

## **Forsmark site investigation**

### **Sampling and analyses of groundwater in percussion drilled boreholes and shallow monitoring wells at drillsite DS1**

**Results from the percussion boreholes  
HFM01, HFM02, HFM03, KFM01A  
(borehole section 0–100 m) and the  
monitoring wells SFM0001, SFM0002  
and SFM0003**

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March 2003

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*Keywords:* groundwater, early water sampling after drilling, chemical analyses, isotope determinations, AP PF 400-02-19, AP PF 400-02-23, Field notes No. 14, 34, 44.

This report concerns a study which was conducted for SKB. The conclusions and viewpoints presented in the report are those of the author and do not necessarily coincide with those of the client.

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# Contents

1	Introduction	5
1.1	Percussion boreholes	5
1.2	Monitoring wells	7
2	Objective and scope	9
2.1	Groundwater sampling in percussion boreholes	9
2.2	Groundwater sampling in monitoring wells	9
3	Equipment	11
3.1	Sampling equipment used in percussion boreholes	11
3.2	Sampling equipment used in monitoring wells	12
4	Performance	13
4.1	Performance of sampling and measurements	13
4.2	Sample treatment and chemical analyses	14
4.3	Data handling	15
5	Results	17
5.1	Analysis results from HFM01,HFM02, HFM03 and KFM01A	17
5.2	Analysis results from SFM0001, SFM0002 and SFM0003	17
5.3	Quality of the analyses	17
6	Future work	21
6.1	Percussion boreholes	21
6.2	Monitoring wells	21
7	References	22
	Appendix 1 Designs of boreholes and monitoring wells	23
	Appendix 2 Sampling and analysis methods	31
	Appendix 3 Water composition, compilation of basic water analysis data	39
	Appendix 4 Isotopes I, compilation of H-, O-, B-, S-, Cl- and C-isotopes and isotope ratios	41
	Appendix 5 Trace elements, compilation of trace metals	43
	Appendix 6 “Biochemistry related” components	45
	Appendix 7 Isotopes II, compilation of U-, Th-, Ra- and Rn isotope data	47

# 1 Introduction

This document reports performance of and results from two activities: “Sampling of percussion boreholes after drilling” and “Sampling of water in monitoring wells”, performed within the site investigation at Forsmark /1/. The work was conducted according to the activity plans AP PF 400-02-19 and AP PF 400-02-23 (SKB internal controlling documents). The report presents groundwater-chemical data from:

- 1) percussion drilled boreholes in hard rock at drillsite DS1 /2/, below referred to as “percussion boreholes”, including section 0–100 m of the telescopic drilled borehole KFM01A /3/,
- 2) monitoring wells drilled in the soil layer at drillsite DS1 /4/, below referred to as “monitoring wells”. Observe that, in this report, “soil” is used synonymously to overburden, i.e. all material covering the bedrock.

The data were obtained during the period May 2002 – February 2003.

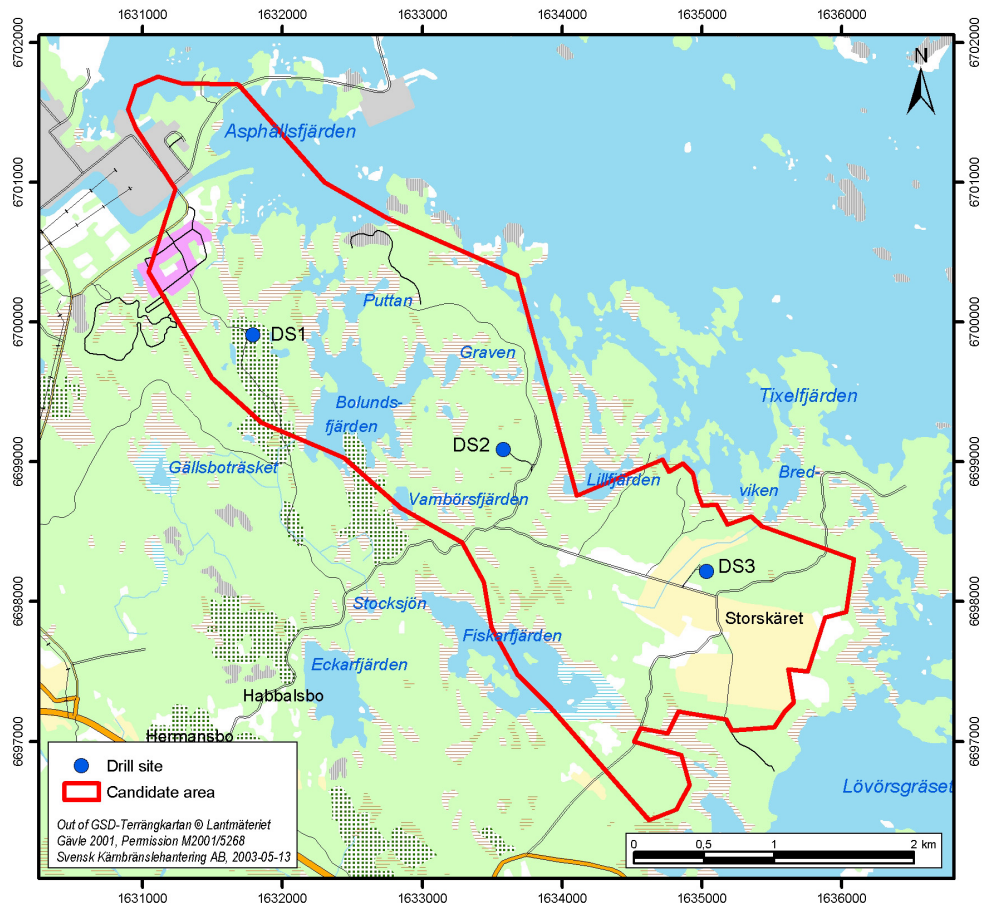
## 1.1 Percussion boreholes

Borehole KFM01A is the first deep (1001.5 m) telescopic borehole drilled at the site investigations in the Forsmark area. The location of the borehole is shown in Figure 1-1. The borehole section 0–100 m is percussion drilled, and today cased with a stainless steel casing with the internal diameter 200 mm, whereas section 100–1001.5 m is core drilled with a diameter of c 76 mm.

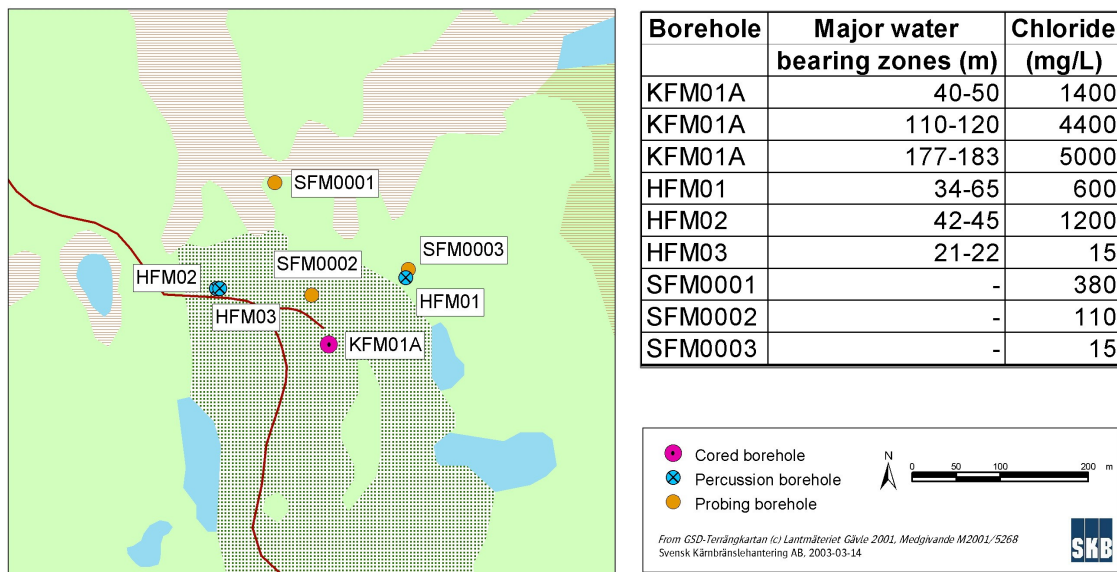
The percussion boreholes HFM01, HFM02 and HFM03 as well as the monitoring wells SFM0001, SFM0002 and SFM0003 were drilled at relatively short distances from the telescopic borehole KFM01A, see Figure 1-2. The first percussion borehole, HFM01 was drilled with the primary purpose to serve as a supply well for the flushing water needed for drilling the core drilled part of borehole KFM01A. Borehole HFM01 is like the telescopic borehole KFM01A of the so called SKB chemical type, see method descriptions MD 620.003 (Method description for drilling cored boreholes) and 610.003 (Method description for percussion drilling). A borehole being of SKB chemical type entails cleaning procedures of all in-hole equipment to be used in the borehole during and after drilling according to level 2 in the cleaning instructions in MD 600.004 (Instruktion för rengöring av borrhålsutrustning och viss markbaserad utrustning).

Boreholes HFM02 and HFM03 were drilled primarily as monitoring wells for groundwater levelling in the shallow part of the bedrock. However, also for these boreholes, cleaning according to level 2 in MD 600.004 was applied in order to let these boreholes serve as reserve flushing water wells.

Basic borehole information is given in Table 1-1 below. The designs of the boreholes are presented in Appendix 1. A map showing the locations of the boreholes at drillsite DS1, depth of dominating water bearing fracture zones and chloride concentrations is presented in Figure 1-2.



**Figure 1-1.** The investigation area at Forsmark (approximately the area inside the black square) including the candidate area selected for more detailed investigations. Drillsites DS1–3 are marked with blue circles.



**Figure 1-2.** Locations of percussion boreholes and monitoring wells in connection with the telescopic borehole KFM01A at drillsite DS1, water bearing zones and typical chloride concentrations.

**Table 1-1. Borehole information, percussion boreholes at drillsite DS1.**

Borehole	Date of completion	Length (m)	Water bearing sections (length along borehole, m)	Comment
HFM01	2002-05-03	200.2	34.5–43 48– 0 60.5–63.5 64–64.5	Source of flushing water for core drilling of KFM01A
HFM02	2002-05-21	100.1	42–44.5	
HFM03	2002-05-28	26.1	21–21.5	
KFM01A	2002-06-10	Borehole section 0–100	40–50	Later on a casing was installed and gap grouted, sealing off water inflow in this part of the borehole

Sampling of KFM01A, HFM01, HFM02 and HFM03 was accomplished a short time after drilling, in connection with pumping tests and flow logging carried out within the programme for hydrogeological investigations /5/. The pumping test and water sampling in the percussion drilled part (section 0–100 m) of the telescopic borehole KFM01A was performed after the first drilling step, when the borehole diameter was approximately 165 mm. Unfortunately, an instability in the borehole wall, prevented logging and sampling below 50 m. Boreholes HFM01, HFM02 and HFM03, which all have a diameter of 140 mm or a few millimetres less, were pumped, flow logged and sampled at the same campaign with a time separation between the individual boreholes of, at most, a few weeks, see Table 4-1. No other borehole tests were carried out prior to the hydrotest/water sampling campaign in HFM01 and HFM03. This was not the case in HFM02 where geophysical logging, BIPS-logging and radar logging were performed before the water sampling.

## 1.2 Monitoring wells

The designs of the monitoring wells are shown in Appendix 1. A map showing the locations of the wells at drillsite DS1 is presented in Figure 1-2.

The first sampling of groundwater in the monitoring wells SFM0001, SFM0002 and SFM0003 was performed a short time after installation of the well equipment (screen, riser pipes, sand filter and bentonite sealings, see Appendix 1) and after conditioning of the wells (pumping to renew the water volume in the borehole and to obtain clean groundwater representative for the soil formation). The monitoring wells were hydraulically characterized by slug testing, although performed after the groundwater sampling /6/.

After the first sampling campaign, sampling has been repeated twice until March 2003. Starting in May 2003, groundwater sampling in the monitoring wells will be part of a long-term sampling programme, in which sampling will be performed four times a year, see also Chapter 6.

The sampling and analyses are performed according to surface water sampling class 5.

Basic borehole information is given in Table 1-2.

**Table 1-2. Borehole information, monitoring wells at drillsite DS1.**

<b>Monitoring well</b>	<b>Date of completion</b>	<b>Length (m)</b>	<b>Comment</b>
SFM0001	2002-05-23	5.5	HDPE-pipes not acid leached.
SFM0002	2002-05-30	5.75	Well subjected to environmental control. Problems with clay suspension in the water. Acid washed HDPE-pipes.
SFM0003	2002-05-30	11.00	Acid leached HDPE-pipes.

## 2 Objective and scope

### 2.1 Groundwater sampling in percussion boreholes

Sampling and analysis of groundwater from boreholes HFM01, HFM02, HFM03 and KFM01A (0–50 m) was performed in order to:

- Check the suitability of HFM01 to serve as a supply well for the flushing water needed for drilling the cored part of the telescopic borehole KFM01A. Pumping capacity and water quality are critical parameters when assessing the suitability of a potential flushing water well.
- Gain data on the groundwater composition of so called “first strike” groundwater, i.e. groundwater sampled before the impact of short circuiting between fractures of different hydrogeochemical character has become significant.
- Obtain groundwater-chemical data from the shallow part of the bedrock (to approximately 200 m depth) at drillsite DS1.

Of primary interest in this activity was to investigate if the groundwater in borehole HFM01 was of sufficient quality to be used as flushing water for drilling the cored part of telescopic borehole KFM01A. Core drilling of a 1000 m long borehole will consume 1000 m<sup>3</sup> or more flushing water. As borehole KFM01A is of SKB chemistry type, the content of organic components in the flushing water should be low, preferably below 5 mg/L. The reason is that introduction of hydrocarbons may affect the microbiological flora in the borehole, which would obstruct a reliable characterization of the in situ microbiological conditions.

Sampling and analysis was performed according to the SKB class 3 procedure /1/.

### 2.2 Groundwater sampling in monitoring wells

Sampling and analyses of groundwater in the monitoring wells were performed in order to:

- Study possible changes in groundwater-chemical composition due to drilling of KFM01A. The drilling may also result in groundwater level fluctuations in the near-surrounding of the telescopic borehole.
- Control possible groundwater contamination (especially in the near-situated well SFM0002) due to unintentional spillage of oil products during the drilling activities in KFM01A. SFM0002 is included in the environmental control programme for drillsite DS1.
- Obtain data that can enhance the understanding of processes at the interface between the geosphere and the near-surface ecosystem.



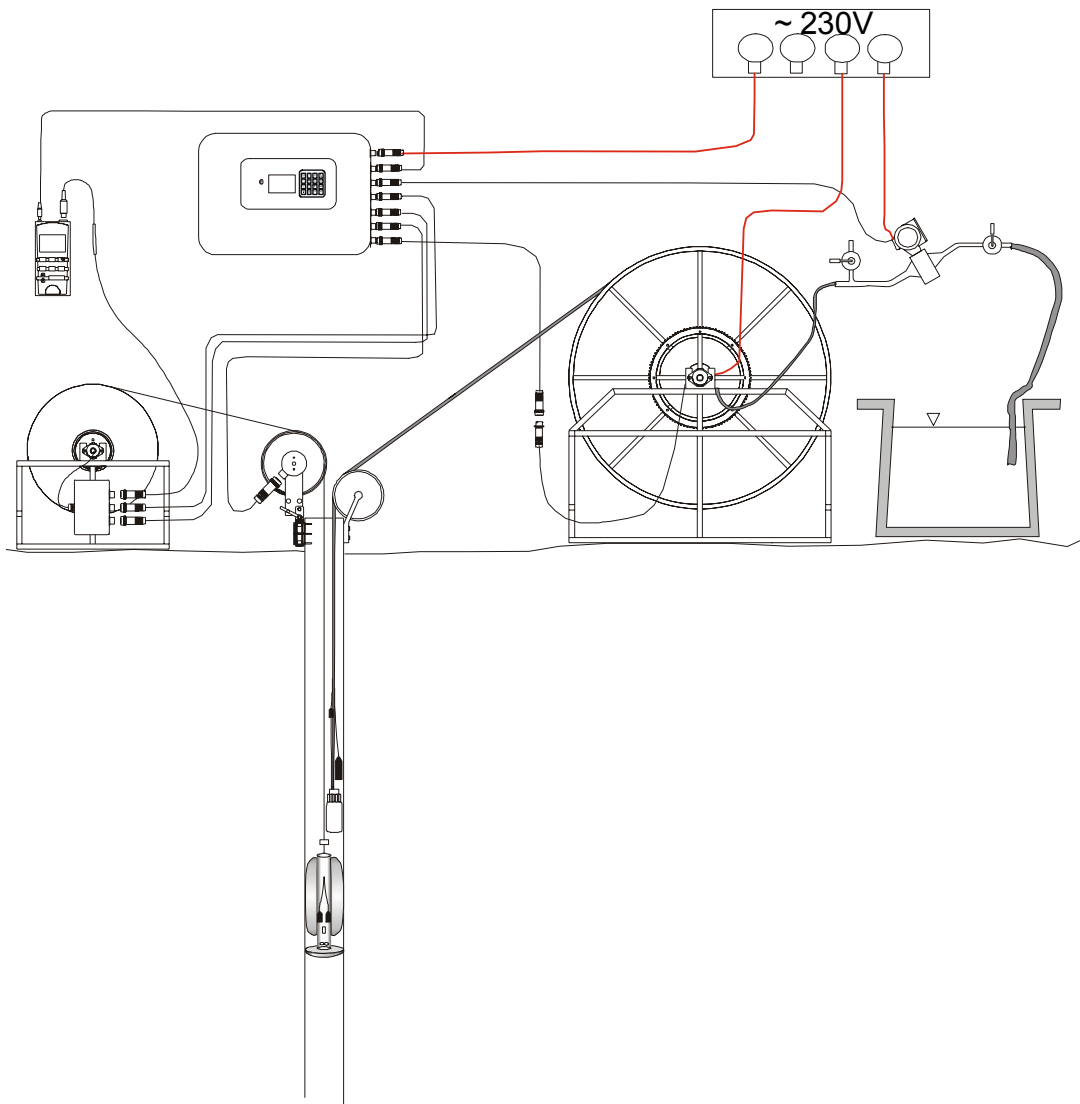
The monitoring wells at drillsite DS1 were sampled at three occasions during the period covered by this report (May 2002 – February 2003). In the future, sampling will be repeated with a frequency of four times per year in order to estimate the size of the natural variations of the groundwater-chemical composition in the soil aquifer. It is not the purpose to study the size and nature of seasonal variations. This would require a much more frequent sampling programme.

Sampling and analysis of groundwater from monitoring wells in soil are performed according to SKB surface water sampling class 5.

## 3 Equipment

### 3.1 Sampling equipment used in percussion boreholes

The sampling in boreholes HFM01, HFM02, HFM03 and KFM01A (section 0–50 m) was performed in connection with hydraulic tests with the HTHB (HydroTester för HammarBorrhål) pump & packer equipment described in SKB MD 326.001 (Mätsystembeskrivning för hydrotestutrustning för hammarborrhål – HTHB). The equipment allows pumping from packed off sections in boreholes of diameter 165 mm and 140 mm ( $\pm$  a few millimetres) using a single- or double packer system. The in-hole equipment includes a packer system, a measurement tube, an enclosed pump, and a combined pressure sensor and data logger. An overview of the HTHB equipment is given in Figure 3-1 below.

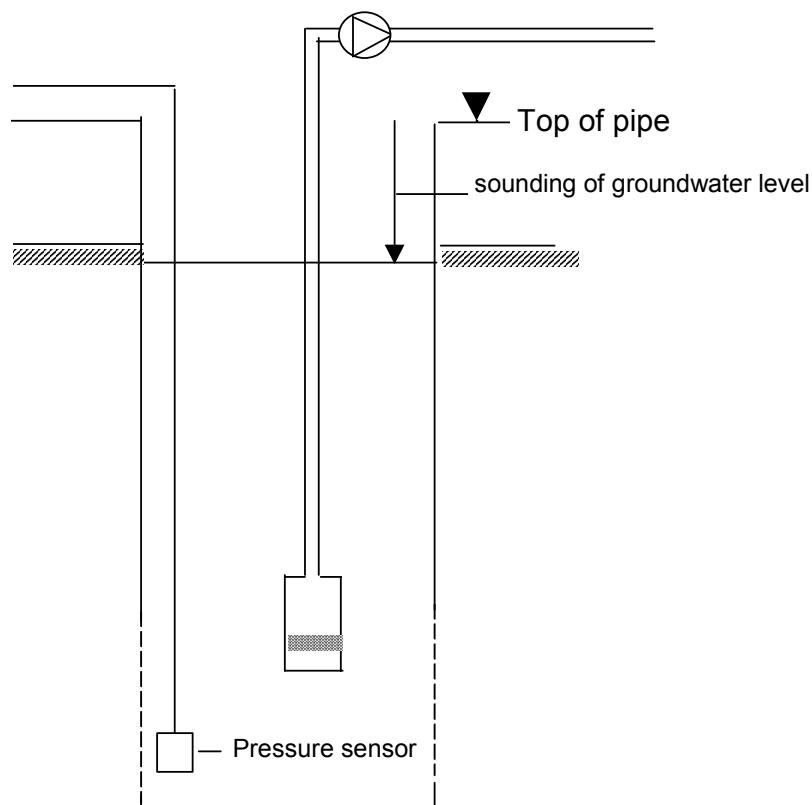


**Figure 3-1.** The HTHB (HydroTester för HammarBorrhål) equipment, configured for pumping at “open hole” conditions in combination with flow logging.

### 3.2 Sampling equipment used in monitoring wells

Sampling of “near-surface” groundwater in monitoring wells was performed using the equipment described below:

- A Grundfors MP1 pump, (diameter = 48mm) enclosed in a cover of acid proof stainless steel, stainless steel quick couplings, and PEH-tubings of dimension 10/8 mm.
- A simple flow through measurement cell made of a 10 L plastic bucket with a lid, a pH-meter, and an electric conductivity meter. No oxygen meter was used in the cell.



**Figure 3-2.** Installation of sampling equipment in monitoring well, pump and pressure sensor.

## 4 Performance

### 4.1 Performance of sampling and measurements

Sampling of the percussion boreholes at drillsite DS1 was performed according to activity plan AP PF 400-02-19 (SKB internal controlling document) following the method described in SKB MD 423.002 (Metodbeskrivning för vattenprovtagning i hammarborrhål efter borrning).

The sampling was carried out in the following order: HFM01, KFM01A, HFM03, and finally HFM02. Generally, pumping was performed during 10 hours, and samples were collected twice during the pumping period. In borehole HFM01, besides the open hole pumping, short pumping tests were performed above and below a single-packer. Samples were collected from both borehole sections as well as from the entire, open borehole. Further, one sample was collected when the pumping of flushing water for core drilling of KFM01A started in June. The pumping times and sampling occasions during the pumping tests are given in Table 4-1.

Sampling and analyses were performed according to SKB class 3, and isotope determinations were performed in the last sample collected for each borehole and sampling occasion. Total organic carbon (TOC) was determined in samples from HFM01 to investigate its suitability as a source for flushing water. The components iron, manganese, hydrogen-sulphide and iodide are not included in class 3 and therefore not determined.

**Table 4-1. Pumping times and sampling occasions in percussion boreholes at drillsite DS1.**

Borehole	Section	Pump start	Pump stop	Sampl. Time	Comments
HFM01	0 – 200.2	020507 17:11	020507 19:36	020507 19:31	Sampling & analyses class 3
HFM01	0 – 200.2	020514 08:13	020514 18:28	020514 08:45 020514 11:58 020514 18:19	Sampling & analyses class 3
HFM01	7 – 200.2	020516 09:46	020516 10:17	020516 11:40	The sample consisted of remaining water in the lifted equipment. Sampling & analyses class 3
HFM01	0 – 71	020516 16:24	020516 17:31	020516 17:24	Sampling & analyses class 3
HFM01	0 – 200.2	–	–	020625	Flushing water sample collected during drilling of KFM01A
KFM01A	0 – 100.4	020524 19:10	020525 15:57	020525 15:55	Sampling & analyses class 3
HFM03	0 – 26	020529 12:18	020529 17:30	020529 12:35	Sampling & analyses class 3
HFM03	0 – 26	020529 12:18	020529 17:30	020529 17:35	Sampling & analyses class 3
HFM02	0 – 100.1	020604 12:27	020604 22:18	020604 13:34	Sampling & analyses class 3
HFM02	0 – 100.1	020604 12:27	020604 22:18	020604 21:45	Sampling & analyses class 3

Sampling of the monitoring wells at drillsite DS1 was performed according to Activity Plan AP PF 400-02-24 (SKB internal controlling document). The wells were sampled three times. The water volume in the pipe was renewed three times before a water sample was collected. Measurements in the flow through cell were performed during pumping.

**Table 4-2. Pumping times and sampling occasions in monitoring wells at drillsite DS1.**

<b>Borehole</b>	<b>Pump start</b>	<b>Pump stop</b>	<b>Sampl. Time</b>	<b>Comments</b>
SFM0001	020718 9:41	020718 11:00	020718 11:00	Sampling & analyses class 5 incl. surface water options
SFM0001	–	–	020920 10:30	Sampling & analyses class 5 incl. surface water options
SFM0001	–	–	021212 11:15	Sampling & analyses class 5 incl. surface water options
SFM0002	020718 9:41	020718 10:15	020718 10:00	Filtering problem, clay suspension. Long recovery period after pumping. Sampling & analyses class 5 incl. surface water options
SFM0002	–	–	020920 14:45	Filtering problem, clay suspension. Long recovery period after pumping. Sampling & analyses class 5 incl. surface water options
SFM0002	–	–	021212 13:50	Filtering problem, clay suspension. Long recovery period after pumping. Sampling & analyses class 5 incl. surface water options
SFM0003	020718 11:00	020718 13:00	020718 13:00	Sampling & analyses class 5 incl. surface water options
SFM0003	–	–	020920 10:30	Sampling & analyses class 5 incl. surface water options
SFM0003	–	–	021212 11:15	Sampling & analyses class 5 incl. surface water options

## **4.2 Sample treatment and chemical analyses**

An overview of sample treatment and analysis routines is given in Appendix 2. The routines are applicable independent of sampling method or sampling object.

### 4.3 Data handling

The field measurement data were manually registered directly in the SICADA table “hydrogeol\_field\_measurement” as soon as possible after performance of the field work.

The following routines for quality control and data management are generally applied for hydrogeochemical analysis data, independent of sampling method or sampling object.

Several components are determined by more than one method and/or laboratory. Moreover, control analyses by an independent laboratory are performed as a standard procedure on each fifth or tenth collected sample.

All analytical results were stored in the SICADA database. The applied hierarchy path “Hydrochemistry/Hydrochemical investigation/Analyses/Water in the database” contains two types of tables, raw data tables and primary data tables (final data tables).

Data on basic water analyses are inserted into raw data tables for further evaluation. The evaluation results in a final reduced data set for each sample. These data sets are compiled in a primary data table named “water\_composition”. The evaluation is based on:

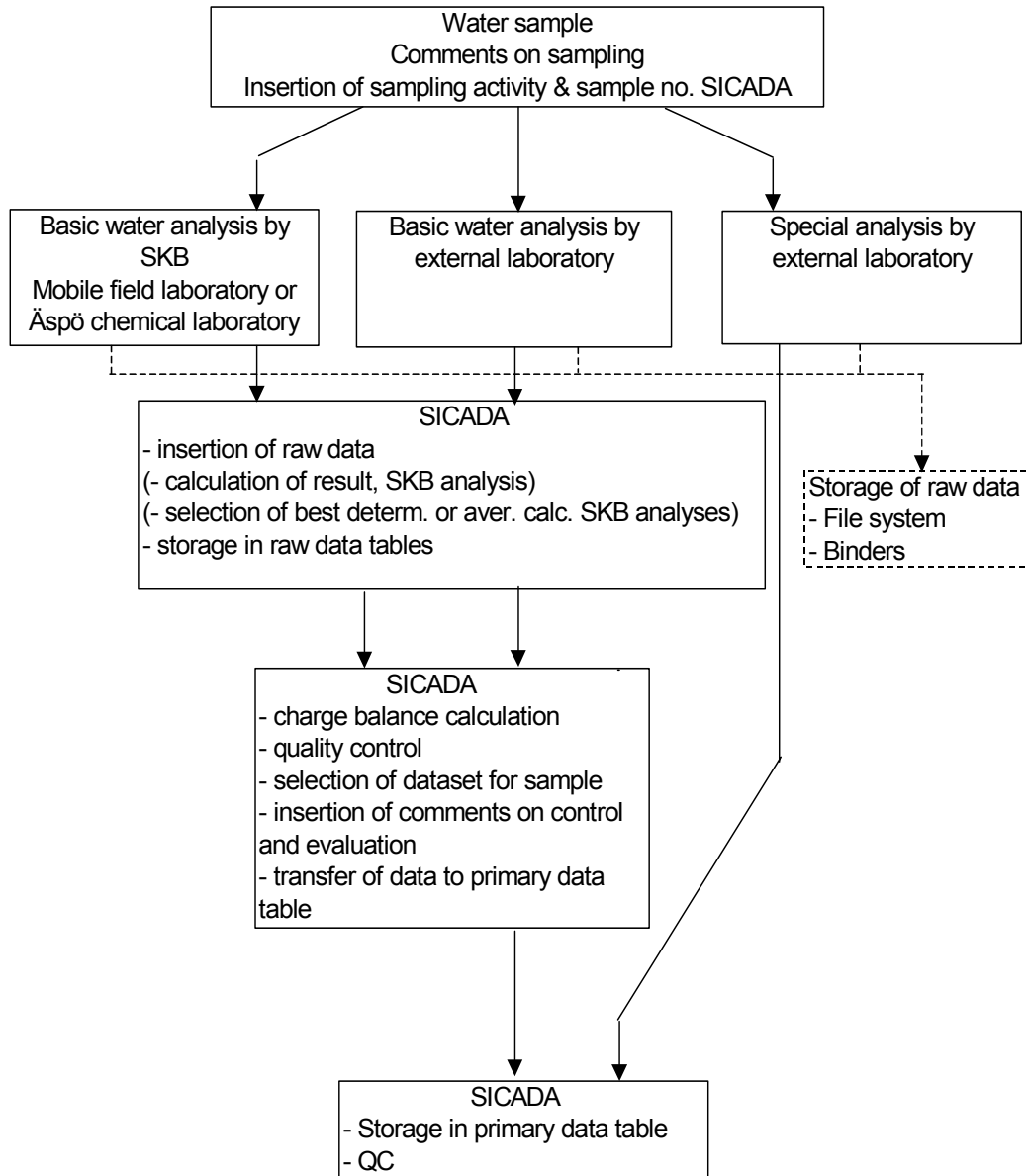
- Comparison of the results from different laboratories and/or methods. The analyses are repeated if a large disparity is noted (generally more than 10 %).
- Calculation of charge balance errors. Relative errors within  $\pm 5\%$  are considered acceptable (in surface waters  $\pm 10\%$ ).

$$\text{Rel. Error (\%)} = 100 \times \frac{(\sum \text{cations(equivalents)} - \sum \text{anions(equivalents)})}{(\sum \text{cations(equivalents)} + \sum \text{anions(equivalents)})}$$

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

All results from “biochemical” components and special analyses of trace metals and isotopes are inserted directly into primary 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 4-1.



*Figure 4-1. Overview of data management for hydrogeochemical data.*

## **5 Results**

### **5.1 Analysis results from HFM01, HFM02, HFM03 and KFM01A**

The analytical data from the percussion boreholes including the percussion drilled part of KFM01A are presented in Appendix 3 and 4.

Samples were collected at least twice during the pumping test, and the water compositions of the two samples differ, depending on pumping time. Generally, the last sample in each sampling series should be regarded as the one most representative for the formation.

The concentration of Total Organic Carbon (TOC) in the samples collected in HFM01 was found to be in the range 10–12 mg/L. These values were considered as too high for the groundwater to be used as flushing water for core drilling without further measures. An active carbon filter system was therefore installed for reduction of organic substances from the pumped groundwater.

### **5.2 Analysis results from SFM0001, SFM0002 and SFM0003**

The analytical data from the monitoring wells at drillsite DS1 are presented in Appendices 3, 4, 5, 6 and 7. Sampling and analysis of the near-surface groundwater prevailing in the soil layer is performed according to SKB surface water sampling class 5, which also includes surface water components, see Appendix 6. Samples were collected three times in each borehole. Some of the results from isotope analyses have not yet been reported from the consulted laboratories and are therefore not included in the present report.

### **5.3 Quality of the analyses**

Comparison between results from different laboratories and methods indicates that the agreement is acceptable in most cases. Generally, the difference in concentrations between each controlled component is less than 10 %.

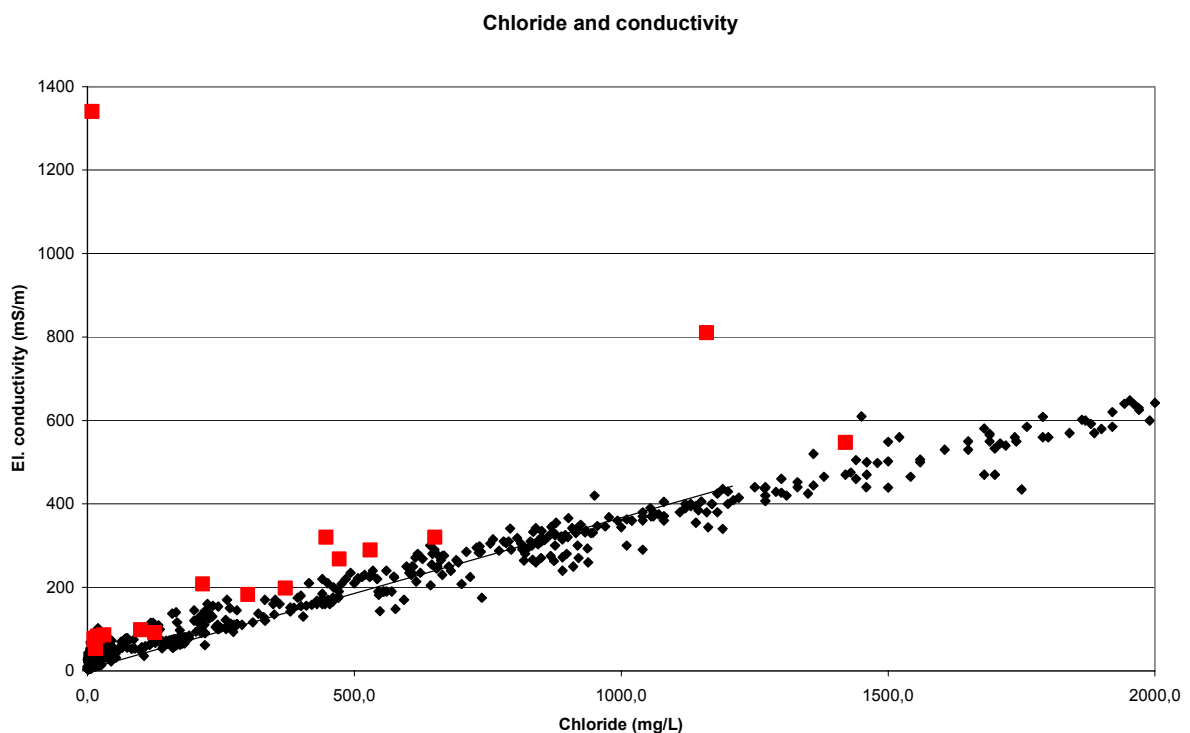
Some early analytical results (hydrogen carbonate or alkalinity, pH and electrical conductivity) were erroneous and are rejected. Alkalinity titrations and pH measurements need to be performed immediately after sampling. Therefore these erroneous analyses cannot be repeated by using archive samples.

The charge balance errors give an indication of the quality and uncertainty of the analyses of the major components. The relative charge balance errors are calculated for the selected sets of data, see Appendix 3. The errors exceed  $\pm 5\%$  in 4 cases out of 20, if the incomplete data sets are excluded. This is not fully satisfactory but could be blamed on starting up problems and limited possibilities to repeat and verify analytical results. In two cases the large errors are due to high and erroneous calcium concentrations (bold values in Appendix 3).

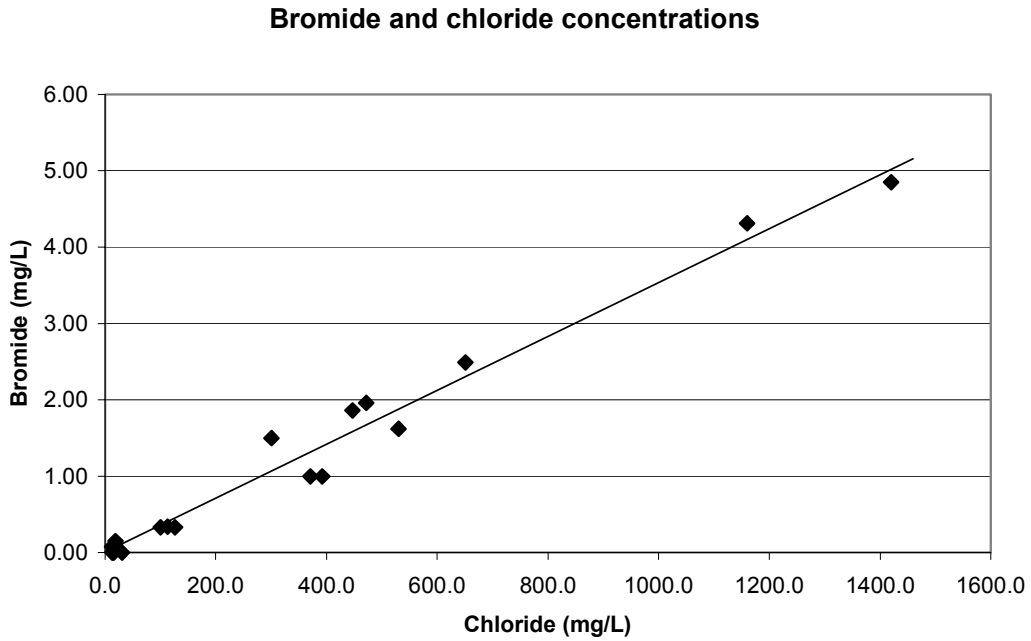


Figures 5-1 to 5-3 illustrate the consistency of the analyses. The figures are based on the data compilation in Appendix 3. Electric conductivity values are plotted versus chloride concentrations in Figure 5-1. The data presented in this report are given together with old data from investigations at the Äspö Hard Rock Laboratory to obtain a better defined line. As displayed in the figure, three outliers deviate considerably from the straight line. These conductivity data are obviously erroneous and therefore rejected from SICADA.

The bromide and chloride concentrations are plotted in Figure 5-2. A plot of bromide versus chloride serves as a rough quality control of the bromide analyses. Points that deviate significantly from the linear trend are most probably erroneous. As shown in the figure, no extreme deviations from a straight line exist.

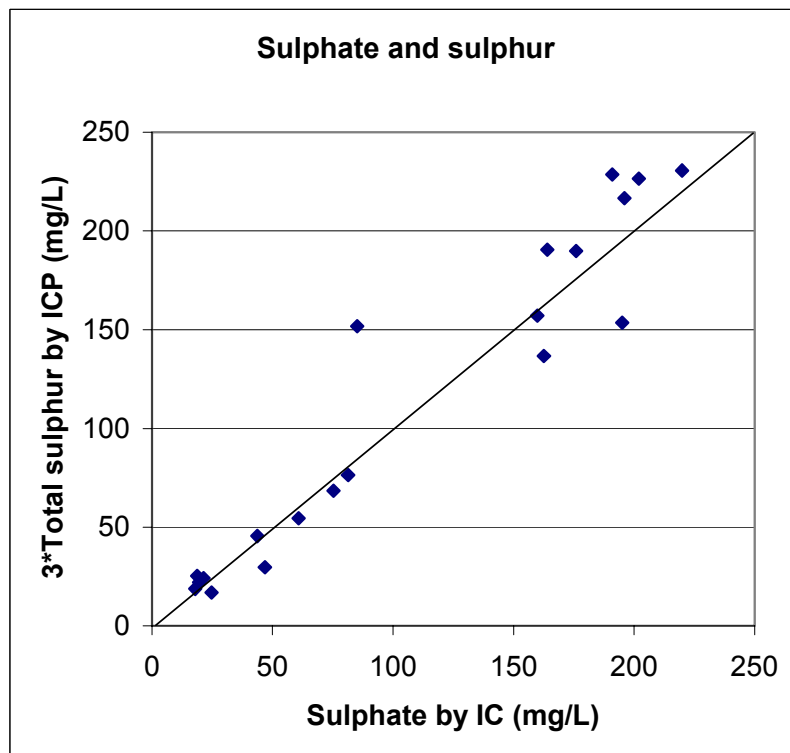


*Figure 5-1. Plot of electric conductivity versus chloride concentration. Recent data from Forsmark=large red squares, old Äspö data = small black dots.*



*Figure 5-2. Plot of bromide concentrations versus chloride concentrations.*

Total sulphur concentrations determined by ICP are recalculated to sulphate and compared with the results from IC analyses. A comparison is shown in Figure 5-3. The most divergent sulphate value is rejected in SICADA.



*Figure 5-3. Plot of total sulphur (ICP) times three, versus sulphate (IC) concentrations.*

## 6 Future work

### 6.1 Percussion boreholes

The initial sampling of percussion boreholes at drillsite DS1 (reported here), performed according to the SKB class 3 procedure, will in the future be repeated on a regular basis in a long-term monitoring programme. This will include a selection of boreholes, and samples will be collected regularly twice a year from one or two packed off sections in each borehole. Sampling and analysis within the frame of the monitoring programme will be performed according to the SKB class 5 procedure /1/.

### 6.2 Monitoring wells

The three monitoring wells at drillsite DS1 reported here, are all situated close to the deep borehole KFM01A. Early this year (2003), a number of “not drillsite connected” monitoring wells have been drilled within or close to the candidate area. Some of them are intended for groundwater sampling and chemical analyses.

A sampling programme (activity plan) is being written, which includes the “drill site connected” wells as well as the new “not drill site connected” hydrogeochemistry wells (totally 16 wells). This new programme for near-surface groundwater will be connected to the surface water sampling programme. Sampling in the wells will be performed four times during 2003, at the same campaigns as for the sampling of surface water in the area of investigation. The sampling occasions during 2003 and early in 2004 as well as types of analytical procedures applied are presented in Table 6-1.

**Tabell 6-1. Sampling occasions during 2003/early 2004 and types of analytical procedures applied in monitoring wells in soil.**

<b>Year</b>	<b>2003</b>	<b>2003</b>	<b>2003</b>	<b>2003</b>	<b>2003</b>	<b>2003</b>
<b>Month</b>	March	April	May	Juni	July	August
<b>Week*</b>			19 (SKB class 5) test run		28 (SKB class 3)	
<b>Year</b>	<b>2003</b>	<b>2003</b>	<b>2003</b>	<b>2003</b>	<b>2004</b>	<b>2004</b>
<b>Month</b>	September	October	November	December	January	February
<b>Week*</b>		42 (SKB class 5)			3 (SKB class 3)	

\* Week numbers when sampling of monitoring wells is planned to be performed

The programme will probably continue for several years according to this structure.

## 7 References

- /1/ **SKB, 2001.** Generellt genomförande program för platsundersökningar. SKB R-01-10, Svensk Kärnbränslehantering AB.
- /2/ **Claesson L-Å, Nilsson G, 2003.** Forsmark site investigation. Drilling of a flushing water well, HFM01, and two groundwater monitoring wells, HFM02 and HFM03, at drillsite DS1. SKB P-03-30, Svensk Kärnbränslehantering AB.
- /3/ **Claesson L-Å, Nilsson G, 2003.** Forsmark site investigation. Drilling of the telescopic borehole KFM01A at drillsite DS1. SKB P-03-32, Svensk Kärnbränslehantering AB.
- /4/ **Claesson L-Å, Nilsson G, 2003.** Forsmark site investigation. Drilling of groundwater monitoring wells SFM0001-SFM0003 in soil at drillsite DS1. SKB P-03-13, Svensk Kärnbränslehantering AB.
- /5/ **Ludvigsson J-E, Jönsson S, Levén J, 2003.** Forsmark site investigation. Pumping tests and flow logging. Boreholes KFM01A (0–100 m), HFM01, HFM02 and HFM03. SKB P-03-33, Svensk Kärnbränslehantering AB.
- /6/ **Werner K, Johansson P-O, 2003.** Forsmark site investigation. Slugtests in observation wells in soil. SKB P-03-46, Svensk Kärnbränslehantering AB.

**Designs of boreholes and monitoring wells**

Figure 1. KFM01A

Figure 2. HFM01

Figure 3. HFM02

Figure 4. HFM03

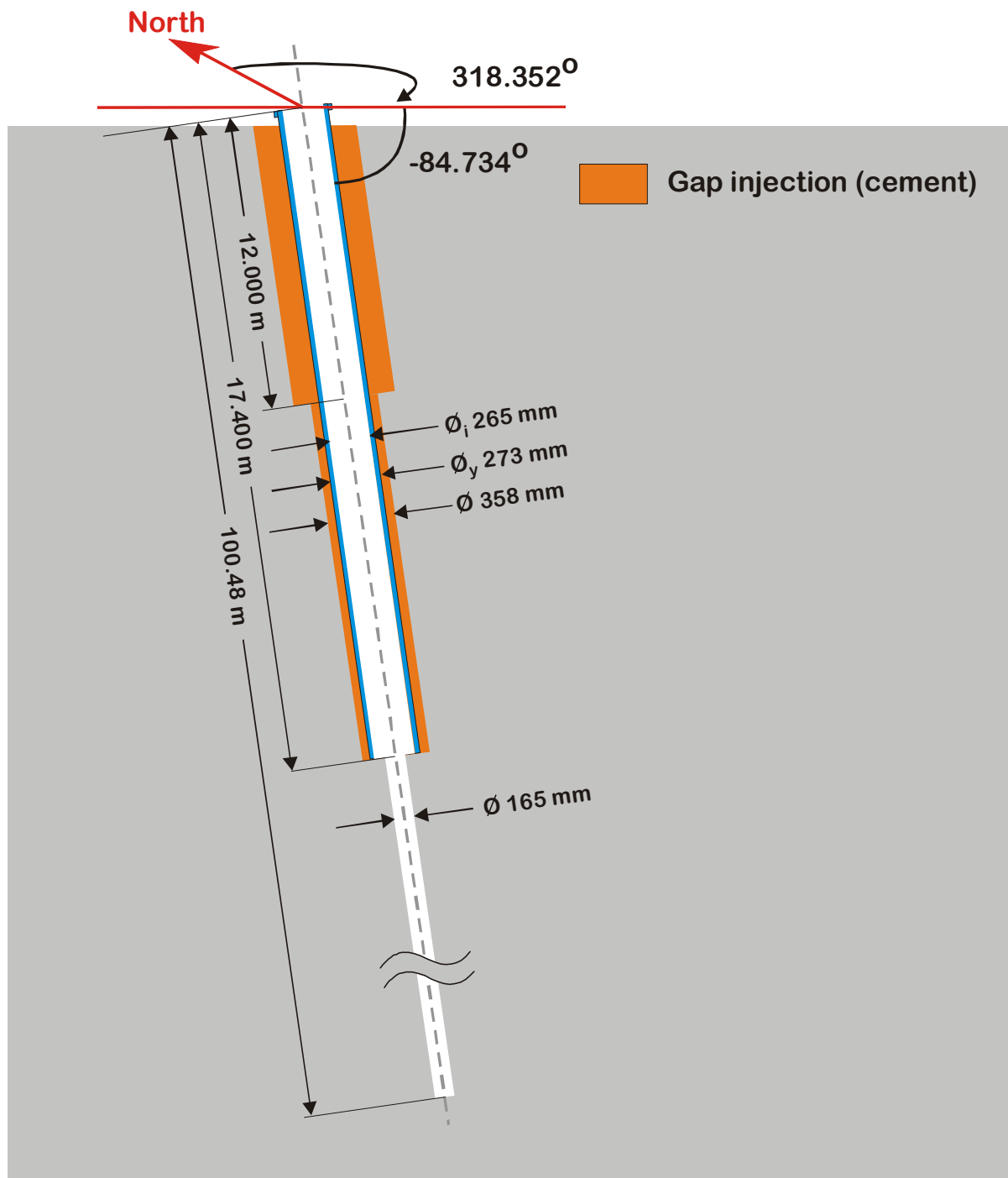
Figure 5. SFM0001

Figure 6. SFM0002

Figure 7. SFM0003

# Technical data

## Borehole KFM01A

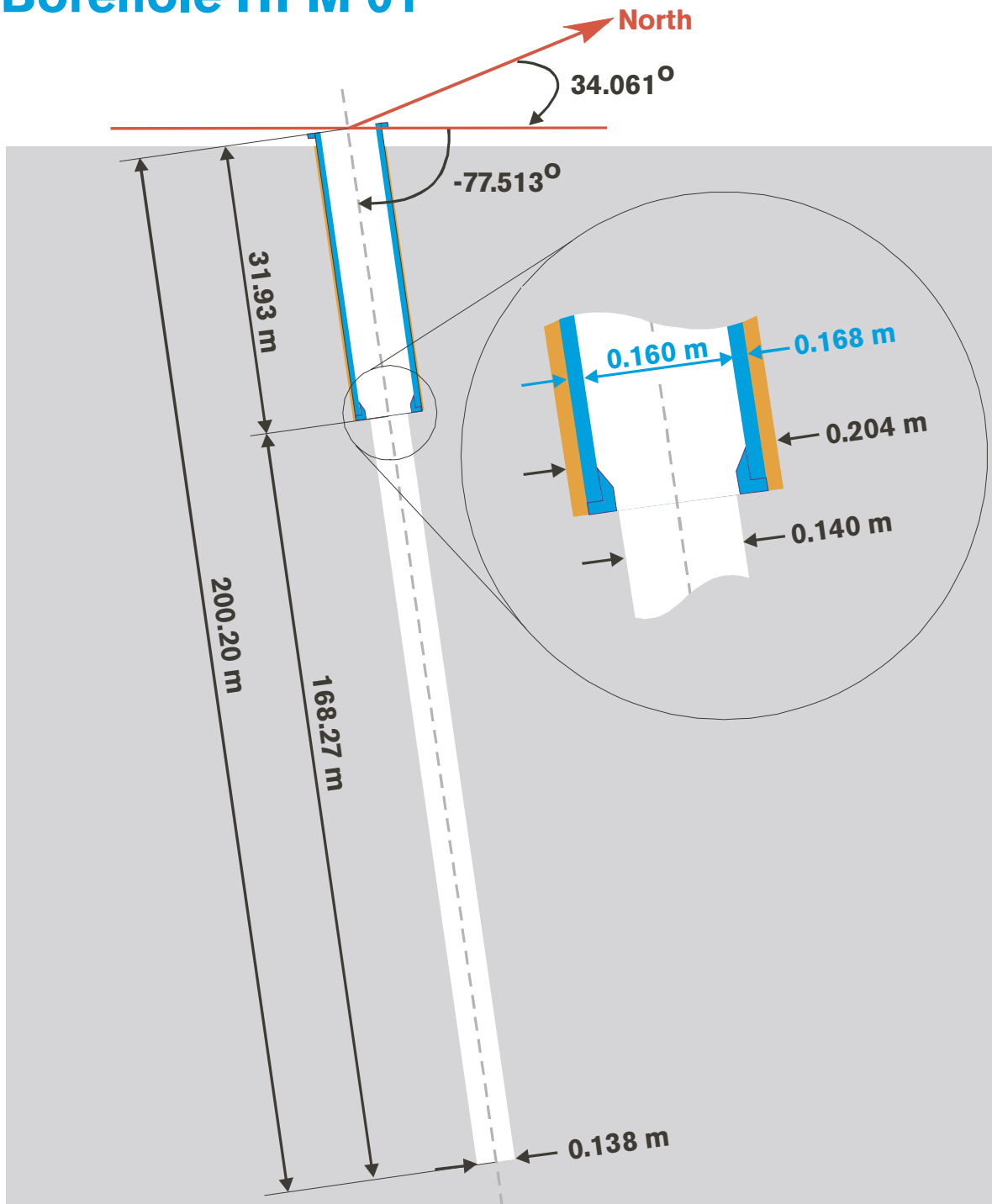


### Drilling reference point

Northing: 6699529.813 (m), RT90 2,5 gon V 0:-15  
Easting: 1631397.160 (m), RT90 2,5 gon V 0:-15  
Elevation: 3.125 (m), RHB 70

# Technical data

## Borehole HFM 01



### Drilling reference point

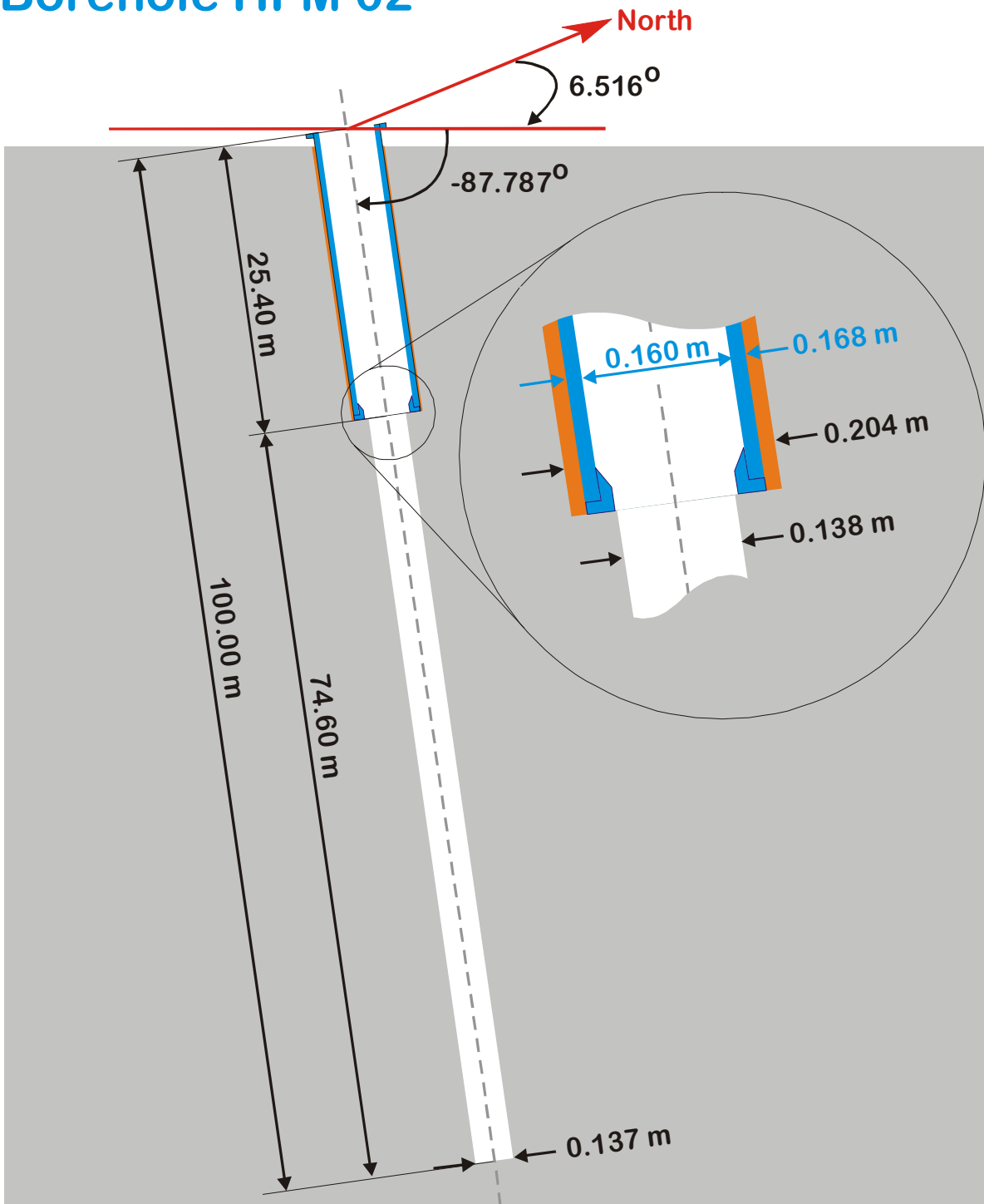
**Northing:** 6699605.181 (m), RT90 2,5 gon V 0:-15  
**Easting:** 1631484.552 (m), RT90 2,5 gon V 0:-15  
**Elevation:** 1.731 (m), RHB 70

### Drilling period

**Drilling start date:** 2002-04-18  
**Drilling stop date:** 2002-05-03

# Technical data

## Borehole HFM 02



### Drilling reference point

Northing: 6699593.212 (m), RT90 2,5 gon V 0:-15  
 Easting: 1631268.674 (m), RT90 2,5 gon V 0:-15  
 Elevation: 3.053 (m), RHB 70

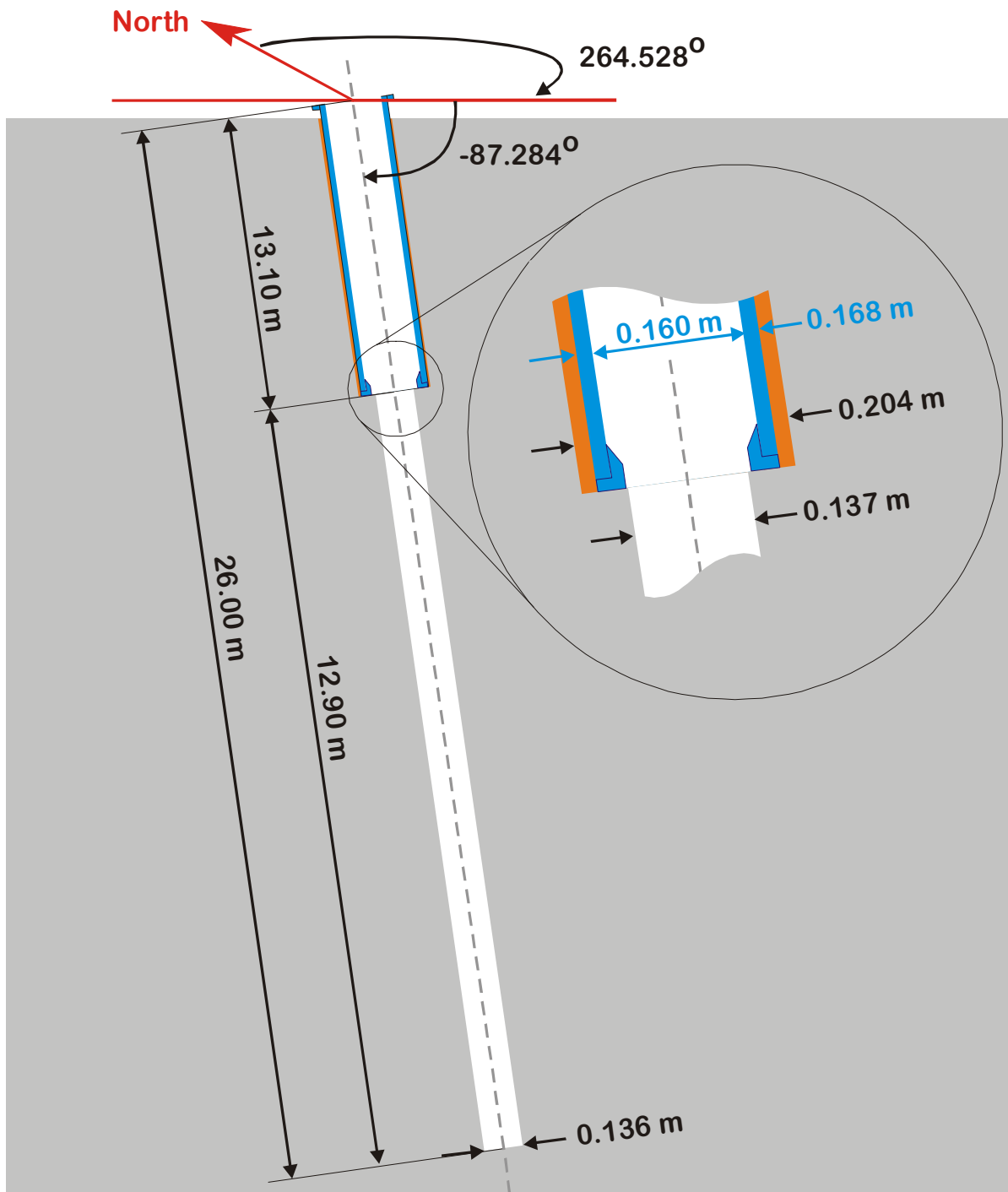
### Drilling period

Drilling start date: 2002-05-07  
 Drilling stop date: 2002-05-21



# Technical data

## Borehole HFM 03



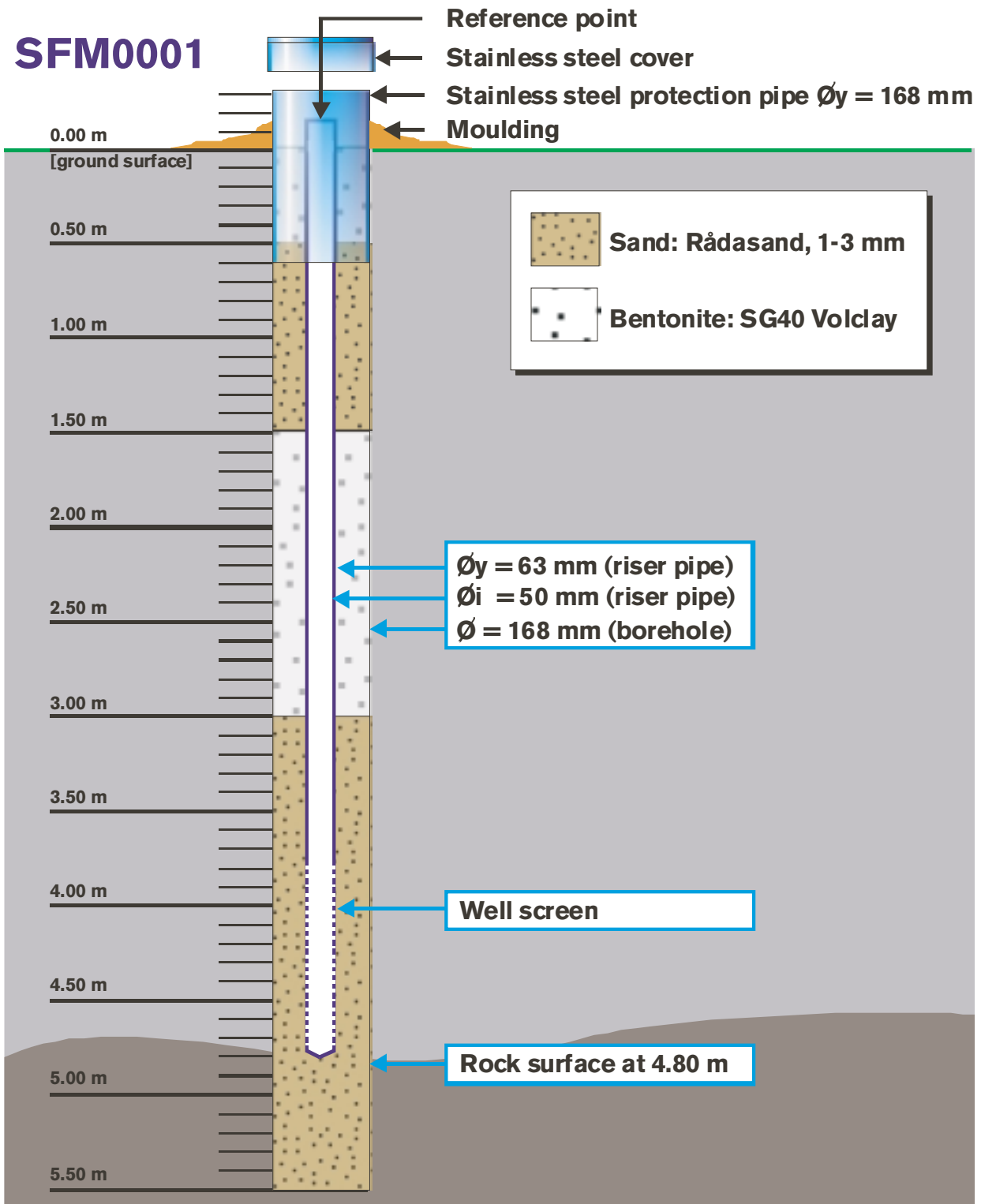
### Drilling reference point

Northing: 6699592.812 (m), RT90 2,5 gon V 0:-15  
 Easting: 1631272.626 (m), RT90 2,5 gon V 0:-15  
 Elevation: 3.148 (m), RHB 70

### Drilling period

Drilling start date: 2002-05-27  
 Drilling stop date: 2002-05-28

# SFM0001



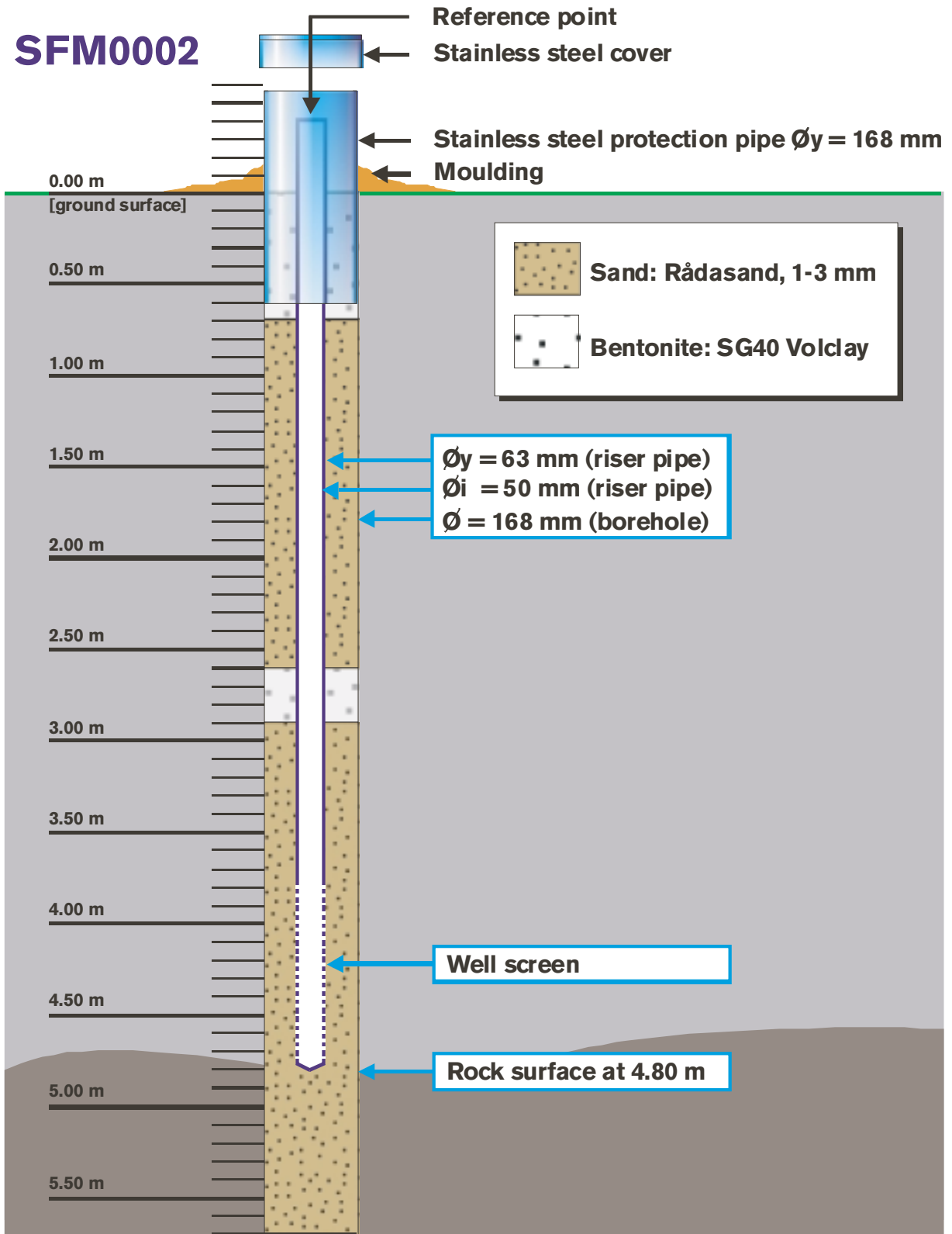
**Installation date:**

2002-05-23

**Reference point**

**Northing:** 6699713.313 (m), RT90 2.5 gon V 0:-15  
**Easting:** 1631335.440 (m), RT90 2.5 gon V 0:-15  
**Elevation:** 1.104 (m), RHB 70

**SFM0002**



**Installation date:**

2002-05-30

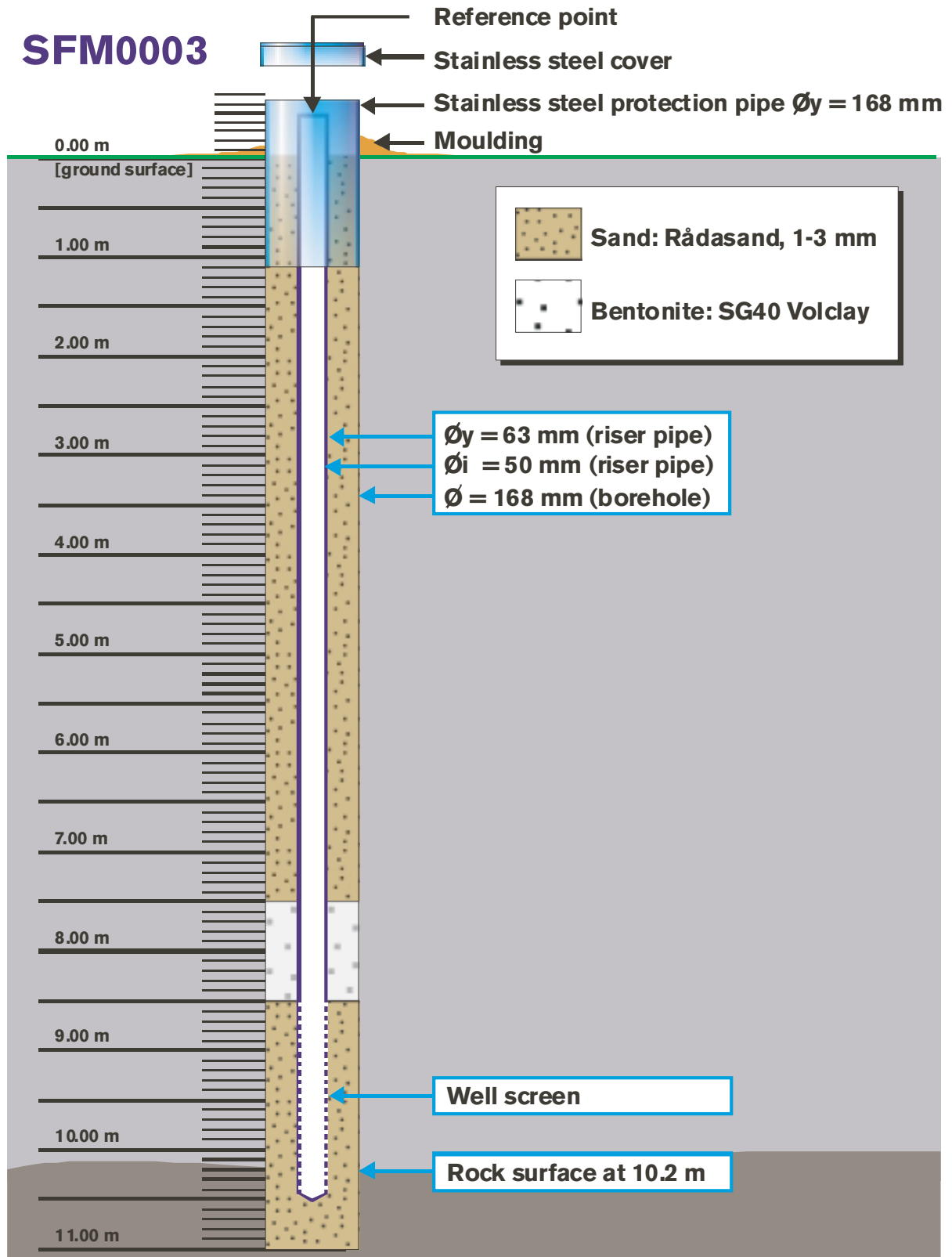
**Reference point**

Northing: 6699585.839 (m), RT90 2.5 gon V 0:-15

Easting: 1631377.686 (m), RT90 2.5 gon V 0:-15

Elevation: 2.022 (m), RHB 70

# SFM0003



**Installation date:**  
2002-05-30

**Reference point**  
 Northing: 6699614.586 (m), RT90 2.5 gon V 0:-15  
 Easting: 1631487.303 (m), RT90 2.5 gon V 0:-15  
 Elevation: 1.944 (m), RHB 70

## Appendix 2

**Table A2-1. Overview of general sample handling routines and analysis methods.**

Component group	Component/element	Sample container (material)	Volume (mL)	Filtering	Preparation/Conservation*	Analysis method	Laboratory****	Analysis within - or delivery time to lab.
Anions 1.	HCO <sub>3</sub> pH(lab) cond (lab)	Plastic	250	Yes (not in the field)	No	Titration Pot. meas, Cond. meas	Mobile field lab. Alcontrol	The same day – maximum 24 hours
Anions 2	Cl, SO <sub>4</sub> , Br <sup>-</sup> , F <sup>-</sup> , I <sup>-</sup>	Plastic	100	Yes (not in the field)	No	Titration (Cl <sup>-</sup> ) IC (Cl <sup>-</sup> , SO <sub>4</sub> , Br <sup>-</sup> , F <sup>-</sup> ) ISE (F <sup>-</sup> )	Åspö:s chemistry lab. Alcontrol	Not critical (month)
	Br, I	Plastic	100	Yes (not in the field)	No	ICP MS	Paavo Ristola OY SGAB Analytica,	Not critical (month)
Cations, Si and S according to SKB class 3	Na, K, Ca, Mg, S(tot), Si(tot), Li, Sr	Plastic (at low conc. acid washed bottles)	100	Yes (not in the field)	Yes (not in the field, 1 mL HNO <sub>3</sub> )	ICP-AES ICP-MS	SGAB Analytica, SLU, Umeå	Not critical (month)
Cations, Si and S according to SKB class 4 and 5	Na, K, Ca, Mg, S(tot), Si(tot), Fe, Mn, Li, Sr	Plastic (Acid washed)	100	Yes (immediately in the field)	Yes (1 mL HNO <sub>3</sub> )	ICP-AES ICP-MS	SGAB Analytica, SLU, Umeå	Not critical (month)
Fe(II), Fe(tot)	Fe(II), Fe(tot)	Plastic (Acid washed)	500	Yes	Yes (5 mL HCl)	Spectrophotometry Ferrozine method	Mobile field lab.	As soon as possible the same day
Hydrogen sulphide	HS-	Glass (Winkler)	About 120×2	No	Ev 1 mL 1 M NaOH+ 1 mL 1M ZnAc	Spectrophotometry	Alcontrol Åspö:s chemistry lab.	Immediately or if conserved, a few days
Nutrient salts	NO <sub>2</sub> , NO <sub>3</sub> +NO <sub>2</sub> , NH <sub>4</sub> , PO <sub>4</sub>	Plastic	250	No	No	Spectrophotometry	Åspö:s chemistry lab. Alcontrol	Maximum 24 hours
Environmental metals	Al, As, Ba, B, Cd, Co, Cr, Cu, Hg, Mo, Ni, P, Pb, V, Zn	Plastic	100	Yes	Yes (1 mL HNO <sub>3</sub> )	ICP-AES ICP-MS	SGAB Analytica, Alcontrol	Not critical (month)

Component group	Component/element	Sample container (material)	Volume (mL)	Filtering	Preparation/Conservation*	Analysis method	Laboratory****	Analysis within - or delivery time to lab.
Lantanoids, U, Th and so on.	Sc, Rb, Y, Zr, I, Sb, Cs, La, Hf, Tl, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, U, Th	Plastic	100	Yes	Yes (1 mL HNO <sub>3</sub> )	ICP-AES ICP-MS	SGAB Analytica, Alcontrol	Not critical (month)
Dissolved organic Carbon, dissolved inorganic Carbon	DOC, DIC	Plastic	250 25	Yes	Frozen, transported in isolated bag	UV oxidation, IR Carbon analysator Shimadzu TOC5000	Paavo Ristola OY Dept. of System ecology, SU	Short transportation time
Total organic Carbon	TOC	Plastic	250 25	No	Frozen, transported in isolated bag	UV oxidation, IR Carbon analysator Shimadzu TOC5000	Paavo Ristola OY Dept. of System ecology, SU	Short transportation time
Environmental isotopes	<sup>2</sup> H, <sup>18</sup> O	Plastic	100	No	- -	MS	IFE	Not critical (month)
Tritium,	<sup>3</sup> H (enhanced.)	Plastic (dry bottle)	500	No	-	LSC	Univ. Of Waterloo	Not critical (month)
Chlorine-37	Chlorine-37	Plastic	100	No	-	ICP MS		
Carbon isotopes	<sup>13</sup> C, <sup>14</sup> C	Glass (brown)	100×2	No	-	(A)MS	Univ. Of Waterloo	A few days
Sulphur isotopes	<sup>34</sup> S	Plastic	500 –1000	Yes	-	Combustion, ICP MS	IFE	No limit
Strontium-isotopes	<sup>87</sup> Sr/ <sup>86</sup> Sr	Plastic	100	Yes	-	TIMS	IFE	Days or Week
Uranium and Thorium isotopes	<sup>234</sup> U, <sup>235</sup> U, <sup>238</sup> U, <sup>232</sup> Th, <sup>230</sup> Th,	Plastic	50	Nej	-	Chemical separat. Alfa/gamma spectrometry	IFE	No limit
Boron isotopes	<sup>10</sup> B	Plastic	100	Yes	Yes (1 mL HNO <sub>3</sub> )	ICP – MS	SGAB Analytica	No limit
Radon and Radium isotopes	<sup>222</sup> Rn, <sup>226</sup> Ra	Plastic	500	No	No	EDA, RD-200	IFE	Immediate transport
Dissolved gas (content and composition)	Ar, N <sub>2</sub> , CO <sub>2</sub> , O <sub>2</sub> , CH <sub>4</sub> , H <sub>2</sub> , CO, C <sub>2</sub> H <sub>2</sub> , C <sub>2</sub> H <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> , C <sub>3</sub> H <sub>8</sub>	Cylinder of stainless steel	200	No	No	GC	Paavo Ristola OY	Immediate transport
Colloids	Filter series and fractionation (see below)	Polycarbonate filter	0.45, 0.2 and 0.05 μm	-	N <sub>2</sub> atmosphere	ICP-AES ICP-MS	SGAB Analytica	Immediate transport

Component group	Component/element	Sample container (material)	Volume (mL)	Filtering	Preparation/Conservation*	Analysis method	Laboratory****	Analysis within - or delivery time to lab.
Humic and fulvic acids	Fractionation	Fractions are collected in plastic bottles	250	-	N <sub>2</sub> atmosphere	UV oxidation, IR (DOC)	Paavo Ristola OY	Immediate transport
Archive samples with acid	-	Plast (washed in acid)	100×2 **	Yes	Yes (1 mL HNO <sub>3</sub> )	-	-	Storage in freeze container
Archive samples without acid	-	Plastic	250×2 **	Yes	No	-	-	Storage in freeze container
Carbon isotopes in humic and fulvic acids	<sup>13</sup> C, <sup>14</sup> C	DEAE cellulose (anion exchanger)	-	-	-	(A)MS	The Ångström laboratory, Uppsala	A few days

\* Suprapur acid is used for conservation of samples.

\*\* Minimum number, the number of archive samples can vary depending on how many similar samples that are collected at the same occasion.

\*\*\*\* Full name and address is given in Table A1-5.

**Table A2-2. Sample handling routines and analysis methods for supplementary analyses in near surface groundwater samples (Monitoring wells/soil pipes).**

Component group	Component/element	Sample container (material)	Volume (mL)	Filtering	Preparation/Conservation*	Analysis method	Laboratory****	Analysis within - or delivery time to lab.
Nutrient salt + silicate	NO <sub>2</sub> , NO <sub>3</sub> , NO <sub>2</sub> +NO <sub>3</sub> , NH <sub>4</sub> , PO <sub>4</sub> , SiO <sub>2</sub>	Sample tubes, plastic	25×2	Yes (in the field)	No, frozen immediately***	Spectrophotometry	Dept. of System ecology, SU	Short transportation time
Total concentrations of Nitrogen and Phosphorous	N-tot, P-tot	Plastic	100	No	No, frozen immediately***	Spectrophotometry	Dept. of System ecology, SU	Short transportation time
Particulate Carbon, Nitrogen and Phosphorous	POC, PON, POP	Plastic	1000	Yes (within 4 h) prepared filters. Blank filters	Filtering, the filters are frozen immediately 2 filters/sample	Elementar-analysator (N, C) own method 990121 (P)	Dept. of System ecology, SU	Short transportation time
Chlorophyll	Chlorophyll a, c and pheopigment	Plastic	1000-2000	Yes (within 4 h)	Filtering, the filters are frozen immediately	Spectrophotometry Fluorometry	Dept. of System ecology, SU	Short transportation time
Oxygen	Dissolved O <sub>2</sub>	Winkler, glass	2×ca 120	No	Mn (II) reagent Iodide reagent	Spectrophotometry SIS SS-EN 25813	Dept. of System ecology, SU Alcontrol	Within 3 days
Archive samples for supplementary radio nuclides		Plastic	5000	No	50 mL HNO <sub>3</sub>	-	-	Storage in freeze container

\* Suprapur acid is used for conservation of samples.

\*\* Minimum number, The number of archive samples can vary depending on how many similar samples that are collected at the same occasion.

\*\*\* The sample is transported in frozen condition to the laboratory. It is possible that the silicate concentration can change due to polymerisation for this reason.

\*\*\*\* Full name and address is given in Table A1-5.

**Abbreviations and definitions:**

IC	Ion chromatograph
ISE	Ion selective electrode
ICP-AES	Inductively Coupled Plasma Atomic Emission Spectrometry
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
INAA	Instrumental Neutron Activation Analysis
MS	Mass Spectrometry
LSC	Liquid Scintillation Counting
(A)MS	(Accelerator) Mass Spectrometry
GC	Gas Chromatography



**Table A2-3. Reporting limits and measurement uncertainties.**

Component	Method	Reporting limits or range	Unit	Measurement uncertainties <sup>3</sup>	"Total" uncertainties <sup>4</sup>
HCO <sub>3</sub>	Alkalinity titration	1	mg/L	4 %	Time delay affects the results
Cl <sup>-</sup> Cl <sup>-</sup>	Mohr- titration IC	> 70 1 – 100	mg/L	5 % 6 %	<10 % 20 %
SO <sub>4</sub>	IC	1	mg/L	10 %	20 %
Br <sup>-</sup> Br <sup>-</sup>	IC ICP	0.2 0.001	mg/L	9 % 15 %	30 %
F <sup>-</sup> F <sup>-</sup>	IC Potentiometric	0.1 -	mg/L	10 % -	20 %
I <sup>-</sup>	ICP	0.001	mg/L	15 %	20 %
Na	ICP	0.1	mg/L	4 %	10 %
K	ICP	0.4	mg/L	6 %	20 %
Ca	ICP	0.1	mg/L	4 %	10 %
Mg	ICP	0.09	mg/L	4 %	10 %
S(tot)	ICP	0.160	mg/L	21 %	20 %
Si(tot)	ICP	0.03	mg/L	4 %	15 %
Sr	ICP	0.002	mg/L	4 %	10 %
Li	ICP	0.2 <sup>1</sup> 2 <sup>2</sup>	mg/L	10 %	20 %
Fe	ICP	0.4 <sup>1</sup> 4 <sup>2</sup>	mg/L	6 %	10 %
Mn	ICP	0.03 <sup>1</sup> 0.1 <sup>2</sup>	µg/L	8 %	10 %
Fe(II), Fe(tot)	Spectrophotometry	0.02 (DL=0.005 mg/L)	mg/L	22 %	30 %
HS <sup>-</sup>	Spectrophotometry	SKB 0.03 (DL=0.002) Alcontrol (DL= 0.003)	mg/L	20 %	30 %
NO <sub>2</sub> as N	Spectrophotometry	0.1	µg/L	2 %	20 %
NO <sub>3</sub> as N	Spectrophotometry	0.2	µg/L	5 %	20 %
NO <sub>2</sub> +NO <sub>3</sub> as N	Spectrophotometry	0.2	µg/L	0.2 (0.2-20 µg/L) 2 % (> 20 µg/L)	20 %
NH <sub>4</sub> as N	Spectrophotometry	0.8  50 (SKB)	µg/L	0.8 (0.8-20 µg/L) 5 % (> 20 µg/L)  20 %	20 %

Component	Method	Reporting limits or range	Unit	Measurement uncertainties <sup>3</sup>	"Total" uncertainties <sup>4</sup>
PO <sub>4</sub> as P	Spectrophotometry	0.7	µg/L	0.7 (0.7-20 µg/L) 3 % (> 20 µg/L)	20 %
SiO <sub>2</sub>	Spectrophotometry	1	µg/L	3 % (>200 µg/L)	
O <sub>2</sub>	Jodometrische titration		mg/L		
Chlorophyll a, c pheopigment <sup>6</sup>	See table A1-2	0.5	µg/L	5 %	
PON <sup>6</sup>	See table A1-2	0.5	µg/L	5 %	
POP <sup>6</sup>	See table A1-2	0.1	µg/L	5 %	
POC <sup>6</sup>	See table A1-2	1	µg/L	4 %	
Tot-N <sup>6</sup>	See table A1-2	10	µg/L	4 %	
Tot-P <sup>6</sup>	See table A1-2	0.5	µg/L	6 %	
Al, Zn	ICP	0.2	µg/L	12 %	20 % <sup>5</sup>
Ba, Cr, Mo, Pb	ICP	0.01	µg/L	7-10 %	20 % <sup>5</sup>
Cd, Hg	ICP	0.002	µg/L	9 resp 5 %	20 % <sup>5</sup>
Co, V	ICP	0.005	µg/L	8 resp 5 %	20 % <sup>5</sup>
Cu	ICP	0.1	µg/L	8 %	20 % <sup>5</sup>
Ni	ICP	0.05	µg/L	8 %	20 % <sup>5</sup>
P	ICP	1	µg/L	6 %	10 %
As	ICP	0.01	µg/L	20 %	Correct order of size
La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb	ICP	0.005 <sup>1</sup> 0.05 <sup>2</sup>	µg/L	10 %	Correct order of size
Sc, In, Th	ICP	0.05 <sup>1</sup> 0.5 <sup>2</sup>	µg/L	10 %	Correct order of size
Rb, Zr, Sb, Cs, Tl	ICP	0.025 <sup>1</sup> 0.25 <sup>2</sup>	µg/L	10 %	Correct order of size
Y, Hf	ICP	0.005 <sup>1</sup> 0.05 <sup>2</sup>	µg/L	10 %	Correct order of size
U	ICP	0.001 <sup>1</sup> -	µg/L	12 %	Correct order of size
DOC, DIC	See table A1-1	0.1	Mg/L	20 %	50 %
TOC	See table A1-1	0.1	Mg/L	20 %	50 %
<sup>2</sup> H	MS	2	‰ dev SMOW	1.0 ‰	
<sup>18</sup> O	MS	0.1	‰ dev SMOW	0.2 ‰	

Component	Method	Reporting limits or range	Unit	Measurement uncertainties <sup>3</sup>	"Total" uncertainties <sup>4</sup>
<sup>3</sup> H	LSC	0.8 eller 0.1	TU	0.8	Correct order of size
<sup>37</sup> Cl	ICP MS	0.2 ‰ (20 mg/L)	SMOC	-	
<sup>13</sup> C	A (MS)	-	PDB	-	
<sup>14</sup> C pmc	A (MS)	-	PMC	-	Correct order of size
<sup>34</sup> S	ICP MS	0.2 ‰		0.3 ‰	
<sup>87</sup> Sr/ <sup>86</sup> Sr	TIMS	-	No unit	<±0.000020	
<sup>10</sup> B/ <sup>11</sup> B	ICP MS	-	No unit	-	
<sup>234</sup> U, <sup>235</sup> U, <sup>238</sup> U, <sup>232</sup> Th, <sup>230</sup> Th, <sup>222</sup> Rn, <sup>226</sup> Ra	Alfa spectr. LSC	0.1 ( <sup>234</sup> U, <sup>238</sup> U, <sup>226</sup> Ra) 0.3 ( <sup>235</sup> U) 0.05 ( <sup>232</sup> Th, <sup>230</sup> Th)	Bq/L	0.05 Bq/L	Correct order of size

<sup>1</sup> Salt ≤ 0.4 ‰ (520 mS/m)

<sup>2</sup> Salt ≤ 3.5 ‰ (3810 mS/m)

<sup>3</sup> Measurement uncertainty reported by consulted laboratory

<sup>4</sup> "Total" uncertainty estimated by experience (includes sampling and sample handling)

<sup>5</sup> Valid for surface water samples collected by metal free "Ruttner sampler", filtered and acidified in the field. The risk of contamination varies depending on sampling method.

<sup>6</sup> Determined only in surface waters and near surface groundwater

**Table A2-4. Consulted laboratories, full name and address.**

Äspö waterchemical laboratory (SKB) Mobile field laboratory, Forsmark (SKB)
Inainöörtoimisto Paavo Ristola Oy Teollisuus-ja Voimalaitoskemia Rajantorantie 8, C-talo 01600 Vantaa FINLAND
Dept. of System ecology Stockholm University 10691 Stockholm
Analytica AB Aurorum 10 977 75 Luleå (Nytorpsvägen 16 Box 511 183 25 Täby)
Environmental Isotope Laboratory Dep. Of earth sciences University of Waterloo Waterloo, Ontario N2L 3G1 CANADA
Institutt for energiteknik (IFE) Insituttveien 18 P.O Box 40 2027 Kjeller NORGE
Alcontrol Nordic AB Box 905 531 19 Lidköping
The Ångström laboratory Box 534 Se-751 21 Uppsala
Environmental research laboratory (SLU), Luleå
Alcontrol Box 1083 581 10 Linköping

Idcode	Secup m	Seclow m	Sample no.	Date	Time	Charge Bal %	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	F <sup>-</sup> mg/L	Si mg/L	Fe mg/L	Mn mg/L	Li mg/L	Sr mg/L	pH
HFM01	0.00	200.20	4112	2002-05-07	19:31	-	366,0	10,60	24,0	7,7	x	216,0	176,0	63,30	0,73	-	5,5	-	-	0,01	0,13	x
HFM01	0.00	200.20	4113	2002-05-14	08:45	-	42,6	5,70	39,3	7,9	x	9,0	24,7	5,62	-	-	3,8	-	-	0,01	0,14	x
HFM01	0.00	200.20	4114	2002-05-14	11:58	-1,74	470,0	12,80	56,1	15,5	480	472,0	196,0	72,20	1,96	-	5,8	-	-	0,01	0,30	8,20
HFM01	71.00	200.20	4115	2002-05-16	11:40	-0,02	162,0	12,40	46,3	8,0	520	30,8	43,7	15,20	-0,20	-	6,9	-	-	0,01	0,14	8,50
HFM01	0.00	71.00	4116	2002-05-16	17:24	-0,9	498,0	13,80	60,4	16,9	440	530,0	202,0	75,50	1,62	-	5,8	-	-	0,02	0,33	8,40
HFM01	0.00	200.20	4172	2002-06-25	-	-1,26	556,0	15,20	79,1	22,8	480	651,0	220,0	76,90	2,49	2,15	6,2	-	-	0,02	0,43	8,10
KFM01A	0.00	100.57	4165	2002-05-25	15:55	-	846,0	24,10	235,0	69,9	x	1420,0	191,0	76,20	4,85	1,56	5,6	-	-	0,03	1,53	x
HFM03	0.00	26.00	4166	2002-05-29	12:35	-	58,6	8,97	66,0	12,6	x	12,8	21,4	8,06	-0,20	1,08	6,7	-	-	0,01	0,27	x
HFM03	0.00	26.00	4167	2002-05-29	17:35	8,90	64,6	9,50	62,0	14,0	310	15,7	18,7	8,45	-0,20	1,13	9,8	-	-	0,01	0,28	7,60
HFM02	0.00	100.10	4169	2002-06-04	13:34	0,54	703,0	21,10	162,0	45,3	340	1160,0	164,0	63,50	4,31	1,75	5,7	-	-	0,02	1,11	7,80
HFM02	0.00	100.10	4170	2002-06-04	21:45	11,3	545,0	16,80	121,0	34,9	640	447,0	xx	50,60	1,86	1,10	4,4	-	-	0,02	0,82	7,50
SFM0001	-	-	4219	2002-07-18	11:00	1,60	242,0	15,90	103,0	33,7	420	300,6	162,6	45,60	1,50	0,67	8,0	2,17	0,19	0,02	0,32	7,6
SFM0001	-	-	4316	2002-09-20	10:30	0,40	321,0	18,90	91,7	40,6	476	392,4	159,8	52,40	1,00	0,86	7,7	1,79	0,20	0,02	0,38	7,3
SFM0001	-	-	4403	2002-12-12	11:15	-4,45	254,0	16,90	89,1	36,5	427	371,1	195,1	51,20	1,00	0,59	6,6	1,73	0,17	0,01	0,35	7,3
SFM0002	-	-	4220	2002-07-18	10:00	12,85	40,7	6,19	<b>187,0</b>	11,8	330	126,2	19,6	7,34	0,33	0,58	8,2	3,46	0,42	0,01	0,25	7,5
SFM0002	-	-	4318	2002-09-20	14:15	-3,97	43,1	5,40	129,0	9,5	390	113,1	18,0	6,24	0,34	0,6	6,3	2,26	0,24	0,01	0,20	7,2
SFM0002	-	-	4405	2002-12-12	13:50	1,59	46,7	6,05	131,0	9,7	351	100,3	46,9	9,91	0,33	0,66	6,0	1,10	0,33	0,01	0,21	7,4
SFM0003	-	-	4221	2002-07-18	13:00	13,22	33,4	15,80	<b>143,0</b>	31,2	410	18,6	81,4	25,50	0,15	0,78	14,0	5,74	0,36	0,02	0,50	7,6
SFM0003	-	-	4317	2002-09-20	12:40	-2,69	33,5	13,70	97,3	27,0	453	17,9	75,3	22,80	0,10	0,77	9,6	1,48	0,20	0,01	0,45	7,4
SFM0003	-	-	4404	2002-12-12	13:20	-0,48	31,1	13,60	93,0	25,2	426	12,7	60,8	18,20	0,08	0,69	9,2	1,33	0,17	0,01	0,42	7,4

- = Not analysed

x = No result due to sampling problems

xx = No result due to analytical problems

- "value" = result less than detection limit

ChargeBal % = Relative charge balance error %

SICADA: water\_composition, 020501-030301

Idcode	Secup m	Seclow m	Sample no.	EiCond mS/m	TOC mg/L	HS <sup>-</sup> mg/L	I <sup>-</sup> mg/L
HFM01	0.00	200.20	4112	208,0	11,6	-	-
HFM01	0.00	200.20	4113	xx	12,7	-	-
HFM01	0.00	200.20	4114	268,0	10,0	-	-
HFM01	71.00	200.20	4115	86,1	10,9	-	-
HFM01	0.00	71.00	4116	289,0	10,4	-	-
HFM01	0.00	200.20	4172	320,0	-	-	-
KFM01A	0.00	100.57	4165	547,0	-	-	-
HFM03	0.00	26.00	4166	74,7	-	-	-
HFM03	0.00	26.00	4167	52,7	-	-	-
HFM02	0.00	100.10	4169	xx	-	-	-
HFM02	0.00	100.10	4170	xx	-	-	-
SFM0001	-	-	4219	183	22,30	0,05	0,009
SFM0001	-	-	4316	-	7,00	-0,03	0,008
SFM0001	-	-	4403	198*	27,27	0,05	0,005
SFM0002	-	-	4220	91,7	15,10	-0,03	0,008
SFM0002	-	-	4318	-	7,40	-0,03	0,010
SFM0002	-	-	4405	98,8*	12,27	-0,03	0,007
SFM0003	-	-	4221	83,5	11,10	-0,03	0,004
SFM0003	-	-	4317	-	11,00	-0,03	0,005
SFM0003	-	-	4404	77,7*	9,55	-0,03	0,004

- = Not analysed

x = No result due to sampling problems

xx = No result due to analytical problems

- "value" = result less than detection limit

ChargeBal % = Relative charge balance error %

SICADA: water\_composition, 020501-030301

**Isotopes I (H-, O-, B-, S-, Cl- and C-isotopes)**

Idcode	Secup m	Seclow m	Sample no	Date	Time	D dev SMOW	Tr TU	O-18 dev SMOW	<sup>10</sup> B/ <sup>11</sup> B no unit	S-34 dev CDT	Cl-37 dev SMOC	C-13 dev PDB	<sup>87</sup> Sr/ <sup>86</sup> Sr no unit	C-14 pmc	AGE_BP years
HFM01	0.00	71.00	4116	2002-05-16	17:24	-64,2	3,7	-9,5	-	-	0,19	-10,2	-	46,3	6135
HFM01	0.00	200.20	4172	2002-06-25	-	-64,6	3,3	-9,4	-	-	0,14	-10,2	-	45,2	6325
KFM01A	0.00	100.57	4165	2002-05-25	15:55	-70,0	5,2	-9,9	-	-	-0,16	-13,7	-	50,7	5400
HFM03	0.00	26.00	4167	2002-05-29	17:35	-79,6	12,0	-11,8	-	-	0,58	-14,9	-	85,3	1225
SFM0001	-	-	4219	2002-07-18	11:00	-90,6	15,3	-10,9	-	-	-0,10	-15,6	-	90,2	775
SFM0001	-	-	4316	2002-09-20	10:30	-76,3	-6,0	-10,8	0,19	10,4	A	A	0,721181	A	A
SFM0001	-	-	4403	2002-12-12	11:15	-80,3	A	-11,1	0,24	A	A	A	A	A	A
SFM0002	-	-	4220	2002-07-18	10:00	-95,2	13,7	-11,8	-	-	-0,48	-15,8	-	85,3	1225
SFM0002	-	-	4318	2002-09-20	14:15	-83,5	13,0	-11,9	0,19	6,1	A	A	0,724237	A	A
SFM0002	-	-	4405	2002-12-12	13:50	-84,0	A	-11,9	0,24	A	A	A	A	A	A
SFM0003	-	-	4221	2002-07-18	13:00	-82,3	24,9	-9,0	-	-	0,26	-11,4	-	69,1	2915
SFM0003	-	-	4317	2002-09-20	12:40	-76,3	-6,0	-9,7	0,19	-2,4	A	A	0,724103	A	A
SFM0003	-	-	4404	2002-12-12	13:20	-74,9	A	-9,9	0,24	A	A	A	A	A	A

- = Not analysed

A = results will be reported later

x = No result due to sampling problems

xx = No result due to analytical problems

Idcode	Sample no.	Date	Time	U ug/L	Th ug/L	Sc ug/L	Rb ug/L	Y ug/L	Zr ug/L	In ug/L	Sb ug/L	Cs ug/L	Ba ug/L	La ug/L	Hf ug/L	Tl ug/L	Ce ug/L	Pr ug/L	Nd ug/L	Sm ug/L	Eu ug/L	Gd ug/L	
SFM0001	4219	2002-07-18	11:00	-	-	-	-	-	-	-	-	-	54,0	-	-	-	-	-	-	-	-	-	-
SFM0001	4316	2002-09-20	10:30	6,09	0,252	0,103	5,54	2,98	8,48	9,73	0,103	0,031	61,5	2,45	0,179	0,005	2,53	0,485	2,03	0,352	0,0488	0,451	
SFM0001	4403	2002-12-12	11:15	-	-	-	-	-	-	-	-	-	52,2	-	-	-	-	-	-	-	-	-	-
SFM0002	4220	2002-07-18	10:00	-	-	-	-	-	-	-	-	-	105	-	-	-	-	-	-	-	-	-	-
SFM0002	4318	2002-09-20	14:15	4,59	0,251	0,155	2,47	5,00	11,3	14,4	0,203	0,009	101	5,11	0,294	0,006	5,61	0,893	3,86	0,560	0,0796	0,754	
SFM0002	4405	2002-12-12	13:50	-	-	-	-	-	-	-	-	-	78,9	-	-	-	-	-	-	-	-	-	-
SFM0003	4221	2002-07-18	13:00	-	-	-	-	-	-	-	-	-	63,2	-	-	-	-	-	-	-	-	-	-
SFM0003	4317	2002-09-20	12:40	0,550	0,0235	0,0202	1,54	0,4	0,44	4,27	0,055	0,01	33,5	0,51	0,0079	0,012	0,289	0,0837	0,347	0,049	0,0078	0,058	
SFM0003	4404	2002-12-12	13:20	-	-	-	-	-	-	-	-	-	33,3	-	-	-	-	-	-	-	-	-	-

- = Not analysed

x = No result due to sampling problems

xx = No result due to analytical problems

- "value" = result less than detection limit

SICADA: trace\_elements, 020501-030301



Trace elements

Idcode	Sample no.	Tb ug/L	Dy ug/L	Ho ug/L	Er ug/L	Tm ug/L	Yb ug/L	Lu ug/L	Al ug/L	As ug/L	Cd ug/L	Cr ug/L	Cu ug/L	Co ug/L	Hg ug/L	Ni ug/L	Zn ug/L	Pb ug/L	V ug/L	Mo ug/L
SFM0001	4219	-	-	-	-	-	-	-	344	1,60	-	1,29	0,700	0,678	-	-	3,16	0,700	3,00	-
SFM0001	4316	0,0547	0,365	0,082	0,213	0,0347	0,220	0,0358	59,8	-0,01	0,0040	0,707	0,392	0,254	-0,0020	12,8	1,59	0,243	1,96	2,97
SFM0001	4403	-	-	-	-	-	-	-	30,3	-	-0,0020	0,451	0,765	0,229	-0,0020	7,33	8,53	0,193	1,36	1,58
SFM0002	4220	-	-	-	-	-	-	-	1020	1,10	-	3,46	1,400	1,740	-	-	10,1	2,300	3,70	-
SFM0002	4318	0,0848	0,55	0,125	0,361	0,0587	0,398	0,066	31,8	0,888	0,0040	10,9	0,345	0,752	-0,0020	42,6	20,4	0,136	2,84	2,29
SFM0002	4405	-	-	-	-	-	-	-	18,5	-	-0,0020	0,560	1,530	0,626	-0,0020	125	56,2	0,228	1,63	2,38
SFM0003	4221	-	-	-	-	-	-	-	2530	8,10	-	3,9	7,900	2,330	-	-	16,2	2,800	5,90	-
SFM0003	4317	0,0056	0,037	0,008	0,022	0,0029	0,018	0,0032	31,0	7,55	0,0030	0,124	0,400	0,215	-0,0020	0,595	2,62	0,096	0,297	0,924
SFM0003	4404	-	-	-	-	-	-	-	1,75	-	0,0060	0,149	0,179	0,129	-0,0020	1,28	1,14	0,075	0,275	0,915

- = Not analysed

x = No result due to sampling problems

xx = No result due to analytical problems

- "value" = result less than detection limit

SICADA: trace\_elements, 020501-030301

**"Biochemistry related" components**

Idcode	Sample no.	Date	Time	NH <sub>4</sub> N (mg/L)	NO <sub>2</sub> N (mg/L)	NO <sub>3</sub> N+NO <sub>2</sub> N (mg/L)	N_Tot (mg/L)	P_Tot (mg/L)	PO <sub>4</sub> P (mg/L)	POP (mg/L)	PON (mg/L)	SiO <sub>2</sub> Si (mg/L)	POC (mg/L)	TOC (mg/L)	DOC (mg/L)	DIC (mg/L)
SFM0001	4219	2002-07-18	11:00	0,170	-	0,0511	1,18	0,0484	0,0174	0,0188	0,0298	4,75	0,967	22,3	17,0	45,2
SFM0001	4316	2002-09-20	10:30	-	-	-	-	-	-	-	-	-	-	6,3	7,00	59,2
SFM0001	4403	2002-12-12	11:15	0,174	0,00278	0,0686	1,25	0,0465	0,0154	7,75	0,00862	4,75	0,554	27,3	25,2	69,6
SFM0002	4220	2002-07-18	10:00	0,260	-	-	0,557	0,118	0,00440	0,0426	0,0398	1,93	3,87	15,1	15,8	45,3
SFM0002	4318	2002-09-20	14:15	-	-	-	-	-	-	-	-	-	-	7,4	7,60	68,8
SFM0002	4405	2002-12-12	13:50	0,0900	0,00113	0,00772	0,509	0,188	0,0025	-	0,0547	4,24	8,79	12,3	12,2	50,8
SFM0003	4221	2002-07-18	13:00	0,222	-	-	0,711	3,04	0,0180	1,07	-	0,711	-	11,1	13,8	66,6
SFM0003	4317	2002-09-20	12:40	0,200	-	0,0280	0,568	0,0631	0,0109	0,0196	0,00460	3,62	0,501	11,0	12,0	-
SFM0003	4404	2002-12-12	13:20	0,146	0,00204	0,00696	0,554	0,0539	0,0114	42,2	0,00813	7,82	0,902	9,55	11,2	69,8

- = Not analysed  
 x = No result due to sampling problems  
 xx = No result due to analytical problems  
 - "value" = result less than detection limit

**Isotopes II (U-, Th, Ra- and Rn-isotopes)**

Idcode	Sample no.	Date	Time	U-238 Bq/L	U235 Bq/L	U-234 Bq/L	Th-232 Bq/L	Th-230 Bq/L	Ra-226 Bq/L	Rn-222 Bq/L
SFM0001	4219	2002-07-18	11:00	-	-	-	-	-	-	-
SFM0001	4316	2002-09-20	10:30	0,1	-0,03	0,1	-0,05	-0,05	0,10	28,00
SFM0001	4403	2002-12-12	11:15	A	A	A	A	A	A	A
SFM0002	4220	2002-07-18	10:00	-	-	-	-	-	-	-
SFM0002	4318	2002-09-20	14:15	0,4	-0,03	0,4	-0,05	-0,05	0,50	47,00
SFM0002	4405	2002-12-12	13:50	A	A	A	A	A	A	A
SFM0003	4221	2002-07-18	13:00	-	-	-	-	-	-	-
SFM0003	4317	2002-09-20	12:40	0,1	-0,03	0,1	-0,05	-0,05	-0,10	26,00
SFM0003	4404	2002-12-12	13:20	A	A	A	A	A	A	A

- = Not analysed

A = Results will be reported later

x = No result due to sampling problems

xx = No result due to analytical problems

- "value" = result less than detection limit

SICADA: u\_th\_isotope\_t, ra\_rn\_isotope\_t, 020501-030301