P-06-81

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Keywords: KFM06C, Geology, Drill core, Comparative mapping, BIPS, Boremap, Fractures, Forsmark, AP PF 400-05-086.

Abstract

This report presents the results from four days of geological mapping of KFM06C, a 1 km long telescopic borehole in the Forsmark area, by using the Boremap system. The mapping is part of a project initiated to evaluate possible differences in the geological judgement and the methodology used for the drill core logging at Forsmark and subarea Laxemar site investigation areas. During the four days period, an interval from 176.5 to 360.9 metres of KFM06C was mapped. All lithological features that occur within this interval have been registered and documented with the same criteria used by the SwedPower team during the regular geological logging of boreholes in the Forsmark area.

The 184.4 metres long interval of KFM06C is dominated by a medium-grained metagranite. Other frequent rock types in the interval include pegmatitic granite, amphibolite, aplitic metagranite and fine- to finely medium-grained granite. None of these occurrences exceed a few metres in length along the borehole. Virtually all rocks have experienced Svecofennian metamorphism under amphibolite facies conditions. Structurally, the rocks are characterised by composite L-S fabrics, with a slight predominance of linear mineral fabrics. Seven minor zones of more intense ductile deformation have been registered in the mapped interval of KFM06C. A faint to weak oxidation of feldspars is generally associated with more intensely fractured intervals.

The total number of fractures registered in the 184.4 metres long interval of KFM06C amounts to 646. Of these are 219 open, 14 partly open and 413 sealed. Two rather narrow crush zones occur in the mapped interval. Three fracture sets may be distinguished. (1) Horizontal to sub-horizontal fractures that are mostly open. The maximum aperture of these fractures is 4 millimetres. The most frequent infilling minerals are calcite, chlorite and clay minerals. (2) Steeply dipping fractures, striking roughly N–S. Most of these fractures are inferred to be sealed. Typical infilling minerals are calcite, chlorite, hematite, adularia, laumontite, quartz and pyrite. (3) Sealed, vertical to sub-vertical fractures with ENE–WSW strike. They are mainly restricted to the length interval below ca 280 metres. The majority is sealed by adularia, calcite and chlorite.

Sammanfattning

Föreliggande rapport redovisar resultaten från fyra dagars Boremapkartering av KFM06C, ett 1 km djupt teleskopborrhål i Forsmarksområdet. Karteringen ingår i ett projekt för att utvärdera eventuella skillnader i geologiska bedömningar och metodiken som används vid borrkärnekartering i undersökningsområde Forsmark respektive delområde Laxemar. Under fyradagarsperioden karterades ett längdintervall från 176,5 till 360,9 meter av KFM06C. Alla strukturer och litologiska enheter som förekommer i intervallet registrerades och dokumenterades med samma kriterier som används av SwedPowers geologer vid den reguljära borrhålskarteringen i Forsmark.

Det 184,4 meter långa intervallet i KFM06C domineras av en medelkornig metagranit. Andra vanligt förekommande bergarter i intervallet är pegmatitisk granit, amfibolit, aplitisk metagranit och fin- till fint medelkornig granit. Enskilda förekomster uppgår aldrig till mer än några meters borrhålslängd. I det närmaste alla bergarter har genomgått Svekofennisk amfibolitfacies-metamorfos. Bergarterna karaktäriseras av en sammansatt L-S-struktur, med en något tydligare mineralstänglighet. Sju mindre zoner med mer kraftig duktil deformation har registrerats i det karterade intervallet av KFM06C. En svag till mycket svag oxidation av fältspater uppträder normalt i längdintervall som är mer kraftigt uppspruckna.

Det totala antalet sprickor som registrerats i det 184,4 meter långa intervallet av KFM06C uppgår till 646. Av dessa är 219 öppna, 14 partiellt öppna och 413 läkta. Två mindre krosszoner förekommer i det karterade intervallet. Tre sprickgrupper kan urskiljas. (1) Horisontella till subhorisontella sprickor som till största delen är öppna. Den maximala aperturen hos dessa uppgår till 4 millimeter. De vanligast förekommande sprickfyllnadsmineralen är kalcit, klorit och lermineral. (2) Brant stupande sprickor som stryker ungefär N–S. De flesta av dessa sprickor bedöms vara läkta. Typiska sprickmineral inkluderar kalcit, klorit, hematit, adularia, laumontit, kvarts och pyrit. (3) Läkta, vertikala till subvertikala sprickor som stryker ENE–VSV. De är huvudsakligen begränsade till ett längdintervall under ca 280 meter. Majoriteten av dem är läkta med adularia, kalcit och klorit.

Contents

1 Introduction

Since 2002, SKB investigates two potential sites at Forsmark and Oskarshamn, for a deep repository in the Swedish Precambrian basement. In order to characterise the bedrock down to a depth of about 1 km at the two site investigation areas, SKB launched several extensive drilling programmes. A detailed geological logging of the drill cores obtained through the drilling programs is essential for subsequent sampling and borehole investigations, and consequently, for the three-dimensional modelling of the two sites. For this purpose, the so-called Boremap system has been developed. The system integrates results from geological drill core logging, or alternatively, the drill cuttings when a core is not available, with information from BIPS-logging (Borehole Image Processing System) and calculates the absolute position and orientation of fractures and various planar lithological features (SKB MD 143.006 and 146.005).

To assure the comparability between the two site investigation areas, it is essential that there is a general consensus in the geological judgements and the methodology used for the drill core logging. The subject has arisen as the geologists involved in the logging have been strictly tied to one of the site investigation areas, and the exchange of experiences is rather limited. In order to evaluate possible differences in the mapping, SKB initiated a project where the core logging teams at the two sites were switching locality to work with a drill core from the other site investigation area. The two boreholes chosen for the mapping were telescopic drilled borehole KFM06C from the Forsmark site investigation area and core drilled borehole KLX07B from the subarea Laxemar, which is part of the Simpevarp site investigation area at Oskarshamn.

This document reports the results from the comparative geological logging of borehole KFM06C performed by geologists from SwedPower AB. The activity is part of the site investigation at Forsmark. The work was carried out in accordance with activity plan AP PF 400-05-086. In Table 1-1 controlling documents for performing this activity are listed. Both activity plan and method descriptions are SKB's internal controlling documents.

Table 1-1. Controlling documents for the performance of the activity.

Activity plan	Number	Version
Jämförande Boremapkartering på del av teleskopborrhål KFM06C och KLX07B	AP PF 400-05-086	1.0
Method documents	**Number**	**Version**
Metodbeskrivning för Boremap-kartering	SKB MD 143.006	2.0
Nomenklatur vid Boremap-kartering	SKB MD 143.008	1.0
Mätsystembeskrivning för Boremapkartering, Boremap v 3.0	SKB MD 146.005	1.0

2 Objective and scope

Borehole KFM06C is a ca 1 km long, telescopic borehole drilled in the northern part of the Forsmark site investigation area with 60° inclination towards NNE (026°). It starts with percussion drilling (Ø = 251 mm) to a length of 100.40 metres, followed by core drilling at Ø = 86 millimetres to a length of 102.08 metres, and at Ø = 77 millimetres down to full borehole length at 1,000.43 metres. The diameters of the two drill cores are 70 and 51 millimetres, respectively, under ideal conditions. The available BIPS-image of KFM06C covers the core drilled length interval at Ø = 77 millimetres.

The comparative geological logging of KFM06C starts at 176.5 metres adjusted length, and should proceed for 4×8 hours. This includes 15–20 minutes of daily mapping controls by examination of Boremap generated variable/summary reports and a WellCad log to match. The length of the interval, which was mapped during the four days, amounts to 184.4 metres (176.5–360.9 meters). All structures and lithologies that occur within this interval have been registered and documented with the same criteria used by the SwedPower team during the regular geological logging of the boreholes in the Forsmark area.

3 Equipment

3.1 Description of equipment/interpretation tools

All BIPS-based mapping was performed in Boremap v 3.6. This software contains the bedrock and mineral standard used by the Geological Survey of Sweden (SGU) for geological mapping of the surface at the Forsmark site investigation area, to enable correlation with the surface geology. Additional software used during the course of the geological logging was BIPS Viewer v 1.10 and Microsoft Access. The final data presentation was made by Geoplot and WellCAD v 3.2.

The following equipment was used to facilitate the core logging: folding rule, concentrated hydrochloric acid diluted with three parts of water, unglazed porcelain plate, knife, hand lens, paintbrush and tap water.

4 Execution

4.1 General

During the core logging, the ca 900 metres drill core obtained from the interval 102.08–1,000.43 metres of KFM06C was available in its full length on roller tables in the core-mapping accommodation at Forsmark (the Llentab hall, near the SKB/SFR-office). No thin-sections were available from the drill cores, and all lithological descriptions are based on ocular inspection. The mapping was done by two geologists; one did the core logging while the other registered the information in Boremap.

The core logging of KFM06C was performed in Boremap v 3.6 according to activity plan AP PF 400-05-086 (SKB internal document) following the SKB method description/instruction for Boremap mapping, SKB MD 143.006 (v 2.0) and 143.008 (v 1.0). A WellCAD summary of the mapping is presented in Appendix 1.

4.2 Preparations

The length registered in the BIPS-image deviates from the true borehole length with increasing depth, and the difference at the bottom of KFM06C is about 5 metres. It was, therefore, necessary to adjust the length in KFM06C with reference to groove millings cut into the borehole wall at every 50 metres. The precise level of each reference mark can be found in SKB's database SICADA (Appendix 4). This adjustment was done already during the start of the regular mapping of KFM06C. Consequently, it was copied directly into the database used for the comparative mapping.

Data necessary for calculations of absolute orientation of structures in the borehole includes borehole diameter, azimuth and inclination, and these data were imported directly from SKB's database SICADA (Appendices 2 and 3).

4.3 Data handling

To obtain the best possible data security, the mapping was performed on the SKB intranet, with regular back-ups on the local drives.

To avoid that any broken fractures become unregistered, the number of broken fractures in the drill core was regularly checked against the number of registered fractures in Boremap. The quality routines include also daily controls of the mapping by detailed examination of Boremap generated variable/summary reports and WellCad log to match. The final quality check of the mapping was done by a routine in the Boremap software. The primary data were subsequently exported to the SKB database SICADA, where they are traceable by the activity plan number.

4.4 Analyses and interpretations

A major flaw in Boremap system is the distinction between fractures that intersect the whole borehole ('infinite fractures') and those that end within the drill core ('finite fractures'). The latter category includes fractures that (1) are slightly curved and runs more or less parallel with the borehole axis, (2) ends in other fractures, (3) splays from other fractures and (4) with no immediately obvious reason ends in the drill core. For modelling purposes, it was decided to separate those fractures that intersect the central borehole axis from those that never reach the centre. Fractures limited to less than half of the borehole are, therefore, marked by '#' in the attached comments.

Another problem with the core logging system is related to geological features (mainly fractures) that can be observed only in the drill core. This problem usually arises from poor resolution in the BIPS-image, which in the present case often is caused by the occurrence of suspension from drilling, brownish black coating from the drilling rods on the borehole walls and/or disturbances in the movement of the BIPS-camera. However, even in the most perfect BIPS-image, it is sometimes difficult to distinguish a thin fracture, sealed by a low contrast mineral. All fractures observed in the drill core, but not recognized in the BIPS-image, have been registered as 'not visible in BIPS' in Boremap, to prevent them from being used in forthcoming fracture orientation analysis. If possible, they are still oriented relative to other structures. Fractures supposed to be induced by the drilling activities fall within this category. Obviously drilling-induced fractures are not included in the mapping.

The resolution of the BIPS-image does generally make it possible to estimate the width of fractures with an error of ± 0.5 millimetres. Thus, reliable measurements of fracture widths/apertures less than 1 millimetre are possible to obtain in the drill core, and the minimum width/aperture given is therefore 0.5 millimetre.

The fracture mapping focuses on the division into broken and unbroken fractures, depending on whether they are parting the core or not. Broken fractures include both open fractures and originally sealed fractures, which were broken during the drilling. To decide if a fracture was open, partly open or sealed in the rock volume (i.e. in situ), SKB has developed a confidence classification expressed at three levels, 'possible', 'probable' and 'certain', on the basis of the weathering of the fracture surface and fit of the fracture planes. The criteria for this classification are given in SKB method description for Boremap mapping, SKB MD 143.006 (v 2.0).

Up to four infilling minerals can be registered in the database for each fracture. As far as possible, they are given in order of decreasing abundance in the fracture. Additional minerals (i.e. five or more), which occur in a few fractures, are noted in the attached comment. However, it must be emphasized that this provides no information of the volumetric amount of individual minerals. In a fracture with two minerals, the mineral registered as 'second mineral' may range from sub-microscopic staining up to amounts equal to that of the mineral registered as 'first mineral'. Hematite, for example, occur consistently as extremely thin coatings or impurities in other fracture minerals, such as adularia and laumontite.

4.5 Nonconformities

Some fracture filling minerals are more conspicuous than other. For example, the distinct red tinting shown by sub-microscopic hematite reveals extremely low concentrations of the mineral. Also the use of diluted hydrochloric acid for identification of calcite makes it possible to detect amounts that are macroscopically invisible. The amount of fractures filled with other less conspicuous minerals may, on the other hand, be underestimated. Pyrite, which typically forms up to millimetre-sized, isolated crystals, might for example be under-represented in unbroken fractures.

As in previous cored boreholes, the comparative mapping of KFM06C was locally hampered by brownish black coatings on the borehole walls as well as mottling of the BIPS-image. The dark coating is frequent in the mapped interval, where it typically forms a spiral pattern or a single band along the borehole axis. This coating phenomenon is obviously drill induced, and the explanation proposed is that the coatings originate from metal fragments abraded from the drill rods. Intervals with mottled BIPS-image occur at four levels: 201.64–202.14, 230.58–232.16, 269.25–271.80, 284.45–286.68 metres (adjusted length). Geological features (e.g. fractures) depicted in these mottled intervals are typically distorted and sometimes difficult to distinguish (Figure 4-1). The mottling is obviously a result of disturbances in the normally constant movement of the BIPS-camera.

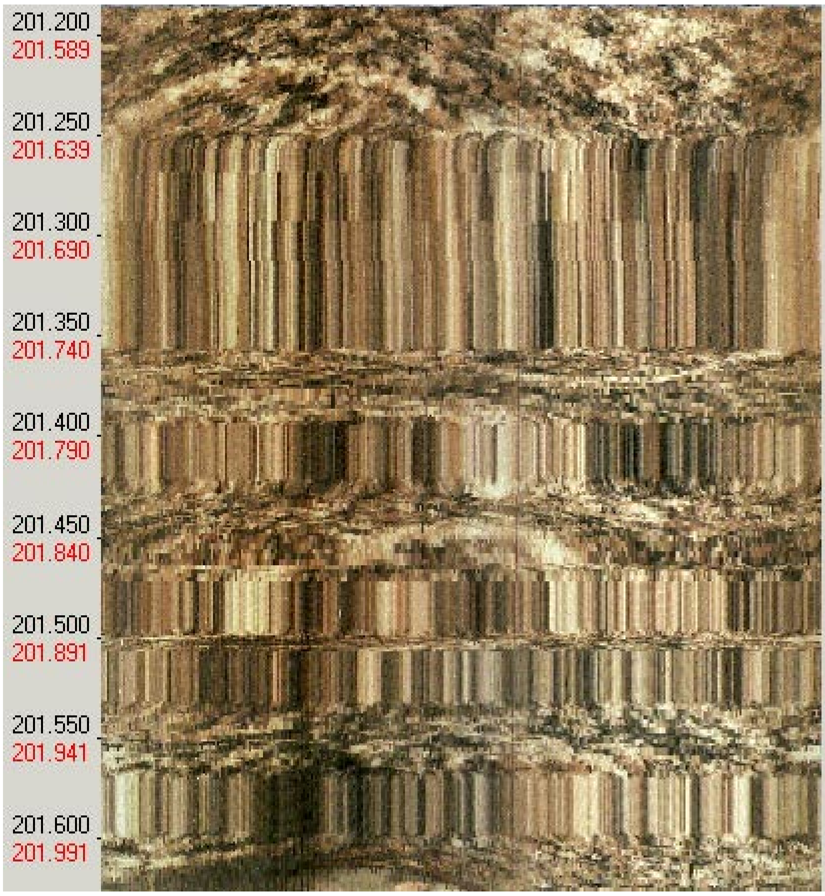


Figure 4-1. *Mottling of the BIPS-image, due to disturbances in the logging movement of the BIPS-camera.*

5 Results

5.1 Core lithology

The 184.4 metres long interval of KFM06C, which was subjected to the comparative mapping, is dominated by a medium-grained metagranite (rock code 101057) with a tendency to be slightly granodioritic. Other frequent rock units in the interval includes pegmatitic granite (rock code 101061), amphibolite (rock code 102017), aplitic metagranite (rock code 101058) and fine- to finely medium-grained granite (rock code 111058). The maximum length of individual occurrences is ca 6.8 metres, though the vast majority are less than a few metres in length. Except for some late veins or dykes, all rocks have experienced Svecofennian metamorphism under amphibolite facies conditions.

The medium-grained metagranite (101057) is rather equigranular with elongated quartz domains, alternating with feldspar-dominated domains and thin streaks of biotite. The colour of the rock varieties ranges from greyish red to grey, whereas completely grey varieties, lacking the reddish tint, are sparse and typically associated with amphibolites.

Amphibolites (102017) and related rocks are generally fine-grained, equigranular and with a large proportion of biotite. All extensions and contacts are broadly parallel with the tectonic fabric.

Dykes, veins and segregations of pegmatite, pegmatitic granite, aplite and leucogranitic material are frequent throughout the interval. Most occurrences are some decimetre or less, but several pegmatites/pegmatitic granites reach up to a few metres in length. The pegmatitic granites are generally texturally heterogeneous, often with a highly variable grain-size, and some occurrences include intervals of finely medium-grained, equigranular granite. Rather coarse magnetite, and subordinately hematite, has been identified in some pegmatites. Despite the textural variability and temporal span within this unit, most of these rocks were grouped as 'pegmatite, pegmatitic granite' (101061). Other, related rocks, which includes aplitic metagranite (101058), fine- to finely medium-grained granite (111058) and aplite (1062) are often highly reminiscent of each other. A distinctive criterion apart from the late-tectonic character of the aplite (1062) and the fine- to finely medium-grained granite (111058), is the anomalously high natural gamma radiation of fine- to finely medium-grained granite. Quartz-dominated segregations or veins were coded as 8021.

In addition, there are a few minor occurrences of granodiorite and tonalite in the interval. None of them appears to fit into the bedrock nomenclature defined by SKB ('Regler för bergarters benämningar vid platsundersökningarna i Simpevarp och Forsmark', v 1.0). Instead they were coded as 1056 (unspecified granodiorite) and 1053 (unspecified tonalite).

5.2 Ductile structures

Most rocks in the mapped interval of KFM06C are characterised by composite L-S fabrics, with a slight predominance of linear mineral fabrics. However, the relative intensity of the two components is locally variable. The intensity of the deformational fabric is mostly weak to medium. It must, however, be emphasized that it often is difficult to distinguish tectonic fabric visually in the pegmatites and some of the fine-grained mafic rocks. The fact that they may appear massive does not necessarily implicate that they actually are post-kinematic. The foliation is generally E–W trending with a moderate dip towards south. None of the linear fabrics have been possible to register with the present methodology, but the general impression is that they are gently to moderately dipping.

Totally seven narrow zones of more intense ductile deformation have been registered in the mapped interval of KFM06C. All of them are found in a ca 50 metres long interval between 180 and 230 metres (adjusted length). Except for a 1.4 metre wide zone at 223.6–225.0 metres adjusted length, individual zones range up to about three decimetres. The protolith in the zones seems mainly to be a highly deformed and grain-size reduced variety of the metagranite (101057). All shear zones are more or less parallel with the local tectonic foliation.

5.3 Alteration

Except for a decimetre-wide occurrence of pre-metamorphic albitization in the aplitic metagranite (101058), the only alteration encountered in the mapped interval of KFM06C is varying degrees of oxidation, manifested as red pigmentation of feldspars. It is generally associated with more intensely fractured intervals, and is most frequent in the length interval 262–297 metres (adjusted length). The oxidation is normally faint to weak in intensity.

5.4 Fractures

5.4.1 Fracture frequencies and orientations

Excluding crush zones and sealed networks, the total number of open (broken fractures with aperture > 0), partly open (unbroken fractures with aperture > 0) and sealed fractures (broken and unbroken fractures with aperture = 0) registered during the comparative mapping of KFM06C amounts to 646, i.e. about 3.5 fractures/m. Of these are 483 visible in the BIPS-image. Moreover, they can be separated in 219 open, 14 partly open and 413 sealed fractures. It should be emphasized that there is a certain degree of uncertainty whether a fracture actually is open or sealed. Throughout the borehole, the frequency of open and sealed fractures varies rather coherently, with an increased number of open fractures in intervals with concentrations of sealed fractures (Appendix 1). Considering the fracture distribution along the mapped interval of KFM06C, there is two sections with somewhat increased fracture frequency: 204–228 and 285–305 metres adjusted length. None of these intervals are especially well-defined, and both are dominated by fractures inferred to be sealed.

The fracture orientations vary considerably throughout the mapped interval of KFM06C, though a stereographic projection in Figure 5-1 reveal three rather distinct fracture sets. The proportion of open and sealed fractures differs significantly between the sets. The first fracture set consists of horizontal to sub-horizontal fractures. Fractures of this set are found throughout both borehole, and most of these fractures are inferred to be open. The maximum aperture of these fractures is 4 millimetres. A second fracture set consists steeply dipping fractures, striking N–S. The majority of these fractures are sealed. A third, well-defined fracture set, mainly restricted to the length interval below ca 280 metres, consists of vertical to sub-vertical fractures with ENE–WSW strike. In addition, there are a number of fractures with varying dips towards south. A considerable amount of these fractures are inferred to be open.

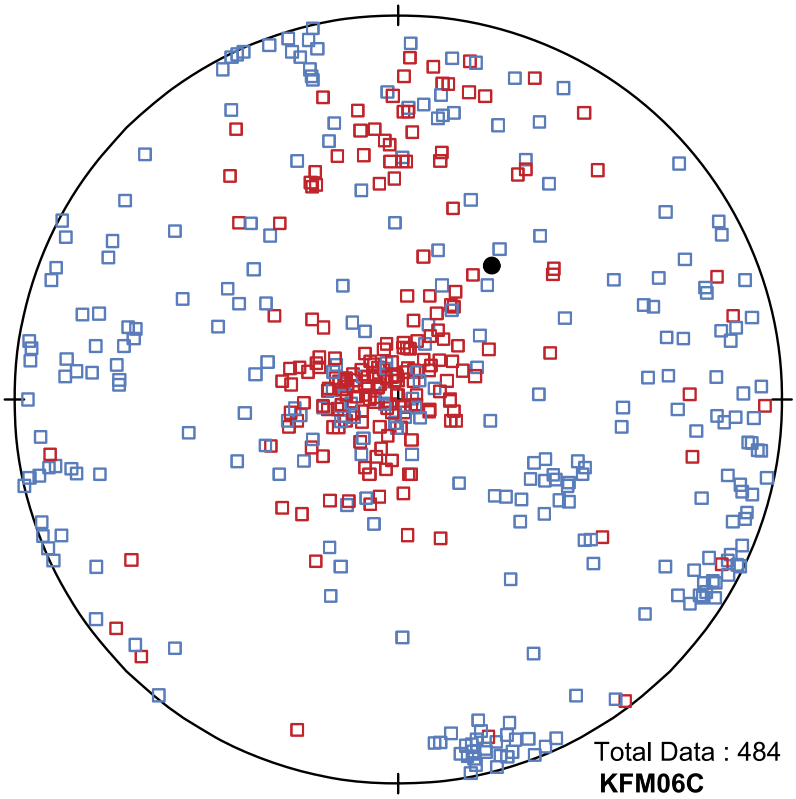


Figure 5-1. *Lower hemisphere, equal-area stereographic projections showing the poles to all sealed (blue squares) and open (red squares) fractures in the adjusted length interval 176.5–360.9 metres of borehole KFM06C. A filled, black circle mark the orientation of the borehole axis.*

Two rather narrow crush zones occur at 284.66–284.76 and 346.53–346.57 metres (adjusted length) in the mapped interval of KFM06C. Both are gently dipping with an approximate NE–SW trending strike. There is also a drill induced crush in the adjusted length interval 284.66–285.11 metres, which hence overlaps with the upper of the two crush zones.

Five sealed networks with fractures of highly variable orientation have been registered in the mapped interval of KFM06C. The width of individual networks ranges up to a few decimetres.

One fracture inferred to be core discing has been observed at 258.22 metres adjusted length.

5.4.2 Fracture mineralogy

Chlorite and/or calcite are found in about 75% of the total number of the registered fractures in the mapped interval of KFM06C. They are found in all fracture sets discussed above (cf Figure 5-1). Other infilling minerals, in order of decreasing abundance, include clay minerals, prehnite, adularia, pyrite, quartz, laumontite, sub-microscopic hematite, biotite, sericite, epidote, fluorite, galena and unspecified sulphides. There are also 80 fractures that are virtually free from visible mineral coatings and oxidized walls. These are mostly open, and a considerable proportion belongs to the horizontal to sub-horizontal fracture set.

The various clay minerals occur typically in open, flat-lying fractures. It is generally impossible to be more specific regarding the type of clay minerals. However, clay minerals registered in more steeply dipping fractures are mostly corrensite, often intimately associated with chlorite.

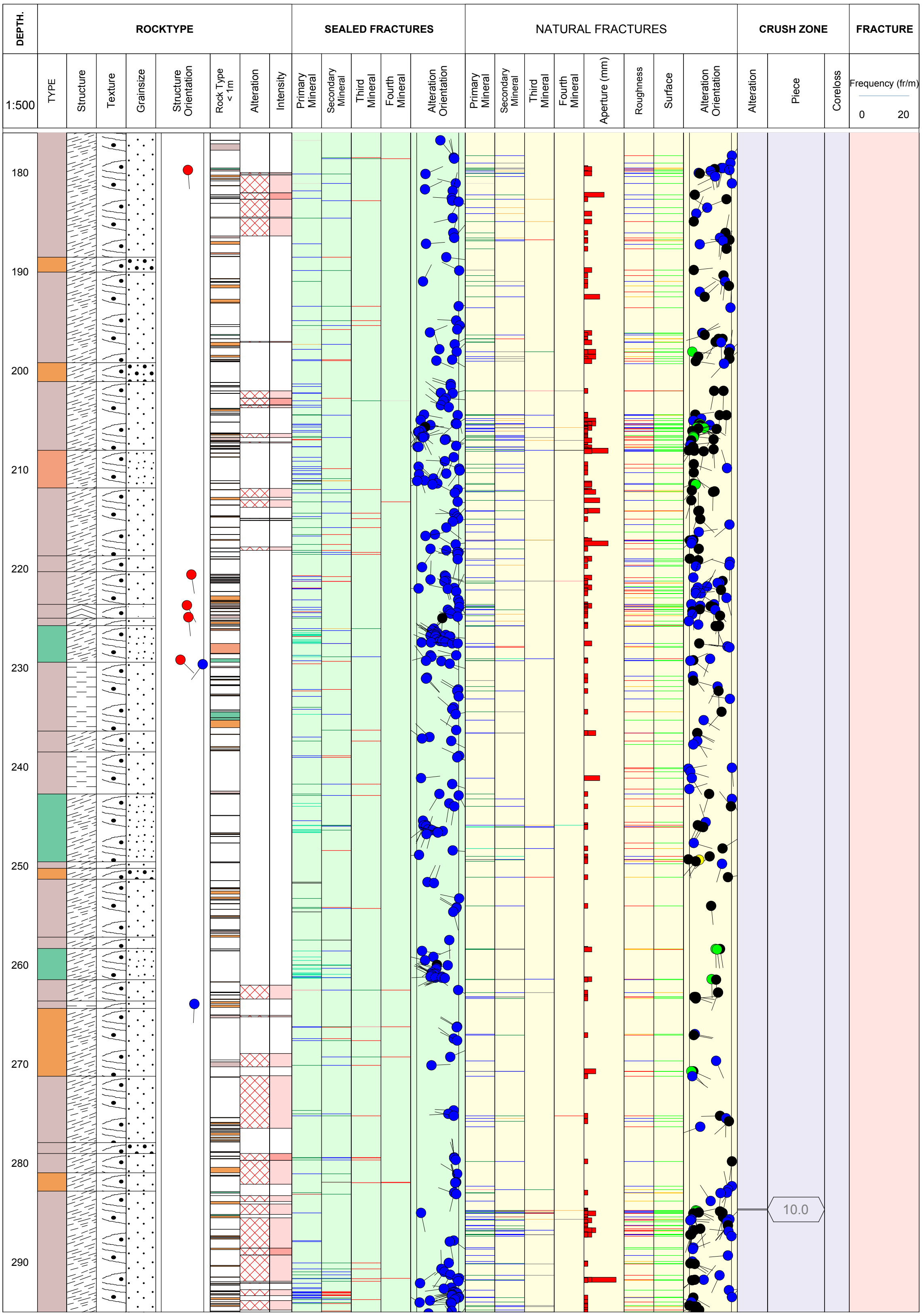
All other minerals, as well as the presence of oxidized walls, are preferentially associated with sealed fractures. A typical mineral assemblage is calcite + chlorite ± hematite stained adularia ± pyrite. The assemblage is found in all the fracture sets discussed above, though the third fracture set is dominated by hematite-stained adularia with subordinate amounts of calcite and chlorite. Laumontite and to some extent quartz tend to be associated with this assemblage. Fractures containing this assemblage often exhibit oxidized walls. A number of very thin (<< 1 millimetre), sealed fractures are only revealed by their oxidized walls. Except for staining of various silicates, such as adularia and laumontite, hematite may occur as thin, reddish coatings, preferentially found in flat lying fractures.

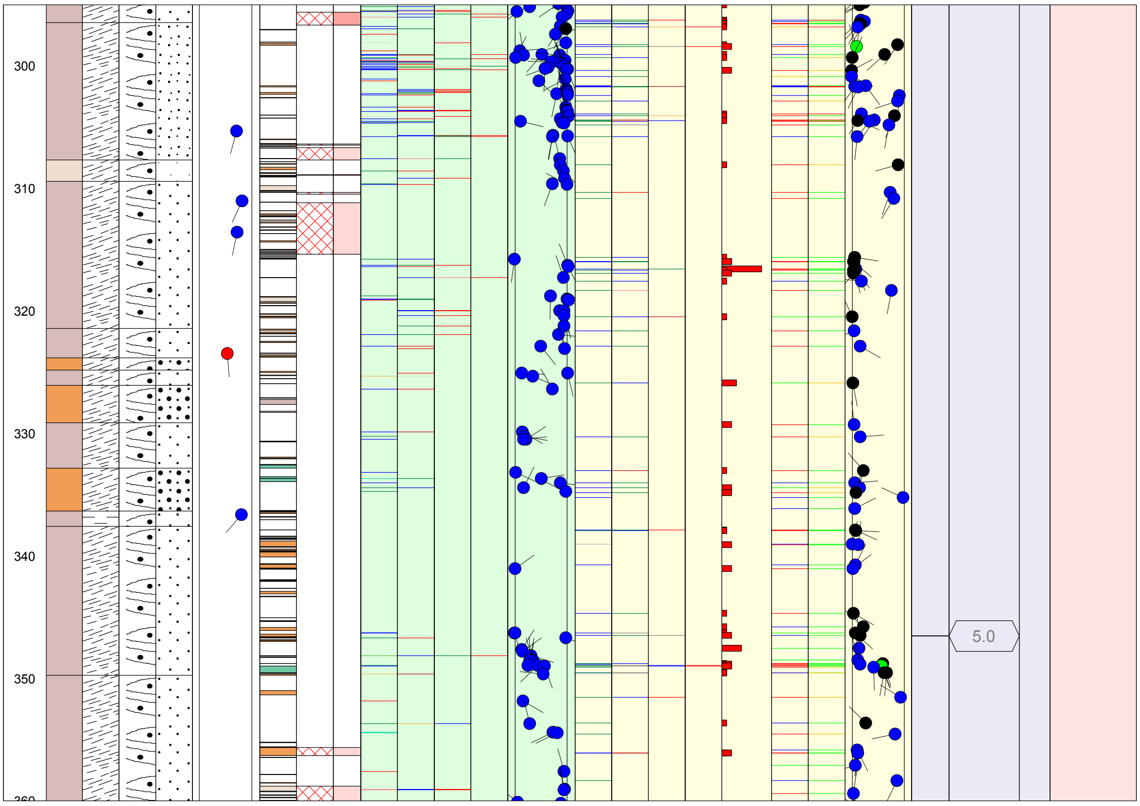
Prehnite is more or less restricted to sealed fractures in amphibolites. Most of these fractures are rather thin (< 1 millimetre). The identification is therefore difficult and some of the light greenish mineral mapped as prehnite might be adularia or possibly epidote.

WellCAD image

Title **GEOLOGY IN KFM06C** **Appendix:** 1

Site	FORSMARK	**Coordinate System**	RT90-RHB70
Borehole	KFM06C	**Northing [m]**	
Diameter [mm]	77.0	**Easting [m]**	
Length [m]		**Elevation [m.a.s.l.]**	
Bearing [°]	26.1	**Drilling Start Date**	
Inclination [°]	-60.0	**Drilling Stop Date**	
Date of corempping		**Plot Date**	
Rocktype data from		**Fracture data from**	




300
310
320
330
340
350
5.0

Appendix 2

Borehole diameters

Hole Diam T – Drilling: Borehole diameter

KFM06C, 2005-04-27 14:30:00 – 2005-06-30 13:44:00 (100.400–1,000.430 m).

Sub secup (m)	Sub seclow (m)	Hole diam (m)	Comment
100.400	102.080	0.086	
102.080	1,000.430	0.077	

Printout from SICADA 2005-10-12 16:50:52.

Appendix 3

Downhole deviation measurements

Maxibor T – Borehole deviation: Maxibor

KFM06C, 2005-08-02 11:01:00 – 2005-08-02 20:19:00 (3.000–978.000 m).

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol flag
3.00	6699742.30	1632437.69	–1.48	RT90-RHB70	–60.12	26.06	0.0000	0.0000	0.0000	
6.00	6699743.65	1632438.34	1.12	RT90-RHB70	–60.01	25.86	1.4900	0.0000	0.0000	
9.00	6699744.99	1632439.00	3.72	RT90-RHB70	–60.03	25.91	2.9900	-0.0100	0.0100	
12.00	6699746.34	1632439.65	6.31	RT90-RHB70	–60.07	26.14	4.4900	-0.0100	0.0100	
15.00	6699747.69	1632440.31	8.91	RT90-RHB70	–60.00	26.49	5.9900	-0.0100	0.0100	
18.00	6699749.03	1632440.98	11.51	RT90-RHB70	–59.87	26.65	7.4900	0.0000	0.0200	
21.00	6699750.38	1632441.66	14.11	RT90-RHB70	–59.82	26.71	9.0000	0.0200	0.0300	
24.00	6699751.72	1632442.33	16.70	RT90-RHB70	–59.75	26.71	10.5000	0.0400	0.0500	
27.00	6699753.07	1632443.01	19.29	RT90-RHB70	–59.67	26.82	12.0100	0.0500	0.0700	
30.00	6699754.42	1632443.70	21.88	RT90-RHB70	–59.61	27.06	13.5300	0.0700	0.0900	
33.00	6699755.78	1632444.39	24.47	RT90-RHB70	–59.56	27.19	15.0500	0.1000	0.1200	
36.00	6699757.13	1632445.08	27.06	RT90-RHB70	–59.54	27.24	16.5700	0.1300	0.1500	
39.00	6699758.48	1632445.78	29.64	RT90-RHB70	–59.49	27.23	18.0900	0.1600	0.1800	
42.00	6699759.83	1632446.47	32.23	RT90-RHB70	–59.43	27.21	19.6100	0.1900	0.2100	
45.00	6699761.19	1632447.17	34.81	RT90-RHB70	–59.42	27.20	21.1400	0.2200	0.2500	
48.00	6699762.55	1632447.87	37.39	RT90-RHB70	–59.35	27.21	22.6600	0.2500	0.2800	
51.00	6699763.91	1632448.57	39.97	RT90-RHB70	–59.25	27.33	24.1900	0.2800	0.3200	
54.00	6699765.27	1632449.27	42.55	RT90-RHB70	–59.10	27.42	25.7200	0.3200	0.3700	
57.00	6699766.64	1632449.98	45.12	RT90-RHB70	–58.97	27.52	27.2600	0.3500	0.4200	
60.00	6699768.01	1632450.70	47.70	RT90-RHB70	–58.79	27.44	28.8100	0.3900	0.4800	

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol flag
63.00	6699769.39	1632451.41	50.26	RT90-RHB70	–58.58	27.29	30.3600	0.4300	0.5500	
66.00	6699770.78	1632452.13	52.82	RT90-RHB70	–58.49	27.30	31.9300	0.4600	0.6300	
69.00	6699772.17	1632452.85	55.38	RT90-RHB70	–58.46	27.41	33.5000	0.5000	0.7100	
72.00	6699773.57	1632453.57	57.94	RT90-RHB70	–58.41	27.49	35.0600	0.5300	0.8000	
75.00	6699774.96	1632454.30	60.49	RT90-RHB70	–58.30	27.58	36.6400	0.5700	0.8900	
78.00	6699776.36	1632455.03	63.04	RT90-RHB70	–58.22	27.62	38.2100	0.6100	0.9800	
81.00	6699777.76	1632455.76	65.59	RT90-RHB70	–58.30	27.51	39.7900	0.6600	1.0800	
84.00	6699779.16	1632456.49	68.15	RT90-RHB70	–58.28	27.25	41.3700	0.7000	1.1800	
87.00	6699780.56	1632457.21	70.70	RT90-RHB70	–58.19	27.13	42.9400	0.7300	1.2700	
90.00	6699781.97	1632457.93	73.25	RT90-RHB70	–58.15	27.21	44.5200	0.7600	1.3800	
93.00	6699783.37	1632458.66	75.80	RT90-RHB70	–58.05	27.24	46.1100	0.7900	1.4800	
96.00	6699784.79	1632459.38	78.34	RT90-RHB70	–58.01	27.23	47.6900	0.8200	1.5900	
99.00	6699786.20	1632460.11	80.89	RT90-RHB70	–58.24	27.04	49.2800	0.8600	1.7000	
102.00	6699787.61	1632460.83	83.44	RT90-RHB70	–58.56	26.73	50.8600	0.8800	1.8000	
105.00	6699789.00	1632461.53	86.00	RT90-RHB70	–58.53	26.71	52.4300	0.9000	1.8800	
108.00	6699790.40	1632462.23	88.56	RT90-RHB70	–58.43	26.94	53.9900	0.9200	1.9600	
111.00	6699791.80	1632462.95	91.11	RT90-RHB70	–58.36	27.18	55.5600	0.9400	2.0500	
114.00	6699793.20	1632463.67	93.67	RT90-RHB70	–58.34	27.31	57.1400	0.9700	2.1400	
117.00	6699794.60	1632464.39	96.22	RT90-RHB70	–58.31	27.36	58.7100	1.0100	2.2300	
120.00	6699796.00	1632465.11	98.77	RT90-RHB70	–58.22	27.44	60.2900	1.0400	2.3300	
123.00	6699797.40	1632465.84	101.32	RT90-RHB70	–58.12	27.63	61.8700	1.0800	2.4300	
126.00	6699798.81	1632466.58	103.87	RT90-RHB70	–58.00	27.83	63.4500	1.1300	2.5300	
129.00	6699800.21	1632467.32	106.41	RT90-RHB70	–57.90	28.02	65.0400	1.1700	2.6400	
132.00	6699801.62	1632468.07	108.95	RT90-RHB70	–57.75	28.17	66.6300	1.2300	2.7600	
135.00	6699803.03	1632468.82	111.49	RT90-RHB70	–57.63	28.37	68.2300	1.2900	2.8800	
138.00	6699804.44	1632469.59	114.03	RT90-RHB70	–57.52	28.62	69.8400	1.3500	3.0100	
141.00	6699805.86	1632470.36	116.56	RT90-RHB70	–57.42	28.85	71.4500	1.4200	3.1400	
144.00	6699807.27	1632471.14	119.08	RT90-RHB70	–57.33	29.09	73.0600	1.5000	3.2800	

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol flag
147.00	6699808.69	1632471.92	121.61	RT90-RHB70	–57.26	29.33	74.6800	1.5900	3.4300	
150.00	6699810.10	1632472.72	124.13	RT90-RHB70	–57.18	29.60	76.3000	1.6800	3.5800	
153.00	6699811.52	1632473.52	126.65	RT90-RHB70	–57.14	29.83	77.9200	1.7800	3.7300	
156.00	6699812.93	1632474.33	129.17	RT90-RHB70	–57.12	30.06	79.5500	1.8900	3.8800	
159.00	6699814.34	1632475.15	131.69	RT90-RHB70	–57.07	30.24	81.1700	2.0000	4.0300	
162.00	6699815.75	1632475.97	134.21	RT90-RHB70	–57.02	30.33	82.8000	2.1200	4.1900	
165.00	6699817.16	1632476.79	136.73	RT90-RHB70	–56.97	30.40	84.4300	2.2400	4.3500	
168.00	6699818.57	1632477.62	139.24	RT90-RHB70	–56.90	30.47	86.0600	2.3600	4.5100	
171.00	6699819.98	1632478.45	141.76	RT90-RHB70	–56.80	30.67	87.6900	2.4900	4.6700	
174.00	6699821.39	1632479.29	144.27	RT90-RHB70	–56.69	30.83	89.3300	2.6200	4.8400	
177.00	6699822.81	1632480.13	146.77	RT90-RHB70	–56.61	31.03	90.9700	2.7600	5.0200	
180.00	6699824.22	1632480.98	149.28	RT90-RHB70	–56.53	31.23	92.6100	2.9000	5.1900	
183.00	6699825.64	1632481.84	151.78	RT90-RHB70	–56.45	31.45	94.2600	3.0500	5.3800	
186.00	6699827.05	1632482.71	154.28	RT90-RHB70	–56.37	31.68	95.9100	3.2100	5.5600	
189.00	6699828.47	1632483.58	156.78	RT90-RHB70	–56.31	31.88	97.5700	3.3700	5.7500	
192.00	6699829.88	1632484.46	159.28	RT90-RHB70	–56.27	32.11	99.2200	3.5400	5.9400	
195.00	6699831.29	1632485.34	161.77	RT90-RHB70	–56.19	32.34	100.8800	3.7100	6.1400	
198.00	6699832.70	1632486.24	164.26	RT90-RHB70	–56.10	32.55	102.5400	3.9000	6.3300	
201.00	6699834.11	1632487.14	166.75	RT90-RHB70	–55.98	32.79	104.2000	4.0900	6.5300	
204.00	6699835.52	1632488.05	169.24	RT90-RHB70	–55.84	33.00	105.8700	4.2800	6.7400	
207.00	6699836.93	1632488.96	171.72	RT90-RHB70	–55.74	33.21	107.5400	4.4900	6.9500	
210.00	6699838.35	1632489.89	174.20	RT90-RHB70	–55.63	33.44	109.2100	4.7000	7.1700	
213.00	6699839.76	1632490.82	176.68	RT90-RHB70	–55.56	33.58	110.8900	4.9100	7.4000	
216.00	6699841.17	1632491.76	179.15	RT90-RHB70	–55.54	33.75	112.5800	5.1300	7.6200	
219.00	6699842.59	1632492.70	181.62	RT90-RHB70	–55.53	33.97	114.2600	5.3600	7.8500	
222.00	6699843.99	1632493.65	184.10	RT90-RHB70	–55.52	34.18	115.9400	5.6000	8.0700	
225.00	6699845.40	1632494.61	186.57	RT90-RHB70	–55.50	34.43	117.6200	5.8400	8.3000	
228.00	6699846.80	1632495.57	189.04	RT90-RHB70	–55.48	34.66	119.3000	6.0800	8.5300	

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231.00	6699848.20	1632496.53	191.52	RT90-RHB70	–55.45	34.88	120.9800	6.3400	8.7500	
234.00	6699849.59	1632497.51	193.99	RT90-RHB70	–55.41	35.09	122.6600	6.6000	8.9800	
237.00	6699850.99	1632498.49	196.46	RT90-RHB70	–55.37	35.27	124.3500	6.8600	9.2100	
240.00	6699852.38	1632499.47	198.92	RT90-RHB70	–55.32	35.43	126.0300	7.1400	9.4400	
243.00	6699853.77	1632500.46	201.39	RT90-RHB70	–55.28	35.61	127.7100	7.4200	9.6700	
246.00	6699855.16	1632501.46	203.86	RT90-RHB70	–55.23	35.79	129.4000	7.7000	9.9000	
249.00	6699856.55	1632502.46	206.32	RT90-RHB70	–55.20	35.96	131.0800	7.9900	10.1300	
252.00	6699857.93	1632503.46	208.78	RT90-RHB70	–55.17	36.15	132.7700	8.2800	10.3700	
255.00	6699859.32	1632504.47	211.25	RT90-RHB70	–55.14	36.36	134.4600	8.5800	10.6100	
258.00	6699860.70	1632505.49	213.71	RT90-RHB70	–55.10	36.58	136.1500	8.8900	10.8400	
261.00	6699862.08	1632506.51	216.17	RT90-RHB70	–55.08	36.77	137.8300	9.2000	11.0800	
264.00	6699863.45	1632507.54	218.63	RT90-RHB70	–55.05	36.97	139.5200	9.5200	11.3200	
267.00	6699864.83	1632508.57	221.09	RT90-RHB70	–55.00	37.14	141.2100	9.8500	11.5600	
270.00	6699866.20	1632509.61	223.55	RT90-RHB70	–54.92	37.26	142.9000	10.1800	11.8000	
273.00	6699867.57	1632510.66	226.00	RT90-RHB70	–54.86	37.38	144.5900	10.5100	12.0400	
276.00	6699868.94	1632511.70	228.45	RT90-RHB70	–54.84	37.48	146.2800	10.8500	12.2800	
279.00	6699870.31	1632512.76	230.91	RT90-RHB70	–54.86	37.57	147.9700	11.1900	12.5300	
282.00	6699871.68	1632513.81	233.36	RT90-RHB70	–54.86	37.75	149.6700	11.5400	12.7800	
285.00	6699873.05	1632514.87	235.81	RT90-RHB70	–54.83	37.86	151.3600	11.8900	13.0200	
288.00	6699874.41	1632515.93	238.27	RT90-RHB70	–54.77	37.99	153.0500	12.2400	13.2600	
291.00	6699875.77	1632516.99	240.72	RT90-RHB70	–54.72	38.17	154.7400	12.6000	13.5100	
294.00	6699877.14	1632518.06	243.17	RT90-RHB70	–54.66	38.39	156.4400	12.9600	13.7600	
297.00	6699878.50	1632519.14	245.61	RT90-RHB70	–54.58	38.63	158.1300	13.3300	14.0100	
300.00	6699879.85	1632520.23	248.06	RT90-RHB70	–54.51	38.88	159.8300	13.7100	14.2700	
303.00	6699881.21	1632521.32	250.50	RT90-RHB70	–54.43	39.08	161.5300	14.1000	14.5200	
306.00	6699882.57	1632522.42	252.94	RT90-RHB70	–54.34	39.24	163.2300	14.4900	14.7800	
309.00	6699883.92	1632523.52	255.38	RT90-RHB70	–54.24	39.44	164.9300	14.8900	15.0400	
312.00	6699885.27	1632524.64	257.81	RT90-RHB70	–54.13	39.68	166.6400	15.2900	15.3100	

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315.00	6699886.63	1632525.76	260.24	RT90-RHB70	–54.05	39.93	168.3400	15.7100	15.5800	
318.00	6699887.98	1632526.89	262.67	RT90-RHB70	–53.96	40.19	170.0500	16.1300	15.8500	
321.00	6699889.33	1632528.03	265.10	RT90-RHB70	–53.86	40.37	171.7700	16.5600	16.1300	
324.00	6699890.67	1632529.18	267.52	RT90-RHB70	–53.82	40.49	173.4800	17.0000	16.4100	
327.00	6699892.02	1632530.33	269.94	RT90-RHB70	–53.75	40.69	175.2000	17.4400	16.6900	
330.00	6699893.37	1632531.48	272.36	RT90-RHB70	–53.66	40.89	176.9100	17.8900	16.9700	
333.00	6699894.71	1632532.65	274.78	RT90-RHB70	–53.56	41.05	178.6300	18.3400	17.2600	
336.00	6699896.05	1632533.82	277.19	RT90-RHB70	–53.45	41.24	180.3500	18.8000	17.5500	
339.00	6699897.40	1632534.99	279.60	RT90-RHB70	–53.34	41.40	182.0800	19.2700	17.8400	
342.00	6699898.74	1632536.18	282.01	RT90-RHB70	–53.24	41.48	183.8000	19.7400	18.1400	
345.00	6699900.08	1632537.37	284.41	RT90-RHB70	–53.16	41.57	185.5300	20.2200	18.4400	
348.00	6699901.43	1632538.56	286.81	RT90-RHB70	–53.09	41.76	187.2700	20.7000	18.7500	
351.00	6699902.77	1632539.76	289.21	RT90-RHB70	–53.04	41.94	189.0000	21.1900	19.0600	
354.00	6699904.12	1632540.97	291.61	RT90-RHB70	–52.99	42.14	190.7400	21.6800	19.3700	
357.00	6699905.46	1632542.18	294.00	RT90-RHB70	–52.94	42.37	192.4700	22.1800	19.6800	
360.00	6699906.79	1632543.40	296.40	RT90-RHB70	–52.91	42.62	194.2100	22.6900	19.9900	
363.00	6699908.12	1632544.62	298.79	RT90-RHB70	–52.87	42.86	195.9400	23.2100	20.3000	
366.00	6699909.45	1632545.85	301.18	RT90-RHB70	–52.81	43.10	197.6800	23.7300	20.6100	
369.00	6699910.77	1632547.09	303.57	RT90-RHB70	–52.76	43.28	199.4100	24.2600	20.9300	
372.00	6699912.10	1632548.34	305.96	RT90-RHB70	–52.70	43.48	201.1400	24.8000	21.2400	
375.00	6699913.42	1632549.59	308.35	RT90-RHB70	–52.64	43.68	202.8800	25.3400	21.5600	
378.00	6699914.73	1632550.85	310.73	RT90-RHB70	–52.60	43.89	204.6100	25.8900	21.8700	
381.00	6699916.04	1632552.11	313.12	RT90-RHB70	–52.55	44.12	206.3500	26.4500	22.1900	
384.00	6699917.35	1632553.38	315.50	RT90-RHB70	–52.50	44.32	208.0800	27.0100	22.5100	
387.00	6699918.66	1632554.65	317.88	RT90-RHB70	–52.48	44.54	209.8200	27.5900	22.8200	
390.00	6699919.96	1632555.94	320.26	RT90-RHB70	–52.42	44.82	211.5500	28.1700	23.1400	
393.00	6699921.26	1632557.23	322.63	RT90-RHB70	–52.35	45.09	213.2800	28.7500	23.4600	
396.00	6699922.55	1632558.52	325.01	RT90-RHB70	–52.26	45.31	215.0100	29.3500	23.7800	

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399.00	6699923.85	1632559.83	327.38	RT90-RHB70	–52.12	45.48	216.7500	29.9600	24.1000	
402.00	6699925.14	1632561.14	329.75	RT90-RHB70	–52.00	45.64	218.4800	30.5700	24.4300	
405.00	6699926.43	1632562.46	332.11	RT90-RHB70	–51.89	45.81	220.2200	31.1900	24.7600	
408.00	6699927.72	1632563.79	334.47	RT90-RHB70	–51.80	46.02	221.9700	31.8100	25.0900	
411.00	6699929.01	1632565.13	336.83	RT90-RHB70	–51.72	46.21	223.7100	32.4500	25.4300	
414.00	6699930.29	1632566.47	339.19	RT90-RHB70	–51.64	46.39	225.4600	33.0900	25.7700	
417.00	6699931.58	1632567.82	341.54	RT90-RHB70	–51.58	46.57	227.2000	33.7300	26.1100	
420.00	6699932.86	1632569.17	343.89	RT90-RHB70	–51.52	46.74	228.9500	34.3900	26.4500	
423.00	6699934.14	1632570.53	346.24	RT90-RHB70	–51.47	46.90	230.6900	35.0500	26.8000	
426.00	6699935.42	1632571.89	348.58	RT90-RHB70	–51.45	47.05	232.4400	35.7100	27.1400	
429.00	6699936.69	1632573.26	350.93	RT90-RHB70	–51.39	47.19	234.1900	36.3800	27.4900	
432.00	6699937.96	1632574.63	353.28	RT90-RHB70	–51.27	47.37	235.9300	37.0600	27.8300	
435.00	6699939.23	1632576.02	355.62	RT90-RHB70	–51.20	47.57	237.6800	37.7400	28.1800	
438.00	6699940.50	1632577.40	357.95	RT90-RHB70	–51.15	47.81	239.4300	38.4300	28.5400	
441.00	6699941.77	1632578.80	360.29	RT90-RHB70	–51.14	48.01	241.1800	39.1200	28.8900	
444.00	6699943.02	1632580.20	362.63	RT90-RHB70	–51.11	48.23	242.9200	39.8300	29.2400	
447.00	6699944.28	1632581.60	364.96	RT90-RHB70	–51.02	48.40	244.6700	40.5400	29.5900	
450.00	6699945.53	1632583.01	367.29	RT90-RHB70	–50.95	48.56	246.4100	41.2500	29.9400	
453.00	6699946.78	1632584.43	369.62	RT90-RHB70	–50.87	48.77	248.1600	41.9800	30.2900	
456.00	6699948.03	1632585.85	371.95	RT90-RHB70	–50.80	48.96	249.9100	42.7100	30.6500	
459.00	6699949.28	1632587.28	374.27	RT90-RHB70	–50.72	49.20	251.6500	43.4500	31.0000	
462.00	6699950.52	1632588.72	376.60	RT90-RHB70	–50.65	49.43	253.4000	44.1900	31.3600	
465.00	6699951.75	1632590.17	378.92	RT90-RHB70	–50.64	49.64	255.1500	44.9500	31.7200	
468.00	6699952.99	1632591.62	381.24	RT90-RHB70	–50.64	49.82	256.8900	45.7100	32.0800	
471.00	6699954.21	1632593.07	383.56	RT90-RHB70	–50.65	50.00	258.6300	46.4700	32.4300	
474.00	6699955.44	1632594.53	385.88	RT90-RHB70	–50.65	50.21	260.3700	47.2500	32.7800	
477.00	6699956.65	1632595.99	388.20	RT90-RHB70	–50.61	50.44	262.1100	48.0200	33.1300	
480.00	6699957.87	1632597.46	390.51	RT90-RHB70	–50.59	50.64	263.8400	48.8100	33.4800	

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483.00	6699959.07	1632598.93	392.83	RT90-RHB70	–50.55	50.87	265.5700	49.6000	33.8300	
486.00	6699960.28	1632600.41	395.15	RT90-RHB70	–50.53	51.05	267.3000	50.4000	34.1700	
489.00	6699961.48	1632601.89	397.46	RT90-RHB70	–50.49	51.27	269.0300	51.2100	34.5200	
492.00	6699962.67	1632603.38	399.78	RT90-RHB70	–50.46	51.46	270.7600	52.0200	34.8600	
495.00	6699963.86	1632604.87	402.09	RT90-RHB70	–50.42	51.64	272.4800	52.8400	35.2100	
498.00	6699965.05	1632606.37	404.40	RT90-RHB70	–50.39	51.80	274.2100	53.6700	35.5500	
501.00	6699966.23	1632607.88	406.72	RT90-RHB70	–50.37	51.98	275.9300	54.5000	35.8900	
504.00	6699967.41	1632609.38	409.03	RT90-RHB70	–50.35	52.16	277.6500	55.3300	36.2300	
507.00	6699968.58	1632610.89	411.34	RT90-RHB70	–50.34	52.36	279.3700	56.1700	36.5700	
510.00	6699969.75	1632612.41	413.65	RT90-RHB70	–50.31	52.56	281.0900	57.0200	36.9100	
513.00	6699970.92	1632613.93	415.95	RT90-RHB70	–50.30	52.75	282.8000	57.8800	37.2500	
516.00	6699972.08	1632615.46	418.26	RT90-RHB70	–50.28	52.99	284.5100	58.7400	37.5800	
519.00	6699973.23	1632616.99	420.57	RT90-RHB70	–50.24	53.25	286.2200	59.6100	37.9100	
522.00	6699974.38	1632618.53	422.88	RT90-RHB70	–50.16	53.50	287.9300	60.4800	38.2500	
525.00	6699975.52	1632620.07	425.18	RT90-RHB70	–50.10	53.75	289.6300	61.3700	38.5800	
528.00	6699976.66	1632621.62	427.48	RT90-RHB70	–50.07	53.99	291.3400	62.2600	38.9100	
531.00	6699977.79	1632623.18	429.78	RT90-RHB70	–50.06	54.22	293.0400	63.1600	39.2400	
534.00	6699978.92	1632624.74	432.08	RT90-RHB70	–50.04	54.44	294.7400	64.0700	39.5600	
537.00	6699980.04	1632626.31	434.38	RT90-RHB70	–50.00	54.64	296.4300	64.9900	39.8900	
540.00	6699981.15	1632627.88	436.68	RT90-RHB70	–49.94	54.82	298.1300	65.9100	40.2100	
543.00	6699982.27	1632629.46	438.98	RT90-RHB70	–49.91	55.02	299.8200	66.8400	40.5400	
546.00	6699983.37	1632631.04	441.27	RT90-RHB70	–49.87	55.20	301.5100	67.7800	40.8600	
549.00	6699984.48	1632632.63	443.56	RT90-RHB70	–49.84	55.42	303.2000	68.7200	41.1800	
552.00	6699985.57	1632634.22	445.86	RT90-RHB70	–49.83	55.60	304.8900	69.6700	41.5000	
555.00	6699986.67	1632635.82	448.15	RT90-RHB70	–49.82	55.79	306.5700	70.6200	41.8200	
558.00	6699987.76	1632637.42	450.44	RT90-RHB70	–49.81	55.95	308.2500	71.5800	42.1300	
561.00	6699988.84	1632639.03	452.73	RT90-RHB70	–49.79	56.10	309.9300	72.5400	42.4500	
564.00	6699989.92	1632640.63	455.02	RT90-RHB70	–49.77	56.25	311.6100	73.5100	42.7600	

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol flag
567.00	6699991.00	1632642.24	457.31	RT90-RHB70	–49.72	56.39	313.2800	74.4900	43.0700	
570.00	6699992.07	1632643.86	459.60	RT90-RHB70	–49.63	56.52	314.9500	75.4700	43.3800	
573.00	6699993.14	1632645.48	461.89	RT90-RHB70	–49.56	56.70	316.6300	76.4500	43.6900	
576.00	6699994.21	1632647.11	464.17	RT90-RHB70	–49.47	56.87	318.3000	77.4400	44.0100	
579.00	6699995.28	1632648.74	466.45	RT90-RHB70	–49.36	57.05	319.9800	78.4400	44.3300	
582.00	6699996.34	1632650.38	468.73	RT90-RHB70	–49.25	57.23	321.6500	79.4500	44.6400	
585.00	6699997.40	1632652.03	471.00	RT90-RHB70	–49.18	57.41	323.3300	80.4600	44.9600	
588.00	6699998.45	1632653.68	473.27	RT90-RHB70	–49.15	57.62	325.0000	81.4800	45.2800	
591.00	6699999.51	1632655.34	475.54	RT90-RHB70	–49.12	57.81	326.6800	82.5100	45.6000	
594.00	6700000.55	1632657.00	477.81	RT90-RHB70	–49.09	57.95	328.3500	83.5400	45.9200	
597.00	6700001.59	1632658.66	480.08	RT90-RHB70	–49.05	58.04	330.0100	84.5800	46.2400	
600.00	6700002.63	1632660.33	482.34	RT90-RHB70	–49.02	58.14	331.6800	85.6200	46.5600	
603.00	6700003.67	1632662.00	484.61	RT90-RHB70	–48.96	58.28	333.3500	86.6700	46.8700	
606.00	6700004.71	1632663.68	486.87	RT90-RHB70	–48.91	58.41	335.0100	87.7200	47.1900	
609.00	6700005.74	1632665.36	489.13	RT90-RHB70	–48.88	58.56	336.6800	88.7700	47.5100	
612.00	6700006.77	1632667.04	491.39	RT90-RHB70	–48.84	58.71	338.3400	89.8300	47.8300	
615.00	6700007.80	1632668.73	493.65	RT90-RHB70	–48.79	58.85	340.0100	90.9000	48.1400	
618.00	6700008.82	1632670.42	495.91	RT90-RHB70	–48.74	58.94	341.6700	91.9700	48.4600	
621.00	6700009.84	1632672.11	498.16	RT90-RHB70	–48.68	59.02	343.3300	93.0400	48.7800	
624.00	6700010.86	1632673.81	500.41	RT90-RHB70	–48.64	59.08	344.9900	94.1200	49.0900	
627.00	6700011.88	1632675.51	502.67	RT90-RHB70	–48.61	59.17	346.6500	95.2000	49.4100	
630.00	6700012.89	1632677.22	504.92	RT90-RHB70	–48.57	59.31	348.3200	96.2800	49.7300	
633.00	6700013.91	1632678.92	507.17	RT90-RHB70	–48.52	59.47	349.9800	97.3700	50.0500	
636.00	6700014.92	1632680.64	509.41	RT90-RHB70	–48.47	59.61	351.6400	98.4600	50.3700	
639.00	6700015.92	1632682.35	511.66	RT90-RHB70	–48.42	59.79	353.2900	99.5600	50.6900	
642.00	6700016.92	1632684.07	513.90	RT90-RHB70	–48.37	59.93	354.9500	100.6700	51.0100	
645.00	6700017.92	1632685.80	516.15	RT90-RHB70	–48.32	60.04	356.6000	101.7800	51.3300	
648.00	6700018.92	1632687.52	518.39	RT90-RHB70	–48.28	60.13	358.2600	102.8900	51.6400	

Length (m)	Northing (m)	Easting (m)	Elevation (m)	Coord System	Inclination (degrees)	Bearing (degrees)	Local A (m)	Local B (m)	Local C (m)	Extrapol flag
651.00	6700019.91	1632689.26	520.63	RT90-RHB70	–48.27	60.26	359.9100	104.0100	51.9600	
654.00	6700020.90	1632690.99	522.86	RT90-RHB70	–48.25	60.42	361.5600	105.1300	52.2800	
657.00	6700021.89	1632692.73	525.10	RT90-RHB70	–48.22	60.56	363.2100	106.2600	52.5900	
660.00	6700022.87	1632694.47	527.34	RT90-RHB70	–48.18	60.68	364.8600	107.3900	52.9100	
663.00	6700023.85	1632696.21	529.58	RT90-RHB70	–48.14	60.81	366.5100	108.5300	53.2200	
666.00	6700024.83	1632697.96	531.81	RT90-RHB70	–48.12	60.95	368.1500	109.6700	53.5300	
669.00	6700025.80	1632699.71	534.04	RT90-RHB70	–48.11	61.09	369.7900	110.8200	53.8500	
672.00	6700026.77	1632701.46	536.28	RT90-RHB70	–48.11	61.23	371.4300	111.9700	54.1600	
675.00	6700027.73	1632703.22	538.51	RT90-RHB70	–48.11	61.35	373.0700	113.1200	54.4600	
678.00	6700028.69	1632704.98	540.74	RT90-RHB70	–48.10	61.48	374.7100	114.2800	54.7700	
681.00	6700029.65	1632706.74	542.98	RT90-RHB70	–48.07	61.61	376.3400	115.4400	55.0700	
684.00	6700030.60	1632708.50	545.21	RT90-RHB70	–48.05	61.71	377.9700	116.6100	55.3700	
687.00	6700031.55	1632710.27	547.44	RT90-RHB70	–48.04	61.81	379.6000	117.7700	55.6800	
690.00	6700032.50	1632712.04	549.67	RT90-RHB70	–48.03	61.93	381.2300	118.9500	55.9800	
693.00	6700033.45	1632713.81	551.90	RT90-RHB70	–48.00	62.04	382.8500	120.1200	56.2700	
696.00	6700034.39	1632715.58	554.13	RT90-RHB70	–47.98	62.15	384.4800	121.3000	56.5700	
699.00	6700035.33	1632717.35	556.36	RT90-RHB70	–47.96	62.27	386.1000	122.4800	56.8700	
702.00	6700036.26	1632719.13	558.59	RT90-RHB70	–47.97	62.36	387.7200	123.6700	57.1600	
705.00	6700037.19	1632720.91	560.82	RT90-RHB70	–47.98	62.44	389.3400	124.8600	57.4600	
708.00	6700038.12	1632722.69	563.04	RT90-RHB70	–47.98	62.55	390.9600	126.0500	57.7500	
711.00	6700039.05	1632724.47	565.27	RT90-RHB70	–47.96	62.69	392.5700	127.2400	58.0400	
714.00	6700039.97	1632726.26	567.50	RT90-RHB70	–47.91	62.81	394.1800	128.4400	58.3300	
717.00	6700040.89	1632728.05	569.73	RT90-RHB70	–47.84	62.96	395.8000	129.6500	58.6100	
720.00	6700041.80	1632729.84	571.95	RT90-RHB70	–47.79	63.09	397.4100	130.8500	58.9000	
723.00	6700042.71	1632731.64	574.17	RT90-RHB70	–47.76	63.22	399.0200	132.0700	59.1900	
726.00	6700043.62	1632733.44	576.39	RT90-RHB70	–47.72	63.35	400.6200	133.2900	59.4800	
729.00	6700044.53	1632735.24	578.61	RT90-RHB70	–47.69	63.46	402.2300	134.5100	59.7600	
732.00	6700045.43	1632737.05	580.83	RT90-RHB70	–47.68	63.57	403.8300	135.7400	60.0500	

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735.00	6700046.33	1632738.86	583.05	RT90-RHB70	–47.67	63.67	405.4400	136.9600	60.3300	
738.00	6700047.23	1632740.67	585.27	RT90-RHB70	–47.65	63.76	407.0400	138.2000	60.6200	
741.00	6700048.12	1632742.48	587.49	RT90-RHB70	–47.63	63.84	408.6300	139.4300	60.9000	
744.00	6700049.01	1632744.30	589.70	RT90-RHB70	–47.62	63.95	410.2300	140.6700	61.1800	
747.00	6700049.90	1632746.11	591.92	RT90-RHB70	–47.60	64.04	411.8300	141.9100	61.4600	
750.00	6700050.78	1632747.93	594.13	RT90-RHB70	–47.58	64.11	413.4200	143.1600	61.7400	
753.00	6700051.67	1632749.75	596.35	RT90-RHB70	–47.61	64.17	415.0200	144.4100	62.0200	
756.00	6700052.55	1632751.57	598.56	RT90-RHB70	–47.69	64.16	416.6100	145.6500	62.2900	
759.00	6700053.43	1632753.39	600.78	RT90-RHB70	–47.77	64.05	418.2000	146.9000	62.5700	
762.00	6700054.31	1632755.20	603.00	RT90-RHB70	–47.81	63.91	419.7900	148.1400	62.8400	
765.00	6700055.20	1632757.01	605.23	RT90-RHB70	–47.80	63.83	421.3800	149.3800	63.1100	
768.00	6700056.09	1632758.82	607.45	RT90-RHB70	–47.85	63.73	422.9700	150.6100	63.3800	
771.00	6700056.98	1632760.63	609.67	RT90-RHB70	–47.89	63.67	424.5600	151.8400	63.6600	
774.00	6700057.87	1632762.43	611.90	RT90-RHB70	–47.92	63.65	426.1600	153.0700	63.9300	
777.00	6700058.76	1632764.23	614.12	RT90-RHB70	–47.93	63.61	427.7500	154.3000	64.2000	
780.00	6700059.66	1632766.03	616.35	RT90-RHB70	–47.98	63.57	429.3500	155.5200	64.4800	
783.00	6700060.55	1632767.83	618.58	RT90-RHB70	–48.03	63.57	430.9400	156.7400	64.7500	
786.00	6700061.44	1632769.63	620.81	RT90-RHB70	–48.06	63.58	432.5300	157.9600	65.0200	
789.00	6700062.33	1632771.42	623.04	RT90-RHB70	–48.09	63.57	434.1200	159.1900	65.2800	
792.00	6700063.23	1632773.22	625.27	RT90-RHB70	–48.12	63.61	435.7100	160.4100	65.5500	
795.00	6700064.12	1632775.01	627.51	RT90-RHB70	–48.11	63.66	437.3000	161.6300	65.8100	
798.00	6700065.01	1632776.81	629.74	RT90-RHB70	–48.08	63.76	438.8900	162.8500	66.0800	
801.00	6700065.89	1632778.60	631.97	RT90-RHB70	–48.02	63.88	440.4700	164.0700	66.3400	
804.00	6700066.78	1632780.41	634.20	RT90-RHB70	–47.95	63.96	442.0600	165.3000	66.6000	
807.00	6700067.66	1632782.21	636.43	RT90-RHB70	–47.87	64.02	443.6400	166.5400	66.8700	
810.00	6700068.54	1632784.02	638.66	RT90-RHB70	–47.78	64.10	445.2300	167.7800	67.1400	
813.00	6700069.42	1632785.83	640.88	RT90-RHB70	–47.69	64.17	446.8200	169.0200	67.4100	
816.00	6700070.30	1632787.65	643.10	RT90-RHB70	–47.62	64.26	448.4100	170.2600	67.6800	

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819.00	6700071.18	1632789.47	645.31	RT90-RHB70	–47.57	64.40	449.9900	171.5100	67.9500	
822.00	6700072.05	1632791.30	647.53	RT90-RHB70	–47.52	64.56	451.5800	172.7700	68.2300	
825.00	6700072.92	1632793.13	649.74	RT90-RHB70	–47.48	64.69	453.1700	174.0300	68.5000	
828.00	6700073.79	1632794.96	651.95	RT90-RHB70	–47.45	64.83	454.7500	175.3000	68.7700	
831.00	6700074.65	1632796.80	654.16	RT90-RHB70	–47.43	64.97	456.3300	176.5700	69.0400	
834.00	6700075.51	1632798.64	656.37	RT90-RHB70	–47.41	65.11	457.9100	177.8400	69.3100	
837.00	6700076.37	1632800.48	658.58	RT90-RHB70	–47.38	65.27	459.4900	179.1200	69.5800	
840.00	6700077.22	1632802.32	660.79	RT90-RHB70	–47.34	65.44	461.0600	180.4100	69.8400	
843.00	6700078.06	1632804.17	662.99	RT90-RHB70	–47.30	65.53	462.6400	181.6900	70.1100	
846.00	6700078.90	1632806.02	665.20	RT90-RHB70	–47.23	65.59	464.2100	182.9900	70.3700	
849.00	6700079.74	1632807.88	667.40	RT90-RHB70	–47.14	65.65	465.7800	184.2800	70.6300	
852.00	6700080.59	1632809.74	669.60	RT90-RHB70	–47.07	65.75	467.3500	185.5900	70.9000	
855.00	6700081.42	1632811.60	671.80	RT90-RHB70	–47.02	65.85	468.9200	186.8900	71.1700	
858.00	6700082.26	1632813.47	673.99	RT90-RHB70	–46.96	65.94	470.4900	188.2000	71.4400	
861.00	6700083.10	1632815.34	676.18	RT90-RHB70	–46.93	66.04	472.0600	189.5100	71.7100	
864.00	6700083.93	1632817.21	678.37	RT90-RHB70	–46.90	66.16	473.6300	190.8300	71.9800	
867.00	6700084.76	1632819.08	680.56	RT90-RHB70	–46.84	66.30	475.2000	192.1500	72.2500	
870.00	6700085.58	1632820.96	682.75	RT90-RHB70	–46.77	66.43	476.7700	193.4700	72.5200	
873.00	6700086.40	1632822.85	684.94	RT90-RHB70	–46.72	66.52	478.3400	194.8000	72.7800	
876.00	6700087.22	1632824.73	687.12	RT90-RHB70	–46.68	66.63	479.9000	196.1400	73.0500	
879.00	6700088.04	1632826.62	689.31	RT90-RHB70	–46.66	66.76	481.4600	197.4800	73.3200	
882.00	6700088.85	1632828.51	691.49	RT90-RHB70	–46.63	66.92	483.0200	198.8200	73.5900	
885.00	6700089.66	1632830.41	693.67	RT90-RHB70	–46.59	67.09	484.5800	200.1700	73.8500	
888.00	6700090.46	1632832.31	695.85	RT90-RHB70	–46.54	67.25	486.1400	201.5200	74.1200	
891.00	6700091.26	1632834.21	698.02	RT90-RHB70	–46.47	67.41	487.6900	202.8800	74.3800	
894.00	6700092.05	1632836.12	700.20	RT90-RHB70	–46.43	67.59	489.2400	204.2400	74.6400	
897.00	6700092.84	1632838.03	702.37	RT90-RHB70	–46.40	67.77	490.7900	205.6200	74.9000	
900.00	6700093.62	1632839.95	704.55	RT90-RHB70	–46.34	67.91	492.3300	206.9900	75.1600	

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903.00	6700094.40	1632841.86	706.72	RT90-RHB70	–46.28	68.03	493.8800	208.3700	75.4100	
906.00	6700095.18	1632843.79	708.88	RT90-RHB70	–46.26	68.19	495.4200	209.7600	75.6700	
909.00	6700095.95	1632845.71	711.05	RT90-RHB70	–46.23	68.34	496.9600	211.1500	75.9200	
912.00	6700096.72	1632847.64	713.22	RT90-RHB70	–46.20	68.48	498.4900	212.5500	76.1700	
915.00	6700097.48	1632849.57	715.38	RT90-RHB70	–46.13	68.62	500.0300	213.9500	76.4300	
918.00	6700098.23	1632851.51	717.55	RT90-RHB70	–46.05	68.74	501.5600	215.3500	76.6800	
921.00	6700098.99	1632853.45	719.71	RT90-RHB70	–45.98	68.83	503.0900	216.7700	76.9300	
924.00	6700099.74	1632855.39	721.86	RT90-RHB70	–45.95	68.94	504.6200	218.1800	77.1800	
927.00	6700100.49	1632857.34	724.02	RT90-RHB70	–45.88	69.09	506.1500	219.6000	77.4300	
930.00	6700101.24	1632859.29	726.17	RT90-RHB70	–45.82	69.23	507.6700	221.0300	77.6800	
933.00	6700101.98	1632861.25	728.33	RT90-RHB70	–45.77	69.38	509.2000	222.4600	77.9300	
936.00	6700102.72	1632863.20	730.47	RT90-RHB70	–45.73	69.53	510.7200	223.8900	78.1800	
939.00	6700103.45	1632865.17	732.62	RT90-RHB70	–45.68	69.69	512.2400	225.3300	78.4300	
942.00	6700104.18	1632867.13	734.77	RT90-RHB70	–45.62	69.85	513.7600	226.7800	78.6700	
945.00	6700104.90	1632869.10	736.91	RT90-RHB70	–45.55	70.02	515.2700	228.2300	78.9200	
948.00	6700105.62	1632871.08	739.05	RT90-RHB70	–45.49	70.21	516.7900	229.6900	79.1600	
951.00	6700106.33	1632873.06	741.19	RT90-RHB70	–45.42	70.36	518.3000	231.1500	79.4100	
954.00	6700107.04	1632875.04	743.33	RT90-RHB70	–45.35	70.49	519.8000	232.6200	79.6500	
957.00	6700107.74	1632877.03	745.46	RT90-RHB70	–45.26	70.64	521.3100	234.1000	79.8900	
960.00	6700108.44	1632879.02	747.60	RT90-RHB70	–45.15	70.79	522.8100	235.5800	80.1300	
963.00	6700109.14	1632881.02	749.72	RT90-RHB70	–45.05	70.95	524.3200	237.0700	80.3800	
966.00	6700109.83	1632883.02	751.85	RT90-RHB70	–44.96	71.09	525.8200	238.5700	80.6200	
969.00	6700110.52	1632885.03	753.97	RT90-RHB70	–44.88	71.25	527.3200	240.0700	80.8700	
972.00	6700111.20	1632887.04	756.08	RT90-RHB70	–44.80	71.42	528.8200	241.5800	81.1100	
978.00	6700112.55	1632891.09	760.30	RT90-RHB70	–44.68	71.67	531.8000	244.6200	81.6000	

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Appendix 4

Length reference marks

Reference Mark T – Reference mark in drillhole

KFM06C, 2005-06-27 19:00:00 – 2005-06-28 06:00:00 (150.000–960.000 m).

Bhlen (m)	Rotation speed (rpm)	Start flow (l/min)	Stop flow (l/min)	Stop pressure (bar)	Cutter time (s)	Trace detectable	Cutter diameter (mm)	Comment
150.00	400.00	250	350	28.0	1	Ja		
200.00	400.00	250	350	30.0	1	Ja		
250.00	400.00	250	350	30.0	0	Ja		
300.00	400.00	250	350	30.0	0	Ja		
350.00	400.00	250	400	30.0	0	Ja		
400.00	400.00	300	400	30.0	1	Ja		
447.00	400.00	400	500	30.0	1	Ja		
500.00	400.00	400	550	35.0	0	Ja		
550.00	400.00	400	550	35.0	0	Ja		
600.00	400.00	400	550	35.0	0	Ja		
652.00	400.00	400	600	35.0	1	Ja		
700.00	400.00	400	600	40.0	0	Ja		
750.00	400.00	400	600	40.0	0	Ja		
800.00	400.00	450	600	40.0	1	Ja		
850.00	400.00	400	600	40.0	1	Ja		
898.00	400.00	400	600	40.0	0	Ja		
960.00	400.00	400	600	40.0	0	Ja		

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