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**Ch. Dezayes, A. Genter, G. Homeier*, M. Degouy**, G. Stein**

(*) STADTWERKE BAD URACH
Erdwärmeforschung - Marktplatz 8-9, D-72574 Bad Urach - Germany
(**) GEIE "Exploitation Minière de la Chaleur"
Route de Soultz - BP38 - 67250 Kutzenhausen - France

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# Abstract

In the framework of the European Geothermal (HDR/HFR) project conducted at Soultz-sous-Forêts (Rhine graben, France), the borehole GPK3 was drilled vertically from 0 to 2700m and was deviated to the South to 5100m depth. The temperature reaches at 5100m depth is 200° C. At the ground level, the borehole GPK3 is located about 6m to the SSW from the previous deep well GPK2 but at the bottom depth, the horizontal distance between the doublet GPK2-GPK3 is about 700m apart.

The top of the granite was reached at 1418m depth. No core was collected at depth. More than 1000 chip samples were collected during the drilling operations in the granite section and about 200 were examined on site in order to realise a petrographic log. Conventional geophysical measurements (caliper log, spectral gamma ray log) and ultrasonic borehole image logs (UBI) were carried out in the whole granite section (1420-5100m) and analysed in order to help to determine the lithology and the location of the fracture zones.

The examination of the chip samples collected between 3800 and 5100m was done on site during the drilling operations. From a general point of view, the geological profile could be summarised as follows :

- between 3800m and 4780m, the well intersected an unaltered porphyritic MFK-rich granite with only one hydrothermal altered zone at 4100m;
- between 4780m and 5000m, the well penetrated a section characterized by lithological variations, made of two-mica granite mainly;
- between 5000m to 5100m, alternations of petrographical variations are evidenced, with porphyritic MFK-rich granite, two-mica granite and biotite-rich granite.

A few hydrothermally altered zones were distinguished and a detailed mineralogical analysis shown surprisingly the absence of clay minerals which characterized fractured zones at Soultz. This result is not consistent with previous studies done at Soultz and it seems that the clay fraction is not collected during the drilling because the chip samples are very fine-grained. Some thin sections of cutting samples and some X-ray diffractions were realised and their analysis confirms the lack of clays in the chip sample.

Conventional geophysical well-log analysis helps to distinguish several lithological sections within the GPK3 well. Furthermore, some strong variations of the different radioactive curves indicate generally the presence of fractures. The analysis of the spectral gamma ray, which indicates Potassium, Thorium and Uranium contents, allows dividing the well in 5 main parts. Based on these logs, the evidences of fracture zones are more numerous in the deeper part.

To improve the vertical zoning, we analysed all the conventional well-log with a statistical method, namely the Hierarchy Ascending Classification (HAC). In the upper part of GPK3 well, between 1.4 and 4.5km depth, 8 main groups were defined in the well. 4 groups correspond to a background signal and represents a rock facies or lithological variations. The other groups correspond to signal anomalies and represent dykes or fracture zones.

It is the first borehole at Soultz which is logged continuously by the Ultrasonic Borehole Imager in the entire granitic section between 1420m to 5100m. Moreover, UBI runs show a very good borehole wall surface reflection and besides that a good fracture detection. They will be analysed later in terms of fracture characterization through a specific software.

The synthesis of the chip sample examination and the HAC analysis help to perform a more general correlation with this new well GPK3, which is well documented, and the previous well GPK2. Then, 4 main lithological sections can be distinguished:

- in the upper part, the sedimentary cover,
- below, the standard porphyritic granite rich in mega K-feldspars,
- in the intermediate part, the same granite but with some texture variations, generally made of more fine-grained rocks,
- and, in the depper part, a new fine-grained granite facies, depleted in K-felspar but richer in biotite and muscovite, namely a 2-mica granite.

A preliminary cross-section between the two deep wells shows that some fracture zones were also correlated such as a large-scale fracture zone observed at about 4800m depth in GPK2 and GPK3.

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# 1. Introduction

In the framework of the European Geothermal (HDR) project conducted at Soultz-sous-Forêts (France), the borehole GPK3 was drilled from 0 to 5100m/KB depth (rotary table reference) started on the $25^{th}$ June 2002 and completed on the $11^{th}$ November 2002.

The aim of this Hot Fractured Rock (HFR) Geothermal project is to demonstrate that heat can be extracted from deep wells for producing electricity. The Soultz site is located on the western side of the Rhine Graben (Fig. 1, Fig. 2). The objective of this HFR project is to develop a heat exchanger within a granite massif overlain by a sedimentary cover (Baria *et al.*, 1998). In 1999, the GPK2 well was deepened to 5093m and a temperature of 200° C was measured at the bottom depth. At the surface, this new borehole GPK3 is located about 6m, SSW of GPK2 (Fig. 3) and, as it is directional drilled, at the bottom depth the horizontal distance between GPK2 and GPK3 is about 700m (Fig. 4). GPK3 is considered to use as an injection geothermal well whereas GPK2 should be a production geothermal well.

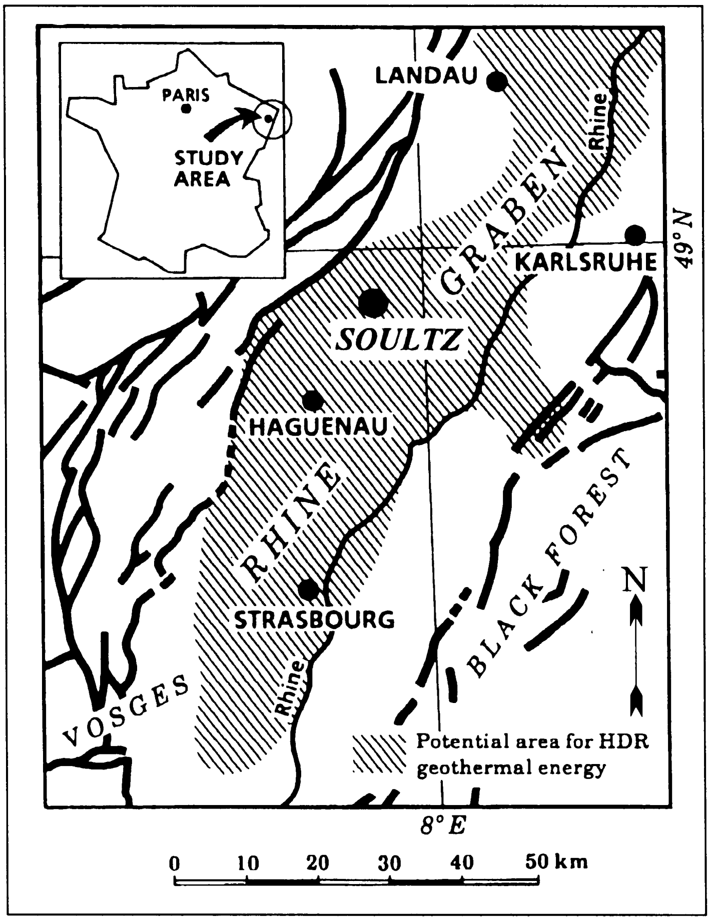


***Fig. 1 - Location of the Soultz site.***

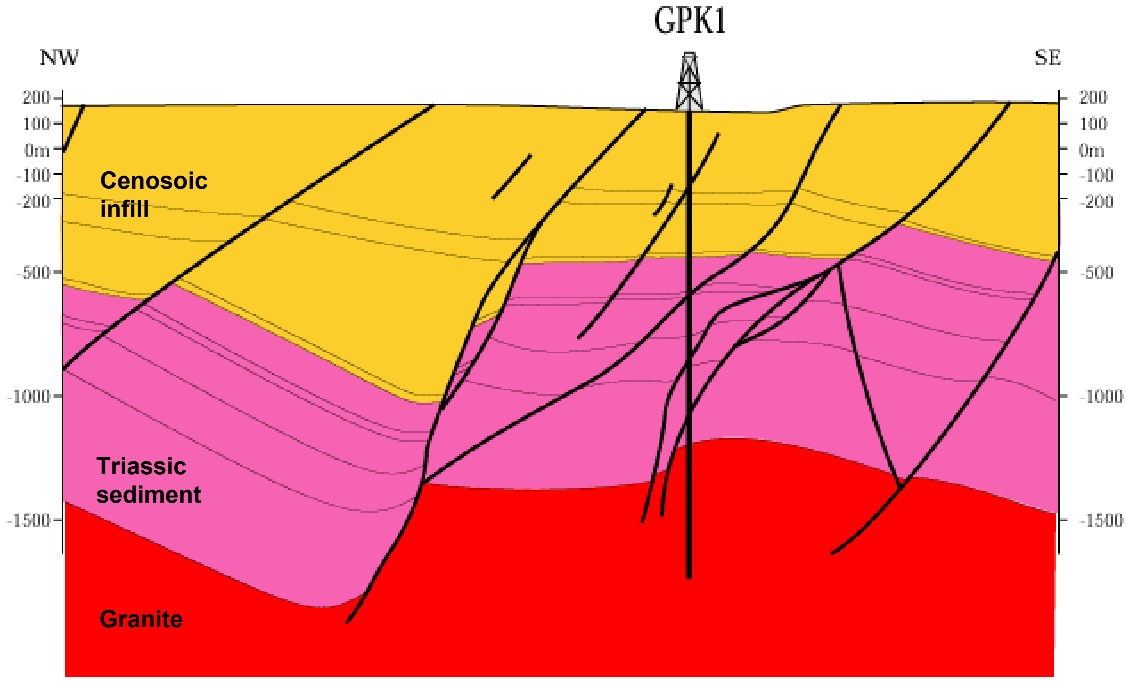


*Fig. 2 - Geological cross-section trought the GPK1 well.*

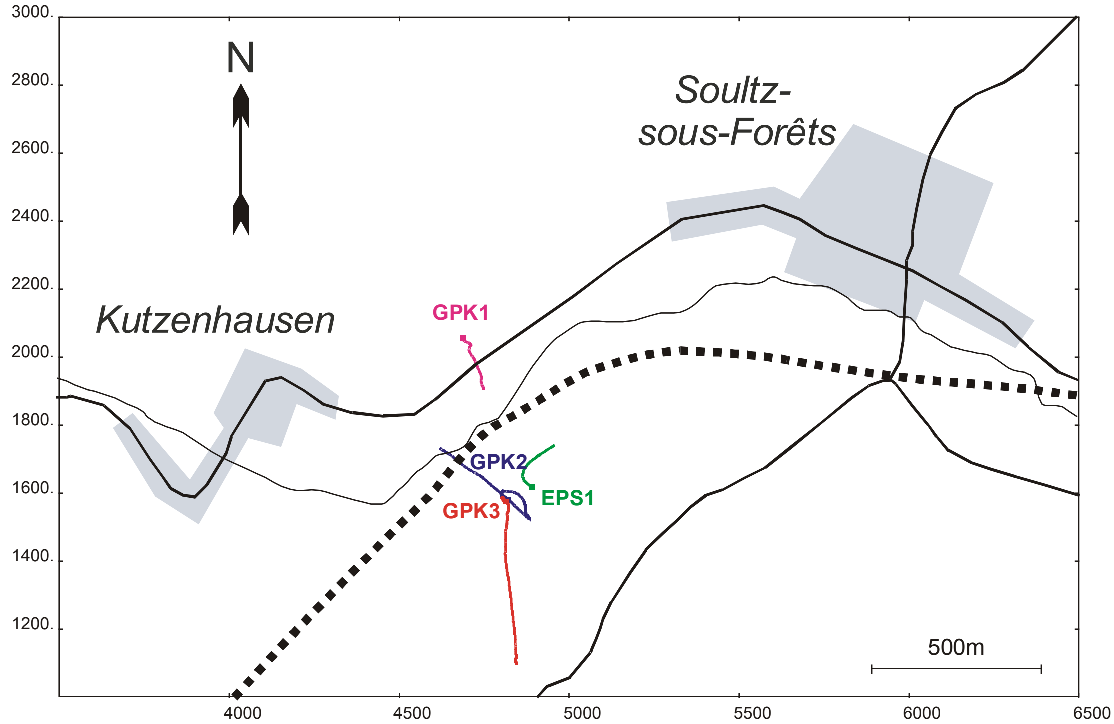


*Fig. 3 - Location of Soultz boreholes and their trajectory.*

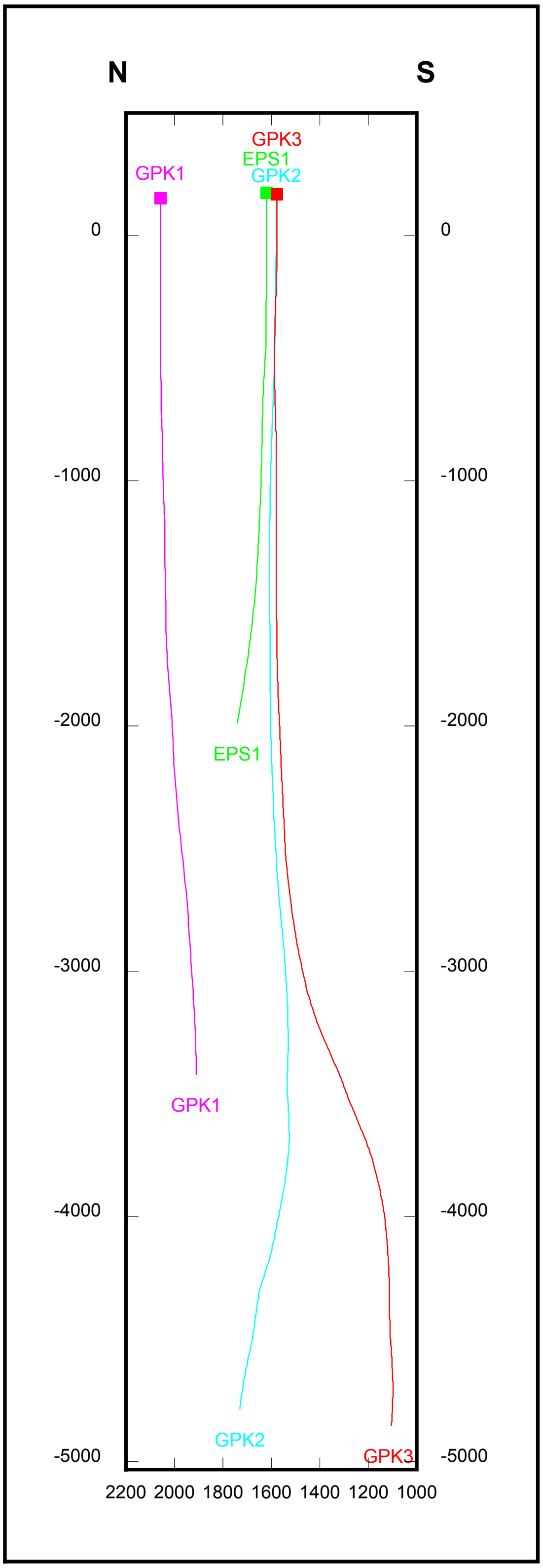


***Fig. 4 - N-S cross section of the Soultz well field.***
The vertical depth are expressed below the sea level.

The initial target of the drilling of GPK3 well was to reach 4500-5000m depth with an anticipated temperature of 195 °C ± 5 °C. The drilling rig was supplied by ENEL. The European Economic Interest Grouping (EIEG) "Heat Mining" assisted by Southern International Inc. acted as the operator for the drilling operations.

GPK3 was drilled in 12-1/4" diameter between 1448 and 4580m and in 8-1/2" diameter between 4580 and 5100m (Ann. 1). As the well was directional drilled between 2670 and 4580m depth, the calculated vertical depth is 5020m (ground reference). The driller depth reference is based on the rotating table located at 9.20m above the ground level. All the geological data (petrography, Rop, X-Ray diffraction) will be provided and plotted according to the driller depth references.

The top of the granite was reached at 1418m depth. No core was collected at depth.

Geological monitoring based on cuttings was conducted on site by the geologists of BRGM and SWBU (Stadtwerke Bad Urach, Germany). Between 3800 and 5100m, a detailed geological monitoring was conducted on site during the drilling operations. In the upper part, between 1420 and 3000m depth, a less detailed geological profile was done by SWBU. The section between 3000 and 3800m is not yet available but will be completed later. This geological study was carried out as a part of BRGM scientific research programme applied to the HDR/HFR-Soultz project (BRGM project 02ENED01). The general objective of this research consists of the geological characterization of the deep granite massif dedicated to HDR/HFR experiments.

The well logging operations were conducted at different times (21/07/02, 21/10/02, 25/10/02, 10/11/02) in the GPK3 well. Schlumberger logs are depth matched according to the 9-5/8" casing shoe at 1448m for the logging in the granitic section.

This geological field report is organized into three different parts :

- the synthetic petrographic log of GPK3 deduced from the examination of the chip samples in the lower part of the granitic section (3800-5093m);
- a microscopic description of thin sections of selected cutting samples;
- a first overview of the new geophysical well logging obtained in the granitic section (550-5100m);
- a comparison with the GPK2 well.

# 2. Synthetic petrographic log from chip samples

## 2.1. METHODS AND PROCEDURES

The drilled cuttings from the borehole GPK3 were collected by ENEL every hour at three or six meter intervals in the granitic section from 1418m to 5092m. These cuttings were washed, cleaned and dried by BRGM and SWBU to remove drilling mud (Ecol Lube), cement, iron or rust particles and lost circulation material. They were first logged in detail on site by conventional binocular microscope examination at 10-50 x magnification between 3800 and 5093m. According to the sample quantity available, one or two cutting samples were packaged by BRGM as reference collection for further investigations. The detailed sample list is available in Annex 2.

Cuttings collected from GPK3 are fine-grained, ranging between 0.1 and 1mm with an average of about 0.5mm. The raw and cleaned samples look like silt particles (Fig. 5). This small size hinders accurate characterization of grain size feature of coarse, medium or fine-grained facies. It also prevents from recognising fracture fillings accurately. The precise characterization of the rock texture is also quite difficult to obtain with these very small grained samples.


***Fig. 5 - Photograph of a cutting sample at 5065m in the GPK3 well.***

Because of the possible mixing of cuttings from neighbouring levels in the drilling mud during its ascent to the surface, the samples represent an average composition for a certain level. For instance, the volume of one meter long drilled section represents 36 litres for 8-1/2" borehole diameter.

Due to the fine size particles of the cuttings samples, the petrographic description is very difficult, more particularly the rock texture identification (porphyritic, coarse grained size, …).

Thus, the examination of the chip samples can only show the changes in petrographic facies and/or the type of alteration, if the well penetrates a reasonably thick layer of granite. Practically, it appears difficult to detect variations covering less than three or four meter thickness.

The drilling rate (Rop, Rate of penetration), expressed in meter per hour was provided by ENEL, but some depth intervals are not documented yet (Fig. 6). The Rop curve is generally strongly related to the rock mass composition. It means that high Rop values correlate with fractured zone locations whereas low Rop values are related to unaltered rock mass (Genter *et al.*, 1999). In the granitic section of GPK3, the Rop data provided by ENEL vary between 2.5m/h and 20m/h with an average between 3 and 4m/h. The mean value is slightly higher than those obtained in the previous well GPK2. The Rop data are quite noisy, and there is no clear relationship with the deep seated geology. Therefore, it is very difficult to point out the fractured zones with the available Rop curve only. However, at about 4770m, the Rop values are higher correlating with the presence of a huge fracture zone suspected by the well-log analysis (cf. § 4).

This new drillhole GPK3 offered the opportunity to recognize a complete geological section though the Soultz granitic batholith. The previous borehole GPK2 had had total mud losses during drilling between 2110m and 3900m depth. Then, no cutting sample was available in this depth section and the geological characterization was poorly constrained. This new drillhole allows to fill the gap and to reconstruct the deep seated geology.

The geological data were processed with the GDM software package of BRGM as well as all the different geological profiles (geology, geophysical measurements, cross-sections).

## 2.2. EXAMINATION OF CHIP SAMPLES

Data log includes the sample colour-facies, primary mineralogy, style and intensity of alteration and hydrothermal fillings. From the previous investigations (Genter, 1989), two alteration styles are known which occur within the Soultz granite. Pervasive (or so-called propylitic) alteration took place on a large scale within the granite without any macroscopic modification of the rock texture. Vein alteration is related to fracture zones where hydrothermal fluid circulation strongly modify the granite. The pervasive alteration is mainly characterized by the occurrence of chlorite whereas the vein alteration is characterized by illite.

The different items integrated into the database of sample examination are in detail the following:

- *Colour* : The small size of the cuttings gives a homogeneous sample colour which is

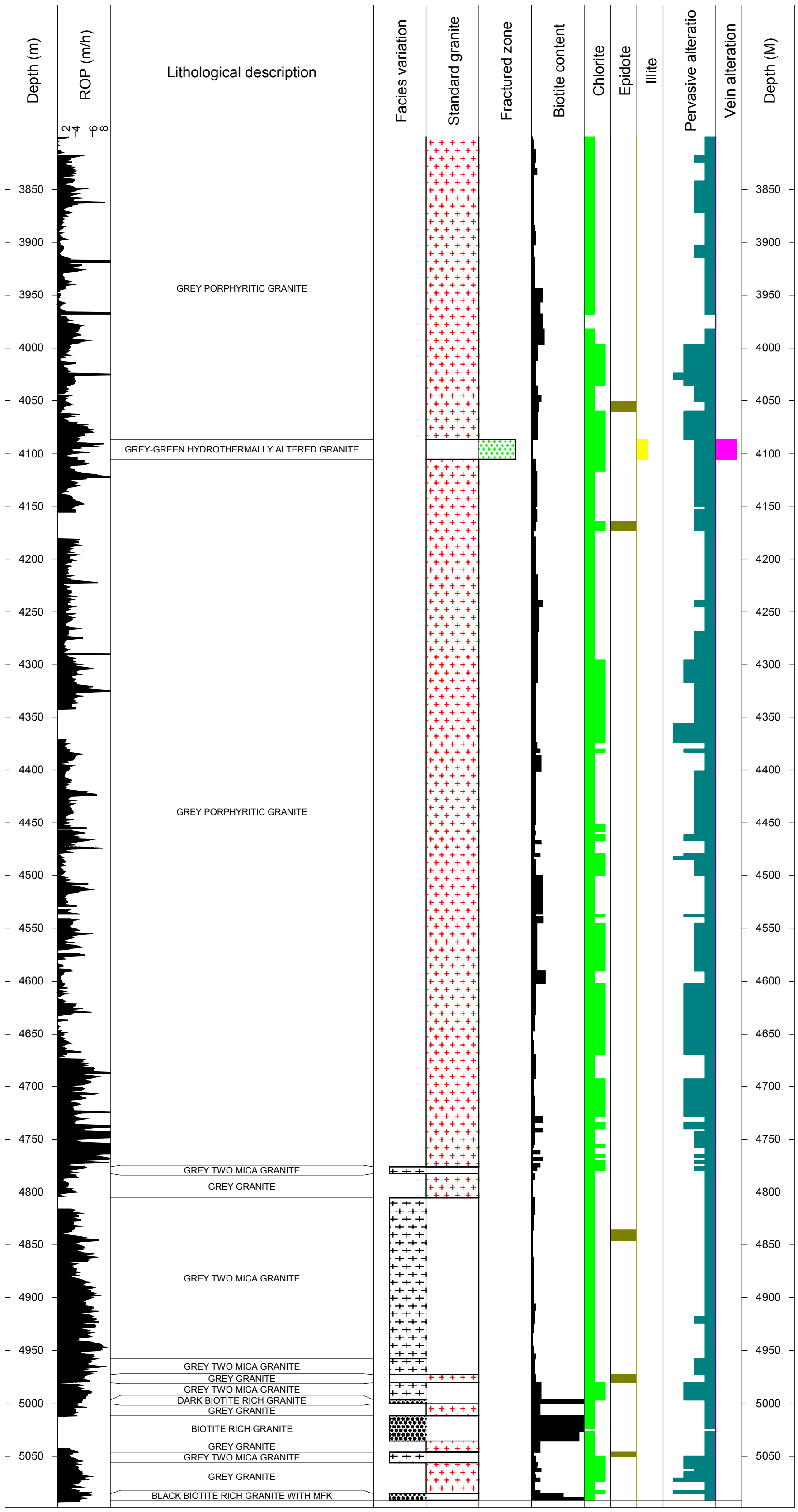


***Fig. 6 - Synthetic log of GPK3 between 3800-5090m based on cutting analysis.***

- a good indicator for characterizing facies variations. The colour is dark to grey, or white. No more colour variations were observed between 3800m and 5100m. In the upper section, cutting colors could be slightly more pronounced (red, orange, green).
- *Primary mineralogy* : Abundance of quartz, K-feldspar, plagioclase and biotite was estimated providing a qualitative evaluation of the primary mineralogical content variation. According to the geological investigations previously performed on EPS-1 core sections (Genter et Traineau, 1991 and 1992), on GPK-1 cuttings (Genter and Traineau, 1993), and on GPK-2 cuttings (Genter and Tenzer, 1995; Genter *et al.*, 1999), primary biotite content was used as the main indicator for showing petrographic variations and hydrothermal alteration types.
- *Style and intensity of alteration*: Chloritization of primary biotite is used as an effective index for pervasive alteration. Primary, black coloured biotite is partially transformed into a green coloured chloritized biotite. Three degrees (low, moderate and high) of biotite alteration into chlorite were defined.
- The occurrence of epidote, that is a hydrothermal mineral characterizing both high temperature in geothermal environment and pervasive alteration, was also described systematically.

Illitisation of primary biotite and plagioclase is used as an effective index for vein alteration. Biotite, partly chloritised, is replaced by pale yellow-green illite. Primary white coloured plagioclase is also replaced by green coloured illite. In this case, the illitised facies shows a prominent white hue. As for chloritization, the intensity of illitisation includes three degrees (low, moderate and high). Hematization, developed on primary minerals (biotite, K-feldspar) and in fracture fillings, could also give evidence of alteration.

The description of these secondary minerals permit us to determine the alteration type (pervasive alteration or vein alteration) and its intensity qualitatively.

As the chip samples are very fine grained, it was very difficult to identify the clay minerals such as illite within the samples. Chlorite is generally more easily detectable by a binocular examination.

According to own knowledge of the deep geology of the Soultz site, we were surprised by the absence of illite in the samples in particular within the suspected fractured zones where the Rop values are high. As a consequence, we suspected that the clay content was so fine grained (< 50µm) that it was not collected during the cutting sampling. The clay fraction of illite composition was probably intimately incorporated within the drilling mud. A specific mineralogical analysis was done in order to evaluate the finest particle proportion (see § 2.3.5). The main result is the absence of illite in the cuttings.

As a consequence, the alteration style deduced from the on site macroscopic examination may be regarded with caution.

## 2.3. PETROGRAPHY

We considered as a main assumption that the drilling of the GPK3 borehole would have crossed the same granite massif as previously penetrated by GPK2 due to its large vertical and lateral extension. We also assumed that possible departures from the standard porphyritic granite facies should be ascribed to texture variations of the granite or vein alteration with associated fracturing.

So, petrographic units defined through the logging of the GPK3 borehole have been tentatively correlated with rock types identified in the upper part of GPK-1 (Traineau *et al.*, 1991), in the lower part of GPK-1 (Genter and Traineau, 1993), in the EPS-1 well (Genter and Traineau, 1992; Traineau *et al.*, 1992) and in GPK-2 (Genter and Tenzer, 1995; Genter *et al.*, 1999). Correlation was accomplished primarily through comparison of GPK3 chip samples with representative petrographic facies observed on the EPS-1 core sections. The following petrographic types encountered in GPK3 between 3800 and 5093m, listed below will be discussed: (a) standard porphyritic granite, (b) biotite-rich granite, (c) two-mica granite, and (d) altered porphyritic granite related to fractured zones which are divided into four alteration grades (low, moderate, high and very high). However, in this borehole section, we assume that this result is not representative because only one altered zone was identified by cutting analysis.

### 2.3.1. Standard porphyritic granite

Chip samples contain primary quartz, K-feldspar (orthoclase), plagioclase, biotite, amphibole and accessory minerals as magnetite, titanite, apatite and allanite. Their colour is dominantly grey to dark. The percentage of biotite grains is roughly estimated around 5 %. This amount does not represent the true biotite content of the granite because it is probably higher in the chip samples than in the penetrated rock.

Small variations of biotite content are ascribed to slight changes in the granite texture, or to drilling features (variations in grinding at the drill bit, enrichment or impoverishment in the ascending mud column).

Individual grains, up to 1mm long, of pink K-feldspar are indicative of the porphyritic texture of the granite. Biotite grains form well-shaped black flakes, are sometimes partially altered to green chlorite. It is the dominant mafic constituent. Hornblende is scarcely observed in the chip samples by binocular observation, probably because it is more powdered by drill bit than biotite (Glenn *et al.*, 1981); however green amphibole appears frequently in thin sections and is sometimes abundant. Quartz and plagioclase occur as anhedral grains. Titanite is quite common with its honey-like colour. Some white-milky minerals that could correspond to plagioclases are also quite common.

### 2.3.2. Biotite-rich granite

Chip samples contain primary quartz, K-feldspar, plagioclase, biotite and amphibole. It is distinguished from standard porphyritic granite by its relatively high biotite content (around 50 %) leading to a darker colour. It is interpreted as reflecting textural variations like schlieren or mafic minerals rich granite. Biotite is partially replaced by secondary chlorite.

### 2.3.3. Two-mica granite

The two-mica granite is characterized by the occurrence of primary muscovite flakes and/or of small pieces of fine-grained granite containing biotite and/or muscovite. Cross-hatched microcline and myrmekite are very interesting specific features which allow to recognise the presence of fine-grained two-mica granite in the thin sections corresponding to cuttings.

### 2.3.4. Altered granite related to fractured zones

The granite has been more or less altered within and near fractured zones. The examination of chip samples leads to determination of hydrothermally altered granite facies. The most characteristic feature is the development of illite removing primary biotite and plagioclase. Altered granite is typically biotite free and cream-white coloured. It contains grains of colourless to pale green illite.

### 2.3.5. Comparative mineralogical analysis of 2 samples

As it was very difficult to characterize alteration minerals such as illite in the chip samples, a detailed mineralogical analysis was carried out by the BRGM lab (Jézéquel and Pedroletti, 2002). The full analysis is described in Annex 3.

Two raw cutting samples considered as altered (4090m) and unaltered (4587m) were investigated in terms of weighting, sifting, density, magnetic sorting and mineralogical content (Ann.3).

After a density separation, the finest particles (< 50µm) represent less than 1 % in the altered sample and about 4 % in the fresh granite sample. Generally, the finest particles (< 50µm) correspond to the clay minerals. Therefore, it means that there is less clay minerals within the altered sample (4096m) than in the fresh sample (4587m). This surprising result is not consistent with previous studies done at Soultz (Traineau *et al*., 1991; Genter and Traineau, 1993; Genter and Traineau, 1992; Traineau *et al.*, 1992; Genter and Tenzer, 1995; Genter *et al.*, 1999). This absence of clay minerals in the altered sample is probably due to a sampling problem. The drill bit could have probably highly crushed the granite and generated very fine-grained chip samples. The clay fraction was not collected on the vibrators because it stayed within the drilling mud.

Within the unaltered sample, magnetite and biotite are abundant whereas chlorite is less represented. Within the altered sample, magnetite is depleted, suggesting hydrothermal alteration and Fe-oxides which are abundant could be derived from hydrothermal alteration of the magnetite. Biotite is less abundant and chlorite is more well expressed.

Therefore, some mineralogical assemblages (biotite, magnetite) are clearly related to the unaltered granite. However, it seems that there is a depletion in terms of finest particle content within the altered granite sample.

This analysis could explain why we were not able to detect so many altered zones in the deeper section of GPK3.

## 2.4. LOG DESCRIPTION

The main objective of the on-site chip sample logging was both to recognize fractured and altered zones and significant petrographical facies variations within the Soultz granite massif while drilling was in progress and also to assist the drilling operation. The synthetic petrographic log of GPK3 includes all the geological data obtained from 3800 to 5092m depth (Fig. 6, Ann.4).
From a general point of view, the geological profile of well GPK3 could be summarised as follows:

- Between 3800m and 4760m, the well intersected an unaltered standard granite with only one hydrothermal altered zone identified at 4100m. Large grey granitic facies were encountered. Epidote is observed at 4060m and 4173m within the unaltered granite facies. Around 4100m, an altered zone was observed and is charaterized by the presence of illite. However, the illite content was estimated as low and we interpreted this zone (4087-4105m) as a low intensity hydrothermal vein alteration section.
- Between 4760m to 5000m, the well penetrated a section characterized by lithological variations, made of two-mica granite mainly. Cuttings show grey facies with some darker samples related to biotite-rich facies. Presence of epidote is observed at 2 depths: 4846m within a two-mica granite and 4980m associated with a standard granite. No hydrothermal altered zone was observed in this section. The pervasive alteration is low and decreases to 4960m related to facies variation with the presence of a biotite rich granite.
- Between 5000m to 5093m, alternations of petrographical variations are evidenced, but no fractured zone was observed based on cutting examination. Standard granite occurs as well as facies variations characterized by biotite rich granite and two-mica granite. Epidote is present only at 5050m in a two-mica granite facies section.

As it was observed in the deeper part of GPK2 (Genter *et al.*, 1999), the GPK3 well has penetrated a new intrusion characterized by a fine-grained texture and a different mineralogical composition with muscovite and biotite enrichment correlated with a depletion of K-Felspar.

After the drilling, the chip sample examination was continued in the upper part of the granite massif, between 1420 and 3800m (Ann. 5). An overview of the petrographic log indicates that GPK3 penetrated a porphyritic MFK-rich granite affected by a series of hydrothermally altered and fractured zones (1640m, 2100m, 2900m, 3170m and 3540m). At 2850m depth, a biotite-rich granite or a xenolith occurs in a fault zone as in the well GPK2 at a different depth (3800-3900m, Genter *et al.*, 1999).

# 3. Petrography from thin sections and X-Ray diffraction analysis

## 3.1. THIN SECTION EXAMINATION

23 thin sections of cutting samples and 2 thin sections of rock fragments found in a roller reamer in the deep section (4980-5093m) were evaluated by microscopic examination (Ann. 6). The thin sections correspond to different petrographic variation: porphyritic granite, biotite rich granite and two-mica granite. The primary mineralogical content was checked and compared with the petrographic description of chip samples done on-site. K-feldspar, plagioclase, biotite, hornblende and the accessory minerals were identified as well as their hydrothermal alteration. However, as it was mentioned in the § 2.3.5, no clay minerals related to vein alteration (illite) were observed.

In terms of hydrothermal alteration, chlorite is the most common mineral observed in biotite. Calcite is also present in a lot of samples. At 4096m depth, calcite and secondary quartz were observed. The two rock fragments clearly correspond to a standard porphyritic MFK granite and biotite-rich granite.

## 3.2. X-RAY DIFFRACTION RESULTS

As it was difficult to point out some altered minerals from microscopic examination of the cuttings, only two X-Ray diffraction analyses were carried out at 4383m and 4635m depth. The primary mineral composition is very closed to those we are able to observe with the binocular (Table 1). It corresponds to a typical granite composition. The main altered minerals (calcite, chlorite, hematite) are also very common in the Soultz granite. The hydrothermal mineral typical of the vein alteration such as illite was not detected by XRD analysis.

***Table 1 - Mineralogical content at 4383m and 4635m depth in GPK3 based on XRD.***

| Sample | 4383m | 4635m |
|---|---|---|
| Primary minerals | Quartz<br>Plagioclase<br>Microcline<br>Mica-Biotite | Quartz<br>Plagioclase<br>Microcline<br>Mica-Biotite<br>Hornblende |
| Secondary mineral | Calcite<br>Chlorite | Calcite<br>Chlorite<br>Hematite |

# 4. Presentation of geophysical well logging and borehole imagery

## 4.1. WELL LOG DATA

Conventional well logs (Gamma Ray, 6-arm caliper) and Ultrasonic Borehole Imagery (UBI) were performed in GPK3 by Schlumberger, with the Maxis-500 data acquisition system (Table 2).

***Table 2 - List of geophysical well logs and borehole imagery carried out in the GPK3 borehole.***

| Type | Tool | Parameters | Depth (m) | Run date |
|---|---|---|---|---|
| | | | | |
| HNGS | Hostile Natural Gamma Ray Spectrometry | Natural radioactivity, U content, K content, Th content | 1448-5027 | 21/10/2002 |
| EMC | Caliper - 6 arms | C1, C2, C3 (3 diameters)<br>R1, R2, R3, R4, R5, R6 (6 independent radii)<br>6 pads - resistivity | 550-1450<br>1448-5027 | 21/07/2002<br>21/10/2002 |
| UBI | Ultrasonic Borehole Imager | Oriented Acoustic Borehole Imagery | 1448-4540<br>4567-5107 | 25/10/2002<br>10/11/2002 |

In order to compare various well logs, it was necessary to match their depth with respect to absolute reference depth. The casing shoe is located at 1448m for the driller and 1448.5m for Schlumberger. All the tools were run with the gamma-ray tool in order to correlate all geophysical data each other.

Various standard open-hole well logs (Caliper and Spectral Gamma Ray logs) were performed in the well in order to determine the main distribution of the petrographic facies in terms of facies variation, standard granite and hydrothermally altered and fractured zones (Table 2). For a better understanding of the existing fracture network, Ultrasonic Borehole Imager (UBI) was run between 1448m and 5110m depth providing fully processed images in real time on the Maxis 500 data acquisition imaging system. The standard geophysical measurement (Spectral Gamma Ray) were run in the entire granitic section between 1448m to 5027m with the caliper log (EMC) (Ann. 7). The caliper log was also run before in the sedimentary section in the upper part of the well in order to measure the roughness of the hole. For the first time at Soultz, logs are continuous at the borehole scale and were run in the entire granitic section from the deepest depth (5100m).

## 4.2. CONVENTIONAL WELL-LOGGING RESPONSES

Two types of analysis have been used to interpret the conventional well-logging responses. First, we used the qualitative correlation between the different raw responses of the well-logs, like caliper, standard gamma ray, spectral gamma ray and the drilling parameters (Rop, input flow rate, output flow rate). Second, we have done a statistical approach, named HAC, of the gamma ray response.

### 4.2.1. Log analyses versus depth

The analysis of conventional geophysical well logging from the top of the granite, permits to distinguish several sections within the GPK3 well (Fig. 7). The peaks, maximum and minimum, of the different radioactive curves (GR, K, Th, U) indicate the presence of fracture with a strong lithologic variation in a very thin depth section. The Potassium element is present in clay minerals like illite and though indicates fractured altered zones. The Potassium is also in K-Feldspar and in biotite. Uranium element is present in some accessory minerals like sphene, apatite and oxides. However, Uranium could be removed in fracture zones. Thorium element is present in zircons. The peaks of these different curves are generally correlated with a sharp increase of the hole diameter. The fracture location, deduced from the main peaks, is indicated in Table 3. We have also indicated a degree of importance of the fracture zone deduced from the magnitude of the peaks and the correlation between the radioactive and the caliper logs.

The analysis of the standard gamma ray (GR) allows to divide the well in 5 main parts:

1- from 1440m to 2100m, the GR curve is very noisy;
2- from 2100m to 2750m, the GR curve shows a slight and regular decreasing trend versus depth;
3- from 2750m to 3950m, the GR curve is again noisy;
4- from 3950m to 4590m, the GR curve shows again a slight and regular decreasing trend versus depth;
5- from 4590m to 5100m, the GR curve is very noisy and disturbed.

1- From 1440m to 2100m, the different radioactive logs (GR, K, Th, U) are noisy but their average value is rather stable versus depth. Some occurrences of fractures (5) are indicated by strong anomalies (Table 3). The borehole diameter shows different enlarged sections corresponding to caving. The GR curve shows a high increasing in radioactivity due to a high Uranium content at 1755m. Under certain conditions, Uranium is very mobile and could be concentrated within a fracture. This peak is correlated to a borehole cave. However, the Potassium curve is very flat suggesting that there is no illite concentration. All the radioactive curves are very noisy in the upper part of the granitic section. This behaviour was already observed in the previous wells and could be ascribed to a certain amount of alteration, hematisation (1440-1570m) and high fracture density.

2- From 2100m to 2750m, the GR curve shows a slight and regular decreasing trend versus depth as the Th and U curves. This slight depletion of radioactive minerals bearing U and Th is well-know in the granitic pluton and already mentioned in the other Soultz wells as indicating by the standard granite (Traineau *et al.*, 1991). The different radioactive curves are very stable versus depth that could indicate a massif granitic rock. Some fracture zone occurs but they have a low amplitude (Table 3). The caliper data show some caves around 2500m. Between 2100m and 2500m, the out flow curve is disturbed by a significant natural flow coming within the well due to permeable fractures which are not identified yet.

3- From 2750m to 3950m, the different radioactive curves as well as the caliper data are again noisy and more disturbed. However, their average value is stable, then this section looks like the upper part of the granite. The average K content is higher than in the upper section and could be interpreted as the occurrence of either a xenolith-rich granite body bearing $K_2O$ or a two-mica granite (Genter *et al.*, 1999). We identified 13 main fracture zones with 4 of them which are most important (Table 3). At 3485m, 3650m and 3815m, the GR peaks are correlated with the Th peaks and a slight increase of K content. The Th element is though to be very stable, so these anomalies could indicate very altered zones. At 3880, the GR peak is correlated with an U peak. As in the upper part at 1744m, that indicate a fracture without alteration halo. At 3306m, we can observe an important cave on the hole diameter curve and a minimum peak of GR associated with a strong decrease of K content and Th content. These high depletion is due to the signal attenuation induced by the well enlargement (cave). Around this zone, the curve of K content increases, suggesting that there is a major altered fractured zone at this depth.

4- Between 3950m and 4590m, the different radioactive curves are again stable as the second part of the well. It corresponds to a standard granite section. The GR, Th and U curves decrease regularly with depth. Only 5 minor fracture zones are identified in this section (Table 3). At 4087m, a peak of the K content correlated with a cave, indicated a fracture bearing illite. This fracture zone was also identified by the cuttings examination (Fig. 8) and some illite minerals were suspected among the cuttings (Fig. 6). In this section, huge caves are correlated with the increase of K content (illite).

5- At 4590m, the hole diameter changes from 12”1/4 to 8”1/2. This changing affects the radioactive measurements because the tool is closer to the wall and the signal is less softened. Then, the average values are higher and the peak of signals is a little higher too. However, the noisier U curve is not related to the reduced diameter, but to an actual response of the signal. So, between 4550m to 5100m, the different radioactive curves are very noisy and disturbed with the U curve showing a lot of peaks. At 4769m, a huge cave is present with an increase of the Th content and corresponds to a major fracture zone. Below this zone, the Th and U values are higher until 4853m. At this depth, there is a peak of U. Then, it appears that there is a petrographic variation bounded by two fracture zones at 4769m and 4853m. From 4926m to the bottom depth, the U curve shows a lot of occurrences of fractures which are not bounded by hydrothermal alteration.

***Table 3 - Location of the main fracture in GPK3 based on well logging data.***
The importance of fracture is indicated by a number: (1) moderate radioactive log anomaly, (2) significant radioactive log anomaly, (3) significant radioactive log anomaly correlated with a cave.

| Depth (m) | Fracture hierarchy | | | Depth (m) | Fracture hierarchy | | |
|---|---|---|---|---|---|---|---|
| 1641 | 1 | | | 4087 | | 2 | |
| 1755 | | 2 | | 4320 | 1 | | |
| 1819 | 1 | | | 4434 | 1 | | |
| 1904 | 1 | | | 4476 | 1 | | |
| 2000 | 1 | | | 4553 | 1 | | |
| 2041 | | 2 | | 4570 | | | |
| 2099 | | 2 | | 4580 | 1 | | |
| 2238 | 1 | | | 4615.5 | | | 3 |
| 2464 | 1 | | | 4622 | | | 3 |
| 2812 | 1 | | | 4650 | | 2 | |
| 2912 | 1 | | | 4769 | | | 3 |
| 2964 | 1 | | | 4801 | | 2 | |
| 3067 | 1 | | | 4853 | | | 3 |
| 3125 | 1 | | | 4881 | | 2 | |
| 3221 | 1 | | | 4926 | | 2 | |
| 3271 | | | 3 | 4945 | | 2 | |
| 3306 | | 2 | | 4956 | | 2 | |
| 3485 | | | 3 | 4978 | | 2 | |
| 3647 | | | 3 | 4995 | | 2 | |
| 3687 | | | 3 | 5000 | | 2 | |
| 3754 | | 2 | | 5007 | | 2 | |
| 3815 | | 2 | | 5018 | | 2 | |
| 3880 | | | 3 | | | | |

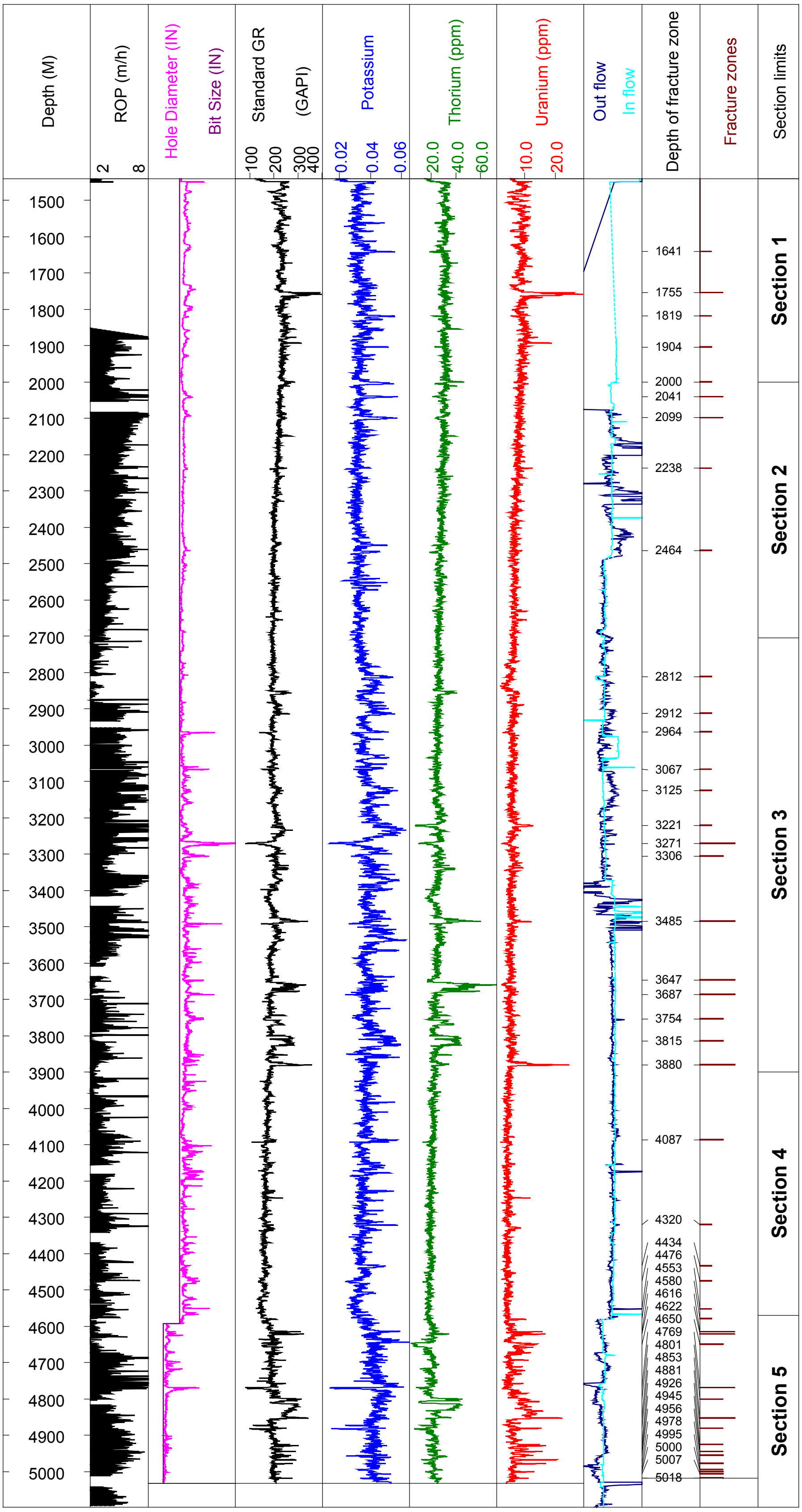


*Fig. 7 - Well-logging data in the GPK3 well between 1440m and 5100m.*

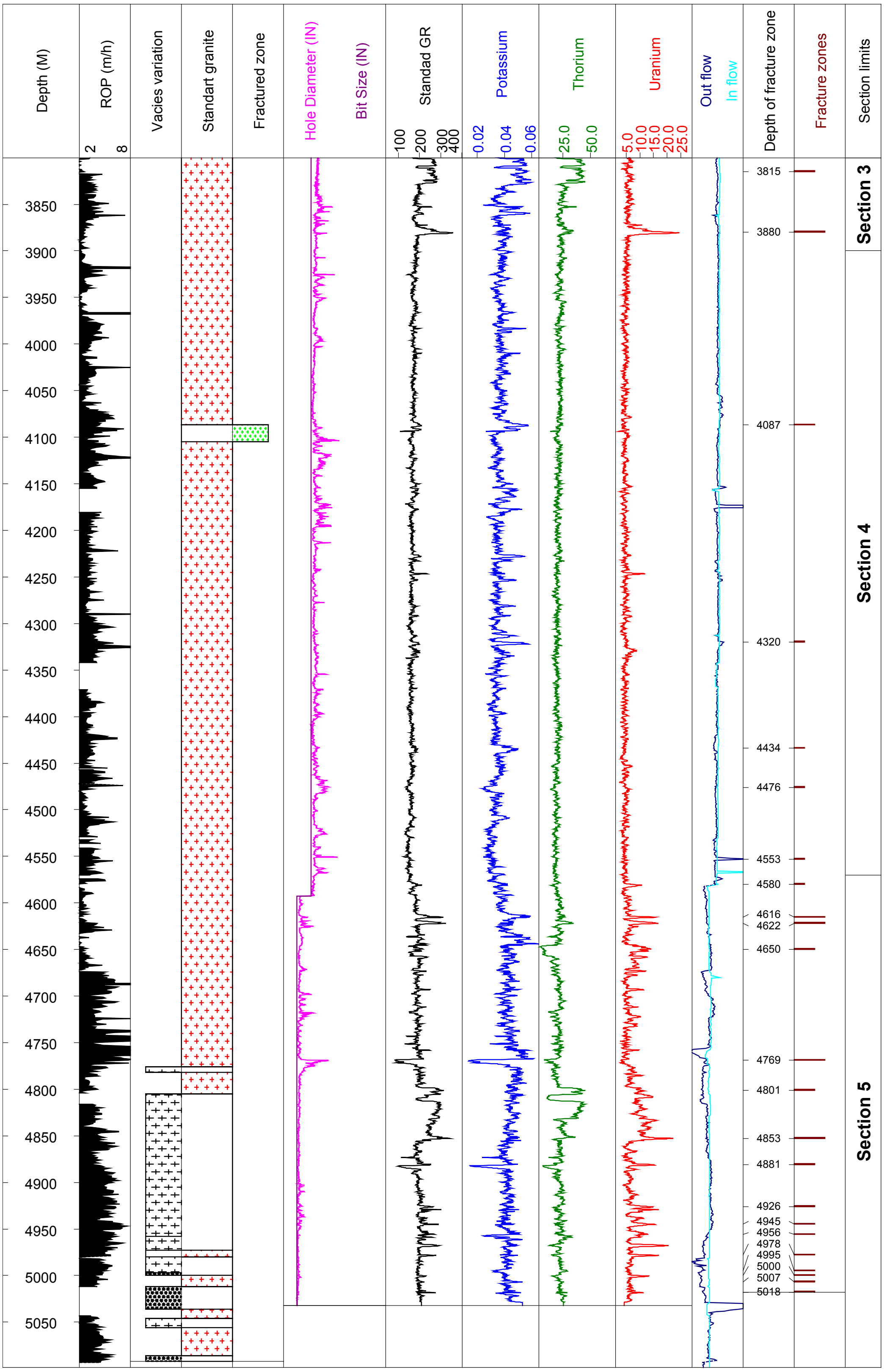


***Fig. 8 - Synthetic log of GPK3 well between 3800m and 5100m from well-logging measurements and cutting analysis.***

### 4.2.2. Hierarchy Ascending Classification analysis

In order to interpret the well-logging data (spectral gamma ray and caliper) in terms of lithological variation and fracture content, all these data are combined by a Hierarchy Ascending Classification (HAC – cluster analysis). The aim of the cluster analysis is to define automatically a synthetic lithological code to each depth section according to its own multivariable content. The multivariable analysis sorts each individual data measurements into separate groups characterized by 4 variables: K, Th, U contents and caliper. The analysis has been done in the 12''1/4 part of the borehole between 1450m and 4600m where the tool diameter is constant. The main 8 HAC groups delimited the GPK3 well in several vertical depth sections (Fig. 9, Ann. 8). Two types of groups are listed (Table 4):

1- the first type corresponds to a background signal (classes 1, 2, 3, 4, 8) and represents lithological variations;
2- the second type corresponds to background signal anomalies (classes 5, 6, 7) and represents thin lithological variations (dykes) or fracture zones.

***Table 4 - HAC classes and their statistical parameters for the different well logging measurements in GPK3 between 1450m and 4600m.***

| Classes | Number of measurements | Statistical parameters | K (%) | Th (ppm) | U (ppm) | Hole radius (in) | |
|---|---|---|---|---|---|---|---|
| **1** | 4219 | Average | 0.0338 | 31.2232 | 9.2070 | 6.5595 | Backgroud signal |
| **Yellow** | | *Standard deviation* | *0.0041* | *2.7339* | *1.4020* | *0.3018* | |
| **4** | 4868 | Average | 0.0325 | 27.8481 | 6.8955 | 6.2372 | |
| **Cyan** | | *Standard deviation* | *0.0026* | *2.7188* | *0.9720* | *0.1682* | |
| **3** | 3526 | Average | 0.0453 | 24.3819 | 5.7169 | 5.9261 | |
| **Pink** | | *Standard deviation* | *0.0050* | *3.2743* | *1.3541* | *0.2719* | |
| **8** | 4584 | Average | 0.0367 | 25.0353 | 5.7988 | 5.7510 | |
| **Grey** | | *Standard deviation* | *0.0024* | *3.5284* | *1.0631* | *0.1719* | |
| **2** | 2751 | Average | 0.0339 | 19.4439 | 4.7114 | 6.2862 | |
| **Orange** | | *Standard deviation* | *0.0029* | *1.6015* | *0.7815* | *0.3131* | |
| **5** | 63 | Average | 0.0364 | 30.2630 | 21.7926 | 6.6609 | Anomalies |
| **Green** | | *Standard deviation* | *0.0039* | *2.2343* | *3.3898* | *0.3882* | |
| **6** | 315 | Average | 0.0280 | 19.0435 | 4.8327 | 8.0425 | |
| **Red** | | *Standard deviation* | *0.0042* | *4.0248* | *0.8671* | *1.4094* | |
| **7** | 295 | Average | 0.0482 | 45.4823 | 5.4182 | 5.7076 | |
| **Blue** | | *Standard deviation* | *0.0054* | *7.1449* | *1.2978* | *0.1106* | |

Class 1 (yellow): This class corresponds to large diameter section in the hole, with both important Th and U signals and a medium K signal. The radioactive curves decrease regularly with depth and the hole diameter remains stable. In the well, the upper and lower limits are 1450m and 2094m respectively.

Class 4 (cyan): As the class 1, this class shows an important Th signal and U signal and a smaller K signal, with a nominal diameter of the hole. The radioactive curves decrease regularly with depth too. In the well, the upper and lower limits are 2094m and 2741m respectively.

The classes 1 and 4 are superimposed in space and are delimited at 2094m by a zone belonging to the class 3. Locally, this transition corresponds to a fault zone which was already evidenced in the neighbouring well GPK2. This fault zone was strongly permeable during drilling and was responsible for total mud losses in GPK2 (Genter *et al.*, 1999).

The depth sections corresponding to the classes 1 and 4 are therefore interpreted in terms of standard porphyritic granite. Cutting observations confirm the deep geology. The slight evolution of the different radioactive curves could be related to a slight evolution of the granite composition (mode) with depth. Comparison with the EPS1 cores allows to propose that those sections correspond to the porphyritic granite facies rich in mega F-K, with biotite and ± hornblende, affected by a low pervasive hydrothermal alteration. Chlorite is the main alteration phase of the biotite. Within the unaltered section, apatite would be one of the mineralogical phase bearing Uranium and Thorium.

Classes 3 and 8 (pink/grey): These classes were grouped because they are very closed spatially and also very close within the HAC analysis. The K signal is high but highly fluctuates whereas Th and U contents are relatively stable but decrease a little bit with depth. In this section where the well is deviated, the borehole diameter is quite low (below the nominal hole diameter) indicating a rather massive rock. Between 2741m and 3420m, the dominating petrographic facies is a standard porphyritic granite rather similar to those encountered in the upper part of the well but with both a more intense pervasive alteration and also a significant hydrothermal vein alteration characterised by quartz and pyrite deposition. Chlorite is associated to the pervasive alteration whereas the superimposed vein alteration developed secondary white mica and pyrite. At about 3420m, an actual facies change occurs. Cuttings are fine-grained size, depleted in K-felspar and enriched in plagioclase and above all biotite. Muscovite is present locally suggesting a 2-mica granite facies. The upper and lower limits of these classes are 2741m and 4093m depth.

Class 2 (orange): All the radioactive logs show average values. The Uranium content has the lowest average values. The Uranium content has the lowest average value at the entire well scale. The borehole diameter is very close to the nominal borehole size. The upper and the lower limits are 4093m and 4590m respectively. This section could be interpreted as a granitic facies depleted in K-Felspar but also depleted in accessory minerals (apatite, zircon, allanite), which bear Th and U. This facies could correspond to a more mafic granite depleted in K-Felspar but richer in biotite and locally muscovite.

Based on the HAC method, the second type of main classes represents some depth section having an anomalous behaviour. They correspond to 3 distinct classes (class 5, class 6, class 7). The class 3 which was defined as a background class, has so many individual anomalous depth section, that it was also described below.

Class 5 (green): This class is characterized by a high content in Uranium associated with some borehole diameter enlargement. Both the K and Th contents are rather stable. This class does not correspond to petrographic variations but it seems more interpreted in terms of fractured and altered zones. The four main sections typical of this class are located at 1755m, 1760m, 1893m and 3880m depth.

Class 6 (red): This class is clearly characterized by an intense caving interpreted in terms of fractured zones. All the radioactive logs show minimum values suggesting an intense leaching due to hydrothermal processes. Cutting observation confirms the presence of alteration. About 32 depth sections characterized this class.

Class 7 (blue): This class is characterized by maximal average value in Th and K, and quite low content in U. However, the borehole size is not enlarged but corresponds to a quite low diameter below the drill bit diameter (11.42 in for 12 ¼ in). About 12 depth sections belong to this class of plurimetric to metric size. Cutting observation in these zones shows a biotite-rich granite facies with quartz-plagioclase-biotite and a depletion in K-Feldspar. Chlorite as a secondary mineral is poorly developed, biotite being very fresh and poorly altered. As the transition is very sharp between the depth sections corresponding to this class and their surrounding, this class was interpreted in terms of magmatic intrusion (dyke, sill). These intrusion are located at 3345m, 3478m, 3484m, between 3656m and 3678m, and between 3802m and 3827m depth (Fig. 9).

### 4.2.3. Acoustic Borehole Imagery: UBI

The drillhole GPK3 was logged by the UBI system. With these acoustic measurements, the coverage of the borehole wall is up to 100 %. Two oriented images are realised: one shows the amplitude of the reflected wave and the other shows the transit time of the wave (Fig. 10). The fractures can be identified with high accuracy and measured in orientation and in dip.

In a first step, the borehole was logged in the 12"¼ section between 1448m and 4540m depth and, in a second step in the 8"½ section between 4567m and 5107m. It is the first borehole at Soultz which is logged continuously in the entire granitic section. Moreover, UBI runs show a very good borehole wall surface reflection and besides that a good fracture detection (Fig. 10). They will be analysed later in terms of fracture characterization through a specific software.

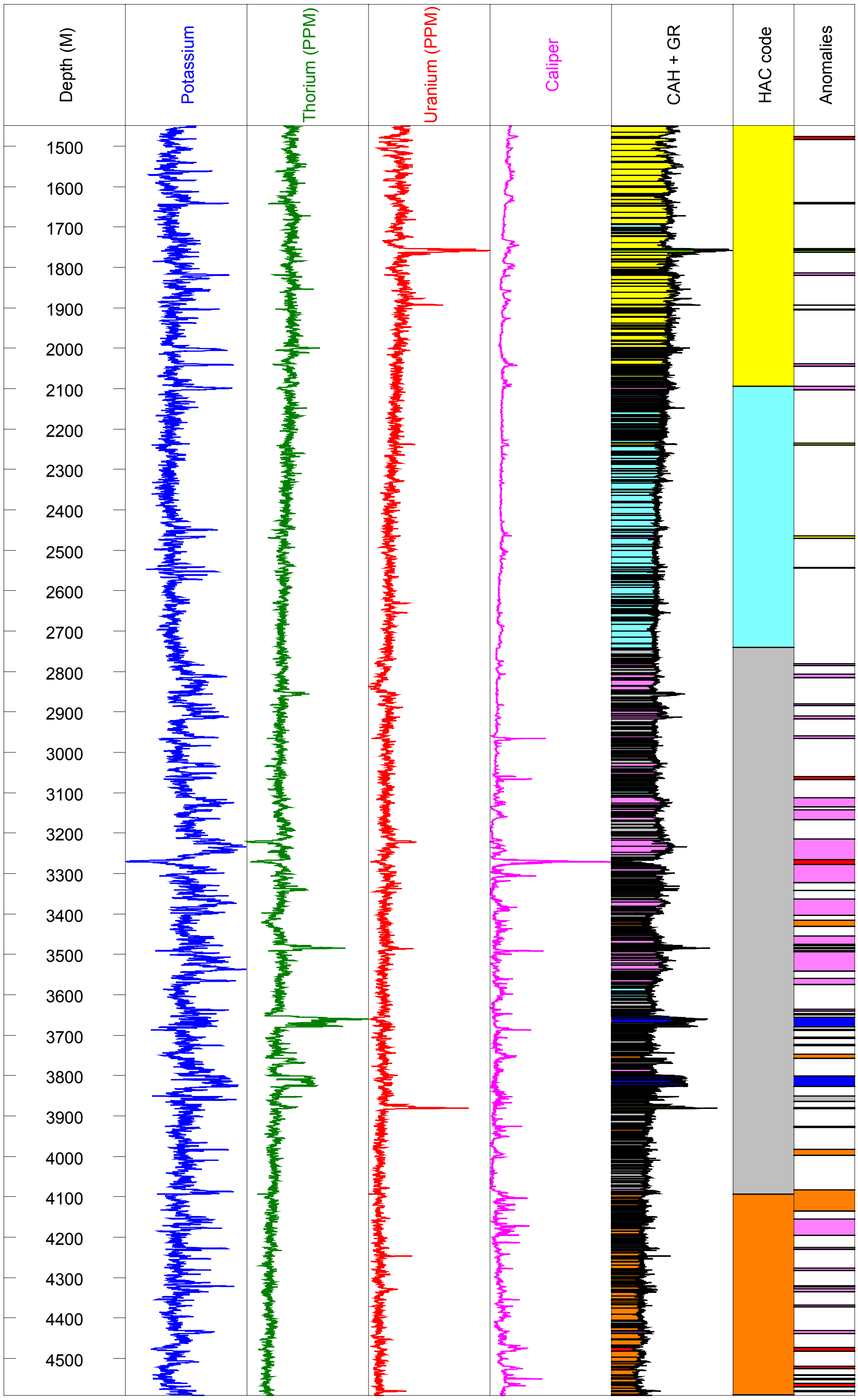


***Fig. 9 - HAC log and fracture zones interpretation in the GPK3 well between 1450m and 4600m depth.***

Class 1: yellow; class 2: orange; class 3: pink; class 4: cyan; class 5: green; class 6: red; class 7: blue; class 8: grey.

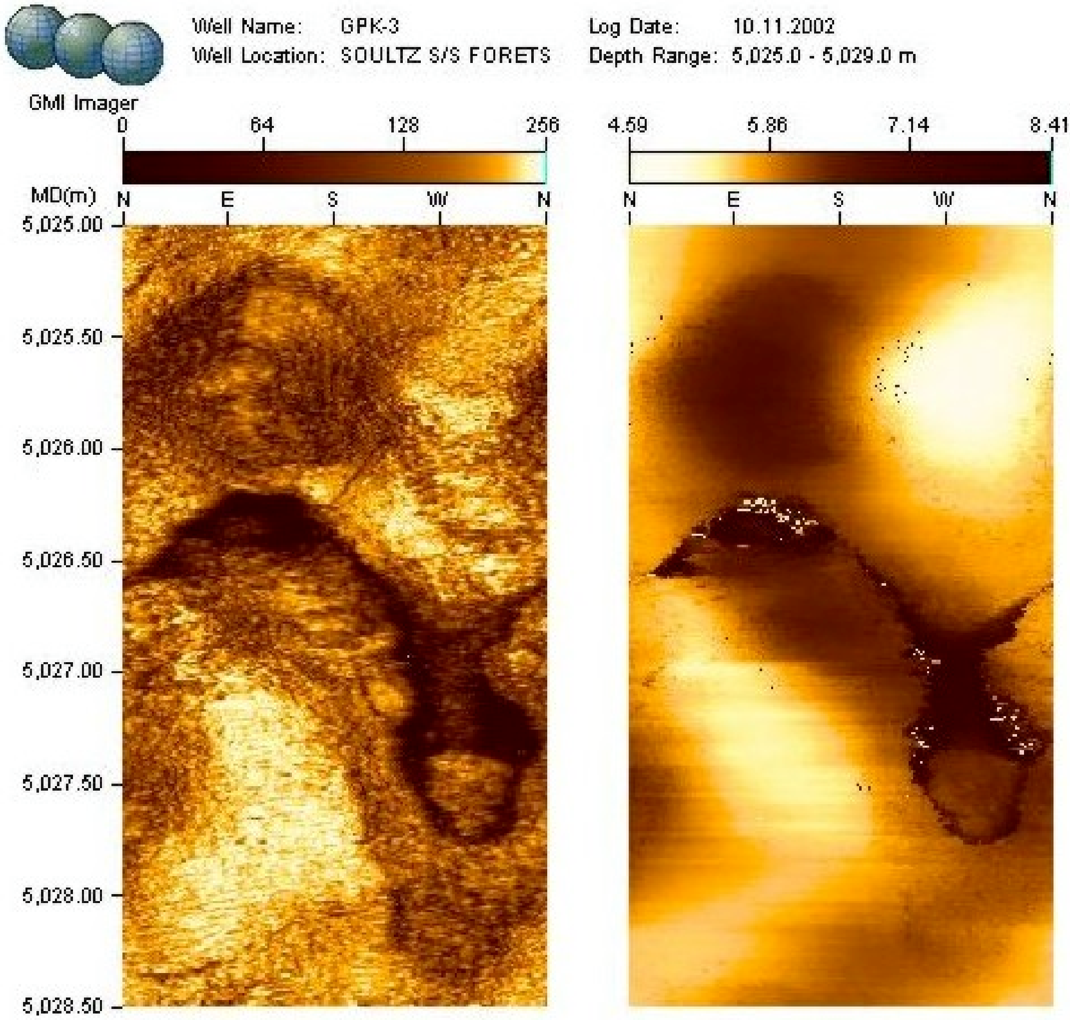


***Fig. 10 - Example of fracture visible on the UBI in GPK3 well.***

# 5. Comparison with other Soultz wells

The GPK3 borehole is deeper than the GPK1 and EPS1 boreholes, then the comparison with these shallow wells is rather difficult. However, these both wells are referential wells because their geology is well known.

Comparison and correlation could be done with GPK2 borehole, which reached the same bottom depth. However, geological and geophysical data in this well are partially or not continuously sampled. Then, the main petrographic units at large-scale could be determined from well-logs, drilling parameters and chip samples. The chip samples are not present below 2100 m in GPK2 because of total mud losses during the drilling operations (Genter & Tenzer, 1995; Genter *et al.*, 1999).

Between GPK1 and GPK2-GPK3 doublet, a N-S cross-section shows the main geological correlations between the large-scale facies (Fig. 11). The main geological units are listed below:

- the top of the granite is reached at about 1420m depth, i. e. -1298m below the sea level (BSL). It corresponds to a porphyritic MFK-rich granite with a high intense fracturing. The top of the granite is hematized and shows a red colour related to a paleo-weathering. The thickness of this hematized unit is about 150m;
- from 1570m to about 2800m depth (-1416m BSL to -2600m BSL), the porphyritic MFK-rich granite has undergone a low pervasive alteration. Some significant fractured zones are present such as at 1820m in GPK1, at 2170m in EPS1, and at 2100m in GPK2 and GPK3;
- from around 2800m to 3550m depth (-2600m BSL to -3850m BSL), the same granite occurs but it is intensively fractured with a high degree of pervasive alteration associated. In GPK2, in the lower limit is a huge fractured zone identified by Genter *et al.* (1999) at 3525m. On the other hand, in GPK3, this limit is not yet defined in terms of fractured zone but would be interpreted by further cutting observation;
- from 3550m to 4800m depth (-3850m BSL to -4600m BSL), the dominant facies is the porphyritic MFK-rich granite but with some texture variations. In this unit, the basement could be a fine-grained to a coarse grained granite. Some large fractured zones occur at 4585m and 4780m in GPK2 and at 4090m and 4770m in GPK3. This deeper fractured zone corresponds to the lower limit of this section;
- from 4800m to the bottom depth, there are some petrographic variations with some new granitic facies, such as biotite-rich granite and 2-mica granite. A core collected in GPK2, was very helpful for characterizing the mineralogical content of a fine-grained 2-mica granite. In this section, as it was observed on the GPK2 core, we suspected significant facies change at metric scale.

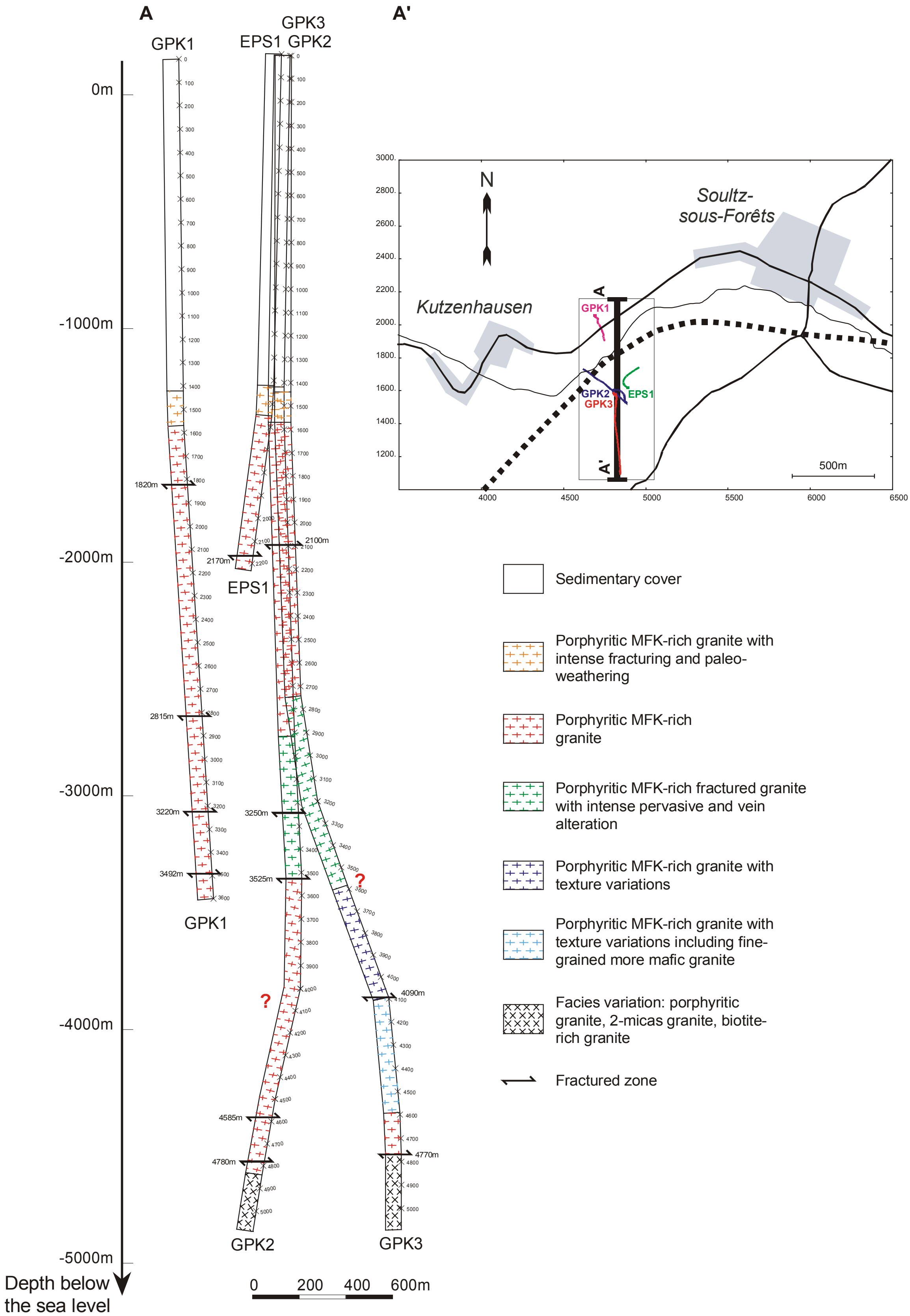


***Fig. 11 - N-S cross-section between GPK1 and GPK2-GPK3 doublet.***

# 6. Conclusion

The GPK3 borehole, located at only a few meters from the previous well GPK2, has been drilled between June and November 2002. It reaches 5093m depth with a slight deviation from 2700m depth.

Cutting samples have been collected between 1418m and 5093m depth. Between 3800m and 5092m depth, the geological profile based on cutting examination has been done on site during drilling operation. Due to the very small size of the chip samples, the characterization of the rock texture as well as the observation of specific alteration minerals (illite) was very difficult. Based on mineralogical analysis, it seems that the clay fraction (< 50µm) is absent within the on-site collected samples. We assume that the clay minerals were completely crushed and lost with the drilling mud. Consequently, the presence of hydrothermally altered and fractured zones was very difficult to determine based on the very fine-grained chip samples. Indeed, only one fracture zone was detected at around 4100m depth. For the future drilling operation (GPK4), the sampling procedure has to be significantly improved especially for the clay fraction collected.

The cutting analysis permits us to distinguish three main petrographic units:

- from 3800m to 4780m, GPK3 penetrated a low altered porphyritic MFK-rich granite;
- from 4780m to 5000m, the lithology changes and the well intersected a granitic unit dominated by a 2-mica granite;
- from 5000 to 5093m, several facies variation occur which are characterized by the alternance between porphyritic MFK-rich granite, biotite-rich granite and 2-mica granite.

Conventional well-logs (caliper, U, Th, K, natural radioactivity) and acoustic borehole imagery (UBI system) were acquired and supervised on site. They provide a continuous profile within the granitic section from 1450m to 5100m depth. These borehole data sets are the deepest geophysical measurements collected on the Soultz site, especially between 4500m and 5100m. They will offer the unique opportunity to fully characterize, for the first time, the fracture system at depth as well as an indirect method for evaluating the deep seated geology.

Conventional well-logs were analysed versus depth in order to define some major petrographic units and fracture zones. However, in order to improve our geological interpretation, a statistical method, called Hierarchy Ascending Classification analysis (HAC), was applied between 1420m and 4580m depth.

The UBI logs are very high quality data sets and then show good acoustic contrast for fracture detection. The detailed fracture analysis of those borehole image logs are not realized in this report.

Based on those analyses (cuttings, well-logs, HAC), five main geological units were defined between 1420m and 5100m depth:

- from 1420m to 1570m, a porphyritic MFK-rich hematized granite with a high intense fracturing;

- from 1570m to about 2800m depth, a porphyritic MFK-rich granite which has undergone a low pervasive alteration. Some significant fractured zones are present;
- from around 2800m to 3550m depth, the same granite occurs but it is intensively fractured with a high degree of pervasive alteration associated;
- from 3550m to 4800m depth, the dominant facies is the porphyritic MFK-rich granite but with some texture variations;
- from 4800m to the bottom depth, there are some petrographic variations with some new granitic facies, such as biotite-rich granite and 2-mica granite.

The deep seated geology of the GPK3 well and the GPK2 well is very similar and is characterized by several granitic intrusions.

# Acknowledgements

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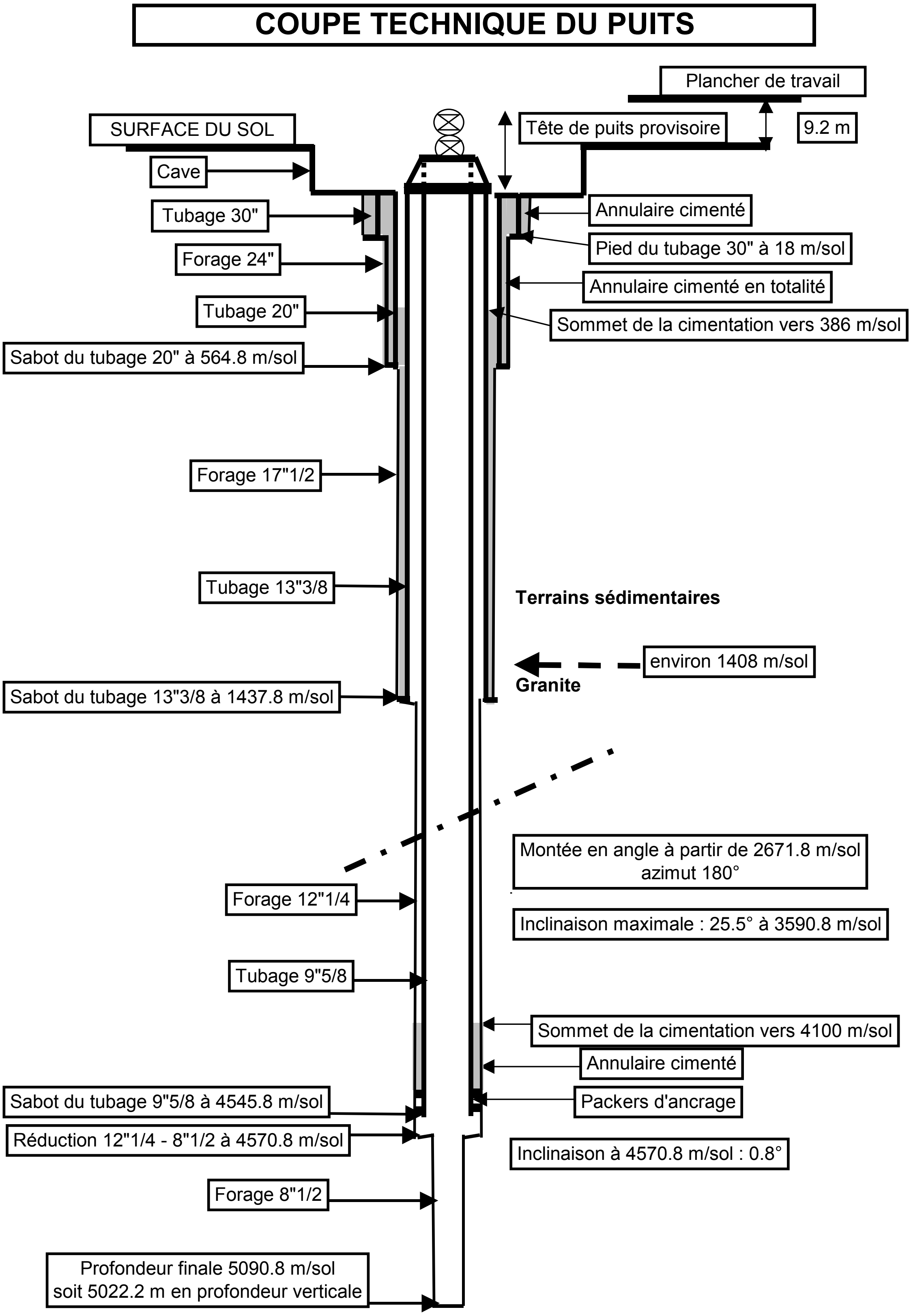
## ANNEX 1

# Technical cross-section of the GPK3 well


COUPE TECHNIQUE DU PUITS
Plancher de travail
SURFACE DU SOL
Tête de puits provisoire
9.2 m
Cave
Tubage 30"
Annulaire cimenté
Pied du tubage 30" à 18 m/sol
Forage 24"
Annulaire cimenté en totalité
Tubage 20"
Sommet de la cimentation vers 386 m/sol
Sabot du tubage 20" à 564.8 m/sol
Forage 17"1/2
Tubage 13"3/8
Terrains sédimentaires
environ 1408 m/sol
Granite
Sabot du tubage 13"3/8 à 1437.8 m/sol
Montée en angle à partir de 2671.8 m/sol
azimut 180°
Forage 12"1/4
Inclinaison maximale : 25.5° à 3590.8 m/sol
Tubage 9"5/8
Sommet de la cimentation vers 4100 m/sol
Annulaire cimenté
Packers d'ancrage
Sabot du tubage 9"5/8 à 4545.8 m/sol
Réduction 12"1/4 - 8"1/2 à 4570.8 m/sol
Inclinaison à 4570.8 m/sol : 0.8°
Forage 8"1/2
Profondeur finale 5090.8 m/sol
soit 5022.2 m en profondeur verticale

**ANNEX 2**

# List of cutting samples collected in the GPK3 well between 1418m and *5093m*

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 1418 | red | | 15.07.02? | | |
| 1423 | red | | 15.07.02? | | |
| 1433 | red | | 15.07.02? | | |
| 1443 | red | coarse | 15.07.02? | | |
| 1453 | red | | 15.07.02? | | |
| 1467 | red | coarse | 27.07.02 | | |
| 1475 | red | | 27.07.02? | | |
| 1485 | red | | 27.07.02? | | |
| 1494 | red | | 27.07.02? | | |
| 1510 | red | | 27.07.02? | | |
| 1520? | red | | 27.07.02? | | |
| 1530 | grey | | 28.07.02 | | |
| 1540 | grey | coarse | 28.07.02? | | |
| 1553 | grey | | 28.07.02? | | |
| 1563 | very red | coarse | 28.07.02? | | |
| 1575 | grey | | 28.07.02? | | |
| 1596,5 | grey | | 29.07.02 | | |
| 1606 | red | | 30.07.02 | | |
| 1620 | very red | | 30.07.02? | | |
| 1630 | very red | coarse-fine | 30.07.02? | | |
| 1640 | very red | | 30.07.02? | | |
| 1650 | very red | | 30.07.02? | | |
| 1663,6 | red | | 31.07.02 | | |
| 1673 | red | | 31.07.02? | | |
| 1677 | red | | 31.07.02? | | |
| 1690 | grey | | 31.07.02? | | |
| 1700 | very red | coarse | 31.07.02? | | |
| 1710 | red | | 31.07.02? | | |
| 1720 | red | | 31.07.02? | | |
| ? | | | 31.07.02? | | |
| 1730 | very red | | 01.08.02 | | |
| 1740 | very red | | 01.08.02? | | |
| 1756 | very red | coarse-fine | 01.08.02? | | |
| 1770 ? | grey | | 01.08.02? | | |
| 1780 | red | | 02.08.02 | | |
| 1793 | red | | 02.08.02? | | |
| 1802,5 ? | red | | 02.08.02? | | |
| 1807 | very red | coarse | 02.08.02? | | |
| 1812 | red | | 02.08.02? | | |
| 1821,5 | red | | 02.08.02? | | |
| 1831 | red grey | | 02.08.02? | | |
| 1841 | red grey | | 02.08.02? | | |
| 1850 | grey | | 03.08.02 | | |
| 1860 | red grey | | 03.08.02? | | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 1863 | red | | 03.08.02? | | |
| 1870 | red | | 03.08.02? | | |
| 1879,5 | very red | coarse | 03.08.02? | | |
| 1888,5 | red | | 03.08.02? | | |
| 1898 | red | | 03.08.02? | | |
| 1918 | red | | 03.08.02? | | |
| 1927 | grey | | 03.08.02? | | |
| 1938 | grey | | 03.08.02? | | |
| 1948 | grey | coarse | 04.08.02 | | |
| 1957 | grey | | 04.08.02 ? | | |
| 1965 | grey | | 04.08.02 ? | | |
| 1974,5 | grey | | 04.08.02 ? | | |
| 1984 | grey | | 04.08.02 ? | | |
| 1993 | grey | | 04.08.02 ? | | |
| 2002 | grey | coarse-fine | 04.08.02 ? | | |
| 2010 | grey | | 04.08.02 ? | | |
| 2021 | grey | | 04.08.02 ? | | |
| 2030,5 | grey | | 04.08.02 ? | | |
| 2040 | red | coarse | 05.08.02 | | |
| 2050 | very red | coarse | 05.08.02 ? | | |
| 2057 | grey | coarse | 05.08.02 ? | | |
| 2066 | grey | coarse | 05.08.02 ? | | |
| 2078,5 | red | coarse | 05.08.02 ? | | |
| 2088 | very red | coarse-fine | 06.08.02 | | |
| 2097 | very red | coarse-fine | 06.08.02 ? | | |
| 2107 | very red | coarse-fine | | | |
| 2117 | grey | coarse | | | |
| 2125 | grey | coarse | | | |
| 2135 | grey | coarse | | | |
| 2144 | grey | coarse | | | |
| 2153 | grey | coarse | | | |
| 2163 | grey | coarse-fine | | | |
| 2173 | | | | | |
| 2191 | | | | | |
| 2202,5 | | | | | |
| 2212 | | | | | |
| 2222 | | | | | |
| 2239 | very red | | | | |
| 2247 | very red | coarse-fine | | | |
| 2248 | very red | | | | |
| 2250 | red | | | | |
| 2266 | red | | | | |
| 2274 | red | coarse-fine | | | |
| 2283 | | | | | |
| 2293 | | | | | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 2303 | grey | coarse | | | |
| 2313 | | | | | |
| 2323 | | | | | |
| 2333 | red | coarse | | | |
| 2343 | red | | | | |
| 2359 | | | | | |
| 2368 | black /grey | coarse | | | |
| 2376 | | | | | |
| 2385 | | | | | Granite sampled about every 3 m from |
| 2387 | | | | | here downwards! |
| 2389 | | | | | |
| 2391 | | | | | |
| 2393 | | | | | |
| 2395 | | | | | |
| 2397 | grey | coarse | | | |
| 2399 | | | | | |
| 2401 | | | | | |
| 2403 | | | | | |
| 2405 | | | | | |
| 2407 | | | | | |
| 2409 | | | | | |
| 2411 | grey | coarse | | | |
| 2413 | | | | | |
| 2416 | | | | | |
| 2419 | | | | | |
| 2422 | | | | | |
| 2425 | | | | | |
| 2428 | | | | | |
| 2431 | | | | | |
| 2434 | red | coarse-fine | | | |
| 2437 | red | | | | |
| 2440 | red | | | | |
| 2443 | red | | | | |
| 2446 | red | | | | |
| 2449 | | | | | |
| 2452 | | | | | |
| 2455 | grey | coarse | | | |
| 2458 | | | | | |
| 2461 | | | | | |
| 2464 | | | | | |
| 2467 | | | | | |
| 2470 | | | | | |
| 2473 | red | coarse-fine | | | |
| 2476 | red | | | | |
| 2479 | | | | | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 2482 | grey | coarse-fine | | | |
| 2485 | | | | | |
| 2488 | | | | | |
| 2492 | | | | | |
| 2495 | black /grey | coarse-fine | | | |
| 2498 | | | | | |
| 2500 | | | | | |
| 2503 | | | | | |
| 2506 | | | | | |
| 2509 | | | | | |
| 2512 | grey | coarse | | | |
| 2515 | red | | | | |
| 2518 | | | | | |
| 2521 | | | | | |
| 2524 | red | coarse | | | |
| 2527 | red | | | | |
| 2530 | red | | | | |
| 2533 | red | | | | |
| 2536 | red | coarse | | | |
| 2539 | red | coarse | | | |
| 2542 | red | fine | 11.08.02 | 0.18 | 2 Samples (different fraction) |
| 2545 | red | | 11.08.02 | 1.05 | |
| 2548 | red | fine | 11.08.02 | 1.50 | 2 Samples |
| 2551 | grey /red | | 11.08.02 | 2.38 | |
| 2554 | grey | fine | 11.08.02 | 3.40 | 2 Samples, c<1 is red due to ipp |
| 2557 | grey | | 11.08.02 | 4.32 | |
| 2560 | grey (brown ) | fine | 11.08.02 | 5.23 | 2 Samples, c<1 is red due to ipp |
| 2563 | grey /black | | 11.08.02 | 6.00 | |
| 2566 | grey | fine | 11.08.02 | 6.50 | 2 Samples, c<1 is red due to ipp |
| 2569 | grey /(black ) | | 11.08.02 | 7.40 | |
| 2572 | grey /(black ) | fine | 11.08.02 | 8.40 | 2 Samples, c<1 is red due to ipp |
| 2575 | grey | | 11.08.02 | 10.30 | |
| 2578 | grey | fine | 11.08.02 | 11.05 | 2 Samples, c<1 is red due to ipp |
| 2581 | grey | | 11.08.02 | 12.00 | |
| 2584 | grey | fine | 11.08.02 | 12.50 | 2 Samples |
| 2587 | grey | | 11.08.02 | 13.45 | |
| 2590 | grey /(red ) | fine | 11.08.02 | 14.20 | 2 Samples, c<1 is red due to ipp |
| 2593 | grey /(red ) | | 11.08.02 | 15.25 | |
| 2596 | grey /(red ) | fine | 11.08.02 | 16.12 | 2 Samples, c<1 is red due to ipp |
| 2599 | grey /black /(red ) | | 11.08.02 | 17.02 | |
| 2601 | grey /black /(red ) | | 11.08.02 | 17.45 | Granite sampled about every 2-3 m from |
| 2603 | grey /black /(red ) | | 11.08.02 | 18.17 | here downwards! |
| 2604 | grey /black | coarse | 11.08.02 | 18.45 | no sieve/filter used (coarse particles) |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| | /(red ) | | | | |
| 2606 | grey /black /(red ) | | 11.08.02 | 19.15 | |
| 2608 | grey /black /(red ) | | 11.08.02 | 20.00 | |
| 2611 | grey /black | coarse | 11.08.02 | 20.38 | no sieve/filter used (coarse particles) |
| 2612 | grey /black | | 11.08.02 | 21.05 | |
| 2614 | grey /(red ) | | 11.08.02 | 21.41 | |
| 2616 | grey /red | coarse | 11.08.02 | 22.13 | no sieve/filter used (coarse particles) |
| 2618 | grey /red | | 11.08.02 | 22.52 | |
| 2620 | grey /(red ) | | 11.08.02 | 23.18 | |
| 2622 | grey /(red ) | coarse | 11.08.02 | 23.48 | no sieve/filter used (coarse particles) |
| 2624 | grey /(red ) | | 12.08.02 | 0.11 | |
| 2626 | grey /red | | 12.08.02 | 0.31 | |
| 2628 | red -grey ? | coarse | 12.08.02 | 1.09 | no sieve/filter used (coarse particles) |
| 2630 | red /(grey ) | | 12.08.02 | 1.38 | |
| 2632 | red | | 12.08.02 | 2.36 | |
| 2634 | red | coarse | 12.08.02 | 2.44 | no sieve/filter used (coarse particles) |
| 2636 | red /(grey ) | coarse | 12.08.02 | 3.17 | no sieve/filter used (coarse particles) |
| 2638 | grey /red | | 12.08.02 | 4.02 | |
| 2640 | grey /black /red | | 12.08.02 | 4.38 | |
| 2642 | grey /black /red | coarse | 12.08.02 | 5.14 | no sieve/filter used (coarse particles) |
| 2644 | grey /black /red | | 12.08.02 | 5.50 | |
| 2646 | grey /black /red | | 12.08.02 | 6.45 | |
| 2648 | black /grey /red | coarse | 12.08.02 | 7.20 | no sieve/filter used (coarse particles) |
| 2650 | black /grey /red | | 12.08.02 | 7.40 | |
| 2652 | grey /black /red | | 12.08.02 | 8.20 | |
| 2654 | grey /black /red | coarse | 12.08.02 | 8.50 | no sieve/filter used (coarse particles) |
| 2656 | grey /black /red | | 12.08.02 | 9.30 | |
| 2658 | grey /black /red | | 12.08.02 | 10.00 | |
| 2660 | grey /black /red | coarse | 12.08.02 | 10.30 | no sieve/filter used (coarse particles) |
| 2662 | grey /black /red | | 12.08.02 | 11.02 | |
| 2664 | grey /black /red | | 12.08.02 | 11.45 | |
| 2666 | black /grey /red | coarse | 12.08.02 | 12.10 | no sieve/filter used (coarse particles) |
| 2668 | grey /black /red | | 12.08.02 | 12.31 | |
| 2670 | grey /black /red | | 12.08.02 | 13.00 | |
| 2672 | grey /red /black | coarse | 12.08.02 | 13.40 | no sieve/filter used (coarse particles) |
| 2674 | red /grey /black | | 12.08.02 | 14.08 | |
| 2676 | red /grey /black | | 12.08.02 | 14.55 | |
| 2678 | red /grey /black | coarse | 12.08.02 | 15.33 | no sieve/filter used (coarse particles) |
| 2680 | red /grey | | 12.08.02 | 16.10 | |
| 2682 | red /grey | coarse | 12.08.02 | | no sieve/filter used (v. coarse particles) |
| 2684 | red /grey | | 12.08.02 | | |
| 2686 | (grey )/red | | 12.08.02 | | |
| 2688 | (grey )/red | coarse | 15.08.02? | | no sieve/filter used (coarse particles) |
| 2690 | grey /red | | 15.08.02? | | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 2692 | grey /red | | 15.08.02? | | |
| 2694 | grey /red | coarse | 15.08.02 | 9.14 | no sieve/filter used (coarse particles) |
| 2696 | grey | | 15.08.02 | 9.50 | |
| 2698 | grey | | 15.08.02 | 10.28 | |
| 2700 | grey | coarse | 15.08.02 | 11.12 | no sieve/filter used (coarse particles) |
| 2702 | grey | | 15.08.02 | 12.30 | |
| 2705 | grey | | 15.08.02 | 13.12 | |
| 2706 | grey | coarse | 15.08.02 | 13.36? | no sieve/filter used (coarse particles) |
| 2708 | grey | | 15.08.02 | 14.09 | |
| 2710 | grey | | 15.08.02 | 14.41 | |
| 2712 | grey | coarse | 15.08.02 | 16.02 | no sieve/filter used (coarse particles) |
| 2715 | grey | | 15.08.02 | 16.58 | |
| 2717 | grey | | 15.08.02 | 17.53? | |
| 2718 | grey /(black ) | coarse | 15.08.02 | 18.24 | no sieve/filter used (coarse particles) |
| 2721 | grey /black | | 15.08.02 | 20.29 | |
| 2723 | grey /black | coarse | 15.08.02 | 21.00 | no sieve/filter used (coarse particles) |
| 2725 | grey /black | | 15.08.02 | 21.43 | |
| 2727 | black /grey | coarse | 15.08.02 | 22.29 | no sieve/filter used (coarse particles) |
| 2729 | grey /black | coarse | 15.08.02 | 23.13 | no sieve/filter used (coarse particles) |
| 2731 | grey /black | | 16.08.02 | 2.15 | |
| 2733 | grey /black | | 16.08.02 | 3.49 | |
| 2735 | grey /black | coarse | 16.08.02 | 4.23 | no sieve/filter used (coarse particles) |
| 2737 | grey /black | | 16.08.02 | 4.56 | |
| 2739 | grey /black | | 16.08.02 | 5.30 | |
| 2741 | grey /black | coarse | 16.08.02 | 6.34 | no sieve/filter used (coarse particles) |
| 2743 | grey /black | | 16.08.02 | 7.14 | |
| 2745 | grey /black | | 16.08.02 | 7.59 | |
| 2747 | (grey )/black | coarse | 16.08.02 | 8.41 | no sieve/filter used (coarse particles) |
| 2749 | (grey )/black | | 16.08.02 | 9.19 | |
| 2751 | (grey )/black | | 16.08.02 | | |
| 2753 | (grey )/black | coarse | 16.08.02 | 10.59 | no sieve/filter used (coarse particles) |
| 2755 | grey /black | | 16.08.02 | 11.40 | |
| 2757 | grey /black | | 16.08.02 | | |
| 2759 | grey /black | coarse | 16.08.02 | 13.26 | no sieve/filter (coarse part. red due to ipp) |
| 2761 | grey /black | | 16.08.02 | 14.10 | |
| 2763 | grey /black | | 16.08.02 | 14.56 | |
| 2765 | black | coarse | 16.08.02 | 15.50 | no sieve/filter used (coarse particles) |
| 2767 | black | | 16.08.02 | 16.55 | |
| 2769 | black /grey | coarse | 16.08.02 | 18.11 | no sieve/filter (coarse part. red due to ipp) |
| 2772 | grey /black | | 16.08.02 | 19.06 | |
| 2774 | grey /black | coarse | 16.08.02 | 20.00 | no sieve/filter (coarse part. red due to ipp) |
| 2777 | red /grey | | 16.08.02 | 21.10 | |
| 2780 | red /grey | coarse | 16.08.02 | 22.40 | no sieve/filter used (coarse particles) |
| 2783 | red /grey | coarse, | 17.08.02 | 0.05 | 2 Samples |
| 2786 | red /grey | coarse | 17.08.02 | 1.15 | no sieve/filter used (coarse particles) |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 2789 | red /grey | | 17.08.02 | 2.30 | |
| 2792 | red /grey | coarse | 17.08.02 | 3.30 | no sieve/filter used (coarse particles) |
| 2795 | grey /red | | 17.08.02 | 5.05 | |
| 2797 | grey /red | coarse | 17.08.02 | 6.17 | no sieve/filter (coarse part. red due to ipp) |
| 2799 | red /grey | | 17.08.02 | 7.04 | |
| 2801 | red /grey | coarse | 17.08.02 | 7.59 | no sieve/filter (coarse part. red due to ipp) |
| 2803 | red /grey | coarse | 17.08.02 | 8.30 | |
| 2806 | red /grey | coarse | 18.08.02? | 9.33 | |
| 2808 | red | | 18.08.02? | 10.20 | |
| 2811 | red | coarse-fine | 18.08.02 | 1.40 | |
| 2814 | red /grey | | 18.08.02 | 2.30 | |
| 2816 | red /grey | coarse-fine | 18.08.02 | 03.20 | |
| 2818 | red /grey | | 18.08.02 | 03.55 | |
| 2820 (?) | red /grey | | 18.08.02 | ?.55 | |
| 2822 | red /grey | coarse-fine | 18.08.02 | 05.48 | |
| 2824 | red | | 18.08.02 | 06.36 | |
| 2826 | red | | 18.08.02 | 07.53 | |
| 2828 | red | coarse | 18.08.02 | 08.37 | |
| 2830 | red | | 18.08.02 | 08.25 | |
| 2832 | red | | 18.08.02 | 10.16 | |
| 2834 | red | coarse | 18.08.02 | 11.05 | |
| 2836 | red | | 18.08.02 | 12.06 | |
| 2838 | red | | 18.08.02 | 12.40 | |
| 2840 | red | coarse | 18.08.02 | 13.23 | |
| 2842 | red | | 18.08.02 | 14.00 | |
| 2845 | red | coarse | 18.08.02 | 15.21 | sample missing! |
| 2847 | red /grey | | 18.08.02 | 16.20 | |
| 2849 | grey /red | coarse | 18.08.02 | 17.32 | |
| 2851 | black /grey /red | | 18.08.02 | 18.51 | |
| 2853 | black /grey /red | coarse | 18.08.02 | 19.51 | |
| 2855 | black /grey /red | | 18.08.02 | 20.48 | |
| 2857 | black /grey | coarse | 18.08.02 | 21.46 | |
| 2859 | black /grey | | 18.08.02 | 20.34 | |
| 2861 | grey /red /black | coarse | 18.08.02 | 23.21 | |
| 2863 | grey /red | | 19.08.02 | 00.35 | |
| 2865 | red /grey | coarse | 19/08/02 | 01.30 | |
| 2867 | red /grey | | 19/08/02 | 02.22 | |
| 2870 | red /grey | coarse | 19/08/02 | 03.24 | |
| 2872 | red /grey | | 19/08/02 | 04.18 | |
| 2873 | grey /red | coarse | 19/08/02 | 05.53 | |
| 2876 | grey /red | | 19/08/02 | 06.22 | |
| 2878 | red /grey | coarse | 19/08/02 | 07.05 | |
| 2880 | red /grey | | 19/08/02 | 07.59 | |
| 2882 | red /grey | coarse | 19/08/02 | 09.07 | |
| 2884 | grey /red | | 19/08/02 | 09.47 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 2886 | grey /red | coarse | 19/08/02 | 11.22 | |
| 2895 | grey /red | coarse-fine | 20/08/02 | 13.10 | contamination? very coarse color particles |
| 2899 | red /grey | coarse-fine | 20.08.02 | 14.35? | |
| 2903 | red /grey | | 20/08/02 | 15.15 | |
| 2904 | red /grey | coarse-fine | 20/08/02 | 15.38 | |
| 2907 | grey /red | | 20/08/02 | 16.00 | |
| 2910 | grey | | 20/08/02 | 16.24 | |
| 2913 | grey | fine-coarse | 20/08/02 | 17.10 | |
| 2916 | grey | | 20/08/02 | 17.40 | |
| 2919 | grey /(red ) | coarse-fine | 20/08/02 | 18.10 | |
| 2922 | grey | | 20/08/02 | 19.18 | |
| 2924 | grey | fine-coarse | 20/08/02 | 19.40 | |
| 2927 | grey | | 20/08/02 | 20.33 | |
| 2930 | grey /black | fine-coarse | 20/08/02 | | |
| 2935 | grey | fine-coarse | 21.08.02 | 06.13 | |
| 2943 | grey /red | coarse-fine | 21.08.02 | 08.08 | |
| 2950 | grey /black | fine-coarse | 21.08.02 | 09.50 | |
| 2953 | grey /black | | 21.08.02 | 10.21 | |
| 2957 | grey /black | fine-coarse | 21.08.02 | 11.00 | |
| 2959 | grey /black | | 21.08.02 | 11.41 | |
| 2962 | grey | coarse-fine | 21.08.02 | 12.15 | |
| 2965 | grey | | 21.08.02 | | |
| 2968 | red | coarse-fine | 21.08.02 | 14.20 | |
| 2971(?) | red | | 21.08.02 | 15.07 | |
| 2974 (?) | red | coarse-fine | 21.08.02 | | |
| 2977 | red /grey | | 21.08.02 | | |
| 2980 | red /grey | coarse-fine | 21.08.02 | | |
| 2983 | red | | 21.08.02 | 18.05 | |
| 2986 | grey /red | coarse-fine | 21.08.02 | 19.30 | |
| 2989 | grey | | 21.08.02 | 20.10 | |
| 2992 | grey | fine-coarse | 21.08.02 | 20.50 | |
| 2996 | grey | | 21.08.02 | 22.10 | |
| 3000 | grey | fine-coarse | 21.08.02 | 22.53 | |
| 3005 | grey | fine-coarse | 21.08.02 | 23.46 | |
| 3010 | grey | fine-coarse | 22/08/02 | 1.14 | |
| 3015 | grey | fine-coarse | 22/08/02 | 2.17 | |
| 3020 | grey /black | | 22/08/02 | 3.34 | |
| 3024 | grey /black | fine-coarse | 22/08/02 | 4.20 | |
| 3029 | grey | | 22/08/02 | 5.32 | |
| 3032 | grey | fine | 22/08/02 | 6.04 | |
| 3035 | grey | | 22/08/02 | | |
| 3038 | grey /red | fine-coarse | 22/08/02 | 7.35 | |
| 3041 | grey /(red ) | | 22/08/02 | 8.13 | |
| 3044 | grey | fine | 22/08/02 | 8.45 | |
| 3047 | grey | | 22/08/02 | 9.25 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 3050 | grey | fine | 22/08/02 | 9.58 | |
| 3053 | grey | | 22/08/02 | 10,38? | |
| 3056 | grey | fine | 22/08/02 | 11.33 | |
| 3059 | grey | | 22/08/02 | 12.07 | |
| 3062 | grey | fine | 22/08/02 | 12.35 | |
| 3065 | grey | | 23/08/02 | 16.50 | |
| 3069 | grey | fine | 23/08/02 | 17.32 | |
| 3071 | grey | | 23/08/02 | 18.01 | |
| 3074 | grey | fine | 23/08/02 | | |
| 3078 | grey | | 23/08/02 | 19.39 | |
| 3082 | grey | fine-coarse | 23/08/02 | 20.10 | |
| 3086 | grey | | 23/08/02 | 21.08 | |
| 3090 | grey | fine-coarse | 23/08/02 | 21.53 | |
| 3093 | grey | | 23/08/02 | 22.56 | |
| 3096 | grey | coarse | 23/08/02 | 23.19 | |
| 3100 | grey | | 24/08/02 | 0.20? | |
| 3103 | grey /red | coarse | 24/08/02 | 1.13 | |
| 3106 | grey /red | | 24/08/02 | | |
| 3109 | red | coarse | 24/08/02 | | |
| 3112 | red | | 24/08/02 | 2.57 | |
| 3115 | red | coarse | 24/08/02 | 3.15 | |
| 3118 | red | | 24/08/02 | | |
| 3121 | red | coarse | 24/08/02 | 3.44 | |
| 3124 | red | | 24/08/02 | | |
| 3127 | red | coarse | 24/08/02 | 5.01 | |
| 3131 | grey | | 24/08/02 | 6.36 | |
| 3134 | grey | coarse | 24/08/02 | | |
| 3137 | grey | | 24/08/02 | 7.55 | |
| 3140 | grey | coarse-fine | 24/08/02 | | |
| 3143 | grey | | 24/08/02 | 9.12 | |
| 3146 | grey | coarse-fine | 24/08/02 | | |
| 3149 | grey | | 24/08/02 | 10.45 | |
| 3152 | grey | coarse-fine | 24/08/02 | 11.10 | |
| 3155 | grey | | 24/08/02 | 11.30 | |
| 3158 | grey | coarse-fine | 24/08/02 | 11.50 | |
| 3161 | grey | | 24/08/02 | 13.10 | |
| 3164 | grey | coarse-fine | 24/08/02 | 13.29 | |
| 3167 | grey | | 24/08/02 | 14.05 | |
| 3171 | grey | coarse-fine | 24/08/02 | 15.52 | |
| 3174 | grey | | 24/08/02 | 16.20 | |
| 3177 | grey | fine-coarse | 24/08/02 | 17.00 | |
| 3190 | grey | | 25/08/02 | 20.03 | |
| 3193 | grey | fine | 25/08/02 | 20.37 | |
| 3195 | grey | | 25/08/02 | 21.06 | |
| 3198 | grey | fine-coarse | 25/08/02 | 21.50 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 3201 | grey | | 25/08/02 | 22.50 | |
| 3204 | grey | fine-coarse | 25/08/02 | 23.32 | |
| 3207 | grey | | 25/08/02 | 0.15 | |
| 3210 | grey | fine-coarse | 25/08/02 | 0.50 | |
| 3213 | grey | | 25/08/02 | 8.02 | |
| 3216 | grey | fine-coarse | 26/08/02 | 2.45 | |
| 3219 | grey | | 26/08/02 | 3.00 | |
| 3222 | grey | fine-coarse | 26/08/02 | 3.15 | |
| 3225 | grey | | 26/08/02 | 3.40 | |
| 3228 | grey | fine-coarse | 26/08/02 | 4.15 | |
| 3231 | grey | | 26/08/02 | 4.46 | |
| 3234 | grey | fine | 26/08/02 | | 2 Samples |
| 3237 | grey | | 26/08/02 | | |
| 3240 | grey | fine | 26/08/02 | 5.38 | 2 Samples |
| 3243 | grey | | 26/08/02 | 6.37 | |
| 3246 | grey | fine | 26/08/02 | 7.27 | 2 Samples |
| 3269 | grey | | 26/08/02 | 8.20 | |
| 3252 | grey | fine-coarse | 26/08/02 | 9.01 | |
| 3256 | grey | | 26/08/02 | 9.45 | |
| 3258 | grey | fine-coarse | 26/08/02 | 10.01 | |
| 3261 | grey | | 26/08/02 | 10.24 | |
| 3264 | grey | fine-coarse | 26/08/02 | 11.11 | |
| 3267 | grey | | 26/08/02 | 11.40 | |
| 3270 | grey | coarse-fine | 26/08/02 | 12.15 | |
| 3273 | grey | | 26/08/02 | 13.21 | |
| 3276 | grey | coarse-fine | 26/08/02 | 14.02 | |
| 3280 | grey | | 26/08/02 | 14.57 | |
| 3283? | grey | | 26/08/02 | 16,10? | |
| 3286 | grey | coarse | 26/08/02 | 16.40 | |
| 3289 | grey | coarse | 26/08/02 | 17.15 | |
| 3292 | grey | coarse-(fine) | 26/08/02 | 18.17 | |
| 3297 | grey | coarse-(fine) | 26/08/02 | 19.15 | |
| 3294 | grey | coarse-fine | 26/08/02 | 20.45 | |
| 3302 | grey | coarse-fine | 26/08/02 | 21.00 | |
| 3305 | grey | coarse-fine | 26/08/02 | 22.00 | |
| 3308 | grey | coarse-fine | 26/08/02 | 22.45 | |
| 3311? | grey | coarse-fine | 27/08/02 | 23.15 | |
| 3314? | grey | coarse-fine | 27/08/02 | | |
| 3317 | grey | coarse-fine | 27/08/02 | | |
| 3320 | grey | coarse-fine | 27/08/02 | 1.45 | |
| 3323 | grey | coarse-fine | 27/08/02 | 3.00 | |
| 3326 | grey | fine-coarse | 27/08/02 | 4.00 | |
| 3329 | grey | coarse-fine | 27/08/02 | 4.45 | |
| 3332 | grey | coarse-fine | 27/08/02 | | |
| 3335 | grey | coarse-fine | 27/08/02 | 7.28 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 3337 | grey | coarse-fine | 27/08/02 | 7.55 | |
| 3340 | grey /black | fine-coarse | 27/08/02 | 8.56 | |
| 3343 | grey /(black ) | fine-coarse | 27/08/02 | 9.57 | |
| 3346 | grey | v.fine | 27/08/02 | 10.40 | |
| 3349 | grey | v.fine | 27/08/02 | | |
| 3352 | grey | fine-coarse | 27/08/02 | | |
| 3355 | grey | fine-coarse | 27/08/02 | | |
| 3358 | grey | fine | 27/08/02 | | |
| 3361 | grey | v.fine | 27/08/02 | 14.10 | |
| 3364 | grey | fine | 27/08/02 | 14.35 | |
| 3367 | grey | fine-coarse | 27/08/02 | 15.00 | |
| 3370 | grey | coarse-fine | 27/08/02 | 16.40 | |
| 3373 | grey | fine | 08/09/02 | 11.50 | |
| 3375 | grey | | 08/09/02 | 12.10 | |
| 3378 | grey | fine | 08/09/02 | 12.31 | |
| 3381 | grey | | 08/09/02 | 13.00 | |
| 3384 | grey | fine | 08/09/02 | 13.10 | |
| 3387 | grey | | 08/09/02 | | |
| 3390 | grey /black | fine | 08/09/02 | | |
| 3393 | grey /black | | 08/09/02 | | |
| 3396 | grey /black | fine | 08/09/02 | | |
| 3399 | grey /black | | 08/09/02 | | |
| 3402 | grey | fine | 08/09/02 | | |
| 3405 | grey | | 08/09/02 | 18.50 | |
| 3408 | grey /black | fine | 08/09/02 | 19.47 | |
| 3411 | grey /black | | 08/09/02 | 20.20 | |
| 3414 | grey /black | fine | 08/09/02 | 21.09 | |
| 3417 | grey | | 08/09/02 | | |
| 3420 | grey | fine | 08/09/02 | | |
| 3423 | grey | | 08/09/02 | | |
| 3426 | grey | fine | 08/09/02 | | oil contamination - brown |
| 3429 | grey | | 11/09/02 | 5.35 | |
| 3432 | grey | fine | 11/09/02 | 6.00 | |
| 3435 | grey | | 11/09/02 | 6.35 | |
| 3438 | grey | fine | 11/09/02 | 7.30 | |
| 3441 | grey | | 11/09/02 | 8.15 | |
| 3444 | grey | fine-coarse | 11/09/02 | 8.55 | |
| 3447 | grey /(black ) | | 11/09/02 | 9.50 | |
| 3450 | grey /(black ) | fine | 11/09/02 | 10.25 | |
| 3453 | grey | | 11/09/02 | 11.00 | |
| 3456 | grey | fine | 11/09/02 | 12.05 | |
| 3459 | grey | | 11/09/02 | 12.40 | |
| 3462 | grey | fine | 11/09/02 | 14.26 | |
| 3465 | grey /(black ) | | 11/09/02 | 14.28 | |
| 3468 | grey | fine | 11/09/02 | 14.49 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 3471 | grey | | 11/09/02 | 15.31 | |
| 3474 | grey | fine | 11/09/02 | 23,50? | |
| 3477 | grey /brown | | 12/09/02 | 0.23 | |
| 3480 | grey /brown | fine | 12/09/02 | 1.05 | |
| 3483 | grey /black | | 12/09/02 | 2.10 | |
| 3486 | grey | fine | 12/09/02 | 2.40 | |
| 3489 | grey | | 12/09/02 | 3.15 | |
| 3492 | grey | fine | 12/09/02 | 4.20 | |
| 3495 | grey /black | | 12/09/02 | 4.45 | |
| 3498 | grey /black | fine | 12/09/02 | 5.43 | |
| 3501 | grey | | 12/09/02 | 6.26 | |
| 3505 | grey /black | fine | 12/09/02 | 7.30 | |
| 3508 | grey | fine | 12/09/02 | 7.58 | |
| 3511 | grey | | 12/09/02 | 8.25 | |
| 3513 | grey | fine | 12/09/02 | 9.16 | |
| 3516 | grey | | 12/09/02 | 10.06 | |
| 3519 | grey | fine | 12/09/02 | 10.44 | |
| 3522 | grey | | 12/09/02 | 11.43 | |
| 3525 | grey /(black ) | fine | 12/09/02 | 12.05 | |
| 3528 | grey | | 12/09/02 | 12.40 | |
| 3532 | grey | fine | 12/09/02 | 13.20 | |
| 3535 | grey | | 12/09/02 | 13.45 | |
| 3538 | grey | fine | 12/09/02 | 15.05 | |
| 3541 | grey | | 12.09.02? | 15.58 | |
| 3544 | grey | fine | 14/09/02 | 4.30 | |
| 3547 | grey /black | | 14/09/02 | 5.45 | |
| 3551 | grey /black | fine | 14/09/02 | 6.45 | oil contamination - brown, 2 Samples |
| 3554 | grey /black | | 14/09/02 | 7.21 | |
| 3557 | grey /black | fine | 14/09/02 | | |
| 3560 | grey /black | | 14/09/02 | | |
| 3563 | grey /black | fine | 14/09/02 | 10.50 | |
| 3566 | (grey )/black | | 14/09/02 | 11.34 | |
| 3569 | (grey )/black | fine | 14/09/02 | 12.14 | oil contamination - brown, 2 Samples |
| 3572 | (grey )/black | | 14/09/02 | 12.50 | |
| 3575 | (grey )/black | fine | 14/09/02 | 14.15 | oil contamination - brown, 2 Samples |
| 3578 | black /grey | | 14/09/02 | 14.45 | |
| 3581 | black /grey | fine | 14/09/02 | 15.30 | oil contamination - brown, 2 Samples |
| 3584 | black /grey | | 14/09/02 | 16.45 | |
| 3587 | black /grey | fine | 14/09/02 | 17.15 | oil contamination - brown, 2 Samples |
| 3590 | black /grey | | 14/09/02 | 18.00 | |
| 3593 | black /grey | fine | 14/09/02 | 19.00 | oil contamination - brown, 2 Samples |
| 3596 | black /grey | | 15/09/02 | 1.10 | |
| 3599 | black /grey | fine | 15/09/02 | 2.15 | oil contamination - brown, 2 Samples |
| 3602 | black /grey | | 15/09/02 | 3.10 | |
| 3605 | black /grey | fine | 15/09/02 | 4.30 | 2 Samples |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 3608 | black /grey | | 15/09/02 | 5.45 | |
| 3611 | black | fine | 15/09/02 | 7.00 | oil contamination - brown, 2 Samples |
| 3614 | black /grey | | 15/09/02 | 8.15 | |
| 3617 | black /grey | fine | 15/09/02 | 9.30 | oil contamination - brown, 2 Samples |
| 3620 | black /grey | | 15/09/02 | 10.40 | |
| 3623 | black /grey | fine | 15/09/02 | 11.52 | 2 Samples |
| 3626 | black /grey | | 15/09/02 | 12.45 | |
| 3629 | black /grey | fine | 15/09/02 | 13.25 | 2 Samples |
| 3632 | black /grey | | 15/09/02 | 14.15 | |
| 3635 | black /grey | fine | 15/09/02 | 15.20 | 2 Samples |
| 3638 | grey /black | | 15/09/02 | 16.20 | |
| 3641 | grey /black | fine | 15/09/02 | 17.00 | 2 Samples |
| 3644 | grey /black | | 15/09/02 | 22.43 | |
| 3647 | grey /black | fine | 16/09/02 | 0.00 | 2 Samples |
| 3650 | black /grey | | 16/09/02 | 1.15 | |
| 3653 | black /grey | fine | 16/09/02 | 2.30 | 2 Samples |
| 3656 | black | | 16/09/02 | 3.46 | |
| 3659 | black | fine | 16/09/02 | 5.10 | 2 Samples |
| 3662 | black | | 16/09/02 | 6.45 | |
| 3665 | black | fine | 16/09/02 | 8.15 | 2 Samples |
| 3668 | black | | 16/09/02 | 9.20 | |
| 3671 | very black | fine | 16/09/02 | 11.30 | 2 Samples |
| 3674 | very black | | 16/09/02 | 12.15 | |
| 3677 | very black | fine | 16/09/02 | 13.20 | 2 Samples |
| 3680 | black | | 16/09/02 | 14.20 | |
| 3683 | very black | fine | 16/09/02 | 15.35 | 2 Samples? |
| 3686 | black | | 16/09/02 | | |
| 3689 | very black | fine | 18/09/02 | 5.00 | |
| 3692 | black | | 18/09/02 | 5.30 | |
| 3695 | black | fine | 18/09/02 | 6.30 | 2 Samples |
| 3698 | black | | 18/09/02 | 7.40 | |
| 3701 | black | fine | 18/09/02 | 9.00 | |
| 3706 | black | | 18/09/02 | 10.21 | |
| 3707 | black | | 18/09/02 | 10.50 | |
| 3710 | black | fine | 18/09/02 | 11.40 | |
| 3713 | black | | 18/09/02 | 12.40 | |
| 3716 | black | fine | 18/09/02 | 13.25 | |
| 3719 | black | | 18/09/02 | 14.15 | |
| 3722 | black | fine | 18/09/02 | 15.40 | |
| 3725 | black | | 18/09/02 | 16.20 | |
| 3728 | black | fine | 18/09/02 | 17.10 | |
| 3731 | black | | 18/09/02 | 18.20 | |
| 3734 | black | fine | 18/09/02 | 19.10 | |
| 3737 | black | | 18/09/02 | 20.00 | |
| 3740 | black | fine | 18/09/02 | 20.50 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 3743 | black | | 18/09/02 | 21.45 | |
| 3746 | black | fine | 18/09/02 | 22.10 | |
| 3749 | black | | 18/09/02 | 22.45 | |
| 3752 | black | fine | 18/09/02 | 24.00 | |
| 3755 | black | | 19/09/02 | 0.45 | |
| 3758 | black | fine | 19/09/02 | 1.48 | |
| 3761 | black /grey | | 19/09/02 | 2.55 | |
| 3764 | grey /black | fine | 19/09/02 | 3.52 | |
| 3767 | grey /black | | 19/09/02 | 4.48 | |
| 3770 | black | fine | 19/09/02 | 5.00 | |
| 3773 | black | | 19/09/02 | 6.55 | |
| 3776 | black | fine | 19/09/02 | | |
| 3779 | black | | 19/09/02 | 8.30 | |
| 3782 | black | fine | 19/09/02 | 9.10 | |
| 3785 | black /grey | | 19/09/02 | | |
| 3788 | black /grey | fine | 19/09/02 | 11.15 | |
| 3791 | black /grey | | 19/09/02 | 12.35 | |
| 3794 | black /grey | fine | 19/09/02 | 14.00 | |
| 3797 | black /grey | | 19/09/02 | 15.30 | |
| 3800 | black | fine | 19/09/02 | 16.37 | |
| 3803 | black | | 19/09/02 | 17.54 | |
| 3806 | black | fine | 19/09/02 | 19.38 | |
| 3809 | black | | 19/09/02 | 21.05 | |
| 3812 | black | fine | 19/09/02 | 22.45 | |
| 3815 | very black | | 20/09/02 | 0.18 | |
| 3818 | very black | fine | 20/09/02 | 1.15 | |
| 3821 | very black | | 20/09/02 | 2.18 | |
| 3824 | very black | fine | 20/09/02 | 3.15 | |
| 3827 | black | | 20/09/02 | 4.15 | |
| 3830 | black | fine | 20/09/02 | 5.10 | |
| 3833 | black | | 20/09/02 | 5.55 | |
| 3836 | black | fine | 20/09/02 | 7.05 | |
| 3839 | black | | 20/09/02 | 8.05 | |
| 3842 | black | fine | 20/09/02 | 8.55 | |
| 3845 | black | | 20/09/02 | 10.09 | |
| 3848 | black | | 22.09.02? | 3,05? | |
| 3851 | black | | 22.09.02? | 3,50? | |
| 3854 | black | fine | 22/09/02 | 4.20 | |
| 3857 | black | | 22/09/02 | 4.50 | |
| 3860 | black /grey | fine | 22/09/02 | 5.20 | |
| 3863 | black /grey | | 22/09/02 | 6.40 | |
| 3866 | black /grey | | 22/09/02 | 7.20 | |
| 3869 | black /grey | | 22/09/02 | 8.15 | |
| 3872 | black /grey | fine | 22/09/02 | 9.30 | |
| 3875 | grey /black | | 22/09/02 | 10,25? | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 3878 | grey /black | | 22/09/02 | 12.00 | |
| 3881 | grey /black | | 22/09/02 | 13.35 | |
| 3884 | grey /black | fine | 22/09/02 | 14.30 | |
| 3887 | grey /black | | 22/09/02 | 16.50 | |
| 3890 | grey /black | fine | 22/09/02 | 17.20 | |
| 3893 | grey /black | | 22/09/02 | 18.35 | |
| 3896 | black /(grey ) | | 22/09/02 | 19.50 | |
| 3899 | black /(grey ) | | 22/09/02 | 21.10 | |
| 3902 | black | fine | 22/09/02 | 10.40 | |
| 3905 | black | | 22/09/02 | 11.50 | |
| 3908 | black | | 23/09/02 | 1.00 | |
| 3911 | black | | 23/09/02 | 2.30 | |
| 3914 | black | fine | 23/09/02 | 3.45 | |
| 3917 | black | | 23/09/02 | 4.45 | |
| 3920 | black | | 23/09/02 | 13.00 | |
| 3923 | black | | 23/09/02 | 13.50 | |
| 3926 | black | | 23/09/02 | 14.39 | |
| 3929 | black | | 23/09/02 | 15.45 | |
| 3932 | black | | 23/09/02 | 17.00 | |
| 3935 | black | | 23/09/02 | 17.55 | |
| 3938 | black | | 23/09/02 | 19.00 | |
| 3941 | black /(grey ) | | 23/09/02 | 20.25 | |
| 3944 | black /grey | fine | 23/09/02 | 21.20 | |
| 3947 | black | | 23/09/02 | 22.30 | |
| 3950 | black | | 24.09.02? | 0.05 | |
| 3953 | black /grey | | 24/09/02 | 1.50 | |
| 3956 | black | fine | 24/09/02 | 3.30 | |
| 3959 | black | | 24/09/02 | 4.25 | |
| 3962 | black | | 24/09/02 | 5.55 | |
| 3965 | black | | 24/09/02 | 7.05 | |
| 3968 | black | fine | 24/09/02 | 8.03 | |
| 3971 | black /grey | | 24/09/02 | 9.25 | |
| 3974 | black | | 24/09/02 | 10,23? | |
| 3979 | black ? | | 24/09/02 | 10,10? | |
| 3982 | black ? | fine | 24/09/02 | 10,50? | oil contamination |
| 3985 | black ? | | 24/09/02 | 11.45 | |
| 3988 | very black | fine | 25/09/02 | | oil contamination |
| 3991 | black | | 25/09/02 | 13.20 | |
| 3994 | black | | 25/09/02 | 14.00 | |
| 3997 | black | | 25/09/02 | 15.05 | |
| 4000 | black /grey | fine | 25.09.02 | 16.00 | |
| 4003 | black /grey | | 25.09.02 | 16.55 | |
| 4006 | black /grey | | 25.09.02 | 18.00 | |
| 4009 | black /(grey ) | | 25.09.02 | 19.05 | |
| 4012 | black /(grey ) | fine | 25.09.02 | 20.25 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 4015 | black /grey | | 25.09.02 | 21.43 | |
| 4018 | black /grey | | 25.09.02 | 22.50 | |
| 4021 | black /grey | | 25.09.02 | 23.50 | |
| 4024 | black /grey | fine | 26.09.02 | 1.08 | |
| 4027 | grey /black | | 26.09.02 | 1.50 | |
| 4030 | grey /black | fine | 26.09.02 | 2.33 | |
| 4033 | grey /black | | 26.09.02 | 3.17 | |
| 4036 | grey /black | fine | 26.09.02 | 4.30 | |
| 4039 | black /grey | | 26.09.02 | 5.20 | |
| 4042 | black | fine | 26.09.02 | 6.30 | |
| 4045 | black | | 26.09.02 | 15.30 | |
| 4048 | very black | fine | 26.09.02 | 16.15 | |
| 4051 | very black | | 26.09.02 | 17.15 | |
| 4054 | (very )black | | 26.09.02 | 18.50 | |
| 4057 | (very )black | fine | 26.09.02 | 20.20 | |
| 4060 | (very )black | | 26.09.02 | 21.00 | |
| 4063 | black | | 26.09.02 | 22.10 | |
| 4066 | black | fine | 26.09.02 | | |
| 4069 | (very )black | | 27.09.02 | 0.17 | |
| 4072 | (very )black | | 27.09.02 | 1.20 | |
| 4075 | (very )black | fine | 27.09.02 | 2.05 | |
| 4078 | (very )black | | 27.09.02 | 2.35 | |
| 4081 | black | | 27.09.02 | 3.20 | |
| 4084 | black | | 27.09.02 | 4.05 | |
| 4087 | black /grey | fine | 27.09.02 | | |
| 4090 | grey /(black ) | | 27.09.02 | 5.23 | |
| 4093 | grey | | 27.09.02 | 6.05 | |
| 4096 | grey | fine | 27.09.02 | 6.45 | |
| 4099 | grey | | 27.09.02 | 7.30 | |
| 4102 | grey | | 27.09.02 | 8.50 | |
| 4105 | grey | | 27.09.02 | 9.36 | |
| 4108 | grey /(black ) | fine | 27.09.02 | 8.40 | |
| 4111 | grey /(black ) | | 27.09.02 | 11.45 | |
| 4114 | grey /(black ) | | 27.09.02 | 12.35 | |
| 4117 | grey /(black ) | | 27.09.02 | | |
| 4120 | black /grey | fine | 27.09.02 | 14.10 | |
| 4123 | black /grey | | 27.09.02 | 14.50 | |
| 4126 | grey /black | | 27.09.02 | | |
| 4129 | grey /black | | 27.09.02 | 16.15 | |
| 4132 | grey /black | fine | 27.09.02 | 17.00 | |
| 4135 | grey /black | | 27.09.02 | 18.10 | |
| 4138 | grey /black | | 27.09.02 | 19.40 | |
| 4141 | grey /black | | 27.09.02 | 20.30 | |
| 4144 | grey /(black ) | fine | 27.09.02 | 21.10 | |
| 4147 | grey /(black ) | | 27.09.02 | 22.00 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 4150 | grey /(black ) | | 27.09.02 | 22.50 | |
| 4153 | grey | fine | 27.09.02 | 23.30 | |
| 4156 | black /(grey ) | fine | 29.09.02 | 6.30 | |
| 4158 | black /(grey ) | | 29.09.02 | 7.00? | |
| 4161 | black /(grey ) | | 29.09.02 | 8.00? | |
| 4164 | black /grey | | 29.09.02 | 8.05? | |
| 4167 | grey | fine | 29.09.02 | 9.00 | |
| 4170 | grey | | 29.09.02 | 14.40 | |
| 4173 | grey | | 29.09.02 | 15.20 | |
| 4176 | grey | v. fine | 29.09.02 | 15.45 | |
| 4179 | grey | | 29.09.02 | 16.55 | |
| 4182 | grey | | 29.09.02 | 17.40 | |
| 4185 | grey | | 29.09.02 | 18.25 | |
| 4188 | grey | | 29.09.02 | 19.28 | |
| 4191 | grey | | 29.09.02 | 20.20 | |
| 4194 | grey /(black ) | fine | 29.09.02 | 21.20 | |
| 4197 | grey /(black ) | | 29.09.02 | 22.30 | |
| 4200 | grey /(black ) | | 29.09.02 | 23.15 | |
| 4203 | grey /(black ) | fine | 30.09.02 | 0.15 | |
| 4206 | grey /(black ) | | 30.09.02 | | |
| 4209 | grey /(black ) | | 30.09.02 | 2.10 | |
| 4212 | grey /(black ) | | 30.09.02 | 3.40 | |
| 4215 | grey /(black ) | | 30.09.02 | 4.20 | |
| 4218 | black /grey | fine | 30.09.02 | 5.00 | |
| 4221 | black /grey | | 30.09.02 | 6.00 | |
| 4224 | black /grey | | 30.09.02 | 6.50 | |
| 4227 | black /grey | | 30.09.02 | 8.05 | |
| 4230 | black /grey | | 30.09.02 | 9.05 | |
| 4233 | black /(grey ) | fine | 30.09.02 | 10.10 | |
| 4236 | black /grey | | 30.09.02 | 11.29 | |
| 4239 | black /grey | | 30.09.02 | 12.22 | |
| 4242 | black | fine | 30.09.02 | 13.20 | |
| 4245 | black | | 30.09.02 | 14.24 | |
| 4248 | black /grey | fine | 30.09.02 | 15.20 | |
| 4251 | black /grey | | 30.09.02 | 16.15 | |
| 4254 | black /grey | | 30.09.02 | 17.25 | |
| 4257 | grey | | 30.09.02 | | |
| 4260 | grey | | 30.09.02 | | |
| 4263 | black /grey | fine | 30.09.02 | 20.33 | |
| 4266 | black /grey | fine | 30.09.02 | 21.30 | |
| 4269 | black /grey | | 30.09.02 | 22.30 | |
| 4272 | black /(grey ) | fine | 30.09.02 | 23.30 | |
| 4275 | black /grey | | 01.10.02 | 0.05 | |
| 4278 | (black )/grey | | 01.10.02 | 1.10 | |
| 4281 | (black )/grey | | 01.10.02 | 2.10 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 4284 | grey /black | fine | 01.10.02 | 3.55 | |
| 4287 | grey /(black ) | | 01.10.02 | 5.00 | |
| 4290 | grey /(black ) | | 01.10.02 | 5.50? | |
| 4293 | grey /(black ) | | 01.10.02 | 6.20 | |
| 4296 | grey /(black ) | | 01.10.02 | 7.10 | |
| 4299 | grey | fine-coarse | 01.10.02 | 12.25 | |
| 4302 | grey | | 01.10.02 | | |
| 4305 | grey | | 01.10.02 | 14.00 | |
| 4308 | grey | | 01.10.02 | 14.36 | |
| 4311 | grey | | 01.10.02 | 15.35 | |
| 4314 | grey /(black ) | | 01.10.02 | | |
| 4317 | grey /(black ) | | 01.10.02 | 17.18 | |
| 4320 | grey /(black ) | fine | 01.10.02 | 18.12 | |
| 4323 | grey | | 01.10.02 | | |
| 4326 | grey | | 01.10.02 | | |
| 4329 | grey | | 01.10.02 | | |
| 4332 | grey | | 01.10.02 | 21.00 | |
| 4335 | grey | | 01.10.02 | 21.55 | |
| 4338 | grey | | 01.10.02 | 23.00 | |
| 4341 | grey | | 01.10.02 | 23.40 | |
| 4344 | grey | fine | 02.10.02 | 22.30 | New bit |
| 4347 | grey | | 02.10.02 | 23.00 | |
| 4350 | grey | | 03.10.02 | 0.05 | |
| 4353 | grey | | 03.10.02 | 1.10 | |
| 4356 | grey /(black ) | fine | 03.10.02 | 2.00 | (oil contaminated) |
| 4359 | grey /(black ) | | 03.10.02 | 3.05 | |
| 4362 | grey /(black ) | | 03.10.02 | 3.50 | |
| 4365 | grey /(black ) | | 03.10.02 | 4.37 | |
| 4368 | grey /(black ) | | 03.10.02 | 5.40 | |
| 4371 | grey /(black ) | | 03.10.02 | 6.35 | |
| 4374 | grey | fine | 03.10.02 | 7.55 | |
| 4377 | black /(grey ) | fine | 03.10.02 | 11.10 | |
| 4380 | black /(grey ) | | 03.10.02 | | |
| 4383 | black | fine | 03.10.02 | 11.10 | (+ - oil contaminated) |
| 4386 | grey | | 03.10.02 | 12.00 | |
| 4389 | black | | 03.10.02 | 12.40 | |
| 4392 | black /(grey ) | | 03.10.02 | | |
| 4395 | black /(grey ) | | 03.10.02 | 14.45 | |
| 4398 | black /(grey ) | | 03.10.02 | 15.50 | |
| 4401 | black /grey | | 03.10.02 | 16.40 | |
| 4405 | black /grey | fine | 03.10.02 | 18.00 | |
| 4407 | black /grey | | 03.10.02 | 19.00 | |
| 4410 | black /grey | | 03.10.02 | | |
| 4413 | grey /black | fine | 03.10.02 | 21.05 | |
| 4416 | black /(grey ) | | 03.10.02 | 22.10 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 4419 | black /grey | | 03.10.02 | 23.20 | |
| 4422 | black /grey | | 04.10.02 | 0.30 | |
| 4425 | black /grey | | 04.10.02 | 0.45? | |
| 4428 | black /grey | fine | 04.10.02 | 1.45 | |
| 4431 | black /grey | | 04.10.02 | 2.57 | |
| 4434 | black /grey | | 04.10.02 | 3.47 | |
| 4437 | black /grey | | 04.10.02 | 5.00 | |
| 4440 | black /grey | | 04.10.02 | 5.45 | |
| 4443 | grey /(black ) | fine | 04.10.02 | | |
| 4446 | black /grey | | 04.10.02 | 7.35? | |
| 4449 | black /grey | | 04.10.02 | 8.35 | |
| 4452 | grey /black | fine | 04.10.02 | | |
| 4455 | grey | | 04.10.02 | | (from here onwards see A. B. Fieldbook ) |
| 4458 | grey | | 04.10.02 | 17.40 | |
| 4461 | grey | | 04.10.02 | 18.15 | |
| 4464 | grey | | 04.10.02 | | |
| 4467 | grey | | 04.10.02 | 19.50 | |
| 4470 | black | | 04.10.02 | 20.50 | (+ - oil contaminated) |
| 4473 | grey /black | | 04.10.02 | | |
| 4476 | grey | | 04.10.02 | 22.50 | |
| 4479 | grey | | 04.10.02 | | |
| 4482 | grey | | 05.10.02 | 1.05 | |
| 4485 | grey | | 05.10.02 | | |
| 4488 | grey | | 05.10.02 | 3.25 | |
| 4491 | grey | | 05.10.02 | 5.10 | |
| 4494 | grey | | 05.10.02 | 6.25 | |
| 4497 | grey | | 05.10.02 | | |
| 4500 | grey | | 05.10.02 | 8.50 | sample missing! |
| 4503 | black | | 05.10.02 | 9.55 | |
| 4506 | black | | 05.10.02 | | sample missing! |
| 4509 | grey | | 05.10.02 | 12.00 | sample missing! |
| 4512 | grey | | 05.10.02 | 12.35 | sample missing! |
| 4515 | black | | 05.10.02 | 13.30 | |
| 4518 | black | | 05.10.02 | 14.20 | |
| 4521 | black /grey | | 05.10.02 | | |
| 4524 | grey | | 05.10.02 | 16.30 | |
| 4527 | grey | | 05.10.02 | 17.30 | |
| 4530 | grey | | 07.10.02 | | |
| 4533 | grey | | 07.10.02 | | |
| 4536 | grey | | 07.10.02 | | |
| 4539 | very black | | 07.10.02 | | (+ - oil contaminated) |
| 4542 | very black | | 07.10.02 | 4.45 | |
| 4545 | very black | | 07.10.02 | 6.00 | |
| 4548 | grey | | 07.10.02 | | |
| 4551 | grey | | 07.10.02 | 7.30 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 4554 | grey | | 07.10.02 | 8.30 | |
| 4557 | grey | | 07.10.02 | | |
| 4560 | grey | | 07.10.02 | 10.00 | |
| 4563 | grey | | 07.10.02 | 11.10 | |
| 4566 | grey | | 07.10.02 | | |
| 4569 | grey | | 07.10.02 | | |
| 4572 | grey | | 07.10.02 | 13.30 | |
| 4575 | grey /black | | 07.10.02 | 14.05 | |
| 4578 | grey /black | | 07.10.02 | 15.10 | |
| 4581 | grey /black | | 09.10.02 | 2.30 | |
| 4584 | grey bright | | 09.10.02 | 4.15 | |
| 4587 | grey bright | | 09.10.02 | 5.20 | |
| 4590 | grey bright | | 09.10.02 | 6.50 | |
| 4593 | grey /black | | 09.10.02 | | |
| 4596 | grey /black | | 09.10.02 | | |
| 4599 | grey /black | | 09.10.02 | 10.50 | |
| 4602 | black | | 09.10.02 | 12.10 | |
| 4605 | grey | | 09.10.02 | | |
| 4608 | grey /black | | 09.10.02 | 1.45 | |
| 4611 | grey | | 09.10.02 | | |
| 4614 | grey | | 09.10.02 | 17.20 | |
| 4617 | grey | | 09.10.02 | 18.50 | |
| 4620 | grey | | 09.10.02 | 20.00 | |
| 4623 | grey | | 09.10.02 | | |
| 4626 | grey | | 09.10.02 | 22.00 | (+ - oil contaminated) |
| 4629 | grey ? | | 09.10.02 | | |
| 4632 | grey | | 09.10.02 | 23.40 | |
| 4635 | grey | | 10.10.02 | | |
| 4638 | grey | | 10.10.02 | 2.55 | |
| 4641 | grey | | 10.10.02 | | |
| 4644 | grey | | 10.10.02 | | |
| 4647 | grey | | 10.10.02 | 7.20 | |
| 4650 | grey | | 10.10.02 | 8.50 | |
| 4653 | grey | | 10.10.02 | | |
| 4656 | grey | | 10.10.02 | | |
| 4659 | grey | | 10.10.02 | | |
| 4662 | grey | | 10.10.02 | | |
| 4669 | grey | | 10.10.02 | 15.30 | |
| 4671 | grey | | 10.10.02 | 16.10 | |
| 4672 | grey | | 12.10.02 | 7.40 | |
| 4675 | grey ? | | 12.10.02 | | New bit |
| 4678 | grey ? | | 12.10.02 | | |
| 4688 | grey ? | | 12.10.02 | 9.30 | |
| 4692 | grey ? | | 12.10.02 | 11.00 | |
| 4695 | grey | | 12.10.02 | 11.40 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 4698 | grey | | 12.10.02 | 12.20 | |
| 4701 | grey | | 12.10.02 | 12.50 | |
| 4704 | grey | | 12.10.02 | 13.55 | |
| 4709 | grey /black | | 12.10.02 | 15.00 | |
| 4712 | grey | | 12.10.02 | 15.30 | |
| 4715 | grey | | 12.10.02 | | |
| 4718 | grey | | 12.10.02 | | |
| 4721 | grey | | 12.10.02 | | |
| 4724 | grey | | 12.10.02 | 19.00 | |
| 4728 | grey | | 12.10.02 | 20.05 | |
| 4731 | grey /black | | 12.10.02 | 20.35 | |
| 4734 | black | | 12.10.02 | 21.30 | |
| 4737 | grey bright | | 12.10.02 | 22.00 | |
| 4740 | grey bright | | 12.10.02 | 22.25 | |
| 4743 | grey /black | | 12.10.02 | 23.00 | |
| 4746 | grey | | 12.10.02 | 23.50 | |
| 4749 | grey | | 13.10.02 | 0.10 | |
| 4751 | grey | | 13.10.02 | 0.40 | |
| 4754 | grey ? | | 13.10.02 | 1.10 | |
| 4757 | grey ? | | 13.10.02 | 1.40 | |
| 4761 | grey ? | | 13.10.02 | 2.05 | |
| 4764 | grey ? | | 13.10.02 | | |
| 4767 | grey ? | | 13.10.02 | 3.10 | |
| 4770 | grey ? | | 13.10.02 | 3.25 | |
| 4773 | grey ? | | 13.10.02 | 4.10 | |
| 4776 | grey /black | | 13.10.02 | 5.04 | |
| 4779 | grey ? | | 13.10.02 | 5.51 | |
| 4782 | grey ? | | 13.10.02 | 6.55 | |
| 4785 | grey ? | | 13.10.02 | 7.42 | |
| 4788 | grey ? | | 13.10.02 | 8.45 | |
| 4791 | grey ? | | 13.10.02 | | |
| 4794 | grey ? | | 13.10.02 | 11.10 | |
| 4798 | grey ? | | 13.10.02 | 12.10 | |
| 4801 | grey ? | | 13.10.02 | 13.30 | |
| 4805 | grey bright | | 13.10.02 | 14.30 | |
| 4808 | grey bright | | 14.10.02 | 19.30 | |
| 4818 | grey dark | | 14.10.02 | 22.46 | |
| 4821 | grey dark | | 14.10.02 | 23.55 | (+ - oil contaminated) |
| 4824 | grey dark | | 15.10.02 | 0.40 | |
| 4827 | grey dark | | 15.10.02 | 1.15 | |
| 4830 | grey | | 15.10.02 | 2.30 | |
| 4833 | grey | | 15.10.02 | 3.15 | |
| 4836 | grey | | 15.10.02 | 4.00 | |
| 4839 | grey bright | | 15.10.02 | 5.15 | |
| 4843 | grey bright | | 15.10.02 | 6.05 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 4846 | grey bright | | 15.10.02 | 6.40 | |
| 4851 | grey bright | | 15.10.02 | 8.10 | |
| 4854 | grey bright | | 15.10.02 | 8.50 | |
| 4858 | grey bright | | 15.10.02 | 9.50 | |
| 4861 | grey bright | | 15.10.02 | 10.20 | |
| 4864 | grey | | 15.10.02 | 10.50 | |
| 4869 | grey | | 15.10.02 | 12.20 | |
| 4872 | grey | | 15.10.02 | 13.10 | |
| 4875 | grey | | 15.10.02 | 14.00 | |
| 4878 | grey | | 15.10.02 | 14.50 | |
| 4881 | grey | | 15.10.02 | 15.40 | |
| 4884 | grey | | 15.10.02 | 16.30 | |
| 4887 | grey | | 15.10.02 | 17.06 | |
| 4891 | grey | | 15.10.02 | 17.20 | |
| 4894 | grey | | 15.10.02 | 18.30 | |
| 4897 | grey | | 15.10.02 | 19.00 | |
| 4900 | grey | | 15.10.02 | 19.35 | |
| 4903 | grey | | 15.10.02 | 20.10 | |
| 4906 | grey | | 15.10.02 | | |
| 4909 | grey dark | | 15.10.02 | 21.22 | |
| 4912 | grey dark | | 15.10.02 | | |
| 4915 | grey dark | | 15.10.02 | 22.55 | |
| 4918 | grey dark | | 15.10.02 | | |
| 4921 | grey dark | | 15.10.02 | 23.55 | |
| 4924 | grey dark | | 16.10.02 | | |
| 4927 | grey dark | | 16.10.02 | 1.06 | |
| 4930 | grey dark | | 16.10.02 | | |
| 4933 | grey dark | | 16.10.02 | 2.25 | |
| 4936 | grey dark | | 16.10.02 | | |
| 4939 | grey dark | | 16.10.02 | 3.40 | |
| 4942 | grey dark | | 16.10.02 | | |
| 4946 | grey dark | | 16.10.02 | 3.40 | |
| 4950 | grey dark | | 16.10.02 | | |
| 4953 | grey dark | | 16.10.02 | 6.22 | |
| 4956 | grey dark | | 16.10.02 | | |
| 4958 | grey dark | | 16.10.02 | 7.25 | |
| 4961 | grey dark | | 16.10.02 | | |
| 4965 | grey dark | | 16.10.02 | 8.50 | |
| 4967 | grey dark | | 16.10.02 | | |
| 4973 | grey dark | | 16.10.02 | 10.33 | |
| 4975 | grey dark | | 16.10.02 | | |
| 4980 | grey dark | | 16.10.02 | 11.42 | |
| 4997 | grey | fine | 18.10.02 | 5.13 | |
| 5000 | | fine | 18.10.02 | 6.00 | |
| 5003 | | fine | 18.10.02 | 6.35 | |

**Cutting Samples GPK 3 - Granite Section**

grey line = cleaned sample

| Drill Depth | Colored on site | Grain-size | Date | Time | Comments |
|---|---|---|---|---|---|
| 5006 | | fine | 18.10.02 | 7.45 | |
| 5012 | | fine | 18.10.02 | 9.00 | |
| 5015 | | fine | 18.10.02 | 15.30 | |
| 5018 | | fine | 18.10.02 | 16.10 | |
| 5021 | | fine | 18.10.02 | 16.45 | |
| 5024 | | fine | 18.10.02 | 17.35 | |
| 5027 | | fine | 18.10.02 | 18.15 | |
| 5030 | very dark | fine | 18.10.02 | 19.20 | |
| 5033 | very dark | fine | 18.10.02 | 20.00 | |
| 5036 | very dark | fine | 18.10.02 | 20.45 | |
| 5039 | | | 18.10.02 | | |
| 5043 | | | 18.10.02 | 22.56 | |
| 5046 | | | 18.10.02 | 23.47 | |
| 5050 | | very fine | 19.10.02 | 2.10 | |
| 5056 | | very fine | 19.10.02 | 4.50 | |
| 5059 | | | 19.10.02 | 5.15 | |
| 5062 | | fine | 19.10.02 | 5.50 | |
| 5065 | | fine | 19.10.02 | 6.30 | |
| 5068 | | fine | 19.10.02 | 7.00 | |
| 5071 | | fine | 19.10.02 | 7.50 | |
| 5074 | | fine | 19.10.02 | | |
| 5077 | | fine | 19.10.02 | 8.30 | |
| 5080 | | fine | 19.10.02 | | |
| 5083 | | fine | 19.10.02 | 9.12 | |
| 5086 | | fine | 19.10.02 | 11.10 | |
| 5089 | | fine | 19.10.02 | 12.40 | |
| 5092 | black | fine | 19.10.02 | 14.00 | |
| 5093 | grey | coarse | 19.10.02 | | |

## ANNEX 3

# Report from BRGM lab: Mineralogical study of two samples from Soultz

# *Étude minéralogique comparative de 2 échantillons en provenance de Soultz*

**Pierre JEZEQUEL**
**Véronique PEDROLETTI**

**Novembre 2002**
**ANA/CMI/NT/02/071**

Orléans, le 18 novembre 2002

**Demandeur :** Albert GENTER
CDG/MA

BRGM
L'ENTREPRISE AU SERVICE DE LA TERRE

**SERVICE ANALYSE et CARACTERISATION MINERALE**
**Unité : *Caractérisation minérale***
**N° note : ANA/CMI/NT/02/071/PJ/vp**
Date de réception des échantillons : 8/11/2002
Date des résultats : /2002
Nombre d'échantillons étudiés : 2
Vos références : v/commande du 8/11/2002 – A.Genter

Etude minéralogique comparative de 2 échantillons en provenance de Soultz

Auteurs : P.Jézéquel – V.Pédroletti

6 pages 2 tableaux 0 spectre – 0 image 1 figure
Documents associés :

Résumé : Comparaison entre un granite sain et un granite altéré en provenance d'un sondage profond effectué à Soultz.

***Mots clés :*** Caractérisation – Diagnose – Minéraux en grains – Expertise minéralogique

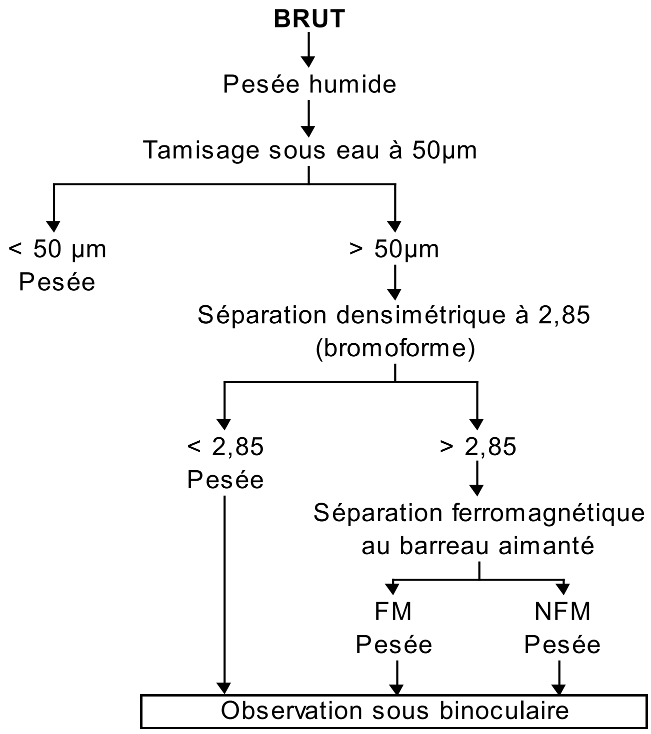
| | | | | |
|---|---|---|---|---|
| ***Intérêt documentaire*** | oui | ☐ | Diffusion : | |
| | non | ☐ | Libre | ☐ |
| | | | BRGM | ☐ |
| | | | Restreinte | ☐ |
| | | | Confidentielle | ☐ |

***VISAS :*** Auteurs : P.Jézéquel V.Pédroletti

## I - LISTE DES ÉCHANTILLONS – OBJECTIF DE L'ÉTUDE

Il s'agit de comparer deux échantillons de granite, l'un sain et l'autre altéré, en provenance d'un sondage profond (> 4000m) à Soultz :
4096 : échantillon altéré
4587 : échantillon granite sain

## II - PROTOCOLE DE TRAITEMENT




## III - TABLEAU DES POIDS

| n° échantillon | | pds total humide | pds total sec | < 50µm | < 2,85 | > 2,85 | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | total | FM | NFM |
| **4096** | **g** | 284,84 | 204,1 | 1,81 | 195,35 | 6,94 | 0,74 | 6,2 |
| | **%** | | 100,00 | 0,89 | 95,71 | 3,40 | | |
| | **%** | | | | | 100,00 | 10,66 | 89,34 |
| **4587** | **g** | 284,85 | 255,75 | 9,18 | 227,96 | 18,61 | 1,09 | 17,52 |
| | **%** | | 100,00 | 3,59 | 89,13 | 7,28 | | |
| | **%** | | | | | 100,00 | 5,86 | 94,14 |

**% humidité**
**4096** : 39,56
**4587** : 11,38

## IV - OBSERVATIONS SOUS BINOCULAIRE

### *4.1. Échantillon 4096*

<u>fraction < 2,85</u>
chlorite : P*
biotite : P
muscovite : R
hydroxyde de fer : R
feldspath laiteux : A
quartz : M

<u>fraction > 2,85 FM</u>
limaille de fer : A
chlorite : P
magnétite : R
hydroxyde de fer : P
feldspath mixtes (+/- magnétite) : R
biotite : T

<u>fraction > 2,85 NFM</u>
chlorite : A
quartz : T
feldspath : F
biotite : P
hydroxyde de fer : T
pyrite : T
muscovite : T
apatite : T

<u>Remarque :</u> les micas biotite et chlorite sont partiellement recouverts d'une pellicule beige (sel possible) qui modifie la couleur de l'échantillon.

* par ordre décroissant : TA = Très Abondant, A = Abondant, M = Moyen, P = Présent, F = Faible, R = Rare, T = Traces

### *4.2. Échantillon 4587*

<u>fraction < 2,85</u>
biotite : R
chlorite : T
hydroxyde de fer : T
quartz : M à A
feldspath : A

<u>fraction > 2,85 FM</u>
hydroxyde de fer : R*
biotite : P
chlorite : R
magnétite : A
quartz : R
sel : P
limaille de fer : T

<u>fraction > 2,85 NFM</u>
quartz : T
feldspath : T
chlorite : P à M
biotite : A
apatite : T
grenat : Infra T
pyrite : Infra T

* par ordre décroissant : TA = Très Abondant, A = Abondant, M = Moyen, P = Présent, F = Faible, R = Rare, T = Traces

### *4.3. Tableau récapitulatif*

| **Espèces minérales présentes** | **4096 granite altéré** | **4587 granite sain** |
|---|---|---|
| Fraction < 2,85 | | |
| - chlorite | P* | T |
| - biotite | P | R |
| - muscovite | R | |
| - hydroxyde de fer | R | T |
| - feldspath laiteux | A | A |
| - quartz | M | M à A |
| Fraction > 2,85 FM | | |
| - limaille de fer | A | T |
| - chlorite | P | R |
| - magnétite | R | A |
| - hydroxyde de fer | P | R |
| - feldspath mixtes (+/- magnétite) | R | |
| - biotite | T | P |
| - quartz | | R |
| - sel | | P |
| Fraction > 2,85 NFM | | |
| - chlorite | A | P à M |
| - quartz | T | T |
| - feldspath | F | T |
| - biotite | P | A |
| - hydroxyde de fer | T | |
| - pyrite | T | T |
| - muscovite | T | |
| - apatite | T | T |
| - grenat | | T |

## V - CONCLUSION

Les différences constatées sur la fraction fine sont difficilement interprétables du fait de la différence de profondeur des échantillons et du degré de rinçage de ceux-ci. Il semblerait que le 4587 soit beaucoup plus riche en sel que le 4096, ceci est apparemment contradictoire avec les observations faites sur la fraction > 50µm de chaque échantillon. Les micas abondants (chlorite + biotite) de l'échantillon 4096 sont recouverts d'une pellicule terne blanchâtre (de sel probable).
La fraction ferromagnétique de l'échantillon 4587 présente de la magnétite en quantité relativement importante. Cette magnétite est par contre rare dans l'échantillon 4096, où l'on observe surtout de la limaille de fer.
Dans la fraction non ferromagnétique des lourds, le rapport chlorite/biotite est inversé d'un échantillon à l'autre, la chlorite est abondante dans le 4096 et la biotite présente, alors que la chlorite est présente dans le 4587 et la biotite abondante.
Les différences de rapport entre chlorite et biotite ainsi que la proportion de magnétite sont les éléments les plus caractéristiques de la différence entre l'échantillon altéré

* par ordre décroissant : TA = Très Abondant, A = Abondant, M = Moyen, P = Présent, F = Faible, R = Rare, T = Traces

4096 et l'échantillon sain 4587. Il ne semble pas y avoir de fraction argileuse dans ces deux échantillons.

## ANNEX 4

# Detailed petrographic log of the GPK3 borehole from chip sample examination from 3800 to 5092m

Depth: 3800 - 5092 m
Scale: 1/1500

# GPK3 BOREHOLE: GEOLOGICAL MONITORING

**DEPTH: 3800 to 5093 m**

## EXPLANATION OF HEADINGS

**Depth:** Raw depth of the cutting samples from ENEL, not yet corrected from lag time.
**Rop:** Rate of penetration (meter/hour) provided by ENEL.

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**Facies variation:** Petrographic variations deduced from cuttings (variation of biotite and K-feldspar content).
**Standard granite:** Porphyritic granite with K-feldspar megacrysts, consistence with previous data acquired on GPK-1 and EPS-1 core sections.
**Fracture zones:** Fractured and altered granite facies deduced from cuttings.

---

**Biotite:** Estimated percentage of biotite from microscopic examination.
**Chorite:** Degree of chloritization of biotite, indicator of pervasive alteration. (0: very weak; 1: weak; 2: moderate; 3: strong).
**Epidote**: Occurrence of epidote (0: absent; 1: present)
**Illite:** Degree of illitisation of biotite and plagioclase, indicator of vein alteration (same scale).

---

**Pervasive alteration:** Degree of pervasive alteration within the granite massif, such as chloritization of biotite. (0: very weak; 2: weak; 4: moderate; 6: strong).
**Vein alteration:** Degree of vein alteration, related to fracture zones and expressed as illitisation in cuttings samples. (0: very weak; 2: weak; 4: moderate; 6: strong).

# HFR BOREHOLE GPK3

*Patterns of the petrographic log*

## Standard Granite

GRAN STANDARD GRANITE

## Facies Variation

MELA BIOTITE-RICH PORPHYRITIC GRANITE

XENO XENOLITH-RICH GRANITE

GR2M FINE GRAINED TWO-MICA GRANITE

## Hydrothermally Altered and Fractured Zone

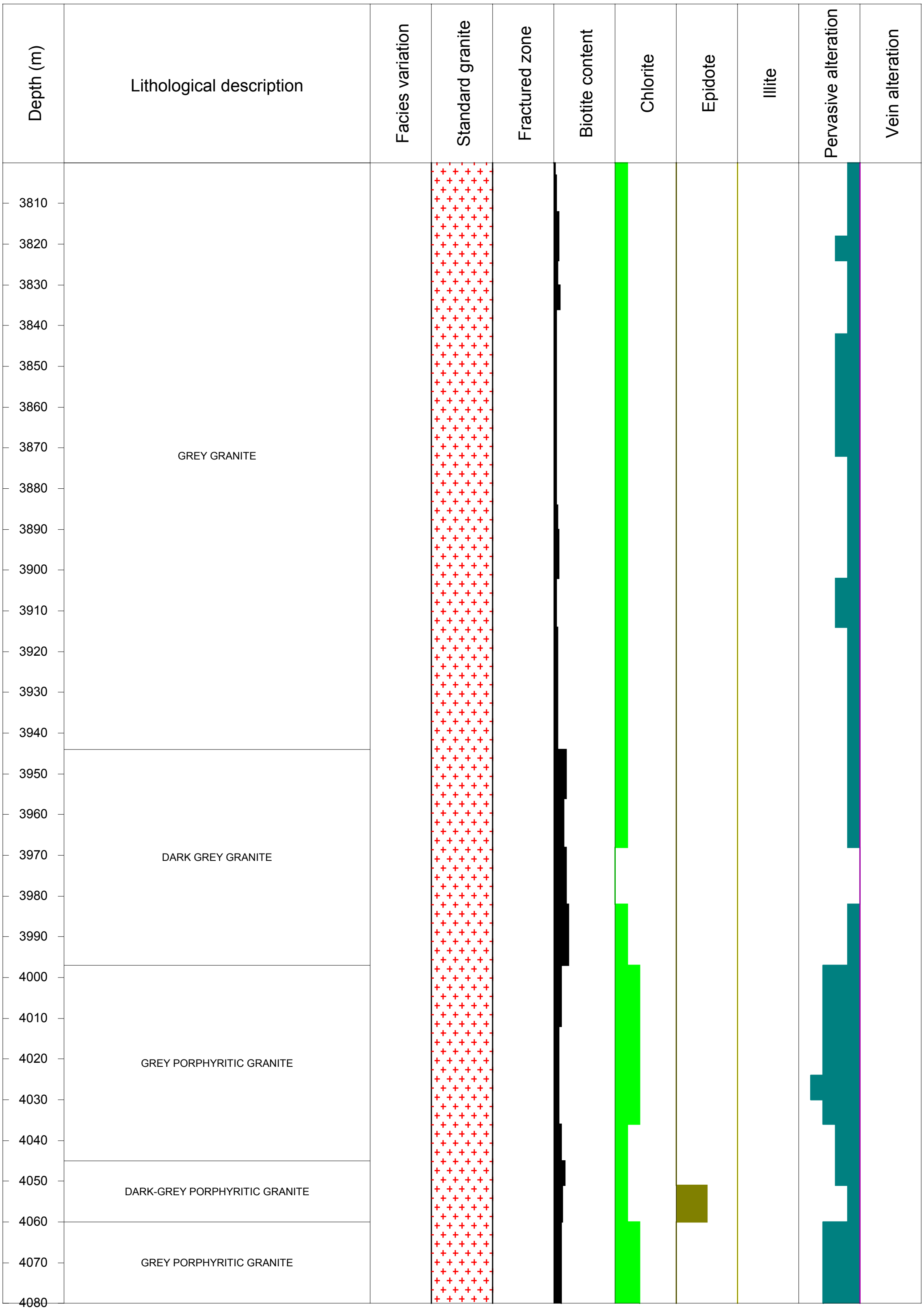
HLOW LOW ALTERED GRANITE

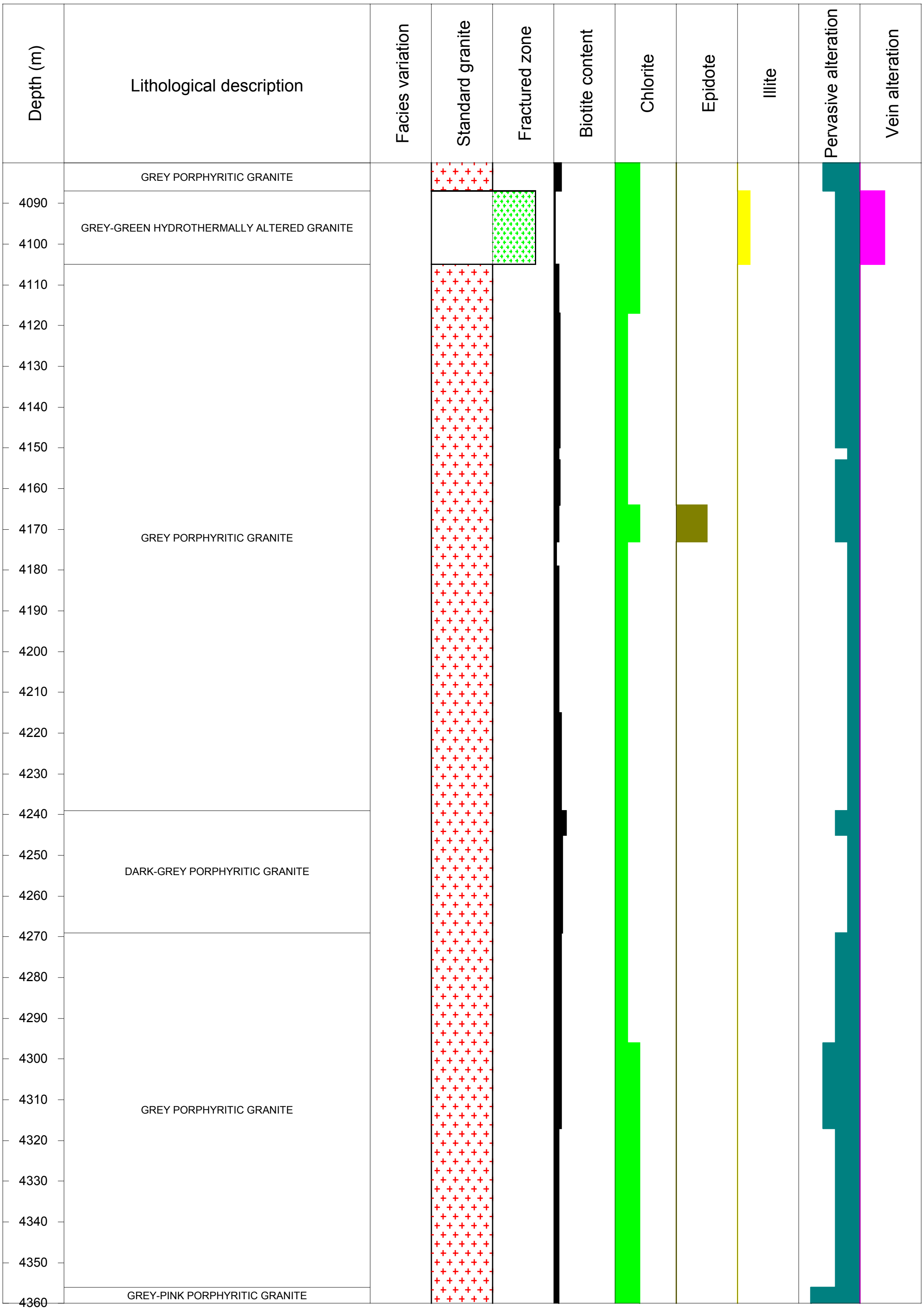
HMOD MODERATELY ALTERED GRANITE

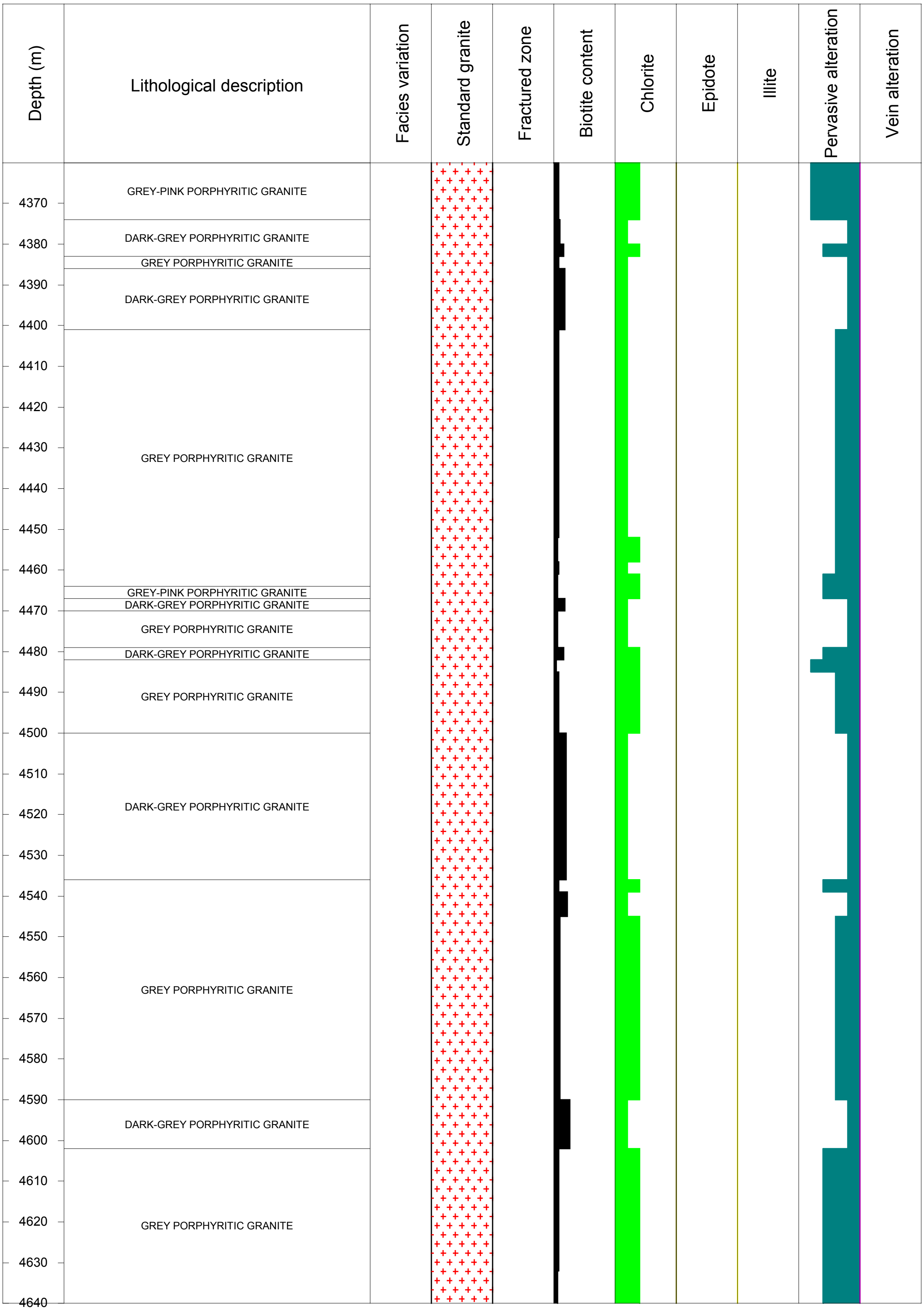
HHIG HIGHLY ALTERED GRANITE

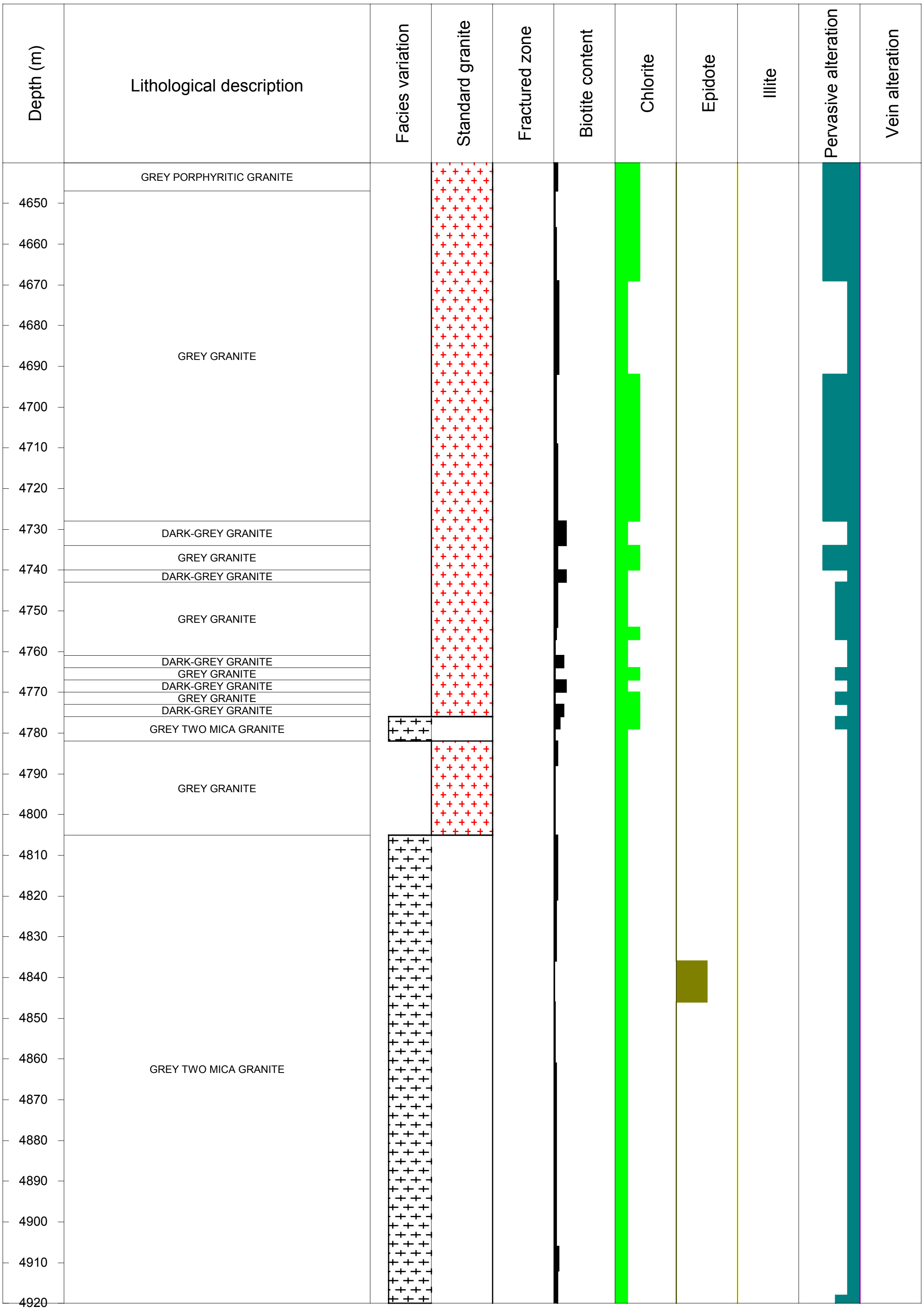
HEXT VERY HIGHLY ALTERED GRANITE

*Alteration gradient*


Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Pervasive alteration
Vein alteration
3810
3820
3830
3840
3850
3860
3870
3880
3890
3900
3910
3920
3930
3940
3950
3960
3970
3980
3990
4000
4010
4020
4030
4040
4050
4060
4070
4080
GREY GRANITE
DARK GREY GRANITE
GREY PORPHYRITIC GRANITE
DARK-GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC GRANITE


Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Pervasive alteration
Vein alteration
GREY PORPHYRITIC GRANITE
GREY-GREEN HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
DARK-GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC GRANITE
GREY-PINK PORPHYRITIC GRANITE
4090
4100
4110
4120
4130
4140
4150
4160
4170
4180
4190
4200
4210
4220
4230
4240
4250
4260
4270
4280
4290
4300
4310
4320
4330
4340
4350
4360


Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Pervasive alteration
Vein alteration
GREY-PINK PORPHYRITIC GRANITE
DARK-GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC GRANITE
DARK-GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC GRANITE
GREY-PINK PORPHYRITIC GRANITE
DARK-GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC GRANITE
DARK-GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC GRANITE
DARK-GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC GRANITE
DARK-GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC GRANITE
4370
4380
4390
4400
4410
4420
4430
4440
4450
4460
4470
4480
4490
4500
4510
4520
4530
4540
4550
4560
4570
4580
4590
4600
4610
4620
4630
4640


Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Pervasive alteration
Vein alteration
GREY PORPHYRITIC GRANITE
GREY GRANITE
DARK-GREY GRANITE
GREY GRANITE
DARK-GREY GRANITE
GREY GRANITE
DARK-GREY GRANITE
GREY GRANITE
DARK-GREY GRANITE
GREY GRANITE
DARK-GREY GRANITE
GREY TWO MICA GRANITE
GREY GRANITE
GREY TWO MICA GRANITE
4650
4660
4670
4680
4690
4700
4710
4720
4730
4740
4750
4760
4770
4780
4790
4800
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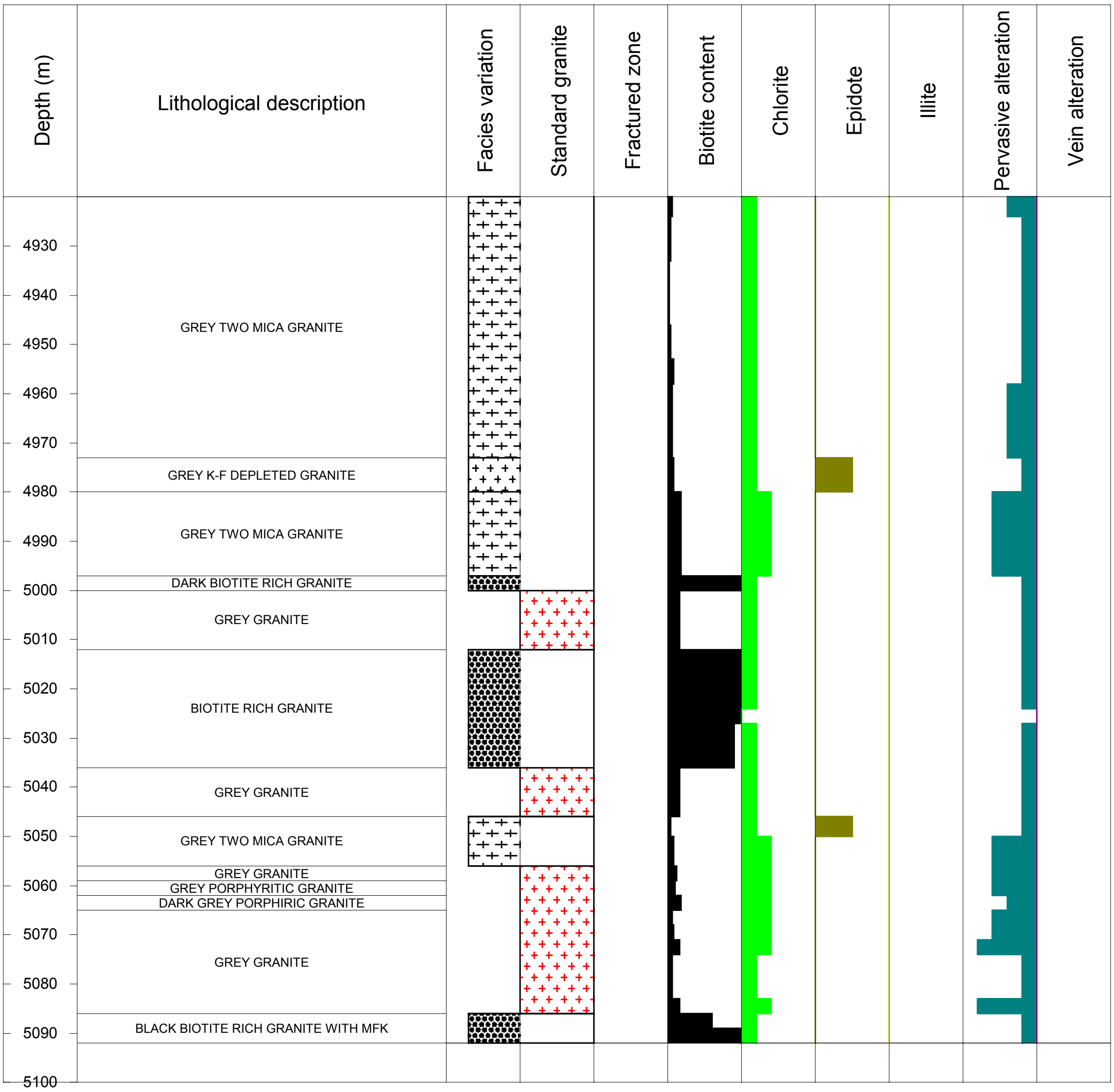
4890
4900
4910
4920

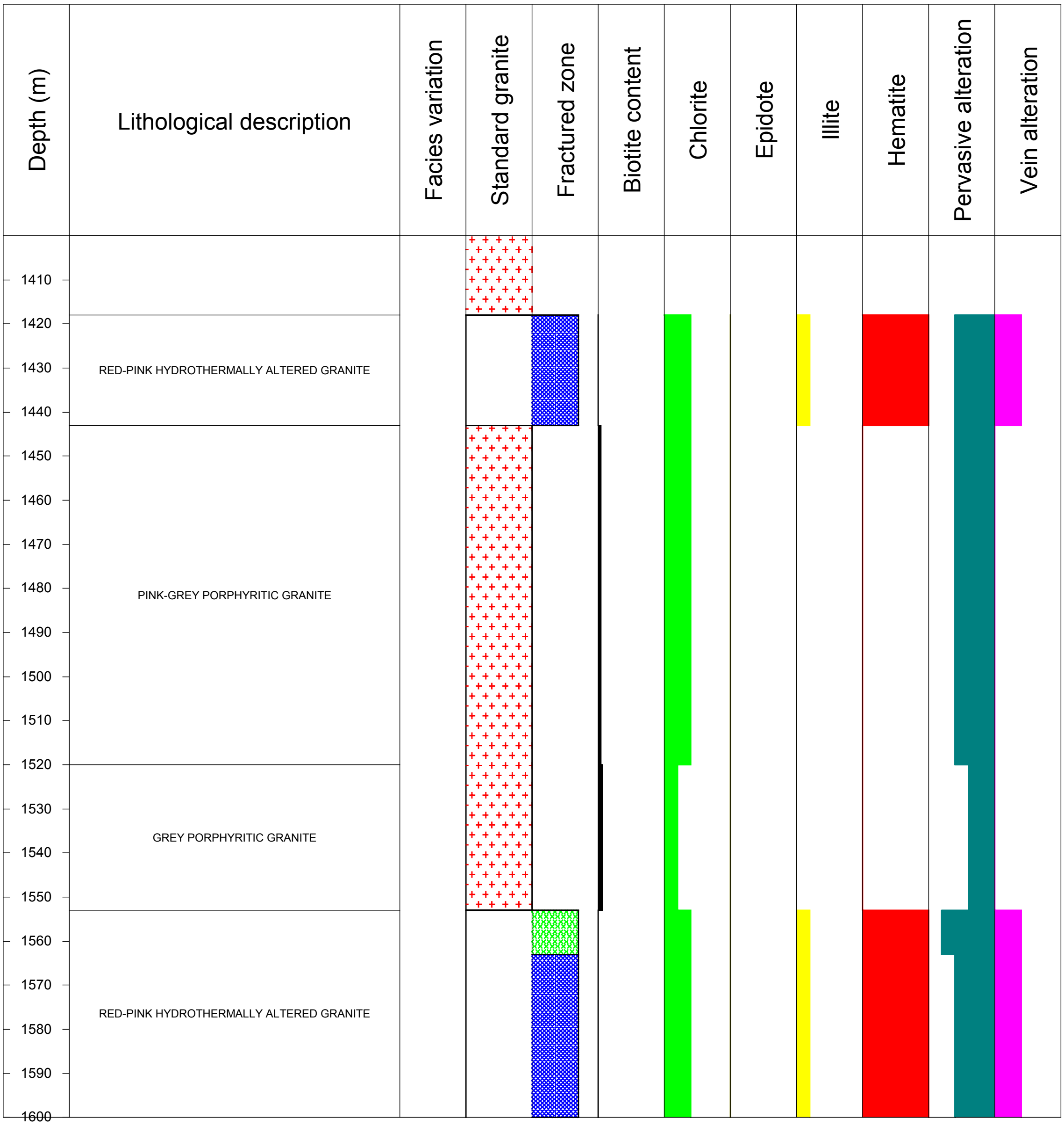

Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Pervasive alteration
Vein alteration
4930
4940
4950
4960
4970
4980
4990
5000
5010
5020
5030
5040
5050
5060
5070
5080
5090
5100
GREY TWO MICA GRANITE
GREY K-F DEPLETED GRANITE
GREY TWO MICA GRANITE
DARK BIOTITE RICH GRANITE
GREY GRANITE
BIOTITE RICH GRANITE
GREY GRANITE
GREY TWO MICA GRANITE
GREY GRANITE
GREY PORPHYRITIC GRANITE
DARK GREY PORPHIRIC GRANITE
GREY GRANITE
BLACK BIOTITE RICH GRANITE WITH MFK

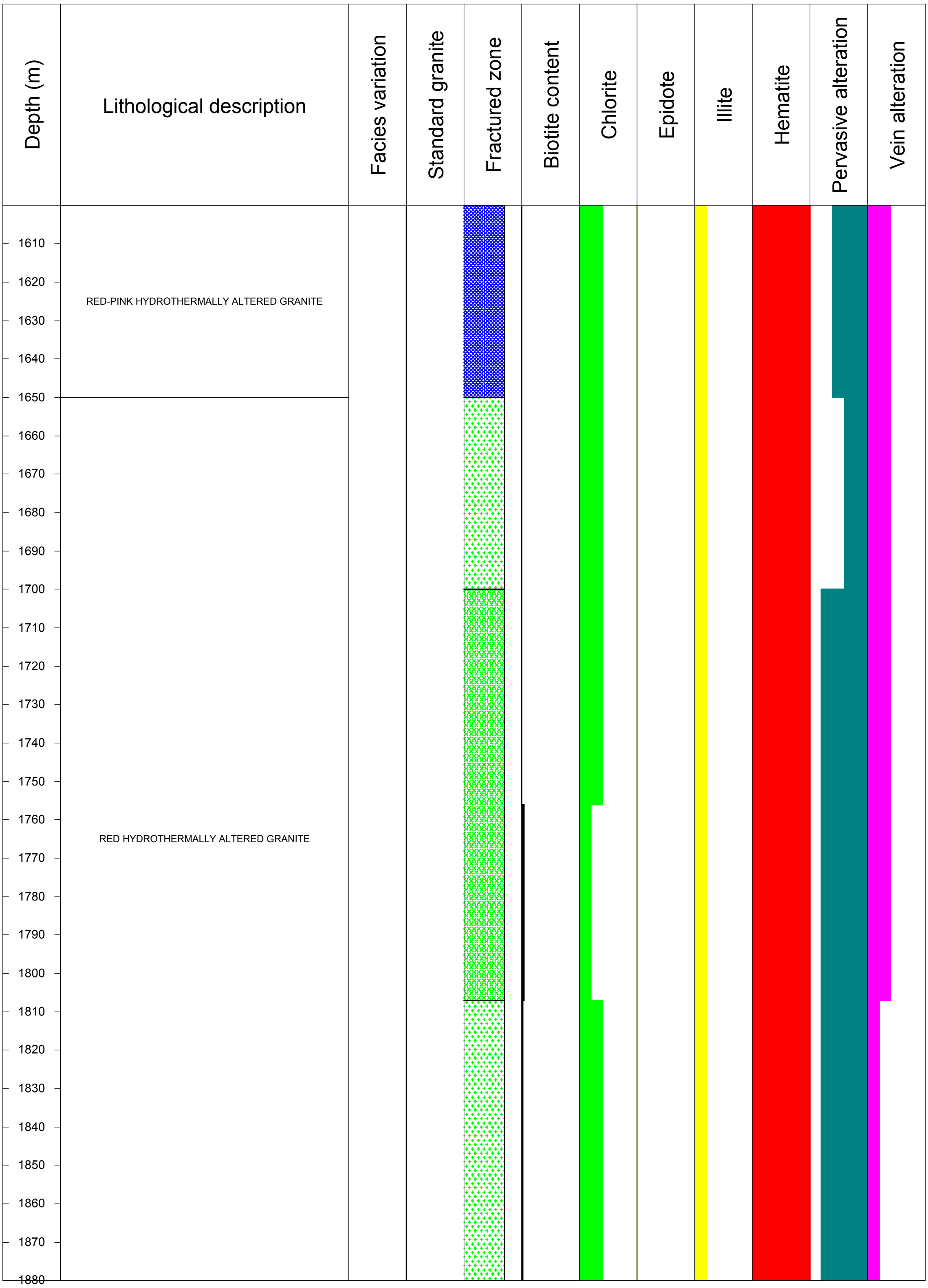
## ANNEX 5

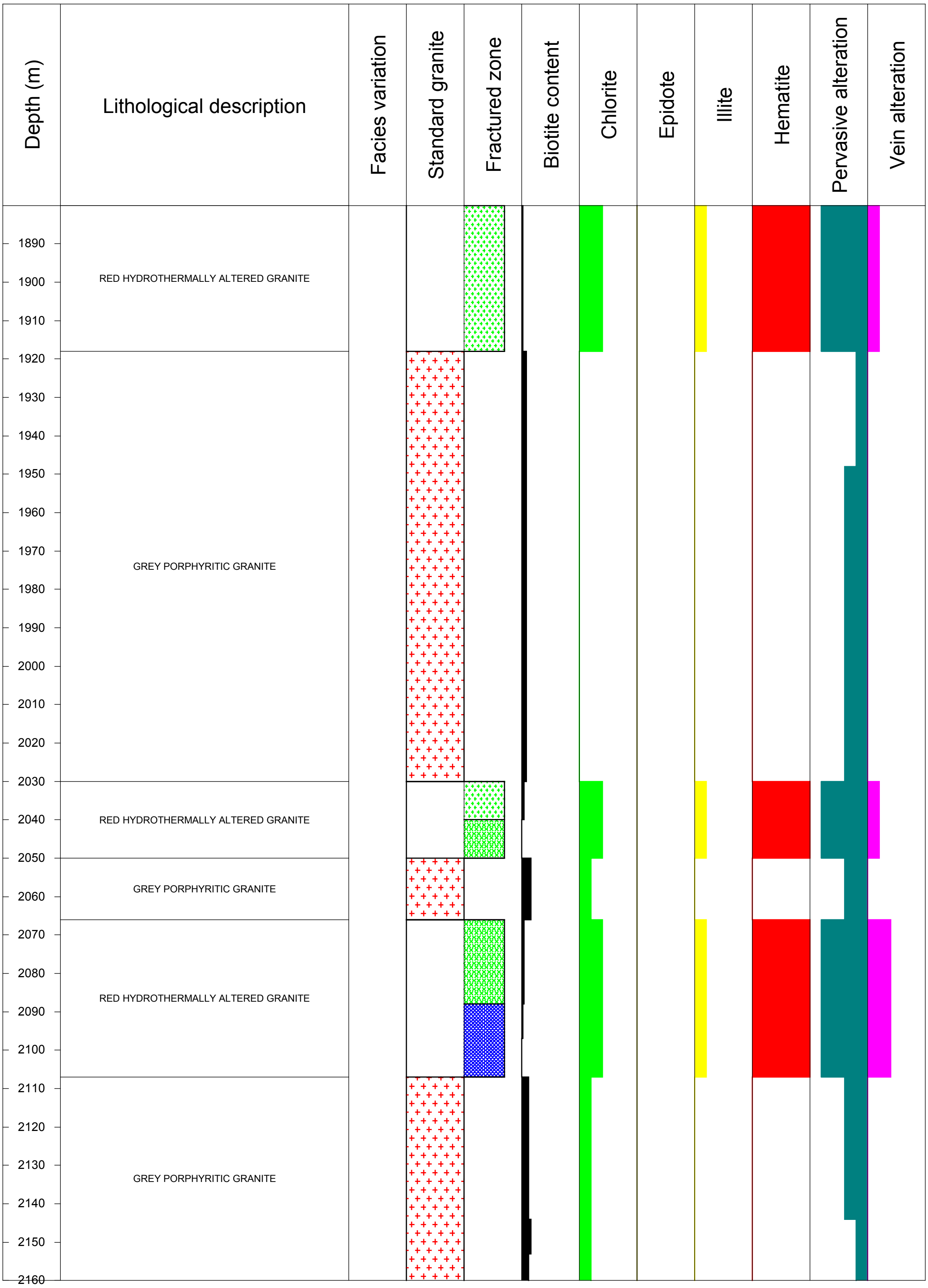
# Detailed petrographic log of the GPK3 borehole from chip sample examination from 1420 to 3800m provided by SWBU

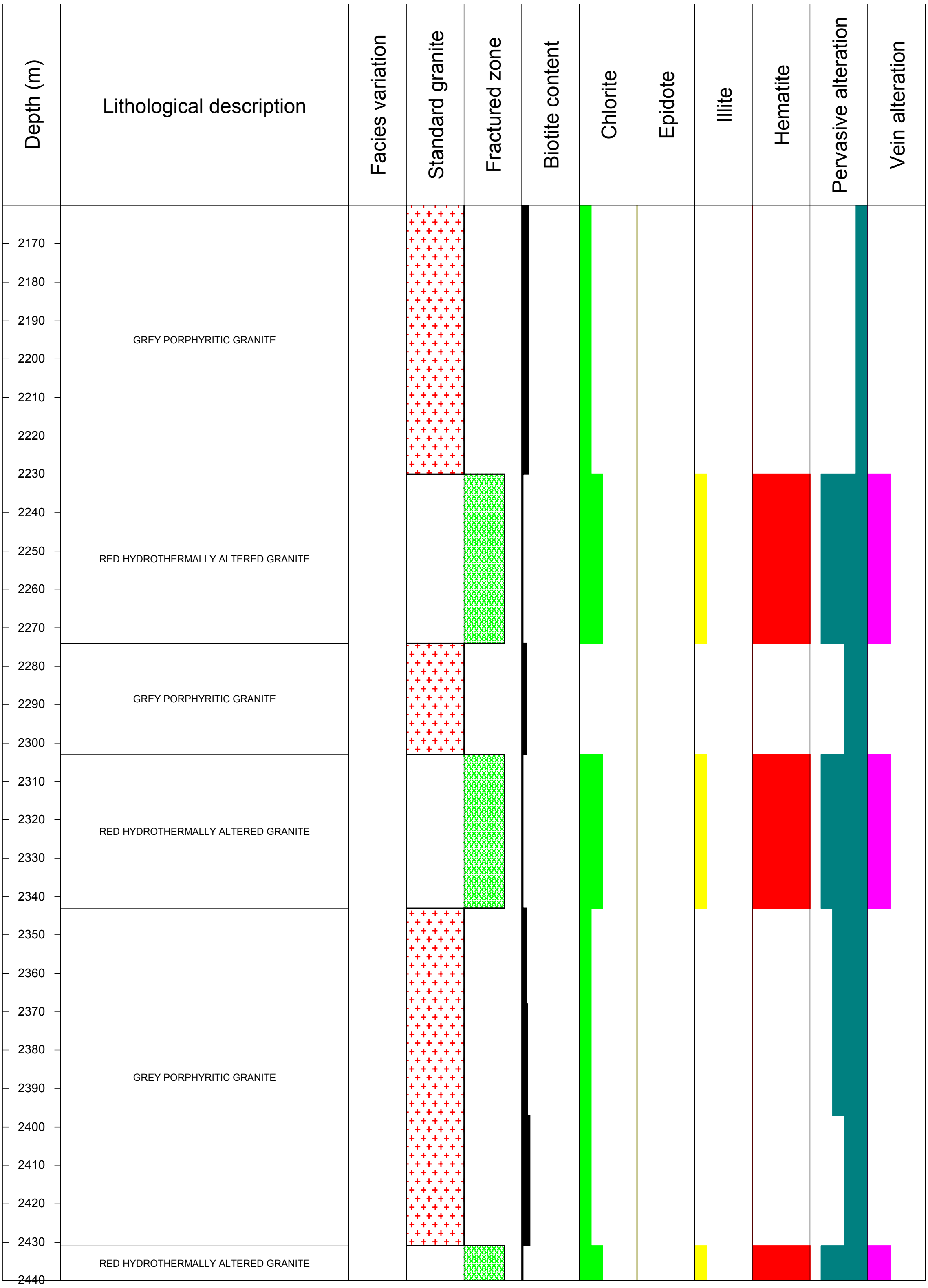
Depth: 1420 - 3800 m
Scale: 1/1500
Description author: SWBU

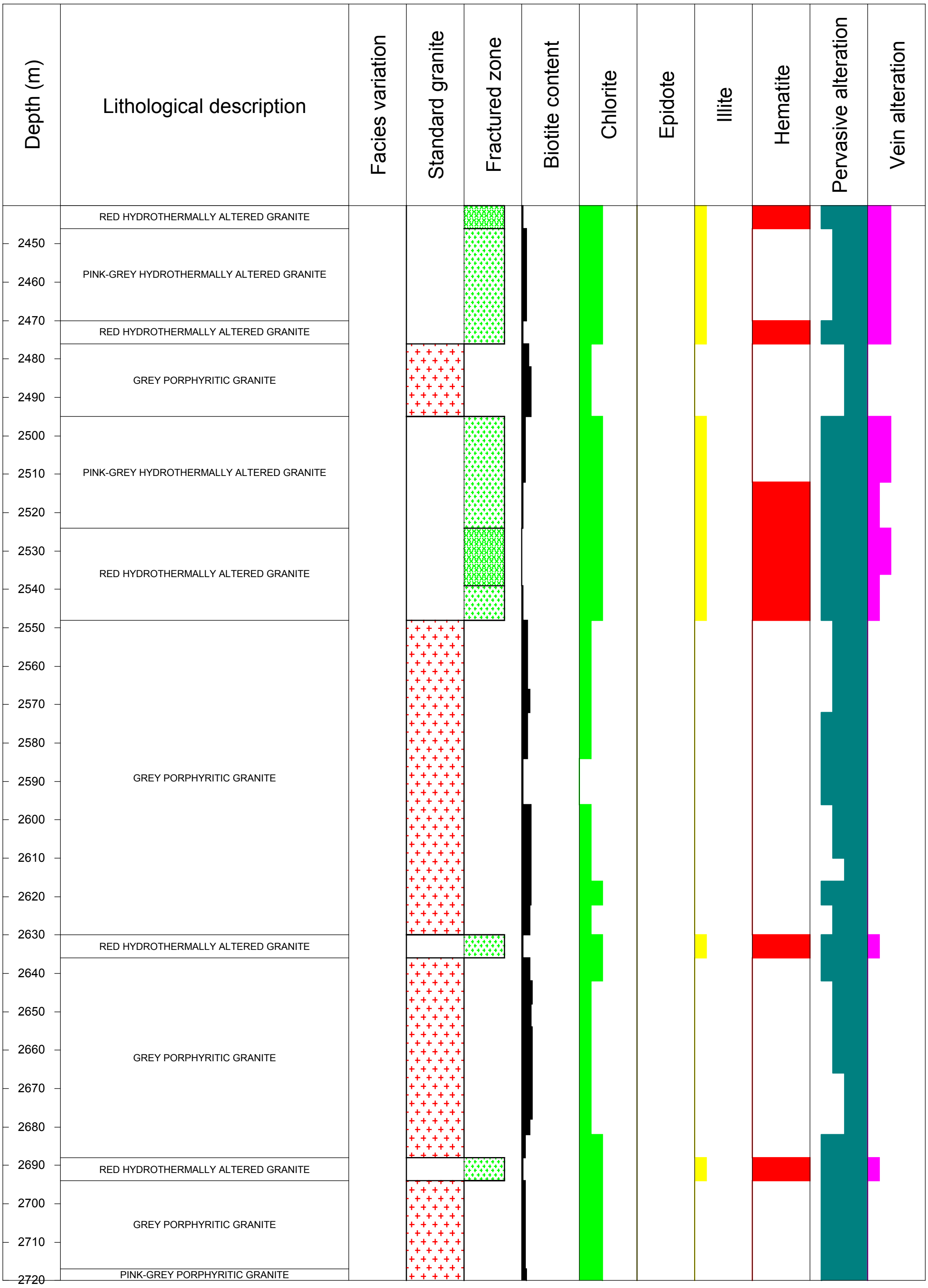
The legend is similar to the Annex 4.

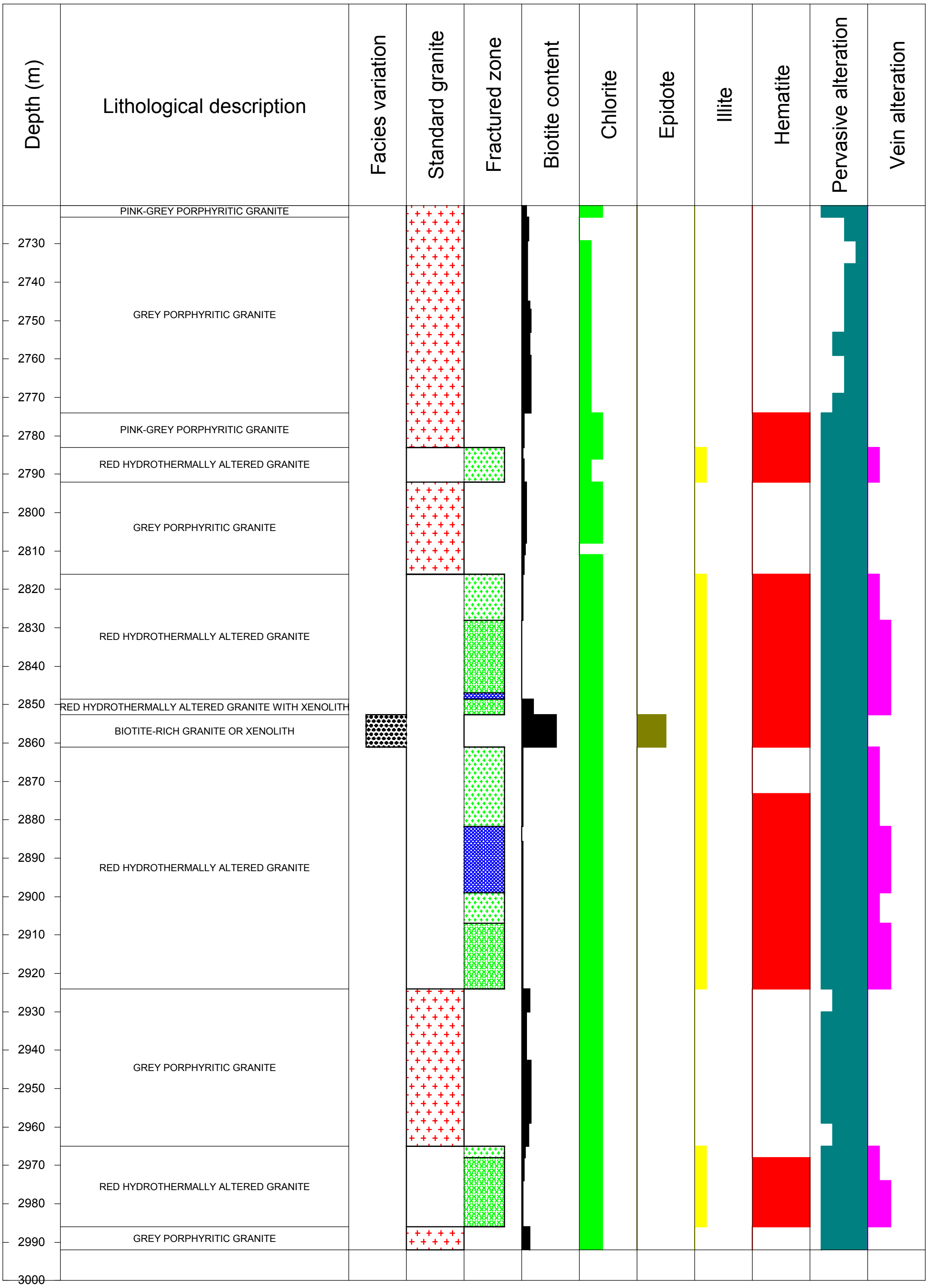


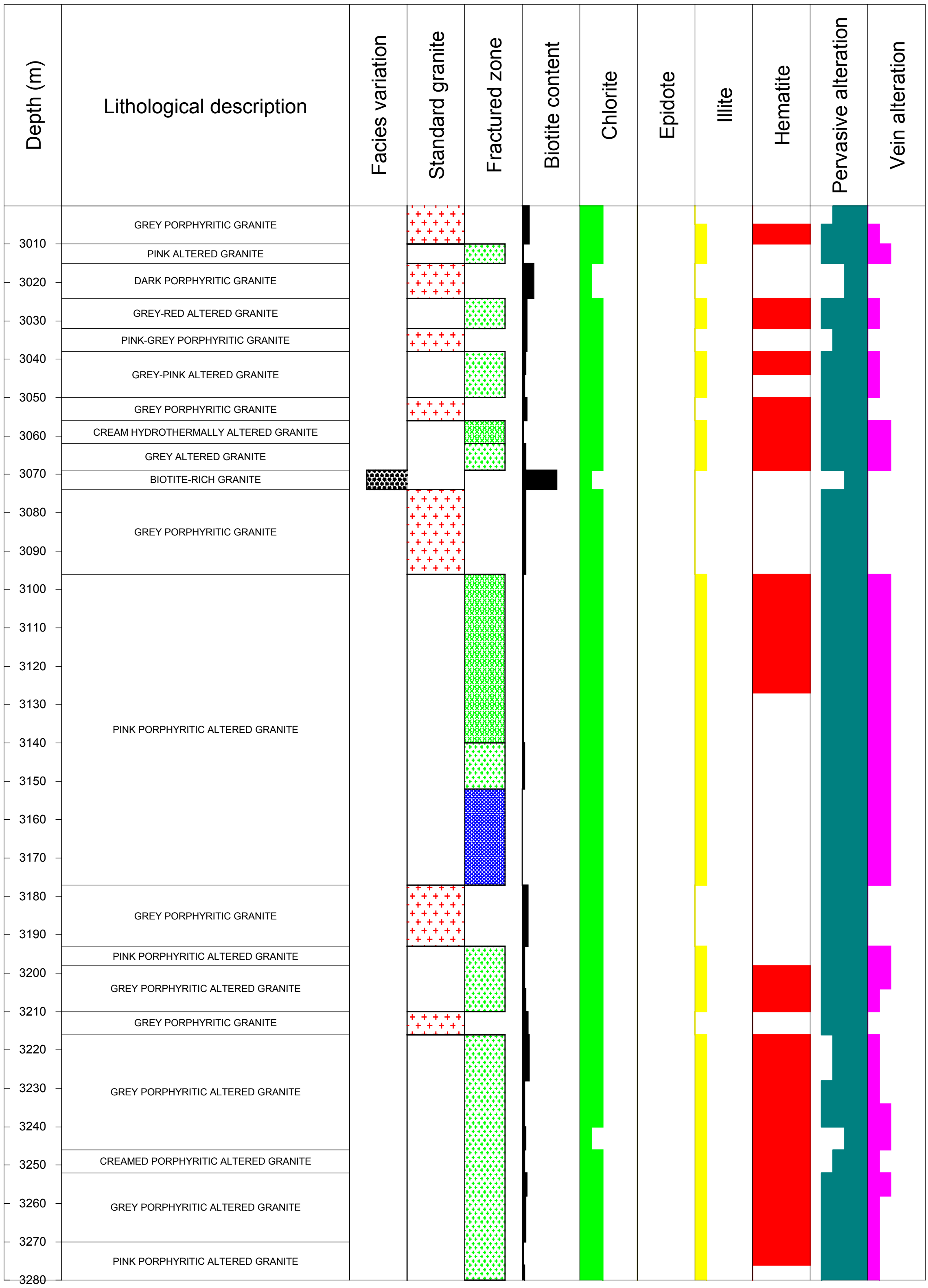

Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Hematite
Pervasive alteration
Vein alteration
1610
1620
1630
1640
1650
1660
1670
1680
1690
1700
1710
1720
1730
1740
1750
1760
1770
1780
1790
1800
1810
1820
1830
1840
1850
1860
1870
1880
RED-PINK HYDROTHERMALLY ALTERED GRANITE
RED HYDROTHERMALLY ALTERED GRANITE

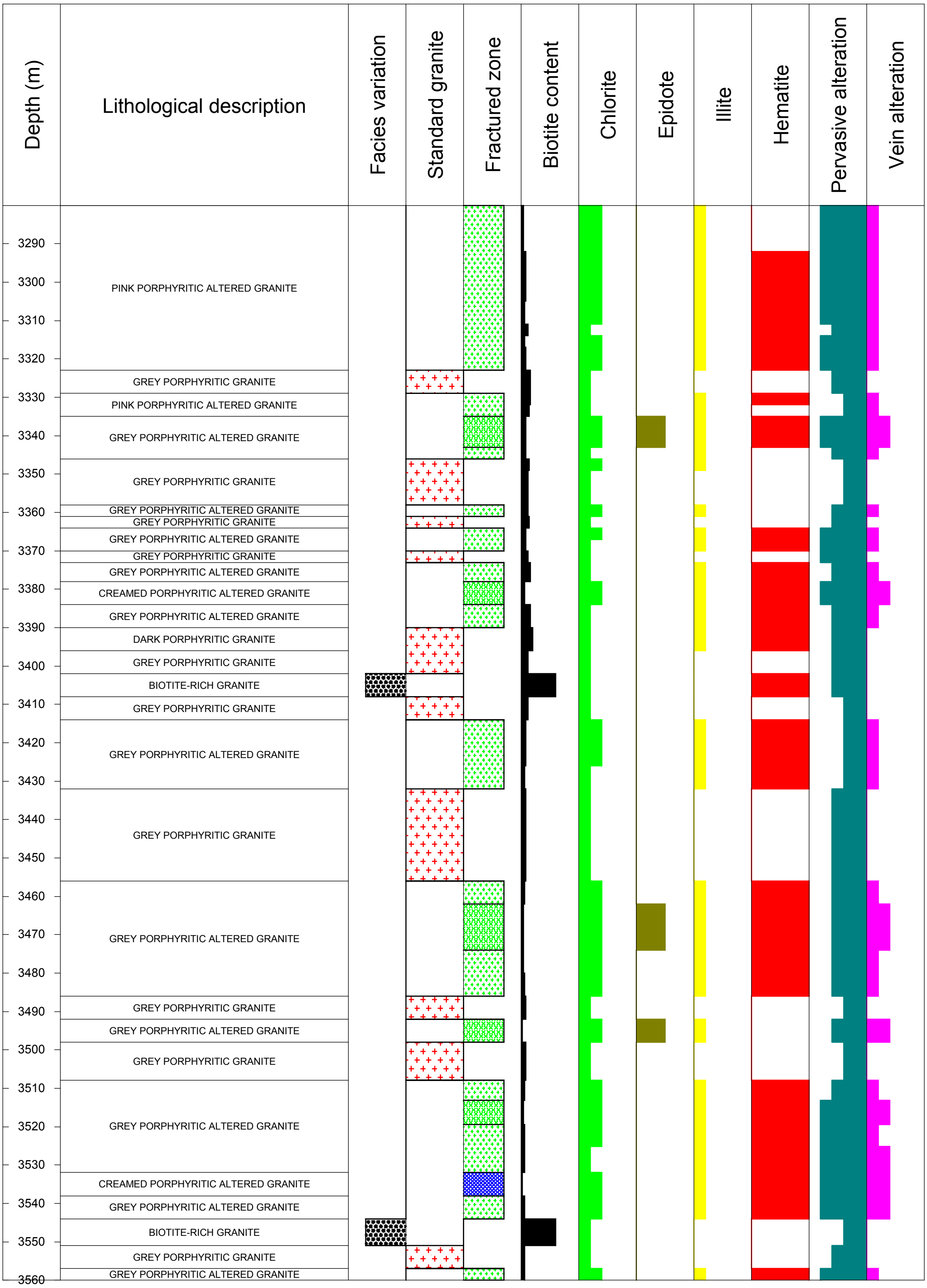

Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Hematite
Pervasive alteration
Vein alteration
RED HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
RED HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
RED HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
2110
2120
2130
2140
2150
2160

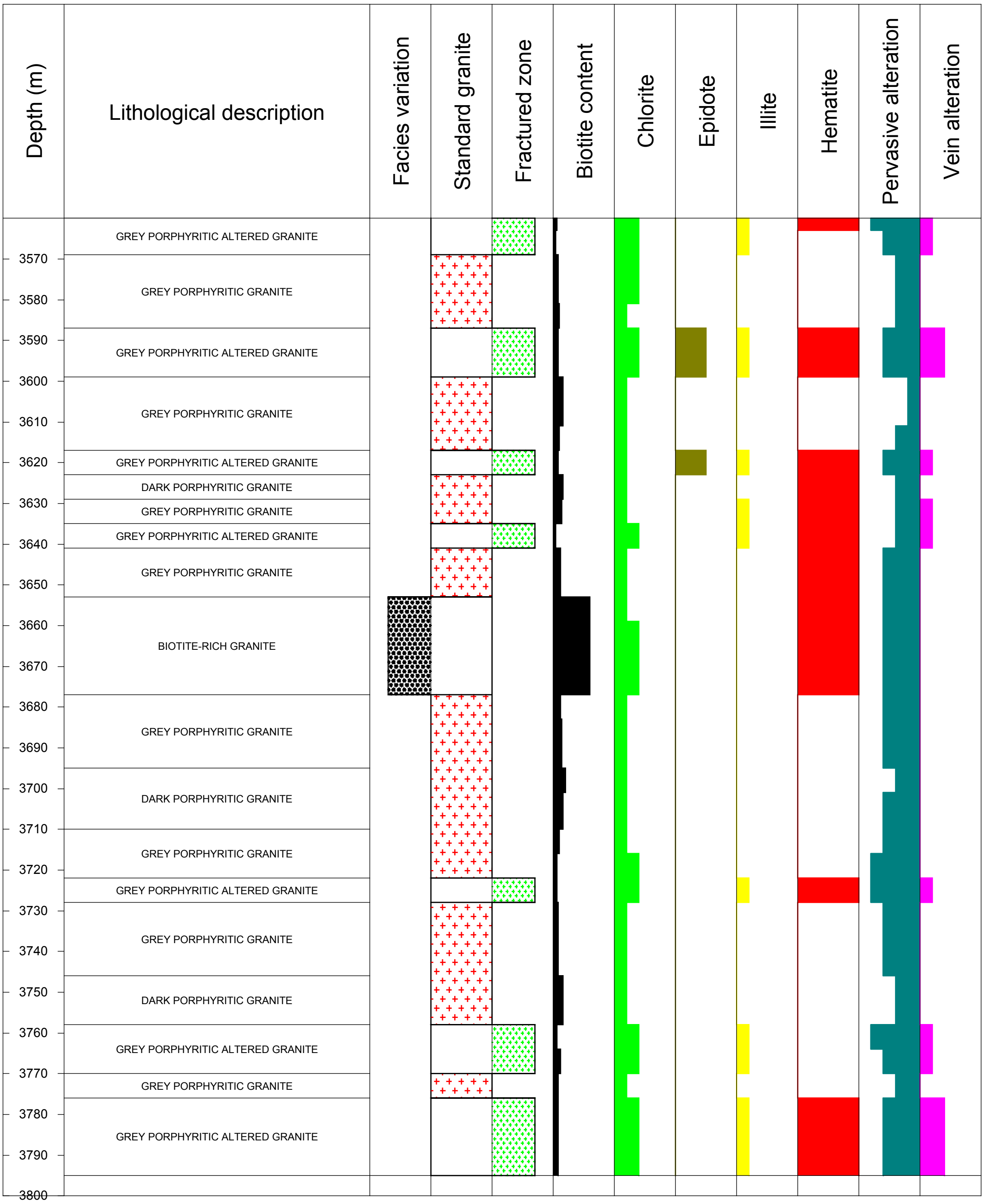

Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Hematite
Pervasive alteration
Vein alteration
2170
2180
2190
2200
2210
2220
2230
2240
2250
2260
2270
2280
2290
2300
2310
2320
2330
2340
2350
2360
2370
2380
2390
2400
2410
2420
2430
2440
GREY PORPHYRITIC GRANITE
RED HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
RED HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
RED HYDROTHERMALLY ALTERED GRANITE


Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Hematite
Pervasive alteration
Vein alteration
RED HYDROTHERMALLY ALTERED GRANITE
PINK-GREY HYDROTHERMALLY ALTERED GRANITE
RED HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
PINK-GREY HYDROTHERMALLY ALTERED GRANITE
RED HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
RED HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
RED HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
PINK-GREY PORPHYRITIC GRANITE
2450
2460
2470
2480
2490
2500
2510
2520
2530
2540
2550
2560
2570
2580
2590
2600
2610
2620
2630
2640
2650
2660
2670
2680
2690
2700
2710
2720


Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Hematite
Pervasive alteration
Vein alteration
PINK-GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC GRANITE
PINK-GREY PORPHYRITIC GRANITE
RED HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
RED HYDROTHERMALLY ALTERED GRANITE
RED HYDROTHERMALLY ALTERED GRANITE WITH XENOLITH
BIOTITE-RICH GRANITE OR XENOLITH
RED HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
RED HYDROTHERMALLY ALTERED GRANITE
GREY PORPHYRITIC GRANITE
2730
2740
2750
2760
2770
2780
2790
2800
2810
2820
2830
2840
2850
2860
2870
2880
2890
2900
2910
2920
2930
2940
2950
2960
2970
2980
2990
3000


Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Hematite
Pervasive alteration
Vein alteration
GREY PORPHYRITIC GRANITE
PINK ALTERED GRANITE
DARK PORPHYRITIC GRANITE
GREY-RED ALTERED GRANITE
PINK-GREY PORPHYRITIC GRANITE
GREY-PINK ALTERED GRANITE
GREY PORPHYRITIC GRANITE
CREAM HYDROTHERMALLY ALTERED GRANITE
GREY ALTERED GRANITE
BIOTITE-RICH GRANITE
GREY PORPHYRITIC GRANITE
PINK PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
PINK PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
CREAMED PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC ALTERED GRANITE
PINK PORPHYRITIC ALTERED GRANITE
3010
3020
3030
3040
3050
3060
3070
3080
3090
3100
3110
3120
3130
3140
3150
3160
3170
3180
3190
3200
3210
3220
3230
3240
3250
3260
3270
3280


Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Hematite
Pervasive alteration
Vein alteration
3290
3300
3310
3320
3330
3340
3350
3360
3370
3380
3390
3400
3410
3420
3430
3440
3450
3460
3470
3480
3490
3500
3510
3520
3530
3540
3550
3560
PINK PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
PINK PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
CREAMED PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC ALTERED GRANITE
DARK PORPHYRITIC GRANITE
GREY PORPHYRITIC GRANITE
BIOTITE-RICH GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
CREAMED PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC ALTERED GRANITE
BIOTITE-RICH GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE


Depth (m)
Lithological description
Facies variation
Standard granite
Fractured zone
Biotite content
Chlorite
Epidote
Illite
Hematite
Pervasive alteration
Vein alteration
3570
3580
3590
3600
3610
3620
3630
3640
3650
3660
3670
3680
3690
3700
3710
3720
3730
3740
3750
3760
3770
3780
3790
3800
GREY PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
DARK PORPHYRITIC GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
BIOTITE-RICH GRANITE
GREY PORPHYRITIC GRANITE
DARK PORPHYRITIC GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
DARK PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE
GREY PORPHYRITIC GRANITE
GREY PORPHYRITIC ALTERED GRANITE

# ANNEX 6

# Petrographic tables and synthetic log of the mineralogical content in GPK3 cuttings from microscopic examination

| N° | Depth (m) | Type | Description échantillon | K-Feldsar | Plagioclase | *alteration minerals* | Primary Micas | *alteration minerals* | Amphibole | Accessory minerals | Other | ***Alteration type*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4024 | GRAN | GREY PORPHYRITIC GRANITE | orthoclase | highly altered | *sericite* | biotite | *chlorite 20%* | hornblende | oxides | calcite | ***Pervasive*** |
| 2 | 4057 | GRAN | DARK-GREY PORPHYRITIC GRANITE | orthoclase, low microcline | highly altered | *sericite* | biotite | *chlorite 10%* | hornblende | | calcite | ***Pervasive*** |
| 3 | 4096 | HLOW | GREY-GREEN HYDROTHERMALLY ALTERED GRANITE | orthoclase | highly altered | *sericite* | low biotite, low muscovite | *chlorite 50%* | | | calcite, lot of quartz | ***Vein*** |
| 4 | 4167 | GRAN | GREY PORPHYRITIC GRANITE | orthoclase majority, low microcline | highly altered | *sericite* | biotite, low muscovite | *chlorite 30%* | hornblende | | | ***Pervasive*** |
| 5 | 4242 | GRAN | DARK-GREY PORPHYRITIC GRANITE | orthoclase majority | highly altered | *sericite* | biotite | *chlorite 20%* | hornblende | low oxides | | ***Pervasive*** |
| 6 | 4299 | GRAN | GREY PORPHYRITIC GRANITE | orthoclase majority, low microcline | highly altered | *sericite* | biotite | *chlorite 20%* | hornblende | low oxides | calcite | ***Pervasive*** |
| 7 | 4383 | GRAN | DARK-GREY PORPHYRITIC GRANITE | orthoclase, low microcline | highly altered | *sericite* | biotite | *chlorite 10%* | | oxides | | ***Pervasive*** |
| 8 | 4461 | GRAN | GREY PORPHYRITIC GRANITE | orthoclase majority, low microcline | highly altered | *sericite* | biotite | *chlorite 30%* | | oxides | | ***Pervasive*** |
| 9 | 4467 | GRAN | GREY-PINK PORPHYRITIC GRANITE | orthoclase majority, microcline | highly altered | *sericite* | biotite | *chlorite 30%* | | oxides | | ***Pervasive*** |
| 10 | 4545 | GRAN | GREY PORPHYRITIC GRANITE | orthoclase majority, microcline | totaly altered | *sericite* | biotite | *chlorite 10%* | hornblende | oxides | | ***Pervasive*** |

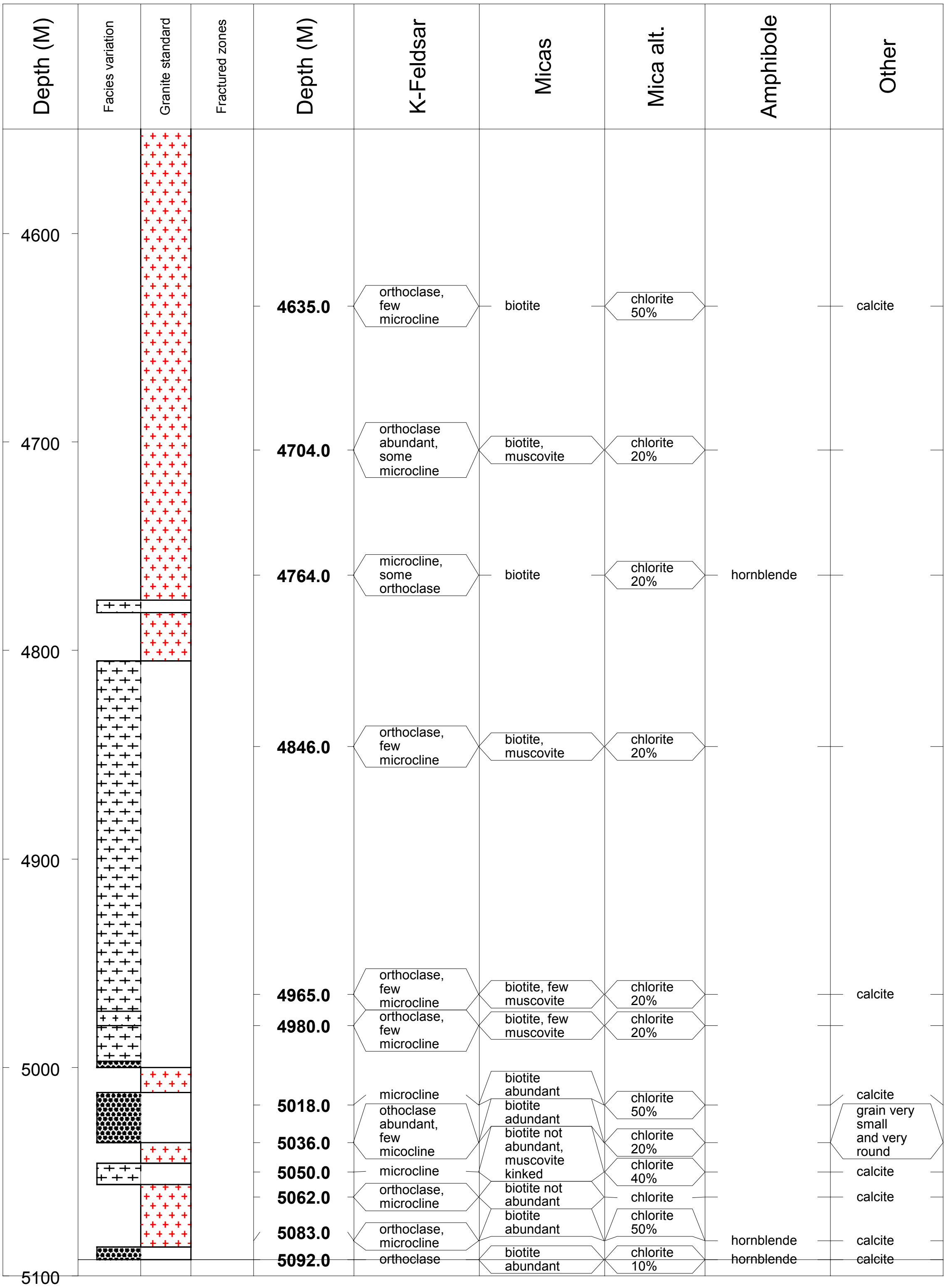
| N° | Depth (m) | Type | Description échantillon | K-Feldsar | Plagioclase | *alteration minerals* | Primary Micas | *alteration minerals* | Amphibole | Accessory minerals | Other | ***Alteration type*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 4635 | GRAN | GREY PORPHYRITIC GRANITE | orthoclase, low microcline | highly altered | *sericite* | biotite | *chlorite 50%* | | | calcite | ***Pervasive*** |
| 12 | 4704 | GRAN | GREY PORPHYRITIC GRANITE | orthoclase abundant, some | highly altered | *sericite* | biotite, muscovite | *chlorite 20%* | | | | ***Pervasive*** |
| 13 | 4764 | GRAN | DARK-GREY GRANITE | microcline, some orthoclase | highly altered | *sericite* | biotite | *chlorite 20%* | hornblende | oxides | | ***Pervasive*** |
| 14 | 4846 | GR2M | GREY TWO MICA GRANITE | orthoclase, low microcline | higly altered | *sericite* | biotite, muscovite | *chlorite 20%* | | | | ***Pervasive*** |
| 15 | 4965 | GR2M | GREY TWO MICA GRANITE | orthoclase, low microcline | higly altered | *sericite* | biotite, low muscovite | *chlorite 20%* | | | calcite | ***Pervasive*** |
| 16 | 4980 | GRAD | GREY K-F DEPLETED GRANITE | orthoclase, low microcline | higly altered | *sericite* | biotite, low muscovite | *chlorite 20%* | | | | ***Pervasive*** |
| 17 | 5018 | MELA | BIOTITE RICH GRANITE | microcline | highly altered | *sericite* | biotite abundant | *chlorite 50%* | | magnetite | calcite | ***Pervasive*** |
| 18 | 5036 | MELA | BIOTITE RICH GRANITE | othoclase abundant, low | highly altered | *sericite* | biotite adundant | *chlorite 20%* | | | | ***Pervasive*** |
| 19 | 5050 | GR2M | GREY TWO MICA GRANITE | microcline | highly altered | *sericite* | biotite not abundant, muscovite | *chlorite 40%* | | magnetite | calcite | ***Pervasive*** |
| 20 | 5062 | GRAN | GREY PORPHYRITIC GRANITE | orthoclase, microcline | abundant, highly altered | *sericite* | biotite not abundant | *chlorite* | | magnetite | calcite | ***Pervasive*** |

| N° | Depth (m) | Type | Description échantillon | K-Feldsar | Plagioclase | *alteration minerals* | Primary Micas | *alteration minerals* | Amphibole | Accessory minerals | Other | ***Alteration type*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 5083 | GRAN | GREY GRANITE | orthoclase, microcline | highly altered | *sericite* | biotite abundant | *chlorite 50%* | hornblende | magnetite, oxides | calcite | ***Pervasive*** |
| 22 | 5092 | MELA | BLACK BIOTITE RICH GRANITE WITH MFK | orthoclase | highly altered | *localy calcite* | biotite abundant | *chlorite 10%* | hornblende | | calcite | ***Pervasive*** |
| 23 | 5093 | MELA | BLACK BIOTITE RICH GRANITE WITH MFK | orthoclase | highly altered | *localy calcite* | biotite abundant | *chlorite 10%* | hornblende | | calcite | ***Pervasive*** |
| 24 | 4980-5093 | GRAN | Granite porphyroide à biotite hornblende (fragments) | big orthoclase abundant, microcline | low altered | *rare sericite, rare calcite* | biotite low altered | *chlorite 10%* | beautiful amphibole | magnetite | apatite, beautiful zircon, sphene | ***Low pervasive*** |
| 25 | 4980-5093 | GRAN | Granite porphyroide à biotite hornblende (fragments) | | | | | | | | | |

Annex 6.2. - Log of thin section location and synthetic description (4000-4500m).

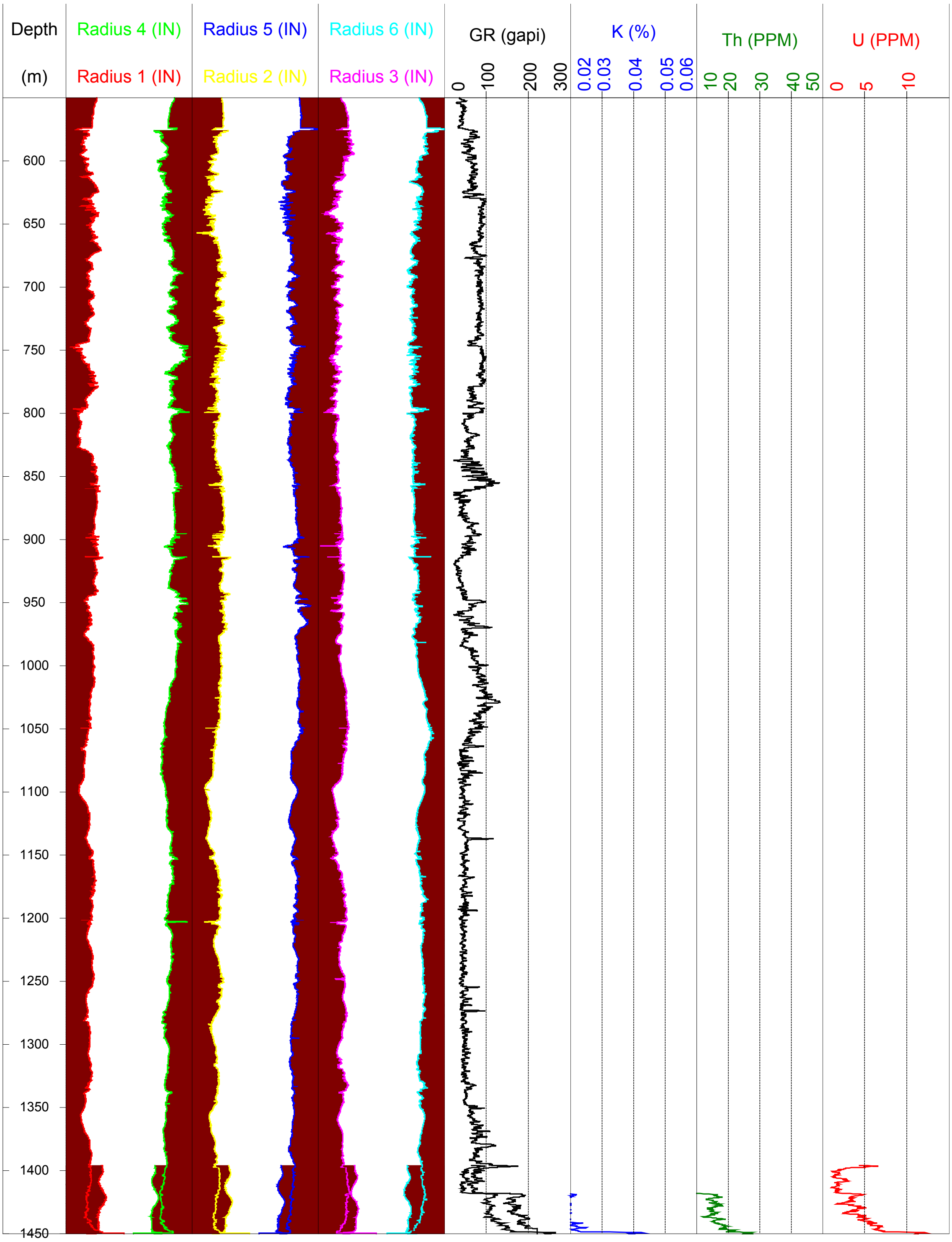
| Depth (M) | K-Feldsar | Micas | Mica alt. | Amphibole | Other |
|---|---|---|---|---|---|
| **4024.0** | orthoclase | biotite | chlorite 20% | hornblende | calcite |
| **4057.0** | orthoclase, few microcline | biotite | chlorite 10% | hornblende | calcite |
| **4096.0** | orthoclase | few biotite, few muscovite | chlorite 50% | | calcite lot of quartz |
| **4167.0** | orthoclase majority, few microcline | biotite, few muscovite | chlorite 30% | hornblende | |
| **4242.0** | orthoclase majority | biotite | chlorite 20% | hornblende | |
| **4299.0** | orthoclase majority, few microcline | biotite | chlorite 20% | hornblende | calcite |
| **4383.0** | orthoclase, few microcline | biotite | chlorite 10% | | |
| **4461.0** | orthoclase majority, few microcline | biotite | chlorite 30% | | |
| **4467.0** | orthoclase majority, microcline | biotite | chlorite 30% | | |
| **4545.0** | orthoclase majority, microcline | biotite | chlorite 10% | hornblende | |

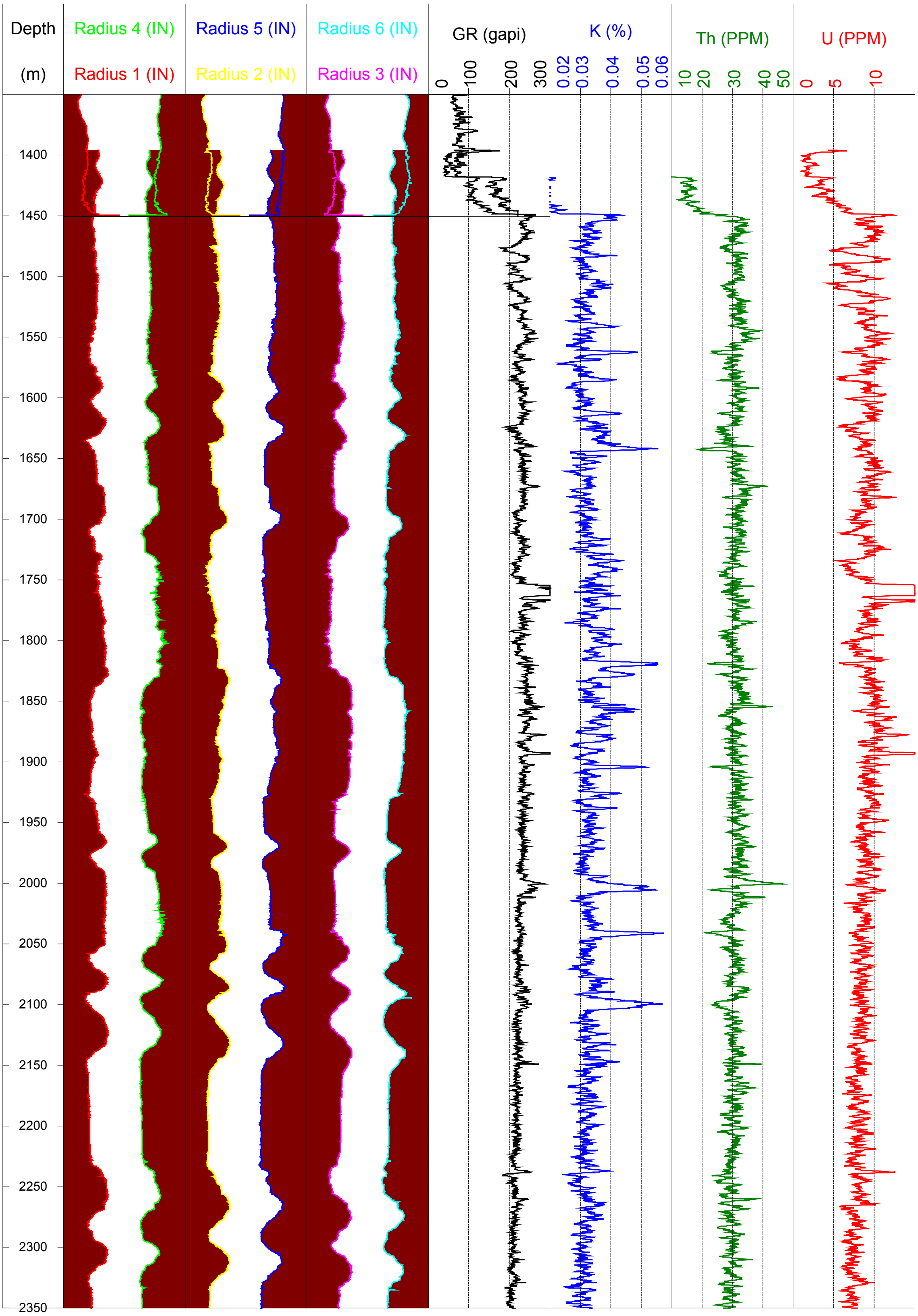
(Continuation) - Log of thin section location and synthetic description (4500-5100m).

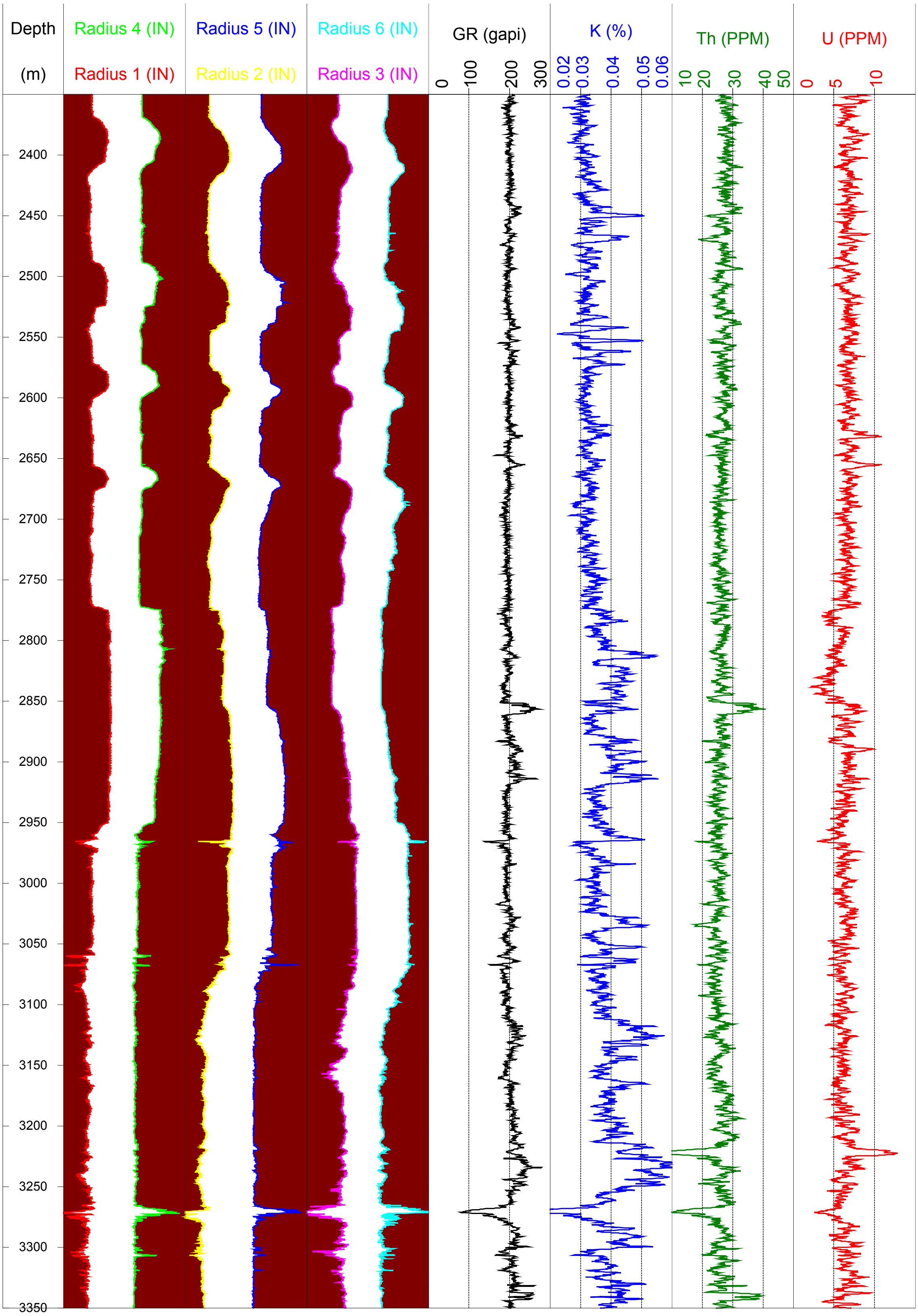


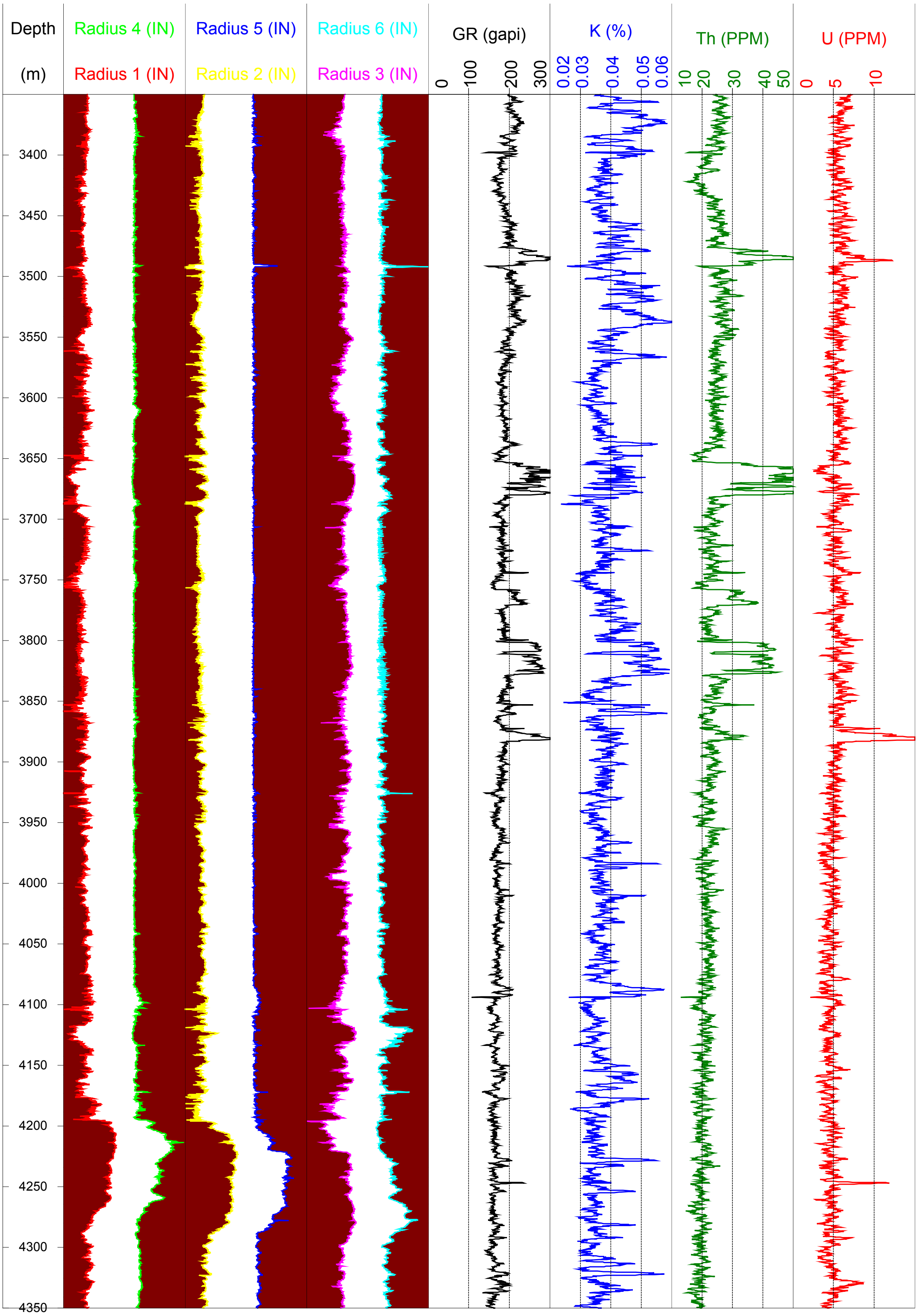
## ANNEX 7

# Detailed geophysical logs (Spectral Gamma Ray and Caliper) of the GPK3 well between 550m and 5027m

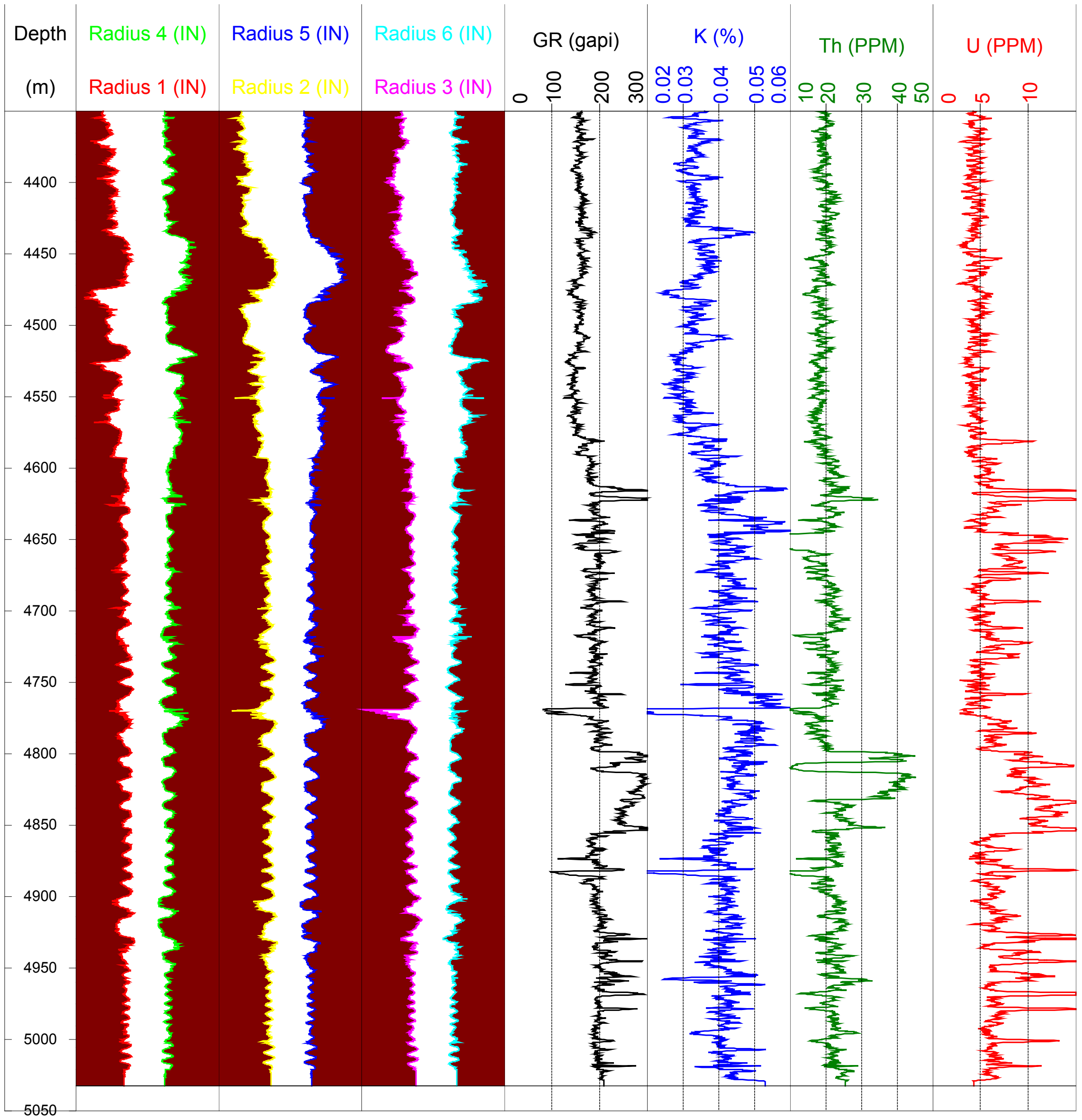

Depth
(m)
Radius 4 (IN)
Radius 1 (IN)
Radius 5 (IN)
Radius 2 (IN)
Radius 6 (IN)
Radius 3 (IN)
GR (gapi)
0
100
200
300
K (%)
0.02
0.03
0.04
0.05
0.06
Th (PPM)
10
20
30
40
50
U (PPM)
0
5
10
600
650
700
750
800
850
900
950
1000
1050
1100
1150
1200
1250
1300
1350
1400
1450


Depth
(m)
Radius 4 (IN)
Radius 1 (IN)
Radius 5 (IN)
Radius 2 (IN)
Radius 6 (IN)
Radius 3 (IN)
GR (gapi)
0 100 200 300
K (%)
0.02 0.03 0.04 0.05 0.06
Th (PPM)
10 20 30 40 50
U (PPM)
0 5 10
1400
1450
1500
1550
1600
1650
1700
1750
1800
1850
1900
1950
2000
2050
2100
2150
2200
2250
2300
2350


Depth
(m)
Radius 4 (IN)
Radius 1 (IN)
Radius 5 (IN)
Radius 2 (IN)
Radius 6 (IN)
Radius 3 (IN)
GR (gapi)
0 100 200 300
K (%)
0.02 0.03 0.04 0.05 0.06
Th (PPM)
10 20 30 40 50
U (PPM)
0 5 10
2400
2450
2500
2550
2600
2650
2700
2750
2800
2850
2900
2950
3000
3050
3100
3150
3200
3250
3300
3350

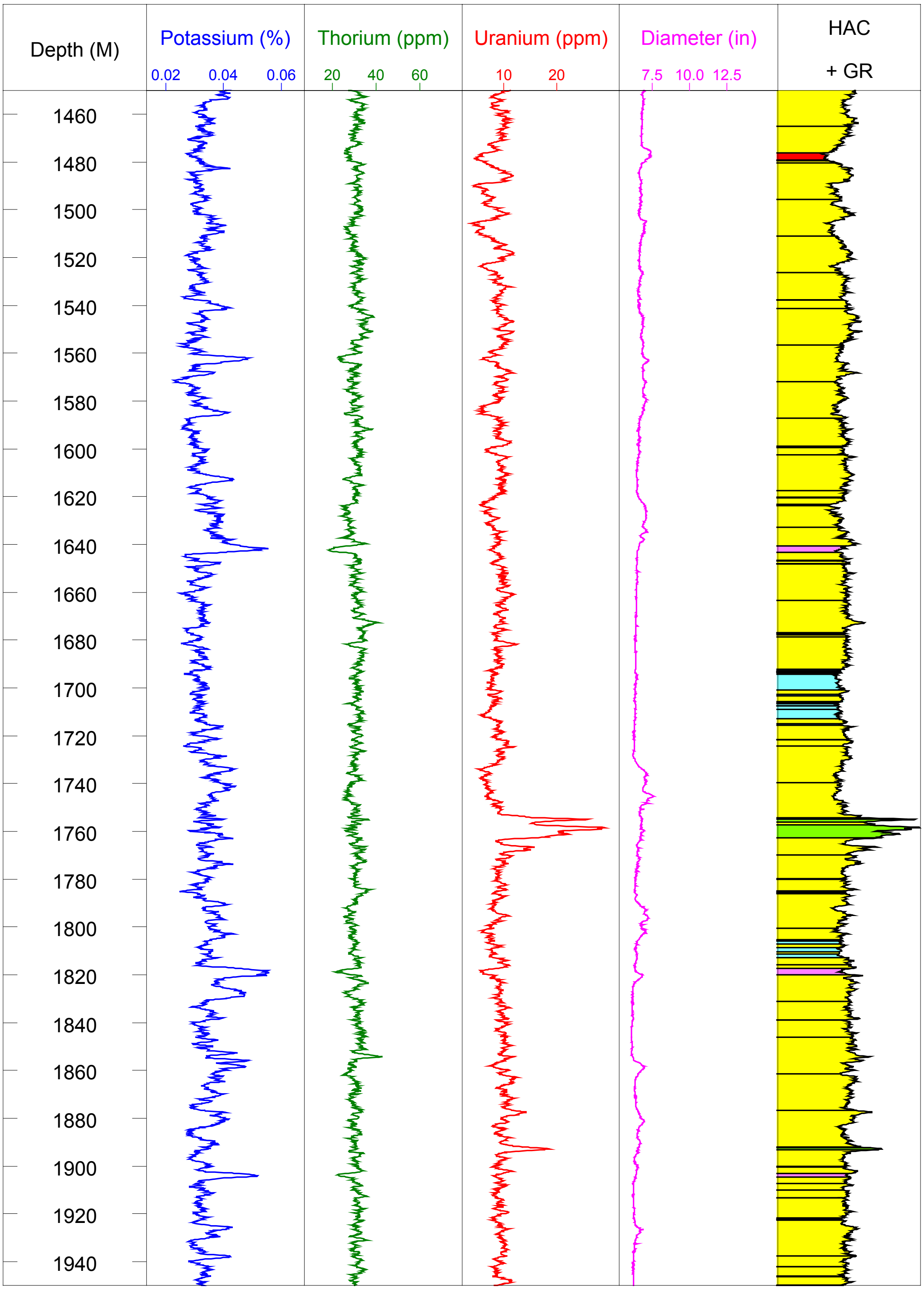


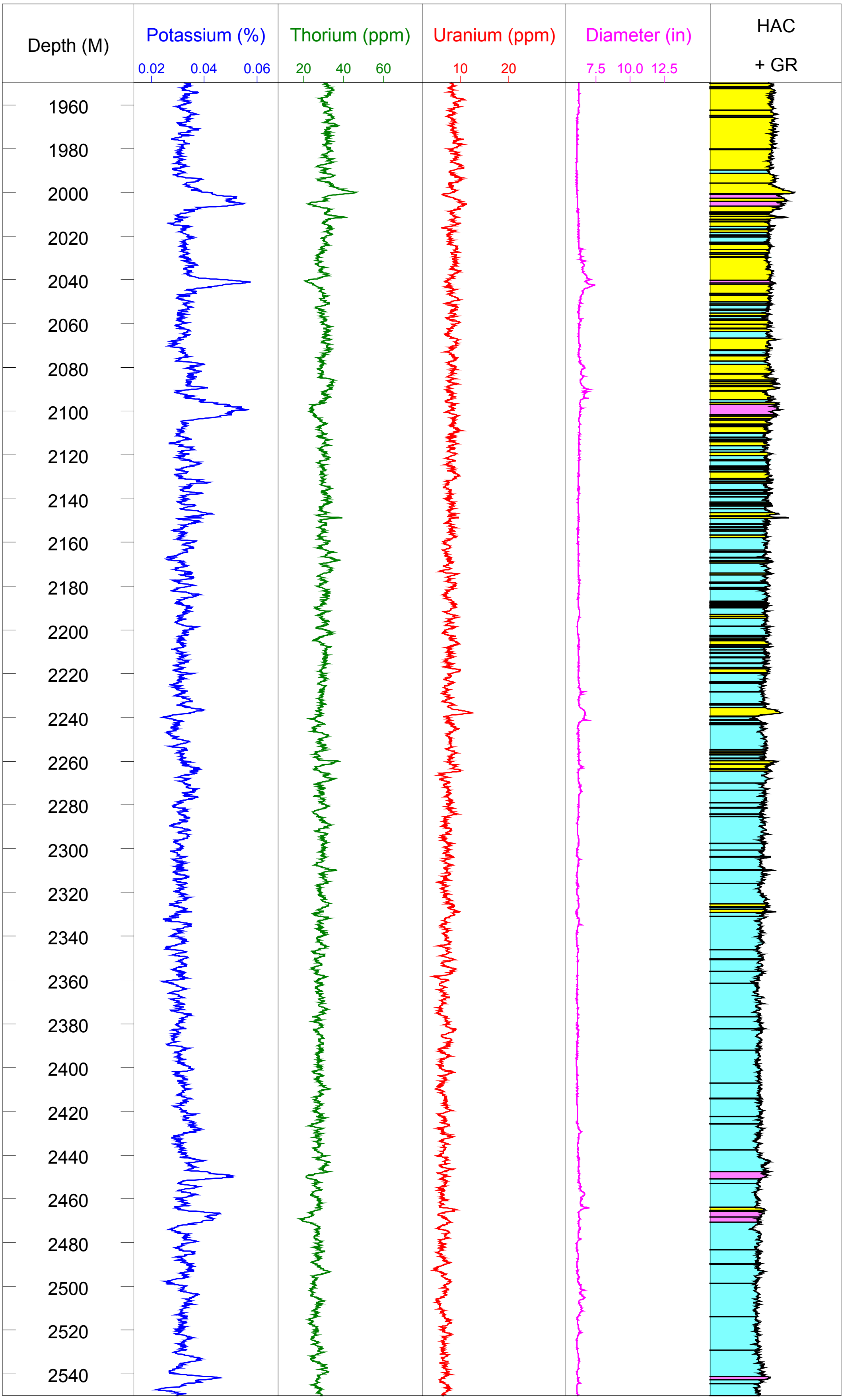
Depth
(m)
Radius 4 (IN)
Radius 1 (IN)
Radius 5 (IN)
Radius 2 (IN)
Radius 6 (IN)
Radius 3 (IN)
GR (gapi)
0
100
200
300
K (%)
0.02
0.03
0.04
0.05
0.06
Th (PPM)
10
20
30
40
50
U (PPM)
0
5
10
3400
3450
3500
3550
3600
3650
3700
3750
3800
3850
3900
3950
4000
4050
4100
4150
4200
4250
4300
4350

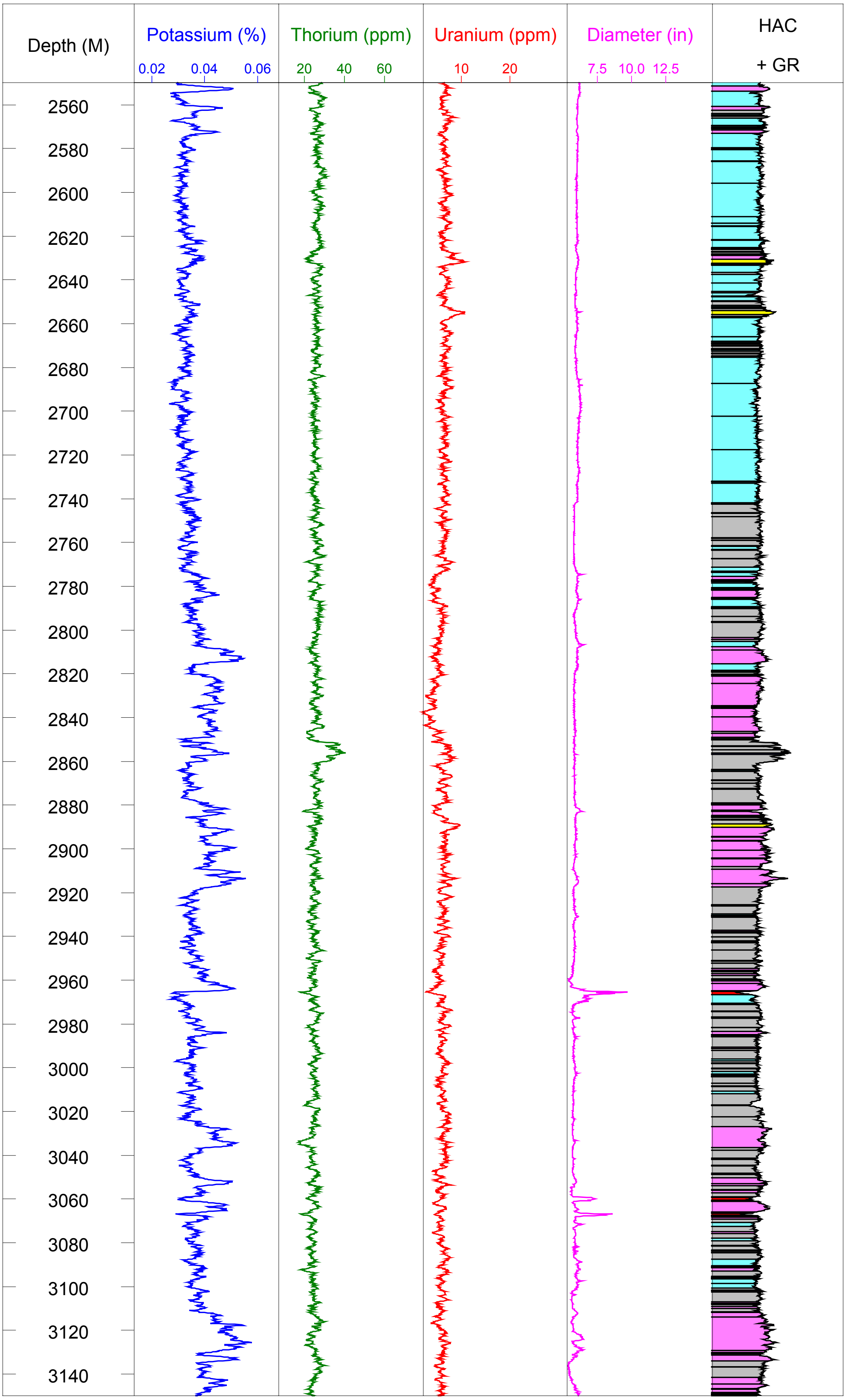

Depth
(m)
Radius 4 (IN)
Radius 1 (IN)
Radius 5 (IN)
Radius 2 (IN)
Radius 6 (IN)
Radius 3 (IN)
GR (gapi)
0
100
200
300
K (%)
0.02
0.03
0.04
0.05
0.06
Th (PPM)
10
20
30
40
50
U (PPM)
0
5
10
4400
4450
4500
4550
4600
4650
4700
4750
4800
4850
4900
4950
5000
5050

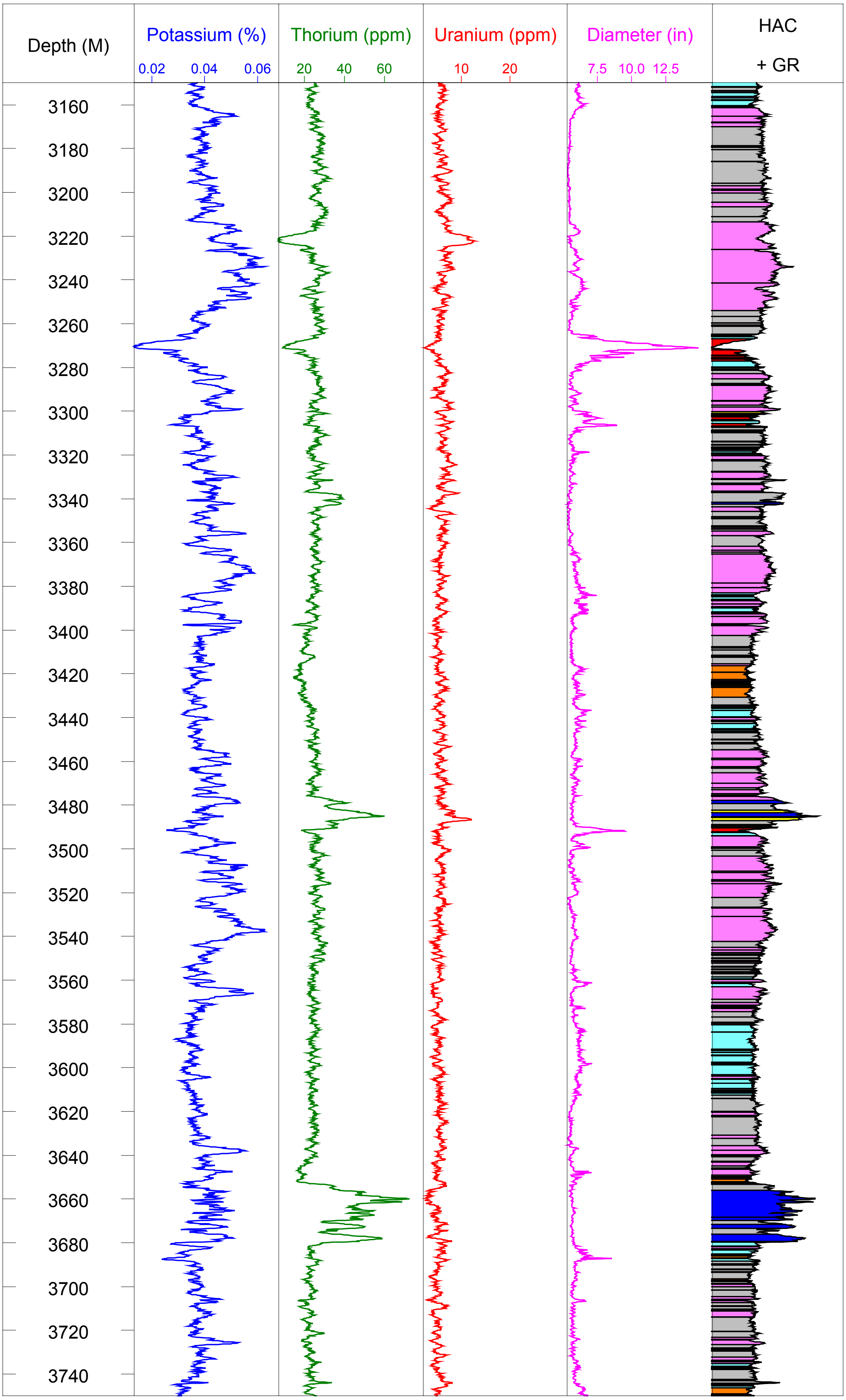
## ANNEX 8

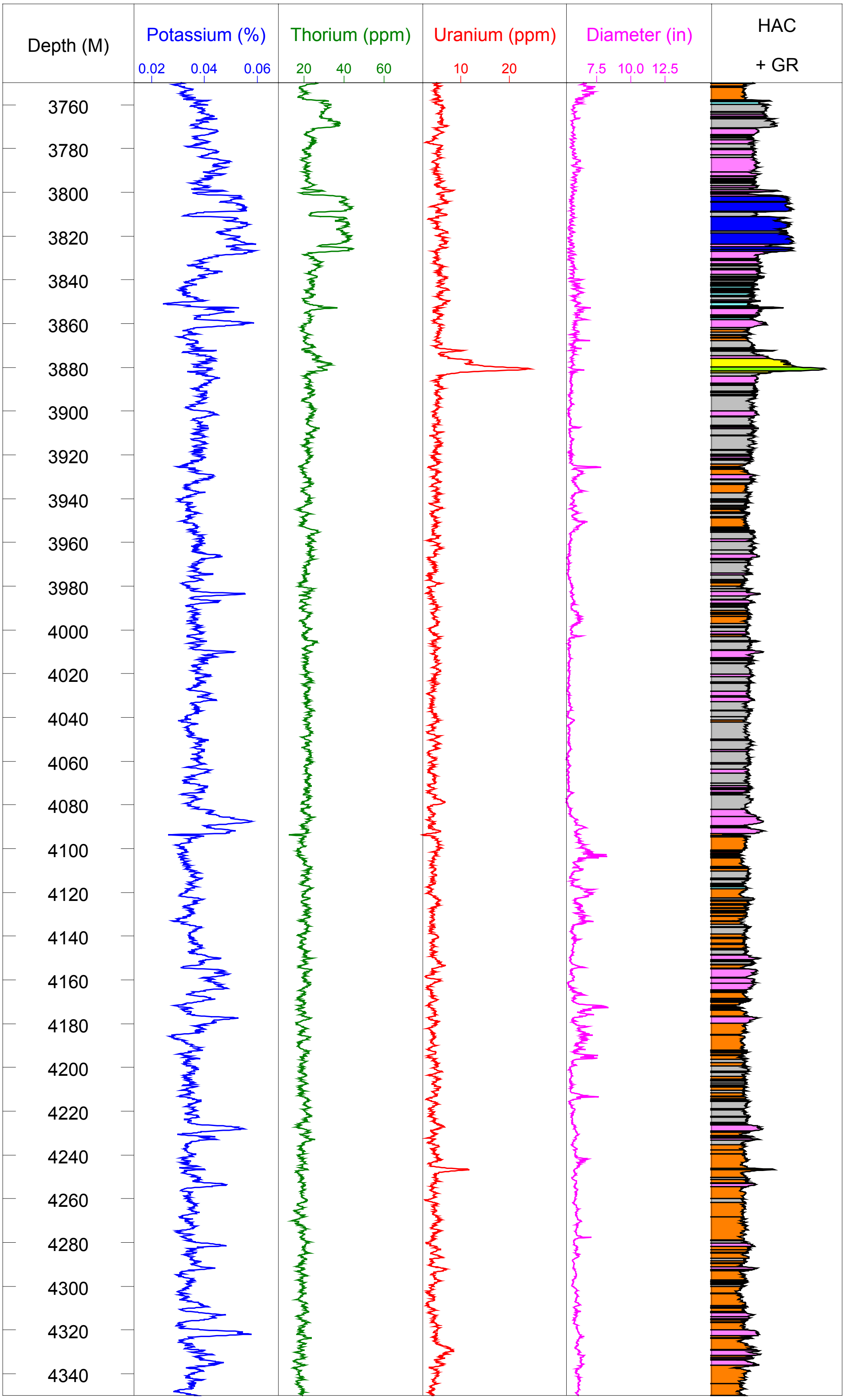
# Detailed HAC log of K, Th, U and caliper parameters in the 12’’1/4 part of GPK3 well

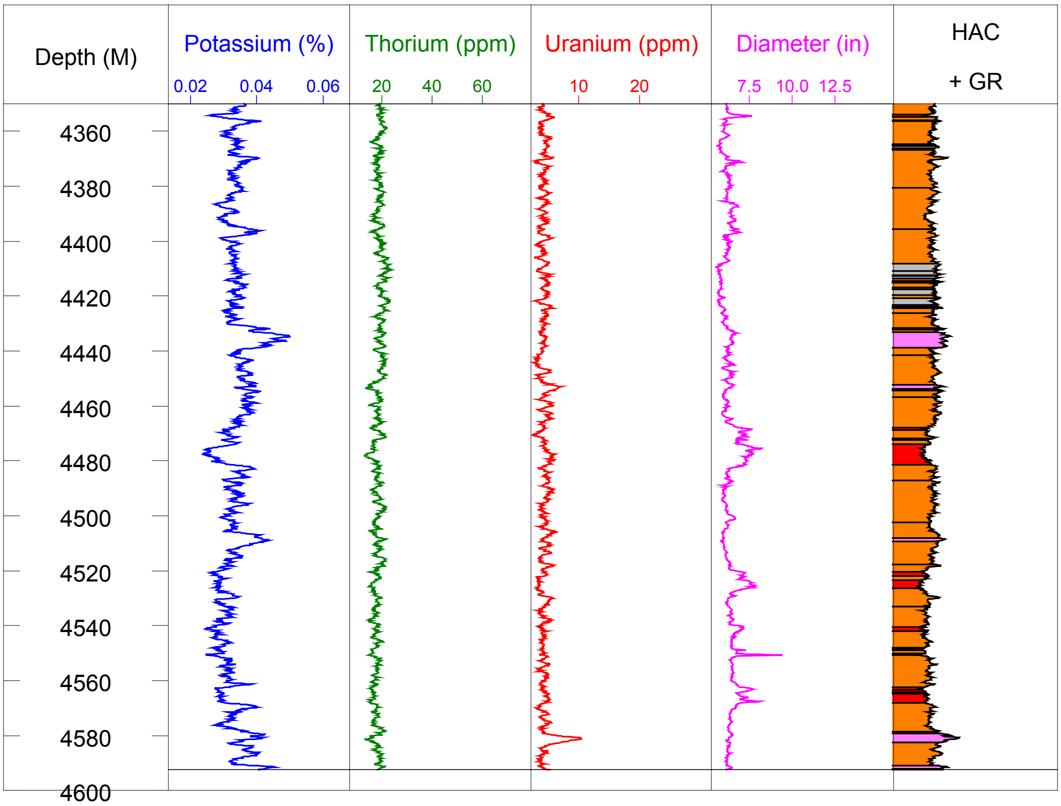

Depth (M)
Potassium (%)
0.02 0.04 0.06
Thorium (ppm)
20 40 60
Uranium (ppm)
10 20
Diameter (in)
7.5 10.0 12.5
HAC
+ GR
1460
1480
1500
1520
1540
1560
1580
1600
1620
1640
1660
1680
1700
1720
1740
1760
1780
1800
1820
1840
1860
1880
1900
1920
1940


Depth (M)
Potassium (%)
0.02 0.04 0.06
Thorium (ppm)
20 40 60
Uranium (ppm)
10 20
Diameter (in)
7.5 10.0 12.5
HAC
+ GR
1960
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
2200
2220
2240
2260
2280
2300
2320
2340
2360
2380
2400
2420
2440
2460
2480
2500
2520
2540


Depth (M)
Potassium (%)
0.02 0.04 0.06
Thorium (ppm)
20 40 60
Uranium (ppm)
10 20
Diameter (in)
7.5 10.0 12.5
HAC
+ GR
2560
2580
2600
2620
2640
2660
2680
2700
2720
2740
2760
2780
2800
2820
2840
2860
2880
2900
2920
2940
2960
2980
3000
3020
3040
3060
3080
3100
3120
3140


Depth (M)
Potassium (%)
0.02 0.04 0.06
Thorium (ppm)
20 40 60
Uranium (ppm)
10 20
Diameter (in)
7.5 10.0 12.5
HAC
+ GR
3160
3180
3200
3220
3240
3260
3280
3300
3320
3340
3360
3380
3400
3420
3440
3460
3480
3500
3520
3540
3560
3580
3600
3620
3640
3660
3680
3700
3720
3740


Depth (M)
Potassium (%)
0.02 0.04 0.06
Thorium (ppm)
20 40 60
Uranium (ppm)
10 20
Diameter (in)
7.5 10.0 12.5
HAC
+ GR
3760
3780
3800
3820
3840
3860
3880
3900
3920
3940
3960
3980
4000
4020
4040
4060
4080
4100
4120
4140
4160
4180
4200
4220
4240
4260
4280
4300
4320
4340


Depth (M)
Potassium (%)
0.02 0.04 0.06
Thorium (ppm)
20 40 60
Uranium (ppm)
10 20
Diameter (in)
7.5 10.0 12.5
HAC
+ GR
4360
4380
4400
4420
4440
4460
4480
4500
4520
4540
4560
4580
4600

**Centre scientifique et technique**
**Service Connaissance et Diffusion de l'Information**
3, avenue Claude-Guillemin
BP 6009 – 45060 Orléans Cedex 2 – France