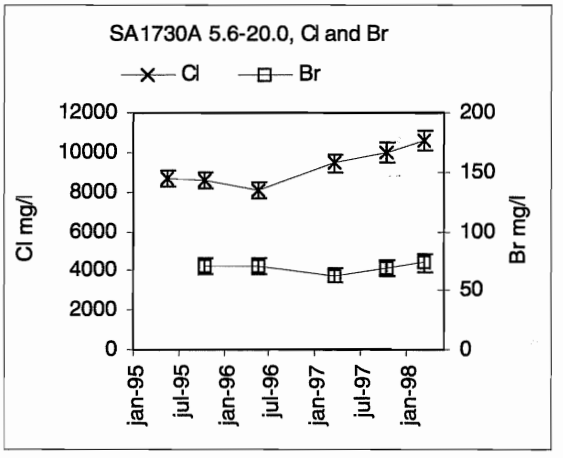
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-20 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-20 *Evolution with time in SA1730B, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

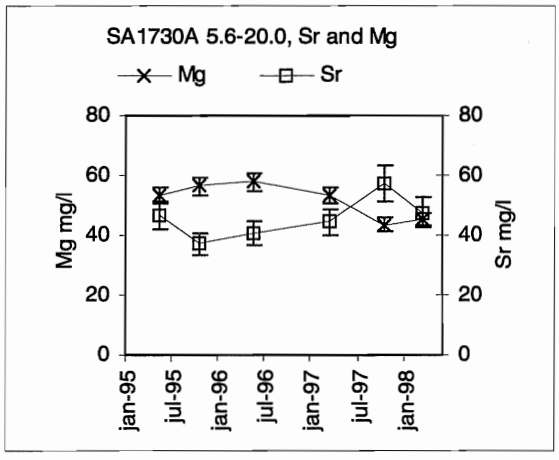
a)



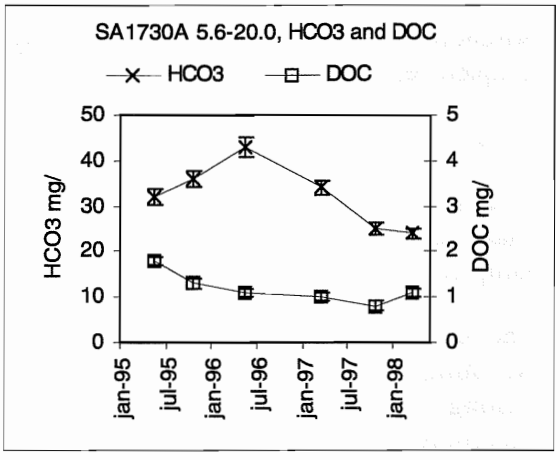
b)



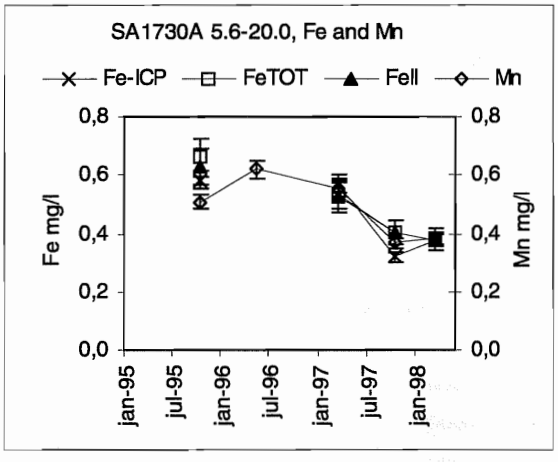
c)


SA1730A 5.6-20.0, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
0
20
40
60
80
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

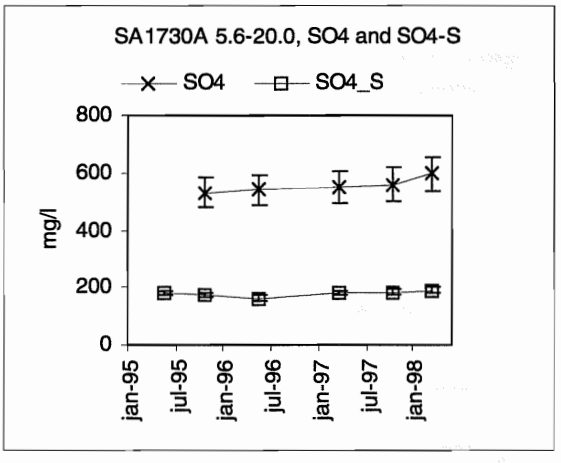
d)


SA1730A 5.6-20.0, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
0
10
20
30
40
50
0
1
2
3
4
5
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

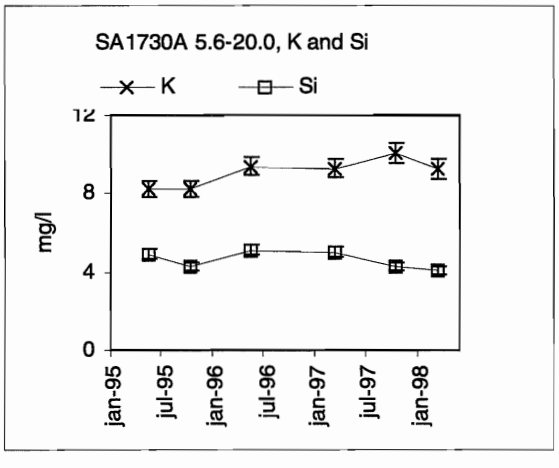
e)


SA1730A 5.6-20.0, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
0,0
0,2
0,4
0,6
0,8
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

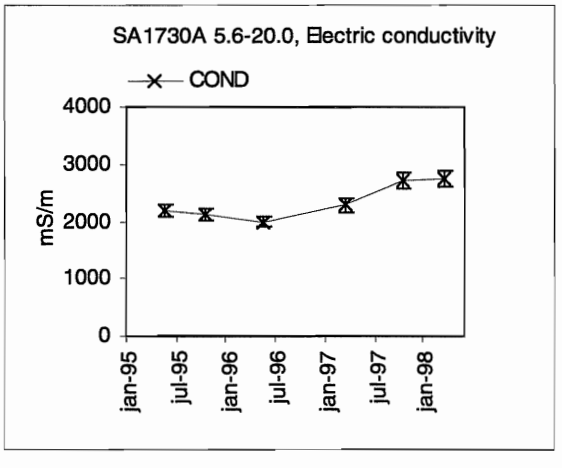
f)


SA1730A 5.6-20.0, SO4 and SO4-S
SO4
SO4_S
mg/l
0
200
400
600
800
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

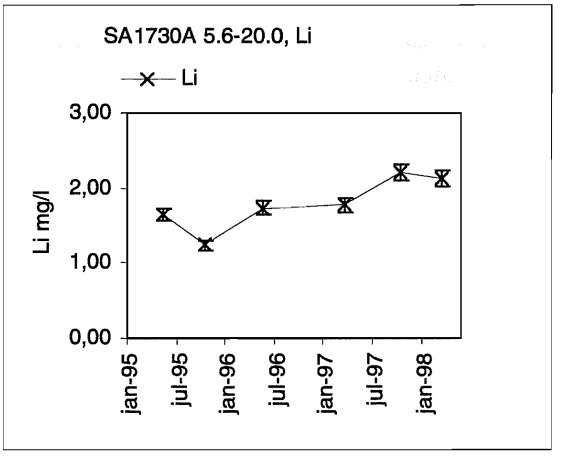
g)


SA1730A 5.6-20.0, K and Si
K
Si
mg/l
0
4
8
12
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

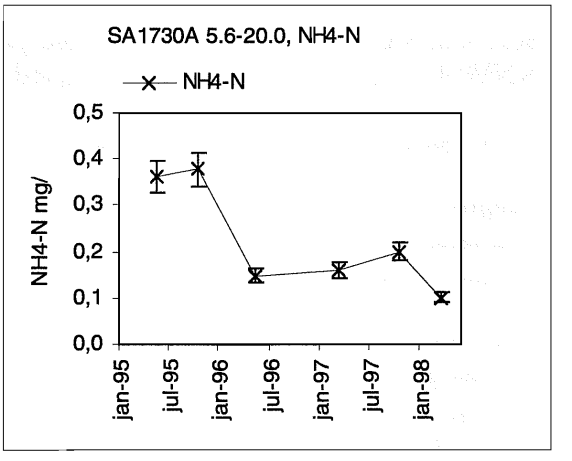
h)


SA1730A 5.6-20.0, Electric conductivity
COND
mS/m
0
1000
2000
3000
4000
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

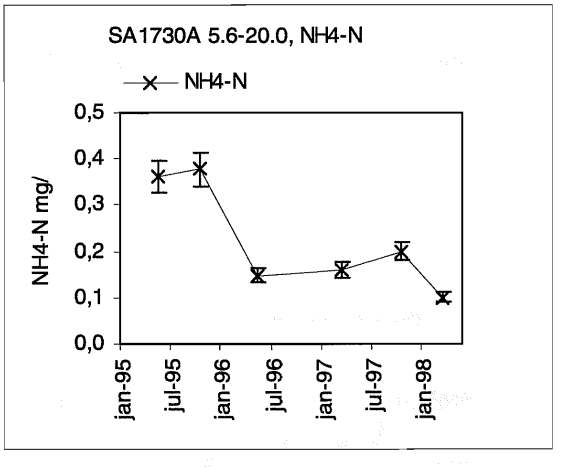
i)


SA1730A 5.6-20.0, Li
Li
3,00
2,00
1,00
0,00
Li mg/l
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


SA1730A 5.6-20.0, NH4-N
NH4-N
0,5
0,4
0,3
0,2
0,1
0,0
NH4-N mg/
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


SA1730A 5.6-20.0, NH4-N
NH4-N
0,5
0,4
0,3
0,2
0,1
0,0
NH4-N mg/
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.14 SA2074B

Borehole SA2074B is a routinely drilled probing hole and it intersects Fracture zone NNW-4. The borehole has been sampled regularly since February 1993.

A few general data on the borehole and the sampled section are given below:

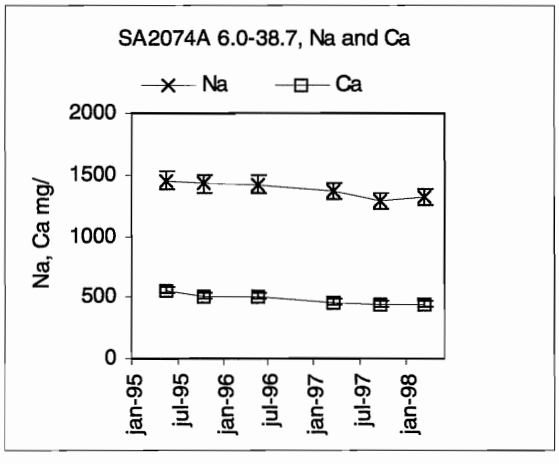
Length: 38.7 m
Diameter: 57 mm
Sampled section: 6.0 - 38.7 m

The local co-ordinates of the section:
Northing 7290.0
Easting 2348.3
Elevation –281.7
The co-ordinates are calculated for the centre of the section.

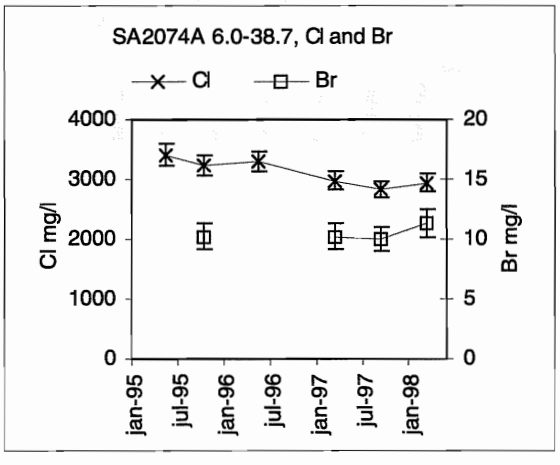
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-21 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-21 *Evolution with time in SA2074B, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

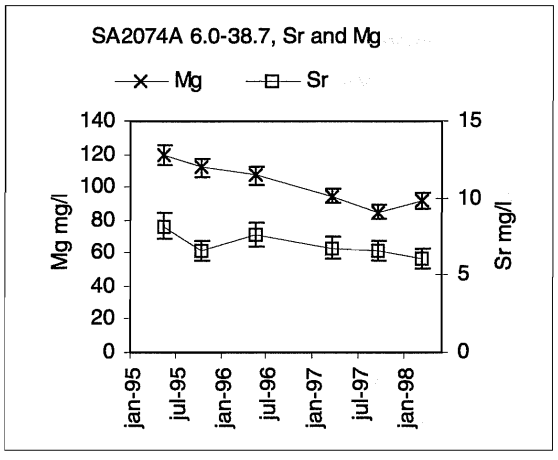
a)



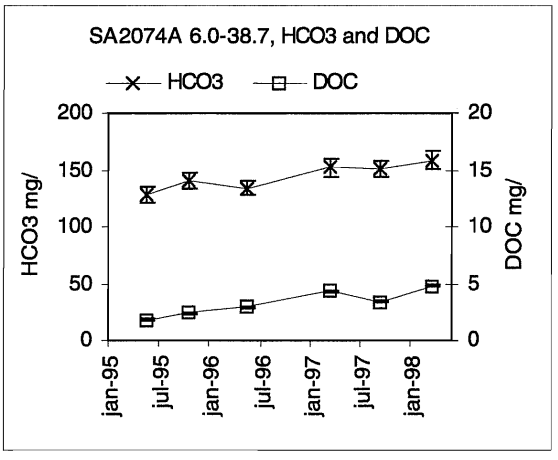
b)



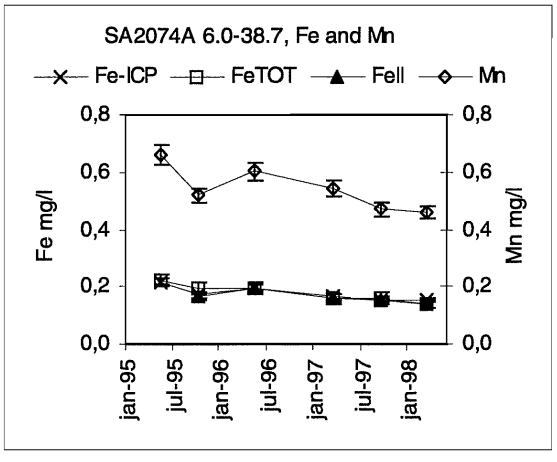
c)


SA2074A 6.0-38.7, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
140
120
100
80
60
40
20
0
15
10
5
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

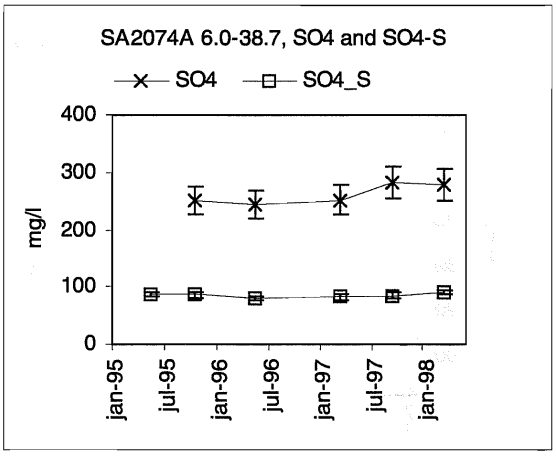
d)


SA2074A 6.0-38.7, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
200
150
100
50
0
20
15
10
5
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

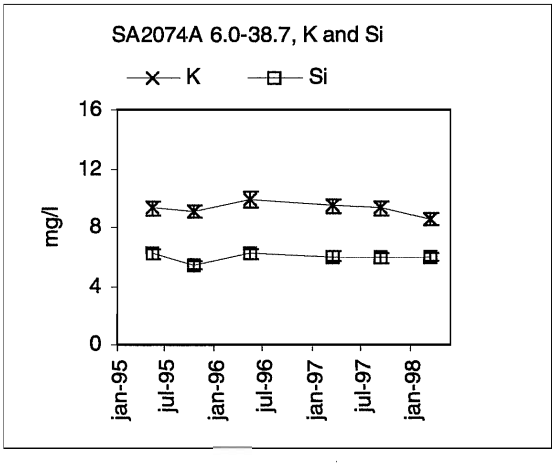
e)


SA2074A 6.0-38.7, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
0,8
0,6
0,4
0,2
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

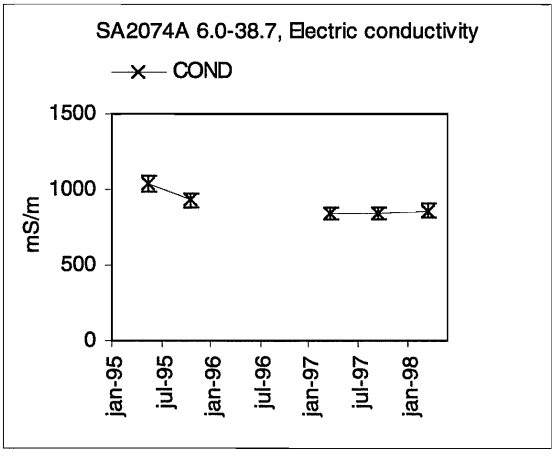
f)


SA2074A 6.0-38.7, SO4 and SO4-S
SO4
SO4_S
mg/l
400
300
200
100
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

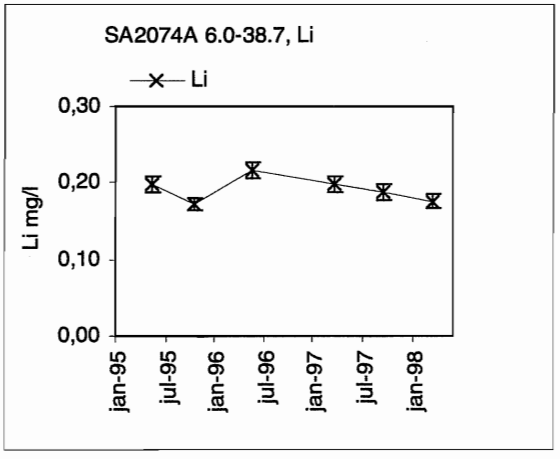
g)


SA2074A 6.0-38.7, K and Si
K
Si
mg/l
16
12
8
4
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

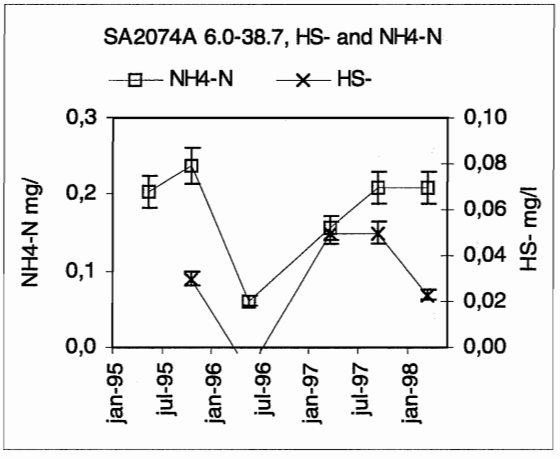
h)


SA2074A 6.0-38.7, Electric conductivity
COND
mS/m
1500
1000
500
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

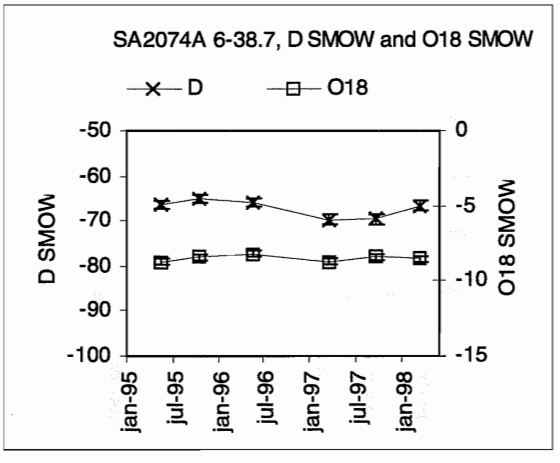
i)


SA2074A 6.0-38.7, Li
Li
Li mg/l
0,30
0,20
0,10
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


SA2074A 6.0-38.7, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
0,3
0,2
0,1
0,0
0,10
0,08
0,06
0,04
0,02
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


SA2074A 6-38.7, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-50
-60
-70
-80
-90
-100
0
-5
-10
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.15 SA2273A

The borehole SA2273A is a routinely drilled probing hole and it is interpreted to intersect Fracture zone NNW-1. The borehole has been sampled regularly since November 1993.

A few general data on the borehole and the sampled section are given below:

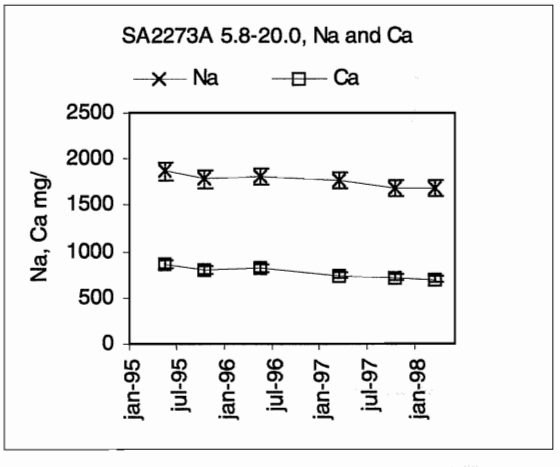
Length: 20.0 m
Diameter: 57 mm
Sampled section: 5.8 - 20.0 m.

The local co-ordinates of the section:
Northing 7149.8
Easting 2221.7
Elevation –306.0
The co-ordinates are calculated for the centre of the section.

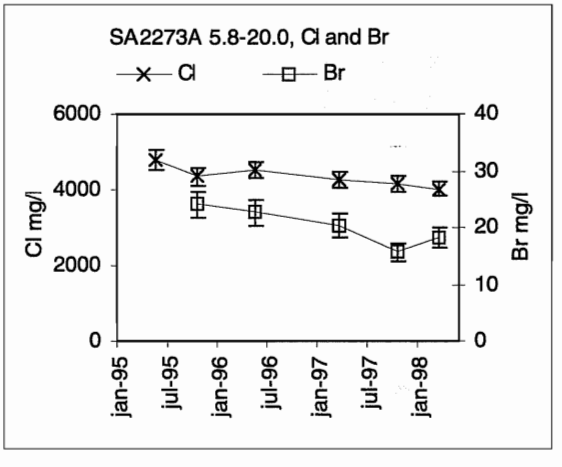
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-22 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-22 *Evolution with time in SA2273A, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

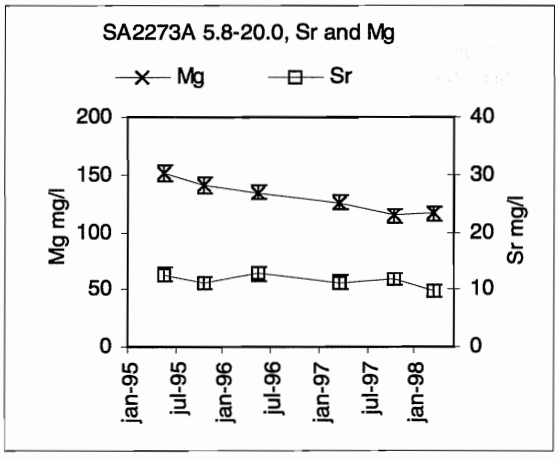
a)



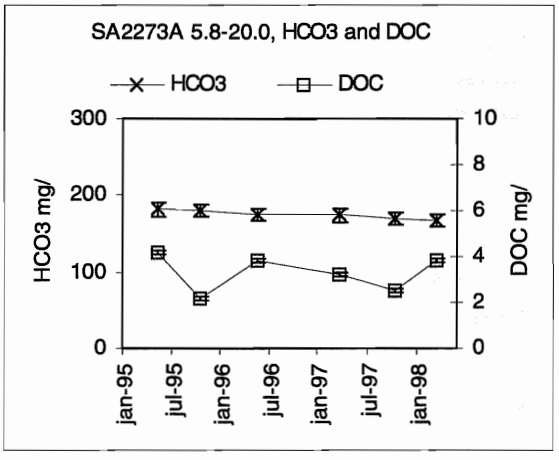
b)



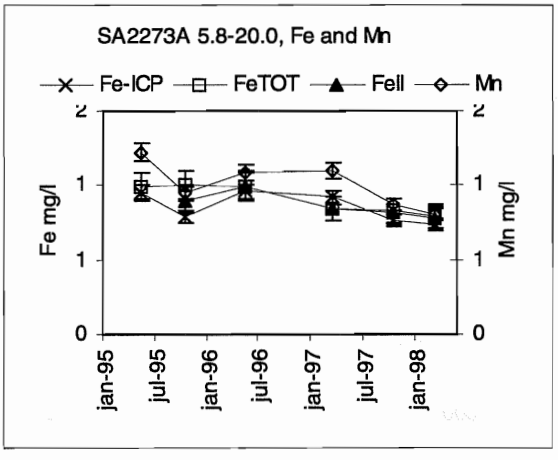
c)


SA2273A 5.8-20.0, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
200
150
100
50
0
40
30
20
10
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

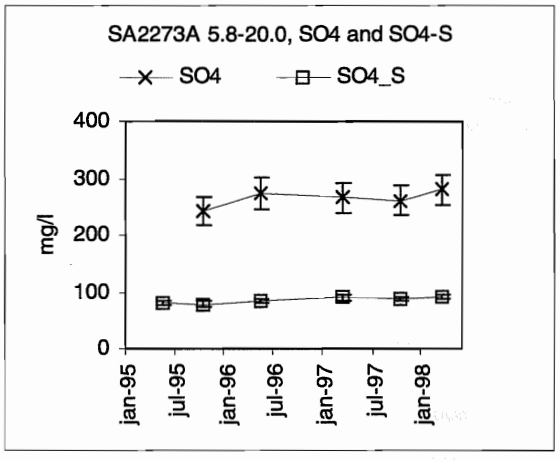
d)


SA2273A 5.8-20.0, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
300
200
100
0
10
8
6
4
2
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

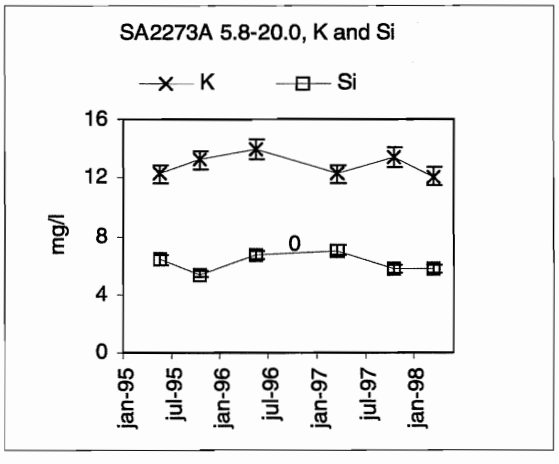
e)


SA2273A 5.8-20.0, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
1
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

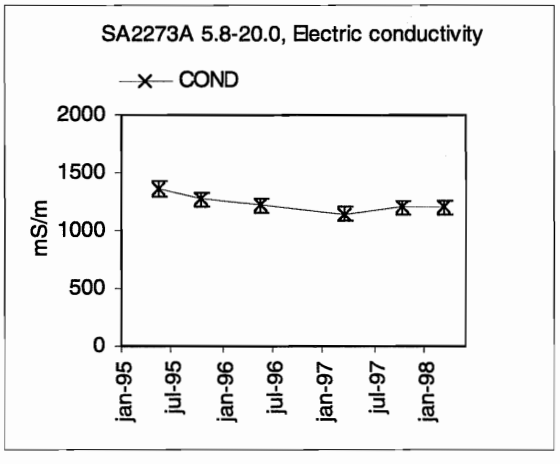
f)


SA2273A 5.8-20.0, SO4 and SO4-S
SO4
SO4_S
mg/l
400
300
200
100
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

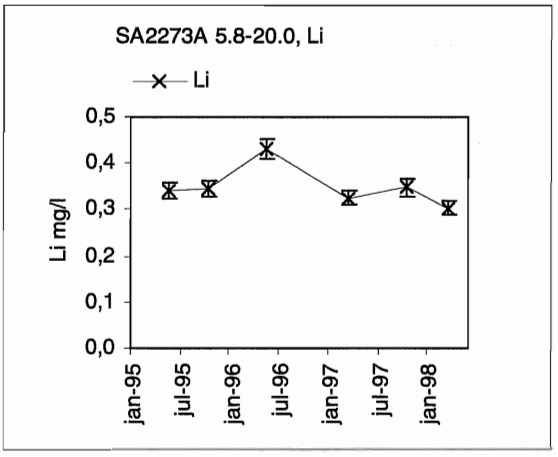
g)


SA2273A 5.8-20.0, K and Si
K
Si
mg/l
16
12
8
4
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

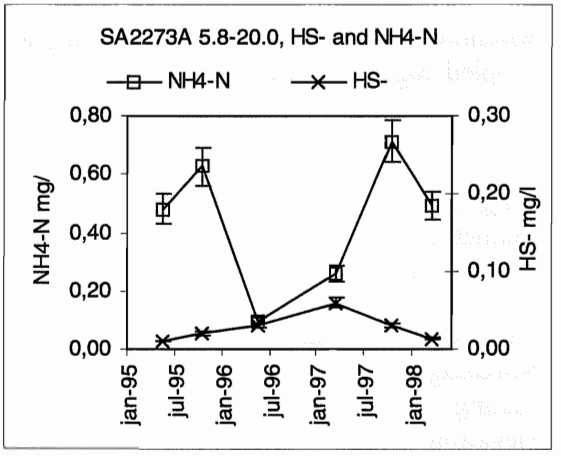
h)


SA2273A 5.8-20.0, Electric conductivity
COND
mS/m
2000
1500
1000
500
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

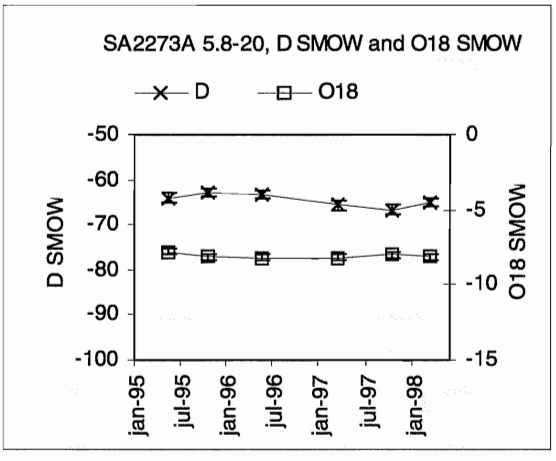
i)


SA2273A 5.8-20.0, Li
Li
Li mg/l
0,5
0,4
0,3
0,2
0,1
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


SA2273A 5.8-20.0, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
0,80
0,60
0,40
0,20
0,00
0,30
0,20
0,10
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


SA2273A 5.8-20, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-50
-60
-70
-80
-90
-100
0
-5
-10
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.16 SA2600A

Borehole SA2600A is one of the routinely drilled probing holes. The borehole has been sampled regularly since March 1994.

A few general data on the borehole and the sampled section are given below:

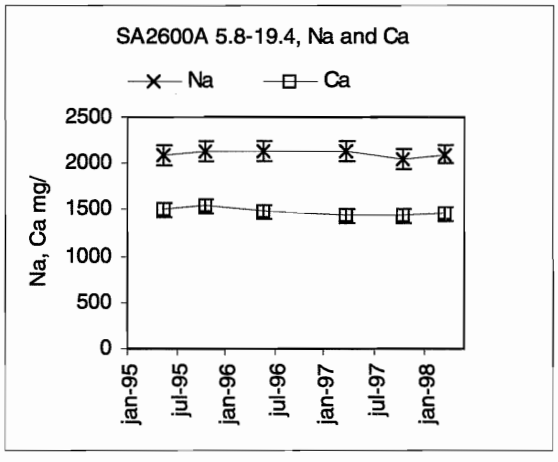
Length: 19.4 m
Diameter: 57 mm
Sampled section: 5.8 - 19.4 m.

The local co-ordinates of the section:
Northing 7315.5
Easting 2044.4
Elevation –345.0
The co-ordinates are calculated for the centre of the section.

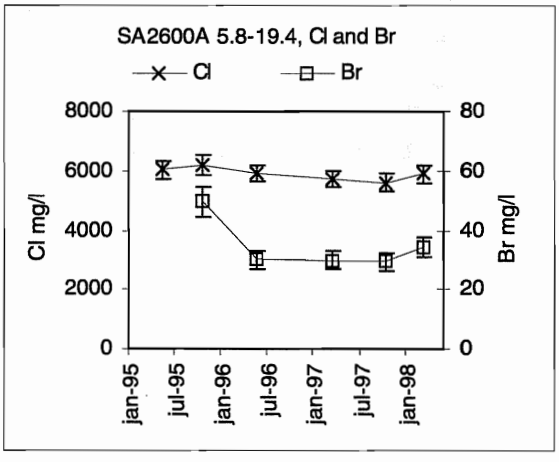
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figure 4-23 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-23 *Evolution with time in SA2600A, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

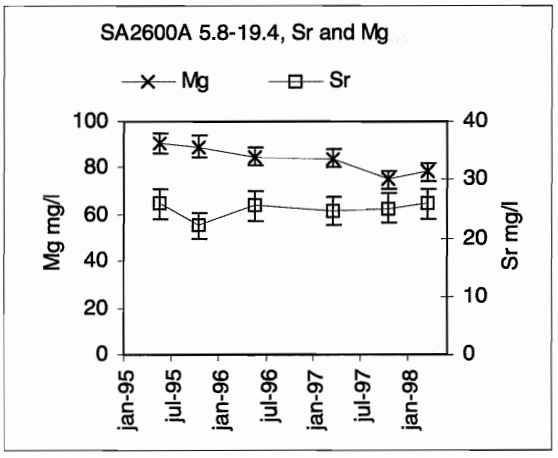
a)



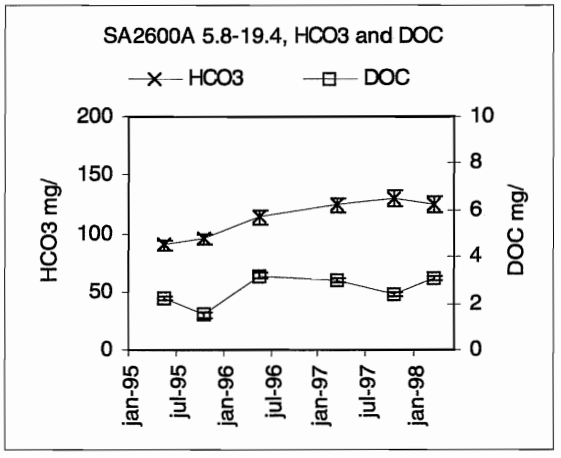
b)



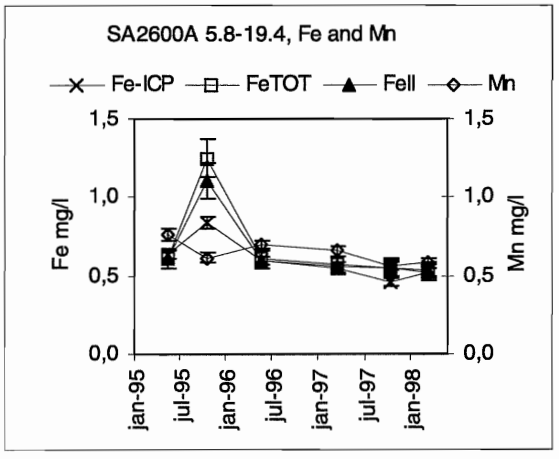
c)


SA2600A 5.8-19.4, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
100
80
60
40
20
0
40
30
20
10
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

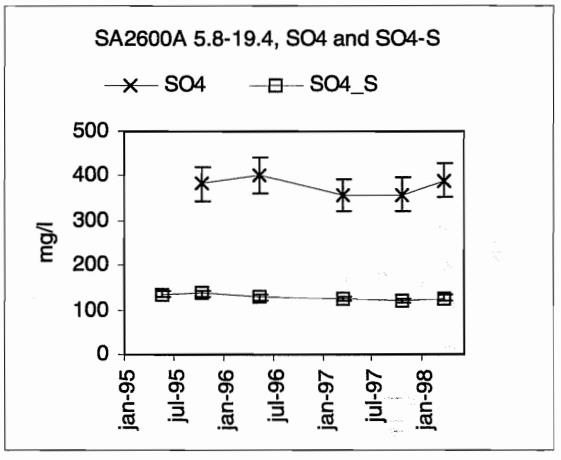
d)


SA2600A 5.8-19.4, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
200
150
100
50
0
10
8
6
4
2
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

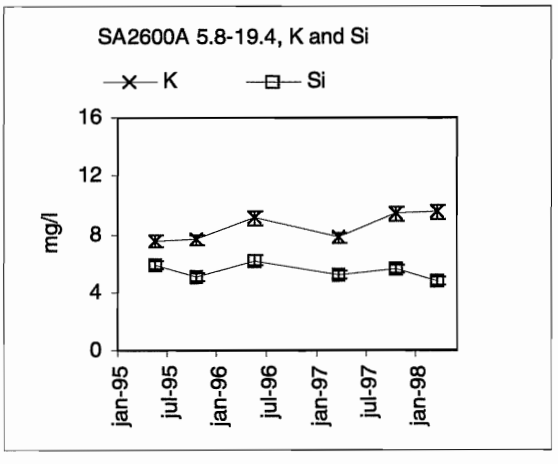
e)


SA2600A 5.8-19.4, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
1,5
1,0
0,5
0,0
1,5
1,0
0,5
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

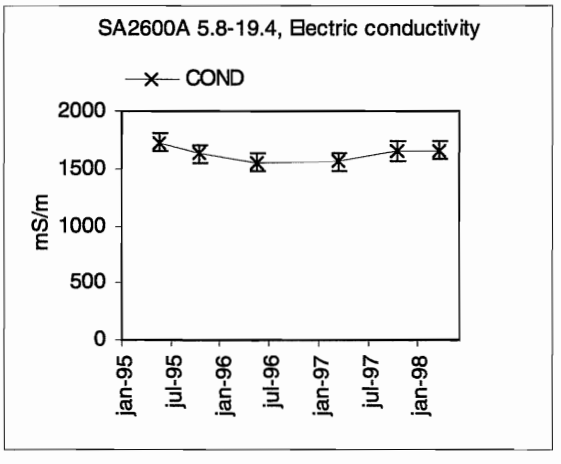
f)


SA2600A 5.8-19.4, SO4 and SO4-S
SO4
SO4_S
mg/l
500
400
300
200
100
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

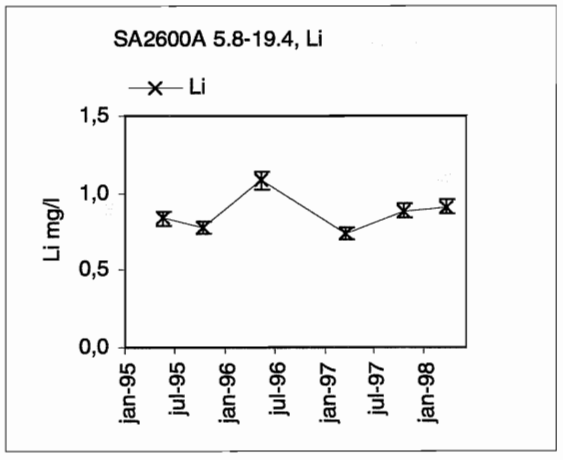
g)


SA2600A 5.8-19.4, K and Si
K
Si
mg/l
16
12
8
4
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

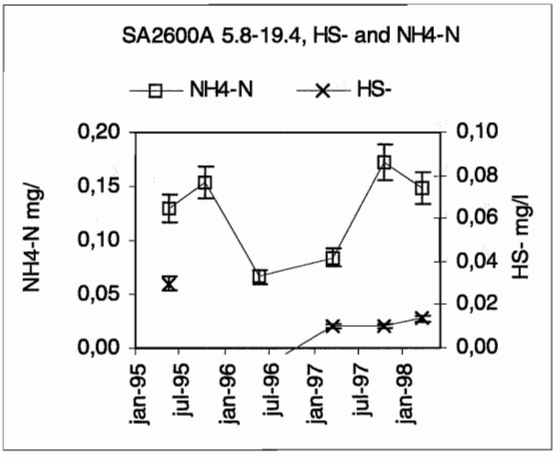
h)


SA2600A 5.8-19.4, Electric conductivity
COND
mS/m
2000
1500
1000
500
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

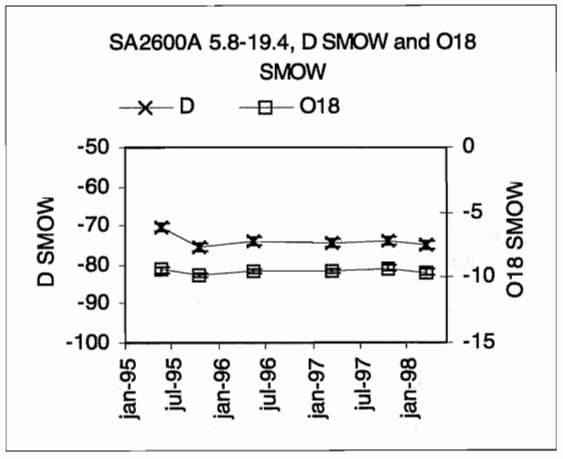
i)


SA2600A 5.8-19.4, Li
Li
Li mg/l
1,5
1,0
0,5
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


SA2600A 5.8-19.4, HS- and NH4-N
NH4-N
HS-
NH4-N mg/
HS- mg/l
0,20
0,15
0,10
0,05
0,00
0,10
0,08
0,06
0,04
0,02
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


SA2600A 5.8-19.4, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-50
-60
-70
-80
-90
-100
0
-5
-10
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.17 SA2783A

The borehole SA2783A is a routinely drilled probing hole and it is interpreted to intersect Fracture zone NNW-2. The borehole has been sampled regularly since February 1994.

A few general data on the borehole and the sampled section are given below:

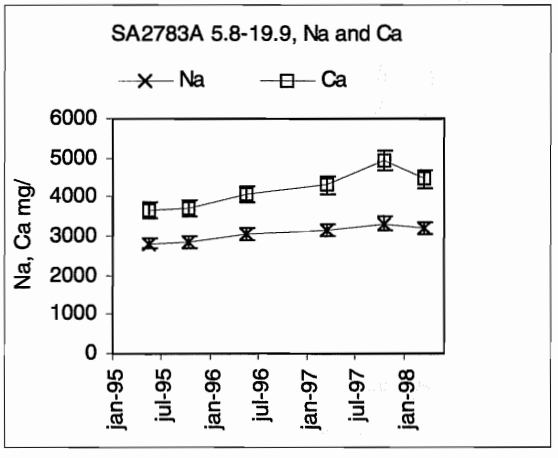
Length: 19.9 m
Diameter: 57 mm
Sampled section: 5.8 - 19.9 m

The local co-ordinates of the section:
Northing 7442.8
Easting 2160.7
Elevation –371.4
The co-ordinates are calculated for the centre of the section.

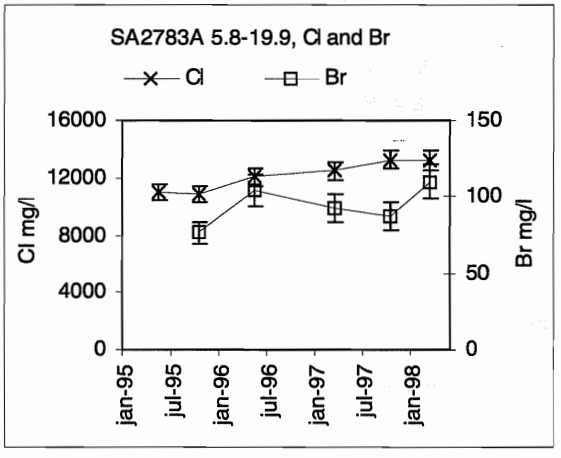
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-24 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-24 *Evolution with time in SA2783A, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

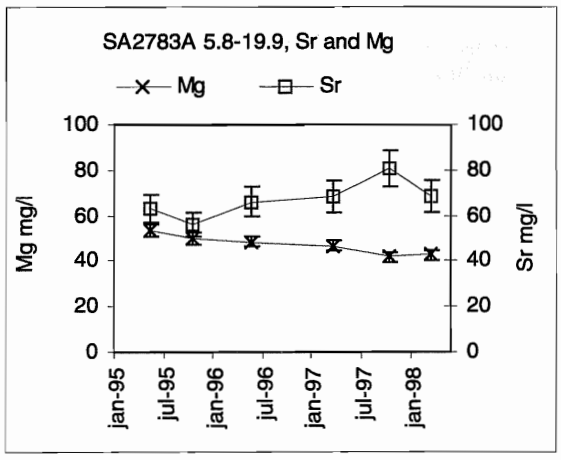
a)



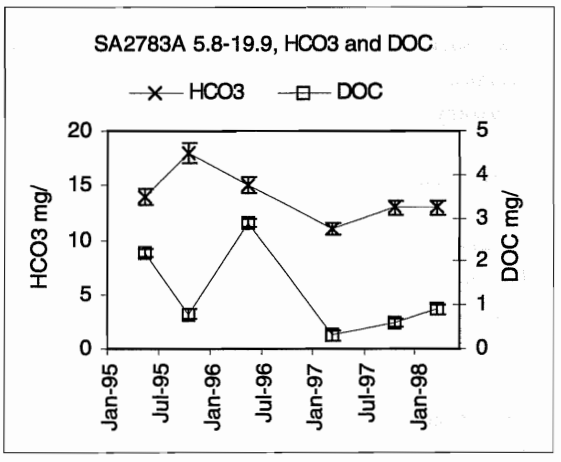
b)



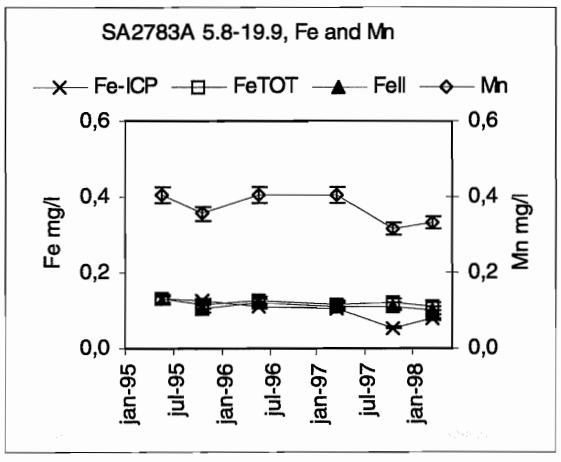
c)


SA2783A 5.8-19.9, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
100
80
60
40
20
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

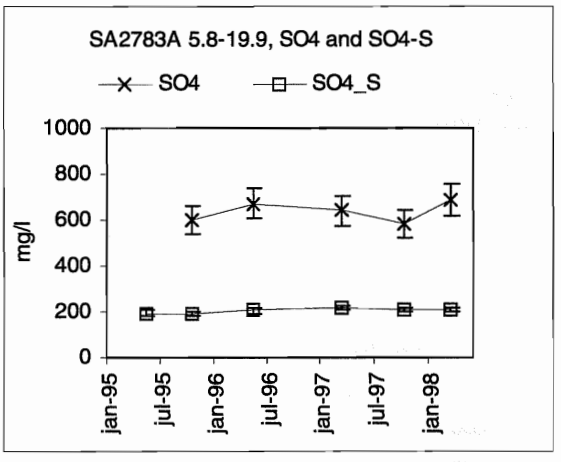
d)


SA2783A 5.8-19.9, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
20
15
10
5
0
4
3
2
1
Jan-95
Jul-95
Jan-96
Jul-96
Jan-97
Jul-97
Jan-98

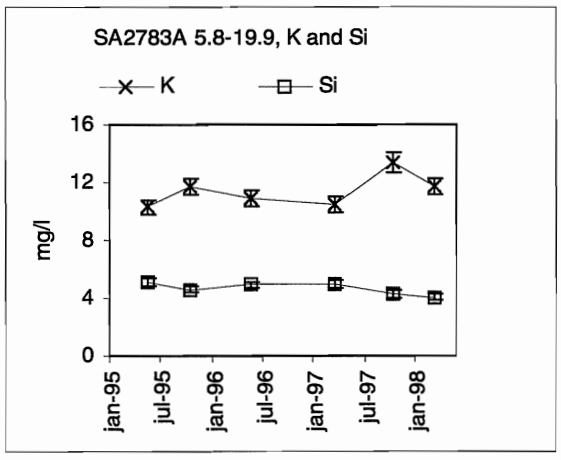
e)


SA2783A 5.8-19.9, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
0,6
0,4
0,2
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

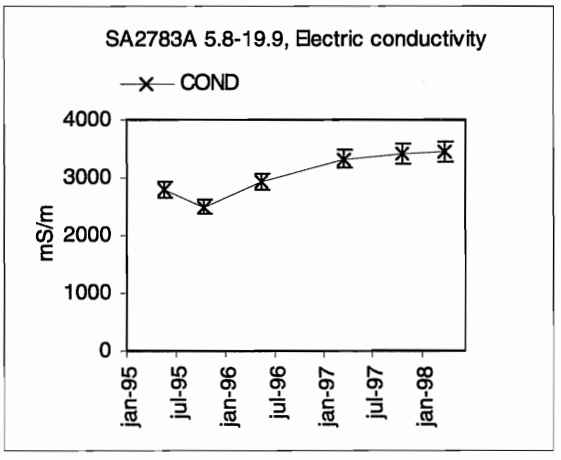
f)


SA2783A 5.8-19.9, SO4 and SO4-S
SO4
SO4_S
mg/l
1000
800
600
400
200
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

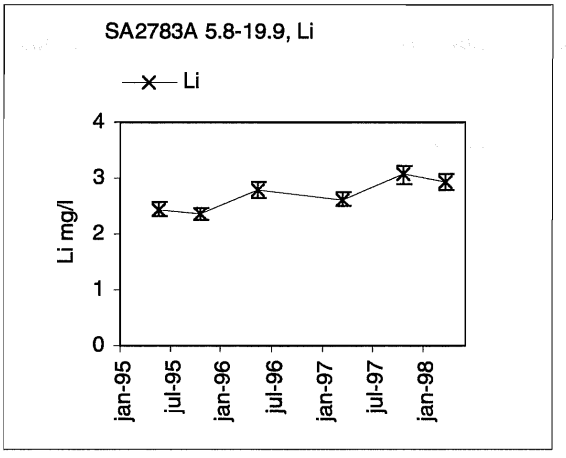
g)


SA2783A 5.8-19.9, K and Si
K
Si
mg/l
16
12
8
4
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

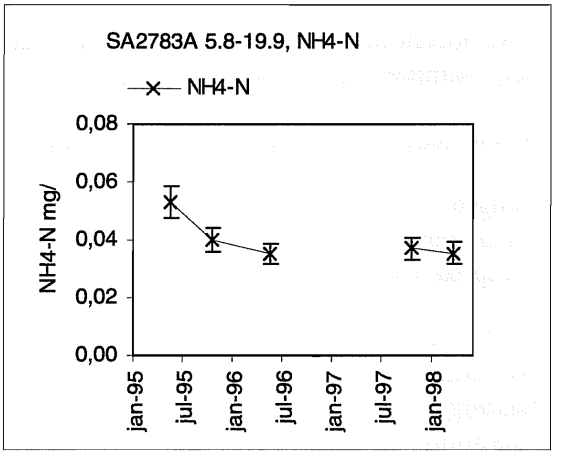
h)


SA2783A 5.8-19.9, Electric conductivity
COND
mS/m
4000
3000
2000
1000
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

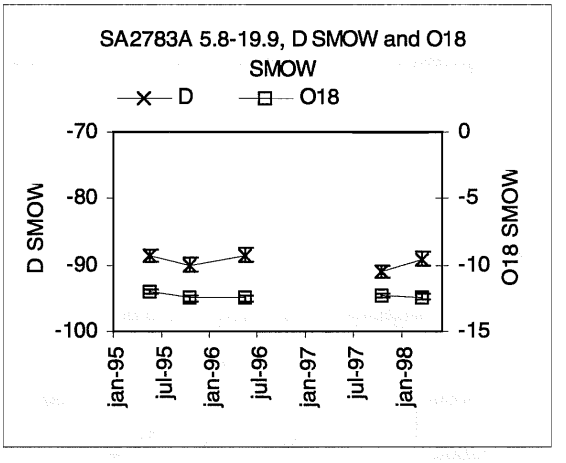
i)


SA2783A 5.8-19.9, Li
Li
Li mg/l
4
3
2
1
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


SA2783A 5.8-19.9, NH4-N
NH4-N
NH4-N mg/
0,08
0,06
0,04
0,02
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


SA2783A 5.8-19.9, D SMOW and O18
SMOW
D
O18
D SMOW
O18 SMOW
-70
-80
-90
-100
0
-5
-10
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.18 SA2880A

The borehole SA2880A is one of the routinely drilled probing holes. The borehole has been sampled since October 1995.

A few general data on the borehole and the sampled section are given below:

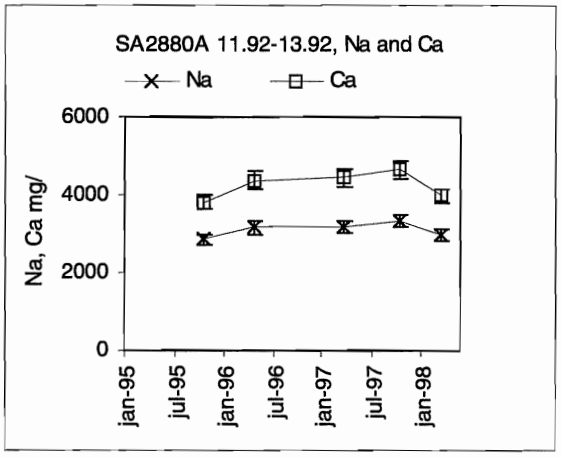
Length: 19.9 m
Diameter: 58 mm
Sampled section: 11.92 - 13.92 m.

The local co-ordinates of the section:
Northing 7455.1
Easting 2259.3
Elevation –384.7
The co-ordinates are calculated for the centre of the section.

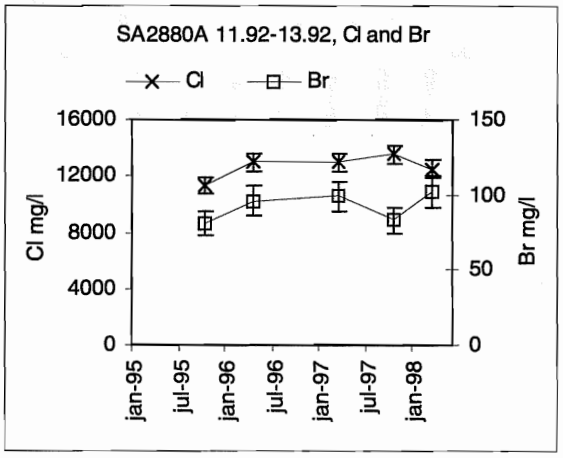
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-25 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-25 *Evolution with time in SA2880A, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

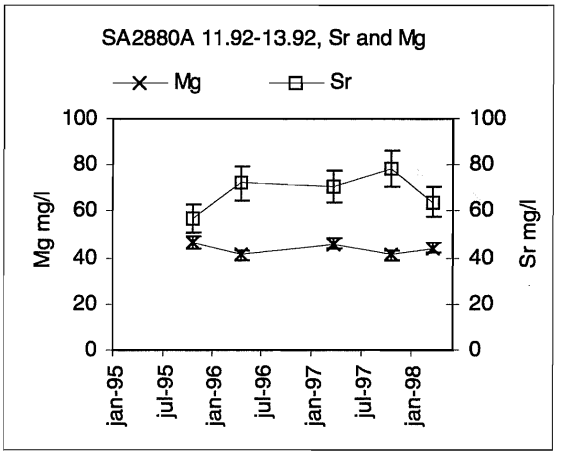
a)



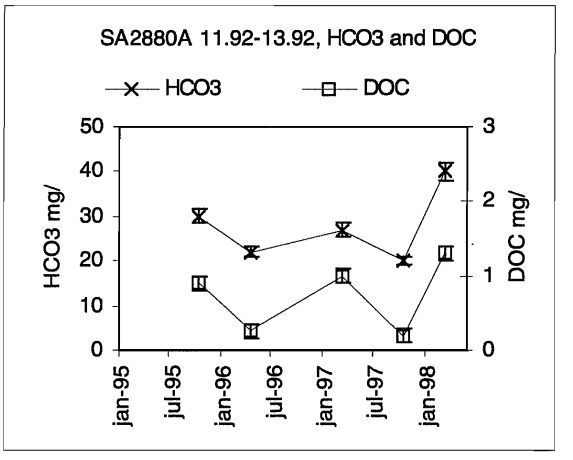
b)



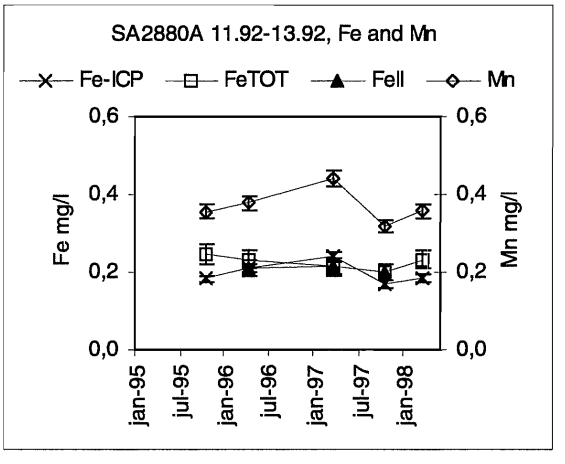
c)


SA2880A 11.92-13.92, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
100
80
60
40
20
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

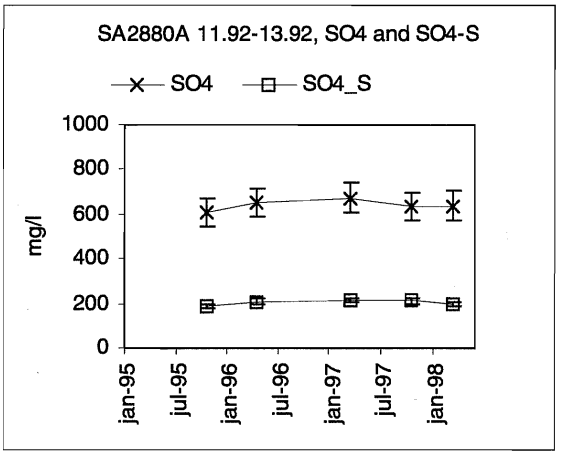
d)


SA2880A 11.92-13.92, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
50
40
30
20
10
0
3
2
1
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

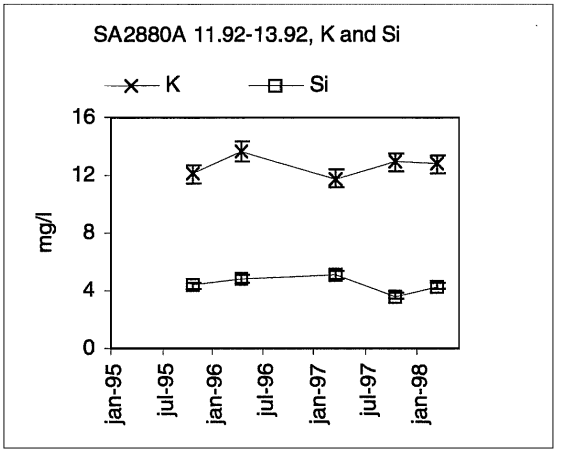
e)


SA2880A 11.92-13.92, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
0,6
0,4
0,2
0,0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

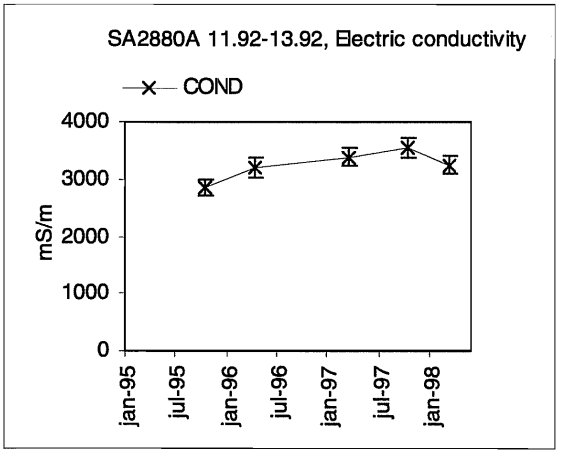
f)


SA2880A 11.92-13.92, SO4 and SO4-S
SO4
SO4_S
mg/l
1000
800
600
400
200
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

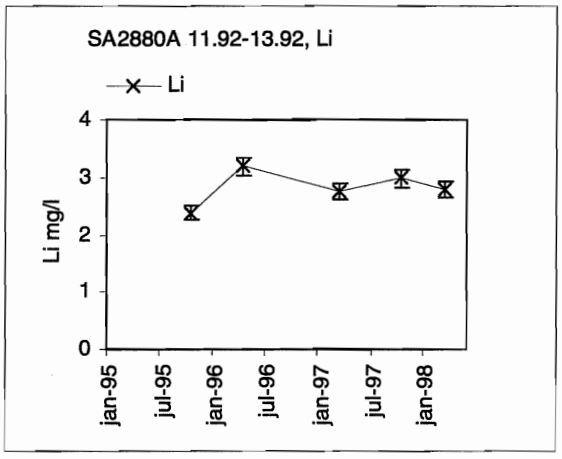
g)


SA2880A 11.92-13.92, K and Si
K
Si
mg/l
16
12
8
4
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

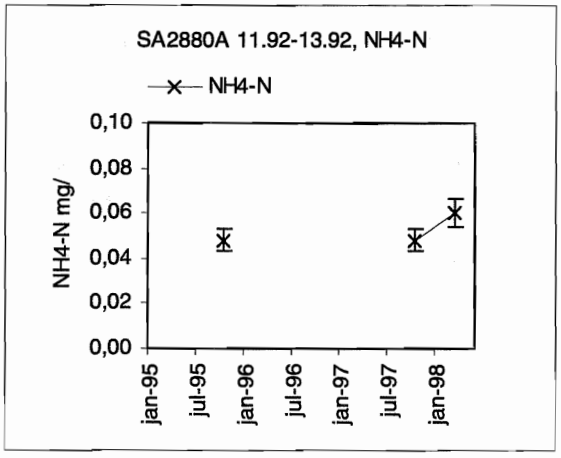
h)


SA2880A 11.92-13.92, Electric conductivity
COND
mS/m
4000
3000
2000
1000
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

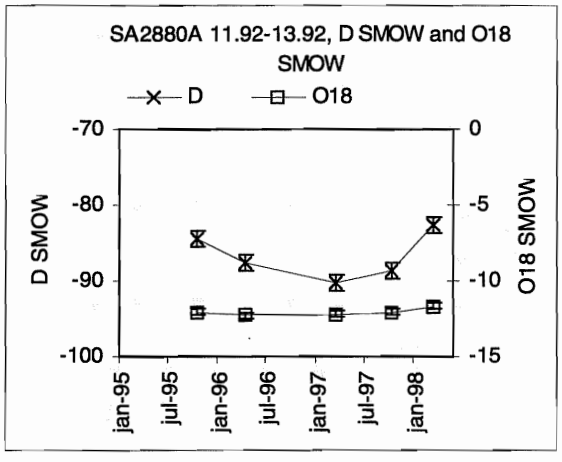
i)


SA2880A 11.92-13.92, Li
Li
Li mg/l
4
3
2
1
0
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


SA2880A 11.92-13.92, NH4-N
NH4-N
NH4-N mg/
0,10
0,08
0,06
0,04
0,02
0,00
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


SA2880A 11.92-13.92, D SMOW and O18 SMOW
D
O18
D SMOW
O18 SMOW
-70
-80
-90
-100
0
-5
-10
-15
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.3.19 SA3045A

The borehole SA3045A is one of the routinely drilled probing. The borehole has been sampled since October 1995.

A few general data on the borehole and the sampled section are given below:

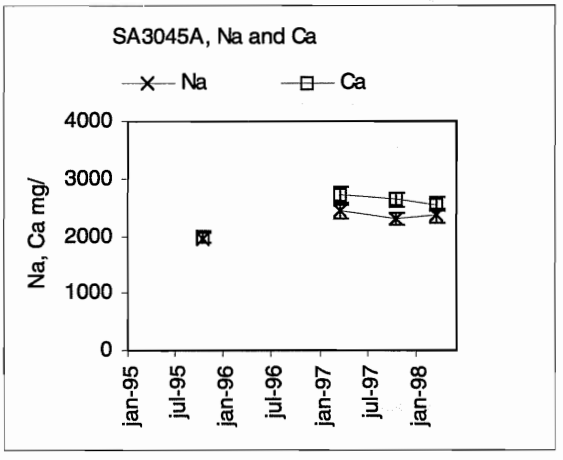
Length: 20.7 m
Diameter: 58 mm
Sampled section: 0 - 20.7 m

The local co-ordinates of the section:
Northing 7363.1
Easting 2394.0
elevation –406.9
The co-ordinates are calculated for the centre of the section.

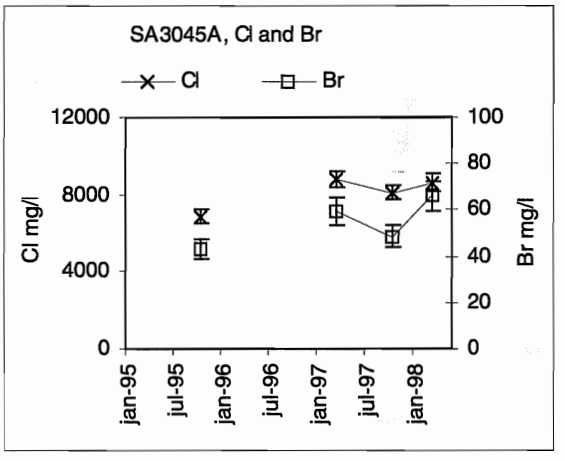
Evolution with time for a number of basic components as well as Deuterium and Oxygen-18 is given in Figures 4-26 a) to k). For concentration values see APPENDIX 2 and 3.

Figure 4-26 *Evolution with time in SA3045A, basic components and environmental isotopes. Error bars symbolise the measurement uncertainty.*

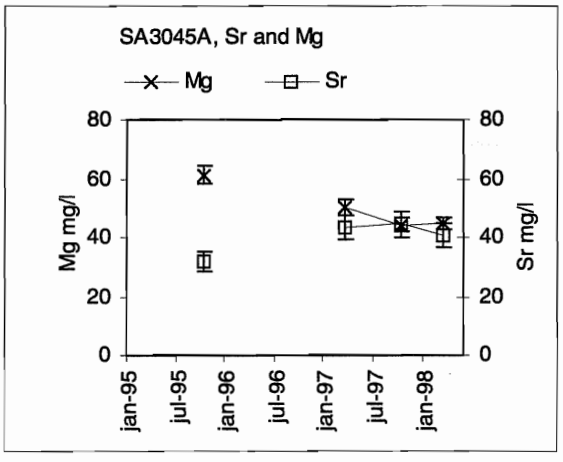
a)



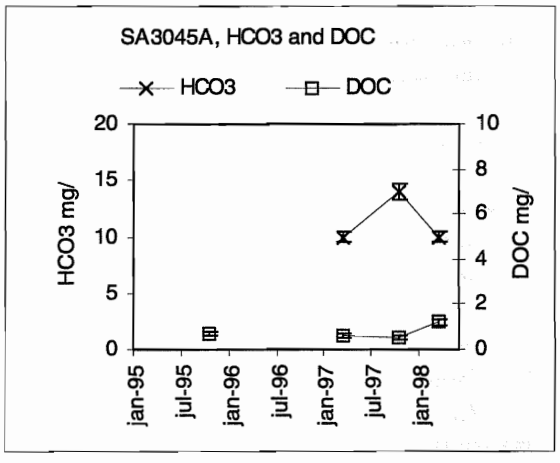
b)



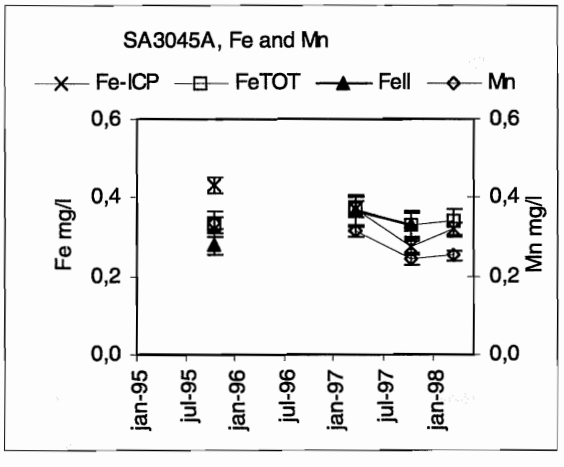
c)


SA3045A, Sr and Mg
Mg
Sr
Mg mg/l
Sr mg/l
0
20
40
60
80
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

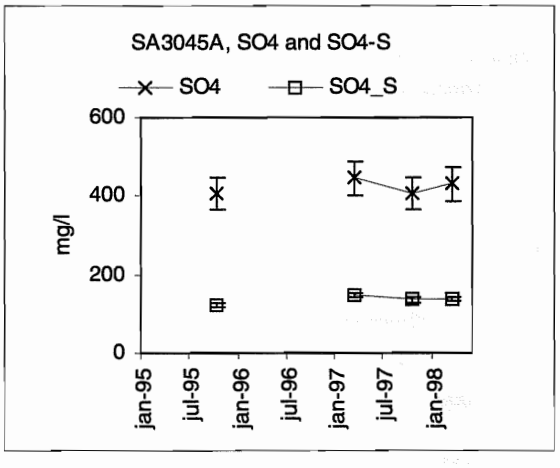
d)


SA3045A, HCO3 and DOC
HCO3
DOC
HCO3 mg/
DOC mg/
0
5
10
15
20
0
2
4
6
8
10
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

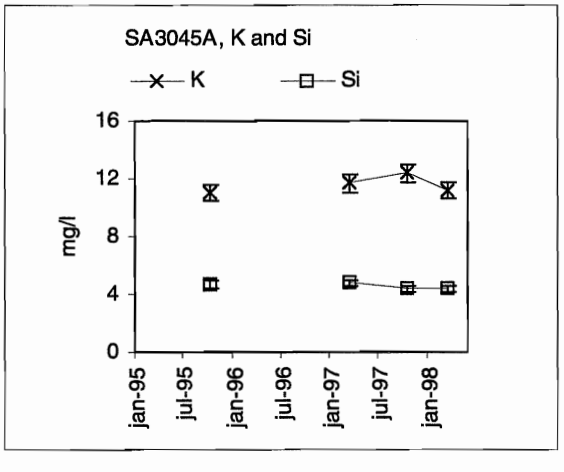
e)


SA3045A, Fe and Mn
Fe-ICP
FeTOT
FeII
Mn
Fe mg/l
Mn mg/l
0,0
0,2
0,4
0,6
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

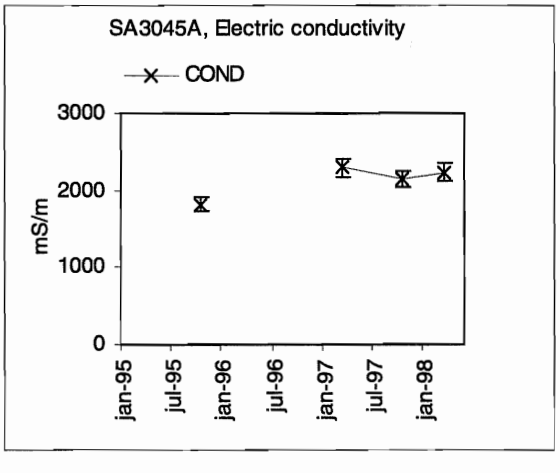
f)


SA3045A, SO4 and SO4-S
SO4
SO4_S
mg/l
0
200
400
600
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

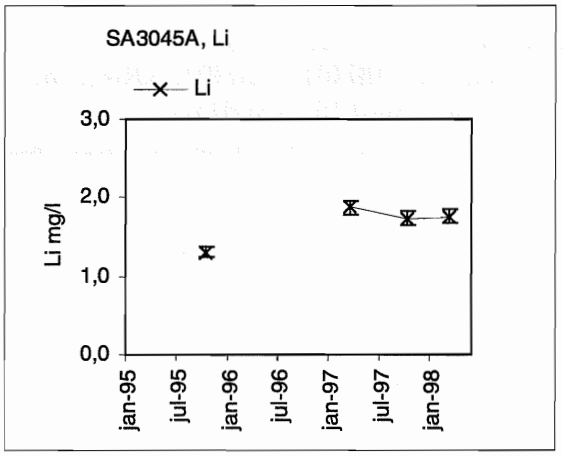
g)


SA3045A, K and Si
K
Si
mg/l
0
4
8
12
16
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

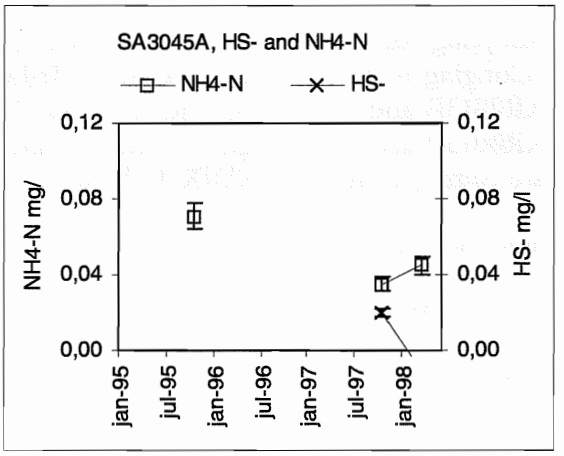
h)


SA3045A, Electric conductivity
COND
mS/m
0
1000
2000
3000
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

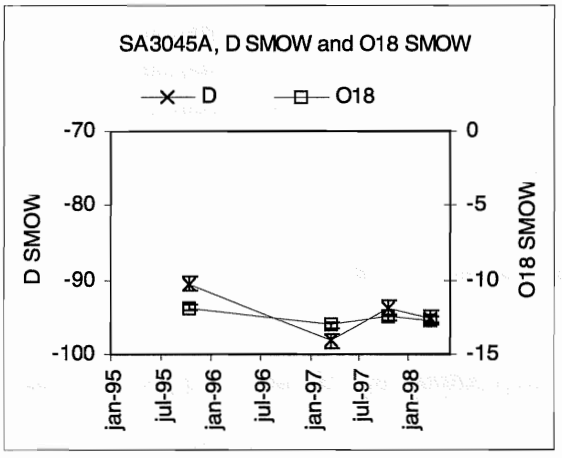
i)


SA3045A, Li
Li
3,0
2,0
1,0
0,0
Li mg/l
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

j)


SA3045A, HS- and NH4-N
NH4-N
HS-
0,12
0,08
0,04
0,00
NH4-N mg/
HS- mg/l
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

k)


SA3045A, D SMOW and O18 SMOW
D
O18
-70
-80
-90
-100
0
-5
-10
-15
D SMOW
O18 SMOW
jan-95
jul-95
jan-96
jul-96
jan-97
jul-97
jan-98

4.4 Carbon isotopes and C-14 age

Sampling for Carbon isotope determinations has been performed in the boreholes belonging to the former Large-Scale Redox Project, i.e.: HBH01, HBH02, KR0012B, KR0013B and KR0015B. The pmc and C-13 data for KR0012B, KR0013B and KR0015B are plotted against time in Figure 4-27 and Figure 4-28. All the available data are compiled in APPENDIX 3, Table A3-4.

pmc (percent modern carbon) is calculated from the C-14 age by using the relation:

$$pmc = 100^* \, e^{((1950 - y - 1.03t) / 8274)}$$

where y = year of C-14 age measurement and t = C-14 age

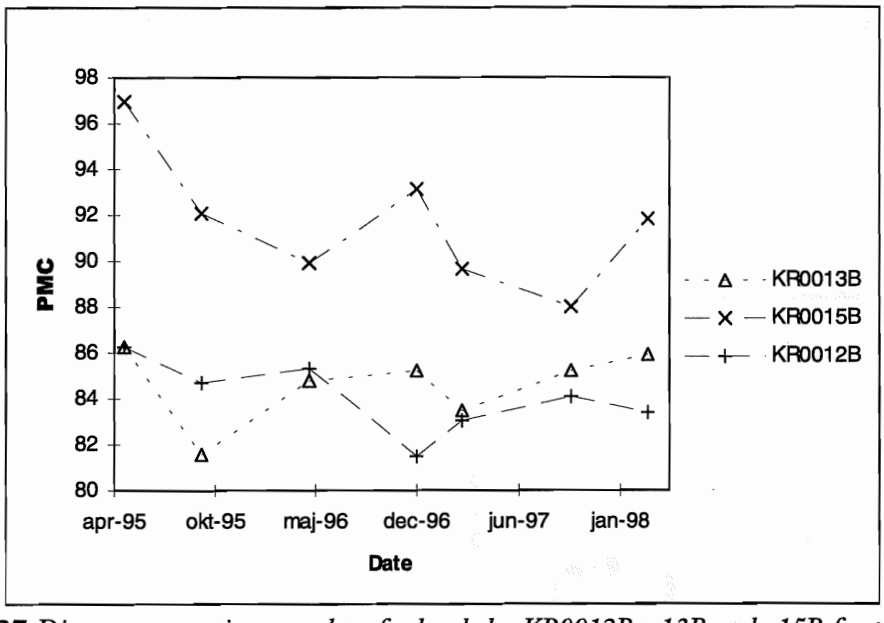


Figure 4-27 Diagram presenting pmc data for boreholes KR0012B, -13B and -15B for the period 1995 to March 1998

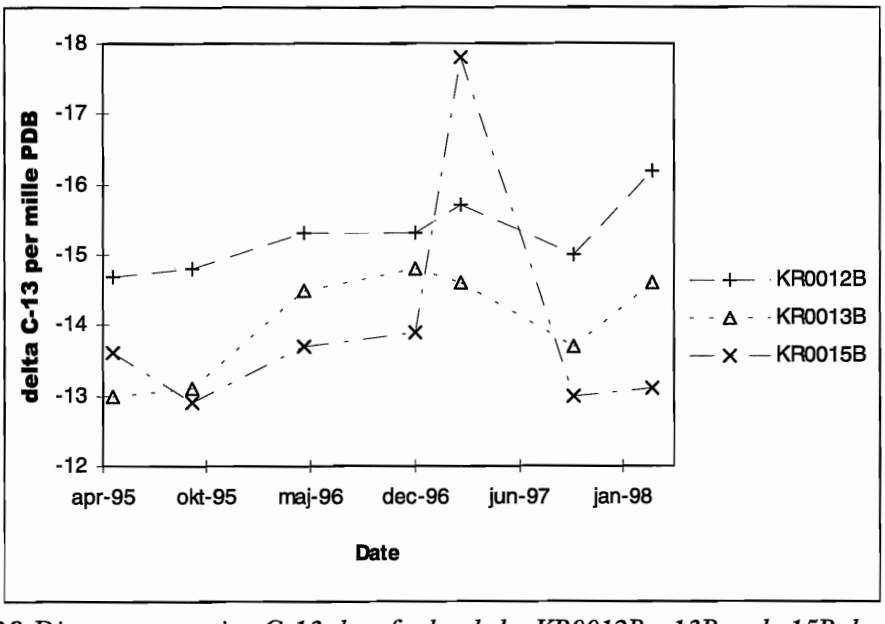


Figure 4-28 Diagram presenting C-13 data for boreholes KR0012B, -13B and -15B during the period 1995 to March 1998

4.5 Special analyses of trace metals and heavy isotopes

Sampling to analyse for heavy isotopes and trace metals has been performed in a few boreholes. The boreholes are listed in Table 4-1.

Table 4-1 Boreholes sampled for trace metals and heavy isotopes

Borehole	Available data
HBH01	Isotopes
HBH02	Isotopes
KAS03	trace elements
KAS09	isotopes, trace elements
KXTT3	Isotopes, trace elements
SA1009B	isotopes, trace elements
SA1229A.	isotopes, trace elements
KXTT3	isotopes, trace elements

Uranium and Thorium isotope analyses and trace element analyses are compared in Table 4-2. Uranium-238 and Thorium-232 are recalculated to element concentrations and compared to the results of the trace metal analyses by ICP-MS. Results within the same order of magnitude are considered satisfactory. The expressions used in the recalculations are:

1 ppm U = 12.4 Bq/ kg ^{238}U

1 ppm Th = 3.93 Bq/kg ^{232}Th

All available data on the trace metals and the isotopes are presented in APPENDIX 3, Table A3-3 and Table A3-4 respectively.

Table 4-2 Comparison of Uranium and Thorium by ICP-MS and alfa-spectrometry

IDCODE	DATE	SAMPLE_ NO	U (ICP-MS) (µg/l)	U (alfa-spectr.) (µg/l*)	Th (ICP-MS) (µg/l)	Th (alfa-spectr.) (µg/l*)
KA2862A	980304	2510	0.017	0.02	0.002	<0.25
KAS03	970313	2401	0.086		0.003	
KAS03	970313	2402	0.259		<0.001	
KXTT3	970702	2404	0.264		<0.005	
KXTT3	971003	2457	0.178	0.20	0.033	<0.05
KXTT3	971202	2473	0.233	0.24	0.026	<0.12
KXTT3	980304	2491	0.634	0.55	0.001	<0.15
SA1009B	970311	2400	0.51	0.67		
SA1229A	970311	2394	1.36	1.85		

Recalculated to µg/l

5 Comments and Discussion

Generally, no major trends can be recognised. The only boreholes that show defined changes in water composition are KR0012B, KR0013B, KR0015B and KXTT3:R2. Continuous pumping in KXTT3 and the fact that KR0013B has been left open for several years may have caused these changes.

In the future modelling work it is valuable with long time series and complete chemical analyses in the boreholes. Therefore it is important that the Groundwater Chemistry Monitoring programme is well defined and also followed. During the period the programme has been extended with more boreholes to cover the lower parts of the tunnel. Furthermore, Class 2 sampling of all weirs have been included in the programme to get a rough estimation of the water composition in the water-bearing fracture zones.

As mentioned earlier the Tritium results are regarded as unreliable and therefore excluded from this report. The experience with the erroneous Tritium determinations shows the importance of good control routines also for the special analyses performed by external laboratories. The control routines should preferably imply sending duplicate samples to at least two laboratories on a regular basis.

6. References

1. **Nilsson A-C, 1989.** Chemical characterisation of deep groundwater on Äspö. SKB PR 25-89-14

2. **Smellie J, Laaksoharju M, 1992.** The Äspö Hard Rock Laboratory: final evaluation of the hydrogeochemical preinvestigations in relation to existing geologic and hydraulic conditions. SKB TR 92-31

3. **Nilsson A-C, 1995.** Compilation of groundwater chemistry data from Äspö, 1990 - 1994.
SKB PR 25-95-02

4. **Wikberg P, Gustavsson E, 1993.** Groundwater chemistry and transport of solutes. Evaluation of the data from the tunnel section 700 - 1475 m. SKB PR 25-93-07

5. **Wikberg P, Skårman C, Laaksoharju M, Ittner T, 1994.** Groundwater chemistry and transport of solutes. Evaluation of the data from the tunnel section 1475 -2265 m. SKB PR 25-93-12

6. **Wikberg P, Skårman C, Laaksoharju M, 1994.** Groundwater chemistry and transport of solutes. Evaluation of the data from the tunnel section 2265 - 2874 m. SKB PR 25-94-21

7. **Nilsson A-C, 1991.** Groundwater chemistry monitoring at Äspö during 1990. SKB PR 25-91-04

8. **Nilsson A-C, 1997.** Demonstration Repository. Water and gas analyses of groundwater sampled in the borehole KZ0027A. SKB PR HRL-97-15

9. **Nilsson A-C, 1996.** First TRUE stage. Results of analyses of groundwater sampled in the TRUE-1 site. SKB TN-97-08t

10. **Alme´n K-E, Andersson O, Fridh B, Johansson B-E, Sehlstedt M, Gustavsson E, Hansson K, Olsson O, Nilsson G, Axelsen K, Wikberg P, 1986.** Site investigation equipment for geological, geophysical, hydrological and hydrochemical characterisation. SKB TR 86-16

11. **Banwart S (ed.), 1995.** The Äspö redox investigations in block scale. Project summary and implications for repository performance assessment. SKB TR 95-26

12. **Laaksoharju M (ed.), 1995.** Sulphate reduction in the Äspö HRL tunnel. SKB TR 95-25

7. Appendices

APPENDIX 1

Table A1-1. List of collected samples between 1995-01-01 and 1998-05-01

APPENDIX 2 Compilation of data for samples of class 1 and class 2.

Table A2-1. Water analysis data, class 1 and class 2

Table A2-2. Environmental isotopes (Deuterium and Oxygen-18)

APPENDIX 3 Compilation of data for samples of class 3, 4 and 5.

Table A3-1. Water analysis data, class 3, 4 and 5.

Table A3-2. Environmental isotopes (Tritium, Deuterium and Oxygen-18)

Table A3-3. Trace metals

Table A3-4. Isotope data including C-14 age

TABLE A1 - 1. LIST OF SAMPLES COLLECTED BETWEEN 1995-01-01 AND 1998-05-01 APPENDIX 1

SICADA: ACTIVITY_HISTORY
SICADA: GWCHEMISTRY / ANALYSES / WATER / SAMPLING_SERIES

IDCODE	START_DATE	STOP_DATE	PROJECT	SECUP	SECLOW	SAMPLE_NO	CLASS_NO	COMMENT
HA3289B	970307 14:25:00	970307 14:26:00	GWCM				2	
HBH01	950324 10:23:00	950324 10:23:00	GWCM	31.00	50.60	2307	5	
HBH02	950324 13:30:00	950324 13:30:00	GWCM	21.00	32.40	2308	5	
HBH05	950324 11:00:00	950324 11:00:00	GWCM	11.00	22.00	2309	4	
HD0025A	950109 14:35:00	950109 14:35:00	SELECT				2	
HD0025A	980303 16:00:00	980303 16:18:00	GWCM			2488	4	
KA1061A	980304 14:00:00	980304 14:35:00	GWCM	0.00	208.50	2489	4	
KA1131B	971008 09:00:00	971008 09:25:00	GWCM	0.00	203.10	2460	4	
KA1131B	980304 14:00:00	980304 14:35:00	GWCM	8.00	203.10	2490	4	
KA1755A	951012 12:47:00	951012 12:47:00	GWCM	88.00	160.00	2335	4	
KA1755A	960521 12:08:00	960522 15:21:00	GWCM	88.00	160.00	2359	4	
KA1755A	970311 17:04:00	970311 17:23:00	GWCM	88.00	160.00	2393	4	
KA1755A	971001 16:00:00	971001 17:10:00	GWCM	88.00	160.00	2451	4	
KA1755A	980305 15:00:00	980305 15:26:00	GWCM	88.00	160.00	2501	4	
KA2050A	970930 13:45:00	970930 14:04:00	GWCM	155.00	211.57	2439	4	
KA2050A	980306 11:00:00	980306 13:02:00	GWCM	155.00	211.57	2507	4	
KA2162B	970930 17:00:00	970930 17:59:00	GWCM	201.50	288.10	2446	4	
KA2162B	980304 19:00:00	980304 19:33:00	GWCM	201.50	288.10	2494	4	
KA2511A	970930 09:00:00	970930 09:58:00	GWCM	139.00	170.00	2438	4	
KA2511A	980305 16:30:00	980305 17:00:00	GWCM	52.00	54.00	2503	4	
KA2511A	980305 16:30:00	980305 17:00:00	GWCM	92.00	109.00	2502	4	
KA2512A	970311 14:27:00	970311 14:43:00	GWCM			2391	4	
KA2512A	980311 12:00:00	980311 15:00:00	GWCM	34.00	37.27	2515	4	
KA2563A	960828 14:12:00	960828 14:12:00	TRUE_BS	0.00	105.01		2	
KA2563A	970930 12:00:00	970930 13:09:00	GWCM	187.00	196.00	2437	4	
KA2563A	980305 16:30:00	980305 17:05:00	GWCM	220.00	224.00	2504	4	
KA2598A	970310 16:00:00	970310 16:00:00	GWCM				3	
KA2858A	950310 12:16:00	950310 12:16:00	SELECT	39.77	40.77	2298	4	
KA2861A	980313 12:00:00	980317 16:00:00	GWCM	0.00	8.52	2517	5	
KA2861A	980204 09:57:00	980206 09:57:00	REX	8.69	9.84	2474	4	
KA2862A	950127 09:15:00	950127 09:15:00	SELECT	0.00	15.98	2297	4	
KA2862A	960918 15:12:00	960918 16:33:00	REX	6.82	6.92		2	
KA2862A	980312 15:00:00	980312 15:30:00	GWCM	6.82	6.92	2516	5	
KA2862A	960627 16:10:00	960627 16:18:00	REX	6.95	7.66		2	

TABLE A1 - 1. LIST OF SAMPLES COLLECTED BETWEEN 1995-01-01 AND 1998-05-01 APPENDIX 1

SICADA: ACTIVITY_HISTORY
SICADA: GWCHEMISTRY / ANALYSES / WATER / SAMPLING_SERIES

IDCODE	START_DATE	STOP_DATE	PROJECT	SECUP	SECLOW	SAMPLE_NO	CLASS_NO	COMMENT
KA2862A	960627 17:00:00	960627 17:08:00	REX	7.45	8.16		2	
KA2862A	980312 15:00:00	980312 15:25:00	GWCM	7.37	15.98	2510	5	
KA2862A	950310 11:44:00	950310 11:44:00	SELECT	15.02	15.98	2299	4	
KA3005A	950310 12:33:00	950310 12:33:00	SELECT	36.93	37.93	2300	4	
KA3005A	960315 07:22:00	960315 13:54:00	TRUE1	39.03	43.78		2	Data are not included in this report
KA3005A	950310 12:21:00	950310 12:21:00	SELECT	44.43	45.43		1	
KA3005A	960411 07:10:00	960411 07:36:00	TRUE1	44.78	45.78	2344	5	Data are not included in this report
KA3005A	960401 10:20:00	960401 12:04:00	TRUE1	46.78	50.03		2	Data are not included in this report
KA3005A	960321 09:15:00	960322 15:47:00	TRUE1	51.03	58.11		2	Data are not included in this report
KA3010A	950310 12:44:00	950310 12:44:00	SELECT	8.56	15.06	2302	4	
KA3067A	960410 10:55:00	960410 11:29:00	TRUE1	6.55	27.05	2342	5	Data are not included in this report
KA3067A	950310 13:49:00	950310 13:49:00	SELECT	28.05	29.55	2303	4	
KA3067A	950310 13:38:00	950310 13:38:00	SELECT				1	
KA3105A	950310 13:21:00	950310 13:21:00	SELECT	22.51	24.51	2304	4	
KA3105A	950310 13:10:00	950310 13:10:00	SELECT				1	
KA3110A	950310 13:31:00	950310 13:31:00	SELECT	20.05	28.63	2305	4	
KA3110A	980306 09:00:00	980306 10:30:00	GWCM	20.05	28.63	2506	4	
KA3385A	950109 14:40:00	950109 14:40:00	SELECT	0.00	25.14		2	
KA3385A	950111 08:05:00	950111 08:15:00	SELECT	0.00	34.18	2296	4	
KA3385A	980302 16:00:00	980302 16:34:00	GWCM	32.00	34.00	2476	4	
KA3385A	950310 13:03:00	950310 13:03:00	SELECT	32.05	34.18	2306	4	
KA3385A	950825 13:50:00	950825 13:50:00	SELECT	32.05	34.18		4	
KA3539G	980302 08:00:00	980303 08:00:00	GWCM	0.00	30.01	2477	4	
KA3545G	980302 08:00:00	980303 08:00:00	GWCM	0.00	8.08	2478	4	
KA3573A	980309 10:03:00	980309 11:35:00	GWCM	4.50	17.00	2511	4	
KA3573A	980309 10:03:00	980309 11:35:00	GWCM	18.00	40.00	2512	4	
KA3593G	980302 08:00:00	980303 08:00:00	GWCM	0.00	30.02	2479	4	
KA3600F	980309 10:05:00	980309 15:26:00	GWCM	4.50	21.00	2513	4	
KA3600F	980309 10:05:00	980309 15:26:00	GWCM	22.00	50.10	2514	4	
KAS03	970312 13:30:00	970312 13:30:00	GWCM	107.00	252.00		1	
KAS03	970313 10:35:00	970313 10:40:00	GWCM	107.00	252.00	2402	5	
KAS03	971003 10:00:00	971003 13:10:00	GWCM	107.00	252.00	2458	4	
KAS03	980331 09:15:00	980402 11:35:00	GWCM	107.00	252.00	2521	4	
KAS03	970313 10:30:00	970313 10:40:00	GWCM	533.00	626.00	2401	5	

TABLE A1 - 1. LIST OF SAMPLES COLLECTED BETWEEN 1995-01-01 AND 1998-05-01 APPENDIX 1

SICADA: ACTIVITY_HISTORY
SICADA: GWCHEMISTRY / ANALYSES / WATER / SAMPLING_SERIES

IDCODE	START_DATE	STOP_DATE	PROJECT	SECUP	SECLOW	SAMPLE_NO	CLASS_NO	COMMENT
KAS03	971002 15:00:00	971002 15:50:00	GWCM	553.00	626.00	2453	4	
KAS03	980331 09:05:00	980402 10:45:00	GWCM	533.00	626.00	2522	4	
KAS03	970312 13:50:00	970312 13:50:00	GWCM	533.00	626.00		1	
KAS07	950324 13:50:00	950324 13:50:00	GWCM	501.00	604.00	2310	5	
KAS09	950324 13:00:00	950324 13:00:00	GWCM	116.00	150.00		1	
KAS09	951012 12:35:00	951012 12:35:00	GWCM	116.00	150.00	2333	5	
KAS09	970313 08:35:00	970313 09:30:00	GWCM	116.00	150.00	2403	4	
KAS09	971008 13:00:00	971008 14:10:00	GWCM	116.00	150.00	2459	4	
KAS09	980331 10:00:00	980401 11:40:00	GWCM	116.00	150.00	2520	4	
KAS09	970312 13:10:00	970312 13:10:00	GWCM	116.00	150.00		1	
KI0023B	971024 13:35:00	971024 13:35:00	TRUE_BS	0.00	43.02	2465	2	
KI0023B	971110 13:10:00	971110 13:10:00	TRUE_BS	0.00	99.65	2468	2	
KI0023B	971111 11:00:00	971111 11:00:00	TRUE_BS	0.00	112.56	2469	2	
KI0023B	971118 09:40:00	971118 09:40:00	TRUE_BS	0.00	171.51	2472	2	
KI0023B	971023 13:10:00	971023 13:10:00	TRUE_BS	5.91	8.79	2464	2	
KI0023B	980305 09:40:00	980305 10:39:00	GWCM	41.45	42.45	2498	4	
KI0023B	980305 09:40:00	980305 11:09:00	GWCM	70.95	71.95	2497	4	
KI0023B	980305 09:40:00	980305 11:59:00	GWCM	84.75	86.20	2496	4	
KI0023B	980305 09:40:00	980305 11:37:00	GWCM	111.25	112.70	2495	4	
KI0023B	971111 18:00:00	971111 18:00:00	TRUE_BS	114.60	116.40	2470	2	
KI0023B	971118 09:30:00	971118 09:30:00	TRUE_BS	168.71	171.51	2471	2	
KI0025F	970929 17:00:00	970929 18:00:00	GWCM	86.00	88.00	2436	4	
KI0025F	980305 09:41:00	980305 14:31:00	GWCM	86.00	88.00	2500	4	
KI0025F	970929 17:00:00	970929 17:42:00	GWCM	158.00	168.00	2435	4	
KI0025F	980305 09:41:00	980305 14:02:00	GWCM	164.00	168.00	2499	4	
KR0012B	950518 11:44:00	950518 11:44:00	GWCM	5.00	10.57	2314	5	
KR0012B	951010 16:16:00	951010 16:16:00	GWCM	5.00	10.57	2323	5	
KR0012B	960521 15:46:00	960522 16:34:00	GWCM	5.00	10.57	2361	4	
KR0012B	961217 09:29:00	961217 09:33:00	REX	5.00	10.57	2370	5	
KR0012B	970121 10:13:00	970121 10:20:00	REX	5.00	10.57	2375	5	
KR0012B	970311 18:26:00	970313 12:16:00	GWCM	5.00	10.57	2396	5	
KR0012B	970930 18:00:00	970930 19:00:00	GWCM	5.00	10.57	2443	5	
KR0012B	971015 07:54:00	971015 09:24:00	GWCM	5.00	10.57	2461	5	
KR0012B	980303 09:53:00	980304 18:50:00	GWCM	5.00	10.57	2484	5	

TABLE A1 - 1. LIST OF SAMPLES COLLECTED BETWEEN 1995-01-01 AND 1998-05-01 APPENDIX 1

SICADA: ACTIVITY_HISTORY
SICADA: GWCHEMISTRY / ANALYSES / WATER / SAMPLING_SERIES

IDCODE	START_DATE	STOP_DATE	PROJECT	SECUP	SECLOW	SAMPLE_NO	CLASS_NO	COMMENT
KR0013B	950518 10:11:00	950518 10:11:00	GWCM	7.05	16.94	2315	4	
KR0013B	951010 16:04:00	951010 16:04:00	GWCM	7.05	16.94	2324	4	
KR0013B	960522 16:45:00	960522 16:45:00	GWCM	7.05	16.94	2362	4	
KR0013B	961217 09:20:00	961217 09:22:00	REX	7.05	16.94	2371	5	
KR0013B	970121 09:54:00	970121 09:59:00	REX	7.05	16.94	2376	5	
KR0013B	970311 18:24:00	970313 12:37:00	GWCM	7.05	16.94	2397	5	
KR0013B	970930 18:00:00	970930 19:00:00	GWCM	7.05	16.94	2444	5	
KR0013B	971015 09:30:00	971015 09:30:00	GWCM	7.05	16.94	2462	5	
KR0013B	980303 09:53:00	980304 18:50:00	GWCM	7.05	16.94	2481	5	
KR0015B	950518 10:01:00	950518 10:01:00	GWCM	19.82	30.31	2316	4	
KR0015B	951010 15:46:00	951010 15:46:00	GWCM	19.82	30.31	2325	4	
KR0015B	960521 15:50:00	960522 16:56:00	GWCM	19.82	30.31	2363	4	
KR0015B	961217 09:25:00	961217 09:28:00	REX	19.82	30.31	2372	5	
KR0015B	970121 10:05:00	970121 10:11:00	REX	19.82	30.31	2377	5	
KR0015B	970311 18:22:00	970313 12:28:00	GWCM	19.82	30.31	2398	5	
KR0015B	970930 18:00:00	970930 19:02:00	GWCM	19.82	30.31	2445	5	
KR0015B	971015 07:53:00	971015 09:34:00	GWCM	19.82	30.31	2463	5	
KR0015B	980303 09:55:00	980304 18:50:00	GWCM	19.82	30.31	2482	5	
KXBLOTA1	961029 11:57:00	961029 12:15:00	LOT			2365	3	
KXBLOTA1	980320 10:00:00	980320 10:00:00	LOT			2518	3	
KXTT1	960314 07:26:00	960314 07:53:00	TRUE1	7.50	11.50		2	Data are not included in this report
KXTT1	951128 10:11:00	951128 10:29:00	TRUE1	8.50	10.50		2	Data are not included in this report
KXTT1	951127 14:41:00	951128 10:10:00	TRUE1	15.00	16.00		2	Data are not included in this report
KXTT1	960410 06:49:00	960410 08:12:00	TRUE1	15.00	16.00	2341	5	Data are not included in this report
KXTT1	960605 11:50:00	960605 11:50:00	TRUE1	15.00	16.00		2	Data are not included in this report
KXTT1	960613 10:43:00	960613 10:43:00	TRUE1	15.00	16.00		2	Data are not included in this report
KXTT1	960614 09:15:00	960614 09:15:00	TRUE1	15.00	16.00		2	Data are not included in this report
KXTT1	951127 10:23:00	951127 14:37:00	TRUE1	17.00	28.76		2	Data are not included in this report
KXTT1	960320 12:56:00	960320 16:37:00	TRUE1	17.00	28.76		2	Data are not included in this report
KXTT2	951129 10:45:00	951129 12:08:00	TRUE1	3.05	7.80		2	Data are not included in this report
KXTT2	960326 11:55:00	960326 12:53:00	TRUE1	7.55	10.55		2	Data are not included in this report
KXTT2	960326 13:40:00	960326 14:20:00	TRUE1	7.55	10.55		2	Data are not included in this report
KXTT2	951128 12:26:00	951128 13:52:00	TRUE1	8.80	10.30		2	Data are not included in this report
KXTT2	951128 11:34:00	951128 12:26:00	TRUE1	11.30	13.30		2	Data are not included in this report

TABLE A1 - 1. LIST OF SAMPLES COLLECTED BETWEEN 1995-01-01 AND 1998-05-01 APPENDIX 1

SICADA: ACTIVITY_HISTORY
SICADA: GWCHEMISTRY / ANALYSES / WATER / SAMPLING_SERIES

IDCODE	START_DATE	STOP_DATE	PROJECT	SECUP	SECLOW	SAMPLE_NO	CLASS_NO	COMMENT
KXTT2	960411 14:02:00	960411 16:05:00	TRUE1	11.55	13.55	2347	5	Data are not included in this report
KXTT2	951129 12:09:00	951130 11:26:00	TRUE1	14.30	18.30		2	Data are not included in this report
KXTT2	960412 08:12:00	960412 11:05:00	TRUE1	14.55	15.55	2348	5	Data are not included in this report
KXTT2	960318 10:21:00	960319 10:25:00	TRUE1	16.55	18.3		2	Data are not included in this report
KXTT3	960313 12:45:00	960313 16:43:00	TRUE1	3.17	7.92		2	Data are not included in this report
KXTT3	951128 10:50:00	951128 11:33:00	TRUE1	8.92	9.92		2	Data are not included in this report
KXTT3	960411 08:01:00	960411 09:34:00	TRUE1	8.92	11.42	2346	5	Data are not included in this report
KXTT3	951128 10:31:00	951128 10:47:00	TRUE1	10.92	14.42		2	Data are not included in this report
KXTT3	960213 10:00:00	960213 10:00:00	TRUE1	12.42	14.42		2	Data are not included in this report
KXTT3	960220 09:50:00	960220 09:50:00	TRUE1	12.42	14.42		2	Data are not included in this report
KXTT3	960228 12:30:00	960228 12:30:00	TRUE1	12.42	14.42		2	Data are not included in this report
KXTT3	960410 12:08:00	960410 12:36:00	TRUE1	12.42	14.42	2343	5	Data are not included in this report
KXTT3	961009 20:02:00	961009 20:02:00	TRUE1	12.42	14.42		2	
KXTT3	970306 13:05:00	970306 13:25:00	GWCM	12.42	14.42	2385	4	
KXTT3	970627 00:30:00	970627 00:30:00	TRUE1	12.42	14.42		2	
KXTT3	970702 10:05:00	970702 10:45:00	TRUE1	12.42	14.42	2404	5	
KXTT3	971003 08:58:00	971003 10:20:00	GWCM	12.42	14.42	2457	5	
KXTT3	971202 09:00:00	971202 10:30:00	TRUE1	12.42	14.42	2473	5	
KXTT3	980304 09:25:00	980304 10:20:00	GWCM	12.42	14.42	2491	5	
KXTT3	951128 13:58:00	951128 14:30:00	TRUE1	15.42	17.43		2	Data are not included in this report
KXTT3	960326 11:03:00	960326 11:29:00	TRUE1	15.42	17.43		2	Data are not included in this report
KXTT4	951128 14:31:00	951128 15:44:00	TRUE1	8.42	10.42		2	Data are not included in this report
KXTT4	960325 11:32:00	960325 14:22:00	TRUE1	8.42	10.92		2	Data are not included in this report
KXTT4	951129 09:25:00	951129 10:42:00	TRUE1	11.42	13.92		2	Data are not included in this report
KXTT4	960411 11:15:00	960411 12:38:00	TRUE1	11.92	13.92	2345	5	Data are not included in this report
KXTT4	960618 00:00:00	960618 00:00:00	TRUE1	11.92	13.92		2	Data are not included in this report
KXTT4	961007 00:00:00	961007 00:00:00	TRUE1	11.92	13.92		2	Data are not included in this report
KXTT4	951128 15:44:00	951128 16:01:00	TRUE1	14.92	23.42		2	Data are not included in this report
KXTT4	960409 08:42:00	960409 14:43:00	TRUE1	14.92	23.42	2340	5	Data are not included in this report
KXTT4	951128 16:06:00	951129 09:23:00	TRUE1	24.42	49.31		2	Data are not included in this report
KXTT4	960314 10:58:00	960314 18:44:00	TRUE1	24.42	49.31		5	Data are not included in this report
KZ0027A	961114 09:00:00	961114 09:00:00	Demo Reposit	3.00	90.48	2366	4	Data are not included in this report
KZ0027A	961125 09:25:00	961125 09:25:00	Demo Reposit	3.00	90.48	2367	4	Data are not included in this report
KZ0027A	961202 09:10:00	961202 09:10:00	Demo Reposit	3.00	90.48	2368	4	Data are not included in this report

TABLE A1 - 1. LIST OF SAMPLES COLLECTED BETWEEN 1995-01-01 AND 1998-05-01 APPENDIX 1

SICADA: ACTIVITY_HISTORY
SICADA: GWCHEMISTRY / ANALYSES / WATER / SAMPLING_SERIES

IDCODE	START_DATE	STOP_DATE	PROJECT	SECUP	SECLOW	SAMPLE_NO	CLASS_NO	COMMENT
KZ0027A	961216 09:10:00	961216 09:10:00	Demo Reposit	3.00	90.48	2369	4	Data are not included in this report
KZ0027A	970113 08:46:00	970113 08:46:00	Demo Reposit	3.00	90.48	2373	4	Data are not included in this report
KZ0027A	970120 09:30:00	970120 09:30:00	Demo Reposit	3.00	90.48	2374	4	Data are not included in this report
KZ0027A	970203 09:23:00	970203 09:23:00	Demo Reposit	3.00	90.48	2378	4	Data are not included in this report
KZ0027A	970210 10:57:00	970210 10:57:00	Demo Reposit	3.00	90.48	2379	4	Data are not included in this report
KZ0027A	970218 09:41:00	970218 09:41:00	Demo Reposit	3.00	90.48	2380	4	Data are not included in this report
KZ0027A	970224 09:35:00	970224 09:35:00	Demo Reposit	3.00	90.48	2381	4	Data are not included in this report
KZ0027A	970303 08:32:00	970303 08:32:00	Demo Reposit	3.00	90.48	2382	4	Data are not included in this report
KZ0027A	970310 09:16:00	970310 09:16:00	Demo Reposit	3.00	90.48	2387	4	Data are not included in this report
MA0682G	950201 12:35:00	950201 12:35:00	0-750 m	0	682		1	
MA0682G	950227 15:56:00	950227 15:56:00	0-750 m	0	682		1	
MA0682G	950314 19:46:00	950314 19:46:00	0-750 m	0	682		1	
MA0682G	950403 16:32:00	950403 16:32:00	0-750 m	0	682		1	
MA0682G	980302 09:00:00	980302 09:00:00	GWCM	0	682		2	
MA1033G	950201 12:25:00	950206 12:35:00	750-3191 m	692	1033		1	
MA1033G	950227 15:49:00	950227 15:49:00	750-3191 m	692	1033		1	
MA1033G	950314 19:43:00	950314 19:43:00	750-3191 m	692	1033		3	
MA1033G	950403 16:30:00	950403 16:30:00	750-3191 m	692	1033		3	
MA1033G	951106 14:45:00	951106 14:45:00	750-3191 m	692	1033		1	
MA1033G	951108 11:10:00	951108 11:10:00	750-3191 m	692	1033		1	
MA1033G	951110 14:10:00	951110 14:10:00	750-3191 m	692	1033		1	
MA1033G	951120 11:00:00	951120 11:00:00	750-3191 m	692	1033		1	
MA1033G	951204 10:48:00	951204 10:48:00	750-3191 m	692	1033		1	
MA1033G	980302 09:00:00	980302 09:00:00	GWCM	692	1033		2	
MA1232G	950201 12:20:00	950201 12:20:00	750-3191 m	1033	1232		1	
MA1232G	950227 15:43:00	950227 15:43:00	750-3191 m	1033	1232		1	
MA1232G	950314 19:40:00	950314 19:40:00	750-3191 m	1033	1232		3	
MA1232G	950403 16:26:00	950403 16:26:00	750-3191 m	1033	1232		3	
MA1232G	980302 09:00:00	980302 09:00:00	GWCM	1033	1232		2	
MA1372G	950201 12:12:00	950201 12:12:00	750-3191 m	1232	1372		1	
MA1372G	950227 15:35:00	950227 15:35:00	750-3191 m	1232	1372		1	
MA1372G	950314 19:37:00	950314 19:37:00	750-3191 m	1232	1372		3	
MA1372G	950403 16:23:00	950403 16:23:00	750-3191 m	1232	1372		3	
MA1372G	980302 09:00:00	980302 09:00:00	GWCM	1232	1372		2	

TABLE A1 - 1. LIST OF SAMPLES COLLECTED BETWEEN 1995-01-01 AND 1998-05-01 APPENDIX 1

SICADA: ACTIVITY_HISTORY
SICADA: GWCHEMISTRY / ANALYSES / WATER / SAMPLING_SERIES

IDCODE	START_DATE	STOP_DATE	PROJECT	SECUP	SECLOW	SAMPLE_NO	CLASS_NO	COMMENT
MA1584G	950201 12:07:00	950201 12:07:00	750-3191 m	1372	1584		1	
MA1584G	950227 15:31:00	950227 15:31:00	750-3191 m	1372	1584		1	
MA1584G	950314 19:33:00	950314 19:33:00	750-3191 m	1372	1584		3	
MA1584G	950403 16:17:00	950403 16:17:00	750-3191 m	1372	1584		3	
MA1584G	980302 09:00:00	980302 09:00:00	GWCM	1372	1584		2	
MA1745G	950201 11:35:00	950201 11:35:00	750-3191 m	1584	1745		1	
MA1745G	950227 15:06:00	950227 15:06:00	750-3191 m	1584	1745		1	
MA1745G	950314 19:14:00	950314 19:14:00	750-3191 m	1584	1745		3	
MA1745G	950403 16:01:00	950403 16:01:00	750-3191 m	1584	1745		3	
MA1745G	980302 09:00:00	980302 09:00:00	GWCM	1584	1745		2	
MA1883G	950201 11:29:00	950201 11:29:00	750-3191 m	1745	1883		1	
MA1883G	950227 15:00:00	950227 15:00:00	750-3191 m	1745	1883		1	
MA1883G	950314 19:10:00	950314 19:10:00	750-3191 m	1745	1883		1	
MA1883G	950403 15:58:00	950403 15:58:00	750-3191 m	1745	1883		1	
MA1883G	980302 09:00:00	980302 09:00:00	GWCM	1745	1883		2	
MA2028G	950201 11:20:00	950201 11:20:00	750-3191 m	1883	2028		1	
MA2028G	950227 14:54:00	950227 14:54:00	750-3191 m	1883	2028		1	
MA2028G	950314 19:05:00	950314 19:05:00	750-3191 m	1883	2028		1	
MA2028G	950403 15:54:00	950403 15:54:00	750-3191 m	1883	2028		1	
MA2028G	980302 09:00:00	980302 09:00:00	GWCM	1883	2028		2	
MA2178G	950201 11:10:00	950201 11:10:00	750-3191 m	2028	2178		1	
MA2178G	950227 14:50:00	950227 14:50:00	750-3191 m	2028	2178		1	
MA2178G	950314 19:01:00	950314 19:01:00	750-3191 m	2028	2178		3	
MA2178G	950403 15:50:00	950403 15:50:00	750-3191 m	2028	2178		3	
MA2178G	980302 09:00:00	980302 09:00:00	GWCM	2028	2178		2	
MA2357G	950201 11:04:00	950201 11:04:00	750-3191 m	2178	2357		1	
MA2357G	950227 14:45:00	950227 14:45:00	750-3191 m	2178	2357		1	
MA2357G	950314 18:58:00	950314 18:58:00	750-3191 m	2178	2357		3	
MA2357G	950403 15:47:00	950403 15:47:00	750-3191 m	2178	2357		3	
MA2357G	980302 09:00:00	980302 09:00:00	GWCM	2178	2357		2	
MA2496G	950201 10:50:00	950201 10:50:00	750-3191 m	2357	2496		1	
MA2496G	950227 14:41:00	950227 14:41:00	750-3191 m	2357	2496		1	
MA2496G	950314 18:54:00	950314 18:54:00	750-3191 m	2357	2496		1	
MA2496G	950403 15:44:00	950403 15:44:00	750-3191 m	2357	2496		3	

SICADA: ACTIVITY_HISTORY
SICADA: GWCHEMISTRY / ANALYSES / WATER / SAMPLING_SERIES

IDCODE	START_DATE	STOP_DATE	PROJECT	SECUP	SECLOW	SAMPLE_NO	CLASS_NO	COMMENT
MA2496G	980302 09:00:00	980302 09:00:00	GWCM	2357	2496		2	
MA2587G	980302 09:00:00	980302 09:00:00	GWCM	220*	333*		2	
MA2699G	950201 10:25:00	950201 10:25:00	750-3191 m	2496	2699		1	
MA2699G	950227 14:14:00	950227 14:14:00	750-3191 m	2496	2699		1	
MA2699G	950314 18:35:00	950314 18:35:00	750-3191 m	2496	2699		3	
MA2699G	950403 15:28:00	950403 15:28:00	750-3191 m	2496	2699		3	
MA2699G	980302 09:00:00	980302 09:00:00	GWCM	2496	2699		2	
MA2840G	950201 10:10:00	950201 10:10:00	750-3191 m	2699	2840		1	
MA2840G	950227 14:04:00	950227 14:04:00	750-3191 m	2699	2840		1	
MA2840G	950314 18:28:00	950314 18:28:00	750-3191 m	2699	2840		3	
MA2840G	950403 15:21:00	950403 15:21:00	750-3191 m	2699	2840		3	
MA2840G	980302 09:00:00	980302 09:00:00	GWCM	2699	2840		2	
MA2994G	950201 09:58:00	950201 09:58:00	750-3191 m	2840	2994		1	
MA2994G	950227 13:57:00	950227 13:57:00	750-3191 m	2840	2994		1	
MA2994G	950314 18:25:00	950314 18:25:00	750-3191 m	2840	2994		1	
MA2994G	950403 15:15:00	950403 15:15:00	750-3191 m	2840	2994		1	
MA3179G	980302 09:00:00	980302 09:00:00	GWCM	2994	3179		2	
MA3384G	951106 14:32:00	951106 14:32:00		340*	450*		1	
MA3384G	951108 10:48:00	951108 10:48:00		340*	450*		1	
MA3384G	951110 10:05:00	951110 10:05:00		340*	450*		1	
MA3384G	951120 11:05:00	951120 11:05:00		340*	450*		1	
MA3384G	951204 10:29:00	951204 10:29:00		340*	450*		1	
MA3384G	980302 09:00:00	980302 09:00:00	GWCM	340*	450*		2	
MA3411G	951106 14:33:00	951106 14:33:00		3179	3426		1	
MA3411G	951108 10:51:00	951108 10:51:00		3179	3426		1	
MA3411G	951110 10:09:00	951110 10:09:00		3179	3426		1	
MA3411G	951120 11:07:00	951120 11:07:00		3179	3426		1	
MA3411G	951204 10:26:00	951204 10:26:00		3179	3426		1	
MA3411G	980302 09:00:00	980302 09:00:00	GWCM	3179	3426		2	
MA3426G	951106 14:34:00	951106 14:34:00		3426	3600		1	
MA3426G	951108 10:54:00	951108 10:54:00		3426	3600		1	
MA3426G	951110 10:13:00	951110 10:13:00		3426	3600		1	
MA3426G	951120 11:09:00	951120 11:09:00		3426	3600		1	
MA3426G	951204 10:24:00	951204 10:24:00		3426	3600		1	

TABLE A1 - 1. LIST OF SAMPLES COLLECTED BETWEEN 1995-01-01 AND 1998-05-01 APPENDIX 1

SICADA: ACTIVITY_HISTORY
SICADA: GWCHEMISTRY / ANALYSES / WATER / SAMPLING_SERIES

IDCODE	START_DATE	STOP_DATE	PROJECT	SECUP	SECLOW	SAMPLE_NO	CLASS_NO	COMMENT
MA3426G	980302 09:00:00	980302 09:00:00	GWCM	3426	3600		2	
MF0061G	951106 14:36:00	951106 14:36:00		0	61		1	
MF0061G	951108 11:05:00	951108 11:05:00		0	61		1	
MF0061G	951110 10:16:00	951110 10:16:00		0	61		1	
MF0061G	951120 11:13:00	951120 11:13:00		0	61		1	
MF0061G	951204 10:32:00	951204 10:32:00		0	61		1	
MF0061G	980302 09:00:00	980302 09:00:00	GWCM	0	61		2	
PAS00100	980302 09:00:00	980302 09:00:00	GWCM	0	61		2	
SA0813B	950517 16:16:00	950517 16:16:00	GWCM	5.60	19.70	2311	4	
SA0813B	951012 00:00:00	951012 00:00:00	GWCM	5.60	19.70	2336	4	
SA0813B	960521 18:00:00	960521 18:00:00	GWCM	5.60	19.70	2353	4	
SA0813B	970311 18:15:00	970313 11:43:00	GWCM	5.60	19.70	2399	4	
SA0813B	971003 10:00:00	971006 15:10:00	GWCM	5.60	19.70	2456	4	
SA0813B	980302 09:00:00	980305 12:00:00	GWCM	5.60	19.70	2485	4	
SA1009B	950517 01:00:00	950517 01:00:00	GWCM	6.00	19.50	2313	4	
SA1009B	951012 00:00:00	951012 00:00:00	GWCM	6.00	19.50	2334	4	
SA1009B	960521 15:56:00	960522 11:48:00	GWCM	6.00	19.50	2356	4	
SA1009B	970311 18:05:00	970313 10:32:00	GWCM	6.00	19.50	2400	5	
SA1009B	971001 12:00:00	971001 13:09:00	GWCM	6.00	19.50	2447	4	
SA1009B	980304 18:00:00	980304 18:55:00	GWCM	6.00	19.50	2493	4	
SA1229A	950518 12:19:00	950518 12:19:00	GWCM	6.00	20.50	2320	4	
SA1229A	951011 16:16:00	951011 16:16:00	GWCM	6.00	20.50	2329	4	
SA1229A	960521 16:00:00	960522 11:11:00	GWCM	6.00	20.50	2357	4	
SA1229A	970311 17:49:00	970313 11:05:00	GWCM	6.00	20.50	2394	5	
SA1229A	980303 10:45:00	980303 11:17:00	GWCM	6.00	20.50	2483	4	
SA1420A	950518 14:53:00	950518 14:53:00	GWCM	6.00	50.00	2318	4	
SA1420A	951011 15:56:00	951011 15:56:00	GWCM	6.00	50.00	2330	4	
SA1420A	960521 16:02:00	960522 10:41:00	GWCM	6.00	50.00	2358	4	
SA1420A	970311 17:39:00	970312 13:43:00	GWCM	6.00	50.00	2395	4	
SA1420A	970930 17:15:00	970930 17:40:00	GWCM	6.00	50.00	2440	4	
SA1420A	980304 15:00:00	980304 15:40:00	GWCM	6.00	50.00	2492	4	
SA1730A	950518 15:18:00	950518 15:18:00	GWCM	5.60	20.00	2319	4	
SA1730A	951011 15:13:00	951011 15:13:00	GWCM	5.60	20.00	2331	4	
SA1730A	960521 15:25:00	960521 15:25:00	GWCM	5.60	20.00	2354	4	

TABLE A1 - 1. LIST OF SAMPLES COLLECTED BETWEEN 1995-01-01 AND 1998-05-01 APPENDIX 1

SICADA: ACTIVITY_HISTORY
SICADA: GWCHEMISTRY / ANALYSES / WATER / SAMPLING_SERIES

IDCODE	START_DATE	STOP_DATE	PROJECT	SECUP	SECLOW	SAMPLE_NO	CLASS_NO	COMMENT
SA1730A	970311 16:37:00	970311 16:55:00	GWCM	5.60	20.00	2392	4	
SA1730A	971002 14:00:00	971002 15:15:00	GWCM	5.60	20.00	2454	4	
SA1730A	980303 13:45:00	980303 14:16:00	GWCM	5.60	20.00	2486	4	
SA2074A	950518 01:00:00	950518 01:00:00	GWCM	6.00	38.70	2317	4	
SA2074A	951011 15:21:00	951011 15:21:00	GWCM	6.00	38.70	2332	4	
SA2074A	960521 12:06:00	960522 15:12:00	GWCM	6.00	38.70	2360	4	
SA2074A	970310 17:01:00	970311 17:39:00	GWCM	6.00	38.70	2388	4	
SA2074A	970930 15:00:00	970930 15:45:00	GWCM	6.00	38.70	2442	4	
SA2074A	980303 16:00:00	980303 16:25:00	GWCM	6.00	38.70	2487	4	
SA2273A	950518 17:33:00	950518 17:33:00	GWCM	5.80	20.00	2321	4	
SA2273A	951011 11:36:00	951011 11:36:00	GWCM	5.80	20.00	2326	4	
SA2273A	960521 14:41:00	960521 14:41:00	GWCM	5.80	20.00	2355	4	
SA2273A	970310 16:38:00	970311 16:22:00	GWCM	5.80	20.00	2389	4	
SA2273A	971002 14:00:00	971002 14:31:00	GWCM	5.80	20.00	2455	4	
SA2273A	980302 17:45:00	980302 18:15:00	GWCM	5.80	20.00	2480	4	
SA2600A	950517 14:57:00	950517 14:57:00	GWCM	5.80	19.40	2312	4	
SA2600A	951011 11:07:00	951011 11:07:00	GWCM	5.80	19.40	2327	4	
SA2600A	960521 11:54:00	960521 15:20:00	GWCM	5.80	19.40	2351	4	
SA2600A	970310 16:01:00	970311 16:15:00	GWCM	5.80	19.40	2390	4	
SA2600A	971001 08:00:00	971001 10:45:00	GWCM	5.80	19.40	2448	4	
SA2600A	980302 15:00:00	980302 15:43:00	GWCM	5.80	19.40	2475	4	
SA2783A	950523 01:00:00	950523 01:00:00	GWCM	5.80	19.90	2322	4	
SA2783A	951025 14:58:00	951025 14:58:00	GWCM	5.80	19.90	2337	4	
SA2783A	960520 14:29:00	960521 15:00:00	GWCM	5.80	19.90	2352	4	
SA2783A	970306 10:35:00	970306 12:37:00	GWCM	5.80	19.90	2383	4	
SA2783A	971002 07:00:00	971002 13:50:00	GWCM	5.80	19.90	2452	4	
SA2783A	980304 14:06:00	980309 16:51:00	GWCM	5.80	19.90	2509	4	
SA2880A	951025 13:18:00	951025 13:18:00	GWCM	11.92	13.92	2338	4	
SA2880A	960412 16:36:00	960422 15:25:00	TRUE1	11.92	13.92	2349	5	
SA2880A	970306 12:46:00	970306 12:58:00	GWCM	11.92	13.92	2384	4	
SA2880A	971001 13:00:00	971001 13:47:00	GWCM	11.92	13.92	2449	4	
SA2880A	980306 09:00:00	980306 09:50:00	GWCM	11.92	13.92	2505	4	
SA3045A	951025 12:52:00	951025 12:52:00	GWCM	0.00	20.70	2339	4	
SA3045A	970306 13:25:00	970306 13:35:00	GWCM	0.00	20.70	2386	4	

TABLE A1 - 1. LIST OF SAMPLES COLLECTED BETWEEN 1995-01-01 AND 1998-05-01

SICADA: ACTIVITY_HISTORY
SICADA: GWCHEMISTRY / ANALYSES / WATER / SAMPLING_SERIES

IDCODE	START_DATE	STOP_DATE	PROJECT	SECUP	SECLOW	SAMPLE_NO	CLASS_NO	COMMENT
SA3045A	971001 14:00:00	971001 14:25:00	GWCM	0.00	20.70	2450	4	
SA3045A	980306 08:55:00	980306 11:10:00	GWCM	0.00	20.70	2508	4	
TASA	950227 13:38:00	950227 13:38:00	750-3191 m	2294.00	3599.00		1	
TASA	950201 09:50:00	950201 09:50:00	750-3191 m	2994.00	3599.00		1	
TASA	950314 18:21:00	950314 18:21:00	750-3191 m	2994.00	3599.00		3	
TASA	950403 15:11:00	950403 15:11:00	750-3191 m	2994.00	3599.00		1	
TASB	950201 12:00:00	950201 12:00:00	750-3191 m	0.00	213.00		1	
TASB	950227 15:14:00	950227 15:14:00	750-3191 m	0.00	213.00		1	
TASB	950314 19:19:00	950314 19:19:00	750-3191 m	0.00	220.00		3	
TASB	950403 16:07:00	950403 16:07:00	750-3191 m	0.00	220.00		3	
TASC	950227 14:35:00	950227 14:35:00	750-3191 m	220.00	333.00		1	
TASC	950314 18:42:00	950314 18:42:00	750-3191 m	220.00	333.00		3	
TASC	950403 15:33:00	950403 15:33:00	750-3191 m	220.00	333.00		3	
TASE	950403 15:05:00	950403 15:05:00	750-3191 m	330.00	450.00		1	

* See Table 2-2 in the report

SICADA: GWCHEMISTRY / ANALYSES / WATER / WATER_COMPOSITION

IDCODE	START_DATE	SECUP	SECLOW	SAMPLE_NO	CLASS_NC	HCO3 (mg/l)	CL (mg/l)	PH	COND (mS/m)	SMPL_FLOW (l/min)	DRILL_WATER (%)
HA3289B	970307 14:25:00				2	102	6440	7.3	1730	10.00	<0.1
HD0025A	950109 14:35:00				2	176	3350	7.6	1030	150.00	0.86
KA2563A	960828 14:12:00	0.00	105.01		2			7.5			
KA2598A	970310 16:00:00	0.00	101.75		2	117	5300	7.4	1400	36.00	<0.1
KA2862A	960918 15:12:00	6.82	6.92		2	6.8	14300	7.9		0.08	
KA2862A	960627 16:10:00	6.95	7.66		2	7.4	14300	8.0	3650	0.07	
KA2862A	960627 17:00:00	7.45	8.16		2	7.4	14000	8.0	3650	0.11	
KA3005A	950310 12:21:00	44.43	45.43		1			7.5	1560	1.27	<0.1
KA3067A	950310 13:38:00	0.00	40.05		1			7.6	1580	0.70	<0.1
KA3105A	950310 13:10:00				1			7.7	1020	4.20	<0.1
KA3385A	950109 14:40:00	0.00	25.14		2	17.0	6700	7.7	1750	105.00	0.22
KAS03	970312 13:30:00	107.00	252.00		1						
KAS09	950324 13:00:00	116.00	150.00		1						
KAS09	970312 13:10:00	116.00	150.00		2	27.0	5670	8.2	1580		1.72
KI0023B	971024 13:35:00	0.00	43.02	2465	2	28.9	5790	7.2	1630	54.00	0.21
KI0023B	971110 13:10:00	0.00	99.65	2468	2		4260	7.3	1250	60.00	<0.1
KI0023B	971111 11:00:00	0.00	112.56	2469	2	196	3850	7.1	1120	63.00	<0.1
KI0023B	971118 09:40:00	0.00	171.51	2472	2	153	4360	7.5	1270	80.00	
KI0023B	971023 13:10:00	5.91	8.79	2464	2	30.1	4400	8.7	1220	5.00	0.33
KI0023B	971111 18:00:00	114.60	116.40	2470	2	200	3990	7.3	1180	3.00	-0.10
KI0023B	971118 09:30:00	168.71	171.51	2471	2	147	4540	7.4	1310	18.00	
MA0682G	950201 12:35:00	0	682		1			8.0	811		
MA0682G	950227 15:56:00	0	682		1				714		
MA0682G	950314 19:46:00	0	682		1				800		
MA0682G	950403 16:32:00	0	682		1			8.0	790		
MA0682G	980302 09:00:00	0	682		2		2350	8.1	780	42	
MA1033G	950201 12:25:00	692	1033		1			7.5	1050		
MA1033G	950227 15:49:00	692	1033		1				1000		
MA1033G	951106 14:45:00	692	1033		1				969		
MA1033G	951108 11:10:00	692	1033		1				956		
MA1033G	951110 14:10:00	692	1033		1				971		
MA1033G	951120 11:00:00	692	1033		1				967		
MA1033G	951204 10:48:00	692	1033		1				965		
MA1033G	980302 09:00:00	692	1033		2		3070	7.7	980	420	
MA1232G	950201 12:20:00	1033	1232		1			7.5	1020		
MA1232G	950227 15:43:00	1033	1232		1				992		
MA1232G	980302 09:00:00	1033	1232		2		3050	7.6	1030	108	
MA1372G	950201 12:12:00	1232	1372		1			7.5	1110		
MA1372G	950227 15:35:00	1232	1372		1				1100		
MA1372G	980302 09:00:00	1232	1372		2		3220	7.8	1030	318	
MA1584G	950201 12:07:00	1372	1584		1			7.6	966		
MA1584G	950227 15:31:00	1372	1584		1				931		
MA1584G	980302 09:00:00	1372	1584		2		3010	8	940	60	
MA1745G	950201 11:35:00	1584	1745		1			8.0	559		
MA1745G	950227 15:06:00	1584	1745		1				1560		
MA1745G	980302 09:00:00	1584	1745		2		5750	7.6	1980	16	
MA1883G	950201 11:29:00	1745	1883		1			7.5	1340		
MA1883G	950227 15:00:00	1745	1883		1				1270		
MA1883G	950314 19:10:00	1745	1883		1				1220		
MA1883G	950403 15:58:00	1745	1883		1			7.7	1220		
MA1883G	980302 09:00:00	1745	1883		2		4570	7.6	1440	20	
MA2028G	950201 11:20:00	1883	2028		1			7.9	923		
MA2028G	950227 14:54:00	1883	2028		1				858		
MA2028G	950314 19:05:00	1883	2028		1				880		
MA2028G	950403 15:54:00	1883	2028		1			7.8	890		
MA2028G	980302 09:00:00	1883	2028		2		2890	7.9	914	28	

SICADA: GWCHEMISTRY / ANALYSES / WATER / WATER_COMPOSITION

IDCODE	START_DATE	SECUP	SECLOW	SAMPLE_NO	CLASS_NC	HCO3 (mg/l)	CL (mg/l)	PH	COND (mS/m)	SMPL_FLOW (l/min)	DRILL_WATER (%)
MA2178G	950201 11:10:00	2028	2178		1			7.5	975		
MA2178G	950227 14:50:00	2028	2178		1				941		
MA2178G	980302 09:00:00	2028	2178		2		2950	7.8	960	36	
MA2357G	950201 11:04:00	2178	2357		1			7.4	1450		
MA2357G	950227 14:45:00	2178	2357		1				1430		
MA2357G	980302 09:00:00	2178	2357		2		3840	7.9	1300	76	
MA2496G	950201 10:50:00	2357	2496		1			7.0			
MA2496G	950227 14:41:00	2357	2496		1				1660		
MA2496G	950314 18:54:00	2357	2496		1				1640		
MA2496G	980302 09:00:00	2357	2496		2		4690	7.6	1580	3.6	
MA2587G	980302 09:00:00	220*	333*		2		4420	7.7	1470	0.72	
MA2699G	950201 10:25:00	2496	2699		1			6.9	1660		
MA2699G	950227 14:14:00	2496	2699		1				1700		
MA2699G	980302 09:00:00	2496	2699		2		6100	7.7	1810	48	
MA2840G	950201 10:10:00	2699	2840		1			6.8	2000		
MA2840G	950227 14:04:00	2699	2840		1				2000		
MA2840G	980302 09:00:00	2699	2840		2		11200	7.3	3180	15	
MA2994G	950201 09:58:00	2840	2994		1			6.8	1740		
MA2994G	950227 13:57:00	2840	2994		1				1710		
MA2994G	950314 18:25:00	2840	2994		1				1720		
MA2994G	950403 15:15:00	2840	2994		1			7.5	1740		
MA3179G	980302 09:00:00	2994	3179		2		4340	7.7	1300	75	
MA3384G	951106 14:32:00	340*	450*		1				1600		
MA3384G	951108 10:48:00	340*	450*		1				1580		
MA3384G	951110 10:05:00	340*	450*		1				1600		
MA3384G	951120 11:05:00	340*	450*		1				1560		
MA3384G	951204 10:29:00	340*	450*		1				1540		
MA3384G	980302 09:00:00	340*	450*		2		5460	7.9	1620	16	
MA3411G	951106 14:33:00	3179	3426		1				1930		
MA3411G	951108 10:51:00	3179	3426		1				1880		
MA3411G	951110 10:09:00	3179	3426		1				1900		
MA3411G	951120 11:07:00	3179	3426		1				1870		
MA3411G	951204 10:26:00	3179	3426		1				1890		
MA3411G	980302 09:00:00	3179	3426		2		7520	7.9	2120	54	
MA3426G	951106 14:34:00	3426	3600		1				1610		
MA3426G	951108 10:54:00	3426	3600		1				1630		
MA3426G	951110 10:13:00	3426	3600		1				1650		
MA3426G	951120 11:09:00	3426	3600		1				1720		
MA3426G	951204 10:24:00	3426	3600		1				1800		
MA3426G	980302 09:00:00	3426	3600		2		5920	7.6	1680	96	
MF0061G	951106 14:36:00	0	61		1				1640		
MF0061G	951108 11:05:00	0	61		1				1720		
MF0061G	951110 10:16:00	0	61		1				1690		
MF0061G	951120 11:13:00	0	61		1				1660		
MF0061G	951204 10:32:00	0	61		1						
MF0061G	980302 09:00:00	0	61		2		5700	8.2	1750	6	
TASA	950227 13:38:00	2294	3599		1				1400		
TASA	950201 09:50:00	2994	3599		1			6.2	1620		
TASA	950403 15:11:00	2994	3599		1			7.9	1560		
TASB	950201 12:00:00	0	213		1			7.5	1080		
TASC	950227 14:35:00	220	333		1						
TASE	950403 15:05:00	330	450		1			8.2	2150		

* See Table 2-2 in the report

ENVIRONMENTAL ISOTOPES, CLASS 1 AND CLASS 2 (Deuterium and Oxygen-18)

IDCODE	START_DATE	SECUP	SECLOW	D*	O18*
HD0025A	950109 14:35:00			-60.4	-7.7
KA3385A	950109 14:40:00	0.00	25.14	-78.3	-10.4

* Delta O-18 SMOW (Standard Mean Oceanic Water) and delta D SMOW

TABLE A3 - 1. WATER ANALYSIS DATA, CLASS 3, 4 AND 5 APPENDIX 3

SICADA: GWCHEMISTRY / ANALYSES / WATER / WATER_COMPOSITION

IDCODE	DATE	SECUP (m)	SECLOW (m)	SAMPLE_NO	CLASS_NO	NA (mg/l)	K (mg/l)	CA (mg/l)	MG (mg/l)	HCO3 (mg/l)	CL (mg/l)	SO4 (mg/l)	SO4_S (mg/l)	BR (mg/l)	SI (mg/l)	FE (mg/l)	FETOT (mg/l)	FEII (mg/l)	MN (mg/l)	LI (mg/l)	SR (mg/l)	Rel. Charge Bal. (%)	PH	COND (mS/m)
HBH01	950324 10:23:00	31.00	50.60	2307	5	286	3.8	94	16.2	290	550		34.2		6.9	0.26			0.24	0.05	1.04	-9.21		
HBH02	950324 13:30:00	21.00	32.40	2308	5	46	1.4	38	3.8	170	100		4.6		5.4	1.82			0.31	0.002	0.15			
HBH05	950324 11:00:00	11.00	22.00	2309	4	27	2.2	36	4.4				4.9		5.8	16.8			0.58	0.010	0.20		7.3	34
HD0025A	980303 16:00:00			2488	4	2040	13.2	1550	94.7	100	6420	368	119	35.8	4.2	0.66	0.70	0.70	0.61	0.91	24.8	-4.33	7.4	1710
KA1061A	980304 14:00:00			2489	4	1690	45.0	163	183	193	3630	395	126	22.5	5.5	1.39	1.44	1.44	0.71	0.04	2.3	-7.44	7.3	968
KA1131B	971008 09:25:00	8.00	203.10	2460	4	1650	26.0	440	136	272	3540	258	85.2	13.5	6.4	1.81	1.93	1.93	0.83	0.18	7.26	-1.85	7.2	1080
KA1131B	980304 14:00:00	8.00	203.10	2490	4	1680	22.8	448	140	277	3720	263	86.2	17.8	6.9	1.91	1.92	1.92	0.85	0.19	7.2	-3.28	7.1	1050
KA1755A	951012 12:47:00	88.00	160.00	2335	4	2680	9.3	3400	40.7	9.0	10400	640	210	69.2	4.1	0.23	0.24	0.22	0.32	1.99	49.7	-2.62	7.8	2600
KA1755A	960522 15:21:00	88.00	160.00	2359	4	2840	9.5	3541	37.6	8.0	10600	698	204	76.0	4.7	0.25	0.27	0.22	0.36	2.58	59.0	-1.28	7.5	
KA1755A	970311 17:23:00	88.00	160.00	2393	4	2950	8.6	3744	39.3	8.0	11300	647	213	79.7	4.9	0.23	0.22	0.22	0.38	2.22	59.6	-2.02	7.6	2700
KA1755A	971001 17:10:00	88.00	160.00	2451	4	2960	10.4	4020	36.1	8.0	11100	659	208	77.8	4.1		0.26	0.24	0.28	2.57	66.7	1.05	7.6	2950
KA1755A	980305 15:00:00	88.00	160.00	2501	4	2840	10.1	3620	38.0	8.0	11400	663	206	82.2	4.1	0.18	0.23		0.32	2.58	58.7	-4.14	7.8	2900
KA2050A	970930 14:04:00	155.00	211.57	2439	4	1660	18.4	1280	66.6	28.0	4960	330	102	22.5	3.9	0.19	0.24	0.23	0.21	0.73	21.1	-1.55	8.1	1440
KA2050A	980306 11:00:00	155.00	211.57	2507	4	1700	15.6	1250	70.7	34.0	5220	330	105	24.1	3.7	0.19	0.23		0.21	0.64	17.0	-3.94	8.2	1420
KA2162B	970930 17:59:00	201.50	288.10	2446	4	2110	9.3	1520	85.7	57.0	6000	377	124	32.4	4.3	0.38	0.43	0.43	0.52	0.82	25.4	-0.80	7.3	1700
KA2162B	980304 19:00:00	201.50	288.10	2494	4	2060	9.8	1480	87.5	64.0	5940	365	122	30.8	4.1	0.37	0.41	0.41	0.50	0.81	24.0	-1.47	7.4	1630
KA2511A	980305 16:30:00	52.00	54.00	2503	4	1650	7.6	748	88.1	170	4080	263	85.3	15.5	6.8	0.49	0.52		0.60	0.38	12.2	-2.73	7.3	1140
KA2511A	980305 16:30:00	92.00	109.00	2502	4	1600	10.9	452	97.9	217	3350	315	101	13.6	6.7	0.44	0.47		0.60	0.20	7.3	-1.88	7.4	1160
KA2511A	970930 09:58:00	139.00	170.00	2438	4	1560	11.1	496	80.7	232	3380	335	96.7	13.4	6.3	0.28	0.33	0.33	0.52	0.24	8.4	-2.74	7.4	1004
KA2512A	970311 14:43:00			2391	4	1680	9.8	541	99.5	234	3720	275	91.3	13.9	6.4	0.74	0.72	0.71	0.72	0.23	8.6	-2.64	7.3	960
KA2512A	980311 12:00:00	34.00	37.27	2515	4	1620	10.9	452	110	240	3370	287	96.4	14.4	5.7	0.77	0.85	0.84	0.65	0.16	6.4	-1.28	7.4	1000
KA2563A	970930 13:09:00	187.00	196.00	2437	4	2140	9.0	1670	44.6	10.0	6300	452	126	39.9	5.1	0.06	0.07	0.06	0.30	1.19	29.1	-1.43	7.4	1710
KA2563A	980305 16:30:00	220.00	224.00	2504	4	1960	9.0	1170	61.8	80.0	5160	335	111	21.8	6.1	0.14	0.17		0.38	0.76	17.5	-1.55	7.3	1440
KA2858A	950310 12:16:00	39.77	40.77	2298	4	2630	9.7	3360	49.7	9.0	10300	577	201	70.1	5.5	0.09	0.09	0.09	0.39	2.17	47.5	-2.81	7.8	2650
KA2861A	980206 09:57:00	8.69	9.84	2474	4	3260	26.3	4970	43.2	29.0	13100	630	189	92.5	4.3	0.54			0.43	3.14	69.4	1.63	7.2	3050
KA2861A	980313 12:00:00	0.00	8.52	2517	5	3190	12.2	4460	49.7	15.0	13600	692	213	108	3.9	0.08			0.38	2.78	66.6	-4.08	7.0	3220
KA2862A	950127 09:15:00	0.00	15.98	2297	4	3230	13.6	4720	41.4	8.0	13300	666	232	102	6.6	0.12	0.13	0.12	0.38	3.24	80.5	-1.22	7.6	3150
KA2862A	980312 15:00:00	6.82	6.92	2516	5	3490	12.0	5340	35.6	8.0	15600	766	230	140	4.5	0.04	0.04		0.24	3.73	86.7	-3.73	7.7	3923
KA2862A	980312 15:00:00	7.37	15.98	2510	5	3510	13.5	5250	37.6	7.0	15400	764	234	133	4.4	0.11	0.12	0.11	0.34	3.82	87.4	-3.52	7.7	3870
KA2862A	950310 11:44:00	15.02	15.98	2299	4	3160	13.6	4600	46.5	8.0	13200	667	235	95.0	5.2	0.15	0.13	0.12	0.39	3.12	64.9	-2.06	7.6	3150
KA3005A	950310 12:33:00	36.93	37.93	2300	4	1740	12.7	1310	85.6	57.0	5400	305	115	22.2	5.8	0.49	0.54	0.48	0.55	0.77	21.4	-3.80	7.6	1400
KA3005A	960411 07:36:00	44.78	45.78	2344	5	1730	13.6	1190	82.5	93.0	4880	351	106	20.8	5.5	0.64	0.68	0.61	0.52	0.72	18.8	-1.33	7.4	1360
KA3010A	950310 12:44:00	8.56	15.06	2302	4	1890	15.1	1820	82.2	43.0	6600	336	127	33.6	5.1	0.76	0.78	0.71	0.50	1.07	29.2	-3.81	7.6	1800
KA3067A	960410 11:29:00	6.55	27.05	2342	5	2370	12.7	2710	49.3	10.0	8580		142	42.3	4.7	0.40	0.41	0.40	0.33	2.03	45.1	-1.58	7.7	2200
KA3067A	950310 13:49:00	28.05	29.55	2303	4	1880	11.2	1950	66.6	26.0	6560	350	123	35.7	5.2	0.41	0.41	0.35	0.43	1.00	29.7	-2.12	7.6	1800
KA3105A	950310 13:21:00	22.51	24.51	2304	4	1260	8.0	754	101	125	3520	217	81.2	10.8	6.2	0.34	0.36	0.30	0.59	0.30	11.0	-2.57	7.6	1020
KA3110A	950310 13:31:00	20.05	28.63	2305	4	1600	20.0	656	133	161	3940	286	99.8	15.0	5.9	1.08	1.14	0.97	0.99	0.26	9.49	-2.63	7.5	1120

SICADA: GWCHEMISTRY / ANALYSES / WATER / WATER_COMPOSITION

IDCODE	DATE	SECUP (m)	SECLOW (m)	SAMPLE_NO	CLASS_NO	SMPL_FLOW (l/min)	DRILL_WATER (%)	DOC	HS⁻	I	NO2_N (mg/l)	NO3_N (mg/l)	NO2NO3_N (mg/l)	NH4_N (mg/l)
HBH01	950324 10:23:00	31.00	50.60	2307	5									
HBH02	950324 13:30:00	21.00	32.40	2308	5									
HBH05	950324 11:00:00	11.00	22.00	2309	4									
HD0025A	980303 16:00:00			2488	4	18.00	0.04	3.00	0.02					0.43
KA1061A	980304 14:00:00			2489	4	1.10	0.05	6.30	0.07					1.10
KA1131B	971008 09:25:00	8.00	203.10	2460	4	1.45	0.02	4.60	0.43					
KA1131B	980304 14:00:00	8.00	203.10	2490	4	1.00	0.08	5.70	0.05					0.70
KA1755A	951012 12:47:00	88.00	160.00	2335	4	1.24			<0.01					0.05
KA1755A	960522 15:21:00	88.00	160.00	2359	4	1.22			<0.01					0.01
KA1755A	970311 17:23:00	88.00	160.00	2393	4	1.20	0.02	0.30						0.03
KA1755A	971001 17:10:00	88.00	160.00	2451	4	1.20	0.07	0.20						0.04
KA1755A	980305 15:00:00	88.00	160.00	2501	4	1.20	0.01	1.10						0.04
KA2050A	970930 14:04:00	155.00	211.57	2439	4	0.68	0.17	1.20	0.01					0.16
KA2050A	980306 11:00:00	155.00	211.57	2507	4	0.66	0.06	2.40	-0.01					0.10
KA2162B	970930 17:59:00	201.50	288.10	2446	4	5.40	0.13	0.80	0.02					0.25
KA2162B	980304 19:00:00	201.50	288.10	2494	4	5.60	0.02	1.60	-0.01					0.04
KA2511A	980305 16:30:00	52.00	54.00	2503	4	0.48	0.04	4.70	0.03					0.10
KA2511A	980305 16:30:00	92.00	109.00	2502	4	0.35	0.04	6.50	0.05					0.40
KA2511A	970930 09:58:00	139.00	170.00	2438	4	1.40	0.32	4.20	0.12					0.47
KA2512A	970311 14:43:00			2391	4		0.13	5.80	0.07					0.17
KA2512A	980311 12:00:00	34.00	37.27	2515	4		0.04	5.80						0.40
KA2563A	970930 13:09:00	187.00	196.00	2437	4	0.28	0.08	1.10	0.01					0.02
KA2563A	980305 16:30:00	220.00	224.00	2504	4	0.25	0.03	3.70	0.02					0.10
KA2858A	950310 12:16:00	39.77	40.77	2298	4	0.14	0.05	1.30						
KA2861A	980206 09:57:00	8.69	9.84	2474	4		0.01	2.90						
KA2861A	980313 12:00:00	0.00	8.52	2517	5	0.01	0.06							0.04
KA2862A	950127 09:15:00	0.00	15.98	2297	4	0.58	0.04	0.70						
KA2862A	980312 15:00:00	6.82	6.92	2516	5	0.01	0.01	3.50						0.02
KA2862A	980312 15:00:00	7.37	15.98	2510	5	0.40	0.01	0.50						0.03
KA2862A	950310 11:44:00	15.02	15.98	2299	4	0.58	0.04	3.10						
KA3005A	950310 12:33:00	36.93	37.93	2300	4	0.51	0.06	1.60						
KA3005A	960411 07:36:00	44.78	45.78	2344	5			1.60						
KA3010A	950310 12:44:00	8.56	15.06	2302	4	0.67	0.06	1.90						
KA3067A	960410 11:29:00	6.55	27.05	2342	5			0.48						
KA3067A	950310 13:49:00	28.05	29.55	2303	4	0.32	0.10	1.90						
KA3105A	950310 13:21:00	22.51	24.51	2304	4	1.35	0.07	3.10						
KA3110A	950310 13:31:00	20.05	28.63	2305	4	1.35	0.09	3.20						

TABLE A3 - 1. WATER ANALYSIS DATA, CLASS 3, 4 AND 5 APPENDIX 3

SICADA: GWCHEMISTRY / ANALYSES / WATER / WATER_COMPOSITION

IDCODE	DATE	SECUP (m)	SECLOW (m)	SAMPLE_NO	CLASS_NO	NA (mg/l)	K (mg/l)	CA (mg/l)	MG (mg/l)	HCO3 (mg/l)	CL (mg/l)	SO4 (mg/l)	SO4_S (mg/l)	BR (mg/l)	SI (mg/l)	FE (mg/l)	FETOT (mg/l)	FEII (mg/l)	MN (mg/l)	LI (mg/l)	SR (mg/l)	Rel. Charge Bal. (%)	PH	COND (mS/m)
KA3110A	980306 09:00:00	20.05	28.63	2506	4	1530	23.6	432	125	178	3390	303	95.6	13.0	5.1	0.98	1.08		0.78	0.16	6.0	-2.70	7.5	1010
KA3385A	950111 08:15:00	0.00	34.18	2296	4	2080	8.5	1860	60.5	10.0	6650	443	155	32.2	5.1	0.14	0.15	0.15	0.44	1.17	30.9	-2.23	7.7	1850
KA3385A	950825 13:50:00	32.05	34.18		4	2170	7.7	1930	61.5				156		4.7	0.11			0.44	1.15	31.0		7.8	1860
KA3385A	980302 16:00:00	32.05	34.18	2476	4	2180	9.0	1820	67.6	11.0	6630	428	138	33.2	3.7	0.13	0.16	0.16	0.39	1.10	30.8	-1.05	7.8	1240
KA3385A	950310 13:03:00	32.05	34.18	2306	4	2090	8.4	1860	63.1	10.0	6710	450	154	33.1	5.0	0.14	0.15	0.13	0.46	1.10	29.7	-2.48	7.5	1820
KA3539G	980302 08:00:00	0.00	30.01	2477	4	1720	8.9	632	90.5	202	3750	308	99.4	15.5	6.9	0.30	0.31	0.34	0.57	0.31	10.2	-0.53	7.4	990
KA3545G	980302 08:00:00	0.00	8.08	2478	4	1730	8.2	639	87.2	192	3790	297	97.6	13.8	7.8	0.13	0.14	0.14	0.53	0.31	10.0	-0.68	7.5	1160
KA3573A	980309 10:03:00	4.50	17.00	2512	4	1730	9.7	603	91.7	213	3780	295	97.6	17.1	6.2	0.31	0.35	0.35	0.54	0.28	9.2	-1.33		
KA3573A	980309 10:03:00	18.00	40.00	2511	4	1650	9.9	539	91.7	209	3530	311	101	16.1	6.2	0.35	0.38	0.38	0.53	0.25	8.3	-1.31	7.4	882
KA3593G	980302 08:00:00	0.00	30.02	2479	4	2020	8.5	950	75.9	105	4900	366	121	23.0	8.4	0.15	0.14	0.14	0.52	0.54	14.8	-1.97	7.3	1470
KA3600F	980309 10:05:00	4.50	21.00	2514	4	1750	9.4	656	91.3	194	3730	298	102	18.0	5.9	0.29	0.34	0.34	0.51	0.30	9.3	0.80	7.3	1120
KA3600F	980309 10:05:00	22.00	50.10	2513	4	1880	13.5	714	105	225	4260	277	94.5	21.4	6.7	0.37	0.39	0.39	0.67	0.38	11.4	-1.31	7.2	1330
KAS03	970313 10:40:00	107.00	252.00	2402	5	772	3.2	217	26.2	67.0	1540	30	14.2	8.38	4.7	0.10	0.09	0.09	0.13	0.20	4.46	1.33	7.8	465
KAS03	971003 13:10:00	107.00	252.00	2458	4	1110	5.5	365	52.6	65.0	2580	22	8.5	13.0	4.4	0.24	0.29	0.28	0.29	0.28	7.8	-2.32	7.8	772
KAS03	980331 09:15:00	107.00	252.00	2521	4	1240	6.0	385	65.1	66.0	2770	23	19.2	16.4	4.3	0.30	0.31		0.33	0.27	7.9	-1.11	8.2	830
KAS03	970313 10:40:00	533.00	626.00	2401	5	2080	7.3	1960	42.1	8.0	6500	490	179	44.2	3.3	0.30	0.31	0.31	0.28	1.28	30.9	-0.66	6.3	1780
KAS03	980331 09:05:00	533.00	626.00	2522	4	2070	6.1	1860	39.8	8.0	6520	507	156	53.0	2.6	0.11	0.14		0.19	1.08	29.1	-1.96	7.9	1850
KAS03	971002 15:50:00	553.00	626.00	2453	4	2140	7.7	2050	38.6	8.0	6730	394	157	36.5	3.3		0.13	0.13	0.21	1.30	35.3	-0.17	7.7	1800
KAS09	951012 12:35:00	116.00	150.00	2333	5	1460	33.9	199	140	175	2800	298	103	8.63	4.6	0.44	0.95	0.99	0.72	0.04	2.68	-1.43	7.7	865
KAS09	970313 09:30:00	116.00	150.00	2403	4	1563	39.5	171	168	162	2870	364	121	9.97	5.3	1.56	1.40	1.36	0.81	0.04	2.39	0.11	7.4	880
KAS09	971008 14:10:00	116.00	150.00	2459	4	1640	45.4	184	177	171	3200	367	126	8.93	4.9	1.49	1.60	1.59	0.81	0.04	2.61	-2.37	7.5	970
KAS09	980331 10:00:00	116.00	150.00	2520	4	1660	41.8	167	178	172	3100	369	129	11.6	4.7	1.41	1.47		0.75	0.03	2.1	-1.08	7.6	980
KI0023B	980305 11:37:00	111.25	112.7	2495	4	1780	8.9	1050	47.5	61	5060	344	115	27.5	7.2	0.12	0.132	0.13	0.38	0.81	18.8	-5.90	7.3	1440
KI0023B	980305 11:59:00	84.75	86.2	2496	4	2030	6.9	1450	41.5	14	6130	406	134	35.2	5.1	0.03	0.04	0.04	0.3	1.13	24.1	-4.95	7.6	1720
KI0023B	980305 11:09:00	70.95	71.95	2497	4	1920	7.8	1290	43.6	26	5590	366	119	29.8	6.1	0.05	0.067	0.07	0.33	0.94	20.6	-4.33	7.4	1570
KI0023B	980305 10:39:00	41.45	42.45	2498	4	1780	9.3	1030	60.2	96	5060	368	123	27	6.4	0.3	0.306	0.31	0.45	0.72	17	-6.24	7.4	1420
KI0025F	970929 18:00:00	86.00	88.00	2436	4	2200	9.0	1820	40.5	8.0	6670	463	133	45.0	4.5	0.03	0.06	0.06	0.23	1.32	28.7	-1.65	8.0	1740
KI0025F	980305 09:41:00	86.00	88.00	2500	4	2140	7.5	1540	46.4	17.0	6050	377	126	35.8	4.7	0.03	0.10		0.24	0.99	24.7	-1.34	7.7	1720
KI0025F	970929 17:42:00	158.00	168.00	2435	4	2090	9.8	1630	45.7	11.0	6100	511	145	34.5	4.6	0.09	0.17	0.13	0.26	1.09	28.7	-1.34	7.7	1620
KI0025F	980305 09:41:00	164.00	168.00	2499	4	2100	9.0	1580	47.7	16.0	6190	424	139	34.0	4.2	0.11	0.15		0.28	1.04	26.2	-2.51	7.7	1740
KR0012B	950518 11:44:00	5.00	10.57	2314	5	381	4.5	110	21.7	308	608		43.3		7.8	0.23	0.24	0.24	0.28	0.07	1.81	-1.87	7.5	250
KR0012B	951010 16:16:00	5.00	10.57	2323	5	375	4.5	116	23.2	295	642	120	38.7	2.38	7.3	0.28	0.28	0.26	0.30	0.07	1.87	-2.45	7.5	300
KR0012B	960522 16:34:00	5.00	10.57	2361	4	327	3.7	84	14.4	302	496	99	34.2		7.4	0.29			0.24	0.07	1.62	-3.30	7.6	
KR0012B	961217 09:33:00	5.00	10.57	2370	5	342	3.6	95.8	19.8	295	522												7.6	215
KR0012B	970121 10:20:00	5.00	10.57	2375	5	334	3.7	96.7	19.0	290	507				6.8	0.38			0.27	0.06	1.61		7.4	222
KR0012B	970313 12:16:00	5.00	10.57	2396	5	418	4.2	123	23.9	279	654	110	38.1	2.28	7.4	0.34	0.34	0.33	0.33	0.07	1.95	1.96	7.3	245
KR0012B	970930 19:00:00	5.00	10.57	2443	5	489	5.4	153	34.5	278	857	144	43.4	3.45	6.2	0.49	0.52	0.51	0.47	0.10	2.67	0.83	7.3	313

TABLE A3 - 1. WATER ANALYSIS DATA, CLASS 3, 4 AND 5

SICADA: GWCHEMISTRY / ANALYSES / WATER / WATER_COMPOSITION

IDCODE	DATE	SECUP (m)	SECLOW (m)	SAMPLE_NO	CLASS_NO	SMPL_FLOW (l/min)	DRILL_WATER (%)	DOC	HS⁻	I	NO2_N (mg/l)	NO3_N (mg/l)	NO2NO3_N (mg/l)	NH4_N (mg/l)
KA3110A	980306 09:00:00	20.05	28.63	2506	4	4.10	0.05	4.90	0.05					0.40
KA3385A	950111 08:15:00	0.00	34.18	2296	4	0.50	0.12	1.60						
KA3385A	950825 13:50:00	32.05	34.18		4	0.70								
KA3385A	980302 16:00:00	32.05	34.18	2476	4	0.70	-0.20	1.20						0.04
KA3385A	950310 13:03:00	32.05	34.18	2306	4	0.80	0.06	1.10						
KA3539G	980302 08:00:00	0.00	30.01	2477	4	0.15	0.03	5.20	-0.01					0.26
KA3545G	980302 08:00:00	0.00	8.08	2478	4	0.01	0.03	5.10	-0.01					0.22
KA3573A	980309 10:03:00	4.50	17.00	2512	4		0.03	6.60	0.03					0.20
KA3573A	980309 10:03:00	18.00	40.00	2511	4	5.40	0.10	5.50	0.04					0.30
KA3593G	980302 08:00:00	0.00	30.02	2479	4	0.14	0.07	4.40	-0.01					0.16
KA3600F	980309 10:05:00	4.50	21.00	2514	4	1.30	0.04	14.60	0.03					0.30
KA3600F	980309 10:05:00	22.00	50.10	2513	4	0.75	0.31	5.50	0.03					0.30
KAS03	970313 10:40:00	107.00	252.00	2402	5	0.29	0.30	4.10	0.95					0.03
KAS03	971003 13:10:00	107.00	252.00	2458	4	0.28	0.17	1.70	0.36					0.08
KAS03	980331 09:15:00	107.00	252.00	2521	4	0.32	0.08	2.20	0.09					0.06
KAS03	970313 10:40:00	533.00	626.00	2401	5	0.25	0.92	13.50	1.45					0.01
KAS03	980331 09:05:00	533.00	626.00	2522	4	0.23	0.16	4.70	0.35					0.01
KAS03	971002 15:50:00	553.00	626.00	2453	4	0.29	0.42	4.50	0.07					0.02
KAS09	951012 12:35:00	116.00	150.00	2333	5				5.64					3.15
KAS09	970313 09:30:00	116.00	150.00	2403	4	0.28	0.17	6.80	0.20					0.69
KAS09	971008 14:10:00	116.00	150.00	2459	4	0.28	0.26	5.20	0.99					
KAS09	980331 10:00:00	116.00	150.00	2520	4	0.25	0.03	53.00	0.55					0.10
KI0023B	980305 11:37:00	111.25	112.7	2495	4	1.84	0.02	2.6	0.01					0.031
KI0023B	980305 11:59:00	84.75	86.2	2496	4	0.68	0.05	1.6	0.01					0.033
KI0023B	980305 11:09:00	70.95	71.95	2497	4	1.82	0.06	2.9	0.01					0.023
KI0023B	980305 10:39:00	41.45	42.45	2498	4	3.6	0.03	3.8	-0.01					0.165
KI0025F	970929 18:00:00	86.00	88.00	2436	4	0.40	0.07	1.00	0.06					0.04
KI0025F	980305 09:41:00	86.00	88.00	2500	4	0.64	0.02	2.40	0.02					0.02
KI0025F	970929 17:42:00	158.00	168.00	2435	4	1.90	0.09	1.20	0.02					0.06
KI0025F	980305 09:41:00	164.00	168.00	2499	4	1.84	0.01	2.00						0.03
KR0012B	950518 11:44:00	5.00	10.57	2314	5	0.45		13.70						0.32
KR0012B	951010 16:16:00	5.00	10.57	2323	5			8.40						0.36
KR0012B	960522 16:34:00	5.00	10.57	2361	4	0.20		12.20	<0.01					0.07
KR0012B	961217 09:33:00	5.00	10.57	2370	5									
KR0012B	970121 10:20:00	5.00	10.57	2375	5									
KR0012B	970313 12:16:00	5.00	10.57	2396	5	0.37	0.25	12.00	0.04					0.13
KR0012B	970930 19:00:00	5.00	10.57	2443	5	0.40	0.27	9.40	0.22					0.35

SICADA: GWCHEMISTRY / ANALYSES / WATER / WATER_COMPOSITION

IDCODE	DATE	SECUP (m)	SECLOW (m)	SAMPLE_NO	CLASS_NO	NA (mg/l)	K (mg/l)	CA (mg/l)	MG (mg/l)	HCO3 (mg/l)	CL (mg/l)	SO4 (mg/l)	SO4_S (mg/l)	BR (mg/l)	SI (mg/l)	FE (mg/l)	FETOT (mg/l)	FEII (mg/l)	MN (mg/l)	LI (mg/l)	SR (mg/l)	Rel. Charge Bal. (%)	PH	COND (mS/m)
KR0012B	971015 09:24:00	5.00	10.57	2461	5					276	851												7.4	320
KR0012B	980303 09:53:00	5.00	10.57	2484	5	492	5.7	141	34.7	281	876	114	43.7	2.8	5.9	0.42	0.42	0.42	0.38	0.09	2.4	-0.90	7.6	325
KR0013B	950518 10:11:00	7.05	16.94	2315	4	716	4.2	309	52.2	273	1520		47.6		7.7	0.34	0.35	0.35	0.44	0.14	5.00	0.72	7.6	560
KR0013B	951010 16:04:00	7.05	16.94	2324	4	620	4.0	270	47.1	267	1460	126	41.2	8.24	7.3	0.36	0.37	0.36	0.40	0.12	4.17	-4.03	7.4	440
KR0013B	960522 16:45:00	7.05	16.94	2362	4	572	3.9	223	35.2	283	1170	118	37.8		7.3	0.35	0.38	0.35	0.35	0.11	3.69	-1.15	7.5	
KR0013B	961217 09:22:00	7.05	16.94	2371	5	471	3.3	175	30.6	275	866												7.4	320
KR0013B	970121 09:59:00	7.05	16.94	2376	5	453	3.6	172	30.0	296	866		36.3		7.4	0.39			0.33	0.08	2.77	-0.99	7.3	325
KR0013B	970313 12:37:00	7.05	16.94	2397	5	579	3.7	228	36.5	275	1140	111	38.4	5.75	7.5	0.37	0.33	0.30	0.36	0.10	3.44	0.79	7.2	385
KR0013B	970930 19:00:00	7.05	16.94	2444	5	563	3.6	211	36.7	285	1060	125	39.4	4.89	6.1	0.48	0.52	0.51	0.38	0.11	3.52	1.54	7.2	380
KR0013B	971015 09:30:00	7.05	16.94	2462	5					286	1050												7.3	390
KR0013B	980303 09:53:00	7.05	16.94	2481	5	517	4.4	179	33.2			114	37.0	4.3	6.2	0.42	0.40	0.42	0.33	0.11	3.0		7.3	344
KR0015B	950518 10:01:00	19.82	30.31	2316	4	579	3.6	207	36.8	346	977		46.8		8.4	0.43	0.44	0.45	0.35	0.10	3.14	3.40	7.5	368
KR0015B	951010 15:46:00	19.82	30.31	2325	4	453	3.2	159	29.2	309	890	121	39.3	4.52	8.0	0.39	0.37	0.34	0.28	0.09	2.48	-3.99	7.4	315
KR0015B	960522 16:56:00	19.82	30.31	2363	4	442	3.5	143	23.0	340	726	97	36.7		8.1	0.42	0.44	0.41	0.28	0.08	2.41	0.07	7.4	
KR0015B	961217 09:28:00	19.82	30.31	2372	5	243	2.4	81	13.0	384	282												7.3	150
KR0015B	970121 10:11:00	19.82	30.31	2377	5	270	2.8	90	14.7	385	333		55.7		8.2	0.43			0.27	0.05	1.49	-4.39	7.2	170
KR0015B	970313 12:28:00	19.82	30.31	2398	5	487	3.3	158	26.6	336	771	107	36.1	3.57	8.5	0.45	0.38	0.38	0.32	0.08	2.42	3.05	7.2	288
KR0015B	970930 19:02:00	19.82	30.31	2445	5	463	2.6	153	27.3	344	734	118	37.2	3.50	6.5	0.50	0.54	0.53	0.31	0.09	2.36	2.53	7.3	283
KR0015B	971015 09:34:00	19.82	30.31	2463	5					345	735												7.2	298
KR0015B	980303 09:55:00	19.82	30.31	2482	5	413	4.2	139	24.5	401	668	101	33.1	3.2	6.7	0.53	0.54	0.54	0.31	0.08	2.2	-0.78	7.3	276
KXTT3	970306 13:25:00	12.42	14.42	2385	4	1880	13.1	1510	80.5	72.0	5520	362	116	31.2	4.6	0.66	0.58	0.55	0.49	0.85	25.9	0.06	7.4	1620
KXTT3	970702 10:45:00	12.42	14.42	2404	5	1890	15.4	1680	67.9	55.0	5840	336	122	17.0	4.8	0.64			0.39	1.03	28.0	-0.22	7.5	1560
KXTT3	971003 10:20:00	12.42	14.42	2457	5	1940	13.4	1710	69.8	43.0	6090	356	122	28.4	4.0	0.58	0.64	0.64	0.40	0.94	27.7	-1.12	7.4	1690
KXTT3	971202 10:30:00	12.42	14.42	2473	5	1820	13.8	1540	70.8	50.0	5970		116		4.4	0.63	0.64	0.64	0.41	1.01	26.8	-4.02	7.6	1650
KXTT3	980304 09:25:00	12.42	14.42	2491	5	1730	12.2	1310	71.5	88.0	5150	332	108	26.5	4.7	0.54	0.28	0.27	0.37	0.72	18.6	-2.17	7.5	1420
SA0813B	950517 16:16:00	5.60	19.70	2311	4	1550	17.5	282	124	311	3080		91.2		7.2	5.28	5.34	5.34	0.67	0.11	4.86	-2.73	7.2	945
SA0813B	951012 00:00:00	5.60	19.70	2336	4	1470	16.2	280	115	318	2980	254	85.7	12.5	5.3	3.78	2.41	2.36	0.48	0.10	3.88	-3.71	7.7	895
SA0813B	960521 18:00:00	5.60	19.70	2353	4	1520	19.4	276	112	319	2960	252	80.5	13.4	7.1	4.82	1.72	1.76	0.63	0.13	5.11	-2.22	7.2	876
SA0813B	970313 11:43:00	5.60	19.70	2399	4	1500	17.0	275	108	329	2780	234	79.5	12.3	7.3	5.39	3.22	3.21	0.60	0.12	4.86	-0.17	7.1	855
SA0813B	971006 15:10:00	5.60	19.70	2456	4	1480	17.8	295	96.9	345	2820	215	73.5	11.9	6.7	4.60	3.15	3.20	0.55	0.12	4.84	-1.20	7.2	890
SA0813B	980302 09:00:00	5.60	19.70	2485	4	1490	15.2	241	102	385	2730	196	64.5	12.8	7.2	7.70	7.80	7.80	0.51	0.11	4.2	-0.87	7.3	870
SA1009B	950517 01:00:00	6.00	19.50	2313	4	1570	31.1	275	152	228	3390		118		6.6	1.47	1.48		0.83	0.08	4.26	-5.56	7.4	
SA1009B	951012 00:00:00	6.00	19.50	2334	4	1530	30.3	240	146	234	3040	330	116	11.1	5.6	1.18	1.39	1.38	0.64	0.05	3.13	-2.97	7.4	900
SA1009B	960522 11:48:00	6.00	19.50	2356	4	1600	35.9	239	150	224	3170	371	117		6.4	1.43	1.40	1.40	0.78	0.08	4.00	-2.80	7.3	
SA1009B	970313 10:32:00	6.00	19.50	2400	5	1590	35.1	226	154	220	3000	359	116	11.9	6.4				0.68	0.06	3.59	-0.82	7.2	921
SA1009B	971001 13:09:00	6.00	19.50	2447	4	1640	37.6	242	160	224	3160	370	122	11.7	5.9	1.28	1.37	1.37	0.71	0.07	3.81	-1.46	7.2	994
SA1009B	980304 18:00:00	6.00	19.50	2493	4	1720	35.5	241	172	217	3270	371	126	13.2	5.5	1.30	1.35	1.38	0.71	0.05	3.4	-0.87	7.3	1010

SICADA: GWCHEMISTRY / ANALYSES / WATER / WATER_COMPOSITION

IDCODE	DATE	SECUP (m)	SECLOW (m)	SAMPLE_NO	CLASS_NO	SMPL_FLOW (l/min)	DRILL_WATER (%)	DOC	HS⁻	I	NO2_N (mg/l)	NO3_N (mg/l)	NO2NO3_N (mg/l)	NH4_N (mg/l)
KR0012B	971015 09:24:00	5.00	10.57	2461	5	0.40								
KR0012B	980303 09:53:00	5.00	10.57	2484	5	0.54	0.17	12.00	0.17					0.30
KR0013B	950518 10:11:00	7.05	16.94	2315	4	2.70		7.70						0.22
KR0013B	951010 16:04:00	7.05	16.94	2324	4			6.60						0.23
KR0013B	960522 16:45:00	7.05	16.94	2362	4	6.32		12.10	0.01					0.03
KR0013B	961217 09:22:00	7.05	16.94	2371	5									
KR0013B	970121 09:59:00	7.05	16.94	2376	5									
KR0013B	970313 12:37:00	7.05	16.94	2397	5		0.78	11.80	0.06					0.09
KR0013B	970930 19:00:00	7.05	16.94	2444	5	10.20	0.09	11.00	0.07					0.23
KR0013B	971015 09:30:00	7.05	16.94	2462	5	10.20								
KR0013B	980303 09:53:00	7.05	16.94	2481	5	2.60	0.13	12.10	0.05					0.08
KR0015B	950518 10:01:00	19.82	30.31	2316	4	1.23		14.20						0.22
KR0015B	951010 15:46:00	19.82	30.31	2325	4			10.10						0.20
KR0015B	960522 16:56:00	19.82	30.31	2363	4	2.46		15.00	0.05					0.02
KR0015B	961217 09:28:00	19.82	30.31	2372	5									
KR0015B	970121 10:11:00	19.82	30.31	2377	5									
KR0015B	970313 12:28:00	19.82	30.31	2398	5		0.16	16.90	0.18					0.08
KR0015B	970930 19:02:00	19.82	30.31	2445	5	2.00	0.06	14.00	0.42					0.19
KR0015B	971015 09:34:00	19.82	30.31	2463	5	2.00								
KR0015B	980303 09:55:00	19.82	30.31	2482	5	2.30	0.13	14.80	0.22					0.10
KXTT3	970306 13:25:00	12.42	14.42	2385	4	0.94	0.05	2.10						
KXTT3	970702 10:45:00	12.42	14.42	2404	5			1.20		0.25	0.00	<0.5	<0.01	0.14
KXTT3	971003 10:20:00	12.42	14.42	2457	5	0.94	0.57	1.50	0.01	0.24	0.00		<0.01	0.14
KXTT3	971202 10:30:00	12.42	14.42	2473	5	0.35	0.12	1.60	0.02					
KXTT3	980304 09:25:00	12.42	14.42	2491	5	0.30	0.02	2.70	0.01					0.15
SA0813B	950517 16:16:00	5.60	19.70	2311	4	0.03		4.60	<0.01					
SA0813B	951012 00:00:00	5.60	19.70	2336	4	0.15			0.02					0.22
SA0813B	960521 18:00:00	5.60	19.70	2353	4	0.16			<0.01					
SA0813B	970313 11:43:00	5.60	19.70	2399	4	0.11	0.45	5.90	<0.01					0.55
SA0813B	971006 15:10:00	5.60	19.70	2456	4	0.04	0.46	5.60	2.50					6.10
SA0813B	980302 09:00:00	5.60	19.70	2485	4	0.01	0.38	6.70						5.39
SA1009B	950517 01:00:00	6.00	19.50	2313	4	0.47		5.70	<0.01					4.20
SA1009B	951012 00:00:00	6.00	19.50	2334	4	0.18			<0.01					8.11
SA1009B	960522 11:48:00	6.00	19.50	2356	4	0.16								0.07
SA1009B	970313 10:32:00	6.00	19.50	2400	5		0.15	5.80	<0.01					1.55
SA1009B	971001 13:09:00	6.00	19.50	2447	4	0.13	0.31	4.20	0.25					9.45
SA1009B	980304 18:00:00	6.00	19.50	2493	4	1.60	0.05	6.00	-0.01					0.90

TABLE A3 - 1. WATER ANALYSIS DATA, CLASS 3, 4 AND 5 APPENDIX 3

SICADA: GWCHEMISTRY / ANALYSES / WATER / WATER_COMPOSITION

IDCODE	DATE	SECUP (m)	SECLOW (m)	SAMPLE_NO	CLASS_NO	NA (mg/l)	K (mg/l)	CA (mg/l)	MG (mg/l)	HCO3 (mg/l)	CL (mg/l)	SO4 (mg/l)	SO4_S (mg/l)	BR (mg/l)	SI (mg/l)	FE (mg/l)	FETOT (mg/l)	FEII (mg/l)	MN (mg/l)	LI (mg/l)	SR (mg/l)	Rel. Charge Bal. (%)	PH	COND (mS/m)
SA1229A	950518 12:19:00	6.00	20.50	2320	4	1630	24.1	467	147	310	3670		82.7		7.5	2.21	2.26		1.00	0.18	7.89	-2.99	7.1	1060
SA1229A	951011 16:16:00	6.00	20.50	2329	4	1620	24.4	440	136	314	3480	224	81.9	15.2	6.8	1.90	2.13	2.09	0.81	0.17	6.86	-1.93	7.5	1010
SA1229A	960522 11:11:00	6.00	20.50	2357	4	1640	28.0	413	137	303	3390	258	82.7		7.3	1.58	1.42	1.35	0.89	0.17	7.12		7.2	
SA1229A	970313 11:05:00	6.00	20.50	2394	5	1590	25.2	380	130	323	3140	249	83.1	13.9	6.9				0.73	0.13	6.12		7.2	906
SA1229A	980303 10:45:00	6.00	20.50	2483	4	1630	29.4	307	146	304	3650	297	96.9	14.1	6.9	1.65	1.64	1.64	0.73	0.11	4.9	0.19	7.2	1010
SA1420A	950518 14:53:00	6.00	50.00	2318	4	1350	20.5	284	136	199	2900		101		6.3	1.85	1.87		0.80	0.07	3.68	-3.74	7.3	900
SA1420A	951011 15:56:00	6.00	50.00	2330	4	1330	20.3	247	129	204	2720	267	97.5	13.7	5.6	1.52	1.64	1.63	0.69	0.06	2.90	-2.88	7.5	815
SA1420A	960522 10:41:00	6.00	50.00	2358	4	1320	21.1	245	119	214	2680	281	88.0		6.0	1.45	1.54		0.69	0.08	3.45	0.19	7.4	
SA1420A	970312 13:43:00	6.00	50.00	2395	4	1390	25.9	210	137	189	2510	301	99.2	9.1	6.2	1.71	1.58	1.57	0.70	0.05	2.60	1.69	7.4	783
SA1420A	970930 17:40:00	6.00	50.00	2440	4	1500	30.9	245	161	194	2970	390	110	11.6	5.6	1.76	1.86	1.86	0.73	0.05	3.01	-1.25	7.4	878
SA1420A	980304 15:00:00	6.00	50.00	2492	4	1530	27.0	246	157	204	3050	324	108	10.2	5.6	1.57	1.56	1.56	0.72	0.05	3.0	-1.95	7.4	914
SA1730A	950518 15:18:00	5.60	20.00	2319	4	2440	8.2	2760	53.5	32.0	8670		180		4.9					1.64	46.7	-1.34	7.2	2200
SA1730A	951011 15:13:00	5.60	20.00	2331	4	2380	8.2	2620	56.4	36.0	8650	530	175	70.7	4.3	0.58	0.66	0.62	0.51	1.24	37.0	-3.31	7.5	2120
SA1730A	960521 15:25:00	5.60	20.00	2354	4	2380	9.4	2450	57.7	43.0	8050	540	162	70.5	5.1				0.62	1.73	40.8	-1.32	7.3	2000
SA1730A	970311 16:55:00	5.60	20.00	2392	4	2640	9.3	2940	53.6	34.0	9460	549	180	62.6	5.0	0.57	0.54	0.52	0.55	1.77	44.4	-2.23	7.4	2280
SA1730A	971002 15:15:00	5.60	20.00	2454	4	2760	10.1	3400	43.5	25.0	10000	560	184	68.8	4.3	0.32	0.41	0.40	0.37	2.21	57.3	0.01	7.5	2700
SA1730A	980303 13:45:00	5.60	20.00	2486	4	2730	9.3	3250	45.3	24.0	10600	595	189	73.5	4.0	0.38	0.38	0.38	0.38	2.12	47.6	-4.37	7.5	2740
SA2074A	950518 01:00:00	6.00	38.70	2317	4	1450	9.3	560	119	128	3410		87.4		6.2	0.22	0.22		0.66	0.20	8.18	-1.20	7.6	1040
SA2074A	951011 15:21:00	6.00	38.70	2332	4	1420	9.1	510	112	140	3240	251	85.4	10.2	5.4	0.17	0.19	0.17	0.52	0.17	6.57	-1.19	7.7	930
SA2074A	960522 15:12:00	6.00	38.70	2360	4	1420	9.9	511	107	134	3290	243	80.0		6.2	0.20	0.20	0.20	0.60	0.22	7.60	-1.78	7.7	
SA2074A	970311 17:39:00	6.00	38.70	2388	4	1370	9.4	462	94.7	152	2980	252	81.9	10.3	6.0	0.16	0.16	0.16	0.54	0.20	6.78	-0.53	7.7	845
SA2074A	970930 15:45:00	6.00	38.70	2442	4	1280	9.3	447	84.9	151	2840	281	85.0	10.0	5.9	0.15	0.16	0.15	0.47	0.19	6.55	-1.53	7.5	845
SA2074A	980303 16:00:00	6.00	38.70	2487	4	1320	8.5	443	92.0	158	2950	279	90.2	11.3	6.0	0.15	0.14	0.14	0.46	0.18	6.1	-2.30	7.7	860
SA2273A	950518 17:33:00	5.80	20.00	2321	4	1870	12.4	852	151	182	4790		80.4		6.4	0.96	0.99		1.22	0.34	12.6	-2.21	7.4	1360
SA2273A	951011 11:36:00	5.80	20.00	2326	4	1780	13.2	796	140	180	4350	242	78.7	24.1	5.4	0.79	1.00	0.81	0.96	0.35	11.0	-0.60	7.4	1270
SA2273A	960521 14:41:00	5.80	20.00	2355	4	1800	14.0	824	135	175	4530	274	83.7	22.7	6.7	0.96	0.99	0.99	1.08	0.43	12.8	-1.87	7.4	1220
SA2273A	970311 16:22:00	5.80	20.00	2389	4	1770	12.3	741	126	174	4240	265	90.1	20.5	7.0	0.92	0.84	0.84	1.09	0.33	11.3	-1.34	7.4	1150
SA2273A	971002 14:31:00	5.80	20.00	2455	4	1680	13.4	719	114	169	4140	260	88.3	15.7	5.8	0.76	0.83	0.82	0.87	0.35	11.8	-2.57	7.5	1210
SA2273A	980302 17:45:00	5.80	20.00	2480	4	1690	12.1	693	116	167	4020	279	91.3	18.2	5.7	0.74	0.80	0.78	0.81	0.30	9.7	-1.61	7.5	1200
SA2600A	950517 14:57:00	5.80	19.40	2312	4	2090	7.6	1500	90.7	90.0	6020		136		5.9	0.64	0.61	0.61	0.76	0.84	25.8	-1.62	7.5	1730
SA2600A	951011 11:07:00	5.80	19.40	2327	4	2140	7.6	1540	89.3	95.0	6180	382	137	49.5	5.1	0.84	1.25	1.10	0.62	0.78	22.1	-1.94	7.4	1630
SA2600A	960521 15:20:00	5.80	19.40	2351	4	2120	9.1	1490	85.0	114	5920	404	127	30.2	6.2	0.60	0.61	0.60	0.69	1.08	25.6	-0.79	7.4	1550
SA2600A	970311 16:15:00	5.80	19.40	2390	4	2130	7.7	1440	84.2	124	5720	357	125	29.7	5.2	0.55	0.57	0.56	0.66	0.73	24.7	0.20	7.4	1560
SA2600A	971001 10:45:00	5.80	19.40	2448	4	2050	9.4	1440	74.8	130	5600	359	121	29.3	5.6	0.46	0.55	0.54	0.56	0.88	25.1	0.00	7.3	1650
SA2600A	980302 15:00:00	5.80	19.40	2475	4	2100	9.6	1460	78.3	125	5900	390	126	34.3	4.8	0.52	0.52	0.53	0.58	0.91	25.9	-1.52	7.4	1660
SA2783A	950523 01:00:00	5.80	19.90	2322	4	2810	10.3	3660	53.3	14.0	10900		195		5.1	0.13	0.13		0.41	2.43	63.1	-1.41	7.1	2800
SA2783A	951025 14:58:00	5.80	19.90	2337	4	2840	11.7	3710	50.1	18.0	10900	599	192	76.4	4.6	0.13	0.12	0.11	0.36	2.35	56.2	-0.99	7.7	2500

TABLE A3 - 1. WATER ANALYSIS DATA, CLASS 3, 4 AND 5

SICADA: GWCHEMISTRY / ANALYSES / WATER / WATER_COMPOSITION

IDCODE	DATE	SECUP (m)	SECLOW (m)	SAMPLE_NO	CLASS_NO	SMPL_FLOW (l/min)	DRILL_WATER (%)	DOC	HS⁻	I	NO2_N (mg/l)	NO3_N (mg/l)	NO2NO3_N (mg/l)	NH4_N (mg/l)
SA1229A	950518 12:19:00	6.00	20.50	2320	4	3.50		5.20						4.61
SA1229A	951011 16:16:00	6.00	20.50	2329	4	2.20								8.28
SA1229A	960522 11:11:00	6.00	20.50	2357	4	2.20			0.12					0.07
SA1229A	970313 11:05:00	6.00	20.50	2394	5	1.91	0.21	6.00	0.01					1.13
SA1229A	980303 10:45:00	6.00	20.50	2483	4	1.80	0.05	6.30	0.01					0.08
SA1420A	950518 14:53:00	6.00	50.00	2318	4	1.55		4.80						2.13
SA1420A	951011 15:56:00	6.00	50.00	2330	4	2.00			0.15					2.16
SA1420A	960522 10:41:00	6.00	50.00	2358	4	1.80			0.05					0.20
SA1420A	970312 13:43:00	6.00	50.00	2395	4	0.50	0.16	7.90	0.03					0.64
SA1420A	970930 17:40:00	6.00	50.00	2440	4	0.50	0.27	5.50	0.20					2.95
SA1420A	980304 15:00:00	6.00	50.00	2492	4	10.00	0.06	7.20	0.10					0.10
SA1730A	950518 15:18:00	5.60	20.00	2319	4			1.80						0.36
SA1730A	951011 15:13:00	5.60	20.00	2331	4	3.60								0.38
SA1730A	960521 15:25:00	5.60	20.00	2354	4	1.48								0.15
SA1730A	970311 16:55:00	5.60	20.00	2392	4	3.20	0.07	1.00						0.16
SA1730A	971002 15:15:00	5.60	20.00	2454	4	1.70	0.11	0.80						0.20
SA1730A	980303 13:45:00	5.60	20.00	2486	4	3.00	0.02	1.10						0.10
SA2074A	950518 01:00:00	6.00	38.70	2317	4			1.80						0.20
SA2074A	951011 15:21:00	6.00	38.70	2332	4	0.25			0.03					0.24
SA2074A	960522 15:12:00	6.00	38.70	2360	4	0.24			<0.01					0.06
SA2074A	970311 17:39:00	6.00	38.70	2388	4	0.24	0.13	4.30	0.05					0.16
SA2074A	970930 15:45:00	6.00	38.70	2442	4	0.24	0.20	3.40	0.05					0.21
SA2074A	980303 16:00:00	6.00	38.70	2487	4	0.40	0.06	4.80	0.02					0.21
SA2273A	950518 17:33:00	5.80	20.00	2321	4			4.20	0.01					0.48
SA2273A	951011 11:36:00	5.80	20.00	2326	4	3.10			0.02					0.63
SA2273A	960521 14:41:00	5.80	20.00	2355	4	2.08			0.03					0.10
SA2273A	970311 16:22:00	5.80	20.00	2389	4	3.10	0.08	3.20	0.06					0.26
SA2273A	971002 14:31:00	5.80	20.00	2455	4	1.50	0.25	2.50	0.03					0.71
SA2273A	980302 17:45:00	5.80	20.00	2480	4	2.30	0.03	3.80	0.01					0.49
SA2600A	950517 14:57:00	5.80	19.40	2312	4	1.88		2.20	0.03					0.13
SA2600A	951011 11:07:00	5.80	19.40	2327	4	2.94								0.15
SA2600A	960521 15:20:00	5.80	19.40	2351	4	1.84			<0.01					0.07
SA2600A	970311 16:15:00	5.80	19.40	2390	4	1.50	0.04	3.00	0.01					0.08
SA2600A	971001 10:45:00	5.80	19.40	2448	4	1.20	0.16	2.40	0.01					0.17
SA2600A	980302 15:00:00	5.80	19.40	2475	4	1.50	0.02	3.10	0.01					0.15
SA2783A	950523 01:00:00	5.80	19.90	2322	4			2.20						0.05
SA2783A	951025 14:58:00	5.80	19.90	2337	4	0.08								0.04

SICADA: GWCHEMISTRY / ANALYSES / WATER / WATER_COMPOSITION

IDCODE	DATE	SECUP (m)	SECLOW (m)	SAMPLE_NO	CLASS_NO	NA (mg/l)	K (mg/l)	CA (mg/l)	MG (mg/l)	HCO3 (mg/l)	CL (mg/l)	SO4 (mg/l)	SO4_S (mg/l)	BR (mg/l)	SI (mg/l)	FE (mg/l)	FETOT (mg/l)	FEII (mg/l)	MN (mg/l)	LI (mg/l)	SR (mg/l)	Rel. Charge Bal. (%)	PH	COND (mS/m)
SA2783A	960521 15:00:00	5.80	19.90	2352	4	3050	10.9	4060	48.6	15.0	12100	673	205	104	4.9	0.11	0.12	0.12	0.41	2.79	66.2	-2.09	7.6	2930
SA2783A	970306 12:37:00	5.80	19.90	2383	4	3150	10.4	4300	46.7	11.0	12500	640	218	92.2	5.0	0.11	0.11	0.11	0.41	2.62	68.3	-1.42	7.0	3320
SA2783A	971002 13:50:00	5.80	19.90	2452	4	3330	13.4	4920	42.0	13.0	13300	582	210	87.3	4.3	0.05	0.12	0.11	0.32	3.06	80.9	0.82	7.6	3400
SA2783A	980304 14:06:00	5.80	19.90	2509	4	3210	11.7	4450	42.9	13.0	13200	685	211	110	4.0	0.08	0.11	0.10	0.33	2.94	68.3	-2.65	7.7	3440
SA2880A	951025 13:18:00	11.92	13.92	2338	4	2850	12.1	3810	46.4	30.0	11400	609	188	81.3	4.4	0.18	0.25		0.36	2.38	57.0	-2.34	7.6	2850
SA2880A	960422 15:25:00	11.92	13.92	2349	5	3160	13.6	4380	41.1	22.0	13000	655	209	96.0	4.8	0.21	0.23	0.21	0.38	3.19	72.3	-2.68	7.5	3200
SA2880A	970306 12:58:00	11.92	13.92	2384	4	3180	11.8	4450	45.9	27.0	13000	672	213	99.2	5.1	0.24	0.21	0.21	0.44	2.74	70.9	-2.09	7.4	3390
SA2880A	971001 13:47:00	11.92	13.92	2449	4	3340	12.9	4650	41.0	20.0	13500	632	210	83.0	3.6	0.17	0.20	0.20	0.32	2.98	78.1	-1.60	7.2	3550
SA2880A	980306 09:00:00	11.92	13.92	2505	4	2990	12.8	3980	44.2	40.0	12500	638	195	102	4.3	0.18	0.23		0.36	2.79	64.0	-4.65	7.3	3250
SA3045A	951025 12:52:00	0.00	20.70	2339	4	1960	11.1	1990	61.3		6860	409	121	42.9	4.7	0.43	0.33	0.28	0.34	1.30	31.9	-2.80	7.7	1820
SA3045A	970306 13:35:00	0.00	20.70	2386	4	2420	11.7	2720	50.2	10.0	8770	446	147	59.6	4.8	0.37	0.37	0.36	0.31	1.87	43.4	-2.19	7.6	2300
SA3045A	971001 14:25:00	0.00	20.70	2450	4	2300	12.4	2630	44.4	14.0	8120	408	135	48.5	4.4	0.27	0.33	0.33	0.24	1.74	44.5	-0.43	7.4	2150
SA3045A	980306 08:55:00	0.00	20.70	2508	4	2350	11.2	2550	44.8	10.0	8630	432	138	66.0	4.4	0.32	0.34		0.25	1.77	40.4	-3.83	7.8	2230
TASA	950314 18:21:00	2994	3599		3	1650	18.9	918	110	124	4380		112		5.3					0.51	14.4	-1.98	7.8	1280
TASB	950314 19:19:00	0	220		3	1230	6.5	772	65.8	178	3290		90.4		6.2					0.44	12.6	-1.74	7.9	980
TASB	950403 16:07:00	0	220		3	1170	8.5	733	65.6	170	3250		87.0		6.6					0.43	12.4	-3.38	7.4	980
TASC	950314 18:42:00	220	333		3	1910	6.5	1190	110	72.0	5400		102		4.3					0.66	19.3	-2.48	7.8	1500
TASC	950403 15:33:00	220	333		3	1790	11.1	1090	114	104	5160		98.1		6.0					0.58	15.2	-3.75	7.6	1460
MA1033G	950314 19:43:00	692	1033		3	1570	25.6	460	127	225	3380		93.5		6.7					0.18	7.60	-1.11	7.6	1020
MA1033G	950403 16:30:00	692	1033		3	1500	21.6	448	126				92.1		6.4					0.17	7.19		7.5	1020
MA1232G	950314 19:40:00	1033	1232		3	1650	38.2	248	154	182	3180		116		6.4					0.09	4.02	-1.03	7.6	980
MA1232G	950403 16:26:00	1033	1232		3	1570	37.8	242	152				114		6.4					0.08	3.76		7.5	980
MA1372G	950314 19:37:00	1232	1372		3	1690	27.2	473	139	274	3610		95.6		6.8					0.19	7.64	-1.30	7.7	1100
MA1372G	950403 16:23:00	1232	1372		3	1600	23.5	451	139				95.9		6.4					0.16	6.98		7.6	1080
MA1584G	950314 19:33:00	1372	1584		3	1360	20.1	360	123	193	3030		97.5		6.6					0.10	4.74	-3.75	7.9	940
MA1584G	950403 16:17:00	1372	1584		3	1360	16.9	354	124				96.0		6.3					0.09	4.75		7.8	900
MA1745G	950314 19:14:00	1584	1745		3	1790	4.7	1600	62.5	96.0	5670		132		4.4					1.02	26.4	-1.86	7.6	1600
MA1745G	950403 16:01:00	1584	1745		3	1800	11.9	1600	61.5				132		6.4					1.05	27.4		7.5	1580
MA2178G	950314 19:01:00	2028	2178		3	1460	27.4	352	126	177	3040		99.9		5.6					0.06	1.98	-1.45	7.8	920
MA2178G	950403 15:50:00	2028	2178		3	1400	26.0	336	123				97.9		5.6					0.11	4.54		7.7	920
MA2357G	950314 18:58:00	2178	2357		3	1900	15.2	942	154	150	4940		90.5		5.7					0.46	14.4	-1.51	7.8	1420
MA2357G	950403 15:47:00	2178	2357		3	1820	17.0	890	148				89.0		5.9					0.44	11.6		7.7	1380
MA2496G	950403 15:44:00	2357	2496		3	1910	27.6	1410	86.2				124		5.9					1.37	24.2		7.4	1640
MA2699G	950314 18:35:00	2496	2699		3	2100	5.0	1620	88.5	64.0	6360		134		4.1					0.88	25.7	-2.34	7.6	1740
MA2699G	950403 15:28:00	2496	2699		3	2060	12.2	1580	86.5				133		5.9					0.97	27.0		7.3	1740
MA2840G	950314 18:28:00	2699	2840		3	2390	13.8	2740	61.0	37.0	8710		164		5.6					1.90	37.4	-1.92	7.6	2250
MA2840G	950403 15:21:00	2699	2840		3	2370	16.6	2780	57.6				169		5.3					1.93	47.5			2400

SICADA: GWCHEMISTRY / ANALYSES / WATER / WATER_COMPOSITION

IDCODE	DATE	SECUP (m)	SECLOW (m)	SAMPLE_NO	CLASS_NO	SMPL_FLOW (l/min)	DRILL_WATER (%)	DOC	HS⁻	I	NO2_N (mg/l)	NO3_N (mg/l)	NO2NO3_N (mg/l)	NH4_N (mg/l)
SA2783A	960521 15:00:00	5.80	19.90	2352	4	0.07								0.04
SA2783A	970306 12:37:00	5.80	19.90	2383	4	0.08	0.03	0.30						
SA2783A	971002 13:50:00	5.80	19.90	2452	4	0.06	0.10	0.60						0.04
SA2783A	980304 14:06:00	5.80	19.90	2509	4	0.11	0.01	0.90						0.04
SA2880A	951025 13:18:00	11.92	13.92	2338	4	1.36		0.90						0.05
SA2880A	960422 15:25:00	11.92	13.92	2349	5			0.26						
SA2880A	970306 12:58:00	11.92	13.92	2384	4	1.10	0.05	1.00						
SA2880A	971001 13:47:00	11.92	13.92	2449	4	1.26	0.11	0.20						0.05
SA2880A	980306 09:00:00	11.92	13.92	2505	4	1.30	0.01	1.30						0.06
SA3045A	951025 12:52:00	0.00	20.70	2339	4	2.40		0.70						0.07
SA3045A	970306 13:35:00	0.00	20.70	2386	4	2.10	0.09	0.60						
SA3045A	971001 14:25:00	0.00	20.70	2450	4	3.00	0.06	0.50	0.02					0.04
SA3045A	980306 08:55:00	0.00	20.70	2508	4	12.00	0.02	1.20	-0.01					0.04
TASA	950314 18:21:00	2994	3599		3		0.13							
TASB	950314 19:19:00	0	220		3		0.45							
TASB	950403 16:07:00	0	220		3		0.42							
TASC	950314 18:42:00	220	333		3		0.15							
TASC	950403 15:33:00	220	333		3		0.14							
MA1033G	950314 19:43:00	692	1033		3		0.08							
MA1033G	950403 16:30:00	692	1033		3		0.17							
MA1232G	950314 19:40:00	1033	1232		3		0.10							
MA1232G	950403 16:26:00	1033	1232		3		0.16							
MA1372G	950314 19:37:00	1232	1372		3		0.07							
MA1372G	950403 16:23:00	1232	1372		3		0.16							
MA1584G	950314 19:33:00	1372	1584		3		0.19							
MA1584G	950403 16:17:00	1372	1584		3		0.18							
MA1745G	950314 19:14:00	1584	1745		3		0.11							
MA1745G	950403 16:01:00	1584	1745		3		1.07							
MA2178G	950314 19:01:00	2028	2178		3		0.19							
MA2178G	950403 15:50:00	2028	2178		3		0.27							
MA2357G	950314 18:58:00	2178	2357		3		0.29							
MA2357G	950403 15:47:00	2178	2357		3		0.18							
MA2496G	950403 15:44:00	2357	2496		3		0.18							
MA2699G	950314 18:35:00	2496	2699		3		0.17							
MA2699G	950403 15:28:00	2496	2699		3		0.44							
MA2840G	950314 18:28:00	2699	2840		3		0.19							
MA2840G	950403 15:21:00	2699	2840		3		0.44							

SICADA: GWCHEMISTRY / ANALYSES / WATER / H_O_ISOTOPE

IDCODE	START_DATE	SECUP	SECLOW	SAMPLE_NO	D*	O18*	COMMENT
HBH01	950324 10:23:00	31.00	50.60	2307	-72.70	-9.80	
HBH02	950324 13:30:00	21.00	32.40	2308	-73.90	-9.90	
HBH05	950324 11:00:00	11.00	22.00	2309	-71.90	-9.60	
HD0025A	950109 14:35:00				-60.40	-7.70	
HD0025A	980303 16:00:00			2488	-75.70	-9.50	
KA1061A	980304 14:00:00	0.00	208.50	2489	-58.70	-6.70	
KA1131B	971008 09:00:00	8.00	203.10	2460	-61.50	7.30	
KA1131B	980304 14:00:00	0.00	203.10	2490	-61.50	-7.40	
KA1755A	951012 12:47:00	88.00	160.00	2335	-91.90	-13.10	
KA1755A	960521 12:08:00	88.00	160.00	2359	-92.20	-13.70	
KA1755A	970311 17:04:00	88.00	160.00	2393	-95.30	-13.00	
KA1755A	971001 16:00:00	88.00	160.00	2451	-95.30	-12.80	
KA1755A	980305 15:00:00	88.00	160.00	2501	-94.70	-12.80	
KA2050A	970930 13:45:00	155.00	211.57	2439	-83.20	-10.30	
KA2050A	980306 11:00:00	155.00	211.57	2507	-82.70	-10.40	
KA2162B	970930 17:00:00	201.50	288.10	2446	-76.40	-9.40	
KA2162B	980304 19:00:00	201.50	288.10	2494	-74.30	-9.40	
KA2511A	980305 16:30:00	52.00	54.00	2503	-68.00	-8.30	
KA2511A	980305 16:30:00	92.00	109.00	2502	-60.70	-7.30	
KA2511A	970930 09:00:00	139.00	170.00	2438	-64.10	-7.50	
KA2512A	970311 14:27:00			2391	-62.50	-7.60	
KA2563A	970930 12:00:00	187.00	196.00	2437	-78.00	-9.90	
KA2563A	980305 16:30:00	220.00	224.00	2504	-71.00	-8.80	
KA2858A	950310 12:16:00	39.77	40.77	2298	-96.60	-13.10	
KA2862A	950127 09:15:00	0.00	15.98	2297	-90.80	-12.70	
KA2862A	980312 15:00:00	6.82	6.92	2510	-89.00	-12.50	
KA2862A	950310 11:44:00	15.02	15.98	2299	-91.30	-12.50	
KA3005A	950310 12:33:00	36.93	37.93	2300	-80.50	-10.00	
KA3005A	960315 07:22:00	39.03	43.78		-78.90	-10.10	
KA3005A	960411 07:10:00	44.78	45.78	2344	-75.50	-10.00	
KA3005A	960401 10:20:00	46.78	50.03		-75.20	-9.70	
KA3005A	960321 09:15:00	51.03	58.11		-75.10	-9.70	
KA3010A	950310 12:44:00	8.56	15.06	2302	-87.90	-11.30	
KA3067A	960410 10:55:00	6.55	27.05	2342	-95.20	-13.00	
KA3067A	950310 13:49:00	28.05	29.55	2303	-91.10	-11.70	
KA3105A	950310 13:21:00	22.51	24.51	2304	-73.50	-8.70	
KA3110A	950310 13:31:00	20.05	28.63	2305	-64.30	-9.20	
KA3110A	980306 09:00:00	20.05	28.63	2506	-63.10	-7.70	
KA3385A	950109 14:40:00	0.00	25.14		-78.30	-10.40	
KA3385A	950111 08:05:00	0.00	34.18	2296	-79.30	-10.40	
KA3385A	980302 16:00:00	32.00	34.00	2476	-79.20	-10.10	
KA3385A	950310 13:03:00	32.05	34.18	2306	-81.80	-10.50	
KA3539G	980302 08:00:00	0.00	30.01	2477	-62.50	-7.70	
KA3545G	980302 08:00:00	0.00	8.08	2478	-61.70	-7.70	
KA3573A	980309 10:03:00	18.00	40.00	2511	-61.00	-7.40	
KA3573A	980309 10:03:00	4.50	17.00	2512	-61.40	-7.50	
KA3593G	980302 08:00:00	0.00	30.02	2479	-71.70	-9.00	
KA3600F	980309 10:05:00	22.00	50.10	2513	-62.10	-7.70	
KA3600F	980309 10:05:00	4.50	21.00	2514	-63.00	-7.60	
KAS03	970313 10:35:00	107.00	252.00	2402	-121.70	-15.70	
KAS03	971003 10:00:00	107.00	252.00	2458	-114.40	-14.60	
KAS03	980331 09:15:00	107.00	252.00	2521	-113.70	-14.20	
KAS03	970313 10:30:00	533.00	626.00	2401	-100.80	-13.40	
KAS03	980331 09:05:00	533.00	626.00	2522	-101.00	-13.50	
KAS03	971002 15:00:00	553.00	626.00	2453	-101.40	-13.30	
KAS09	951012 12:35:00	116.00	150.00	2333	-56.70	-7.00	

* delta ^{18}O SMOW (Standard Mean Oceanic Water) and delta D SMOW

SICADA: GWCHEMISTRY / ANALYSES / WATER / H_O_ISOTOPE

IDCODE	START_DATE	SECUP	SECLOW	SAMPLE_NO	D*	O18*	COMMENT
KAS09	970313 08:35:00	116.00	150.00	2403	-57.20	-7.20	
KAS09	971008 13:00:00	116.00	150.00	2459	-58.10	-6.60	
KAS09	980331 10:00:00	116.00	150.00	2520	-57.60	-6.70	
KI0023B	980305 09:40:00	41.45	42.45	2498	-70.00	-8.80	
KI0023B	980305 09:40:00	70.95	71.95	2497	-72.20	-9.20	
KI0023B	980305 09:40:00	84.75	86.20	2496	-87.30	-11.30	
KI0023B	980305 09:40:00	111.25	112.70	2495	-69.00	-8.70	
KI0025F	970929 17:00:00	86.00	88.00	2436	-83.50	-10.50	
KI0025F	980305 09:41:00	86.00	88.00	2500	-77.50	-9.80	
KI0025F	970929 17:00:00	158.00	168.00	2435	-74.50	-9.30	
KI0025F	980305 09:41:00	164.00	168.00	2499	-77.10	-9.60	
KR0012B	950518 11:44:00	5.00	10.57	2314	-68.80	-9.40	
KR0012B	951010 16:16:00	5.00	10.57	2323	-66.70	-9.50	
KR0012B	960521 15:46:00	5.00	10.57	2361	-70.40	-9.90	
KR0012B	970311 18:26:00	5.00	10.57	2396	-73.50	-9.60	
KR0012B	970930 18:00:00	5.00	10.57	2443	-72.30	-9.40	
KR0012B	980303 09:53:00	5.00	10.57	2484	-71.50	-9.50	
KR0013B	950518 10:11:00	7.05	16.94	2315	-69.80	-9.30	
KR0013B	951010 16:04:00	7.05	16.94	2324	-70.60	-9.50	
KR0013B	960522 16:45:00	7.05	16.94	2362			The bottle was broken.
KR0013B	970311 18:24:00	7.05	16.94	2397	-74.80	-9.80	
KR0013B	970930 18:00:00	7.05	16.94	2444	-73.40	-9.60	
KR0013B	980303 09:53:00	7.05	16.94	2481	-73.60	-9.80	
KR0015B	950518 10:01:00	19.82	30.31	2316	-70.80	-9.60	
KR0015B	951010 15:46:00	19.82	30.31	2325	-71.80	-9.70	
KR0015B	960521 15:50:00	19.82	30.31	2363	-72.90	-9.70	
KR0015B	970311 18:22:00	19.82	30.31	2398	-72.90	-9.80	
KR0015B	970930 18:00:00	19.82	30.31	2445	-75.00	-9.60	
KR0015B	980303 09:55:00	19.82	30.31	2482	-73.70	-9.80	
KXTT3	970306 13:05:00	12.42	14.42	2385			The bottle was broken.
KXTT3	971003 08:58:00	12.42	14.42	2457	-86.80	-11.10	
KXTT3	971202 09:00:00	12.42	14.42	2473	-85.60	-11.00	
KXTT3	980304 09:25:00	12.42	14.42	2491	-81.40	-10.30	
SA0813B	950517 16:16:00	5.60	19.70	2311	-53.20	-6.80	
SA0813B	951012 00:00:00	5.60	19.70	2336	-58.90	-7.50	
SA0813B	960521 18:00:00	5.60	19.70	2353	-57.50	-7.30	
SA0813B	970311 18:15:00	5.60	19.70	2399	-62.90	-7.80	
SA0813B	971003 10:00:00	5.60	19.70	2456	-63.20	-7.40	
SA1009B	950517 01:00:00	6.00	19.50	2313	-54.30	-6.70	
SA1009B	951012 00:00:00	6.00	19.50	2334	-57.40	-7.00	
SA1009B	960521 15:56:00	6.00	19.50	2356	-54.50	-7.10	
SA1009B	970311 18:05:00	6.00	19.50	2400	-57.00	-7.10	
SA1009B	971001 12:00:00	6.00	19.50	2447	-58.00	-6.90	
SA1009B	980304 18:00:00	6.00	19.50	2493	-56.90	-6.80	
SA1229A	950518 12:19:00	6.00	20.50	2320	-46.30	-6.50	
SA1229A	951011 16:16:00	6.00	20.50	2329	-54.70	-7.30	
SA1229A	960521 16:00:00	6.00	20.50	2357	-56.30	-7.30	
SA1229A	970311 17:49:00	6.00	20.50	2394	-60.60	-7.40	
SA1229A	980303 10:45:00	6.00	20.50	2483	-56.90	-6.70	
SA1420A	950518 14:53:00	6.00	50.00	2318	-60.30	-7.10	
SA1420A	951011 15:56:00	6.00	50.00	2330	-58.40	-7.30	
SA1420A	960521 16:02:00	6.00	50.00	2358	-58.30	-7.60	
SA1420A	970311 17:39:00	6.00	50.00	2395	-60.90	-7.50	
SA1420A	970930 17:15:00	6.00	50.00	2440	-59.70	-6.70	
SA1420A	980304 15:00:00	6.00	50.00	2492	-58.60	-6.80	
SA1730A	950518 15:18:00	5.60	20.00	2319	-90.20	-12.00	

* delta ^{18}O SMOW (Standard Mean Oceanic Water) and delta D SMOW

SICADA: GWCHEMISTRY / ANALYSES / WATER / H_O_ISOTOPE

IDCODE	START_DATE	SECUP	SECLOW	SAMPLE_NO	D*	O18*	COMMENT
SA1730A	951011 15:13:00	5.60	20.00	2331	-88.80	-12.10	
SA1730A	960521 15:25:00	5.60	20.00	2354	-87.10	-11.90	
SA1730A	970311 16:37:00	5.60	20.00	2392	-90.00	-12.10	
SA1730A	971002 14:00:00	5.60	20.00	2454	-90.90	-12.20	
SA1730A	980303 13:45:00	5.60	20.00	2486	-89.30	-11.90	
SA2074A	950518 01:00:00	6.00	38.70	2317	-66.30	-8.70	
SA2074A	951011 15:21:00	6.00	38.70	2332	-65.10	-8.40	
SA2074A	960521 12:06:00	6.00	38.70	2360	-66.00	-8.20	
SA2074A	970310 17:01:00	6.00	38.70	2388	-69.80	-8.70	
SA2074A	970930 15:00:00	6.00	38.70	2442	-69.60	-8.40	
SA2074A	980303 16:00:00	6.00	38.70	2487	-66.60	-8.50	
SA2273A	950518 17:33:00	5.80	20.00	2321	-64.00	-7.80	
SA2273A	951011 11:36:00	5.80	20.00	2326	-62.80	-8.10	
SA2273A	960521 14:41:00	5.80	20.00	2355	-63.20	-8.20	
SA2273A	970310 16:38:00	5.80	20.00	2389	-65.70	-8.20	
SA2273A	971002 14:00:00	5.80	20.00	2455	-66.70	-8.00	
SA2273A	980302 17:45:00	5.80	20.00	2480	-65.10	-8.10	
SA2600A	950517 14:57:00	5.80	19.40	2312	-70.40	-9.40	
SA2600A	951011 11:07:00	5.80	19.40	2327	-75.50	-9.80	
SA2600A	960521 11:54:00	5.80	19.40	2351	-74.00	-9.50	
SA2600A	970310 16:01:00	5.80	19.40	2390	-74.50	-9.50	
SA2600A	971001 08:00:00	5.80	19.40	2448	-74.00	-9.30	
SA2600A	980302 15:00:00	5.80	19.40	2475	-75.10	-9.60	
SA2783A	950523 01:00:00	5.80	19.90	2322	-88.60	-12.00	
SA2783A	951025 14:58:00	5.80	19.90	2337	-90.00	-12.50	
SA2783A	960520 14:29:00	5.80	19.90	2352	-88.50	-12.50	
SA2783A	970306 10:35:00	5.80	19.90	2383			The bottle was broken.
SA2783A	971002 07:00:00	5.80	19.90	2452	-91.00	-12.30	
SA2783A	980304 14:06:00	5.80	19.90	2509	-89.10	-12.40	
SA2880A	951025 13:18:00	11.92	13.92	2338	-84.50	-12.10	
SA2880A	960412 16:36:00	11.92	13.92	2349	-87.70	-12.30	
SA2880A	970306 12:46:00	11.92	13.92	2384	-90.20	-12.20	
SA2880A	971001 13:00:00	11.92	13.92	2449	-88.70	-12.10	
SA2880A	980306 09:00:00	11.92	13.92	2505	-82.60	-11.70	
SA3045A	951025 12:52:00	0.00	20.7	2339	-90.50	-11.90	
SA3045A	970306 13:25:00	0.00	20.7	2386	-98.20	-13.00	
SA3045A	971001 14:00:00	0.00	20.7	2450	-93.80	-12.50	
SA3045A	980306 08:55:00	0.00	20.7	2508	-95.10	-12.70	

* delta ^{18}O SMOW (Standard Mean Oceanic Water) and delta D SMOW

TABLE A3 - 3. TRACE METALS (ug/l) APPENDIX 3

SICADA: GWCHEMISTRY / ANALYSES / WATER / TRACE_METALS

IDCODE	START_DATE	SECUP	SECLOW	SAMPLE_NO	LAB_ID	U	TH	SC	RB	Y	ZR	IN	SB	CS	BA	LA	HF	TL	CE	PR	ND	SM	EU
KAS03	970313 10:30:00	533.00	626.00	2401	27	0.086	0.003		26.3	0.334		0.011		2.04	97.8	0.666		0.003	0.855	0.080	0.286	0.029	0.010
KAS03	970313 10:35:00	107.00	252.00	2402	27	0.259	<0.001		9.2	0.064		0.005		2.38	990	0.050		0.001	0.049	0.005	0.019	0.004	0.048
KXTT3	960410 12:08:00	12.42	14.42	2343		0.659	0.070	0.023	41.0	0.427	<40	0.079	0.157	3.76	57.0	0.357	<0.13	<0.02	0.379	0.048	0.428	0.071	<0.05
KXTT3	970702 10:05:00	12.42	14.42	2404	27	0.264	<0.005	0.648	43.6	0.471				4.39	58.1	0.357		<0.005	0.352	0.034	0.169	0.010	<0.005
KXTT3	971003 08:58:00	12.42	14.42	2457	27	0.178	0.033	0.440	44.3	0.403				3.39	60.0	0.340		<0.001	0.312	0.028	0.102	0.012	0.001
KXTT3	971202 09:00:00	12.42	14.42	2473	27	0.233	0.027	0.350	43.3	0.400				3.68	66.7	0.324			0.282	0.028	0.113	0.013	0.012
SA1009B	970311 18:05:00	6.00	19.50	2400	27	0.510									135								
SA1229A	970311 17:49:00	6.00	20.50	2394	27	1.360									309								

Values below
the detection limit (DL) are represented
by the "<DL value" notation.

SICADA: GWCHEMISTRY / ANALYSES / WATER / TRACE_METALS

IDCODE	START_DATE	SECUP	SECLOW	SAMPLE_NO	LAB_ID	GD	TB	DY	HO	ER	TM	YB	LU
KAS03	970313 10:30:00	533.00	626.00	2401	27	0.032	0.003	0.016	0.003	0.009	0.001	0.019	0.002
KAS03	970313 10:35:00	107.00	252.00	2402	27	0.007	0.001	0.001	0.000	0.001	0.001	0.062	0.004
KXTT3	960410 12:08:00	12.42	14.42	2343		0.134	0.012	0.068	0.109	0.047	<0.014	0.118	0.013
KXTT3	970702 10:05:00	12.42	14.42	2404	27	0.010	<0.005	0.009	<0.005	0.007	<0.005	<0.005	
KXTT3	971003 08:58:00	12.42	14.42	2457	27	0.026	0.002	0.009	0.003	0.007	0.001	0.005	
KXTT3	971202 09:00:00	12.42	14.42	2473	27	0.026	0.002	0.011	0.003	0.008	0.001	0.008	0.002
SA1009B	970311 18:05:00	6.00	19.50	2400	27								
SA1229A	970311 17:49:00	6.00	20.50	2394	27								

Values below
the detection limit (DL) are represented
by the "<DL value" notation.

SICADA: GWCHEMISTRY / ANALYSES / WATER / C_S_ISOTOPE
SICADA: GWCHEMISTRY / ANALYSES / WATER / U_TH_ISOTOPE
SICADA: GWCHEMISTRY / ANALYSES / WATER / RA_RN_ISOTOPE

IDCODE	START_DATE	SECUP	SECLOW	SAMPLE_NO	PMC*	C13**	AGE_BP (years)	U-238 (Bq/l)	U-235 (Bq/l)	U-234 (Bq/l)	TH-232 (Bq/l)	TH-230 (Bq/l)	TH-228 (Bq/l)	RA-226 (Bq/l)	RA-228 (Bq/l)	RN-222 (Bq/l)
KA2862A	980312 15:00:00	7.37	15.98	2510				0.21	0.213	0.72	<0.98	<0.98	410	0.972	2.78	379
HBH01	950324 10:23:00	31.00	50.60	2307	86.00	-16.7	1210	79.2	3.87	150	<0.44		59.3			
HBH02	950324 13:30:00	21.00	32.40	2308	66.20	-14.9	3365	64.6	2.58	102	1.51	16.4	167			
KAS09	951012 12:35:00	116.00	150.00	2333				17.2	1.04	63.7	<4.2		49.6			
KR0012B	950518 11:44:00	5.00	10.57	2314		-14.7	1140									
KR0012B	951010 16:16:00	5.00	10.57	2323	84.70	-14.8	1290									
KR0012B	960521 15:46:00	5.00	10.57	2361	85.27	-15.3	1235									
KR0012B	961217 09:29:00	5.00	10.57	2370	81.49	-15.3	1600									
KR0012B	970311 18:26:00	5.00	10.57	2396	83.07	-15.7	1445									
KR0012B	971015 07:54:00	5.00	10.57	2461	84.10	-15.0	1340									
KR0012B	980304 09:53:00	5.00	10.57	2484	83.40	-16.2	1410									
KR0013B	950518 10:11:00	7.05	16.94	2315	86.30	-13.0	1175									
KR0013B	951010 16:04:00	7.05	16.94	2324	81.60	-13.1	1585									
KR0013B	960522 16:45:00	7.05	16.94	2362	84.74	-14.5	1285									
KR0013B	961217 09:20:00	7.05	16.94	2371	85.22	-14.8	1240									
KR0013B	970311 18:24:00	7.05	16.94	2397	83.49	-14.6	1405									
KR0013B	971015 09:30:00	7.05	16.94	2462	85.20	-13.7	1245									
KR0013B	980304 09:55:00	7.05	16.94	2481	85.90	-14.6	1175									
KR0015B	950518 10:01:00	19.82	30.31	2316	97.00	-13.6	205									
KR0015B	951010 15:46:00	19.82	30.31	2325	92.10	-12.9	620									
KR0015B	960521 15:50:00	19.82	30.31	2363	89.91	-13.7	810									
KR0015B	961217 09:25:00	19.82	30.31	2372	93.15	-13.9	525									
KR0015B	970311 18:22:00	19.82	30.31	2398	89.63	-17.8	835									
KR0015B	971015 07:53:00	19.82	30.31	2463	88.00	-13.0	980									
KR0015B	980304 09:53:00	19.82	30.31	2482	91.80	-13.1	645									
KXTT3	960410 12:08:00	12.42	14.42	2343	57.40	-10.0	4420	7.94		31.8			68.0	0.67	1.17	333
KXTT3	960411 08:01:00	8.92	11.42	2346				6.61		28.6			62.6	0.61	1.06	463
KXTT3	971003 08:58:00	12.42	14.42	2457				2.53		11.0	<0.17	<0.21	49.4	0.90	1.60	331
KXTT3	971202 09:00:00	12.42	14.42	2473				3.02		12.4	<0.46	<0.46	25.8	1.02	1.77	321
KXTT3	980304 09:25:00	12.42	14.42	2491				6.91		27.8	<0.59	<0.59	180.0	0.76	1.43	340
SA1009B	970311 18:05:00	6.00	19.50	2400				8.32	0.37	34.4			44.9			
SA1229A	970311 17:49:00	6.00	20.50	2394				22.9	1.07	101			32.1			

* Percent Modern Carbon
** Delta C-13 per mille PDB (PeeDee Belemnite, a standard)

Explanation to parameter names APPENDIX 4

The following parameter names are used in the tables in the database SICADA. The columns and descriptions are listed table by table.

activity_history:

Activity history table

Column	Description
Site	Site
activity_type	Activity type
start_date	Date (yymmdd hh:mm:ss)
stop_date	Date (yymmdd hh:mm:ss)
Project	Project code
Idcode	Object or borehole identification code
secup (m)	Upper section limit (m)
seclow (m)	Lower section limit (m)
section_no (number)	Section number
error_flag	Flag
in_use	Flag
Sign	Signature for QA data acknowledge (QA - OK)
sample_no	Sample number
lab_id (number)	Laboratory identification number

water_composition:

Water composition, data table

Column	Description
na (mg/l)	Sodium
k (mg/l)	Potassium
ca (mg/l)	Calcium
mg (mg/l)	Magnesium
hco3 (mg/l)	Hydrogen carbonate (alkalinity titration)
cl (mg/l)	Chloride
so4 (mg/l)	Sulphate
so4_s (mg/l)	Sulphate as Sulphur (total Sulphur by ICP)
br (mg/l)	Bromide
f (mg/l)	Fluoride
si (mg/l)	Silicon
fe (mg/l)	Iron (total Iron by ICP)
fetot (mg/l)	Total Iron (spectrophotometric method)
feii (mg/l)	Ferrous Iron (spectrophotometric method)
mn (mg/l)	Manganese
li (mg/l)	Lithium
sr (mg/l)	Strontium
ph (pH unit)	pH
cond (mS/m)	Electric conductivity
smpl_flow (l/min)	Water flow rate at the sampling occasion
drill_water (%)	Drilling water residue
toc (mg/l)	Total Organic Carbon
doc (mg/l)	Dissolved Organic Carbon
s2 (mg/l)	Hydrogen Sulphide as total Sulphide
i (mg/l)	Iodide
no2_n (mg/l)	Nitrite as Nitrogen
no3_n (mg/l)	Nitrate as Nitrogen
no2no3_n (mg/l)	Nitrite + Nitrate as Nitrogen
nh4_n (mg/l)	Ammonium as Nitrogen
po4_p (mg/l)	Phosphate as Phosphorus

h_o_isotope:

Hydrogen and Oxygen isotopes, data table

Column	Description
d (dev SMOW)	Deuterium, deviation from SMOW(Standard Mean Oceanic Water)
tr (TU)	Tritium (in Tritium units), 1 Bq/l Tritium = 8.45 TU (Tritium units)
o18 (dev SMOW)	Oxygen-18, deviation from SMOW (Standard Mean Oceanic Water)

c_s_isotope:

Carbon and Sulphur isotopes, data table

Column	Description
pmc (pmc)	Carbon-14 or PMC (% Modern Carbon)
c13 (per mill)	Delta C-13 per mille PDB (the standard PeeDee Belemnite)
age_bp (year)	Groundwater age
age_bp_corr (year)	Groundwater age corrected for C-13
s34 (dev SMOW)	S-34, deviation from SMOW (Standard Mean Oceanic Water)

trace_elements:

Trace elements, data table

Column	Description
u (ug/l)	Uranium
th (ug/l)	Thorium
al (ug/l)	Aluminum
sc (ug/l)	Scandium
cr (ug/l)	Chromium
co (ug/l)	Cobalt
ni (ug/l)	Nickel
zn (ug/l)	Zinc
rb (ug/l)	Rubidium
y (ug/l)	Yttrium
zr (ug/l)	Zirconium
mo (ug/l)	Molybdenum
indium (ug/l)	Indium
sb (ug/l)	Antimony
cs (ug/l)	Cesium
ba (ug/l)	Barium
la (ug/l)	Lanthanum
hf (ug/l)	Hafnium
tl (ug/l)	Thallium
ce (ug/l)	Cerium
pr (ug/l)	Praseodymium
nd (ug/l)	Neodymium
sm (ug/l)	Samarium
eu (ug/l)	Europium
gd (ug/l)	Gadolinium
tb (ug/l)	Terbium
dy (ug/l)	Dysprosium
ho (ug/l)	Holmium
er (ug/l)	Erbium
tm (ug/l)	Thullium
yb (ug/l)	Ytterbium
lu (ug/l)	Lutetium

u_th_isotope:

Uranium and Thorium isotopes, data table

Column	Description
u238 (mBq/kg)	Uranium-238
u235 (mBq/kg)	Uranium-235
u234 (mBq/kg)	Uranium-234
th232 (mBq/kg)	Thorium-232
th230 (mBq/kg)	Thorium-230
th228 (mBq/kg)	Thorium-228

ra_rn_isotope:

Radium and Radon isotopes, data table

Column	Description
lab_id (number)	Laboratory identification number
ra226 (Bq/l)	Radium-226
ra226dev (Bq/l)	Uncertainty given as +- ra226dev = +- 1 standard dev. in the measurement. A measure of the instrumental spread.
ra228 (Bq/l)	Radium-228
ra228dev (Bq/l)	given as +- ra228dev = +- 1 standard dev. in the measurement. A measure of the instrumental spread.
rn222 (Bq/l)	Radon-222
rndev (Bq/l)	Uncertainty given as +- rndev = +- 1 standard dev. in themeasurement. A measure of the instrumental spread