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Analysis of groundwater from deep boreholes in Kamlunge

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A list of other reports published in this series during 1983 is attached at the end of this report. Information on KBS technical reports from 1977-1978 (TR 121), 1979 (TR 79-28), 1980 (TR 80-26), 1981 (TR 81-17) and 1982 (TR 82-28) is available through SKBF/KBS.

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SUMMARY

Groundwater from four boreholes in granitic rock at an investigation site in Kamlunge has been sampled and analysed. This is part of a larger program of geological, geophysical and hydrogeological investigations aimed at finding a suitable site for a high level radioactive waste repository.

One to four water-bearing levels in each borehole between a depth of 100 and 600 m were selected. Prior to sampling, the water-bearing level is isolated between packer sleeves. The water is then pumped to the surface where sensitive parameters such as redox potential, pH, sulphide and oxygen content are measured electrochemically on the flowing water in a system isolated from the air. Water, filter and gas samples are sent to several laboratories for further analysis.

The present report is a presentation of the results of the groundwater analyses. The reliabilty of the results is discussed but there is no evaluation in relation to geology and hydrogeology. This report presents the basic results from the groundwater analyses to be further evaluated by experts in different fields.

CONTENTS

1 INTRODUCTION

Groundwater from four boreholes in Kamlunge has been sampled and analyzed. Boreholes KM3, KM8 and KM13 are core boreholes and KM20 (also called HB20) is a percussion-drilled borehole. The sampling levels were chosen on the basis of hydrological measurements in the boreholes. Sampling was carried out by Sveriges Geologiska AB. Personnel from IPK and VIAK performed the field measurements and sampling. Several laboratories participated in the water analysis (see below).

The boreholes were pumped out with a gas lift prior to the hydrological investigation and immediately before the equipment for water sampling was lowered to the first sampling level. On the latter occasion, three such gas lift pumpings - called mammoth pumpings - were performed in a row. Iodide (NaI, 0.01 mmol/l) was added to the drilling water during drilling to enable any residual drilling water to be traced in the groundwater. The selected fracture zones were sealed off by packers spaced at a distance of 2.7 m.

Sampling was carried out in KM3 (2 levels) from December 1982 to February 1983, in KM8 (1 level) during May-June 1983, in KM13 (4 levels) in March-June 1983 and in KM20 (1 level) during April 1983. Depth is given both as vertical depth (depth) and/or borehole length (length). It is always vertical depth that is given, unless otherwise specified in the table heading.

The work was carried out in periods of 14 days - 4 days off while the sampling pump works and 9 days field measurement and water sampling. The sampling took place in two consecutive work periods at all levels except KM13, 197 and 564 m, which were only sampled during one period. Lowering to a new level is done on the last day of a work period.

The present report consists primarily of a presentation of the results of the groundwater analyses. The reliability of the results is subjected to some scrutiny. There is, however, no further evaluation in relation to geology or hydrogeology. The material in this report will be further analyzed by experts in different fields.

The geology and hydrogeology of the study area are described in KBS TR 83-55.

A general description of the chemistry of groundwater from great depths in granite and gneiss has previously been published by G Jacks (KBS TR 88). The same author has also described the chemistry of groundwater in Blekinge (KBS TR 79-07), where Sternö is situated. The results of analyses of the groundwater from the Finnsjö, Gideå, Fjällveden and Svartboberget areas are presented in KBS TR 82-23, 83-17, 83-19 and 83-41, respectively. A summary and description of the groundwater chemistry in these areas has been published by Bert Allard et al (KBS TR 83-59). A geochemical evaluation of fracture minerals and the relation between fracture minerals and groundwater composition in Finnsjön has been published by E-L Tullborg and co-workers in KBS TR 82-20. The relationship between pH and carbonate content in deep groundwaters has been discussed by Bert Allard in KBS TR 82-25. The expected groundwater composition and its importance for the final storage of radioactive waste have been discussed in KBS TR 90 and the final report KBS-2 Volume 2 (Handling and Final Storage of Unreprocessed Spent Nuclear Fuel, Technical Volume). Hydrology and groundwater age are also taken up in the latter report. The sampling equipment is described in KBS TR 83-44.

2 SAMPLING

2.1 Drilling water

Some of the drilling water that is used in the core drilling of the sampling holes can penetrate into fractures and contaminate the groundwater there. In order to get rid of the drilling water to as great an extent as possible prior to sampling, three mammoth pumpings (using nitrogen gas) are performed immediately prior to installation of the sampling equipment.

The sampling equipment (2.2) is lowered to the chosen level and allowed to work for 3-4 days before sampling begins. Periodic sampling during a period of 8-9 days makes it possible to follow changes in the composition of the water that might derive from drilling water or some other source of contamination. The changes may also be due to the incursion of water from different aquifers.

Water from percussion-drilled boreholes has been used as drilling water. The drilling water was filtered through mechanical filters of cellulose (18 CMC 3-2), which are supposed to retain particles with diameters larger than 5 μm. The filtered drilling water was then analyzed. The results of the drilling water analyses from the entire Kamlunge area are presented in table 10. The borehole and its length at the time of sampling are given in the table. The results for the water to KM13 are also given at the bottom of tables 6-9b.

Before the drilling water was used, it was "marked" by the addition of 0.01 mmol/l (1.3 mg/l) sodium iodide in order to make it possible to trace any drilling water that may have contaminated the sampled water. Unfortunately, it has been found that both the drilling water and sampled groundwater can sometimes have considerable contents of natural iodide (KBS TR 83-17). 3×10^{-4} mg iodide per mg chloride has been observed in Stripa.

The drilling water for KM3 was taken from a percussion-drilled borehole only about 10 m from the core borehole. According to the iodide analysis of the water from the percussion-drilled borehole, drilling water intruded into this borehole to such an extent that up to 40% of the drilling water may have been recirculated. Iodide contents of up to 2.0 mg/l have therefore been found in the drilling water at KM3.

The analyzed drilling waters are presented in table 10. As can be seen, all iodide concentrations are low compared to the concentrations measured in the sample waters (table 9). For this sample material, the iodide concentration should therefore provide a good picture of the contamination of the sampled waters with drilling water, especially since the sampled waters all have a low chloride content. It should be noted, however, that the iodide content in KM20, which is a low-lying percussion-drilled borehole, is unexpectedly high. Since no drilling water has been used, this must be a naturally high concentration or a very massive contamination from core boreholes within the area. The total water flow at KM20 was 30-50 l/min (2.2).

2.2 Sampling equipment

Core boreholes KM3, KM8 and KM13 are drilled with a diameter of 56 mm. The 2.7 m long sampling zone is sealed off by rubber packers that are expanded to a pressure that is 0.8-1 MPa above the groundwater pressure. The KM13, 564 m zone is sealed off by one packer, and sampling has taken place between this packer and the bottom at about 580 m. The sampling pump is positioned immediately above the sealed-off zone. The intake is from the upper part of the zone. The pump, which is made of steel and furnished with teflon seals, has a capacity of 0.12 l/stroke and pumps 300-390 l/d. The water flow at some levels is lower due to the fact that the flow of water in the rock is lower than the capacity of the pump. A schematic illustration of the sampling pump and packers is shown in Fig. 1.

Sampling at the percussion-drilled borehole was done in the same manner within a 3 m long zone sealed off by packers. The water flow rate was, however, so great (30-50 l/min) that only a portion of the water was conducted via the test chamber. The flow given in the table (2.3) pertains solely to the flow through the test chamber. It has not been possible to calculate the total flow.

The water is pumped up through polyethylene-lined iron pipes to a test chamber of stainless steel on the ground surface. The test chamber is equipped with electrodes and measuring cells for recording pH, Eh (glassy carbon), Eh (platinum), pS, oxygen content and conductivity. The test chamber is also equipped with valves for the extraction of water samples.

The equipment has been augmented with an extra measuring chamber of glass, which is positioned between the borehole and the test chamber as described above. It is equipped with 2 Eh electrodes of the same kind as those in the test chamber (glassy carbon and platinum). In order to give these electrodes plenty of time to stabilize, they are not calibrated and they are only cleaned when the level is changed. The measurement results are given under "ex" in tables 1-4.

2.3 Water flow during sampling

The water flow at different levels is shown in the table below. The approximate pumped-up water volume has also been calculated - "F 1" is the quantity of water before and "P 1" during the first period, "F 2" is the quantity of water between the periods and "P 2" during the second period. The mean flow and the total quantity of water during the entire measuring period have also been calculated. Disturbances in the work at the boreholes are described in the notes to the table.

BH	Depth m	Mean flow l/d	F 1 m^3	P 1 m^3	F 2 m^3	P 2 m^3	Total m^3	Notes
KM3	106	325	1.9	2.2	1.9	2.9	8.9	
	376	315	-	2.5	4.1	2.6	>9	1
KM8	198	365	-	3.1	1.8	3.1	>8	2
KM13	197	125	-	1.4	-	-	>1	3
	432	165	2.3	1.5	-	1.1	>5	4
	556	160	-	1.0	0.9	1.5	>3	5
	564	250	-	1.8	-	-	>2	
KM20	146	320						6

Note 1 The high value of F2 is due to the fact that the pump ran during a long leave period at Christmastime. A problem occurred with a non-return valve on day 50-7, which caused pressure variations in the test chamber.

Note 2 A problem with the generator caused two-hour long pump stoppages on day 20-6.

On day 20-7, the pressure in the packers was adjusted from 400 to 700 kPa.

Note 3 Power outage for 2.5 h on day 24-5.

Note 4 There was no pressure in the packers on the morning of day 18-1.

The pump stopped during the work pause between the sampling periods. The disturbances continued through day 20-4.

Pump stoppage again on the night before 20-6.

Note 5 The pump worked poorly. No continuous pumping until day 12-3.

Note 6 Power outage on night before 15-6.

The packer pressure was increased on day 16-3 from 770 to 1020 kPa.

Pump stoppages of 30 minutes or less are not noted. Such short stoppages are usually due to oil changes or other routine measures on the generator.

3 FIELD MEASUREMENTS

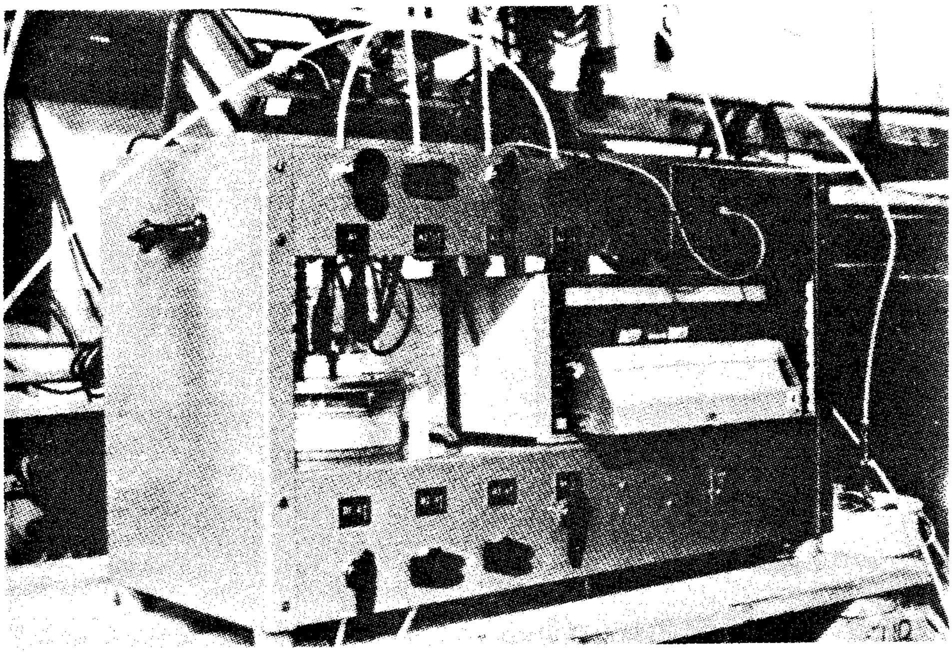
The field measurements are recorded in tables 1-4, the E^0 values obtained from the field calculations in table 5 and the field values obtained during water sampling in table 6.

The photograph below shows the field equipment with test chamber, measuring equipment and valves for water sampling.

3.1 Calibrations

Each calibration has been assigned a calibration number. Measurements made after the calibration have the same number. All calibration solutions are freshly prepared from concentrate and deaerated distilled water, except the one used for calibration of the conductivity cell. During calibration, the solutions are circulated through the test chamber.

Three buffer solutions with pH 4, 7 and 10 are used for calibration of the pH electrode. Quinhydrone is added to the buffer solutions with pH 4 and 7 for simultaneous calibration of the Eh



electrodes. Concentrate diluted to solutions that are 0.01 and 0.05 moler with respect to sulphide ion is used for calibration of the sulphide electrode. The E^{o} values obtained are presented in table 5.

If a calibration shows that the electrodes have to be cleaned, the reading before the cleaning is normally also noted in order to document the condition of the electrodes immediately prior to the calibration. For the same purpose, the work on a level is usually concluded with a calibration without cleaning of the electrodes. Such calibrations are marked with an asterisk after the calibration number in table 5.

The oxygen probe is calibrated against air-saturated distilled water and the conductivity cell against 0.01 and 0.1 mol/l KCl.

3.2 Measurement results

Each measuring occasion is identified with a calibration number, borehole designation, length of borehole (core length) as well as day and time. The vertical depths corresponding to the borehole lengths are shown in the table below. The percussion-drilled borehole KM20 is vertical.

Bore-hole	Length m	Depth m	Bore-hole	Length m	Depth m
KM3	123	106	KM13	230	197
	445	376		514	432
				670	556
KM8	238	198		680	564

Owing to the fact that it takes some time after each calibration before the water in the test chamber is representative of the borehole water and before the Eh and pS values have stabilized, no measurement results have been included until at least 24 hours after the calibration - in general, from and including the second day after calibration. Nor are values included that have been obtained from obviously unsuccessful measurements owing to problems encountered in the field.

3.3 Temperature measurement

The temperature is measured in the test chamber to permit calibration and calculation of the electrode potentials.

Owing to the relatively slow rate of water turnover in the test chamber, the temperature measured is not representative of the groundwater. It is therefore not reported.

3.4 Measurement of pH, Eh and pS

The system often seems to need to remain undisturbed for at least a week before the Eh and pS values are more or less stable. The pH value normally stabilizes much faster.

The calibrations show that the electrodes must be cleaned relatively frequently. Normally, they are cleaned when they are lowered to a new level. The electrodes were also cleaned immediately after the calibrations marked with an asterisk in table 5.

3.5 Oxygen measurement with probe

It would appear that the oxygen probe has to be calibrated more frequently than is possible with a view towards the other electrodes. The condition of the probe prior to a new calibration was checked by making a reading in air-saturated water prior to cleaning and membrane change, if any. If the error was greater than 20%, the values obtained prior to the calibration were omitted.

3.6 Measurement of conductivity

The conductivity measurements were consistently stable. Calibration was done at the beginning of each level.

4 MAIN COMPONENTS OF THE WATER

Each sampling occasion has been assigned a unique sampling number which is the same for all samples taken on the same occasion ("No." in the tables).

The main components were analyzed by SGAB's water laboratory in Uppsala and by Hydroconsult in Stockholm. The TOC analyses were mainly done at IVL in Stockholm and the filters were analyzed at SGAB in Luleå. The analysis results are reported in tables 5-8. Drilling water (table 10) was analyzed by SGAB in Uppsala.

The following analysis methods were used in the water analysis:

pH, conductivity and turbidity (Hydroconsult), conventionally according to Swedish Standard (SS).

Sulphide (Hydroconsult), colorimetrically on Zn-preserved specimen (SS).

Sodium and potassium (Hydroconsult), emission with flame.

Iron(II) (SGAB), colorimetrically with o-phenanthroline.

Other metals in water (SGAB), optical emission with ICP.

Iron, aluminium and sulphur on filter (SGAB), X-ray fluorescence.

Nutrient salts (Hydroconsult), colorimetrically according to SS.

Bicarbonate, chloride and fluoride (Hydroconsult), titrimetrically according to SS.

Sulphate (Hydroconsult), gravimetrically (>100 mg/l) or turbidimetrically.

TOC, carbon analyzer (Astro at IVL, Carlo Erba at SGAB).

Silicon dioxide, colorimetrically with methylene blue.

Iodide, potentiometrically or colorimetrically (<5 g/l).

In addition to the date of the sampling and of the arrival of the sample at the laboratory, the field values obtained simultaneously with the water sampling and the laboratory analyses of the same parameters are presented in table 6. Note that the field values, which are measured during water sampling, are often not representative of the borehole. Sampling may, for example, have been done immediately after a calibration.

All determinations of metals are presented in table 7. Parameters that contain nitrogen are compiled in table 8 and other anions as well as TOC, turbidity and silicic acid are presented in table 9.

4.1 Sampling

The water samples were taken through a valve immediately after the test chamber. On each sampling occasion, a new tube, kept well protected from dust, was attached to the valve. The free and untouched end of the tube was inserted down to the bottom of the sample bottle. At least two bottle volumes of sample water were allowed to run over before the bottle was sealed, without any air having been trapped inside. The samples were kept in a refrigerator awaiting transport (4.2).

4.1.1 Unpreserved samples

Unpreserved samples for analysis of negative ions etc. were taken in bottles of borosilicate glass (1 litre) with a ground, filled stopper held in place with a steel clip. The bottles were stored and transported upside-down. In this manner, the moisture in the pores in the ground surface was preserved, preventing air from leaking into the sample.

4.1.2 Preserved samples

Preserved samples for analysis of metal ions were taken in acid-washed polyethylene bottles (250 ml).

The samples were preserved with 2.5 ml of concentrated hydrochloric acid (super-pure). The acid was added through a dispenser below the sample surface immediately before the sample bottle was sealed. Hydrochloric acid was chosen as a preservative because iron(II) was to be determined.

Only occasionally are the analysis results specified to more than two decimal places. No adjustment has therefore been made for dilution of the samples with acid.

4.1.3 Filtration

Filtration through a Nuclepore membrane filter with a pore diameter of 0.4 µm was done on each sampling occasion. The filter was thereby attached immediately after the test chamber. The total quantity of filtrate was measured and recorded. The volume varied between 200 and 2300 ml.

The first water that passed the filter was discarded, after which a 250 ml polyethylene bottle containing 2.5 ml concentrated hydrochloric acid was filled (if possible) with filtrate. Iron(II and total) was determined in the filtrate. The total quantity of aluminium, iron and sulphur was determined on the filter and the concentration in the water was calculated (table 7).

A millipore filter (0.45 µm) was used at KM13, 556 m and for sample Nos. 344-348 and 441-44.

4.2 Transport of samples

The samples were packed in specially-made insulated boxes with frozen cooler blocks. The boxes were mailed "express" on the afternoon of the sampling day and delivered to the laboratory the following morning. No water sampling took place on Fridays and Saturdays, since the samples could then not be taken care of by the laboratory until Monday or Tuesday. The Sunday samples were sent together with the Monday samples.

4.3 Sampling levels

The concentrations within the levels are generally more or less consistent. More or less pronounced trends can frequently be seen. The concentrations at all levels in KM13 change, for example, with the pumping time.

The change in the two uppermost levels in KM13 is particularly marked, where all concentrations except manganese and bicarbonate increase - the concentrations doubled during the pumping period at 432 m. The concentrations of calcium and sulphate are unusually high at these levels, while the concentrations of sodium and chloride are low in the entire borehole. Strangely enough, iodide exhibits the sharpest concentration change, with an increase in concentration by more than 3-5 times. This would correspond to an increase of drilling water contamination from 3 to 15% at the 197 m level and from 4.5 to 12% at the 432 m level, which is certainly not noticeable in other parameters.

At KM13 556 m, a marked anomaly occurs between sample Nos. 354 and 355, i.e. during the period of leave between the sampling periods. The potential changes from negative to positive and several parameters reach extreme values in samples 355 and 356.

KM3, 376 m shows an unusually large and somewhat remarkable scatter in several parameters (see e.g. 4.7), and the first two samples in KM13, 564 m fall "outside the trend".

4.4 pH

pH was determined directly in the field and at a laboratory (table 6). The scatter of the field values in KM8 and KM13 is significantly greater than that of the laboratory values. The field values are systematically around 0.2 pH units higher than the laboratory values. Approximately the same difference has been found in many groundwater studies.

The most alkaline water with pH (lab) 7.7-8.6 is in KM3 and the most acid with pH (lab) 6.0-6.2 in KM8. KM13, 556 m and KM20 also have pH values that do not exceed 6.7.

4.5 Conductivity

Conductivity was determined both in the field and in the laboratory. The laboratory values have a greater scatter within the levels than the field values. This is particularly marked at KM20, where the standard variation for the laboratory values is 37%, while it is only 0.7% for the field values. The standard variation for the bicarbonate analyses is also large (18%) - in both cases, the last two samples have the highest values.

4.6 Organic carbon (TOC)

The concentrations are low (usually 1.5-3 mg/l), except in KM13, where the concentrations are consistently high, which is probably due to the fact that diesel oil was spilled in the borehole during the work phase prior to sampling. During the work to save an umbilical hose unit, soft soap was also introduced into the borehole. Strangely enough, however, the highest concentrations are found at the lowermost level, which was sampled after the 432 m and the 556 m levels.

4.7 Negative ions

The negative ions are compiled in tables 7 and 8. The results generally show good consistency within the sample zones, even where trends occur.

Samples 331 and 335 (KM3, 376 m) have exceptionally high concentrations of nitrate, at the same time as the concentration of iron(II) is also exceptionally high. In sample 475 (KM13, 432 m) a slightly elevated nitrate concentration is matched by low concentrations of iron(II).

The nitrate concentration in sample 488 (KM13, 197 m) is five times higher than any other sample within the level. The concentration has been confirmed by the laboratory. However, the possibility of contamination in connection with sampling cannot be excluded.

The greatest scatter in bicarbonate concentration within a level is found in KM20 (see 4.5), where the phosphate content of two samples is also unexpectedly low.

4.8 Positive ions

The positive ions are compiled in table 7. Agreement within the levels is generally good.

Besides the anomalies that have already been mentioned above, it should be pointed out that iron(II and total) in the unfiltered samples from KM13, 197 m, with the exception of No. 489, exhibit the opposite trend to the filtered samples, which is verified by the trend for the particulate iron - where, however, No. 489 falls into the pattern.

5 PARTICULATE MATTER

The particulate matter was subjected to several different types of analyses (5.1-5.5).

5.1 Chemical composition

The water was filtered through a membrane filter (4.1.3). Iron (II and total) was determined in the filtrate and iron, aluminium and sulphur on the membrane. The results are presented in table 7. The concentrations are reported as mg/l of filtered sample.

5.2 Turbidity

Turbidity (table 8) was determined for all samples except the five that were taken first (KM3, 376 m). With the exception of a few samples from the two deepest levels in KM13, all turbidities are below 10 NTU. Only in the sample from the 564 m level is the high turbidity matched by an elevated concentration of particulate matter according to 5.1.

5.3 Particle distribution

The particle distribution within the range 2-80 µm was determined at all levels. The determination was performed by VIAK´s water pollution research laboratory in Stockholm. The results are shown by curves in figs. 2-15.

5.4 Humic and fulvic acids

The determination was performed at Batelle, USA, through combined dialysis and gel film chromatography (GFC). The method, which fractionates the sample into humic acids and four molecular weight fractions of fulvic acid, is described by Means et al 1977 (Limnol. Oceanogr., 22, 957-965). Sodium tetraborate (pH 9.1) was used on recommendation by Swift and Posner 1971 (J. Soil Science, 22, 237-249).

The samples were concentrated ten times before analysis. No loss of volatile organic matter was found in connection with the concentration process.

Borehole	Depth m	No.	TOC mg/l	HA[a] %	Molecular weight
KM3	376	335	0.28	80	>700
KM8	198	460	0.42	85	>700

[a]Humic acid fraction of TOC content.

According to Means the organic content of the above refered samples from KM3 and KM8 consists mainly of polymeric humic acid substances.

6 ISOTOPE ANALYSIS

Isotope analysis of light substances in the water is done mainly to permit calculations of the age and origin of the water. The heavy radioactive substances are determined primarily because the natural background concentrations are of great interest for the KBS project.

The analyses were carried out at the following laboratories:

Laboratory for Isotope Geology, Stockholm (6.1, 6.3)
Mass Spectrometry Laboratory, Uppsala University (6.2)
Studsvik Energiteknik, Nyköping, Sweden (6.4)

6.1 Carbon isotopes

The determination was used for dating by means of the carbon 14 method. The water's contents of carbon dioxide and carbonate have to be concentrated before the determination. It is thereby of the utmost importance that the concentrate not be contaminated by carbon-containing chemicals or contact with air.

6.1.1 Sample preparation

Sample preparation is done in the field. A polyethylene barrel holding 130 l and filled from the beginning with nitrogen is filled with water. Hydrochloric acid is added to disintegrate carbonates present in the water. A nitrogen gas stream is then used to drive the carbon dioxide over to a wash bottle containing carbonate-free sodium hydroxide.

6.1.2 Groundwater age

Groundwater age is presented in the table below as "Age BP" and after correction for C-13 content as "Age BP, corr".

Borehole	Depth m	No.	Age BP	Age BP corr	C-13 o/oo	
KM3	106	343	3535	3575	-22.5	
KM3	106	348	3310	3375	-21.1	Note 1
KM3	376	338	2910	2985	-20.3	Note 2
KM8	198	459	<250	<250	-25.9	
KM13	197	489	7260	7365	-18.3	
KM13	432	474	5755	5925	-14.7	
KM13	432	477	6335	6460	-14.2	
KM13	556	352	835	860	-23.5	
KM13	556	358	975	1015	-22.6	
KM13	564	484	785	800	-24.0	

Note 1 The volume increased in the adsorption bottle during concentration in the field.

Note 2 Bottle damaged during transport. Air in sample.

6.2 Oxygen-18

The analyses can furnish information on the climatic conditions prevailing at the time of infiltration.

The concentrations in the table refer to deviations in per mill from SMOW (Standard Mean Oceanic Water).

Borehole	Depth m	Length m	No.	0-18 o/oo
KM3	106	123	343	-13.66
KM3	106	123	348	-13.76
KM3	376	445	335	-13.78
KM3	376	445	338	-13.76
KM8	198	238	460	-14.57
KM13	197	230	489	-13.72
KM13	432	514	474	-13.49
KM13	432	514	478	-14.17
KM13	556	670	353	-13.61
KM13	556	670	359	-14.90
KM13	564	680	484	-15.04
KM20	146	146	445	-13.64
KM20	146	146	450	-13.72

6.3 Tritium

Owing to its short half-life (about 12 years) tritium is an important isotope in hydrologic studies. The amount of tritium in the atmosphere has increased drastically due to experiments with nuclear fission. The tritium content of rainwater has increased by more than 10 times, which makes it possible to determine whether "young" water is present in a groundwater sample.

The tritium content is given in the tables in the unit TU, which is the number of tritium atoms per 10^{18} hydrogen atoms.

It should be noted that the tritium content at depth is consistently higher than would be expected. The presence of drilling water residues measured by the remaining quantities of the iodine marker does not explain this. One possible explanation is that surface water or young near surface water has infiltrated during the time the borehole have been standing open after drilling and before sampling which is usually 2-3 months. Another possible explanation is that young water standing in the borehole has accidentaly circumvented the packer system and mixed with

The tritium content in the sampled groundwaters:

Borehole	Depth m	No.	Tr TU
KM3	106	339	36±2
KM3	106	341	48±2
KM3	106	343	49±2
KM3	106	345	35±2
KM3	106	347	49±2
KM3	106	348	39±2
KM3	376	331	51±3
KM3	376	333	37±2
KM3	376	335	56±3
KM3	376	336	48±2
KM3	376	338	56±3
KM8	198	451	28±1
KM8	198	454	20±1
KM8	198	456	34±2
KM8	198	458	24±1
KM8	198	460	30±1
KM13	197	485	18±1
KM13	197	487	10±1
KM13	197	489	9±1
KM13	432	360	29±1
KM13	432	473	25±1
KM13	432	474	28±1
KM13	432	475	21±1
KM13	432	477	26±1
KM13	432	479	18±1
KM13	556	349	33±2
KM13	556	351	31±2
KM13	556	354	43±2
KM13	556	355	40±2
KM13	556	357	37±2
KM13	556	359	39±2
KM13	564	480	29±1
KM13	564	482	30±1
KM13	564	484	25±1
KM20	146	442	26±1
KM20	146	443	22±1
KM20	146	445	28±1
KM20	146	446	21±1
KM20	146	450	22±2

the relevant water from the sampling zone. This latter explanation is supported by the observation in Kamlunge that pumping frequency may affect field parameters like Eh, pS, pO_2 and conductivity.

For KM20 the situation is different. This is a percussion-drilled hole in an area where probably a fairly rapid natural connection with the surface waters exists, which is indicated by the occurrence of ammonium ions (see table 8c) and iodine (see table 9 c). Iodine marked water is not used in this drilling procedure and ammonium concentrations is usually very low at this depth.

The tritium content in all analyzed drilling waters from the area is presented below. Drilling water is taken from percussion-drilled boreholes. The core borehole where the drilling waters are used, as well as the length of the core borehole at the time of sampling, are given.

Borehole	Length m	Tr TU
KM2	106	48±2
KM2	492	46±2
KM3	139	48±2
KM3	463	51±2
KM4	509	68±3
KM9	0	51±2
KM12	630	52±3
KM13	216	49±2
KM13	500	35±2
KM14	175	38±2
KM14	500	41±2

6.4 Uranium, thorium, radium and radon

The natural concentration of these elements in the groundwater is of great interest for the project. The following results were obtained:

Bore-hole	Depth m	No.	Th µg/l	U Bq/l	Ra-226 Bq/l	Rn-222 Bq/l
KM3	106	343	< 1.1 E-1	(3.03±0.08)E-1	(5.9 ±0.7)E-3	471±5
		348	< 5.4 E-2	(3.68±0.09)E-1	(5.6 ±0.6)E-3	469±8
	376	335	< 3.0 E-1	(1.01±0.05)E-1	(1.21±0.34)E-2	837±5
		338	< 3.3 E-2	(1.40±0.06)E-1	(2.03±0.36)E-2	860±5
KM8	198	454			(1.76±0.46)E-3	330±5
		460			(7.56±0.36)E-2	262±7
KM13	432	474	< 3.2 E-2	(2.90±0.08)E-1	(8.42±0.40)E-2	641±9
		479			(9.53±0.13)E-2	773±8
	556	353	< 4.9 E-2	< 4.7 E-3	(4.73±0.33)E-2	418±6
		359	< 2.8 E-2	(1.53±0.34)E-2	(2.87±0.20)E-2	203±5
	564	484			< 5.3 E-3	404±7
KM20	146	445	< 3.5 E-2	(8.7 ±3.2)E-3	(2.3 ±0.6)E-2	137±5
		450	< 6.7 E-2	(1.58±0.32)E-2	(2.6 ±0.5)E-2	125±5

The concentrations for U, Ra and Rn are given in Bq/l. The following relationships apply:

39.4 µg U per Bq
2.74×10^{-5} µg Ra-226 per Bq
1.76×10^{-10} µg Rn-222 per Bq

7 GAS ANALYSIS

Helium, carbon dioxide and nitrogen were determined in the gas that spontaneously leaves the water on its passage through a Horst bottle. The analyses were carried out by AGA SpecialGas, Lidingö.

In the table below, besides the gas phase's percentage content of the analyzed gases, the amount of water that has passed through the Horst bottle and the gas volume obtained are also given. This enables the reader to form his own rough idea of the quantity of dissolved gases in the water. The gas content of the water has not been calculated, since degassing is dependent on a number of uncontrolled parameters. We know, for example, that temperature variations of >20°C occur in the tent where the borehole opens out and the sampling equipment is located.

BH	Depth	No.	He %	CO_2 %	N_2 %	Water l	Gas ml	Notes
KM3	106	343	.006	.134	96.8	230	120	
KM3	376	335	.003			165		1
		338	.004			365	145	
KM8	198	458				395	<1	2
KM13	197	488	.23	.004	92.9	92	75	
KM13	432	474	.115	.036	95.6	50	180	
		479	.182		96.5	9	45	3
KM13	556	357	.001	.31	96.4	220	73	
KM13	564	483				160	<1	2
KM20	146	445	.025	1.35	94.6	790	70	

Note 1 Data on gas volume lacking.
Note 2 Gas volume insufficient for analysis.
Note 3 Gas volume was not enough for all analyses.

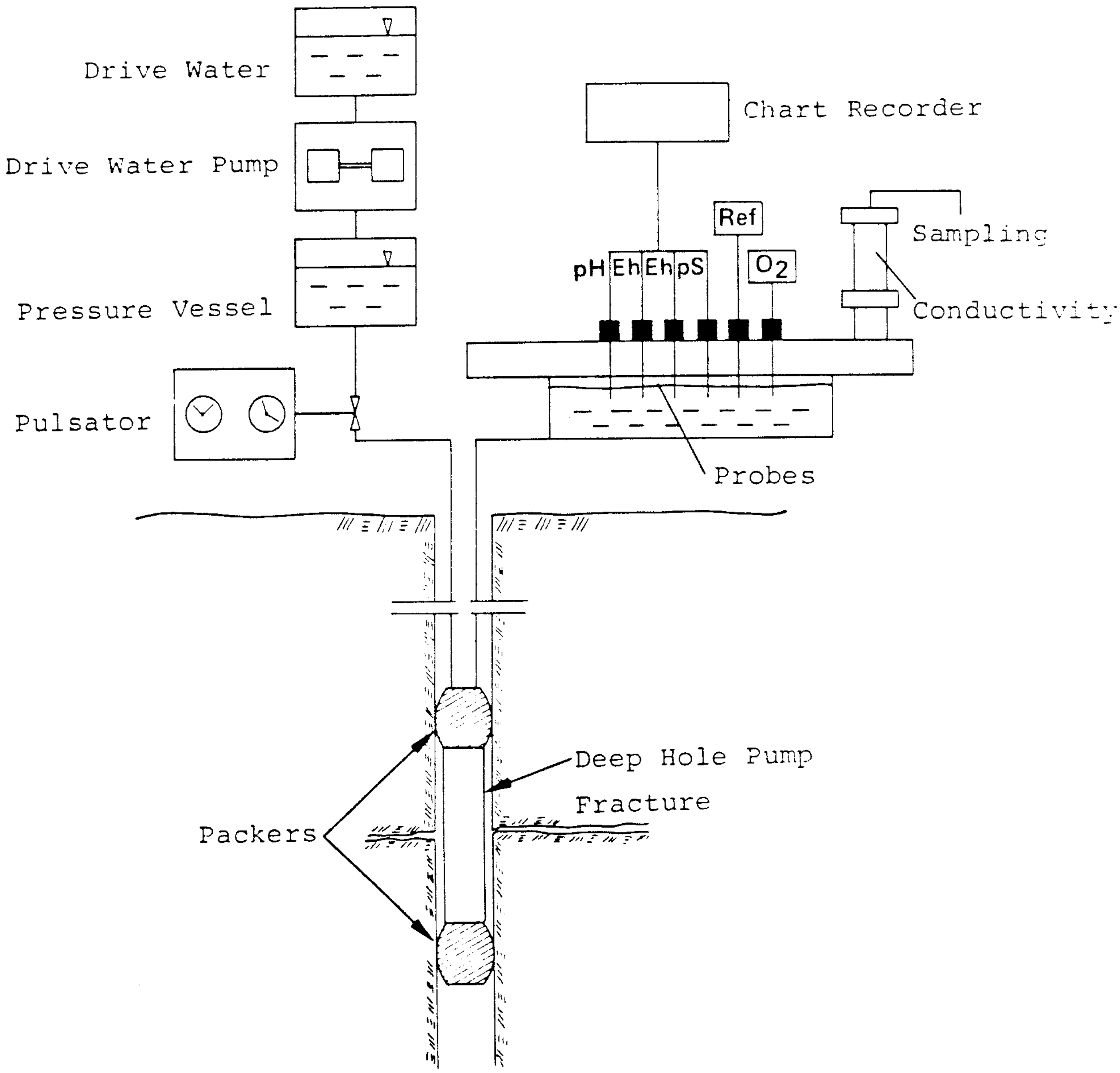


Figure 1. Schematic illustration of sampling equipment

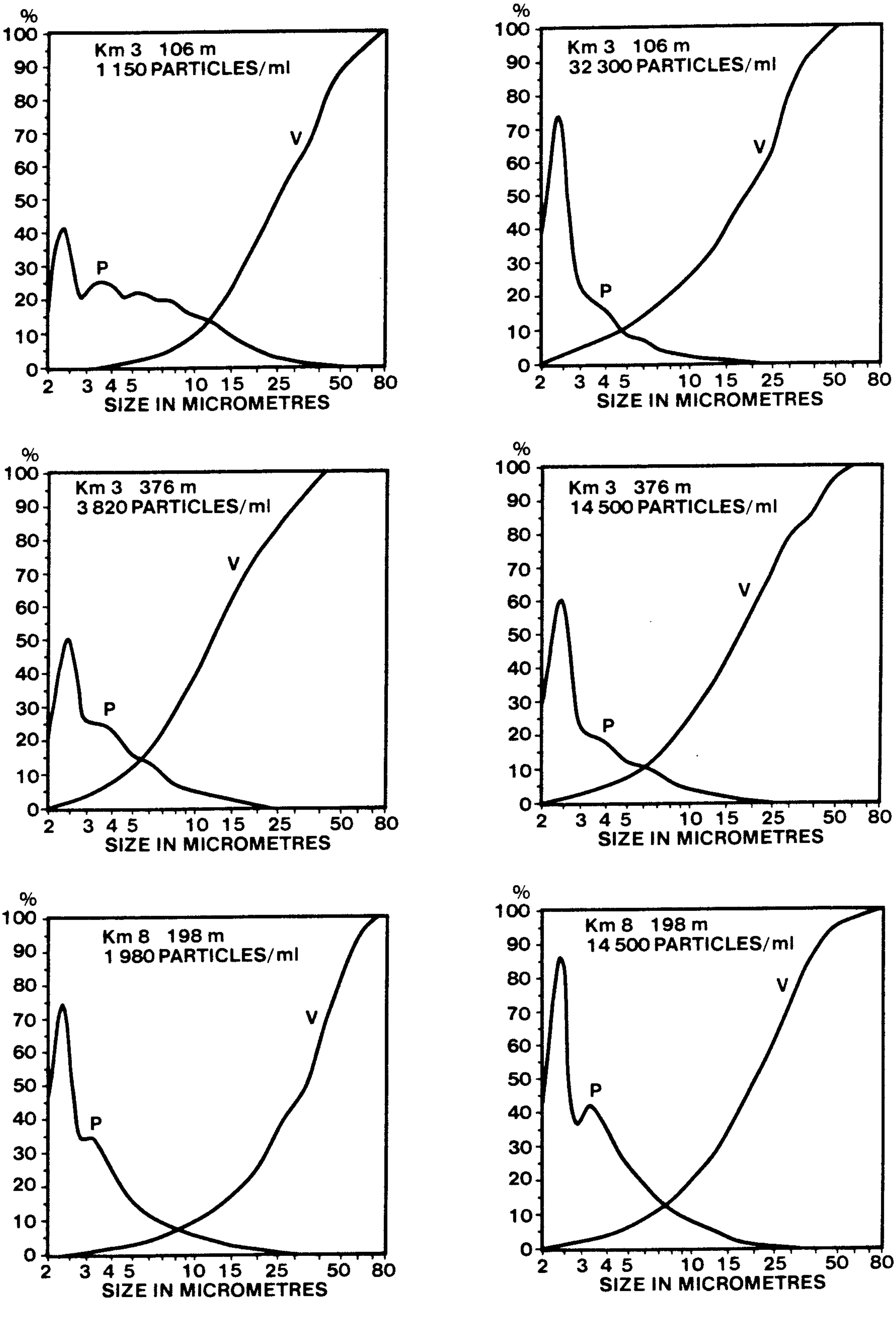


Figure 2[a]. Particle size distribution analysis in the region 2-80 μm. An HIAC PA 500 instrument is used. P represents the percent of the total number of particles with a certain particle size. V represents the percent of the total particle volume less than a certain particle size.

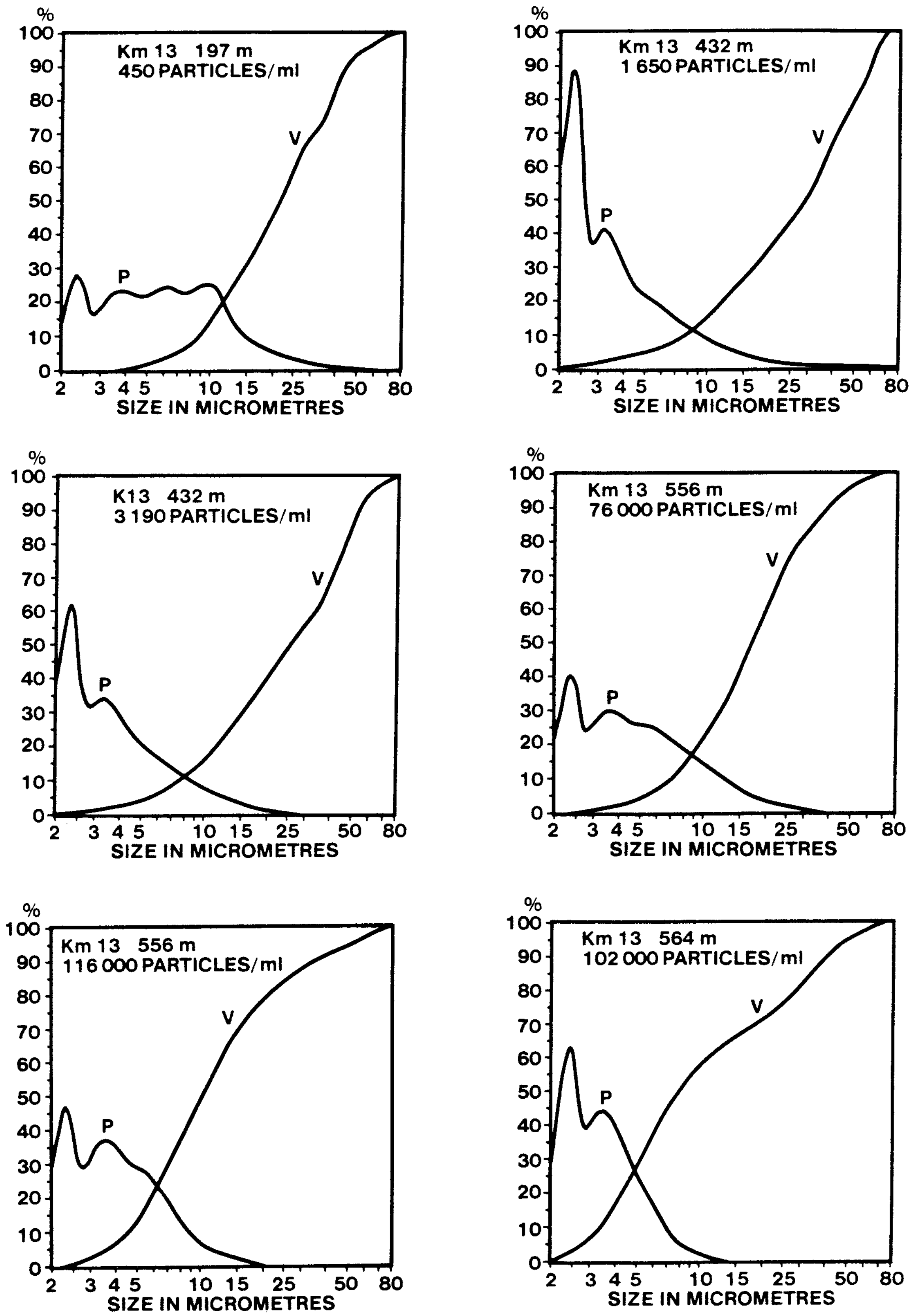


Figure 2[b]. Particle size distribution analysis in the region 2-80 µm. An HIAC PA 500 instrument is used. P represents the percent of the total number of particles with a certain particle size. V represents the percent of the total particle volume less than a certain particle size.

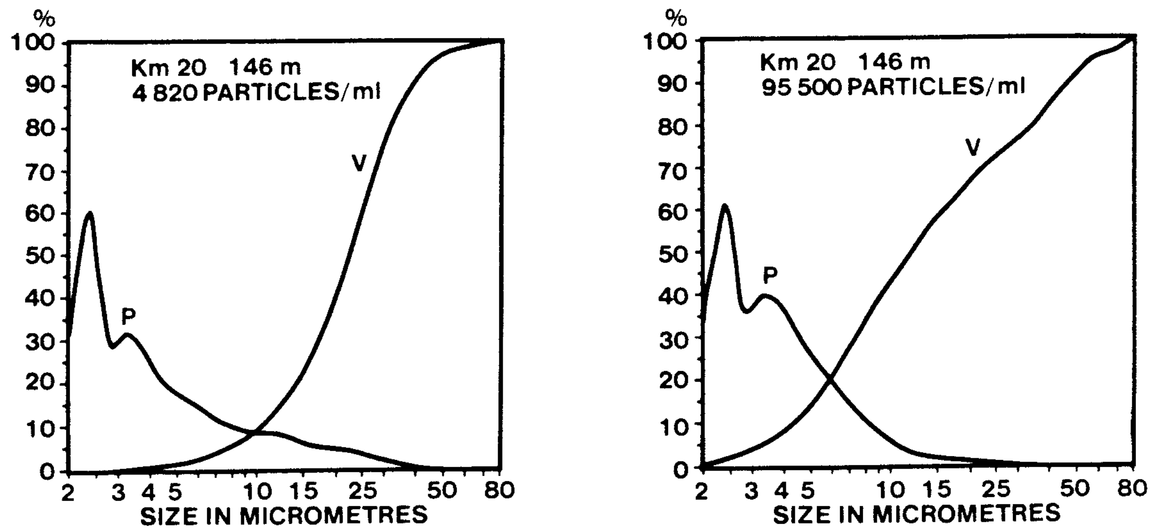


Figure 2c. Particle size distribution analysis in the region 2-80 μm. An HIAC PA 500 instrument is used. P represents the percent of the total number of particles with a certain particle size. V represents the percent of the total particle volume less than a certain particle size.

KAMLUNGE - Field measurements

Cali-bration nr	Bore-hole	Vert. depth m	Date ww-d	Time	pH	Eh, C mV	Eh, C ex mV	Eh, Pt mV	Eh, Pt ex mV	pS	Oxy-gen mg/l	Conduc-tivity mS/m
605	KM3	106										
			03-1	1325	7.97	115	80	137	58	25.92		12.2
			03-1	1430	7.98	120	78	147	57	26.07		12.0
606	KM3	106										
			03-3	0730	8.08	115	86	130	59	26.93	3.80	12.0
			03-3	0930	8.06	115	73	132	46	26.72	1.80	12.0
			03-3	1245	8.03	113	77	127	48	26.38	1.80	12.0
			03-3	1400	8.04	114	79	128	51	26.36	1.30	12.0
			03-3	1550	8.04	114	83	129	54	26.30	1.25	12.0
			03-4	0745	8.03	114	76	130	49	26.24	1.00	12.0
			03-4	0950	8.03	115	75	130	48	26.23	1.10	12.1
			03-4	1200	8.03	114	76	131	47	26.16	1.10	12.1
			03-4	1400	8.02	114	77	131	50	26.17	1.20	12.1
			03-4	1555	8.02	115	74	131	49	26.18	1.05	12.1
			03-5	0730	7.99	114	79	132	55	26.10	.80	12.1
			03-5	0950	8.01	119	83	134	60	26.26	.75	12.1
			03-5	1600	8.00	119	79	133	55	26.12	.55	12.1
			03-6	0715	7.96	111	82	127	61	25.72	.55	12.1
			03-6	0910	7.97	112	83	128	61	25.74	.55	12.2
			03-6	1035	7.97	113	77	131	56	25.78	.65	12.1
			03-6	1300	7.99	114	82	132	60	25.95	.65	12.1
			03-6	1500	7.98	114	82	132	60	25.97	.65	12.1
			03-7	0720	7.96	108	87	131	61	26.16	.80	12.1
			03-7	0920	7.99	111	84	131	59	26.27	.65	12.1
			03-7	1125	7.98	111	84	129	60	26.26	.55	12.1
			03-7	1230	7.98	112	82	130	58	26.20	.95	12.1
			03-7	1400	7.93	111	84	124	63	26.10	.55	12.1
			03-7	1530	7.90	109	80	122	62	25.89	.55	12.1
			04-1	0730	7.84	99	87	113	66	25.08	.40	12.1
			04-1	0940	7.92	101	82	115	63	25.28	.30	12.1
			04-1	1130	7.91	103	101	116	80	25.31	.45	12.1
			04-1	1330	7.94	105	78	123	55	25.52	.50	12.1
			04-1	1530	7.94	107	83	125	59	25.71	.55	12.1
			04-1	1720	7.96	106	81	127	58	25.83	.65	
			04-2	0735	7.96	109	90	128	62	26.12	.60	12.1
			04-2	0900	7.97	110	91	128	63	26.14	.55	12.1
607	KM3	106										
			05-1	1340	7.83	108	135	112	125	23.33	.52	12.2
			05-1	1440	7.84	108	107	113	126	23.33	.07	12.2
608	KM3	106										
			05-3	0745	7.87	112	169	124	149	25.54	.24	11.8
			05-3	0845	7.88	112	171	124	149	25.52	.23	11.8
			05-3	1100	7.88	112	169	124	148	25.46	.24	11.7
			05-3	1250	7.88	112	170	123	149	25.40	.22	11.7
			05-3	1615	7.86	112	174	123	151	25.41	.20	11.8
			05-4	0740	7.87	107	168	115	152	24.59	.12	11.8
			05-4	0940	7.88	105	177	111	154	24.44	.08	11.8
			05-4	1140	7.88	106	173	112	151	24.39	.09	11.8
			05-4	1440	7.87	108	176	114	155	24.35	.09	11.8
			05-4	1620	7.87	109	178	111	157	24.31	.05	11.8
610	KM3	106										
			05-7	0735	7.82	94	11	92	128	24.81	.17	11.8
			05-7	0935	7.84	94	18	92	93	24.69	.14	11.7
			05-7	1200	7.87	96	26	94	61	24.57	.13	11.8
			05-7	1340	7.89	98	34	95	57	24.74	.10	11.6
			05-7	1545	7.88	98	41	94	56	24.56	.06	11.7
			05-7	1915	7.87	96	40	93	46	24.27	.06	11.7
			05-7	2050	7.87	94	44	91	46	24.14	.60	11.6
			05-7	2320	7.87	93	49	90	43	23.98	.05	11.7
			06-1	0052	7.87	92	52	89	41	23.89	.04	11.7
			06-1	0530	7.87	92	59	88	38	23.64	.04	11.7
			06-1	0745	7.87	91	62	87	37	23.53	.02	11.7
			06-1	0945	7.89	92	64	87	35	23.52	.02	11.7
			06-1	1145	7.88	94	67	89	36	23.42	.03	11.7
			06-1	1545	7.88	92	72	86	35	23.33	.01	11.7
			06-1	2030	7.89	88	75	82	33	23.16	.01	11.7
			06-2	0755	7.89	86	75	76	32	22.88	.01	11.7
			06-2	0955	7.90	86	75	75	32	22.86	.00	11.7
			06-2	1155	7.90	85	74	74	32	22.79	.01	11.7
			06-2	1355	7.90	84	73	72	32	22.73	.01	11.7
			06-2	1555	7.89	80	76	68	37	22.71	.00	11.7
			06-3	0745	7.91	83	71	59	33	22.43	.00	11.7
			06-3	0915	7.92	82	68	58	32	22.41	.00	11.7

KAMLUNGE - Field measurements

Cali-bration nr	Bore-hole	Vert. depth m	Date ww-d	Time	pH	Eh,C mV	Eh,C ex mV	Eh,Pt mV	Eh,Pt ex mV	pS	Oxy-gen mg/l	Conduc-tivity mS/m
601	KM3	376										
			50-3	0815	9.07	-165	- 71	-421	- 91	13.62	.09	13.8
			50-3	1015	9.12	-160	- 67	-417	- 87	14.26	06	13.8
			50-3	1220	9.13	-159	- 64	-413	- 87	13.50	.06	13.8
			50-3	0015	4.60	-146	- 35	-400	- 58	13.67	.06	14.1
			50-3	1700	9.13	-151	- 47	-397	- 73	13.35	.05	14.1
			50-4	0855	9.07	-150	- 58	-416	- 90	12.59	.05	14.1
			50-4	1130	9.09	-147	- 54	-412	- 86	12.56	.05	14.1
			50-4	1415	9.05	-148	- 54	-406	- 88	12.39	.05	14.1
			50-4	1615	9.04	-143	- 45	-389	- 79	12.35	.05	14.1
			51-1	0900	8.70	-118	-118	-147	- 37	15.86	.04	12.3
			51-1	1210	8.69	-120	-121	-157	- 45	15.53	.03	12.5
			51-1	1510	8.67	-122	-122	-162	- 46	15.32	.04	12.3
			51-1	1810	8.66	-124	-119	-166	- 49	15.12	.04	12.3
			51-1	2000	8.65	-124	-107	-169	- 51	15.01	.05	12.5
			51-1	2200	8.65	-124	- 97	-172	- 52	14.88	.05	12.5
			51-2	0820	8.61	-127	- 81	-183	- 57	14.31	.05	12.5
			51-2	1000	8.62	-120	- 77	-181	- 55	14.34	.02	12.3
602	KM3	376										
			01-1	1530	8.70	-192	-178	-196	-210	13.00		12.9
			01-1	1730	8.73	-186	-111	-191	-137	13.01		12.9
603	KM3	376										
			01-3	0745	8.38	-100	- 94	-118	-101	14.64		12.9
			01-3	0930	8.38	- 99	- 97	-117	-113	14.59		12.9
			01.3	1140	8.38	- 99	- 96	-118	-114	14.51		12.9
			01-3	1400	8.42	- 99	- 93	-118	-110	14.42		12.9
			01-3	1540	8.38	- 99	- 96	-117	-113	14.46		12.9
			01-4	0730	8.30	-104	-106	-124	-121	13.95		12.9
			01-4	1135	8.39	-102	-102	-122	-119	14.08		12.9
			01-4	1330	8.39	-100	-102	-121	-117	14.08		12.9
			01-4	1535	8.38	-100	-102	-121	-118	14.04		12.9
			01-5	0730	8.35	-100	-105	-123	-119	13.84		13.0
			01-5	0845	8.38	-100	-104	-123	-118	13.87		13.0
			01-5	1125	8.38	- 99	-102	-123	-119	13.82		13.0
			01-5	1330	8.38	- 99	-105	-123	-118	13.82		13.0
			01-5	1530	8.37	- 99	-106	-123	-120	13.80		13.0
			01-6	0730	8.36	-100	-107	-126	-120	13.66		13.0
			01-6	0930	8.36	- 99	-105	-126	-120	13.65		13.0
			01-6	1205	8.36	- 99	-107	-126	-120	13.65		13.0
			01-6	1400	8.37	- 99	-106	-127	-119	13.64		13.0
			01-6	1550	8.36	-100	-107	-127	-120	13.61		13.0
			01-7	0735	8.36	-102	-109	-131	-122	13.53		13.0
			01-7	0935	8.37	-102	-109	-132	-122	13.53		13.0
			01-7	1145	8.37	-102	-109	-133	-122	13.53		13.0
			01-7	1405	8.37	-103	-109	-133	-123	13.52		13.0
			01-7	1545	8.38	-105	-111	-135	-123	13.50		13.0
			02-1	0730	8.37	-111	-119	-143	-131	13.30		13.0
			02-1	0925	8.39	-111	-116	-143	-130	13.34		13.0
			02-1	1130	8.37	-112	-126	-143	-131	15.95		13.0
			02-1	1350	8.38	-113	-119	-144	-131	13.32		13.0
			02-1	1705	8.37	-114	-120	-145	-132	13.31		13.0

KAMLUNGE - Field measurements

Cali-bration nr	Bore-hole	Vert. depth m	Date ww-d	Time	pH	Eh, C mV	Eh, C ex mV	Eh, Pt mV	Eh, Pt ex mV	pS	Oxy-gen mg/l	Conduc-tivity mS/m
652	KM8	198										
			20-4	0815	7.20	310	371	289	369	28.83	2.00	4.3
			20-4	1015	7.22	309	367	288	364	28.82	2.00	4.3
			20-4	1200	7.23	308	355	287	346	28.81	1.95	4.3
			20-4	1545	7.25	307	305	286	315	28.80	1.90	4.2
			20-5	0900	7.32	302	365	287	340	28.86	1.65	4.2
653	KM8	198										
			21-1	0830	6.27	303	293	292	286	27.91	1.10	3.9
			21-1	1030	6.26	303	327	292	320	27.89	1.11	3.9
			21-1	1240	6.26	300	332	291	343	27.89	1.11	3.9
			21-1	1440	6.23	299	362	291	360	27.83	1.11	3.9
			21-1	1700	6.24	298	363	291	362	27.86	1.06	3.9
			21-2	0750	6.26	300	359	289	356	27.96	1.06	3.8
			21-2	1000	6.25	301	360	289	354	28.04	1.06	3.8
			21-2	1210	6.24	300	340	289	331	27.99	1.06	3.8
			21-2	1450	6.26	300	335	289	306	28.02	1.05	3.8
			21-2	1920	6.26	300	322	288	308	28.05	1.05	3.8
			21-3	0840	6.25	299	321	286	305	28.03	1.04	3.8
			21-3	0940	6.26	298	324	285	309	28.04	1.04	3.8
657	KM8	198										
			22-3	1035	6.79	257	268	200	218	25.34	1.36	4.2
			22-3	1310	6.79	257	296	203	232	25.46	.95	4.2
			22-3	1510	6.78	254	283	197	231	25.33	1.21	4.2
			22-3	1620	6.79	254	116	195	63	25.33	1.21	4.2
			22-4	0840	6.85	249	363	188	320	25.58	1.28	4.1
			22-4	1040	6.83	247	328	186	284	25.55	1.27	4.1
			22-4	1240	6.83	249	79	184	25	25.56	1.27	4.1
			22-4	1440	6.82	249	- 10	184	- 55	25.56	1.27	4.1
			22-4	1530	6.81	250	- 61	184	-107	25.60	1.28	4.1
			22-5	0830	6.86	249	226	180	173	25.97	1.24	4.0
			22-5	1030	6.85	247	238	177	184	25.87	1.26	4.1
			22-5	1230	6.84	246	246	174	191	25.84	1.22	4.0
			22-5	1430	6.83	244	250	172	196	25.77	1.22	4.1
			22-5	1650	6.85	244	256	169	199	25.81	1.17	4.1
			22-6	0835	6.88	246	272	161	214	25.97	1.19	4.0
			22-6	1135	6.87	246	270	159	210	25.95	1.18	4.0
			22-6	1335	6.87	246	270	157	208	25.93	1.16	4.0
			22.6	1550	6.87	245	270	155	208	25.92	1.15	4.0
			22-7	0750	6.88	248	276	147	209	26.07	1.13	4.0
			22-7	0950	6.87	246	273	145	203	26.00	1.11	3.0
			22-7	1150	6.86	245	269	142	201	25.89	1.11	4.0
			22-7	1350	6.87	244	269	140	198	25.89	1.10	4.0
			22-7	1510	6.87	244	269	138	198	25.88	1.10	4.0
			23-1	0825	6.88	246	273	120	199	25.93	1.08	4.0
			23-1	1025	6.88	245	270	118	195	25.88	1.10	4.0
			23-1	1715	6.89	244	231	107	153	25.82	1.05	4.0
			23-2	0840	6.91	248	258	86	173	25.96	.94	4.0
			23-2	1020	6.90	248	256	87	174	25.93	.97	4.0

KAMLUNGE - Field measurements

Calibration nr	Borehole	Vert. depth m	Date ww-d	Time	pH	Eh,C mV	Eh,C ex mV	Eh,Pt mV	Eh,Pt ex mV	pS	Oxygen mg/l	Conductivity mS/m
630	KM13	197										
			24-1	0830	7.22	67	- 84	48	- 59	24.06	.30	35.5
			24-1	1800	7.17	56	- 28	29	- 47	22.56	.16	38.2
			24-1	2000	7.31	47	-119	21	- 90	22.46	.15	36.6
631	KM13	197										
			24-3	0815	7.71	45	- 90	42	- 45	23.76		45.1
			24-3	1000	7.68	46	- 88	46	- 50	23.69		46.4
			24-3	1130	7.62	48	- 91	46	- 54	23.63		46.6
			24-3	1445	7.66	45	- 96	43	- 65	23.43		47.1
			24-3	1645	7.71	42	- 99	42	- 70	23.39		47.5
			24-4	0800	7.78	33	-112	34	- 95	22.83		49.6
			24-4	1030	7.76	33	-115	33	- 99	22.73		50.0
			24-4	1430	7.70	32	-126	31	-112	22.34		50.1
			24-4	1600	7.77	29	-125	29	-111	22.30		50.4
			24-5	0810	8.13	16	-139	21	-128	22.10		52.4
			24-5	1610	8.03	15	-142	28	-133	21.95		52.9
			24-6	0815	8.15	4	-158	11	-151	20.79		54.2
			24-6	1030	8.14	1	-131	7	-122	20.36		54.5
			24-6	1230	8.14	- 2	-157	3	-151	19.98		54.7
			24-6	1500	8.20	- 4	-195	- 1	-189	19.71		55.0
			24-6	1630	8.24	- 4	-196	- 3	-190	19.67		55.0
			24-7	0810	8.41	- 13	-203	- 20	-198	18.59		56.5
			24-7	1030	8.39	- 15	-205	- 24	-201	18.29		56.6
			24-7	1330	8.38	- 19	-206	- 30	-202	17.84		57.0
			24-7	1615	8.40	- 22	-207	- 35	-206	17.58		57.1
			24-7	1830	8.45	- 24	-211	- 39	-207	17.43		57.2
			25-1	0750	8.67	- 29	-214	- 51	-210	16.99		58.0
			25-1	1030	8.57	- 27	-215	- 52	-213	16.80		58.1
			25-1	1400	8.56	- 35	-214	- 55	-212	16.64		58.4
			25-1	1715	8.53	- 34	-212	- 56	-212	16.60		58.5
			25-1	2030	8.60	- 36	-210	- 58	-210	16.69		58.6
			25-1	2115	8.62	- 36	-209	- 58	-209	16.70		58.6
			25-2	0740	8.74	- 38	-211	- 63	-211	16.70		59.0
			25-2	0945	8.69	- 41	-214	- 64	-214	16.50		59.1
624	KM13	432										
			18-4	0805	8.27	- 4	106	- 8	55	24.74		61.5
			18-4	1005	8.29	- 7	111	- 11	61	24.59		61.7
			18-4	1205	8.31	- 6	107	- 10	60	24.63		61.7
			18-4	1405	8.31	- 3	103	- 8	55	24.67		61.8
			18-4	1605	8.33	- 11	99	- 15	49	24.47		62.2
			18-5	0805	8.39	- 16	82	- 19	30	24.20		63.5
			18-5	1010	8.43	- 16	81	- 18	26	24.18		63.7
			18-5	1610	8.23	- 18	125	- 21	112	24.06		64.2
			18-6	0805	8.24	- 28	89	- 29	63	23.44		66.3
			18-6	1100	8.21	- 25	84	- 27	53	23.40		66.8
			18-6	1410	8.19	- 27	79	- 29	25	23.26		67.1
			18-6	1625	8.15	- 24	76	- 26	45	23.26		67.5
			18-7	0820	8.19	- 24	38	- 27	8	23.27		69.3
			18-7	1220	8.17	- 31	11	- 33	- 23	22.81		69.7
			18-7	1440	8.15	- 34	11	- 36	- 15	22.51		70.0
			18-7	1640	8.14	- 36	28	- 38	2	22.23		70.2
			18-7	1925	8.16	- 45	6	- 47	- 27	21.63		70.6
			19-1	0805	8.12	- 50		- 52	- 29	20.29		72.5
			19-1	1020	8.07	- 50	4	- 52	- 41	19.96		72.9
			19-1	1220	8.10	- 54	- 4	- 57	- 37	19.62		73.3
			19-1	1420	8.12	- 52	- 13	- 54	- 40	19.43		73.6
			19-1	1520	8.16	- 54	- 37	- 57	- 45	19.32		73.8
			19-2	0008	8.16	- 58	- 26	- 62	- 57	18.70		76.4
			19-2	1005	8.24	- 61	- 23	- 65	- 59	18.39		76.8
			19-2	1205	8.15	- 64	- 32	- 69	- 64	18.07		77.2
			19-2	1435	8.21	- 67	- 36	- 73	- 67	17.86		77.6
			19-2	1750	8.23	- 69	- 39	- 76	- 69	17.68		78.2
			19-2	2030	8.23	- 71	- 41	- 77	- 71	17.59		78.6
627	KM13	432										
			20-6	1015	8.67	-112	- 20	-120	- 43	16.72		98.4
			20-6	1230	8.70	-119	- 28	-123	- 52	16.39		98.8
			20-6	1515	8.70	-120	- 28	-125	- 52	16.19		100.0
			20-6	1640	8.69	-120	- 26	-126	- 49	16.07		100.0
			20-7	0830	8.72	-113	- 25	-128	- 55	15.44		102.2
			20-7	0930	8.70	-114	78	-128	- 55	15.36		102.6
			20-7	1130	8.69	-115	- 23	-119	- 58	15.28		100.5
			20-7	1650	8.70	-115	- 27	-129	- 63	15.21		103.6
			21-1	0830	8.68	-113	- 23	-130	- 66	14.71		105.4
			21-1	1045	8.66	-114	- 25	-130	- 69	14.60		106.0
			21-1	1315	8.60	-118	- 30	-132	- 76	14.41		106.2
			21-1	1500	8.61	-116	- 27	-132	- 68	14.43		105.0
			21-1	1645	8.62	-117	- 31	-132	- 78	14.37		107.0
			21-2	0745	8.64	-116	- 35	-132	- 86	13.98		108.0
			21-2	1000	8.64	-116	- 34	-132	- 85	13.96		108.2
			21-2	1140	8.66	-109	- 33	-132	- 89	13.93		108.3
			21-2	1400	8.65	-107	- 34	-132	- 88	13.88		108.8

KAMLUNGE - Field measurements

Calibration nr	Borehole	Vert. depth m	Date ww-d	Time	pH	Eh,C mV	Eh,C ex mV	Eh,Pt mV	Eh,Pt ex mV	pS	Oxygen mg/l	Conductivity mS/m
621	KM13	556	12-5	0750	7.62	- 51	95	- 70	78	18.75	.11	7.7
			12-5	1000	7.59	- 52	98	- 72	78	18.58	.11	7.7
			12-5	1240	7.55	- 54	99	- 75	75	18.39	.10	7.7
			12-5	1450	7.59	- 54	84	- 76	64	18.36	.10	7.7
			12-5	1900	7.62	- 49	86	- 73	66	18.50	.10	7.7
			12-6	0900	7.69	- 33	56	- 67	35	18.86	.08	7.7
			12-6	1100	7.58	- 36	48	- 71	26	18.59	.10	7.7
			12-6	1645	7.55	- 39	37	- 73	15	18.40	.11	7.7
			12-7	0830	7.45	- 40	- 1	- 76	- 21	18.14	.12	7.8
			12-7	1130	7.50	- 42	- 5	- 79	- 25	18.08	.16	7.8
			12-7	1300	7.51	- 42	- 6	- 79	- 27	18.06	.15	7.8
			12-7	1650	7.52	- 41	- 13	- 79	- 28	18.13	.12	7.8
			13-1	0730	7.55	- 51	- 63	- 95	- 72	17.71	.12	8.0
			13-1	0930	7.57	- 54	- 68	- 98	- 76	17.63	.12	8.0
			13-1	1535	7.54	- 61	- 85	-108	- 92	17.30	.13	8.0
			13-1	1810	7.55	- 63	- 88	-111	- 95	17.22	.12	8.0
			13-2	1045	7.55	- 82	-120	-133	-121	16.43	.15	8.1
			13-2	1130	7.56	- 84	-121	-135	-124	16.38	.15	8.1
			13-2	1620	7.68	- 88	-111	-138	-116	16.38	.12	8.1
			13-2	1850	7.68	- 92	-120	-140	-125	16.29	.12	8.1
			13-3	0905	7.73	-111	-139	-151	-142	15.84	.11	8.2
			13-3	1200	7.66	-119	-138	-156	-142	15.54	.13	8.3
			13-3	1615	7.85	-118	-141	-153	-145	15.79	.09	8.3
			13-3	1715	7.74	-120	-144	-155	-147	15.58	.10	8.3
			14-2	1400	7.36	-162	-235	-188	-242	13.51	.12	15.2
			14-2	1600	7.26	-168	-236	-193	-249	13.23	.14	15.3
			14-2	1745	7.28	-173	-240	-198	-252	13.12	.14	15.4
622	KM13	556	14-4	0825	6.89	104	78	103	68	24.82	.35	15.8
			14-4	1030	6.87	101	67	99	60	24.64	.35	15.9
			14-4	1235	6.85	98	69	97	61	24.41	.34	16.0
			14-4	1430	6.86	98	66	97	58	24.35	.35	16.0
			14-4	1625	6.89	96	65	94	58	24.38	.30	16.2
			14-5	0825	6.91	92	62	89	47	24.11	.22	16.6
			14-5	1035	6.92	90	59	87	58	23.97	.20	16.6
			14-5	1230	6.92	91	61	88	55	23.89	.19	16.6
			14-5	1500	6.90	91	62	89	60	23.89	.20	16.6
			14-6	0810	6.94	94	60	96	44	23.88	.15	14.6
			14-6	1010	6.93	95	48	96	45	23.88	.14	13.9
			14-6	1310	6.91	92	50	93	46	23.68	.16	13.2
			14-7	1105	6.98	104	48	105	37	24.22	.09	9.6
			14-7	1305	7.00	105	46	105	41	24.23	.08	9.1
			14-7	1535	7.00	107	42	107	40	24.28	.07	8.8
			15-1	0910	7.00	111	40	110	38	24.29	.06	7.2
			15-1	1110	7.00	109	38	109	32	24.22	.06	7.2
			15-1	1310	6.99	108	34	108	29	24.13	.06	7.0
			15-1	1610	6.99	109	33	109	29	24.16	.07	7.0
			15-2	0845	7.00	109	22	108	16	24.07	.06	6.4
			15-2	1045	6.93	104	17	104	10	23.71	.10	6.4
			15-2	1245	6.94	17	12	101	12	23.56	.09	6.4
			15-2	1545	6.96	105	15	106	10	23.70	.09	6.3
			15-2	1645	6.97	105	14	106	9	23.70	.06	6.2
			15-3	0820	7.04	109	6	108	4	23.92	.04	6.1
			15-3	1020	7.02	107	4	107	- 2	23.80	.05	6.1
			15-3	1215	7.01	104	- 4	105	- 11	23.68	.06	6.0
			15-3	1700	7.04	101	- 1	102	- 3	23.50	.06	6.0
			15-3	1750	7.07	100	- 1	102	93	23.51	.06	6.0
			15-4	0900	7.09	102	- 16	102	- 20	23.48	.05	6.0
			15-4	1100	7.06	100	- 16	99	- 23	23.28	.06	6.0
			15-4	1200	7.20	99	- 16	99	- 23	23.40	.05	6.0
			15-4	1350	7.11	100	- 17	99	- 26	23.36	.05	6.0
629	KM13	564	22-4	0830	6.81	133	241	129	128	25.69	.35	5.2
			22-4	1030	6.76	132	233	128	120	25.45	.35	5.2
			22-4	1230	6.76	130	233	126	117	25.32	.35	5.2
			22-4	1430	6.76	131	227	125	114	25.30	.37	5.2
			22-4	1545	6.71	135	238	128	126	25.26	.35	5.2
			22-5	0830	6.89	128	246	118	142	25.26	.20	5.2
			22-5	1030	6.82	125	231	116	122	24.96	.21	5.2
			22-5	1230	6.81	124	228	114	130	24.81	.22	5.2
			22-5	1530	6.81	122	223	112	124	24.72	.20	5.2
			22-5	1710	6.81	122	239	112	137	24.64	.20	5.2
			22-6	0830	6.91	114	180	99	115	24.09	.12	5.3
			22-6	1025	6.93	112	163	96	94	23.95	.12	5.3
			22-6	1230	6.93	109	186	93	119	23.74	.13	5.3
			22-6	1530	6.96	107	164	90	103	23.62	.12	5.3
			22-7	0735	7.02	98	110	76	83	23.15	.10	5.5
			22-7	0940	7.01	94	107	73	83	22.97	.11	5.5
			22-7	1130	7.00	91	111	71	78	22.83	.11	5.5
			22-7	1330	7.00	89	110	68	80	22.71	.11	5.6
			22-7	1445	7.01	90	102	68	74	22.72	.11	5.6
			23-1	0820	7.07	81	79	57	61	22.40	.09	5.6
			23-1	1035	7.05	78	25	54	3	22.22	.11	5.6
			23-1	1210	7.01	77	77	53	54	22.09	.09	5.6
			23-1	1410	7.07	72	69	50	47	22.02	.11	5.6
			23-1	1710	7.09	72	64	49	44	22.01	.10	5.6
			23-2	0655	7.12	68	54	42	48	21.71	.10	5.7
			23-2	0855	7.15	68	50	42	36	21.72	.10	5.7
			23-2	1105	7.14	69	46	41	28	21.78	.11	5.7
			23-2	1230	7.13	68	50	40	35	21.72	.11	5.7
			23-2	1415	7.11	68	22	40	3	21.63	.11	5.7
			23-5	1030	7.54	-126	270	-101	269	13.33	.10	7.2

KAMLUNGE - Field measurements

Calibration nr	Borehole	Vert. depth m	Date ww-d	Time	pH	Eh,C mV	Eh,C ex mV	Eh,Pt mV	Eh,Pt ex mV	pS	Oxygen mg/l	Conductivity mS/m
642	KM20	146										
			14-4	0805	6.87	185	235	153	177	25.06	.01	16.8
			14-4	1020	6.83	179	229	148	169	24.62	.10	17.0
			14-4	1145	6.88	181	232	150	170	24.71	.07	16.9
			14-5	0820	6.86	183	248	155	180	24.86	.00	16.8
			14-5	1530	6.85	183	250	155	179	24.80	.04	16.8
			14-5	0016	6.88	182	245	154	175	24.80	.01	17.0
			14-6	0950	6.88	178	241	154	165	24.64	.00	16.8
			14-6	1150	6.88	175	237	152	161	24.49	.00	16.8
			14-6	1350	6.88	173	234	152	157	24.44	.00	16.8
			14-7	1220	6.84	168	219	154	162	24.24	.00	16.8
			14-7	1420	6.89	170	225	159	162	24.56	.00	16.8
			14-7	1520	6.90	172	226	160	158	24.69	.00	16.8
			15-1	0930	6.92	170	223	152	136	24.57	.00	16.8
			15-1	1130	6.88	172	228	164	140	24.69	.00	16.8
			15-1	1330	6.88	173	227	165	140	24.78	.00	16.8
			15-2	0830	6.90	173	234	162	145	24.85	.00	16.8
			15-2	1030	6.90	171	227	159	136	24.72	.01	16.8
			15-3	0830	6.92	158	215	132	121	23.96	.04	16.8
			15-3	1030	6.90	156	226	128	136	23.78	.05	17.6
			15-3	1230	6.90	152	214	126	119	23.67	.06	16.8
			15-3	1330	6.89	151	202	124	114	23.59	.05	16.8
644	KM20	146										
			15-3	1705	6.58	240	271	159	185	22.26	.45	16.9
			15-7	0830	6.71	185	223	151	175	24.11	.05	16.7
			15-7	1400	6.07	184	226	152	176	24.09	.10	16.5
			16-1	1200	6.04	179	228	152	172	24.05	.05	16.6
			16-1	1545	6.74	180	229	153	174	24.05	.05	16.7
			16-1	1645	6.73	179	227	153	171	23.98	.05	16.8
646	KM20	146										
			16-1	2000	6.51	252	384	163	173	24.85	.50	16.8
			16-4	1035	6.76	189	272	152	226	22.49	.22	16.8
			16-4	1235	6.76	186	292	153	229	22.63	.19	16.6
			16-4	1445	6.75	184	275	153	219	22.67	.16	16.6
			16-5	0910	6.76	176	270	151	207	22.73	.08	16.6
			16-5	1110	6.79	176	291	151	225	22.81	.06	16.7
			16-5	1410	6.75	176	300	152	251	22.70	.10	16.7
			16-6	1145	6.74	167	260	144	195	22.32	.05	16.7
			16-6	1300	6.75	166	241	143	173	22.31	.06	16.7
			16-6	1500	6.76	167	242	144	172	22.37	.05	16.7
			16-7	1145	6.76	164	254	145	182	22.25	.05	16.7
			16-7	1645	6.80	166	257	147	182	22.48	.03	16.6
			16-7	1830	6.81	165	285	146	213	22.44	.02	16.7
			17-1	1345	6.64	253	298	163	200	25.42	.35	16.8
			17-1	1500	6.68	239	263	160	201	24.42	.30	16.7
			17-2	0655	6.78	200	287	168	268	23.33	.10	16.6
			17-2	0855	6.75	194	265	164	218	23.01	.10	16.7
			17-2	1055	6.74	191	246	163	200	22.92	.14	16.7
			17-2	1255	6.76	190	241	165	194	22.99	.10	16.6
			17-2	1355	6.76	190	266	165	218	22.99	.10	16.7
			17-3	0850	6.81	181	239	159	187	23.02	.02	16.6
			17-3	0950	6.80	179	241	158	184	22.91	.03	16.6

KAMLUNGE - E^{O}-values (field)

Bore-hole	Length m	Kal nr	E0,pH4 mV	E0,pH7 mV	E0,pH10 mV	E0,C4 mV	E0,C7 mV	E0,Pt4 mV	E0,Pt7 mV	E0,S1 mV	E0,S5 mV
KM3	123	605	376.7	375.9	379.6	258.0	260.2	255.1	256.0	-829.8	-828.9
KM3	123	606	378.3	378.1	384.8	261.6	259.5	260.1	256.5	-835.1	-829.5
KM3	123	607	376.5	377.4	380.2	268.0	260.6	261.9	256.1	-816.1	-822.0
KM3	123	608	378.2	377.9	379.0	271.5	258.1	257.6	250.8	-821.5	-822.9
KM3	123	609 *	379.7	379.6	380.5	268.8	258.0	254.6	252.0		
KM3	123	610	377.5	380.6		259.0	256.7	256.7	255.7	-771.3	-835.2
KM3	123	611 *	372.9	376.9	378.6	264.5	261.2	260.4	259.5	-852.8	-848.6
KM3	445	601	394.8	384.3	383.5	247.8	256.1	240.8	254.9	-869.7	-845.4
KM3	445	602	381.1	386.1	386.9	255.1	253.7	256.0	253.7	-853.2	-839.0
KM3	445	603	370.9	372.5	379.0	271.2	265.8	263.2	291.0	-859.8	-829.3
KM3	445	604 *	373.6			276.8		262.0			
KM13	230	630	346.9	356.6	362.5	271.8	279.3	290.4	279.1	-845.7	-855.4
KM13	230	631	360.3	365.5	366.3	277.0	273.4	278.2	273.5	-836.0	-844.2
KM13	230	632 *	347.3	357.0	360.3	363.8	291.4	325.8	293.4	-832.3	-837.3
KM13	514	624	388.9	369.9	370.4	273.2	269.1	273.8	265.8	-820.4	-854.8
KM13	514	625	398.9	397.3	398.6	279.4	275.5	284.8	276.4	-835.3	-844.1
KM13	514	626 *	403.7			381.0		302.1			
KM13	514	627	409.4	414.1	415.1	272.4	271.0	274.7	265.3	-882.8	-877.0
KM13	514	628 *	419.4	422.2	423.2	280.7	269.8	299.0	278.3	-838.0	-855.5
KM13	670	621	366.5	367.9	372.6	271.4	267.7	266.1	266.1	-840.8	-835.7
KM13	670	622	372.1	374.3	374.8	268.1	265.9	267.7	265.8	-834.7	-839.3
KM13	670	623	354.0	357.4	365.4	274.8	268.9	269.6	268.1	-795.3	-828.4
KM13	680	629	361.1	361.4	362.3	277.3	267.3	268.2	269.0	-846.0	-853.0
KM20	146	641 *	402.8	400.4		262.2	233.9	264.6	265.4		
KM20	146	642	398.5	399.2	399.0	259.7	247.1	246.3	247.9	-778.3	-788.7
KM20	146	643 *	382.4	389.1		289.5	252.5	259.2	254.0		
KM20	146	644	389.0	389.1	389.2	257.8	254.5	251.3	253.2	-742.3	-773.4
KM20	146	645 *	390.2			381.8		250.6			- 46.9
KM20	146	646	390.2	388.5	391.0	254.4	255.4	249.9	253.1	-739.6	-743.6
KM20	146	647 *	379.0	378.8	383.3	297.1	252.2	273.8	271.9	-720.8	-737.8
KM8	238	650	216.2	452.5	449.9	501.3	255.0	501.3	254.2	-161.3	- 62.6
KM8	238	651 *	439.7	489.1		269.3	222.1	258.2	253.5		
KM8	238	652	452.6	455.3	545.6	255.7	254.4	252.0	249.7	-763.2	-777.8
KM8	238	653	395.5	404.0	402.7	261.3	249.4	256.1	249.1		
KM8	238	654 *	282.3			272.9		257.8			
KM8	238	655	339.2	483.6	700.2	258.4	256.3	256.4	255.4	-742.6	-734.9
KM8	238	656 *	392.8			282.9		256.1			
KM8	238	657	396.0	393.7	393.7	260.9	260.9	254.2	256.5	-708.5	-721.2
KM8	238	658 *	387.4	387.8		269.2	249.3	259.9	259.5		
KM8	238	659	388.2	387.9	388.6	261.8	258.5	258.6	259.7	-771.2	-776.8

Table 6a

KAMLUNGE - Field measurements and corresponding laboratory values

Bore-hole	Depth m	Hole-length m	No	Date sampling yy-ww-d	Date lab ww-d	pH field	pH lab	Eh,C field mV	Eh,C ex mV	Eh,Pt field mV	Eh,Pt ex mV	pS field	S2- mg/l	Cond field mS/m	Cond. lab mS/m	Oxygen field mg/l
KM2	106	123														
			339	83-03-2	03-3	8.1	7.9	110	92	128	68	27.0	<.01	12.0	11.5	5.00
			340	83-03-3	03-4	8.0	7.8	114	79	128	51	26.4	<.01	12.0	11.5	1.30
			341	83-03-4	03-5	8.0	7.8	114	76	131	48	26.2	<.01	12.1	11.5	1.15
			342	83-03-7	04-2	7.9	7.8	112	83	126	60	26.1	<.01	12.1	11.5	55
			343	83-04-1	04-2	7.9	7.8	104	85	120	65	25.4	<.01	12.1	12.0	48
			344	83-05-2	05-3	7.9		121	173	140	158	26.3	<.01	11.8		50
			345	83-05-3	05-4	7.9	7.6	113	173	125	151	25.5	<.01	11.7	11.5	25
			346	83-05-4	05-5	7.9	7.7	108	174	114	152	24.4	<.01	11.8	11.5	.10
			347	83-05-7	06-2	7.9		96	26	94	61	24.6	<.01	11.8		13
			348	83-06-1	06-2	7.9	7.6	95	68	90	36	23.4	<.01	11.7	12.0	02
KM3	376	445														
			331	82-50-2	50-3	8.9	8.6	218	230	209	225	29.0	<.01	13.5	13.0	15
			332	82-50-3	50-4	9.1	8.6	-159	- 64	-413	- 87	13.5	<.01	13.8	13.5	.06
			333	82-50-4	50-5	9.1	8.4	-148	- 54	-406	- 88	12.4	<.01	14.1	13.0	05
			334	82-50-7	51-3	8.7	8.1	- 43	79	- 49	72	21.6	<.01	12.3	11.5	.07
			335	82-51-1	51-3	8.7	8.0	-120	-121	-157	- 45	15.5	<.01	12.5	12.0	.03
			336	83-01-2	01-3	8.4	7.7	- 96	- 84	-113	-107	15.1	<.01	12.9	12.0	.01
			337	83-01-7	02-2	8.4	7.8	-102	-109	-133	-122	13.5	<.01	13.0	12.0	00
			338	83-02-1	02-2	8.4	7.8	-112	-121	-143	-131	13.3	<.01	13.0	12.0	00
KM2																
			910	SEPT-82	139		7.4								12.0	
			911	OKT-82	463		7.6								12.[illegible]	

KAMLUNGE - Field measurements and corresponding laboratory values

Bore-hole	Depth m	Hole-length m	No	Date sampling yy-ww-d	Date lab ww-d	pH field	pH lab	Eh,C field mV	Eh,C ex mV	Eh,Pt field mV	Eh,Pt ex mV	pS field	S2- mg/l	Cond field mS/m	Cond lab mS/m	Oxygen field mg/l
KM13	197	230														
			485	83-24-2	24-3	7.6	7.3	76	- 66	60	8	24.3	.01	42.4	41	78
			486	83-24-3	24-4	7.6	7.4	48	- 91	46	- 54	23.6	.02	46.6	45	36
			487	83-24-4	24-5	7.8	7.4	33	-115	33	- 99	22.7	.02	50.0	48	13
			488	83-24-7	25-3	8.4	7.4	- 15	-205	- 24	-201	18.3	.03	56.6	52	07
			489	83-25-1	25-3	8.6	7.5	- 27	-215	- 52	-213	16.8	.02	58.1	55	06
KM13	432	514														
			360	83-18-2	18-4	8.2	7.7	78	45	58	38	24.4	<.01	58.9	59	1.93
			471	83-18-3	18-4	8.2	7.8	12	119	6	78	25.1	<.01	60.5	60	42
			472	83-18-4	18-5	8.3	7.8	- 6	107	- 10	60	24.6	<.01	61.7	62	18
			473	83-18-7	18-4	8.1	7.9	- 34	11	- 36	- 15	22.5	<.01	70.0	70	03
			474	83-19-1	18-4	8.1	7.9	- 50	4	- 52	- 41	20.0	<.01	72.9	74	02
			475	83-20-2	20-4	8.6	7.9	- 61	121	10	115	22.8	<.01	85.0	85	25
			476	83-20-4	20-5	8.7	7.8	-107	- 20	-101	- 32	18.1	<.01	88.8	88	.11
			477	83-20-7	21-3	8.7	7.7	-115	- 23	-119	- 58	15.3	.01	100	99	00
			478	83-21-1	21-3	8.7	7.7	-114	- 25	-130	- 69	14.6	.02	106	98	.10
			479	83-21-2	21-3	8.6	7.7	-116	- 34	-132	- 85	14.0	.02	108	102	.10
KM13	556	670														
			349	83-12-2	12-4	6.6	6.7	148	182	152	173	25.1	<.01	6.6	5.5	1.20
			350	83-12-3	12-4	6.7	6.7	113	98	111	98	25.8	<.01	7.2	5.5	68
			351	83-12-4	12-5	7.4	6.6	- 28	113	- 41	98	19.8	<.01	7.6	5.5	.12
			352	83-12-7	13-3	7.5	6.6	- 42	- 6	- 79	- 27	18.1	<.01	7.8	6.0	.15
			353	83-13-1	13-3	7.6	6.5	- 54	- 68	- 98	- 76	17.6	<.01	8.0	6.0	12
			354	83-13-2	13-3	7.6	6.5	- 86	-116	-136	-120	16.4	<.01	8.1	6.0	.13
			355	83-14-3	14-4	6.7	6.3	113	86	106	79	24.6	<.01	15.6	12.5	45
			356	83-14-4	14-5	6.9	6.6	98	68	97	60	24.4	<.01	16.0	13.5	.34
			357	83-14-7	15-2	7.0	6.3	107	42	107	40	24.3	<.01	8.8	6.5	.07
			358	83-15-1	15-2	7.0	6.3	109	36	109	30	24.2	<.01	7.1	5.0	.06
			359	83-15-2	15-3	6.9	6.4	105	15	105	10	23.7	<.01	6.4	5.0	.09
KM13	564	680														
			480	83-22-2	18-1	8.1	7.1	78	205	68	166	25.2	<.01	10.8	11.0	72
			481	83-22-3	18-1	6.7	6.6	128	280	128	197	25.6	<.01	5.5	4.5	51
			482	83-22-4	18-2	6.8	6.7	131	227	125	114	25.3	<.01	5.2	4.7	.37
			483	83-22-7	23-2	7.0	6.6	91	111	71	78	22.8	<.01	5.5	4.2	11
			484	83-23-1	23-2	7.0	6.5	75	73	51	50	22.0	<.01	5.6	3.9	10
KM13																
			923	JAN-83			7.0								6.8	
			926	FEBR-83			7.1								7.8	

KAMLUNGE - Field measurements and corresponding laboratory values

Bore-hole	Depth m	Hole-length m	No	Date sampling yy-ww-d	Date lab ww-d	pH field	pH lab	Eh,C field mV	Eh,C ex mV	Eh,Pt field mV	Eh,Pt ex mV	pS field	S2- mg/l	Cond field mS/m	Cond lab mS/m	Oxygen field mg/l
KM20		146														
			441	83-14-3	14-4	6.8	6.5	198	217	150	173	25.5	<.01	16.9	15.5	.20
			442	83-14-4	14-5	6.8	6.6	179	229	148	169	24.6	<.01	17.0	15.5	10
			443	83-14-7	15-2	6.8	6.6	168	219	154	162	24.2	<.01	16.8	13.5	00
			444	83-15-1	15-2	6.9	6.5	172	228	164	140	24.7	<.01	16.8	13.0	00
			445	83-15-2	15-3	6.9	6.6	171	227	159	136	24.7	<.01	16.8	13.0	01
			446	83-16-2	16-3	6.7	6.7	199	309	155	249	23.3	<.01	16.8	15.5	18
			447	83-16-3	16-4	6.7	6.6	178	358	145	295	22.5	<.01	16.9	15.5	12
			448	83-16-4	16-5	6.8	6.7	186	292	153	229	22.6	<.01	16.6	14.0	19
			449	83-16-7	17-2	6.8	6.6	166	241	143	173	22.3	<.01	16.7	16.5	06
			450	83-17-2	17-3	6.7	6.7	191	246	163	200	22.9	<.01	16.7	17.0	14
KM2	198	238														
			451	83-20-3	20-4	7.4	6.2	299	320	283	337	28.0	<.01	4.4	4.1	2.50
			452	83-20-4	20-5	7.2	6.2	308	355	287	346	28.8	<.01	4.3	4.1	1.95
			453	83-20-7	21-3	6.3	6.1	299	129	288	348	28.3	<.01	4.0	3.8	1.22
			454	83-21-1	21-3	6.3	6.2	295	327	287	339	28.6	<.01	3.9	3.8	1.11
			455	83-21-2	21-3	6.3	6.1	296	355	285	350	28.8	<.01	3.8	3.4	1.06
			456	83-22-2	18-1	6.7	6.0	271	312	213	268	25.3	<.01	4.1	3.9	1.87
			457	83-22-3	18-1	6.8	6.2	254	283	197	231	25.3	<.01	4.2	4.1	1.21
			458	83-22-4	18-2	6.8	6.1	249		184		25.6	<.01	4.1	4.1	1.27
			459	83-22-7	23-2	6.9	6.3	245	269	142	201	25.9	<.01	4.0	4.0	1.11
			460	83-23-1	23-2	6.9	6.2	245	270	118	195	25.9	<.01	4.0	4.1	1.10

KAMLUNGE - Metal ions

Bore-hole	Depth m	No	Na tot mg/l	K tot mg/l	Ca tot mg/l	Mg tot mg/l	Sr tot mg/l	Mn tot mg/l	Al tot mg/l	Fe2+ tot mg/l	Fe tot mg/l	Fe2+ <.4um mg/l	Fe <.4um mg/l	Fe >.4um mg/l	Al >.4um mg/l	S >.4um mg/l
KM3	106															
		339	5.4	1.5	13	2.8	.10	04	<.01	.24	.35	.07	.13	.32	015	.0017
		340	5.6	1.4	13	2.8	.10	04	<.01	.19	.33	.04	.12	.27	020	0022
		341	5.8	1.4	13	2.8	.10	04	<.01	.06	.33	.04	.09	.29	.031	.0029
		342	5.8	1.2	13	2.8	.10	04	.025	.08	.31	.05	.13	.23	.026	.0057
		343	5.7	1.2	13	2.8	.11	04	.025	.04	.28	.07	.12	.22	.028	.0056
		345	6.0	1.3	13	2.7	.10	03	.027	.09	.27	.04	.10	.16	.023	.0021
		346	6.2	1.3	13	2.8	.11	02	.025	.14	.29	.08	.15	.13	026	.0023
		347	5.6	1.2								.14	.19	.26	.040	.0057
		348	6.1	1.3	13	2.7	.11	02	.028	.18	.27	.12	.15	.15	.026	0029
KM3	376															
		331	5.7	1.5	16	2.6	.12	06	.014	.90	.90	.11	.11	1.13	.200	.0044
		332	5.9	1.6	15	2.6	.12	06	.016	.68	.90	.12	.27	.70	.166	.0040
		333	6.0	1.2	15	2.5	.12	.06	<.01	.76	.96	.50	.54	.57	.102	0021
		334	5.4	1.6	13	3.1	.11	.08	<.01	.86	1.0	.55	.56	.73	.211	0022
		335	4.8	1.8	13	3.1	.096	.12	.016	1.3	1.3	.90	.91	.61	.293	0049
		336	5.4	1.8	13	3.0	.095	.14	<.01	.75	1.8	.65	1.4	.63	.028	.0018
		337	5.0	1.9	13	3.3	.090	.15	.026	.90	2.2	.66	1.4	1.07	.051	0027
		338	5.0	1.8	13	3.2	.089	.15	.022	.86	1.8	.67	1.4	.61	.029	.0012
KM3																
		910	4.8	2.7	13	4.4		.03			1.8					
		911	4.8	1.5	13	3.9		<.01			.28					

KAMLUNGE - Metal ions

Bore-hole	Depth m	No	Na tot mg/l	K tot mg/l	Ca tot mg/l	Mg tot mg/l	Sr tot mg/l	Mn tot mg/l	Al tot mg/l	Fe2+ tot mg/l	Fe tot mg/l	Fe2+ <.4um mg/l	Fe <.4um mg/l	Fe >.4um mg/l	Al >.4um mg/l	S >.4um mg/l
KM13	197															
		495	13	1.6	68	.8	.30	.11	<.01	.73	.80	.63	.61	.14	.0009	.011
		486	15	1.6	76	.9	.34	.09	<.01	.68	.68	.62	.56	.08	.0009	.010
		487	15	1.6	81	.7	.40	.07	<.01	.63	.61	.58	.56	.07	.0004	.009
		488	18	1.6	99	.6	.47	.04	<.01	.51	.48	.42	.41	.05	.0013	.010
		489	18	1.6	106	.6	.49	.05	<.01	.89	1.20	.48	.41	.04	.0004	.007
KM13	432															
		360	14	5.0	99	3.4	.20	.21	<.01	.49	.81	.43	.48	.45	.0016	.022
		471	14	5 2	104	3.1	.21	.18	<.01	.56	.78	.42	.41	.44	.0018	.025
		472	15	5.1	108	3.4	.21	.18	<.01	.55	.78	.32	.33	.51	.0013	.026
		473	18	5.6	132	3.6	.25	.17	<.01	.53	.76	.40	.48	.34	.0012	.019
		474	19	5.8	145	3 9	.27	.18	<.01	.55	.78	.47	.63	.22	.0005	010
		475	17	6 2	151	3.7	.35	.17	<.01	.31	.58	.20	.31	.28	.0027	.063
		476	20	5.7	156	3.4	.35	.13	<.01	.53	.65					
		477	23	6.2	190	3.2	.38	.12	<.01	.67	.83	.70	.77	.01	.0013	.009
		478	23	6.2	192	3.2	.38	.12	<.01	.73	.83	.72	.76	.01	.0009	.009
		479	23	6.2	232	3.3	.40	.11	<.01	.72	.83	.79	.79	.01	.0010	.014
KM13	354															
		349	2 3	1.2	5.2	.8	.025	.33	.01	3 9	4.4					
		350	2.1	1.2	5.5	.8	.026	.34	.014	5.5	5.3	5.5	5.3	.20	.0005	.004
		351	2.1	1.1	5.6	.8	.026	.35	.026	7.2	6.3	6.9	6 2	.21	.0013	.013
		352	1.9	1.1	5.4	.8	.027	.33	<.01	7.9	7.5	8.1	7.5	.16	.0011	.003
		353	1.9	1.0	5.4	.8	.027	.33	.01	8.1	8.0	8.2	8 0	.10	.0005	.003
		354	1.9	1.0	5.4	1.0	.027	.35	.01	8.5	8.5	9.6	8.5	.09	.0005	.002
		355	2.6	1.6	8.1	1.2	.052	.56	.49	18.2	20	19.8	19	.63	.0653	.024
		356	2.6	1.5	8.2	1.5	.053	.55	.71	18 3	21	19.4	19	.94	.1733	.065
		357	1.7	1.0	5.2	.9	.027	.37	.14	10.1	12	11.7	11	1.33	.0356	.016
		358	1.5	.9	4.1	.9	.020	.33	.13	6.8	10	7.6	8.8	1.34	.0237	.010
		359	1.4	.8	3.5	.6	.018	.33	.06	6.8	8.1	7.1	7.3	.76	.0118	.005
KM13	564															
		480	2.5	.9	13.6	.4	.031	.20	.03	.42	1.5					
		481	1.2	.7	3.9	.6	.015	.31	.03	4.5	6.1	4.2	5.5	.94	.0276	.008
		482	1.1	.6	3.4	.3	.013	.31	.01	4.9	6.2	4.6	5.7	.49	.0121	.003
		483	1.0	.7	3.1	.4	.012	.31	.01	6 9	7.5	7.2	6.9	.44	.0100	.003
		484	1.0	.7	3.0	.5	.012	.30	<.01	8.2	7.9	7.7	7.8	.32	.0088	.002
KM13																
		923	4.0	1.4	6.2	2.1		.02			.49					
		926	3.5	1.4	5.6	2.1		.01			.13					

Table 7c

KAMLUNGE - Metal ions

Bore-hole	Depth m	No	Na tot mg/l	K tot mg/l	Ca tot mg/l	Mg tot mg/l	Sr tot mg/l	Mn tot mg/l	Al tot mg/l	Fe2+ tot mg/l	Fe tot mg/l	Fe2+ <.4um mg/l	Fe <.4um mg/l	Fe >.4um mg/l	Al >.4um mg/l	S >.4um mg/l
KM20																
		441	9.0	1.7	10	2.6	.064	.25	<.01	13.2	16	15.5	16	.014	<.0007	<.0007
		442	8.8	1.6	10	2.5	.066	.26	<.01	14.2	16	15.7	16	.018	<.0004	.0013
		443	8.7	1.8	11	2.6	.064	.25	<.01	13.8	16	16.0	17	.026	<.0004	<.0004
		444	8.8	2.0	11	2.5	.063	.24	<.01	14.8	16	17.4	17	.011	<.0004	<.0004
		445	8.7	1.6	11	2.4	.062	.26	<.01	16.3	16	16.2	17	.009	.0004	<.0004
		446	8.2	1.8	11	2.6	.064	.26	<.01	15.1	16	15.3	16	.008	<.0004	<.0004
		447	8.2	1.8	11	2.4	.064	.25	<.01	14.9	16	15.1	16	.007	<.0004	<.0004
		448	7.9	1.6	11	2.4	.065	.25	<.01	14.8	16	15.0	16	.011	<.0004	<.0004
		449	8.3	1.8	10	2.5	.064	.26	<.01	15.2	16	15.0	16	.009	<.0004	<.0004
		450	8.1	1.7	11	2.6	.063	.25	<.01	16.7	16	16.2	16	.014	<.0009	<.0004
KM8	195															
		451	.8	.2	2.3	.5	<.01	.15	.01	4.5	5	4.2	5	.176	.0165	.0035
		452	.8	.1	2.3	.8	<.01	.16	.01	4.4	5	4.0	4	.125	.0113	.0013
		453	.8	.1	2.2	.5	<.01	.18	.01	3.0	4	3.0	4	.129	.0094	.0012
		454	.8	.1	2.1	.7	<.01	.18	.01	2.8	4	2.7	4	.150	.0088	.0013
		455	.8	.1	2.1	.6	<.01	.19	.01	3.1	4	2.8	4	.167	.0078	.0011
		456	1.0	.2	2.2	.6	<.01	.2	.01	2.9	5	2.9	4	.530	.0070	.0020
		457	1.0	.2	2.2	.6	<.01	.21	.01	4.3	5	3.6	5	.378	.0056	.0022
		458	.8	.1	2.2	.7	<.01	.21	<.01	3.8	5	3.3	5	.556	.0056	.0022
		459	.8	.2	1.9	.4	<.01	.26	<.01	4.0	4	3.5	4	.438	.0038	.0013
		460	.8	.2	2.0	.6	<.01	.21	<.01	4.0	4	5.1	3	.350	.0038	.0038

KAMLUNGE - Nitrogen containing ions

Bore-hole	Depth m	Length m	No	NO2 mg/l	NO3 mg/l	NH4 mg/l	NO2-N mg/l	NO3-N mg/l	NH4-N mg/l	Sum-N mg/l
KM3	106	123								
			339	<.002	.035	.010	<.001	.008	.008	.016
			340	<.002	.035	.010	<.001	.008	.008	.016
			341	<.002	.035	.010	<.001	.008	.008	.016
			342	.005	.030	.020	.002	.007	.016	.024
			343	.005	.025	.020	.002	.006	.016	.023
			345	<.002	.035	.010	<.001	.008	.008	.016
			346	<.002	.045	.015	<.001	.010	.012	.022
			348	<.002	.045	.010	<.001	.010	.008	.019
KM3	376	445								
			331	.010	.070	.030	.003	.016	.023	.042
			332	<.002	.035	.010	<.001	.008	.008	.016
			333	.007	.020	.010	.002	.005	.008	.014
			334	<.002	.035	.015	<.001	.008	.012	.020
			335	<.002	.050	.015	<.001	.011	.012	.024
			336	<.002	.035	.010	<.001	.008	.008	.016
			337	<.002	.030	.015	<.001	.007	.012	.019
			338	<.002	.030	.015	<.001	.007	.012	.019

KAMLUNGE - Nitrogen containing ions

Bore-hole	Depth m	Length m	No	NO2 mg/l	NO3 mg/l	NH4 mg/l	NO2-N mg/l	NO3-N mg/l	NH4-N mg/l	Sum-N mg/l
KM13	197	230								
			485	<.002	.025	.020	<.001	.006	.016	.022
			486	<.002	.030	.015	<.001	.007	.012	.019
			487	<.002	.020	.015	<.001	.005	.012	.017
			488	<.002	.180	.020	<.001	.041	.016	057
			489	<.002	.030	.015	<.001	.007	.012	.019
KM13	432	514								
			360	<.002	.050	.015	<.001	.011	.012	.024
			471	<.002	.050	.015	<.001	.011	.012	.024
			472	<.002	.040	.020	<.001	.009	.016	.025
			473	<.002	.040	.020	<.001	.009	.016	.025
			474	<.002	.020	.020	<.001	.005	.016	.021
			475	.003	.040	.015	.001	.009	.012	.022
			476	<.002	.020	.020	<.001	.005	.016	.021
			477	<.002	.010	.015	<.001	.002	.012	.015
			478	<.002	.015	.015	<.001	.003	.012	.016
			479	<.002	.040	.010	<.001	.009	.008	.017
KM13	556	670								
			349	.010	.030	.020	.003	.007	.016	.025
			350	.007	.055	.020	.002	.012	.016	.030
			351	.005	.055	.020	.002	.012	.016	.029
			352	<.002	.075	.015	<.001	.017	.012	.029
			353	.003	.025	.025	.001	.006	.019	.026
			354	.003	.030	.010	.001	.007	.008	.015
			355	<.002	.045	.040	<.001	.010	.031	.042
			356	<.002	.040	.015	<.001	.009	.012	.021
			357	.003	.040	.015	.001	.009	.012	.022
			358	.002	.040	.015	.001	.009	.012	.021
			359	.002	.025	.015	.001	.006	.012	.018
KM13	564	680								
			480	.005	.040	.020	.002	.009	.016	.026
			481	.005	.030	.020	.002	.007	.016	.024
			482	<.002	.030	.025	<.001	.007	.019	.027
			483	<.002	.030	.015	<.001	.007	.012	.019
			484	.003	.025	.015	.001	.006	.012	.018

KAMLUNGE - Nitrogen containing ions

Bore-hole	Depth m	Length m	No	NO2 mg/l	NO3 mg/l	NH4 mg/l	NO2-N mg/l	NO3-N mg/l	NH4-N mg/l	Sum-N mg/l
KM20		146								
			441	<.002	.085	.375	<.001	.019	.291	.311
			442	<.002	.050	.385	<.001	.011	.299	.311
			443	.002	.025	.380	.001	.006	.295	.301
			444	.002	.040	.350	.001	.009	.272	.281
			445	.003	.035	.380	.001	.008	.295	.304
			446	.005	.055	.350	.002	.012	.272	.286
			447	.005	.035	.390	.002	.008	.303	.312
			448	.020	.050	.390	.006	.011	.303	.320
			449	<.002	.045	.380	<.001	.010	.295	.306
			450	.003	.030	.385	.001	.007	.299	.307
KM8	198	238								
			451	.003	.050	.015	.001	.011	.012	.024
			452	<.002	.035	.020	<.001	.008	.016	.024
			453	<.002	.025	.010	<.001	.006	.008	.014
			454	<.002	.010	.010	<.001	.002	.008	.011
			455	<.002	.020	.015	<.001	.005	.012	.017
			456	<.002	.060	.020	<.001	.014	.016	.030
			457	<.002	.070	.020	<.001	.016	.016	.032
			458	<.002	.035	.015	<.001	.008	.012	.020
			459	<.002	.050	.020	<.001	.011	.016	.027
			460	<.002	.035	.015	<.001	.008	.012	.020

KAMLUNGE - Remaining anions and other parameters

Bore-hole	Depth m	Length m	No	HCO3 mg/l	Cl mg/l	F mg/l	SO4 mg/l	PO4 mg/l	TOC mg/l	SiO2 mg/l	Turb. NTU	I mg/l
KM3	106	123										
			339	66	3	.14	4	.020	2	9.2	3.2	.05
			340	66	2	.12	4	.020	2	8.5	2.4	.063
			341	66	2	.14	4	.025	2	8.3	2.8	.066
			342	65	3	.15	4	.020	2	8.7	3.5	.036
			343	65	3	.15	4	.025	1	8.7	2.9	.036
			344				3		2			
			345	65	2	.12	4	.015	3	7.8	1.2	.043
			346	66	3	.14	4	.020	3	7.7	3.8	.036
			347				4		2			
			348	65	3	.13	4	.020	2	7.0	2.5	.035
KM3	376	445										
			331	59	3	.17	11	.045	3	4.2		.040
			332	62	3	.19	11	.030	3	4.3		.05
			333	61	3	.21	11	.045	3	5.2		.05
			334	62	3	.14	6	.035	3	5.4		.040
			335	62	3	.11	6	.040	3	5.6		.05
			336	65	3	.20	6	.035	2	6.1	5.4	.037
			337	69	3	.11	6	.040	2	6.8	8.5	.033
			338	66	3	.10	6	.035	2	6.9	9.8	.042
KM3												
			910	68	1	.13	5			9.5		
			911	68	1	.11	4			9.6		

Table 9b

KAMLUNGE - Remaining anions and other parameters

Bore-hole	Depth m	Length m	No	HCO3 mg/l	Cl mg/l	F mg/l	SO4 mg/l	PO4 mg/l	TOC mg/l	SiO2 mg/l	Turb NTU	I mg/l
KM13	197	230										
			485	16	5	1.9	160	.040	16	5.4	5.0	.048
			486	15	5	2.0	180	.045	15	5.4	3.6	.081
			487	15	5	2.0	200	.030	19	5.3	3.7	.09
			488	15	5	2.1	230	.040	8	5.4	3.6	.21
			489	13	6	2.1	240	.050	10	5.4	2.7	.19
KM13	432	514										
			360	23	10	.42	240	.005	5	3.6	5.7	.06
			471	23	10	.45	244	.010	5	3.8	8.3	.05
			472	24	10	.49	256	.015	3	3.9	7.1	.05
			473	23	10	.54	290	.015	3	4.2	6.2	.05
			474	23	11	.55	300	.015	9	4.4	6.9	.066
			475	20	15	.44	380	.025	9	3.0	5.0	.042
			476	19	15	.58	420	.020	18	4.3	5.0	.08
			477	20	19	.64	480	.025	10	5.2	5.0	.12
			478	19	19	.67	480	.030	16	5.3	4.4	.016
			479	19	20	.70	520	.030	21	5.4	7.4	.155
KM13	556	670										
			349	20	1	<.1	6	<.005	11	2.1	25	.023
			350	23	2	<.1	8	.005	11	2.1	25	.023
			351	27	2	<.1	8	<.005	13	2.1	11	.024
			352	31	3	<.1	8	<.005	15	3.6	12	.029
			353	31	2	<.1	7	<.005	11	3.6	13	.029
			354	32	3	<.1	8	<.005	12	3.7	19	.028
			355	16	22	<.1	4	.010	12	3.7		.016
			356	12	26	<.1	4	.020	13	3.7	3.0	.007
			357	12	8	<.1	4	.015	5	3.5	6.3	.016
			358	12	6	<.1	5	.005	5	3.3	6.6	.019
			359	8	5	<.1	5	.005	5	3.2	4.0	.02
KM13	564	680										
			480	16	3	.14	27	.025	42	2.4	7.2	.021
			481	11	1	<.1	7	<.005	24	3.4	19	.014
			482	9	1	<.1	7	.045	33	3.4	8.4	.014
			483	9	1	<.1	6	.055	54	3.4	4.5	.014
			484	9	1	<.1	6	.060	45	3.4	5.0	.023
KM13		903										
			923	34	1	.04	4			11		.001
			926	38	1	.07	4			11		.001

KAMLUNGE - Remaining anions and other parameters

Bore-hole	Depth m	Length m	No	HCO3 mg/l	Cl mg/l	F mg/l	SO4 mg/l	PO4 mg/l	TOC mg/l	SiO2 mg/l	Turb. NTU	I mg/l
KM20		146										
			441	72	11	.12	3	.520	1.4	31		.028
			442	63	10	.13	2	.515	1.8	29	2.2	.040
			443	56	9	.13	3	.580	3.4	29	2.0	.027
			444	55	10	.13	3	.385	2.1	29	4.0	.038
			445	59	11	.13	2	.435	1.9	28	1.0	.028
			446	54	8	.14	3	.560	1.4	25	1.3	.035
			447	49	10	.13	3	.550	1.4	23	1.5	.030
			448	54	10	.13	3	.575	1.3	23	1.0	.029
			449	80	9	.14	3	.550	1.7	21	2.6	.024
			450	81	9	.13	3	.530	1.7	33	2.3	.029
KM8	198	238										
			451	8	1	<.1	4	.015	5.2	4.4	3.9	.02
			452	8	1	<.1	4	.015	3.4	4.4	2.0	.018
			453	7	1	<.1	5	.015	2.1	4.4	6.3	.03
			454	7	1	<.1	5	.020	2.3	4.3	4.2	.038
			455	7	1	<.1	5	.020	2.2	4.4	5.3	.031
			456	7	1	<.1	5	.030	2.0	5.3	9.0	.014
			457	7	1	<.1	5	.020	1.6	4.9	6.7	.011
			458	7	1	<.1	5	.020	1.5	4.9	9.1	.009
			459	8	1	<.1	5	.015	1.4	5.0	7.0	.009
			460	8	1	<.1	5	.005	1.3	5.1	7.0	.012

KAMLUNGE - Drilling waters

Bore- hole	Length m	No	pH	Cond. mS/m	Na mg/l	K mg/l	Ca mg/l	Mg mg/l	Mn mg/l	Fe,tot mg/l	HCO3 mg/l	Cl mg/l	F mg/l	SO4 mg/l	SiO2 mg/l	I mg/l
KM11	67	919	6.1	8.7	2	1.3	8	1.9	.01	.06	5	22	.23	3	5.9	.001
KM12	310	920	5.9	2.7	2	.5	1	1.3	.01	.01	6	1	.02	4	5.3	.001
KM12	520	925	7.0	18.0	5	2.3	19	7.2	.8	15	112	1	.09	2	13	.001
KM12	630	924	7.2	7.6	3	1.5	6	2.3	.01	.01	37	1	.06	5	9.6	.001
KM13	216	923	7.0	6.8	4	1.4	6	2.1	.02	.49	34	1	.04	4	11	.001
KM13	500	926	7.1	7.8	4	1.4	6	2.1	.01	.13	38	1	.07	4	11	.001
KM14	175	922	6.6	2.5	2	.9	2	1.1	.01	.03	7	1	.02	4	5.6	.001
KM14	500	927	7.1	8.7	5	1.3	6	2.1	.01	.01	39	1	.24	5	9.6	.001
KM2	106	913	6.9	4.6	3	.9	4	1.3	.01	.01	19	1	.08	6	8.7	.005
KM2	492	914	6.9	5.9	4	1.1	5	1.9	.01	.01	27	1	.11	6	9.1	.005
KM3	139	910	7.4	12.0	5	2.7	13	4.4	.03	1.8	68	1	.13	5	9.5	
KM3	463	911	7.6	12.3	5	1.5	13	3.9	.01	.28	68	1	.11	4	9.6	
KM4	94	915	6.8	6.0	3	1.5	5	2.6	.01	.03	29	1	.08	4	12	.005
KM4	509	916	7.0	6.1	3	1.2	4	2.0	.01	.24	31	1	.10	3	13	.008
KM9	215	921	7.0	6.9	3	1.2	5	2.2	.01	.08	36	1	.26	4	12	.001
KM9	408	918	6.6	3.9	2	1.3	3	1.9	.01	.25	17	1	.15	4	9.7	.001
KM9	OM	917	6.8	4.9	3	1.2	3	1.9	.01	.27	23	1	.08	2	13	.005

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