P-03-87

Oskarshamn site investigation

Hydrochemical logging in KSH01A

Pia Wacker, Geosigma AB

April 2003

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Contents

1 Introduction

This document reports the chemical data obtained by Hydrochemical logging in the core drilled borehole KSH01A within the site investigation in Oskarshamn. The logging was performed 29:th of January 2003 according to the activity plan AP PS 400-02-032 (SKB internal controlling document). The data is reported to SICADA in field note number 37.

2 Objective and scope

The activity is performed in order to obtain a fast overview of the ground water composition along the borehole.

3 Equipment

The equipment used is illustrated in Figure 3-1: Equipment for Hydrochemical logging. The method and equipment is described in the method description SKB MD 422.001, version 1 (SKB internal controlling document).

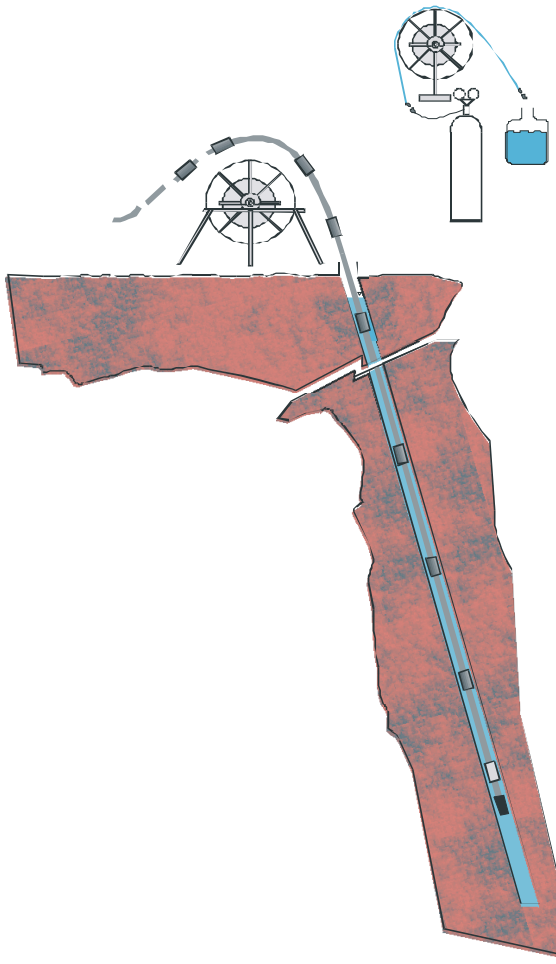

Figure 3-1. *Equipment for hydrochemical logging in boreholes.*

3.1 Description of equipment

The hydrochemical logging was performed using a 1000 meter long tube divided into 50 meter units connected to each other with couplings. A weight is placed at the end of the tube array. The length of the tube units is given in Table 3-1.

Table 3-1. Tube length.

Unit	Length [m]
1	49.9
2	49.6
3	49.6
4	49.3
5	49.2
6	49.2
7	49.7
8	50.6
9	50.3
10	49.7
11	49.7
12	49.6
13	49.9
14	49.9
15	50.0
16	50.0
17	49.3
18	50.0
19	50.1
20	49.7
Sum:	994.9
Coupling	2.8
Weight	0.82
Total tube length:	**998.5**

4 Performance

The logging was performed the 29:th of January a cloudy, windy day with temperature minus 2°C. The ground water level was measured at 09:15 to a level of 5.12 meter. The first tube unit was descending at 09:35. The uptake started at 13:40 and all tube units were lifted at 17:15. The ground water level was measured once again after the logging now to a level of 5.59 meter. The water samples from the tubes were portioned/ collected into bottles the same evening. Sample preparation and consulted laboratories are listed in the activity plan.

5 Results

Sample bottles were filled according to Table 5-1. The dashed line symbolises filled sample portions. No control samples were collected from tube units with even numbers, counting from the top of the borehole, due to lack of water. Tube unit number 11, 13, 15 and 17 were not used.

Table 5-1. Sampling.

Tubes			Sampling from even tubes						Sampling from odd tubes				
Tube	[m]	SKB:nr	pH,alk,cond	Anions	Headcomp.	Deut, O-18, Sr	Tr 37, Cl	C-13, PMC	S-34	Archives			
			250ml	250ml	100ml	100ml	1000ml	100ml	1000ml	250ml	100ml	250ml	100ml
1	1 50	5164								100ml			
2	50 100	5165											
3	100 150	5166											
4	150 200	5167											
5	200 250	5168											
6	250 300	5169											
7	300 350	5170											
8	350 400	5171											
9	400 450	5172											
10	450 500	5173											
11	500 550	0							Not used				
12	550 600	5174	Relative ion balance error										

13	600 650	0							Not used				
14	650 700	5175											
15	700 750	0							Not used				
16	750 800	5176											
17	800 850	0							Not used				
18	850 900	5177	Relative ion balance error										
19	900 950	5178											
20	950 1000	5179											

No control samples from even tube units, because of the lack of water.

One 50 m tube unit can contain 2.5 dm^3 water. The total volume water in each tube unit was less than expected. See Table 5-1, above. Tube unit 11, 13, 15 and 17 was not used and the water volume was not measured. A small grain of gravel in the back valve, placed in the end of the deepest tube, could have affected the volume of water in all the tube units when the units were lifted. The water in the two tubes units from the deepest part of the borehole showed the same colour as drilling debris. Precipitation or suspended material occurred in most of the sample bottles. The hydrochemical data from the logging are stored in the database SICADA in field note number 37. The SKB sample numbers are 5164 to 5179.

5.1 Analyse results

Results from the different analyses are shown in Figure 5-1 to 10 below. Analysis results have been plotted at the mean length of each tube. For example; tube number one with the length of 1 to 50 meter is plotted at 25 meter and so on. The results from analyses performed by the University of Waterloo are not reported yet and the present data compilation will be completed with these data later on.

Flushing water

The analysis of uranin was made the 24:th of February, almost one month after the performance of the Hydrochemical logging.

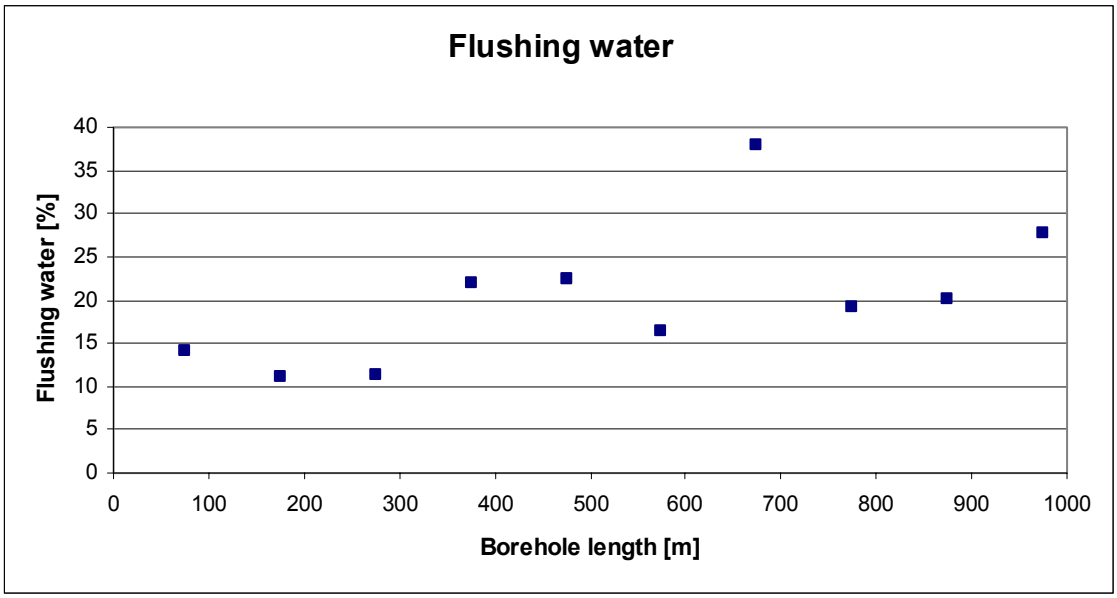

Figure 5-1. *Flushing water.*

pH

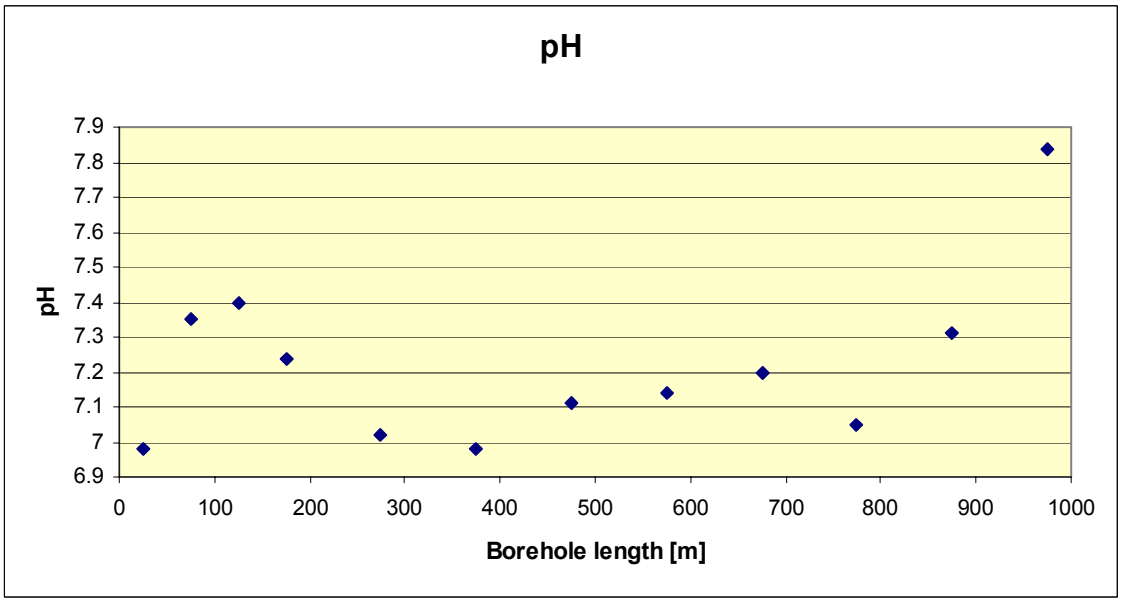

Figure 5-2. *pH.*

Electric conductivity

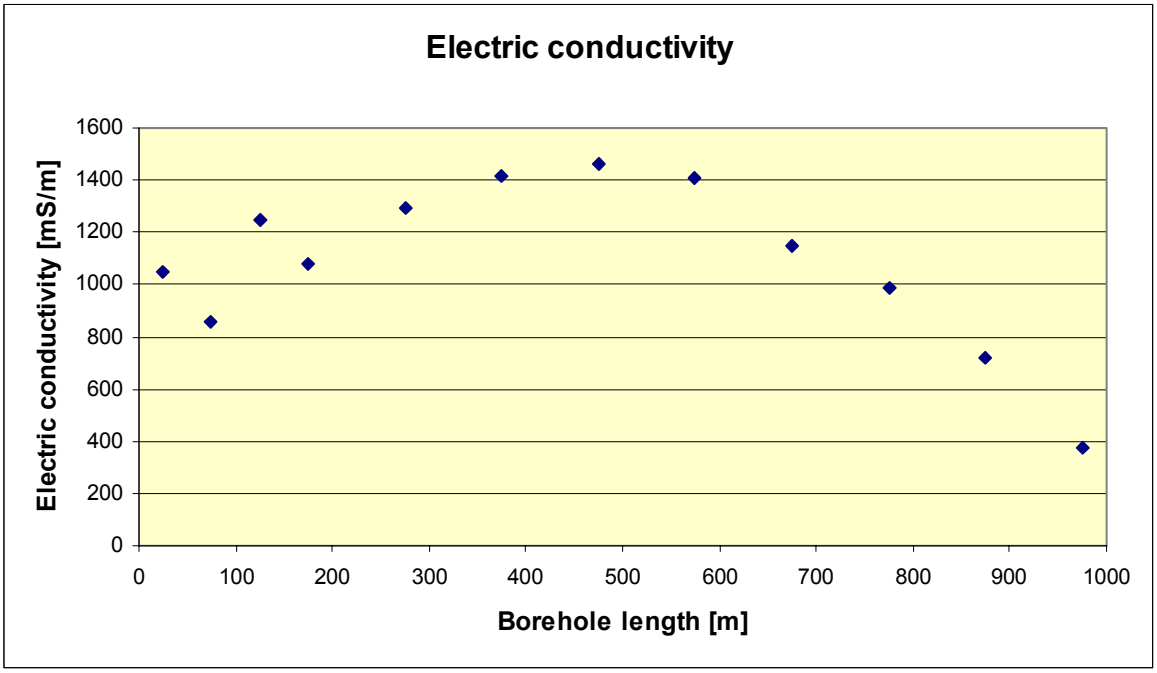

Figure 5-3. *Conductivity.*

Alkalinity

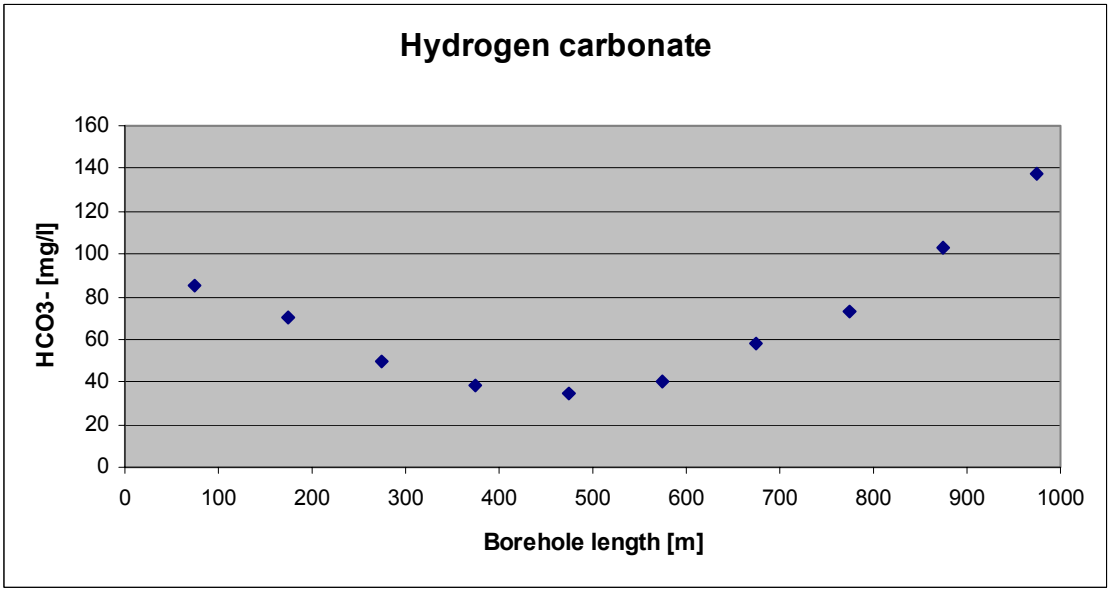

Figure 5-4. *Hydrogen carbonate.*

Ions

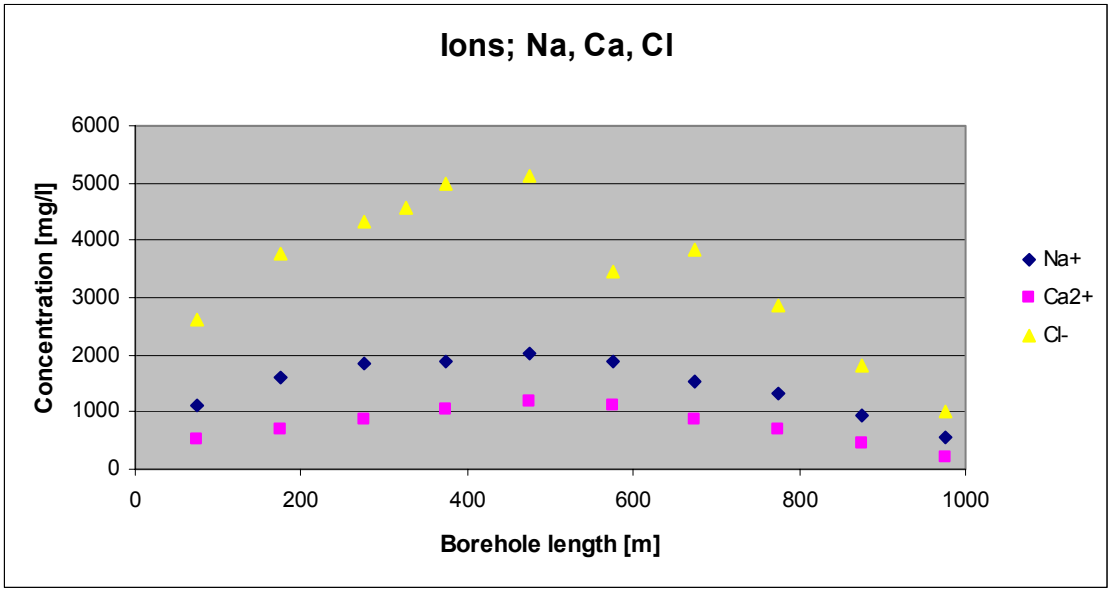

Figure 5-5. *Na, Ca and Cl.*

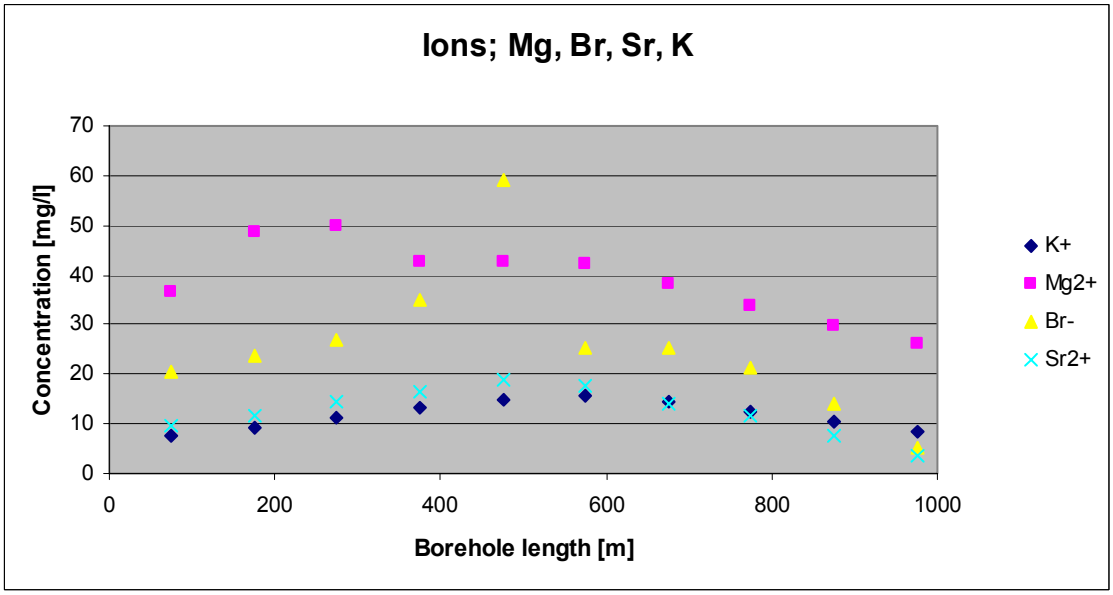

Figure 5-6. *Mg, Br, Sr and K.*

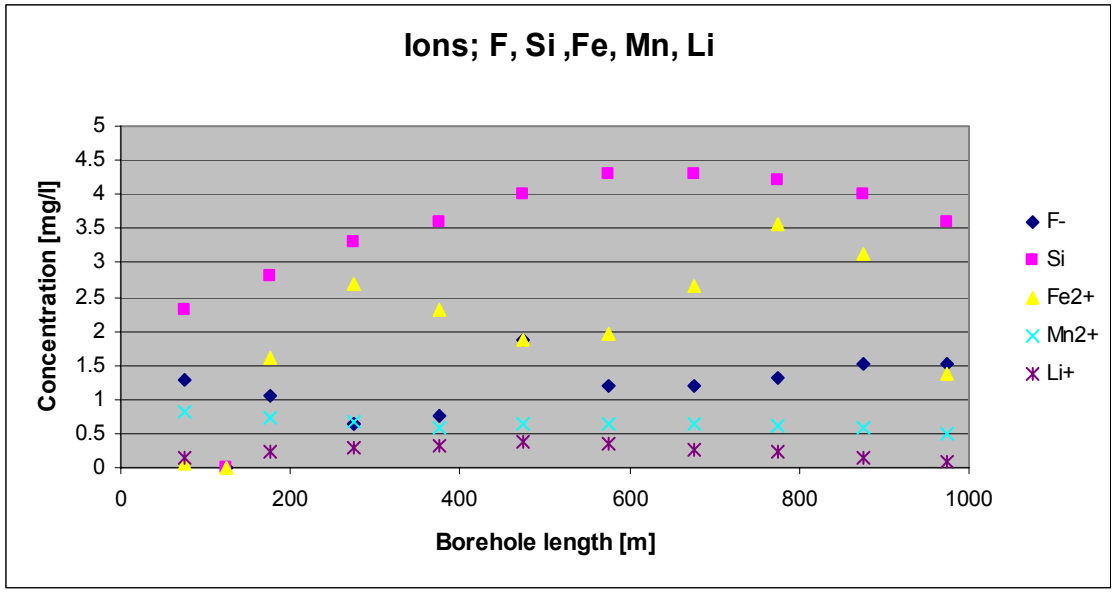

Figure 5-7. *F, Si, Fe, Mn and Li.*

Sulphur

The agreement between sulphate measured by ion chromatography and total sulphur determined by ICP AES (Inductively Coupled Plasma Atomic Emission Spectrometry) is doubtful. Three times the total sulphur value should correspond to the sulphate concentration if sulphate is the only sulphur containing component.

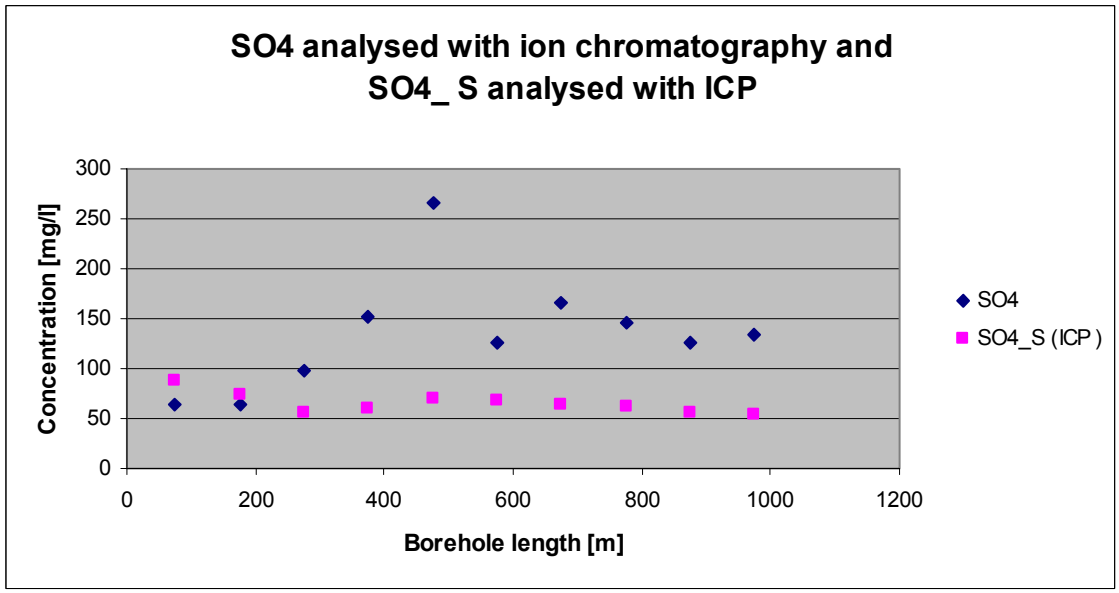

Figure 5-8. *SO_4 analysed with ion chromatography and SO_4_ S analysed with ICP.*

O-18, Deuterium

Deuterium and O-18 is given as per mill deviation from SMOW (Standard Mean Oceanic Water).

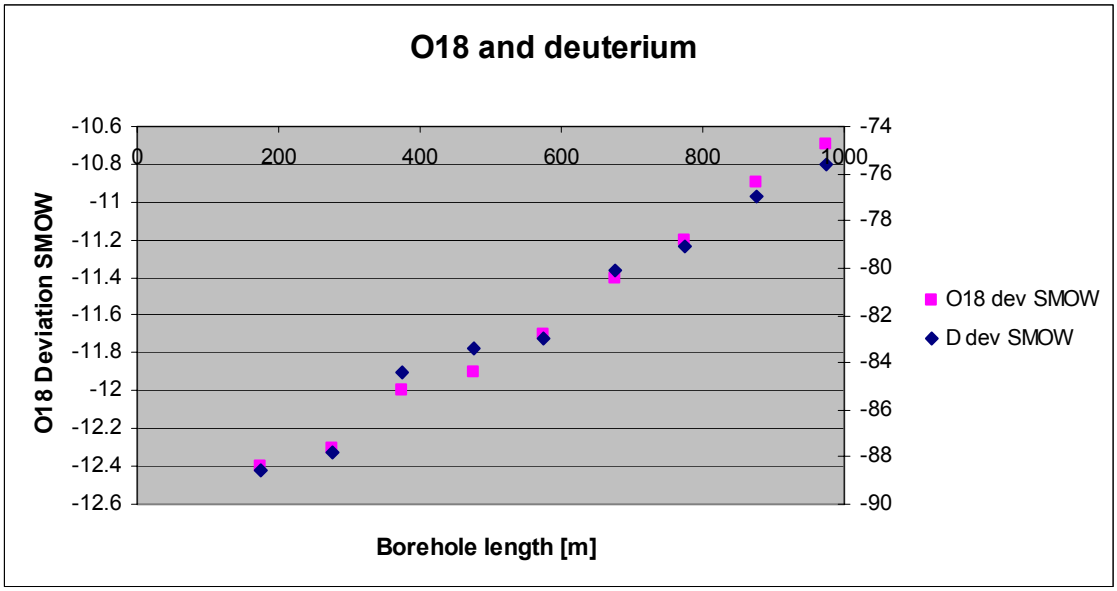

Figure 5-9. *O18 and deuterium.*

Atomic B10/B11, S34 CDT, Sr87/Sr86

Analysis results show constant B10/B11 and Sr87/Sr86 along the borehole and S34 differ only slightly. The S34 is given as the standard Cañon Diablo Triolite, CDT.

Table 5-2. B10/B11, S34 and Sr87/Sr86.

Mean length	B10/B11	S34 dev CDT	Sr87/Sr86
25		20.8	
75	0.2357		
125		20.9	
175	0.2373		0.715039
225		21.1	
275	0.2393		0.715184
325		19.6	
375	0.2401		0.715366
425		19.5	
475	0.2409		0.715431
575	0.2408		0.715467
675	0.2414		0.715529
775	0.2405		0.715532
875	0.2409		0.715525
925		21.2	
975	0.2407		0.715467

6 Conclusion

The relative charge balance errors of sample number 5174 and 5177 from tube number 12 and 18 are higher than acceptable. This is probably due to that the concentrations of chloride are erroneous. The values seam to be to low especially considering the electric conductivity.

The analysis of uranin was, due to a misunderstanding at SKB, made the 24:th of February, almost one month after the performance of the Hydrochemical logging. The delay could have affected the analysis results of uranin, the volume of flushing water in the borehole.

Appendix 1

Water composition

IDCODE	Sample 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	F mg/L	Si mg/L	Fe mg/L	Mn mg/L
KSH01A	5164													
KSH01A	5165	1130	7,56	535	36,5	85	2613,9	63,78	88,9	20,41	1,29	2,3	0,068	0,81
KSH01A	5166													
KSH01A	5167	1610	9,13	692	48,5	70	3781,9	63,5	74,5	23,82	1,06	2,8	1,6	0,72
KSH01A	5168													
KSH01A	5169	1850	11,1	881	49,9	50	4311,1	98,94	55,7	26,83	0,64	3,3	2,69	0,66
KSH01A	5170						4559,3							
KSH01A	5171	1890	13,1	1030	42,6	38	4986,5	151,26	60,6	35,2	0,75	3,6	2,3	0,59
KSH01A	5172													
KSH01A	5173	2010	14,8	1180	42,7	35	5138	265,12	70,2	59,23	1,88	4	1,87	0,63
KSH01A	5174	1880	15,6	1100	42,2	40	3445,3	125,08	68,9	25,47	1,2	4,3	1,96	0,65
KSH01A	5175	1530	14,4	858	38,4	58	3826,3	165,1	64,4	25,52	1,2	4,3	2,65	0,64
KSH01A	5176	1310	12,5	705	33,9	73	2865,7	145,19	62,1	21,43	1,32	4,2	3,58	0,62
KSH01A	5177	938	10,4	451	29,8	103	1830,1	126,11	56	14,09	1,53	4	3,12	0,58
KSH01A	5178													
KSH01A	5179	558	8,5	206	26	138	1028,1	134,8	53,4	5,43	1,52	3,6	1,36	0,51

IDCODE	Sample no.	Li mg/L	Sr mg/L	pH	ElCond mS/m	Flushing water %	D dev SMOW	O18 dev SMOW	B10/B11	S34 dev CDT	SR87/ SR86
KSH01A	5164			6,98	1049					20,8	
KSH01A	5165	0,16	9,5	7,35	861	14,09			0,24		
KSH01A	5166			7,4	1247					20,9	
KSH01A	5167	0,224	11,5	7,24	1079	11,19	-88,6	-12,4	0,24		0,72
KSH01A	5168									21,1	
KSH01A	5169	0,279	14,4	7,02	1295	11,24			0,24		0,72
KSH01A	5170						-87,8	-12,3		19,6	
KSH01A	5171	0,323	16,5	6,98	1416	21,96	-84,4	-12	0,24		0,72
KSH01A	5172									19,5	
KSH01A	5173	0,366	18,8	7,11	1465	22,52	-83,4	-11,9	0,24		0,72
KSH01A	5174	0,348	17,6	7,14	1411	16,47	-83	-11,7	0,24		0,72
KSH01A	5175	0,275	14	7,2	1150	37,86	-80,1	-11,4	0,24		0,72
KSH01A	5176	0,225	11,7	7,05	991	19,12	-79,1	-11,2	0,24		0,72
KSH01A	5177	0,149	7,58	7,31	722	20,04	-77	-10,9	0,24		0,72
KSH01A	5178									21,2	
KSH01A	5179	0,074	3,46	7,84	376,8	27,66	-75,6	-10,7	0,24		0,72