**-FINAL REPORT-**

# PETROGRAPHIC STUDY
# FOR
# QGC-A BG GROUP BUSINESS
# DUNK NO. 1 WELL
# SURAT BASIN
# BACK ALLEY SHALE, TINOWON, UPPER TINOWON, OVERSTON, AND LORELLE SANDSTONES
# QUEENSLAND, AUSTRALIA

**WFT FILE NO.: AB-74306**

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September 30, 2015

Ms. Heidi Sutton
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Australia

SUBJECT: *Final Report - Petrographic Study*
Dunk No. 1 Well
Surat Basin
Back Alley Shale, Tinowon, Upper Tinowon, Overston, and Lorelle Sandstones
Queensland, Australia
WFT File No.: AB-74306

Dear Ms. Sutton:

Twenty (20) rotary sidewall core samples and twenty-two (22) conventionl core samples from the above referenced well were submitted for X-ray diffraction (XRD) analysis, thirty-five (35) for detailed thin section analysis, while the remaining seven (7) samples were analyzed using general thin section analytical techniques. Lastly, thirteen (13) were selected for scanning electron microscopy (SEM) analysis. This report provides all data and photomicrographs associated with these analyses. One (1) copy of this report is provided; additional copies can be prepared upon request.

It has been a pleasure to provide this study for QGC – A BG Group Business . Please feel free to contact us if you have any questions concerning this report or if we can be of further service.

Sincerely,
WEATHERFORD LABORATORIES

| | |
|---|---|
| Angela Schwartz | Jamie Mills |
| Manager, Petrology Group | Project Geologist |

## INTRODUCTION

Twenty (20) rotary sidewall core samples and twenty-two (22) conventional core samples from the Dunk-1 well located within the Surat Basin of Queensland, Australia were submitted for X-ray diffraction (XRD) analysis. Twenty (20) rotary sidewall core samples and twenty-two (22) conventional core samples were chosen for thin section preparation, thin section photography, and quantitative thin section analysis. Based on lithology, thirty-five (35) samples were considered suitable for quantitative modal analysis while the remaining seven (7) were analyzed utilizing qualitative techniques. Thirteen (13) samples were selected for scanning electron microscopy (SEM) analysis. The primary objectives of this study are to:

1. document the mineral composition, fabric, grain size and texture of the samples
2. determine controls on porosity and permeability and interpret reservoir quality as it relates to compaction and cementation
3. examine mineralogical effects on well log response
4. address formation sensitivity concerns

Several formations are represented in this sample suite, including the Back Alley Shale (2813.00m), the Tinowon Sandstone (2872.08m-2888.12m), the Upper Tinowon Sandstone (2895.09m-2931.50m), the Overston Sandstone (3005.00m-3008.80m), and the Lorelle Sandstone (3061.00m-3133.75m). Table 1 provides the sample depths and the analyses performed.

## TABLE 1

## SAMPLE DEPTHS AND ANALYSIS PERFORMED

| Sample Number | Sample Depth (m) | Sample Type | Formation | Thin Section Preparation & Photography | Detailed Thin Section Analysis | General Thin Section Analysis | Scanning Electron Microscopy | X-Ray Diffraction |
|---|---|---|---|---|---|---|---|---|
| 43 | 2813.00 | SWC | Back Alley Shale | X | | X | X | X |
| 1_3P | 2872.08 | DS | Tinowon SS | X | | X | | X |
| 1_8P | 2877.04 | DS | Tinowon SS | X | X | | | X |
| 1_10P | 2878.05 | DS | Tinowon SS | X | X | | | X |
| 1_19P | 2887.10 | DS | Tinowon SS | X | X | | | X |
| 1_20P | 2888.12 | DS | Tinowon SS | X | X | | | X |
| 1_27P | 2895.09 | DS | Upper Tinowon SS | X | X | | X | X |
| 1_28P | 2896.07 | DS | Upper Tinowon SS | X | X | | | X |
| 2_2P | 2897.06 | DS | Upper Tinowon SS | X | X | | X | X |
| 21 | 2898.51 | RCA | Upper Tinowon SS | X | X | | | X |
| 2_6P | 2901.06 | DS | Upper Tinowon SS | X | X | | X | X |
| 25 | 2902.49 | RCA | Upper Tinowon SS | X | X | | | X |
| 28 | 2905.56 | RCA | Upper Tinowon SS | X | X | | X | X |
| 2_12P | 2906.05 | DS | Upper Tinowon SS | X | X | | | X |
| 2_13P | 2907.04 | DS | Upper Tinowon SS | X | X | | | X |
| 31 | 2908.50 | RCA | Upper Tinowon SS | X | X | | X | X |
| 2_16P | 2910.05 | DS | Upper Tinowon SS | X | X | | | X |
| 34 | 2912.30 | SWC | Upper Tinowon SS | X | X | | | X |
| 35 | 2912.50 | RCA | Upper Tinowon SS | X | X | | X | X |
| 2_20P | 2914.04 | DS | Upper Tinowon SS | X | X | | X | X |
| 2_23P | 2916.04 | DS | Upper Tinowon SS | X | X | | | X |
| 2_26P | 2919.05 | DS | Upper Tinowon SS | X | X | | X | X |
| 33 | 2920.70 | SWC | Upper Tinowon SS | X | X | | | X |
| 2_29P | 2922.04 | DS | Upper Tinowon SS | X | X | | | X |
| 2_32P | 2924.21 | DS | Upper Tinowon SS | X | X | | X | X |
| 32 | 2931.50 | SWC | Upper Tinowon SS | X | X | | | X |
| 21 | 3005.00 | SWC | Overston SS | X | X | | | X |
| 24 | 3006.80 | SWC | Overston SS | X | X | | | X |
| 23 | 3007.90 | SWC | Overston SS | X | X | | X | X |
| 22 | 3008.80 | SWC | Overston SS | X | X | | | X |
| 12 | 3061.00 | SWC | Lorelle SS | X | X | | | X |
| 11 | 3075.00 | SWC | Lorelle SS | X | X | | X | X |
| 10 | 3076.47 | SWC | Lorelle SS | X | X | | | X |
| 9 | 3081.43 | SWC | Lorelle SS | X | X | | | X |
| 8 | 3083.00 | SWC | Lorelle SS | X | X | | X | X |
| 7 | 3085.33 | SWC | Lorelle SS | X | X | | | X |
| 6 | 3093.00 | SWC | Lorelle SS | X | X | | | X |
| 5 | 3112.78 | SWC | Lorelle SS | X | | X | | X |
| 4 | 3116.00 | SWC | Lorelle SS | X | | X | | X |
| 3 | 3120.00 | SWC | Lorelle SS | X | | X | | X |
| 2 | 3126.00 | SWC | Lorelle SS | X | | X | | X |
| 1 | 3133.75 | SWC | Lorelle SS | X | | X | | X |

## PETROGRAPHIC RESULTS

The following sections characterize the intervals with respect to sedimentary fabric and texture, framework grain composition, authigenic minerals, clay mineralogy, reservoir quality, the effects of mineralogy on log response, and formation sensitivity. Specific information on individual samples is included in Appendices A through E.

Of the forty-two (42) samples provided from this well, thirty-five (35) were analyzed utilizing quantitative techniques, while the remaining seven (7) were analyzed utilizing qualitative techniques. Detailed petrographic analysis is required to quantify the amounts of the different types of grains, cements, and porosity types present in these samples in order to accurately characterize the rock lithology (e.g., using the Folk, 1980 classification scheme). The values presented in the following sections reflect data acquired on the samples that underwent modal analysis. General petrographic assessment of the remaining thin sections are available in the appendix.

### ❖ Back Alley Shale Formation (1 sample; 2813.00m)

**Sedimentary Fabric and Texture**

Only one (1) sample was provided from the Back Alley Shale Formation, and was determined to be unsuitable for detailed point count analysis, a general description was performed instead. X-ray diffraction (XRD) and scanning electron microscopy (SEM) analyses was also performed on this sample. This one sample (2813.00m) was classified as a welded tuff, consisting of an ash flow composed predominantly of plagioclase and microquartz. The average particle size ranges from <0.01mm (clay) to 0.73mm (coarse sand). Intact silt-sized crystals of plagioclase, quartz and volcanic glass suggest low compaction.

**Framework Grain Mineralogy**

The one sample representing the Back Alley Shale Formation is predominantly composed of plagioclase feldspar and lithic fragments, with lesser amounts of potassium feldspar. Lithic varieties consist mainly of intermediate volcanic glass and schistose metamorphic fragments, with lesser amounts of tuffaceous volcanic fragments and mudstone fragments. Feldspar varieties are identified based on optical characteristics (i.e., twinning) and with the aid of chemical staining: sodium cobaltinitrite for potassium feldspar (stains yellow) and rhodamine B for plagioclase (stains red/pink). Some lithic fragments and feldspars are slightly altered (seriticized or recrystallized) and partially dissolved.

**Cement/Replacement**

Authigenic minerals occur in minor amounts in this welded tuff. Illitic clay occurs as pore-filling and replacement of altered grains. Rare kaolinite replacement is present. Microcrystalline quartz cement occurs as part of the matrix and as rare coating on preserved grains. Rare calcite and Fe-calcite replace partially dissolved feldspar grains. Calcite varies in iron content throughout the entire well and is differentiated based on thin section staining; calcite is stained red while iron-rich calcite is purple.

Other minerals occurring in lesser amounts include, Ti-oxides, siderite, and pyrite. Titanium oxide and pyrite mainly occur as a replacement of unstable particles, such as detrital matrix clays and organics, and is present as a rare grain-coating cement. Minor amounts of altered authigenic clays occur as pore-filling material and as replacement of susceptible grains.

## Clay Mineralogy

Clays occurring in this Back Alley Shale sample represent a combination of both detrital (depositional) and authigenic (secondary) origins, which are difficult to distinguish in this thin section. Both detrital and authigenic clays occur as grain-coating and pore-filling material. Authigenic clays, such as kaolinite, occur as replacement of altered grains.

X-ray diffraction (XRD) and scanning electron microscopy (SEM) analyses represent the best way to determine individual clay types. Both of these analyses utilize an energy dispersive spectrometer (EDS) that is essential in determining the elemental differences between clay varieties, especially when considering detrital matrix clays. The identification of authigenic clays in thin section can be extremely difficult because of the physical limitations of petrographic techniques. Scanning electron microscopy techniques are more comprehensive; however, the identification of clay distribution is limited because of the reduced size of SEM samples.

Scanning electron microscopy (SEM) indicates authigenic illite intermixed with microcrystalline quartz comprise the tuffaceous matrix material. Illite is a probable alteration product of partially to completely dissolved potassium feldspar grains and volcanic fragments.

X-ray diffraction (XRD) analysis (Appendix B) reveals that mixed-layer illite/smectite (2%, by weight) is the predominant clay type, followed by lesser amounts of illite/mica (1%), and trace amounts of kaolinite and chlorite. The mixed-layer illite/smectite consists of ordered interstratified layers that are 15%-35% and 40%-55% expandable.

## Reservoir Quality

Porosity and permeability measurements were obtained for this rotary sidewall core sample and for ease of reference, that data is also provided in the appendix (see Appendix E). Measurements obtained during core analysis reveal the porosity value of 8.7%, with a permeability value (to air) of 0.0047mD. The porosity of this sample is likely due to the microporosity associated with detrital clay, authigenic clay, and leached and altered detrital feldspar and lithic grains. Intergranular pores are occluded with cement and detrital matrix, no open primary pores were observed in thin section or scanning electron microscopy (SEM) analyses.

**TABLE 2**

**SUMMARY OF PETROGRAPHIC RESULTS THE BACK ALLEY SHALE FORMATION**

| Sample Number | Sample Depth (m) | Grain Size Avg. (mm) | Visual Sorting | Fabric | Total Matrix (vol. %) | Cement/ Replacement Minerals (vol. %) | Total Porosity (vol. %) | Poro./Perm (RCA) |
|---|---|---|---|---|---|---|---|---|
| 43 | 2813.00 | N/A | N/A | Ash Flow | N/A | N/A | N/A | N/A |

=Tuff/Basalt

## ❖ Tinowon Sandstone Formation (5 samples; 2872.08m to 2888.12m)

### Sedimentary Fabric and Texture

Five (5) of the samples analyzed from this well represent the Tinowon Sandstone Formation and range in depth from 2872.08m to 2888.12m. One sample (1) was determined unsuitable for point count analysis (2872.08m), therefore a general thin section analysis was performed. Four (4) samples were selected for detailed point count analysis and all five (5) were submitted for X-ray diffraction (XRD). Based on visual estimates of thin section derived grain size analysis, the samples are classified as one (1) argillaceous packstone, two (2) lithic arkoses, one (1) litharenite, and one (1) feldspathic litharenite. Average grain sizes range from <0.01mm (silt) to 12.92mm (pebble). Sample fabrics vary massive to laminated and the samples are poor to moderately well sorted. Several of the samples (2872.08m and 2887.10m) contain relatively large lithic fragments.

Silt- and sand-sized detrital grains range in shape from subangular to round with most grains being subrounded. The argillaceous packstone at 2872.08m displays microstylolites, which indicate high compaction.

### Framework Grain Mineralogy

The Tinowon Sandstone Formation samples consist of minor to abundant amounts of feldspar (2.00%-34.75%, by volume; total feldspar) and common amounts of lithic fragments (12.25%-21.75%; total lithics), with slightly lesser amounts of quartz (11.00%-26.00%; total quartz). Other grain varieties occurring in lesser amounts include, by volume, siltstone fragments (0.25%-1.50%), chert (4.00%-8.25%), mudstone fragments (0.25%-1.75%), tuffaceous/glass volcanic fragments (0.50%-5.50%), mafic volcanic fragments (1.50%-5.75%), and felsic volcanic fragments (0.00%-0.75%).

Accessory grain types include carbonaceous plant material (0.25%-1.00%; by volume), muscovite mica (trace-0.75%), biotite mica (trace-2.25%), heavy minerals (trace-0.25%), and chamosite (trace-0.50%). Heavy mineral varieties include rutile, pyrite, apatite, staurolite, tourmaline, and zircon.

## Cement/Replacements

Authigenic minerals occurring in these samples are common. Please note that the sample at depth 2872.08m was not analyzed using quantitative techniques and therefore the values present here only reflect the samples that were suitable for modal point count analysis. The dominant authigenic mineral present is calcite (14.5%-28%; total calcite; by volume) occurring as both cement and replacement of unstable material. Minor amounts of authigenic clay minerals occur as minor pore fillings, scattered grain coatings, and as a result of altered unstable feldspar grains and lithic fragments. Authigenic clays types observed include illite, mixed-layer illite/smectite, and trace amounts of kaolinite.

Other authigenic minerals occurring in lesser amounts (by volume) include siderite, quartz overgrowths, feldspar overgrowths, pyrite, calcite, and ankerite. Siderite occurs as a replacement of matrix clays and as cement in these samples (0.75%-4.50%). Quartz (trace-0.50%) and feldspar (0.00%-0.75%) overgrowths precipitate on the surfaces of host detrital grains, although unlike quartz overgrowths, feldspar overgrowths are also observed in relation to the reprecipitation of partially dissolved feldspar remnants within secondary intragranular or grain-moldic pores (0.00%-0.75%). Pyrite is rare and occurs as both microcrystalline masses and framboids within intergranular pores (0.25%-1.25%) and as a partial replacement of labile grains (0.50%-1.50%).

## Clay Mineralogy

Clay observed in the Tinowon Sandstone Formation represent a combination of both detrital (depositional) and authigenic (secondary) origins. Detrital clays are abundant in the one (1) of the Tinowon sandstone samples (2877.04). Generally minor detrital clays occur in two (2) of these samples (2878.05 and 2888.12), and no detrital clays observed for 2887.10. Detrital clays occur in these arkose/litharenite samples as distinct laminations, as minor pore-filling material, and as infiltrated clay that is erratically dispersed throughout the samples. Authigenic clays, including illite, chlorite, and kaolinite, occur as precipitated grain coatings, as pore-filling accumulations, and a diagenetic alteration of unstable grains.

Distinguishable authigenic clay types include web-like to fibrous grain-coating and grain-replacing illite; chlorite which is differentiated by a face-to-edge morphology of blade-like crystals, and occurs as grain-coating/pore-filling clay and grain-replacement; and kaolinite which precipitates as book-shaped crystals that occur as both a patchy pore-filling clay within intergranular areas and as an *in situ* replacement of susceptible grains.

Clay types detected during XRD analysis of the five (5) samples representing the Tinowon Sandstone Formation include mixed-layer illite/smectite (7%-30%, by weight), kaolinite (trace), illite/mica (1%-6%), and chlorite (trace-1%). These samples contain mixed-layer illite/smectite consisting of ordered interstratified layers that are 15%-30% expandable.

## Reservoir Quality

Routine core analyses was performed on four (4) samples from the Tinowon Sandstone Formation. Measured porosity values for the lithic arkose and litharenite samples range from 1.8% to 5.9%. Permeability measurements to air range from 0.0040mD to 0.017mD.

Intergranular pores are occluded due to the abundance and distribution of detrital and authigenic clays as well as authigenic cement. Secondary intragranular and grain-moldic pores (trace-0.75%) occurring within partially to completely dissolved detrital grains contribute rare amounts of porosity to the overall pore system. Susceptible grains include feldspars and feldspar-bearing lithic fragments, such as volcanic or metamorphic fragments. Micropores (0.50%-3.0%) associated with detrital clay, authigenic clay, argillaceous fragments, and partially dissolved grains are dominant. Thin section results are summarized in Table 3 (below).

**TABLE 3**

**SUMMARY OF PETROGRAPHIC RESULTS THE TINOWON SANDSTONE FORMATION**

| Sample Number | Sample Depth (m) | Grain Size Avg. (mm) | Visual Sorting | Fabric | Total Matrix (vol. %) | Cement/ Replacement Minerals (vol. %) | Total Porosity (vol. %) | Poro./Perm. (RCA) |
|---|---|---|---|---|---|---|---|---|
| 1_3P-DS | 2872.08 | N/A | Poor | Lam.; Microstylolites | N/A | N/A | N/A | N/A |
| 1_8P-DS | 2877.04 | 0.27 | Poor | Massive | 20.00 | 11.75 | 3.00 | 5.9%/0.0098mD |
| 1_10P-DS | 2878.05 | 0.49 | Poor to Mod. Well | Massive | 1.75 | 30.50 | 0.50 | 3.3%/0.0040mD |
| 1_19P-DS | 2887.10 | 0.49 | Very Poor | Massive | 0.00 | 32.50 | 0.75 | 1.8%/0.017mD |
| 1_20P-DS | 2888.12 | 0.34 | Moderate | Massive | 7.25 | 28.25 | 2.25 | 5.0%/0.0063mD |

=Medium-grained
=Packstone

❖ **Upper Tinowon Sandstone Formation (20 samples; 2895.09m to 2931.50m)**

## Sedimentary Fabric and Texture

Twenty (20) samples analyzed from this well represent the Upper Tinowon Sandstone Formation and range in depth from 2895.09m to 2931.50m. All twenty (20) were selected for detailed thin section analysis and X-ray diffraction (XRD) analysis, with nine (9) being also selected for scanning electron microscopy (SEM) analysis. Fifteen (15) samples are classified as lithic arkoses, four (4) samples are classified as feldspathic litharenites and one (1) sample was a combination of both lithologies. The average grain size of all of these samples was visually estimated to range from 0.24mm (fine sand) to 0.70mm (coarse sand).

Sorting ranges from poor to well and sample fabrics include massive and faintly laminated to massive. The angularity of the grains ranges from subangular to rounded, with most grains being subrounded. Tangential to concavo-convex grain contact boundaries and ductile grain deformations indicate that some of these sandstones have undergone mainly moderate to high sedimentary compaction.

## Framework Grain Mineralogy

Based on the Folk (1980) classification scheme (Figure 1; Appendix C), the twenty (20) sandstones are classified as feldspathic litharenite and lithic arkose. Detailed point count analysis reveals that framework grains in the sandstones from the Upper Tinowon Sandstone Formation consist predominantly of feldspar grains (21.25%-33.50%) and quartz grains (12.00%-28.25%). Lithic fragments (13.00%-23.50%; total lithics, by volume), in particular intermediate volcanic fragments (1.75%-8.00%), occur in lesser amounts.

Lithic grain varieties are further subdivided and include, by volume, chert (3.50%-8.75%), siltstone fragments (0.75%-3.50%), mudstone fragments (trace-3.25%), tuffaceous/glass volcanic fragments (1.75%-8.25%), felsic volcanic fragments (0.00%-0.25%), schistose metamorphic fragments (0.00%-1.25%), plutonic fragments (0.00%-0.75%), and phyllitic metamorphic fragments (0.00%-0.75%). Feldspar varieties primarily include plagioclase (17.25%-32.50%) with minor amounts of potassium feldspar (0.25%-4.25%) also present. Quartz varieties include monocrystalline quartz (11.00%-26.25%), polycrystalline quartz (0.25%-3.50%), and metaquartzite (0.00%-0.50%).

Accessory grain types include chamosite (0.00%-0.75%, by volume), muscovite mica (trace-1.50%), organic material (0.00%-1.00%), various heavy minerals (trace-0.75%; total heavy minerals), and biotite mica (0.00%-0.50%). Heavy mineral varieties include metamorphic chlorite, apatite, tourmaline, and zircon. Organic plant fragments appear to be partially replaced by pyrite, Fe-oxide, and/or Ti-oxide.

## Cement/Replacement

Authigenic minerals in these samples vary slightly from minor to moderate in abundance with the calculated amount (modal analysis) of authigenic cements ranging from 2.25%-4.25% (by volume), while authigenic minerals occurring as replacements range from 5.75%-10.00% (by volume). Authigenic clay represents the most influential type of mineral occurring in these samples (7.00%-9.00%; total authigenic clays, by volume). Thin section analysis indicates that illite (2.25%-5.25%; total illite) is the dominant authigenic clay based on color, birefringence, and morphology, but that kaolinite (1.50%-4.00%, total kaolinite, by volume) and chlorite (0.75%-1.50%, total chlorite) clays are also present (see Clay Mineralogy section in the following section for detailed clay information). The distribution of various authigenic clay types was determined based upon the occurrence of those clays as either pore linings/grain coatings, pore fillings, or as a diagenetic replacement of susceptible grains.

Other authigenic minerals occurring in the Upper Tinowon Sandstone Formation samples are minor to rare and include microquartz, Ti-oxides, Fe-oxides, feldspar overgrowths, quartz overgrowths, pyrite, and siderite. Microquartz occurs primarily as a late-stage pore-filling cement (0.00%-2.00%, by volume) and less often as a replacement of dissolved grains (0.00%-trace). Titanium (0.00%-0.50%) and iron (0.00%-0.50%) oxides occurs as rare microcrystalline grain coatings, while only Ti-oxide occur as alteration mineral associated with organic fragments and other susceptible detrital grains (trace-1.50%). Titanium oxides occur as rare microcrystalline grain coatings and as alteration minerals associated with organic fragments and other susceptible detrital grains (0.0%-0.7%). Quartz (0.00%-0.25%) and feldspar (0.00%-0.50%) overgrowths occur as syntaxial crystals on the surfaces of respective detrital grain varieties. These overgrowths are typically poorly developed and are locally inhibited by grain coatings of detrital clay and other authigenic minerals (e.g., clay, Ti-oxides). Authigenic quartz (0.00%-trace) and feldspar (0.25%-0.75%) are also associated with the minor recrystallization and/or replacement of dissolved grains and occur within secondary intragranular pores. Pyrite occurs as microcrystals and framboids on the surfaces of sand-sized grains (0.00%-trace), and less often as a replacement product of organic material, detrital matrix clays, or within secondary pores of partially dissolved grains (trace-0.75%, total replacement pyrite). The high density mineral siderite (0.00%-0.25%) occurs locally as a replacement of mudstone fragments and detrital matrix clays.

## Clay Mineralogy

Clays observed in the sandstone samples from the Upper Tinowon Sandstone Formation are both detrital (depositional) and authigenic (secondary) in origin. Detrital clays in the sandstones however, are minor and occur as sparse grain-supporting matrix (1.75%-13.00%) and are scattered throughout the samples. Detrital clays are not distinguishable from one another based on appearance without the aid of an energy dispersive spectrometer (EDS).

Authigenic clays occur as grain coatings, pore fillings and as a diagenetic alteration of unstable detrital grains. As in the previous Tinowon Sandstone Formation samples, kaolinite is the easiest clay to distinguish in thin section because of its characteristic book-shaped morphology and pore-filling character. Kaolinite occurs within intergranular pores (0.00%-1.25%) and also occurs as replacement of potassium-rich labile grains (0.00%-0.50%). Authigenic illite occurs as thin grain coatings on the surfaces of detrital grains, as minor pore-filling, and as an alteration product of partially dissolved unstable grains (0.50%-2.50%). Chlorite is also present and occurs as rare, blade-like crystals on the surfaces of detrital grains (0.00%-1.00%), and as a replacement of altered grains (0.00%-1.75%).

Scanning electron microscopy (SEM) indicates the matrix material consists of primarily mixed layer illite/smectite, cryptocrystalline quartz, and illite. Grain-coating, fibrous illite/smectite clays are observed at depth 2897.06m. Authigenic clays occur as a result of the partial dissolution of unstable feldspars and lithic grains. Microporosity is present within these clays.

X-ray diffraction (XRD) analysis (Appendix B) of the twenty (20) samples representing the Upper Tinowon Sandstone Formation reveals that mixed-layer illite/smectite (2%-23%, by weight) is the predominant clay type, followed by lesser amounts of illite/mica (3%-16%), chlorite (trace-1%) and trace amounts of kaolinite (trace).

**Reservoir Quality**

Routine core analysis was performed on the samples from the Upper Tinowon Sandstone Formation and are provided in Appendix E as a reference. Measured porosity values range from 4.5% to 13.1%. Permeability values (to air) range from 0.0047mD to 0.17mD. Primary intergranular pores are reduced by the minor detrital matrix clays and by moderate to high sedimentary compaction. Secondary intragranular pores associated with partially to completely dissolved lithic fragments and feldspars are the dominant pore type present in these sandstone samples (1.50%-9.75%; by volume). Primary intergranular pores (0.00%-1.50%) are minor. Micropores (1.50%-5.00%, by volume) are associated with detrital clay, authigenic clay (predominantly kaolinite and illite), and leached and altered detrital feldspar and lithic grains. Very narrow, often tortuous, pathways may interconnect the micropores to the larger pore throats. Grain-moldic pores are often identified as oversized pores that can significantly increase the connectivity of the pore system where intragranular pores are often isolated and poorly interconnected. Rare examples of intragranular fracture porosity (0.00%-0.25%) occurs within the more rigid quartz or feldspar grains. Petrographic thin section results are summarized in Table 4.

## TABLE 4

## SUMMARY OF PETROGRAPHIC RESULTS OF THE UPPER TINOWON SANDSTONE FORMATION

| Sample Number | Sample Depth (m) | Grain Size Avg. (mm) | Visual Sorting | Fabric | Total Matrix (vol. %) | Cement/ Replacement Minerals (vol. %) | Total Porosity (vol. %) | Poro./Perm. (RCA) |
|---|---|---|---|---|---|---|---|---|
| 1_27P-DS | 2895.09 | 0.07/0.49 | Mod to Poor | Lam. to Massive | 13.00 | 14.50 | 4.00 | 5.9%/0.020mD |
| 1_28P-DS | 2896.07 | 0.34 | Mod. Well | Massive | 5.00 | 17.75 | 6.50 | 10.6%/0.023mD |
| 2_2P-DS | 2897.06 | 0.42 | Moderate | Massive | 4.00 | 17.50 | 13.00 | 11.9%/0.062mD |
| 21-RCA | 2898.51 | 0.32 | Mod. To Mod Well | Massive; Coarse Upward | 6.75 | 13.75 | 8.75 | N/A |
| 2_6P-DS | 2901.06 | 0.41 | Moderate | Massive | 2.50 | 15.00 | 7.00 | 8.3%/0.17mD |
| 25-RCA | 2902.49 | 0.36 | Moderate | Massive | 7.00 | 12.50 | 11.75 | N/A |
| 28-RCA | 2905.56 | 0.32 | Mod. Well to Well | Massive | 6.25 | 17.00 | 12.75 | N/A |
| 2_23P-DS | 2906.05 | 0.44 | Moderate | Massive; Stylolites | 4.25 | 29.25 | 3.75 | 4.5%/0.0047mD |
| 2_13P-DS | 2907.04 | 0.36 | Moderate | Massive | 3.00 | 18.50 | 10.50 | 12.4%/0.055mD |
| 31-RCA | 2908.50 | 0.38 | Poor | Massive | 8.50 | 15.00 | 7.50 | 10.1%/0.051mD |
| 2-16P-DS | 2910.05 | 0.46 | Mod. To Poor | Massive | 4.75 | 14.25 | 9.75 | 11.3%/0.073mD |
| 34-SWC | 2912.30 | 0.46 | Moderate | Massive | 1.75 | 22.5 | 6.25 | 9.0%/0.023mD |
| 35-RCA | 2912.50 | 0.24 | Mod. To Well | Massive | 4.50 | 16.25 | 6.50 | N/A |
| 2_20P-DS | 2914.04 | 0.38 | Poor | Massive | 3.00 | 15.25 | 11.50 | 13.1%/0.11mD |
| 2_23P-DS | 2916.04 | 0.30 | Well to Poor | Massive | 2.50 | 16.00 | 9.25 | 10.8%/0.044mD |
| 2_26P-DS | 2919.05 | 0.45 | Mod. Well | Massive | 2.00 | 20.25 | 11.75 | 11.8%/0.040mD |
| 33-SWC | 2920.70 | 0.42 | Moderate | Massive | 2.00 | 20.00 | 11.00 | 11.7%/0.038mD |
| 2_29P-DS | 2922.04 | 0.70 | Moderate | Massive | 5.50 | 13.50 | 8.00 | 11.4%/0.13mD |
| 2_32P-DS | 2924.21 | 0.52 | Moderate | Massive | 2.75 | 23.25 | 11.50 | 10.9%/0.051mD |
| 32-SWC | 2931.50 | 0.53 | Moderate | Massive | 1.75 | 19.75 | 12.25 | 11.0%/0.069mD |

=Very fine to medium grained
=Fine-grained
=Medium-grained
=Coarse-grained

## ❖ Overston Sandstone Formation (4 samples; 3005.00m to 3008.80m)

### Sedimentary Fabric and Texture

All four (4) of the rotary sidewall core samples analyzed from this well were deemed suitable for modal point count analysis and X-ray diffraction (XRD) and with one (1) sample submitted for scanning electron microscopy (SEM) analysis. Two (2) of these samples are classified at sublitharenite and the other two (2) are classified as feldspathic litharenite. These samples range from very poor to moderately sorted and are considered generally massive. Average grain sizes range from 0.39mm to 1.08mm.

The angularity of the grains ranges from subangular to rounded, with most grains being subrounded. Tangential to concavo-convex grain contact boundaries, ductile grain deformations, the presence of pseudomatrix in the majority of samples indicate that these sandstones have undergone high to very high sedimentary compaction.

### Framework Grain Mineralogy

Mineralogically, the four samples within the Overston Sandstone Formation are very similar in composition. All of the sandstones are composed predominantly of quartz (48.00%-63.50%; by volume), many varieties of lithic fragments (9.25%-17.75%; total lithics), with lesser amount of feldspar (2.75%-8.75%, by volume; total feldspar). The lithic fragments consist mainly, by volume, of intermediate/mafic volcanic fragments (1.00%-1.50%), mudstones (1.50%-1.75%), felsic volcanic fragments (0.00%-0.25%), siltstones (3.00%-6.50%), chert (2.50%-5.75%), tuffaceous volcanic glass (2.00%-4.75%), schistose metamorphic fragments (0.25%-4.50%), and plutonic fragments (trace-6.25%). Plagioclase feldspar (2.75%-7.75%) is slightly more abundant than potassium feldspar (trace-1.00%). Monocrystalline quartz (34.75%-41.75%) far exceeds polycrystalline quartz (6.25%-19.75%) and metaquartzite (0.00%-9.00%) varieties in terms of abundance. Some lithic fragments and feldspars are slightly altered and partially dissolved.

Based on the Folk (1980) classification scheme (Figure 1; Appendix C), the sandstones are classified as two (2) feldspathic litharenite and two (2) sublitharenite. Accessory grain types include, by volume, organic material (0.00%-0.25%), muscovite mica (0.25%-1.75%), biotite mica (0.00%-0.75%), and heavy minerals (0.00%-0.50%). Organic plant matter appears to be partially replaced by pyrite and/or Ti-oxide.

### Cement/Replacement

Authigenic minerals occur in moderate to abundant amounts in these sandstones as a result of the minor amount and distribution of detrital matrix clays. Authigenic minerals occurring as cements account for 5.00% to 12.75% (by volume, per modal analysis) of the samples while authigenic minerals occurring as replacements range from 4.75% to 11.25%. Authigenic quartz overgrowth cement is common within the Overston

Sandstone samples ranging from 1.75% to 9.25% according to modal analysis (by volume).

Authigenic clay is another influential type of authigenic mineral present in these sandstone samples. Thin section analysis indicates that illite is the dominant authigenic clay based on color, birefringence, and morphology, but that kaolinite (trace) and chlorite (trace-0.50%; by volume) clays are also present (see Clay Mineralogy section for detailed clay information). The distribution of various authigenic clay types was determined based upon the occurrence of those clays as pore linings/grain coatings, as pore fillings, or as replacement of dissolved grains within secondary intragranular and grain-moldic pores. The distribution of continuous clay coatings tends to inhibit the development of grain-binding cement, such as quartz overgrowths.

Other minerals occurring in lesser amounts include, by volume, feldspar overgrowths, pyrite, ankerite, and microquartz. Feldspar overgrowths (trace-0.25%) precipitate in much the same way as quartz overgrowths, as syntaxial projections on the surfaces of host sand grains. Pyrite predominantly occurs as a replacement of detrital grains, such as organic material or lithic grains (trace-0.50%). Microcrystalline framboidal masses of pyrite are also observed occurring as clusters within intergranular areas or attached to the surfaces of detrital sand grains (0.00%-trace).

## Clay Mineralogy

Three (3) of the four (4) sandstones within the Overston Sandstone Formation contain minor to rare amounts of detrital clay minerals, 3005.00 does not contain detrital clay (based on modal analysis). Detrital clays are minor (0.00%-4.25%). Authigenic clays are minor to common and occur as precipitating grain coatings, as pore-filling accumulations, and as a diagenetic alteration of unstable detrital grains.

Authigenic kaolinite, the easiest clay to distinguish in thin section because of its characteristic book-shaped morphology and pore-filling character. Kaolinite (trace-0.50%, by volume) has a patchy distribution within intergranular pores and also occurs as an *in situ* replacement of undifferentiated labile grains, such as potassium feldspar, and plutonic fragments. Authigenic illite occurs as thin grain coatings on the surfaces of detrital grains, as minor pore-filling masses, and as an alteration product of partially to completely dissolved unstable detrital sand grains. Authigenic illitic clay (both discrete illite and mixed-layer illite/smectite) typically displays characteristic crenulated/wavy morphology or occurs as web-like aggregates along selective grain surfaces and as masses intermixed with other clay types within intergranular pores. Illitic clays less commonly occur as pore-lining grain coats (trace-1.25%) or pore-filling masses (1.00%-2.25%), and more often are associated with the alteration of partially dissolved detrital grains (2.25%-3.00%). Chlorite is also present and occurs as minor, blade-like crystals on the surfaces of detrital grains (trace-0.50%) and is more readily associated with the alteration of susceptible grains, such as volcanic fragments (trace-0.50%) or other labile grains.

Scanning electron microscopy (SEM) analysis was only preformed on one sample from the Overston Formation (3007.90m). These images indicate the presence of grain-coating illite and kaolinite. In some places the kaolinite booklets are engulfed by quartz overgrowths.

XRD data supports thin section petrographic analysis by indicating that the samples are similar mineralogically. Clay minerals are prevalent, ranging from 17% to 23% (total clay) and consist of mixed-layer illite/smectite (5%-14%; total mixed clay), illite/mica (6%-12%), kaolinite (trace), and chlorite (trace). The mixed layer clay consists of ordered interstratified 15%-35% and 40%-55% expandable clay. Complete XRD data is available in Appendix B.

## Reservoir Quality

Porosity and permeability measurements for the Overston Sandstone Formation (see Appendix E) were obtained during routine core analysis. Measured porosity values range from 10.5% to 12.6% for the samples selected for petrographic analysis, while measured permeability values (to air) range from 0.29mD to 0.49mD. Porosity, as measured during thin section modal analysis for the majority of the sandstones, ranges from 8.25%-9.75%; total porosity by volume. The pore systems of these sandstones consist predominantly of intragranular pores associated with partial or complete dissolution of unstable grains (5.50%-7.00%, by volume per modal analysis), with effective porosity being reduced by a combination of sedimentary compaction and authigenic cements (e.g., calcite & authigenic clays). Micropores are associated with detrital clay, authigenic clay, and leached detrital grains. Primary intergranular pores (trace-1.50%, by volume; primary pores) are minor with poor pore connectivity. Pores occurring within fractured grains are rare, only accounting for 0.00% to 0.25% amounts. Petrographic thin section results are summarized in Table 5 (below).

**TABLE 5**

**SUMMARY OF PETROGRAPHIC RESULTS OF THE OVERSTON SANDSTONE FORMATION**

| Sample Number | Sample Depth (m) | Grain Size Avg. (mm) | Visual Sorting | Fabric | Total Matrix (vol. %) | Cement/ Replacement Minerals (vol. %) | Total Porosity (vol. %) | Poro./Perm. (RCA) |
|---|---|---|---|---|---|---|---|---|
| 21-SWC | 3005.00 | 0.71 | Very Poor | Massive | 0.00 | 13.25 | 8.25 | N/A |
| 24-SWC | 3006.80 | 1.08 | Mod. To Poor | Mass.; Stylolites | 4.25 | 16.25 | 8.75 | 12.6%/0.49mD |
| 23-SWC | 3007.90 | 0.39 | Mod. To Poor | Mass.; Burrowed | 0.75 | 18.75 | 9.75 | 11.9%/0.29mD |
| 22-SWC | 3008.80 | 0.74 | Poor | Mass.; Stylolites | 0.75 | 13.50 | 9.50 | 10.5%/0.33mD |

=Medium-grained
=Coarse-grained

❖ **Lorelle Sandstone Formation (12 samples; 3061.00m to 3133.75m)**

**Sedimentary Fabric and Texture**

Seven (7) of the twelve (12) samples from this Lorelle Sandstone Formation were selected for detailed thin section analysis, the remaining five (5) were considered unsuitable for point count analysis and submitted for general thin section analysis. All twelve (12) were analyzed using X-ray diffraction (XRD), and two (2) were submitted for scanning electron microscopy (SEM) analysis. According to Folk's (1980) sandstone classification scheme (Figure 1, Appendix C), these quartz-rich sandstones are classified as one (1) quartzarenite, two (2) sublitharenite, three (3) litharenite, and one (1) sublitharenite to litharenite. The average grain size of these sandstones are visually estimated to range from 0.34mm (medium sand) to 3.58mm (gravel).

Sorting of the sandstones ranges from poor to moderate. Sample fabrics include massive to faintly laminated, bioturbated, stylolites, and massive. The overall angularity of the grains ranges from subangular to rounded, with the majority of grains being subround. Tangential to concavo-convex grains boundaries, ductile grain deformation, and the presence of microstylolites indicate that the majority of these sandstones have predominantly experienced moderate to very high burial compaction.

**Framework Grain Mineralogy**

Thin section analysis results (Appendix C) reveal that framework grain components in the Lorelle Sandstone Formation sandstones are dominated by quartz (25.00%-61.25%; total quartz, by volume), with lesser amounts of lithic fragments (0.25%-27.25%; total lithics) and feldspars (0.00%-3.75%; total feldspars). Quartz varieties include monocrystalline quartz (6.00%-45.75%), polycrystalline quartz (3.50%-55.25%), and metaquartzite (0.00%-19.25%). Potassium feldspar (0.00%-1.50%) occurs in slightly higher amounts than plagioclase feldspar (0.00%-2.50%). Lithic varieties include, by volume, felsic volcanic fragments (0.00%-0.25%), mudstone fragments (0.00%-0.50%), chert (1.00%-7.25%), siltstone fragments (0.00%-5.00%), intermediate volcanic fragments (0.00%-0.25%), schistose metamorphic fragments (0.00%-3.50%), plutonic fragments (0.00%-0.75%), and tuffaceous/glass fragments (0.00%-18.75%). Some lithic fragments are slightly altered (seriticized or recrystallized) and partially dissolved.

Accessory grain types are minor and consist of muscovite mica (0.25%-2.25%), heavy minerals (trace-0.25%, total heavy minerals by volume), biotite mica (0.00%-0.25%), carbonaceous material (trace-3.25%), and glauconite (0.00%-trace).

**Cement/Replacement**

Authigenic minerals typically occur in minor to common amounts in these sandstones. Authigenic minerals occur as cement (4.75% to 16.50%, by volume) and replacement (4.00% to 16.25%). Quartz overgrowths (0.25%-10.75%) represent the most commonly occurring authigenic mineral in these sandstones. Overgrowths occur as syntaxial crystals on the surfaces of host detrital quartz grains. Quartz overgrowths are typically moderately developed and are locally inhibited by grain coatings of detrital clay and authigenic minerals (e.g., chloritic or illitic clay). These overgrowths rarely coalesce with overgrowths from adjacent grains to occlude entire intergranular pores. Quartz cement also occurs within secondary intragranular and grain-moldic pores within partially to completely dissolved lithics or feldspars.

Authigenic clay represents another influential type of authigenic mineral in these sandstone samples. Thin section analysis indicates that trace to rare amounts of illite, chlorite, and kaolinite are present in these sandstones and the distribution of these various authigenic clay types was determined based upon the occurrence of those clays as either pore linings/grain coatings and pore fillings. Illitic clays occur as both pore-lining (trace-5.50%) and pore-filling (0.25%-4.50%) precipitations and is also present as replacement of dissolved lithics and feldspars (trace-2.00%). Chlorite is distinguished based on its characteristic greenish color and platelet to sometimes rosette-like morphology. Like the illitic clays, chlorite occurs as a rare grain-coating clay and pore-filling clay, but is slightly more abundant as a replacement of susceptible grains.

Authigenic minerals occurring in minor to trace amounts include feldspar overgrowths, pyrite, calcite, and siderite. Feldspar overgrowth precipitation (trace) and replacement (trace) is rare in these sandstones. The minerals pyrite and calcite occur as sparse, microcrystalline accumulations within intergranular pores and as replacements of labile grains. Siderite only occurs as a rare replacement of mudstone fragments.

**Clay Mineralogy**

Clay occurring in the Lorelle Sandstone Formation samples are predominantly authigenic in origin, with only minor to rare amounts of detrital clay. The total detrital matrix content for these samples ranges from 0.00%-13.75% (by volume, per modal analysis). Detrital clays occur as poorly defined laminations and as minor coatings on larger sand-sized grains. Authigenic clay precipitation is more abundant, with the total amount of authigenic clays occurring in these sandstones. Authigenic clays occur as precipitated grain-coating or pore-filling accumulations and as a diagenetic alteration of unstable detrital grains.

Authigenic kaolinite clay (0.00%-1.00%; total kaolinite, by volume) has a patchy distribution within intergranular pores and also occurs as an *in situ* replacement of unstable grains. The kaolinite crystals that are loosely attached to pore walls may become easily dislodged, subsequently blocking pore throats as they migrate during fluid flow through the reservoir. Authigenic illite occurs as thin grain coatings on the surfaces of detrital grains, as minor pore-filling, and as an alteration product of partially to completely dissolved unstable detrital grains. Chlorite (0.00%-1.75%; total chlorite) occurs as a replacement of altered grains and as scattered grain coatings that are distinguished by a face-to-edge morphology of blade-like crystals.

Scanning electron microscopy (SEM) indicates the grain-coating/pore-filling material consists of mainly mixed layer illite/smectite. Kaolinite booklets and clusters of bladed chlorite fill secondary pores (3075.00m).

X-ray diffraction (XRD) analysis (Appendix B) of the twelve (12) Lorelle Sandstone Formation samples reveals that kaolinite (trace-8%, by weight) is the predominant clay type, followed by lesser amounts of chlorite (trace-20%), mixed-layer illite/smectite (0%-59%), and illite/mica (trace-50%). The mixed-layer illite/smectite consists of ordered interstratified layers that are 15%-35% and 40%-55% expandable. The bottom five (5) samples, which were not suitable for modal analysis, contain the majority of the clays within this formation.

**Reservoir Quality**

Porosity and permeability measurements were obtained for the Lorelle Sandstone Formation samples during routine core analysis (see Appendix E). Measured porosity values range from 1.3% to 18.4%, while measured permeability values (to air) range from 0.0011mD to 0.28mD. For the majority of the samples, reservoir quality estimates indicated low connectivity of the available macropores as determined during thin section analysis. Porosity is locally reduced in these sandstones by compaction, especially in the sandstones containing microstylolites, and by isolated pore-filling cements, such as quartz overgrowth cement or pore-filling calcite.

Secondary intragranular and grain-moldic pores (trace-8.25%), occurring within partially to completely dissolved detrital grains are the dominant pore type occurring in these sandstones. Susceptible grains include feldspars and feldspar-bearing lithic fragments, such as volcanic fragments. Primary intergranular pores (0.00%-1.50%, by volume) often contribute a significant amount of porosity to the pore system in several samples. Micropores (1.25%-8.25%; total micropores) associated with detrital clay, authigenic clay (especially kaolinite), argillaceous fragments, and partially dissolved grains are typically minor. Rare grain fracture pores (0.00%-trace) are observed in all of the samples in rare amounts. Thin section results are summarized in Table 6.

## TABLE 6

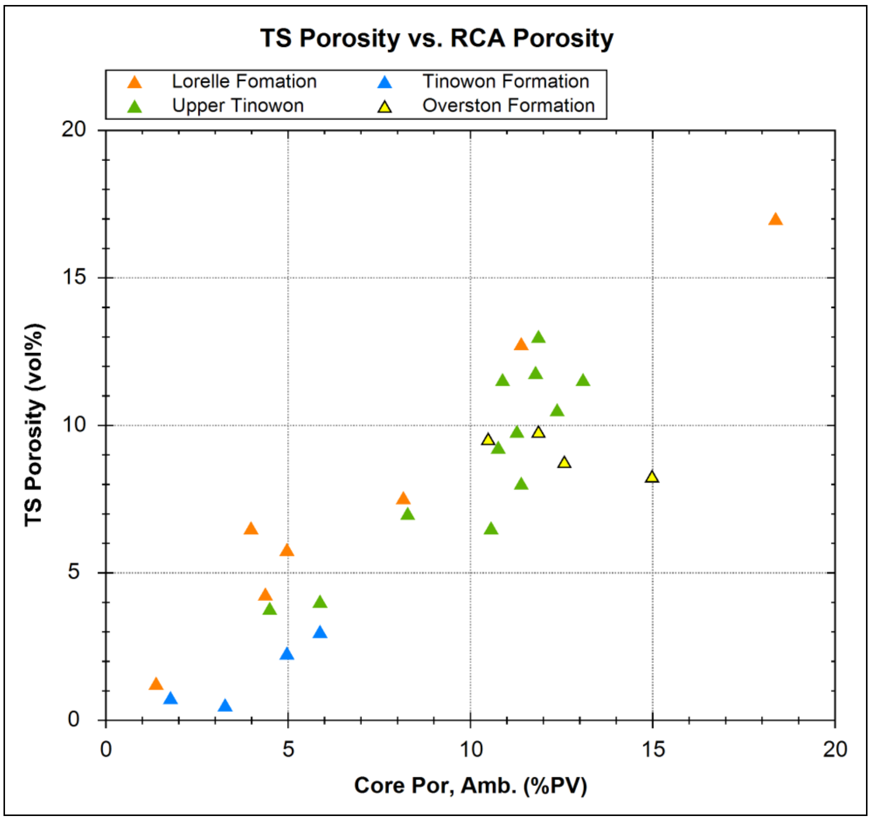
## SUMMARY OF PETROGRAPHIC RESULTS OF LORELLE SANDSTONE FORMATION SAMPLES

| Sample Number | Sample Depth (m) | Grain Size Avg. (mm) | Visual Sorting | Fabric | Total Matrix (vol. %) | Cement/ Replacement Minerals (vol. %) | Total Porosity (vol. %) | Poro./Perm. (RCA) |
|---|---|---|---|---|---|---|---|---|
| 12-SWC | 3061.00 | 0.39 | Moderate | Mass.; Stylolites | 13.75 | 12.25 | 6.50 | 4.0%/0.020mD |
| 11-SWC | 3075.00 | 0.71 | Poor | Lam to Massive | 11.50 | 12.25 | 5.75 | 5.0%/0.045mD |
| 10-SWC | 3076.47 | 0.53 | Moderate | Massive | 2.00 | 24.50 | 7.50 | 8.2%/0.15mD |
| 9-SWC | 3081.43 | 2.36 | Moderate | Massive | 0.00 | 21.00 | 17.00 | 18.4%/2.70mD |
| 8-SWC | 3083.00 | 0.34 | Moderate | Mass.; Bioturbated | 2.25 | 19.50 | 12.75 | 11.4%/0.28mD |
| 7-SWC | 3085.33 | 3.58 | Very Poor | Mass.;Stylolites | 3.25 | 8.75 | 4.25 | 4.4%/0.24mD |
| 6-SWC | 3093.00 | 0.39 | Poor | Lam.; Disturb.; Stylo | 4.50 | 24.25 | 1.25 | 1.4%/0.028mD |
| 5-SWC | 3112.78 | >2.00cm | Poor | Mass.; Frac.; Rework | N/A | N/A | N/A | 1.3%/0.0011mD |
| 4-SWC | 3116.00 | N/A | N/A | Aphanitic; Fractured | N/A | N/A | N/A | 3.6%/0.0058mD |
| 3-SWC | 3120.00 | N/A | N/A | Aphanitic; Fractured | N/A | N/A | N/A | 4.8%/0.098mD |
| 2-SWC | 3126.00 | >2.00cm | Poor | Mass.; Frac.; Rework | N/A | N/A | N/A | 2.3%/ N/A |
| 1-SWC | 3133.75 | >2.00cm | Poor | Mass.; Frac.; Rework | N/A | N/A | N/A | 4.9%/0.0059mD |

=Medium-grained
=Coarse-grained
=Tuff/Basalt

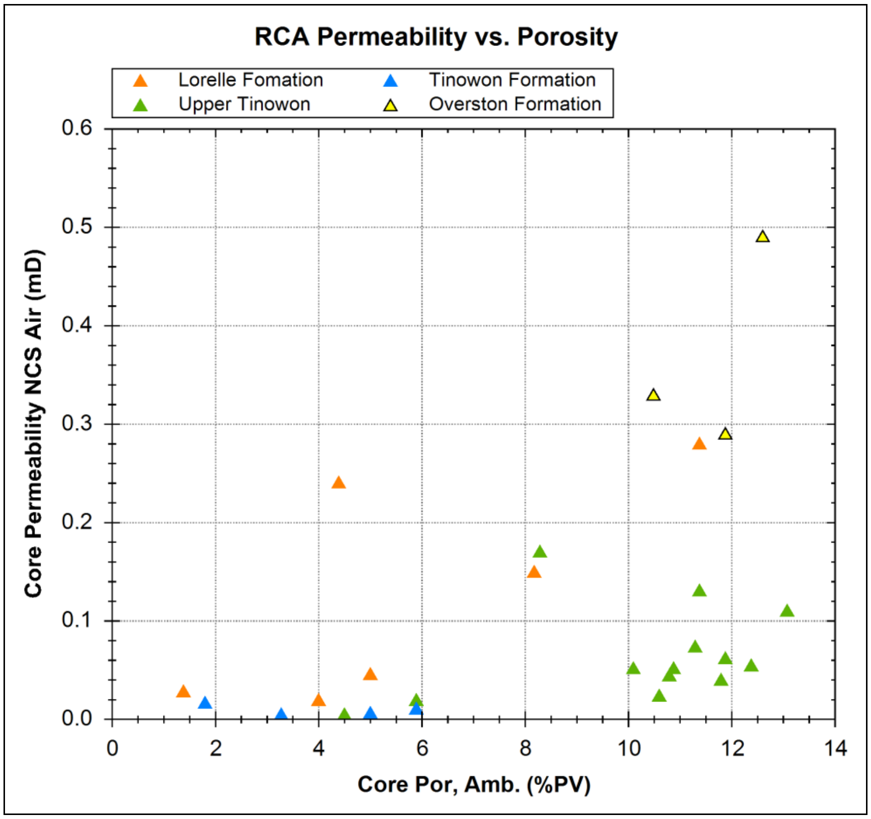
## POROSITY AND PERMEABILITY CORRELATION

A comparison of thin section porosity versus routine core analysis (RCA) porosity (Appendix E), displayed in the plot below, shows generally good agreement. However, some variances in the data are evident. Routine core analysis porosity is slightly higher than thin section derived porosity in some samples, likely due to microporosity associated with detrital and/or authigenic clays not detected during thin section analysis. The samples from the Tinowon Formation have lower porosity values for both thin section and RCA, while the samples from the other formations are more varied. Note the one sample from the Back Alley Shale Formation was not suitable for modal analysis and therefore is not represented in the following plots.

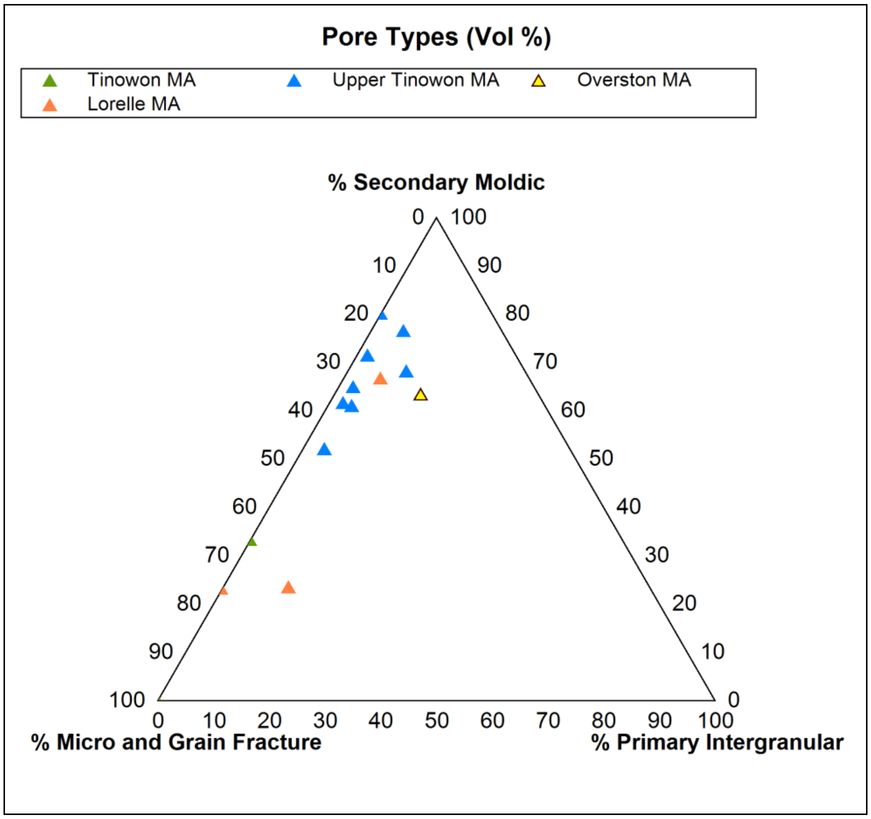



Thin section derived porosity measurements for the Tinowon, Upper Tinowon, Overston, and Lorelle Formation samples are similar, with the majority of the samples containing porosity values that range from 4.00% to 13.00% (by volume, per modal analysis). There are two depths within the Lorelle Sandstone and Tinowon Formation with reduced porosity (0.50-1.25%) that are cemented by calcite. The Lorelle Sandstone Formation samples contain the most variation in porosity values (0.50%-17.00%; per modal anaylsis), the high value is due to the abundant amount of preserved intragranular pores and micropores associated with clays.

The higher porosity samples show similar effects on remaining porosity compared to the other samples within the well. A plot of permeability versus routine porosity showing a slight correlation follows.

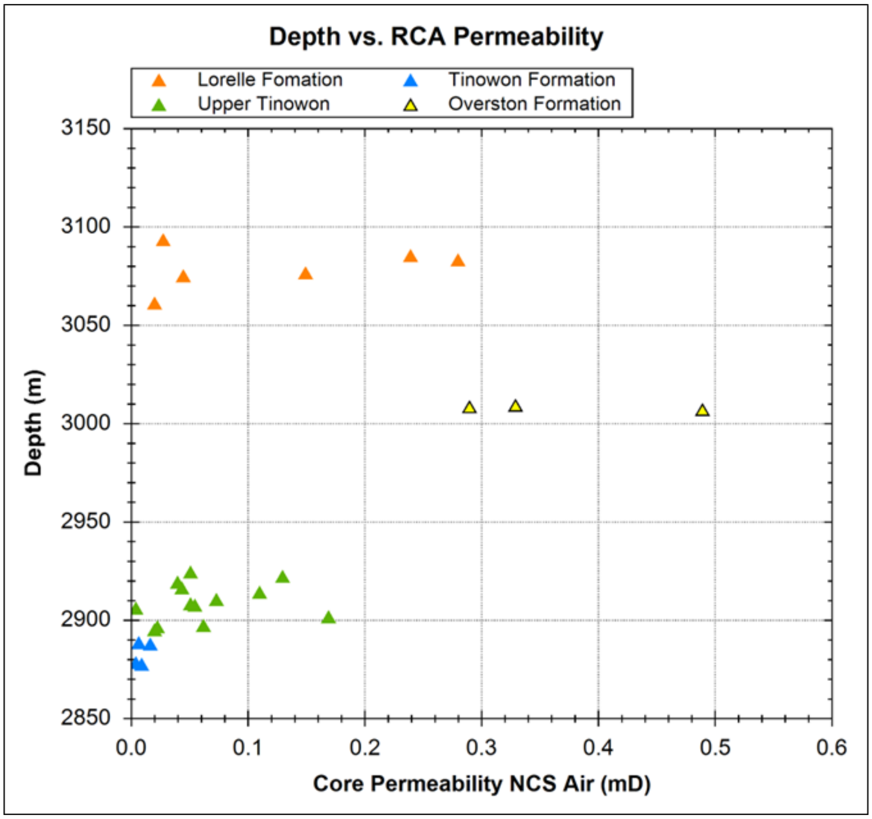


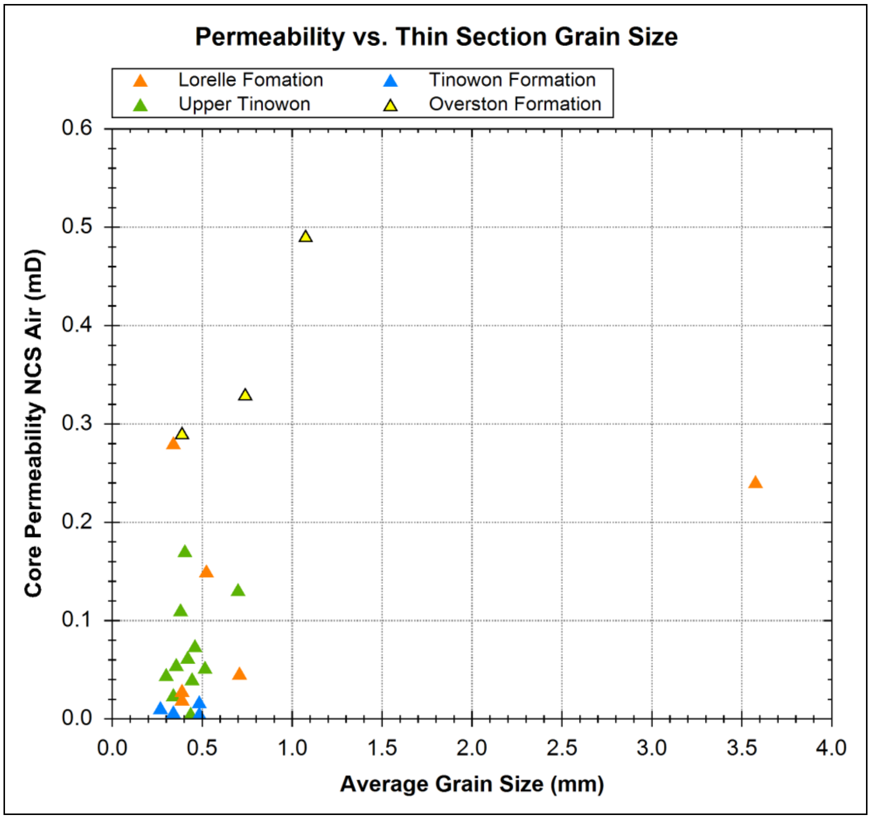

Porosity types occurring in these samples are identified according to thin section analysis and SEM examination. Effective porosity consists of primary intergranular pores (0.00%-1.50%, by volume; per modal analysis), secondary intragranular pores (trace-9.75%), micropores (0.50%-8.25%), and pores occurring within fractured grains (0.00%-0.25%). Porosity percentages vary throughout the well, ranging from abundant porosity in the coarse-grained Lorelle Formation to minor porosity in the well cemented samples from the Tinowon Formation. Factors contributing to the reduction of effective porosity, when present, include abundant pore-filling cements (i.e., calcite), grain-supporting detrital matrix clays, volcanic matrix, and sedimentary compaction. The following plot provides a ternary diagram of distribution of the pore types for each formation (following page).




This example illustrates the abundance of micropores and secondary intragranular pores present in these samples.

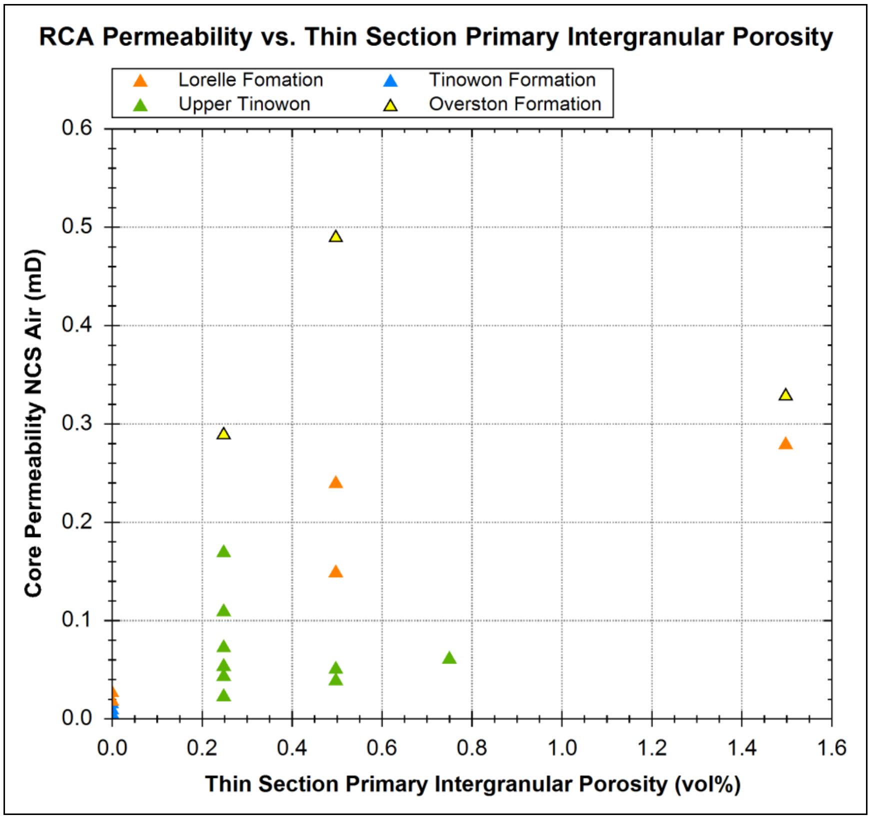
Permeability is also controlled by pore types, cement volume, and compaction. Data sets were plotted with permeability to assess their effect on different formations. The plot below illustrates that permeability is higher in the Lorelle and Overston formations where there is low compaction and trace amounts of cement. In the Upper Tinowon and the Tinowon formations there is high compaction and common amounts of cement there is also low permeability.

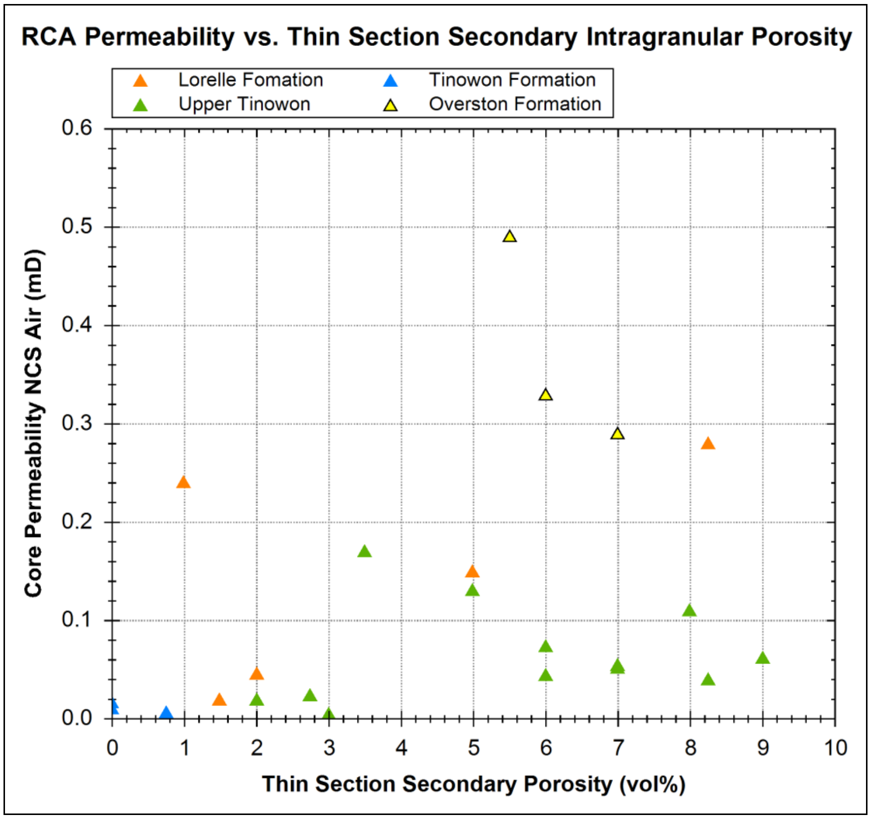


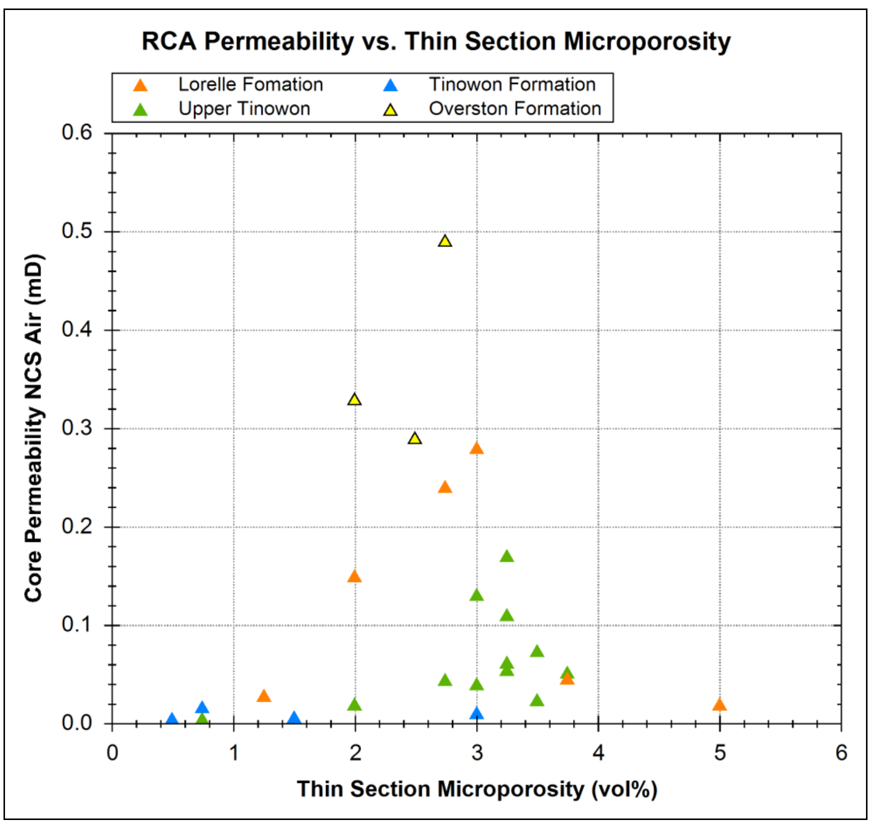



This plot depicts permeability versus average grain size, indicating that grain size is a significant factor contributing to permeability changes. The Lorelle Formation sandstone (3081.43m) contains oversized secondary moldic pores created from the complete dissolution of coarse-grained feldspars and possible lithic grains; causing this sample to plot as an outlier.

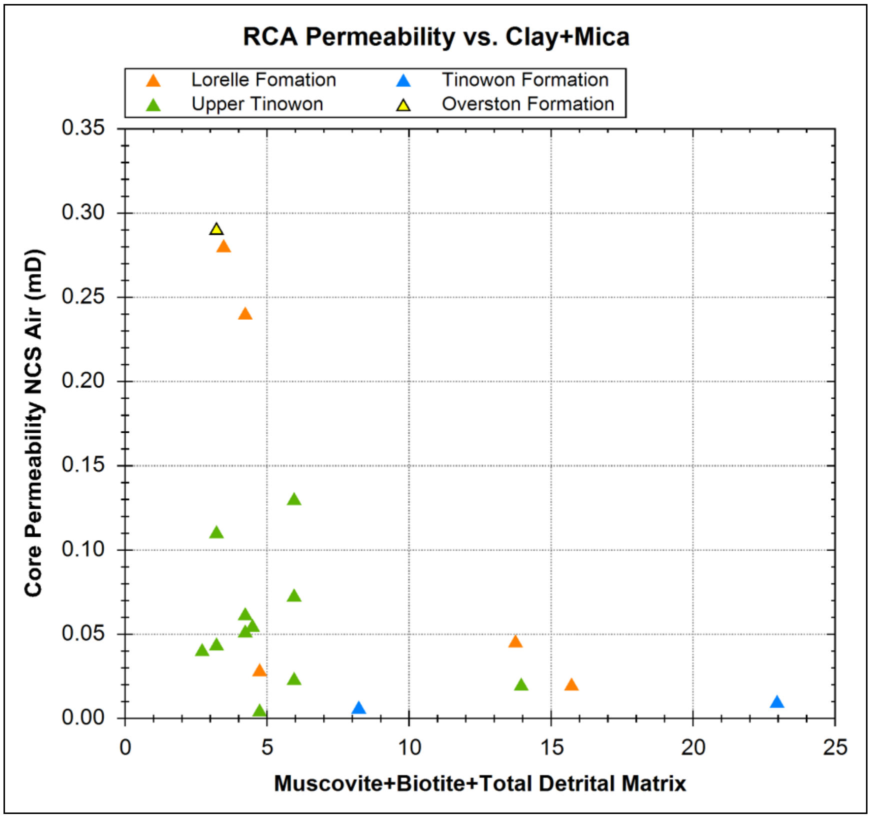
Permeability versus various types of porosities do not always correlate, as illustrated in the graphs on the following pages.



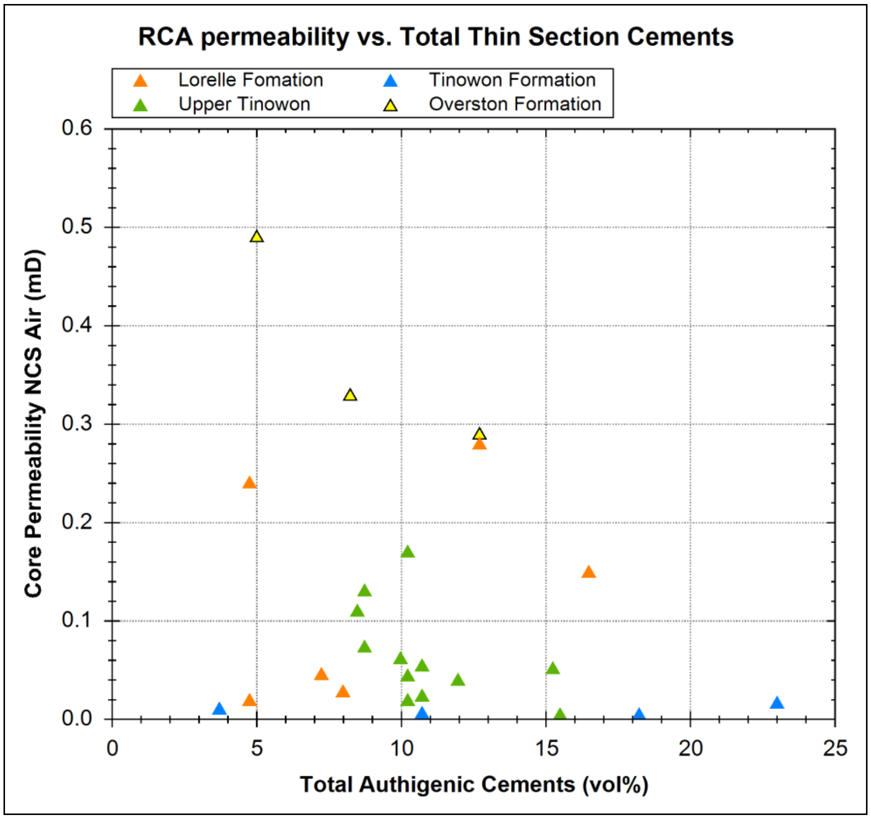

RCA Permeability vs. Thin Section Secondary Intragranular Porosity
Lorelle Fomation
Tinowon Formation
Upper Tinowon
Overston Formation
Core Permeability NCS Air (mD)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
1
2
3
4
5
6
7
8
9
10
Thin Section Secondary Porosity (vol%)


RCA Permeability vs. Thin Section Microporosity
Lorelle Fomation
Tinowon Formation
Upper Tinowon
Overston Formation
Core Permeability NCS Air (mD)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0
1
2
3
4
5
6
Thin Section Microporosity (vol%)

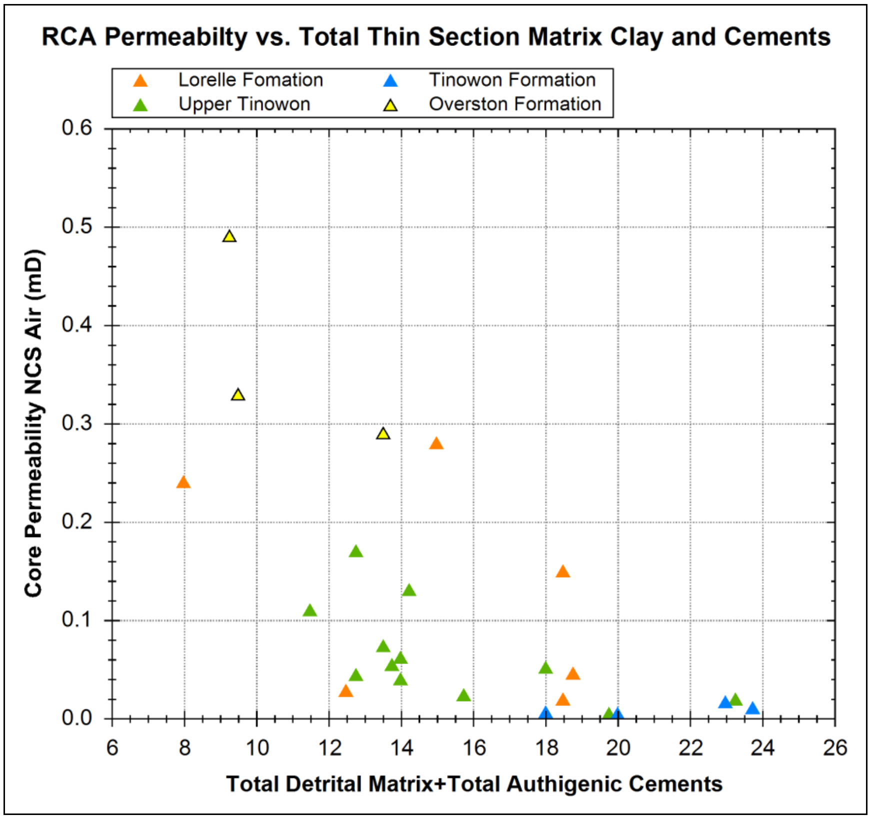
Examination of these samples indicates that many contain ductile materials (clays, mudstone fragments, micas, etc.). Sediment compaction is also evident based on grain-contact relationships and the presence of stylolites. The relationship between permeability and the amount of ductile material is illustrated in the following graph.



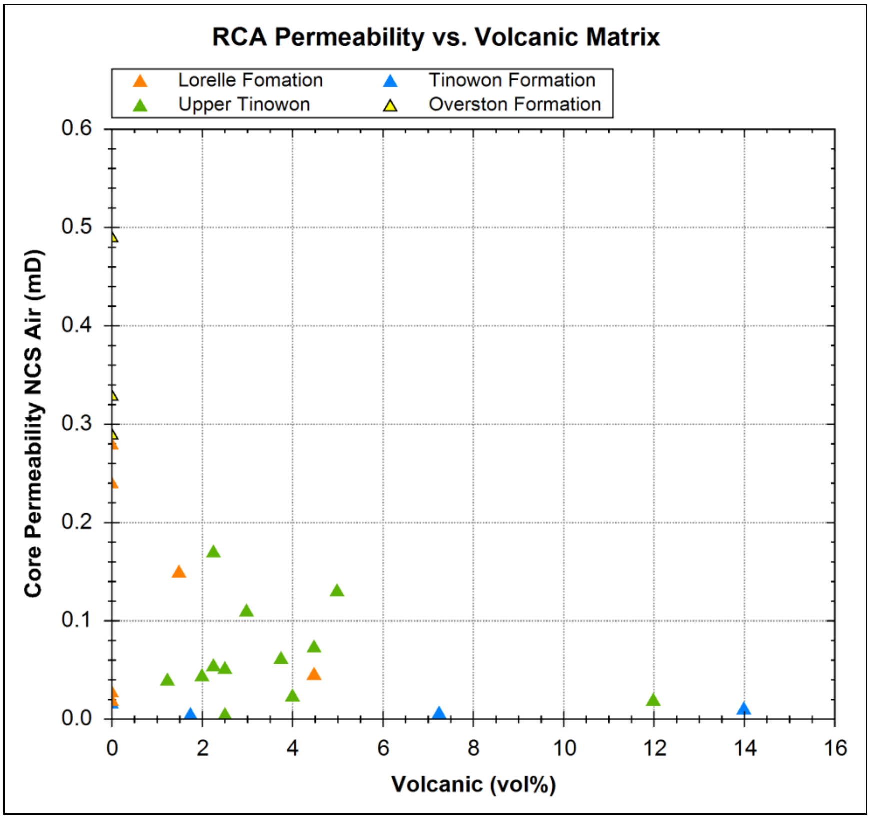
Rigid cements, such as quartz overgrowths and carbonates, also affect permeability by occluding intergranular pores and pore throats.  This relationship is illustrated in the following graph.



The combination of rigid cement and ductile material constitutes a negative impact on permeability. Pore throats that control permeability are also the most affected areas by cements and ductile components. A plot of permeability versus cements and ductile material is provided below.



Several samples contain minor to common amounts of volcanic matrix. A detrital, volcanic matrix consisting of cryptocrystalline quartz and feldspar, microcrystalline rock debris, and probable volcanic glass generally occurs in minor amounts. The samples containing common amounts of volcanic matrix contain little to no porosity. A plot of permeability versus volcanic matrix is provided below.



## Mineralogic Influences On Log Response

The following section discusses the effects on log response of the mineralogy and associated pore types occurring in these samples.

**Resistivity Logs:** The main factors that may suppress resistivity in the samples from this well are pore-filling authigenic kaolinite, grain-coating/pore-filling authigenic illitic and chloritic clay, laminar to grain-supporting concentrations of detrital clay, microporous partially dissolved and clay-altered grains (i.e., potassium feldspar and metamorphic grains), widespread pore-filling Fe-calcite, microcrystalline siderite, and microcrystalline pyrite. Resistivity suppression can result from conductive minerals and from the immovable water bound in microporous clay minerals. High resistivity suppression is expected in the intervals containing higher amounts of detrital clay or pore-filling Fe-calcite; however, low to minor resistivity suppression is expected in the cleaner samples with less clay minerals or pyrite.

**Density Logs:** The sandstone samples analyzed typically contain minor amounts of the high density minerals pyrite, Ti-oxides, Fe-oxides, calcite, Fe-calcite, dolomite, or siderite. These samples also often contain minor amounts of lower density minerals, such as feldspars, feldspar-bearing lithic fragments, and matrix clays. According to core analysis results, the samples selected for petrographic analysis range in density from 2.63g/cm$^3$ to 2.80g/cm$^3$.

**Gamma-Ray Log:** Gamma-ray logs respond to radioactive isotopes. The clay minerals kaolinite and chlorite will not be detected by gamma-ray logs due to the absence of potassium in these minerals. Conversely, the mineral potassium feldspar will be detected by the gamma-ray logs due to the presence of potassium, and may be interpreted as “clay” in a Vclay calculation based on gamma-ray response. In addition, thin section analysis reveals the minor presence of plutonic fragments and organic-debris. These components will slightly increase the gamma-ray response due to the presence of potassium or other radioactive minerals. The net result of these components would be that the gamma-ray log response could under-estimate the total clay volume in the samples.

## FORMATION SENSITIVITY

The presence of microporous mixed-layer illite/smectite clay in many samples is a concern. These clays are observed in SEM examination lining pores and pore-throat walls, infilling pores, occurring as a component of detrital matrix clays, and as a component of mudstone fragments. The use of benign completion fluids such as KCl fluid is recommended to prevent any clay swelling/interaction. It is suggested that any fluid used in completion be tested with the formation water (if available) to assess the potential for fluid interaction and potential solids precipitation.

Petrographic analysis reveals that these samples are predominantly quartz- and feldspar-rich and lithic-rich sandstones; however, there was an exception (welded tuff). The carbonate minerals calcite, Fe-calcite, dolomite, and siderite occur in variable amounts (minor to very high) as pore-filling cement, as a replacement of partially to completed dissolved labile grains, as disseminated microcrystals, and as detrital grains. Carbonate minerals are not compatible with HF acid systems, and an acid treatment is not recommended. However, if acid is needed, HCl acid coupled with an iron chelating agent can be used. If mud acid is used, be sure to pump enough HCl ahead to remove carbonate minerals, before pumping HF acid. Otherwise an inert damaging precipitate ($CaF_2$) may form.

## DIAGENESIS

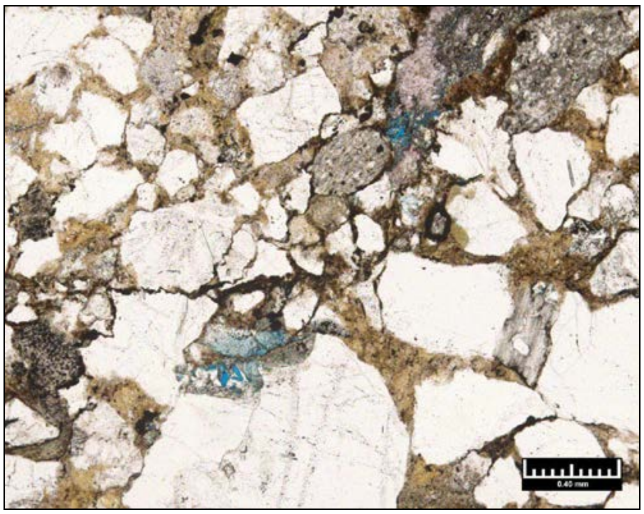
The diagenetic sequence was developed by examining the relative occurrences of the various diagenetic processes and products. Depositional features that originated prior to burial may no longer exist because of compaction, dissolution, and replacement. Based on the results of thin section petrography, point count data, X-ray diffraction (XRD) analysis, and scanning electron microscopy (SEM) examination, a schematic generalized diagenetic sequence is provided, and a discussion of the major diagenetic elements follows.

Three (3) main diagenetic sequences are observed, and include initial sediment compaction, subsequent cementation, and secondary dissolution. Initial sediment compaction is observed by grain-contact relationships and compaction/contortion of less stable components, such as organic material and micas. Mechanical compaction is less pronounced in the samples containing smaller quantities of detrital clay and was largely limited to grain rotation and rearrangement. The presence of quartz overgrowths, pore-filling calcite cement, or volcanic matrix inhibited additional burial compaction by providing a rigid framework. As a result, major mechanical compaction was largely impeded after these cements were developed.

The diagenetic sequencing is variable between the different formations, despite the samples occurring within the same basin. Various import sources, e.g. fluvial or wind deposits, significantly changed the resulting of the deposited lithologies. The mineralogy of these lithic/quartz-rich sandstones are relatively consistent throughout the Dunk-1 well, the exception of the basaltic samples from the bottom of Lorelle Sandstone Formation. Descriptions of each authigenic mineral occurrence, with example photomicrographs is provided on the following pages.

## Compaction

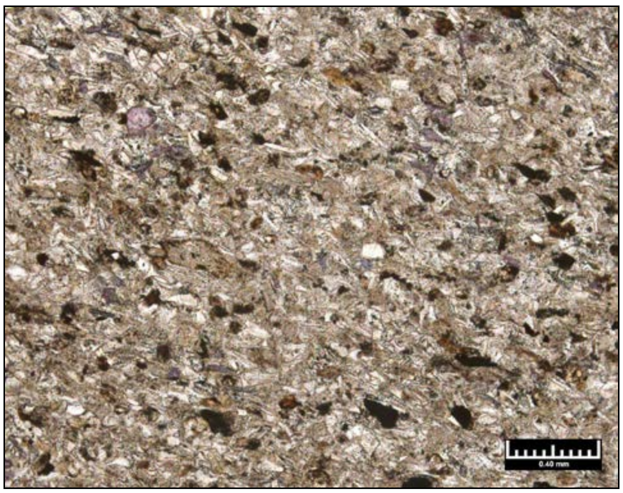
Compaction was generally greater in the samples containing more matrix material, because of abundant ductile material. Below is a thin section photomicrograph of a sample that contains moderate amounts of matrix material (3061.00m). This photo illustrates a organic-filled stylolite which indicated very high compaction. Mechanical compaction is less pronounced in the clean samples and was largely limited to grain rotation and rearrangement. In some samples the presence and localized abundance of cements, such as quartz overgrowths or calcite cement inhibited further burial compaction by providing a rigid framework. Some samples (2896.07m, 2898.51m, 3075.00m) also contain fractured gains due to compaction.



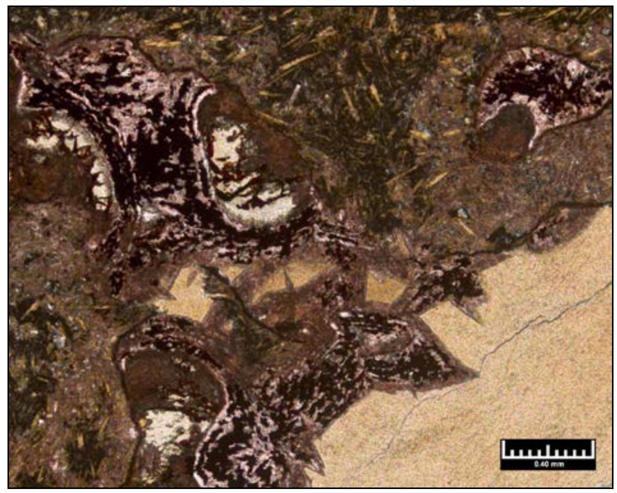
3061.00m 50X Magnification (thin section photo)

## Volcanic matrix

A detrital, volcanic matrix (groundmass) composed of cryptocrystalline quartz and feldspar, microcrystalline rock debris, and probable trace volcanic glass occurs in abundant amounts in the Back Alley Shale sample and samples from the bottom of the Lorelle Formation. While depositional in origin, when present in sufficient amounts this matrix material significantly reduces pore spaces and inhibits the precipitation of authigenic cements The amount of volcanic matrix is generally absent to minor in the majority of formations from this well, with the exception of the Back Alley Shale Formation and the bottom of the Lorelle Formation where volcanic matrix is abundant. Below thin section photographs represent two different formations illustrating the abundant amount of volcanic matrix present.



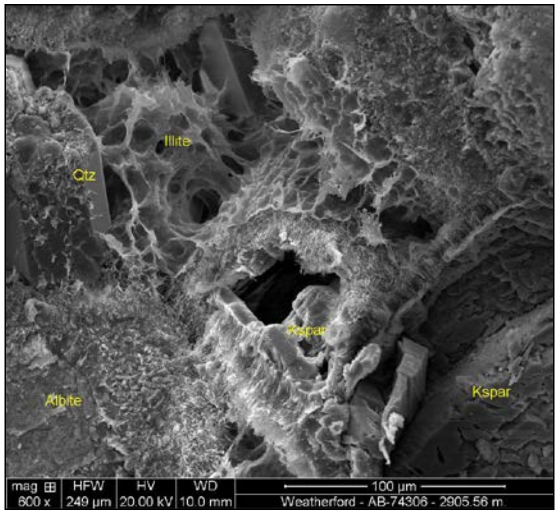
2813.00m 50X Magnification (thin section photo)



3112.78.00m 50X Magnification (thin section photo)

## Authigenic Grain-Coating Clay

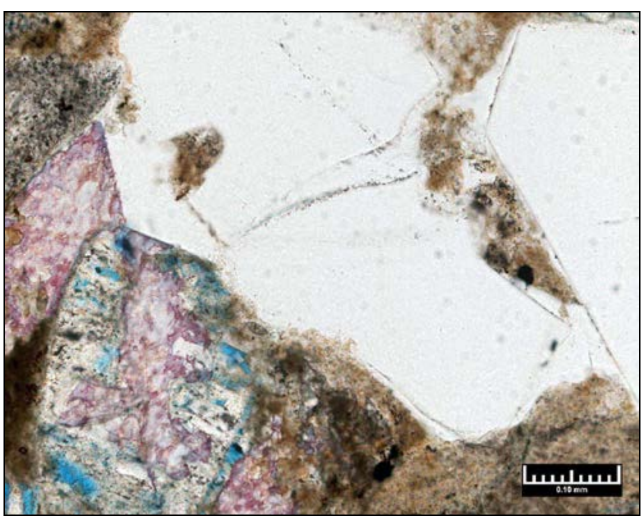
The amount and distribution of authigenic grain-coating clay varies in these samples, ranging from trace (visual estimated, by volume) to 10.75% in the fine- to coarse-grained sandstones. Petrographic analysis indicates that grain-coating clays consist of a combination of illite, mixed-layer illite/smectite, kaolinite, and minor chlorite. These clays occur on the surfaces of detrital grains, as pore-filling material, and as an alteration product of labile grains. Grain surfaces containing continuous clay rims will inhibit the precipitation of secondary quartz cements, which essentially preserves the adjacent intergranular pore space. Illitic clays, both illite and mixed-layer illite/smectite, occur as crenulated to web-like crystals; however, minor occurrences of fibrous illite are also present. The thin section photomicrograph on the following page illustrates grain coatings of authigenic clay that line pores and inhibit quartz precipitation. The SEM photomicrograph, also on the next page, illustrates the fibrous, grain-coating, illitic clay.

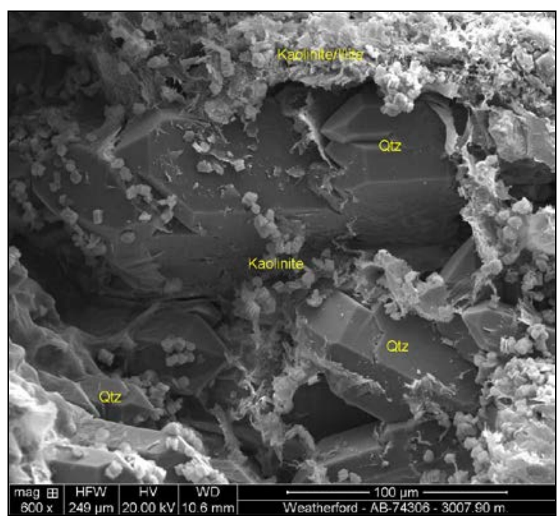


2905.56m 600X Magnification (SEM photo)

**<u>Quartz Overgrowths</u>**

Quartz overgrowth cement precipitated early in the diagenetic history of these samples. Quartz overgrowth cement is rigid and is resistant to dissolution and compaction. Quartz overgrowth cement is less developed in the samples containing continuous grain coatings of clay. Both the thin section and SEM photomicrographs below illustrate the potential pore-filling characteristic of quartz overgrowths and the localized inhibition of this cement type by grain coatings of authigenic clay. In the SEM image, secondary quartz is observed occurring within intragranular pores as a replacement of less stable material or as possible overgrowths. The thin section photo provides an example of well developed, grain-binding quartz overgrowths.

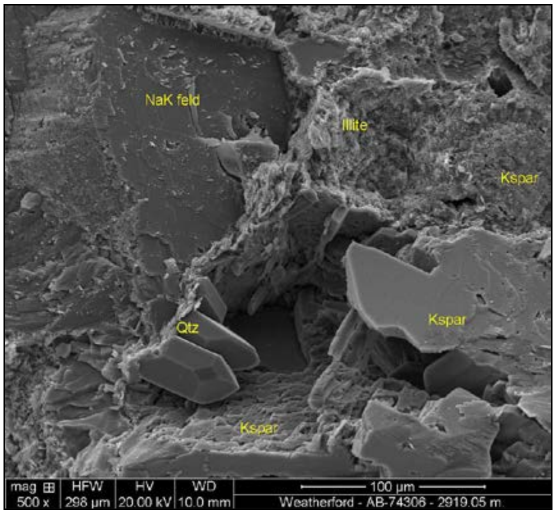

2924.21m 200X Magnification (thin section photo)



3007.90m 600X Magnification (SEM photo)

## Feldspar Overgrowths

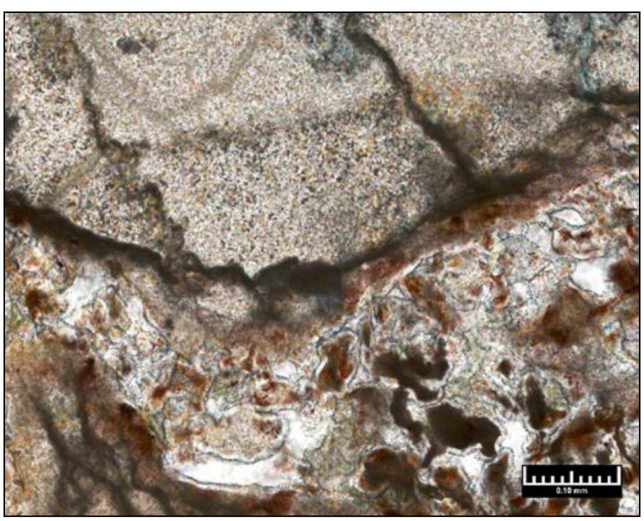
Minor amounts of albite and potassium overgrowths precipitate on host detrital feldspar grains, and partially occlude adjacent intergranular pores.  Thin section and SEM analysis revealed that feldspar overgrowths occurred concurrently with dissolution of detrital feldspar grains. Below is a SEM microphotograph illustrating a potassium feldspar overgrowth precipitating on a partially dissolved feldspar grain.



2919.05m 500X Magnification (SEM photo)

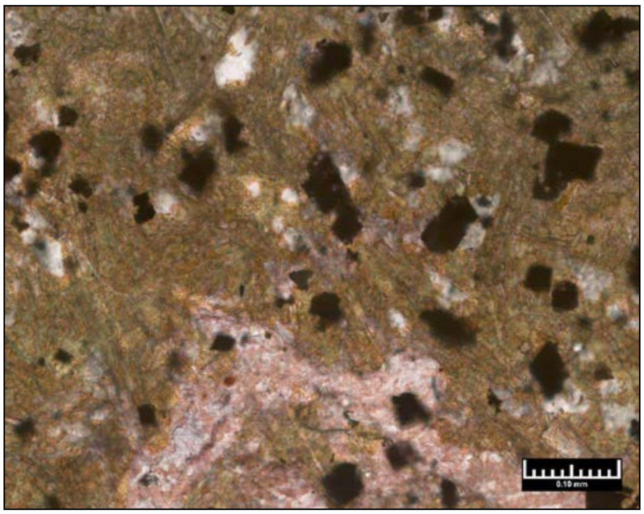
## Microquartz/Opal-CT

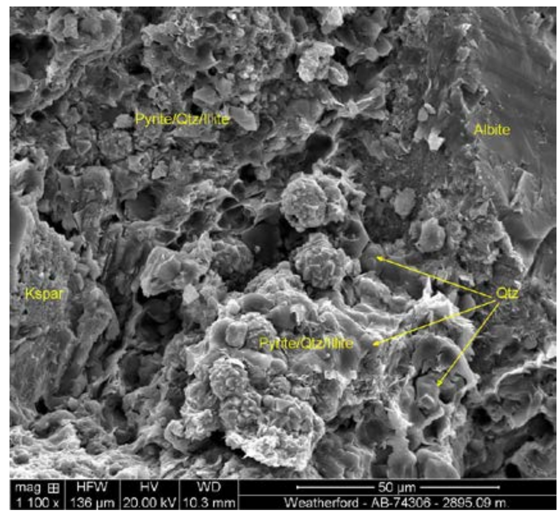
Following the formation of grain-coating chlorite, a common amount of microquartz crystals occurs as cement and possible replacement, and in this sample (3133.75m) cryptocrystalline quartz rims are observed.


3133.75m 200X Magnification (thin section photo)

## Pyrite

Pyrite occurs as a replacement of organic material, as intragranular pore-filling cement, and as microcrystalline framboidal masses attached to the surfaces of detrital grains. Authigenic pyrite is observed attached to the surfaces of sand grains that are engulfed by adjacent quartz cement, but is also observed within secondary intragranular pores, which suggests that pyrite precipitation and replacement occurred before and after dissolution. The thin section photomicrograph below depicts pyrite crystals disseminated though out the matrix. The SEM photomicrograph illustrates framboidal pyrite clusters within another sample.


3116.00m 200X Magnification (thin section photo)

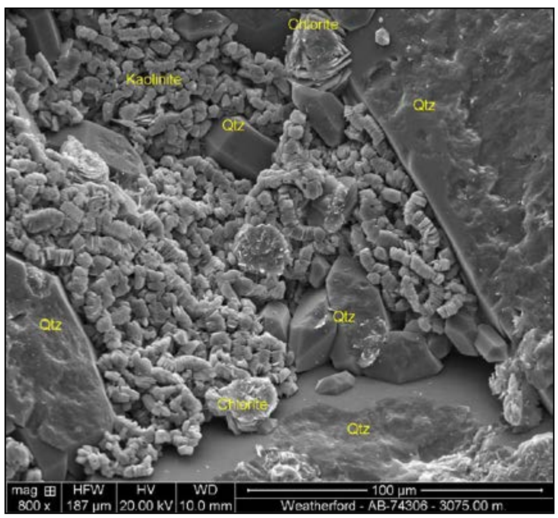


2895.09m 1100X Magnification (SEM photo)

## Kaolinite and Grain-Replacing Clays

Overall, kaolinite is a minor constituent in these samples. Authigenic kaolinite is easily distinguished from other authigenic clays based on its characteristic booklet morphology and pore-filling occurrence. Kaolinite is also associated with the *in situ* alteration of partially dissolved grains, which indicates that it predominantly occurred after dissolution. An SEM photomicrograph of authigenic kaolinite is provided below.

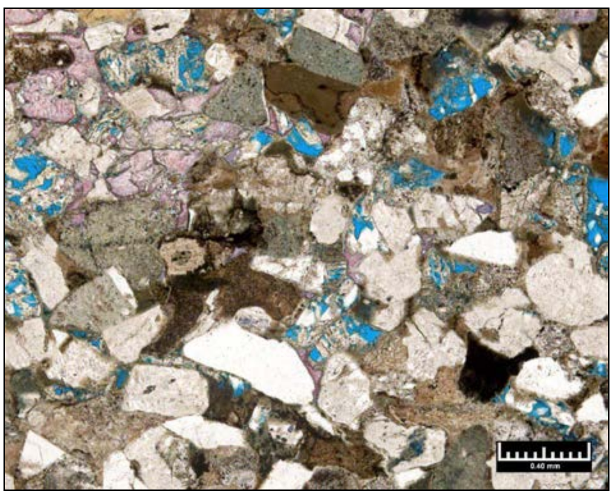
Other authigenic clays occurring as replacements of dissolved or altered grains include illite and mixed-layer illite/smectite. The distinguishing factor between the occurrence of grain-replacing clays and grain-coating clays are their placement within secondary pores or in association with partially dissolved grains, rather than on the outer rim of the detrital particles. Morphologically the appearance is the same, but the benefit of the separation allows for the determination of their emplacement, indicating that authigenic clays precipitated over an extended period of time and/or precipitated more than once. Total grain-replacing illite and mixed-layer illite/smectite is abundant, in the Back Alley Shale Formation and the bottom of the Lorrelle Formation, and trace in the Tinowon and Overston Formations.



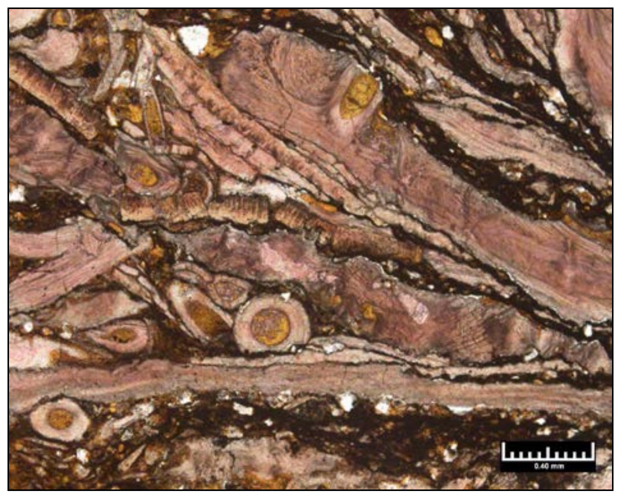
3075.00m 800X Magnification (SEM photo)

## Carbonate Cements

The carbonate cement calcite, dolomite, ankerite, and siderite each occur in these samples in various amounts (rare to abundant) and at various times diagenetic (relatively early to last). These authigenic minerals occur as blocky/patchy pore fillings and as replacement of unstable or partially dissolved detrital grains/allochems. The infilling of secondary pores indicate a relatively late precipitation, at least after the initial dissolution phase of the diagenetic process. Dolomite, ankerite, and siderite occur on the surfaces of detrital grains. Grain coatings of siderite locally inhibit quartz cementation and are often associated with authigenic clay. These carbonate minerals are also present as minor replacements of matrix material and detrital grains, such as argillaceous rock fragments and biotite. The first thin section photomicrograph provided below illustrates calcite (stained red) locally filling primary intergranular pores. In the second photomicrograph calcite (stained red) occurs as replacement of various fossil fragments.



2905.56m 50X Magnification (thin section photo)



2872.08m 50X Magnification (thin section photo)

## Hydrocarbon

Hydrocarbon is observed in mainly the Tinowon and Lorelle Formations. This organic material occurs on the surfaces of detrital grains, in association with authigenic clay minerals and as backfill material in stylolites. The presence of hydrocarbons is rare to minor, ranging from 0.00% to 3.25% (by volume, per modal analysis). The emplacement of this organic-based material is extremely late, and is considered the last stage of authigenic mineralization observed.

## REFERENCES

Folk, R.L., 1980, *Petrology of Sedimentary Rocks*, Hemphill Publishing Company, Austin, TX, 184p.

## APPENDIX A

## PETROGRAPHIC ANALYTICAL PROCEDURES

**X-ray Diffraction (XRD) Analysis**

For XRD analysis, a representative portion (preferably 2 grams) of each sample is typically cleaned utilizing a mixture of chloroform and methyl alcohol (70% : 30% respectively). The chloroform is used to remove any oil and the methyl alcohol is used to remove any salts associated with the mud system. However, if indigenous salt is to be retained in the sample, only chloroform is used in the cleaning process.

**Bulk/Whole Rock Analysis**

The sample is dried in a laboratory oven at a temperature of 110°C for a minimum of 1 hour. The sample is then ground in a Retsch MM-400 ball mill to a fine powder (1-5 microns). A portion of the ground sample is then loaded into a stainless steel sample holder. The sample holder has been modified to accommodate a side loading method. This side loading method allows the sample to be sifted and retain a random particle orientation. This procedure helps minimize preferred orientation.

This "bulk" sample mount is scanned with a Bruker AXS D4 Endeavor X-ray diffractometer using copper K-alpha radiation. A nickel filter slit is in place to eliminate K-beta peaks and an air scatter screen to help reduce background noise. The scanning parameters for a bulk scan are from 5° 2-theta to 70° 2-theta. The step size is 0.020° and the dwell time at each step is 0.5 seconds. Full scanning parameters are:

***Standard Scanning Parameters:*** For both bulk and clay
Cu K-alpha1 0.15406nm and K-alpha2 0.1544390nm
Operating voltage is 50Kv
Operating amperage is 40mA
An axial soller slit is in place
Goniometer diameter is 400mm
A Lynx Eye High speed detector with a 2 theta scanning range of $4^{o}$
A nickel filter for K beta peaks
A Lynx Iris motorized antiscatter slit
An air scatter screen to reduce fluorescence
A variable divergent slit at .3mm for bulk and 0.5mm for clay

Computer analysis of the diffractograms provide identification of mineral phases and quantitative analysis of the relative abundance (in weight percent) of the various mineral phases. MDI Jade 9+ 2011 and PDF 4+ 2011 software and the ICDD JCPDS mineral database, with over 790,000 known compounds, are used to identify mineral phases present. It should also be noted that X-ray diffraction does not allow the identification of non-crystalline (amorphous) material, such as organic material and volcanic glass.

**Clay Fraction Analysis**

An oriented clay fraction mount is prepared for each sample from the ground powder. The samples will be checked for any carbonate minerals using 10% HCl. If carbonate material is present then the samples will be treated with 10% HCl to remove all carbonate material. The samples are then washed using a small amount of sodium hexa-meta-phosphate (a deflocculating agent) mixed with distilled water. The samples are then dismembrated using a Fisher Scientific Ultra Sonifier to bring the clays into suspension.

The samples are further size fractionated by accelerating in a centrifuge to separate the size fraction to between 1 and 15 microns. The supernatant containing the clay fraction is passed through a Fisher filter membrane apparatus allowing the solids to be collected on a cellulose metrucel membrane filter.

These solids are mounted on a glass slide. The oriented clay mount is glycolated using 99.9% ethylene glycol for 12 hours at a temperature of 110°C. The sample is loaded by hand one at a time to ensure maximum sample glycolation. The glycolated clay is scanned in the Bruker AXS diffractometer. The following scan parameters are utilized for clay separates: 2° 2-theta to 30° 2-theta at a step size of 0.025° per step and a dwell time of 0.15 seconds at each step to identify the expandable, water sensitive minerals. Full scanning parameters are above.

The slide is then heat-treated in a furnace at a temperature of 565°C and scanned with the same parameters to aid in distinguishing kaolinite and chlorite. After the clay is heated the kaolinite peak is collapsed, the chlorite peak is more prominent, and the smectite is collapsed rendering the discrete illite plus the illite associated with the mixed-layer illite/smectite.

The method for determining the ratios of kaolinite, chlorite, illite, a mixed-layer illite/smectite and/or a pure smectite are done using the calculation methods of Schultz, USGS Open File Report 01-041, “A Laboratory Manual for X-ray Powder diffraction”, 2001, Poppe, Paskevich, Hathaway, and Blackwood. The diagnostic peak of chlorite is located at 6.1° 2-theta in the heat treated clay. The diagnostic peak for kaolinite is located at 12.3° 2-theta in the glycolated clay. The diagnostic peak of Illite is located at 8.9° 2-theta in both the glycolated and heat treated clay. The peak range for randomly interstratified mixed-layer illite/smectite is from 2.0° to 4.9° and for ordered interstratified mixed-layer illite/smectite is from 5.1° to 8.8° 2-theta on the glycolated clay scan. In this degree range, the angstrom size of the smectite mineral phase is obtained from the MDI Jade software at the maximum peak height using a d-line spacing. The method for calculating the ordered and/or randomly interstratified mixed layers are based upon angstrom size of the smectitic clay as illustrated by the paper “The Nature of Interlayering in Mixed Layer Illite-Montmorillonite”, Clays and Clay Minerals 18, 1970, Reynolds and Hower. 5.0° 2-theta is the location of pure 100% expandable smectite..0

## Interpretation

Once the scanning is complete, the diffractograms of the bulk and clay samples are evaluated using MDI Jade software and the ICDD JCPDS powder diffraction files are applied. The primary peaks are measured using the area under the curve, subtracting the background, to one standard deviation. The area counts are then applied to a mathematical equation using mineral intensity factors. Mineral intensity factors are generated for each diffractometer using pure mineral standards mixed with quartz in a 50-50 weight percent. Once the total area counts are obtained for each mineral present and applied to the equation, the bulk mineral data is rendered onto a table to the nearest whole number as weight percent. Once the bulk data is complete, the total clays obtained from the bulk data, are broken down into their species and values are given to each mineral phase based upon the calculation method mentioned above. Each clay is then examined with a d-line spacing to determine expandability and type of interstratified mixed layering.

## References

Quantitative Analysis "Measurement of Line Intensities, Foundation of Quantitative Phase Analysis, The Absorption-Diffraction Method, Use of Measured Mass Attenuation Coefficients, The International Standard Method of Quantitative Analysis, I/I corundum and the Referenced Ratio Method, Quantitative Analysis with RIRs, Constrained XRD Phase analysis, Quantitative Phase Analysis Using Crystal Structure Constraints, Quantitative Methods Based on Use of Total Pattern, The Rietveld Method, and Full Pattern Fitting", Introduction to X-Ray Powder Diffractometry, R. Jenkins and R. Snyder 1996, p.355-385.

## <u>Thin Section Preparation and Analyses</u>

Samples selected for thin section analysis were prepared by first vacuum impregnating with blue-dyed epoxy. The samples were then mounted on an optical glass slide and cut and lapped in mineral oil to a thickness of 0.03 mm (30 microns). The samples were stained for potassium and plagioclase feldspar using the method described by Bailey and Stevens in 1960, and by Laniz et al in 1964. The sections were also stained for carbonate minerals using Alizarin Red S for calcite, and potassium ferricyanide for ferroan dolomite/calcite. This dual carbonate staining technique stains calcite pink or red, ferroan calcite purple or mauve, and ferroan dolomite sky blue. Non-ferroan dolomite remains unstained. First, hydrofluoric acid (HF) is used to etch the surface. Then sodium cobaltinitrite is used to stain any K-feldspar on that surface a yellow color. Then the samples are re-etched and submerged in rhodamine B to stain plagioclase feldspar a reddish/pink color. Finally, the slides are re-etched again and stained for the carbonate minerals. The prepared sections were then covered with index oil and temporary cover slips, and then analyzed using standard petrographic techniques.

Bailey, E.H., Stevens, R.E., 1960, Selective staining of K-feldspar and plagioclase on rock slabs and thin sections. The American Mineralogist, vol. 45 (Sept-Oct).

Laniz, R.V.; Stevens,R.E.; Norman, M.B., 1964, Staining of plagioclase feldspars and other minerals with F.D. and C red no. 2: U. S. Geological Survey, Prof. Paper 501-B.

## **Scanning Electron Microscopy (SEM) Analysis**

Samples selected for scanning electron microscopy analysis were first broken, or split, to expose fresh surfaces. The samples were then mounted on sample holders with a conductive carbon paste and coated with gold in a "cool" sputter coater to prevent heat damage to sensitive clay minerals or friable samples. The samples were analyzed with a Quanta 200 Scanning Electron Microscope (SEM) and an Oxford Inca X-sight energy dispersive spectrometer (EDS).

# APPENDIX B

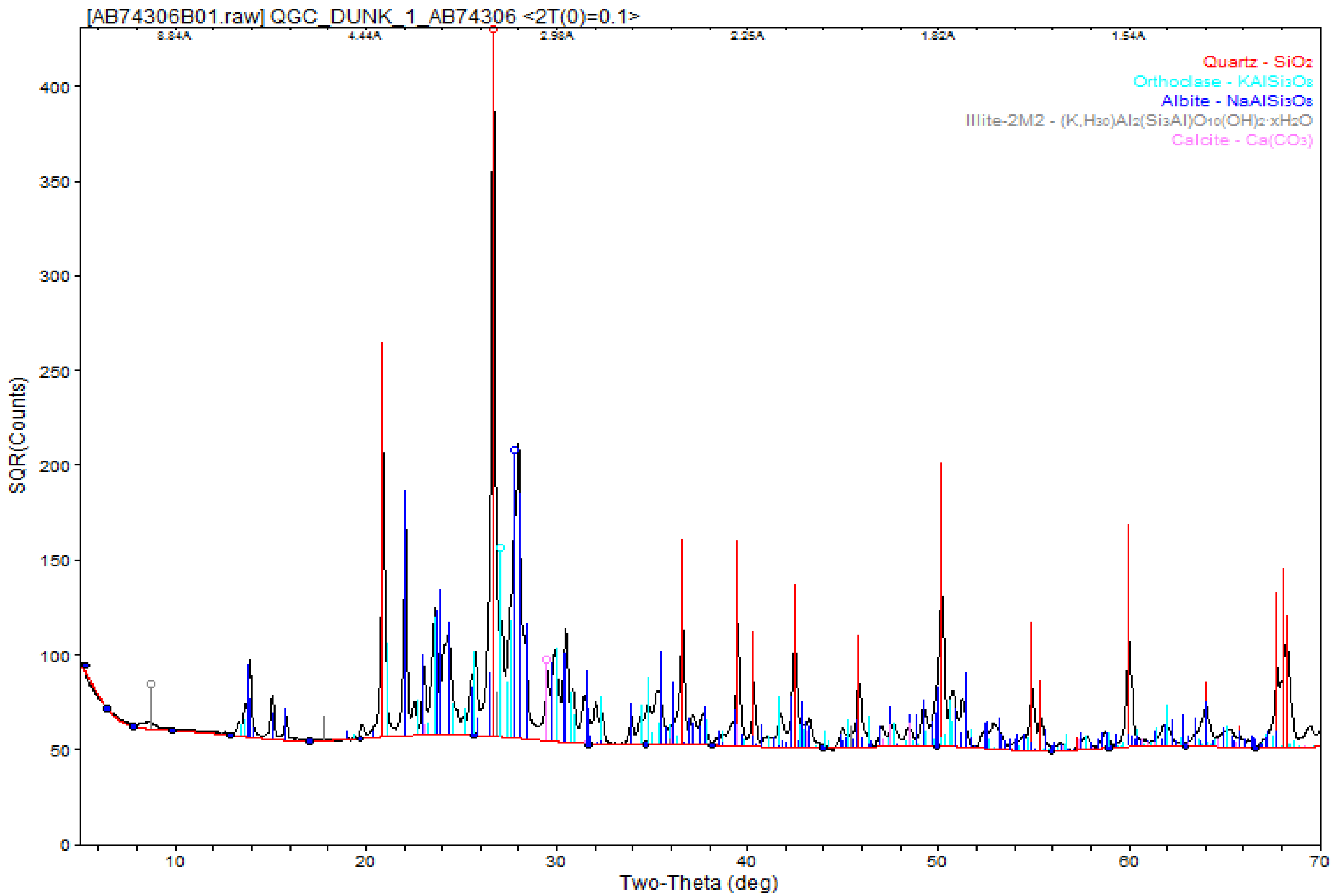
# X-RAY DIFFRACTION DATA
# &
# DIFFRACTOGRAMS

**WEATHERFORD LABORATORIES**
**X-RAY DIFFRACTION**
**(WEIGHT %)**

**Client:** QGC - A BG Group business
**Well:** Dunk-1
**Area:** Queensland, Australia
**Sample Type:** Rotary Sidewall Core

**File No:** AB-74306
**Date:** 03/19/15
**Analyst:** G. Torrez And R. Schulze

| Barcode Number | XRD File Number | Sample Number | Sample Depth (m) | CLAYS | | | | | CARBONATES | | | OTHER MINERALS | | | | | | | TOTALS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Chlorite | Kaolinite | Illite/Mica | Mx I/S* | Mx I/S** | Calcite | Dolomite(Fe/Ca$^+$)[1] | Siderite | Quartz | K-spar | Plag. | Pyrite | Marcasite | Hematite | Barite | Clays | Carb. | Other |
| 4500173724 | 1 | 43 SWC | 2813.00 | Tr | Tr | 1 | 2 | 0 | 2 | Tr | Tr | 35 | 17 | 43 | 0 | 0 | 0 | 0 | 3 | 2 | 95 |
| 6122506737 | 2 | 1_3P DS | 2872.08 | 1 | Tr | 2 | 20 | | 46 | Tr | 0 | 17 | 2 | 10 | 2 | 0 | 0 | 0 | 23 | 46 | 31 |
| 6122506739 | 3 | 1_8P DS | 2877.04 | 1 | Tr | 1 | 30 | | 4 | 0 | 1 | 30 | 2 | 30 | 1 | 0 | 0 | 0 | 32 | 5 | 63 |
| 6122506741 | 4 | 1_10P DS | 2878.05 | 1 | Tr | 1 | 19 | | 16 | 0 | 5 | 29 | 1 | 25 | 3 | 0 | 0 | 0 | 21 | 21 | 58 |
| 6122506743 | 5 | 1_19P DS | 2887.10 | Tr | Tr | 4 | 7 | | 51 | Tr | Tr | 28 | 1 | 8 | 1 | 0 | 0 | 0 | 11 | 51 | 38 |
| 6122506745 | 6 | 1_20P DS | 2888.12 | Tr | Tr | 1 | 22 | | 7 | Tr | 1 | 44 | 3 | 18 | 3 | 1 | 0 | 0 | 23 | 8 | 69 |
| 6122506747 | 7 | 1_27P DS | 2895.09 | Tr | Tr | 6 | 18 | | 3 | Tr | 0 | 32 | 18 | 19 | 4 | 0 | 0 | 0 | 24 | 3 | 73 |
| 6122506749 | 8 | 1_28P DS | 2896.07 | Tr | Tr | 3 | 20 | | 1 | Tr | 1 | 35 | 14 | 26 | Tr | 0 | 0 | 0 | 23 | 2 | 75 |
| 6122506751 | 9 | 2_2P DS | 2897.06 | Tr | Tr | 5 | 11 | | 5 | Tr | 1 | 41 | 11 | 26 | Tr | 0 | 0 | 0 | 16 | 6 | 78 |
| 6122506771 | 10 | 21 RCA | 2898.51 | 1 | Tr | 5 | 14 | | 1 | Tr | Tr | 36 | 11 | 32 | Tr | 0 | 0 | 0 | 20 | 1 | 79 |
| 6122506753 | 11 | 2_6P DS | 2901.06 | Tr | Tr | 6 | 14 | | 2 | Tr | 1 | 38 | 18 | 20 | 1 | 0 | 0 | 0 | 20 | 3 | 77 |
| 6122506773 | 12 | 25 RCA | 2902.49 | Tr | Tr | 6 | 19 | | 1 | Tr | 1 | 32 | 10 | 30 | 1 | 0 | 0 | 0 | 25 | 2 | 73 |
| 6122506775 | 13 | 28 RCA | 2905.56 | Tr | Tr | 7 | 17 | | 2 | Tr | 1 | 29 | 13 | 31 | Tr | 0 | 0 | 0 | 24 | 3 | 73 |
| 6122506755 | 14 | 2_12P DS | 2906.05 | Tr | Tr | 10 | 9 | | 22 | Tr | Tr | 26 | 14 | 19 | Tr | 0 | 0 | 0 | 19 | 22 | 59 |
| 6122506757 | 15 | 2_13P DS | 2907.04 | Tr | Tr | 6 | 17 | | 2 | Tr | 1 | 33 | 13 | 28 | Tr | 0 | 0 | 0 | 23 | 3 | 74 |
| 6122506777 | 16 | 31 RCA | 2908.50 | Tr | Tr | 6 | 22 | | 1 | Tr | Tr | 34 | 14 | 22 | 1 | 0 | 0 | 0 | 28 | 1 | 71 |
| 6122506759 | 17 | 2_16P DS | 2910.05 | Tr | Tr | 6 | 20 | | 1 | Tr | Tr | 34 | 13 | 26 | Tr | 0 | 0 | 0 | 26 | 1 | 73 |
| 4500173706 | 18 | 34 SWC | 2912.30 | Tr | Tr | 7 | 11 | 0 | 8 | Tr | Tr | 40 | 12 | 22 | Tr | 0 | 0 | 0 | 18 | 8 | 74 |
| 6122506779 | 19 | 35 RCA | 2912.50 | 1 | Tr | 13 | 23 | | 1 | Tr | 1 | 24 | 9 | 28 | Tr | 0 | 0 | 0 | 37 | 2 | 61 |
| 6122506761 | 20 | 2_20P DS | 2914.04 | Tr | Tr | 13 | 14 | | 2 | Tr | Tr | 36 | 12 | 23 | Tr | 0 | 0 | 0 | 27 | 2 | 71 |
| 6122506763 | 21 | 2_23P DS | 2916.04 | 1 | Tr | 14 | 7 | | Tr | Tr | Tr | 32 | 14 | 32 | Tr | 0 | 0 | 0 | 22 | 0 | 78 |
| 6122506765 | 22 | 2_26P DS | 2919.05 | Tr | Tr | 12 | 10 | | 1 | Tr | 1 | 32 | 16 | 27 | 1 | 0 | 0 | 0 | 22 | 2 | 76 |
| 4500173704 | 23 | 33 SWC | 2920.70 | Tr | Tr | 16 | 2 | 0 | 5 | Tr | Tr | 36 | 18 | 23 | Tr | 0 | 0 | 0 | 18 | 5 | 77 |
| 6122506767 | 24 | 2_29P DS | 2922.04 | Tr | Tr | 12 | 9 | | 2 | Tr | Tr | 39 | 18 | 20 | Tr | 0 | 0 | 0 | 21 | 2 | 77 |
| 6122506769 | 25 | 2_32P DS | 2924.21 | Tr | Tr | 12 | 10 | | 3 | Tr | Tr | 29 | 19 | 27 | Tr | 0 | 0 | 0 | 22 | 3 | 75 |
| 4500173702 | 26 | 32 SWC | 2931.50 | Tr | Tr | 11 | 5 | 0 | 5 | 1 | Tr | 41 | 17 | 20 | Tr | 0 | 0 | 0 | 16 | 6 | 78 |
| 4500173680 | 27 | 21 SWC | 3005.00 | Tr | Tr | 12 | 5 | 0 | Tr | Tr | 0 | 75 | 0 | 7 | 1 | 0 | 0 | Tr | 17 | Tr | 83 |
| 4500173686 | 28 | 24 SWC | 3006.80 | Tr | Tr | 9 | 14 | 0 | 5 | 1 | 0 | 64 | 0 | 6 | 1 | 0 | 0 | 0 | 23 | 6 | 71 |
| 4500173684 | 29 | 23 SWC | 3007.90 | Tr | Tr | 9 | 11 | 0 | 1 | Tr | 0 | 70 | 0 | 8 | 1 | 0 | 0 | 0 | 20 | 1 | 79 |
| 4500173682 | 30 | 22 SWC | 3008.80 | Tr | Tr | 6 | 13 | 0 | 1 | Tr | 0 | 72 | Tr | 7 | 1 | 0 | 0 | 0 | 19 | 1 | 80 |
| 4500173662 | 31 | 12 SWC | 3061.00 | 1 | Tr | 10 | 19 | 0 | 1 | Tr | 1 | 59 | 2 | 5 | 2 | 0 | 0 | 0 | 30 | 2 | 68 |
| 4500173660 | 32 | 11 SWC | 3075.00 | 1 | Tr | 20 | 22 | 0 | Tr | Tr | 1 | 52 | 1 | 3 | Tr | 0 | 0 | 0 | 43 | 1 | 56 |
| 4500173658 | 33 | 10 SWC | 3076.47 | Tr | Tr | 9 | 13 | 0 | 2 | Tr | Tr | 74 | 1 | 1 | Tr | 0 | 0 | 0 | 22 | 2 | 76 |
| 4500173656 | 34 | 9 SWC | 3081.43 | 2 | Tr | 50 | 1 | 0 | 1 | Tr | 0 | 46 | 0 | 0 | Tr | 0 | 0 | 0 | 53 | 1 | 46 |
| 4500173654 | 35 | 8 SWC | 3083.00 | Tr | Tr | 16 | 8 | 0 | 1 | Tr | 1 | 72 | 1 | 1 | Tr | 0 | 0 | 0 | 24 | 2 | 74 |
| 4500173652 | 36 | 7 SWC | 3085.33 | Tr | Tr | 14 | 16 | 0 | Tr | Tr | Tr | 68 | 1 | 1 | Tr | 0 | 0 | 0 | 30 | Tr | 70 |
| 4500173650 | 37 | 6 SWC | 3093.00 | Tr | Tr | 10 | 12 | 0 | 45 | Tr | 1 | 28 | 1 | 1 | 2 | 0 | 0 | 0 | 22 | 46 | 32 |
| 4500173648 | 38 | 5 SWC | 3112.78 | 20 | 8 | Tr | 0 | 12 | 15 | Tr | 1 | 39 | 1 | Tr | 1 | 0 | 3 | 0 | 40 | 16 | 44 |
| 4500173646 | 39 | 4 SWC | 3116.00 | 10 | 7 | 1 | 0 | 42 | 21 | Tr | 1 | 16 | 1 | Tr | Tr | 0 | 1 | 0 | 60 | 22 | 18 |
| 4500173644 | 40 | 3 SWC | 3120.00 | 10 | 5 | Tr | 0 | 59 | 3 | Tr | 1 | 15 | 2 | 4 | Tr | 0 | 1 | 0 | 74 | 4 | 22 |
| 4500173642 | 41 | 2 SWC | 3126.00 | 8 | 1 | Tr | 0 | 9 | 37 | Tr | 2 | 30 | 0 | 6 | Tr | 0 | 7 | 0 | 18 | 39 | 43 |
| 4500173640 | 42 | 1 SWC | 3133.75 | 14 | 1 | Tr | 21 | 0 | 12 | Tr | 0 | 33 | Tr | 17 | Tr | 0 | 2 | 0 | 36 | 12 | 52 |

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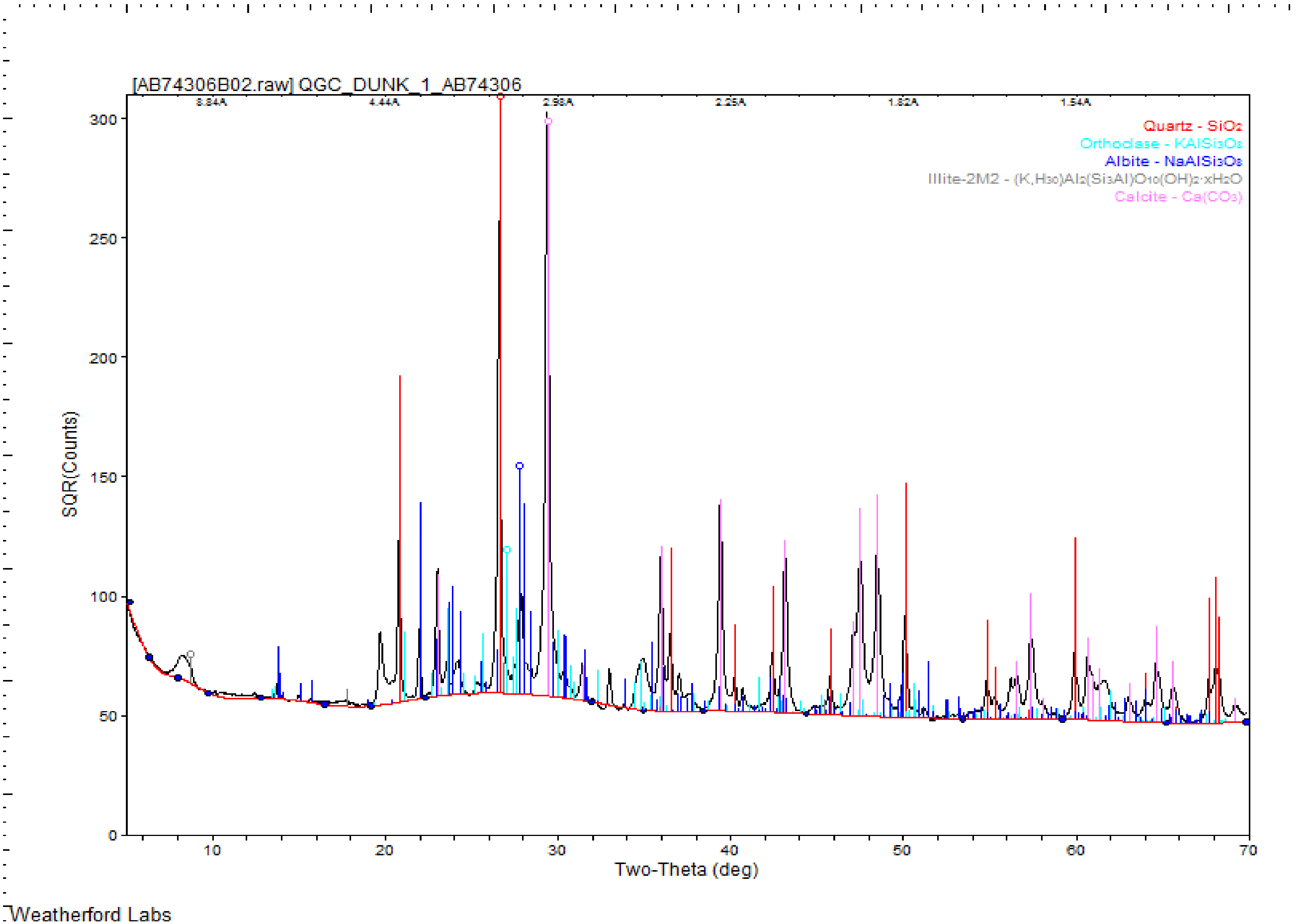

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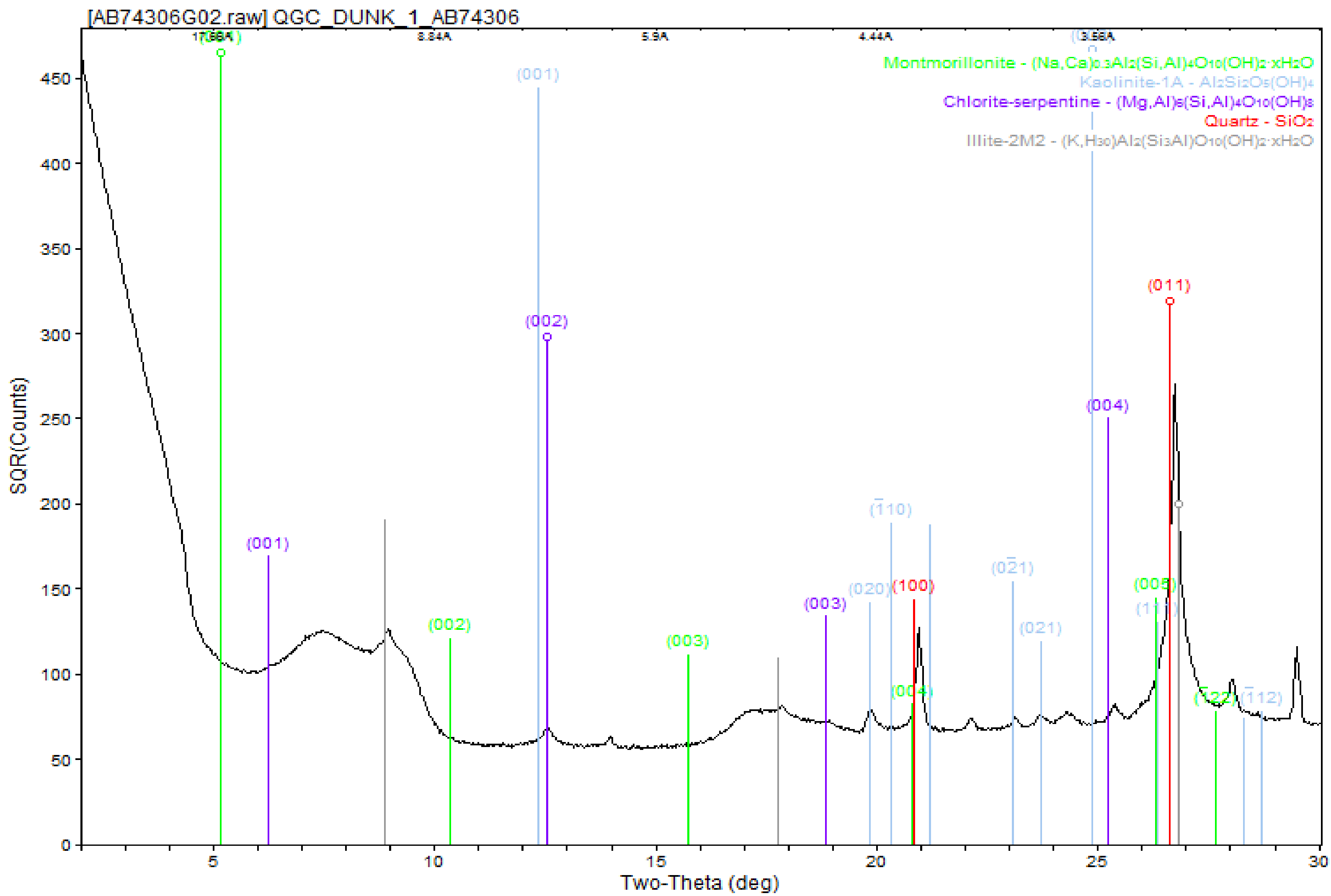
4.44A
2.98A
2.25A
1.82A
1.54A
Quartz - SiO2
Orthoclase - KAlSi3O8
Albite - NaAlSi3O8
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
Calcite - Ca(CO3)
SQR(Counts)
300
250
200
150
100
50
0
10
20
30
40
50
60
70
Two-Theta (deg)
Weatherford Labs

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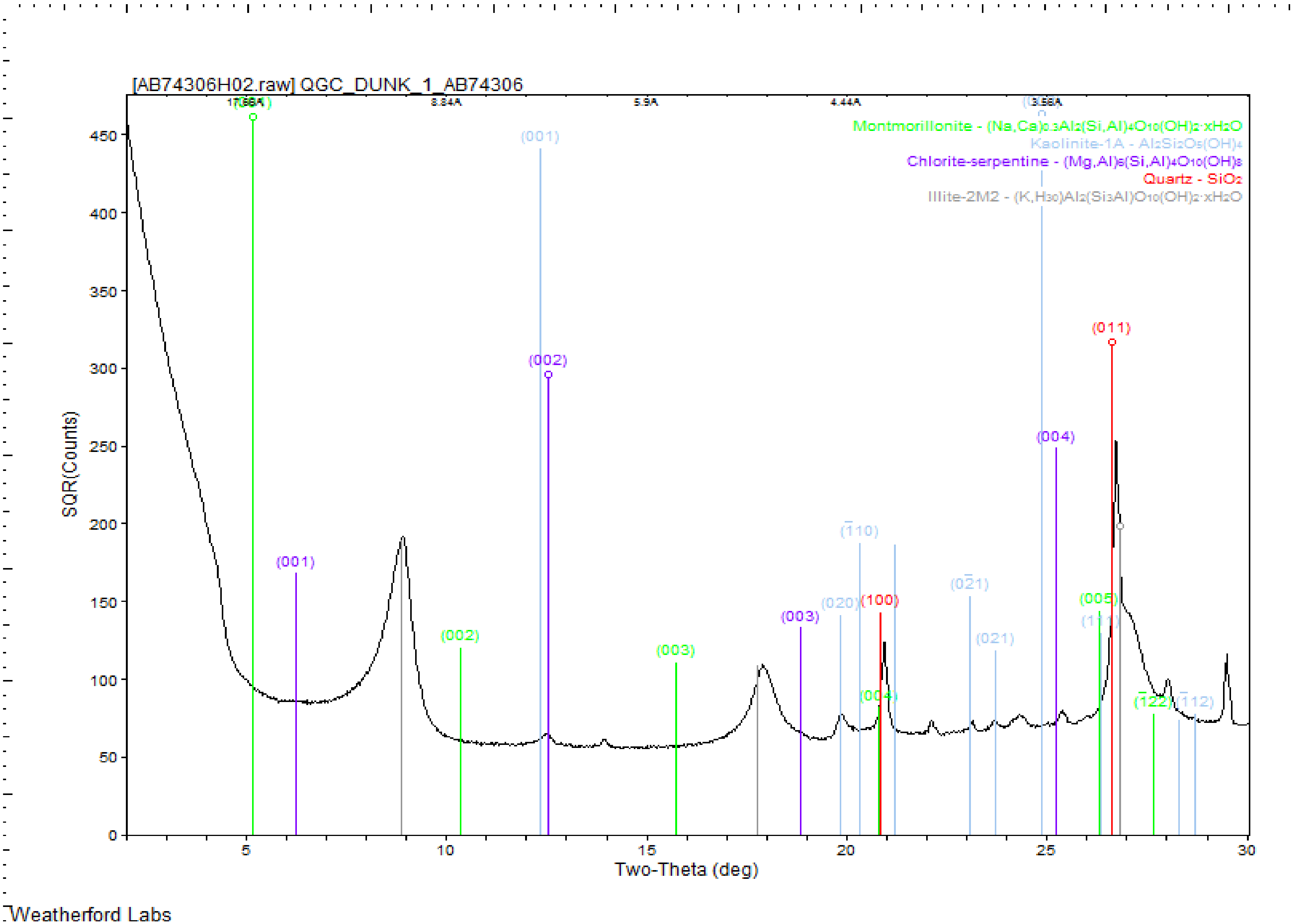
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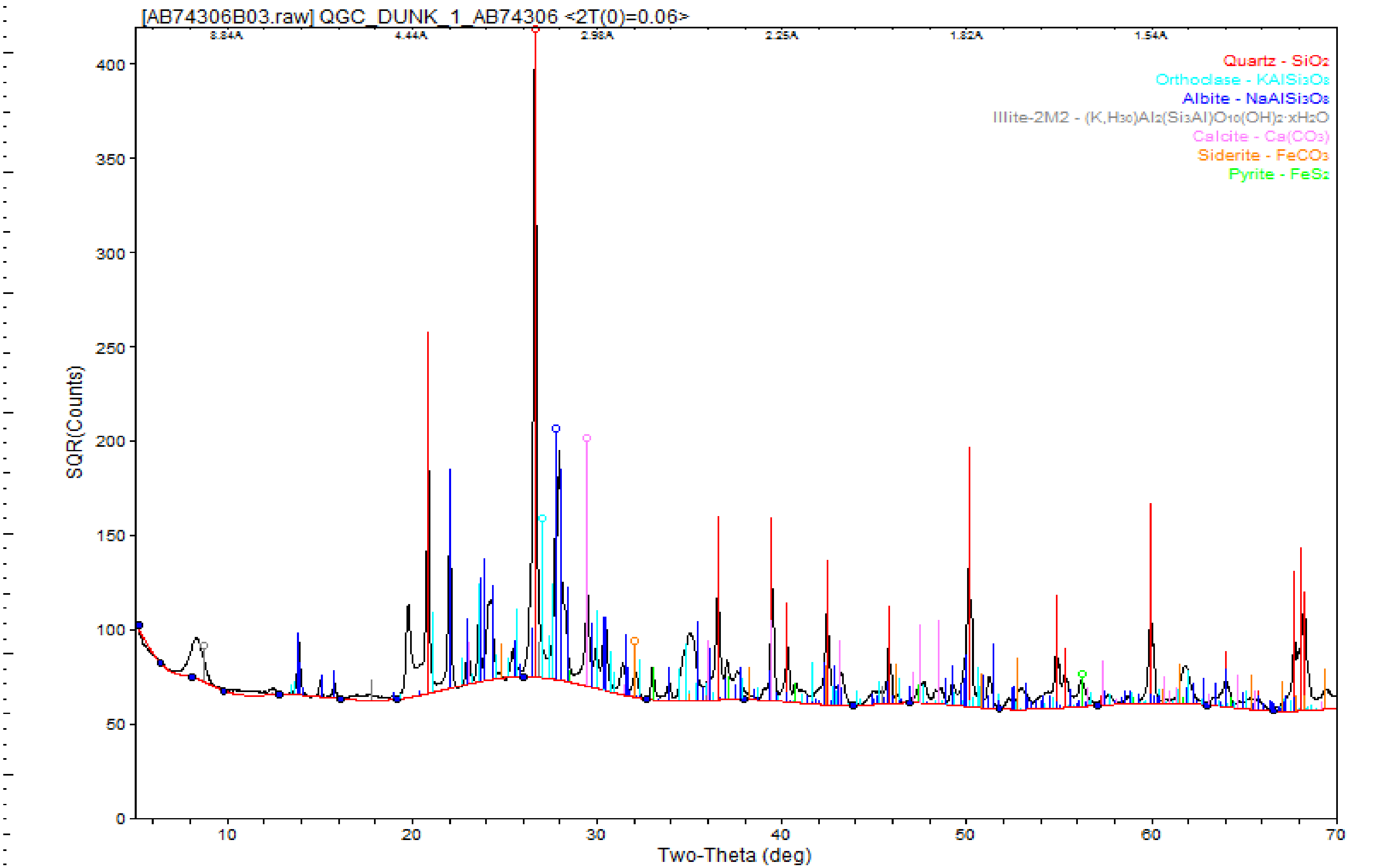
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs

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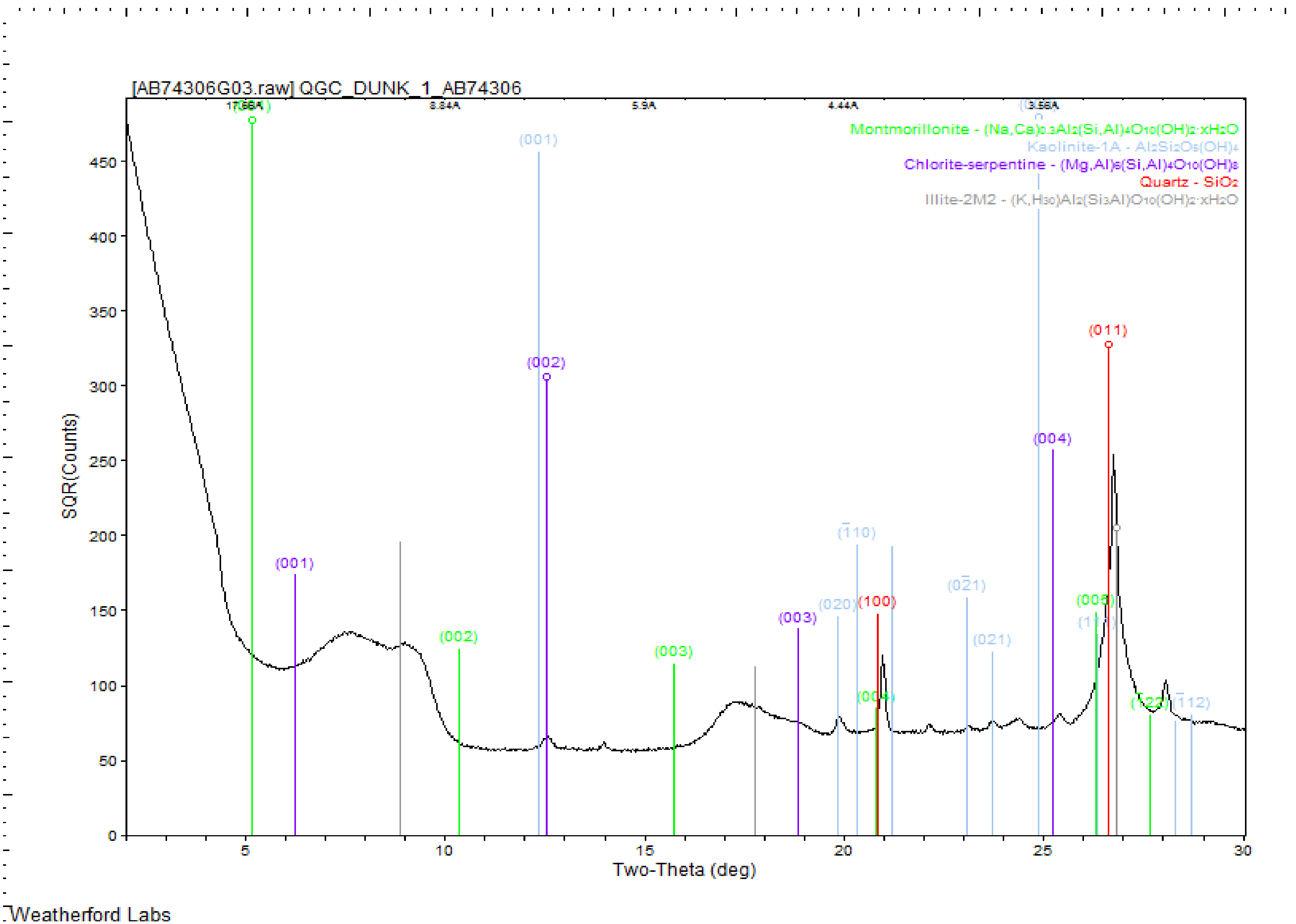
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Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
(001)
(002)
(003)
(004)
(011)
(100)
(020)
(110)
(021)
(112)
0
50
100
150
200
250
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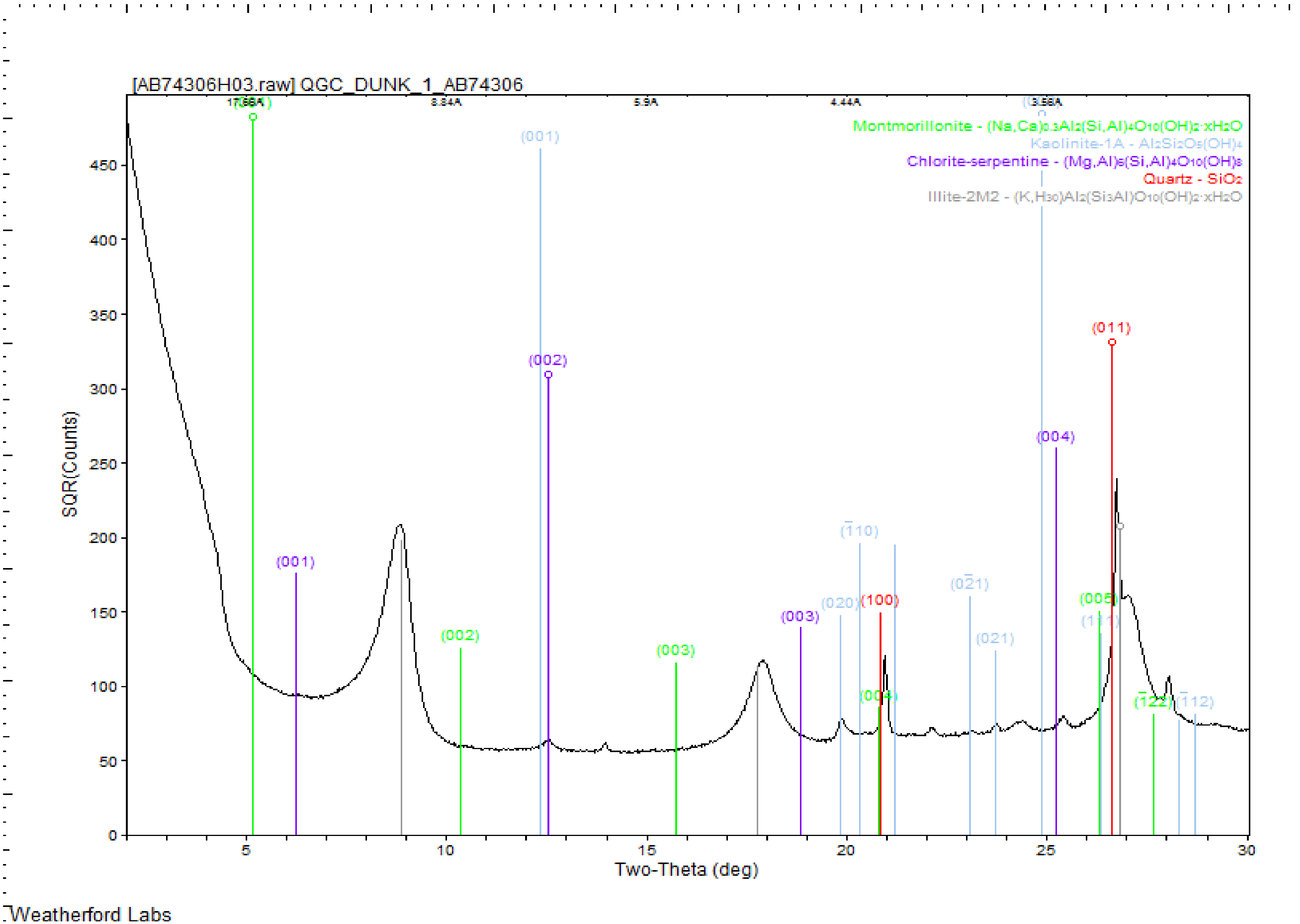
5
10
15
20
25
30
8.84A
5.9A
4.44A
3.56A
Weatherford Labs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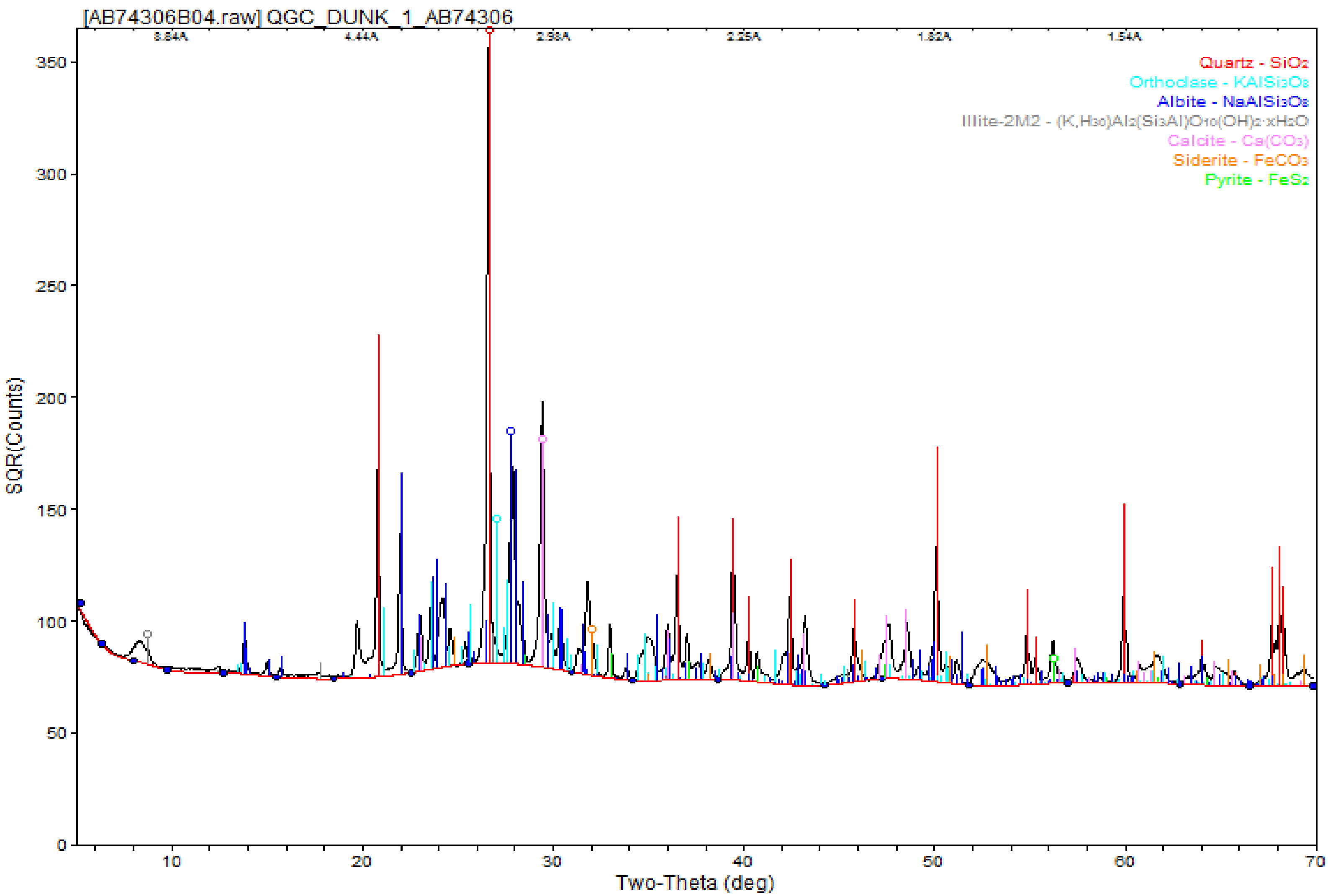
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs

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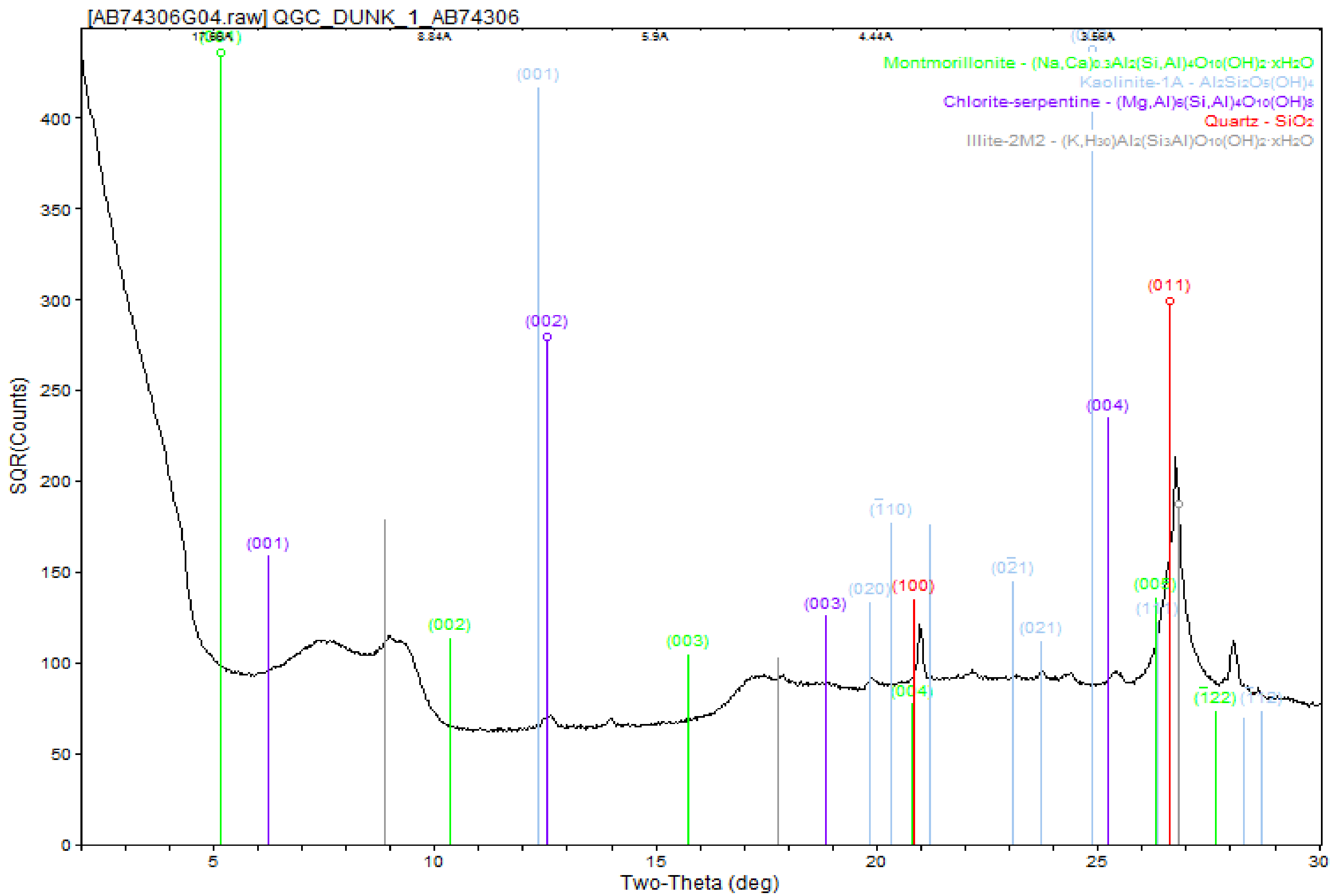


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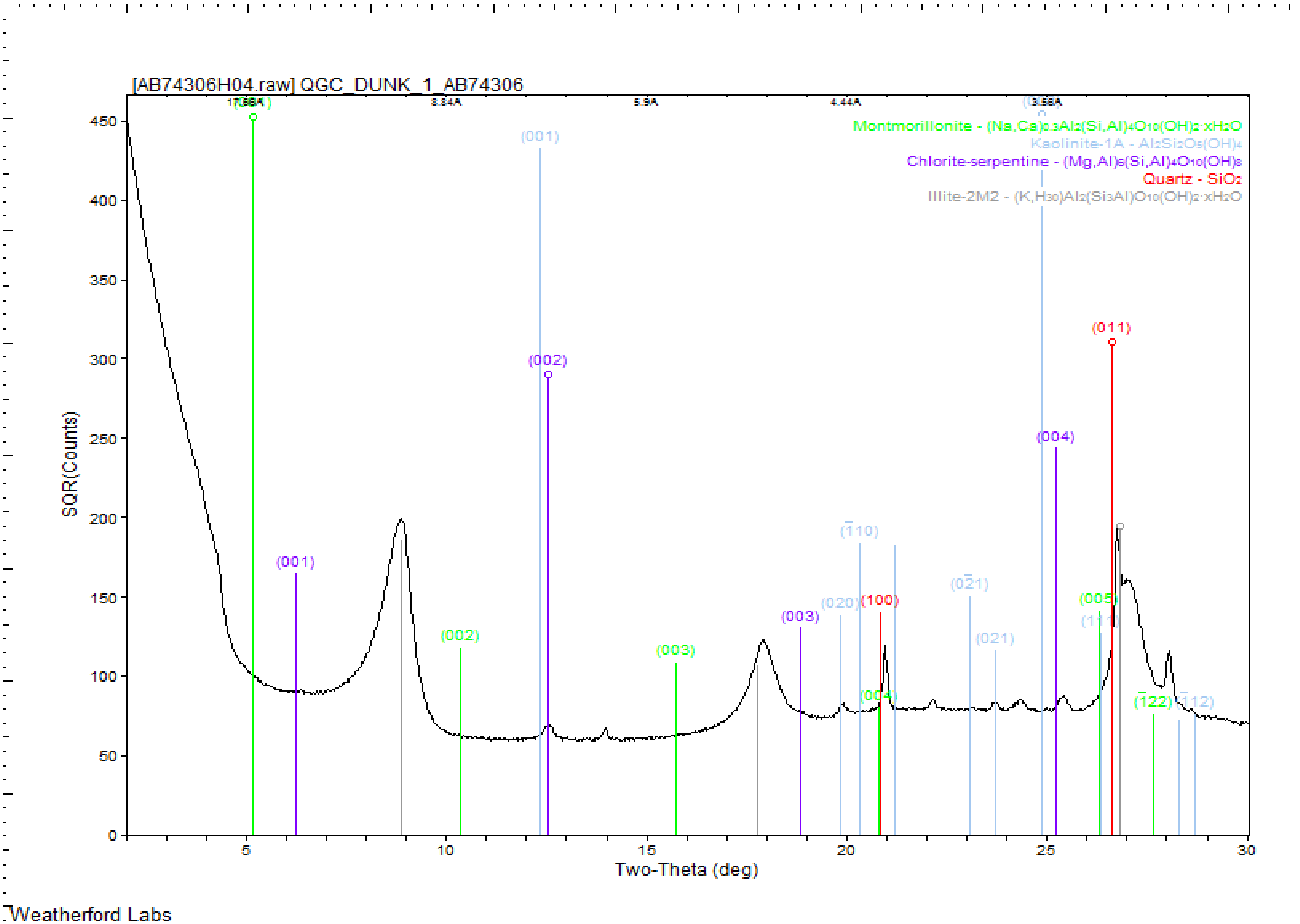


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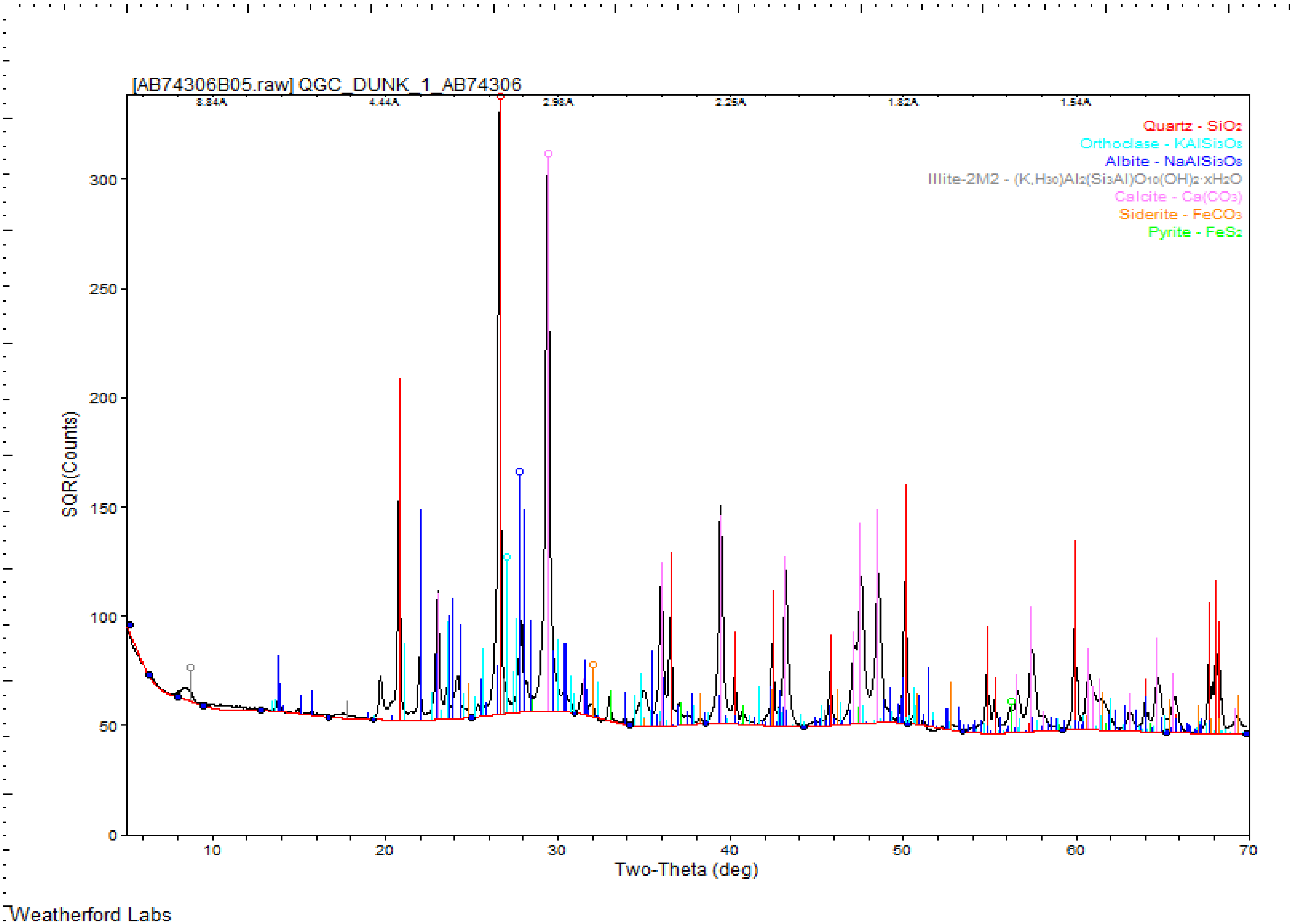

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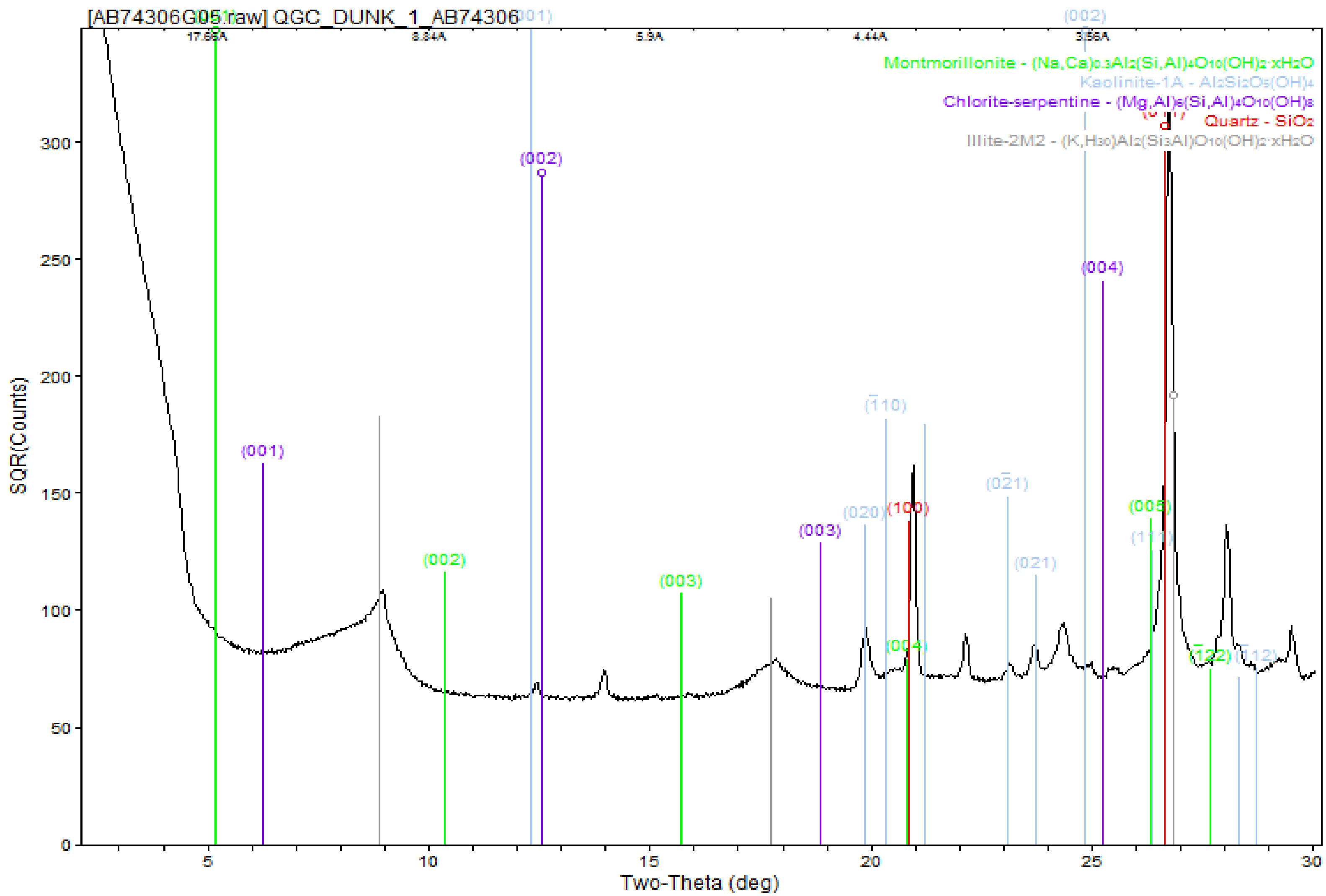


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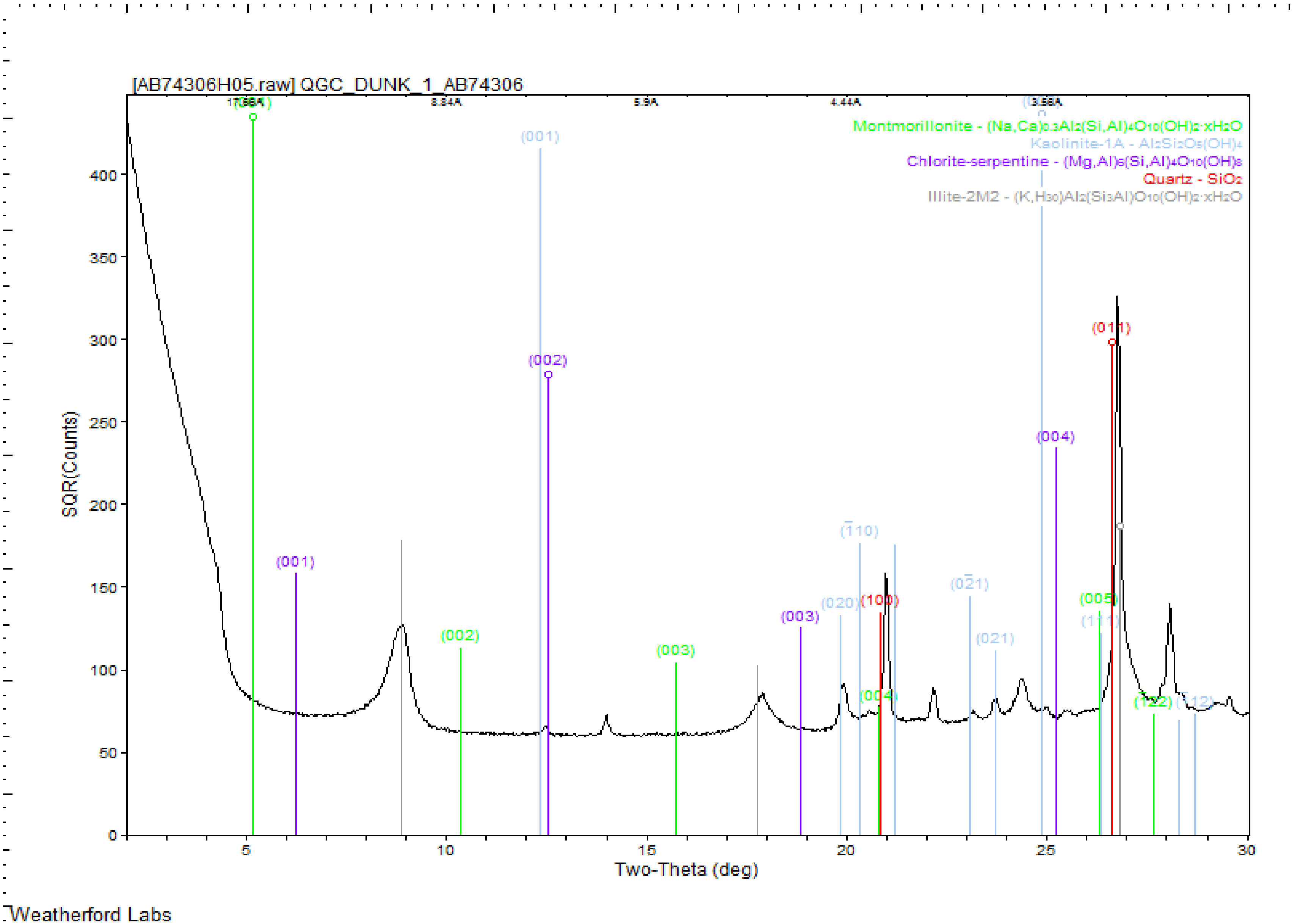
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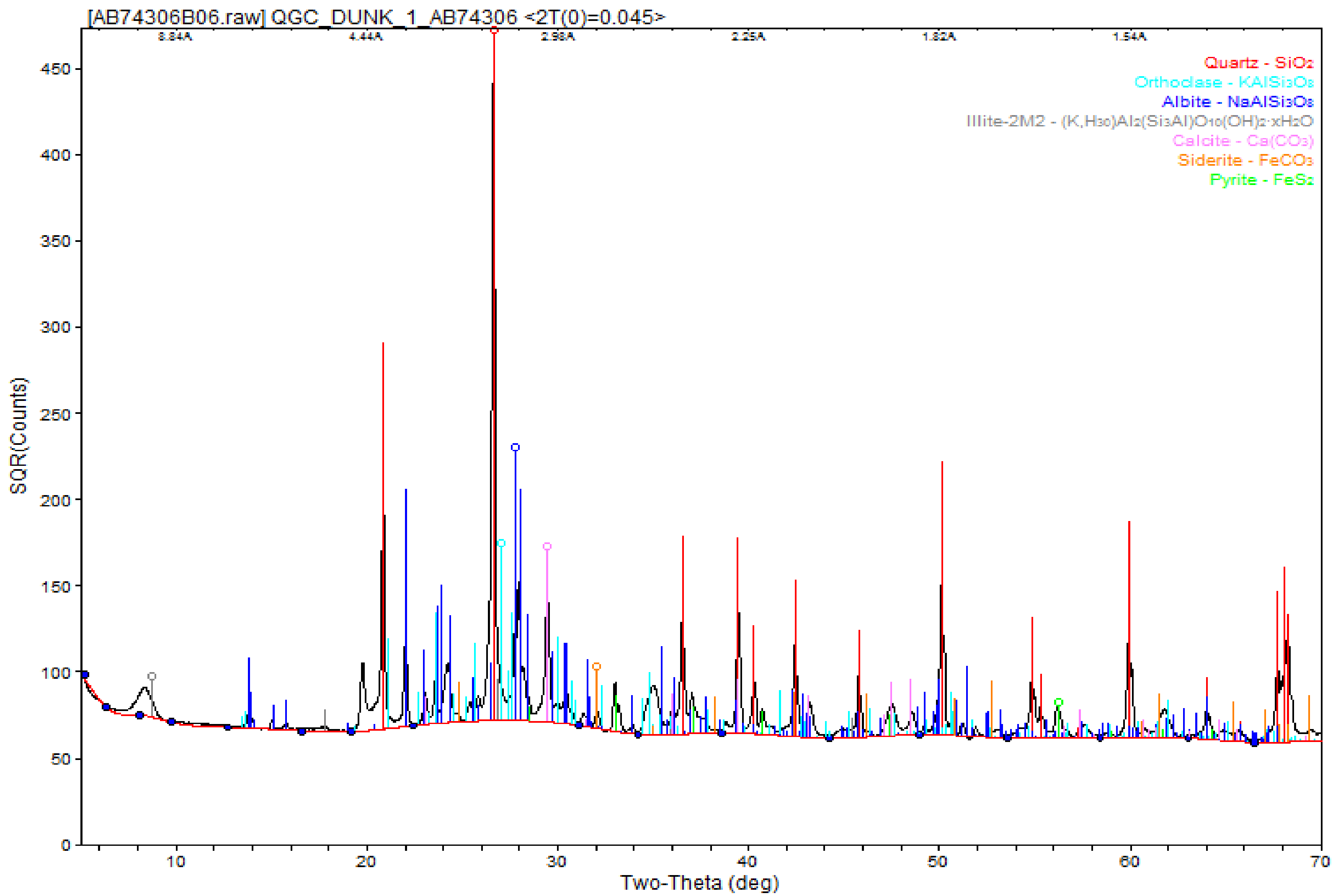
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs

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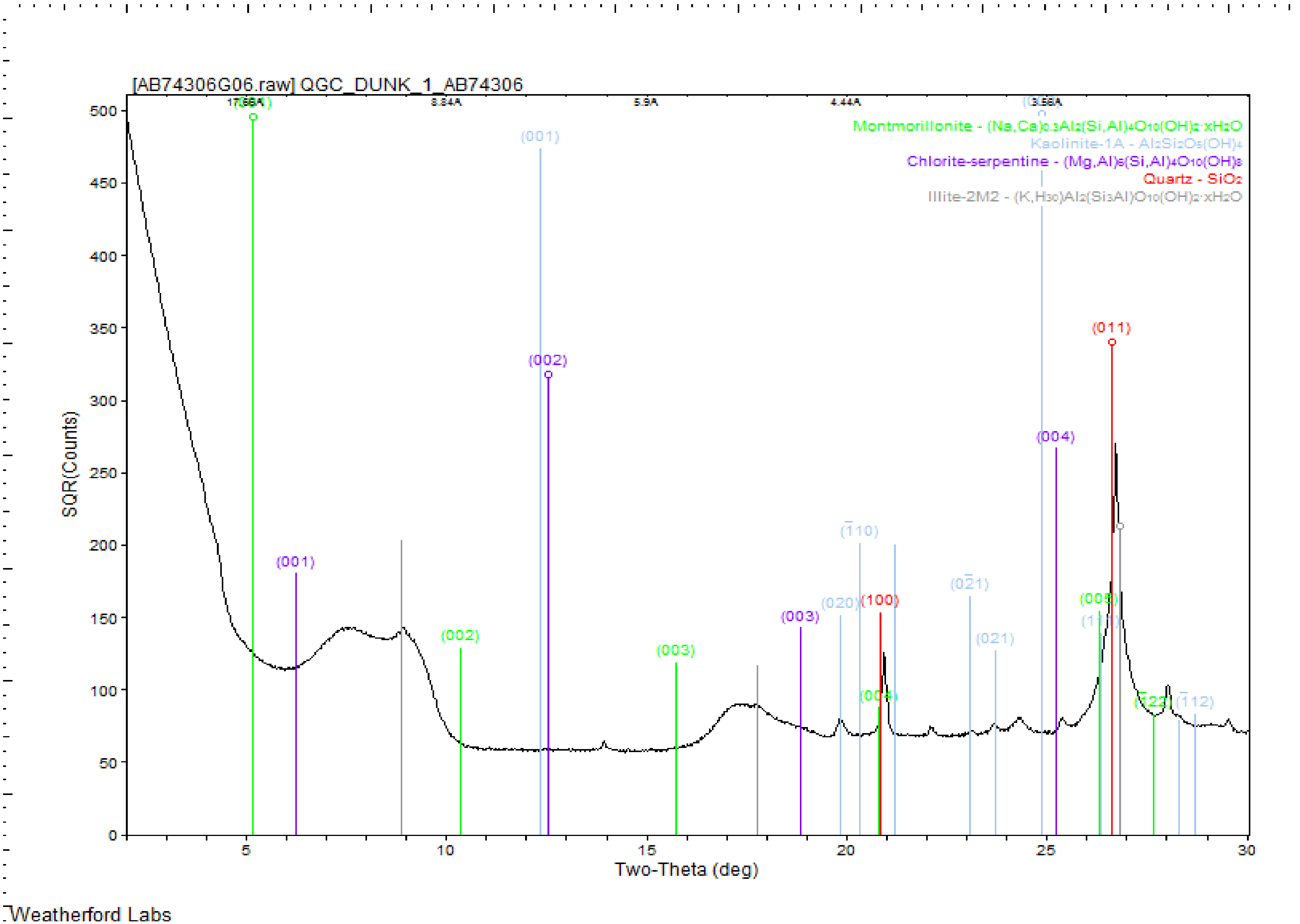


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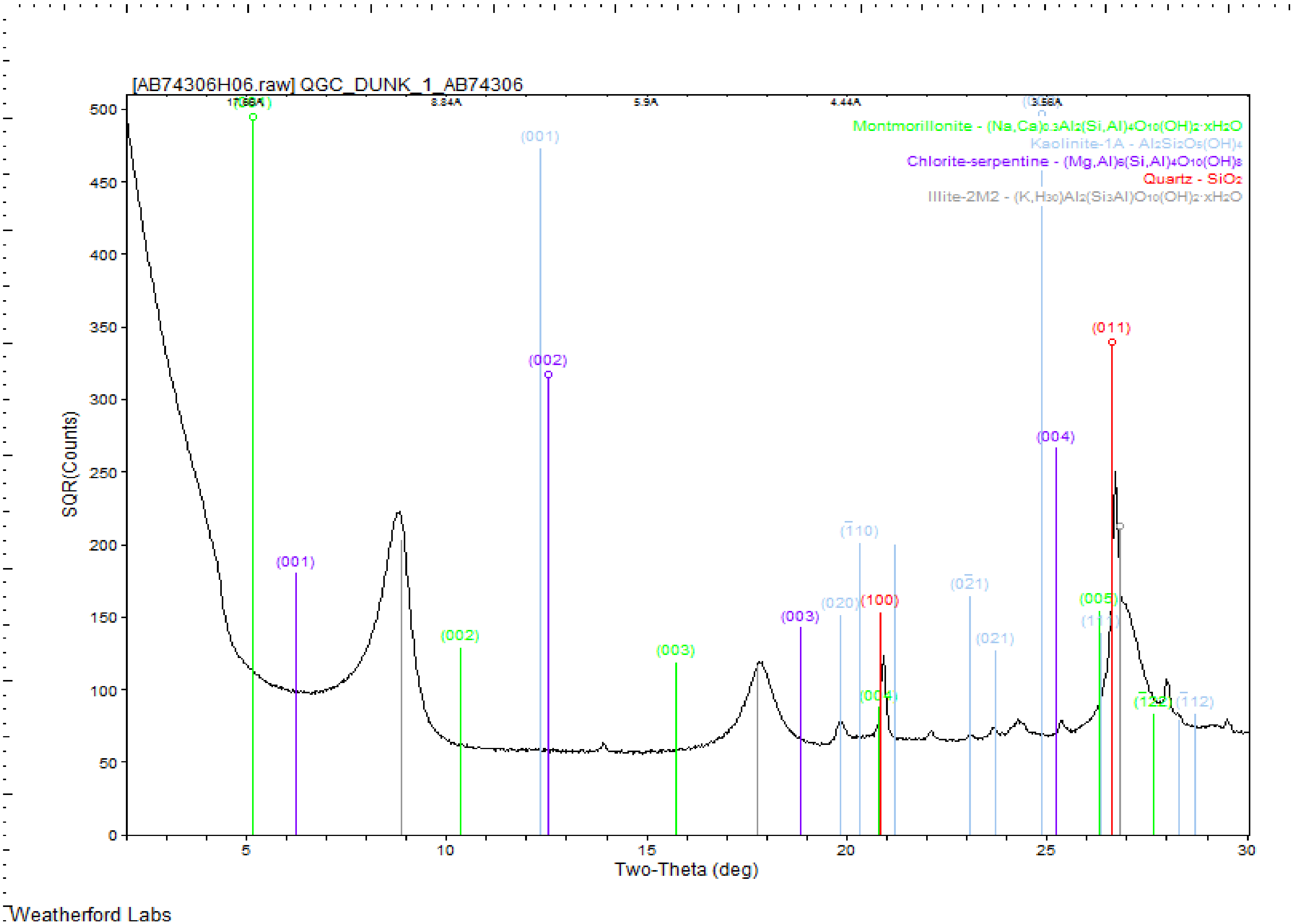


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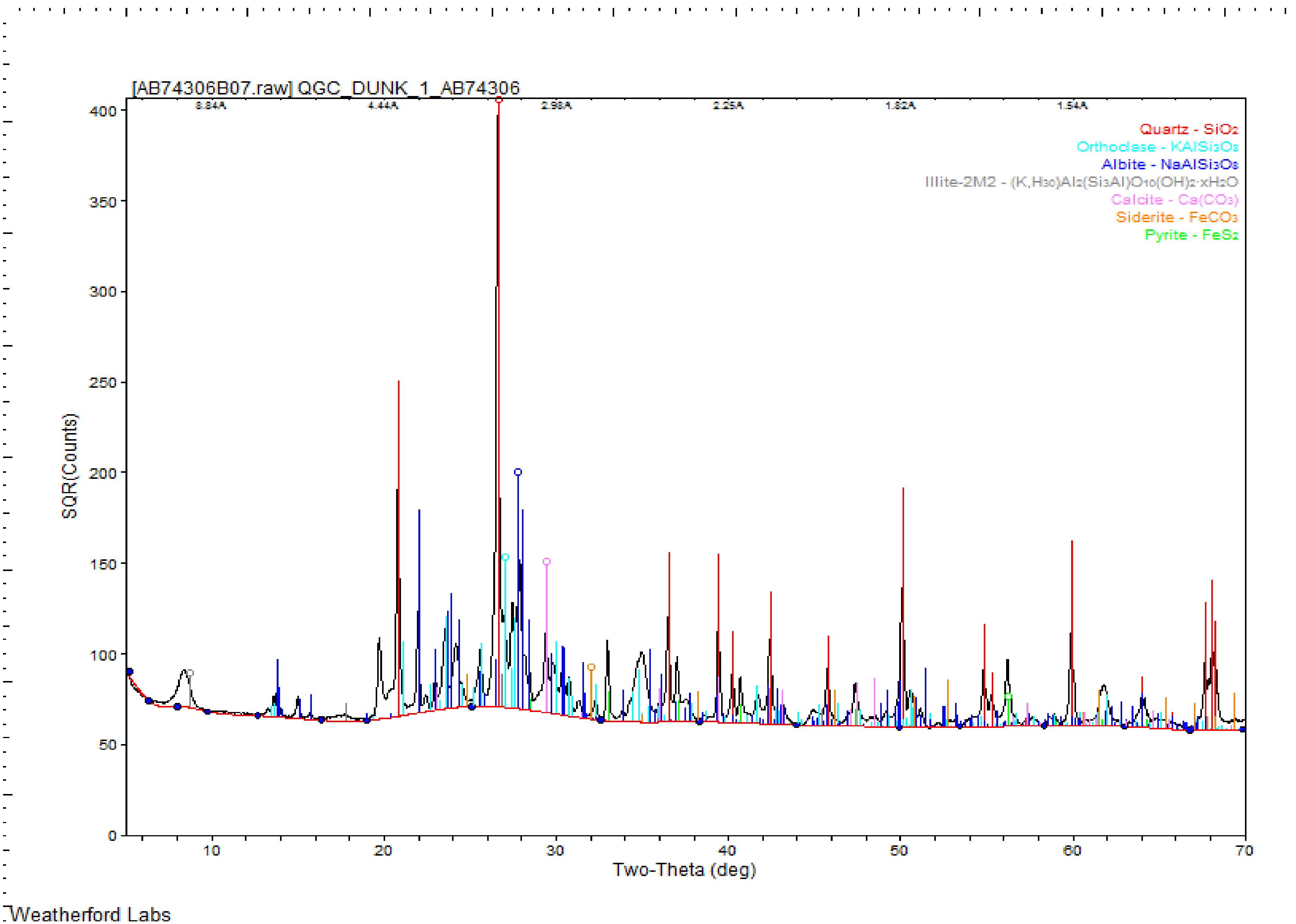

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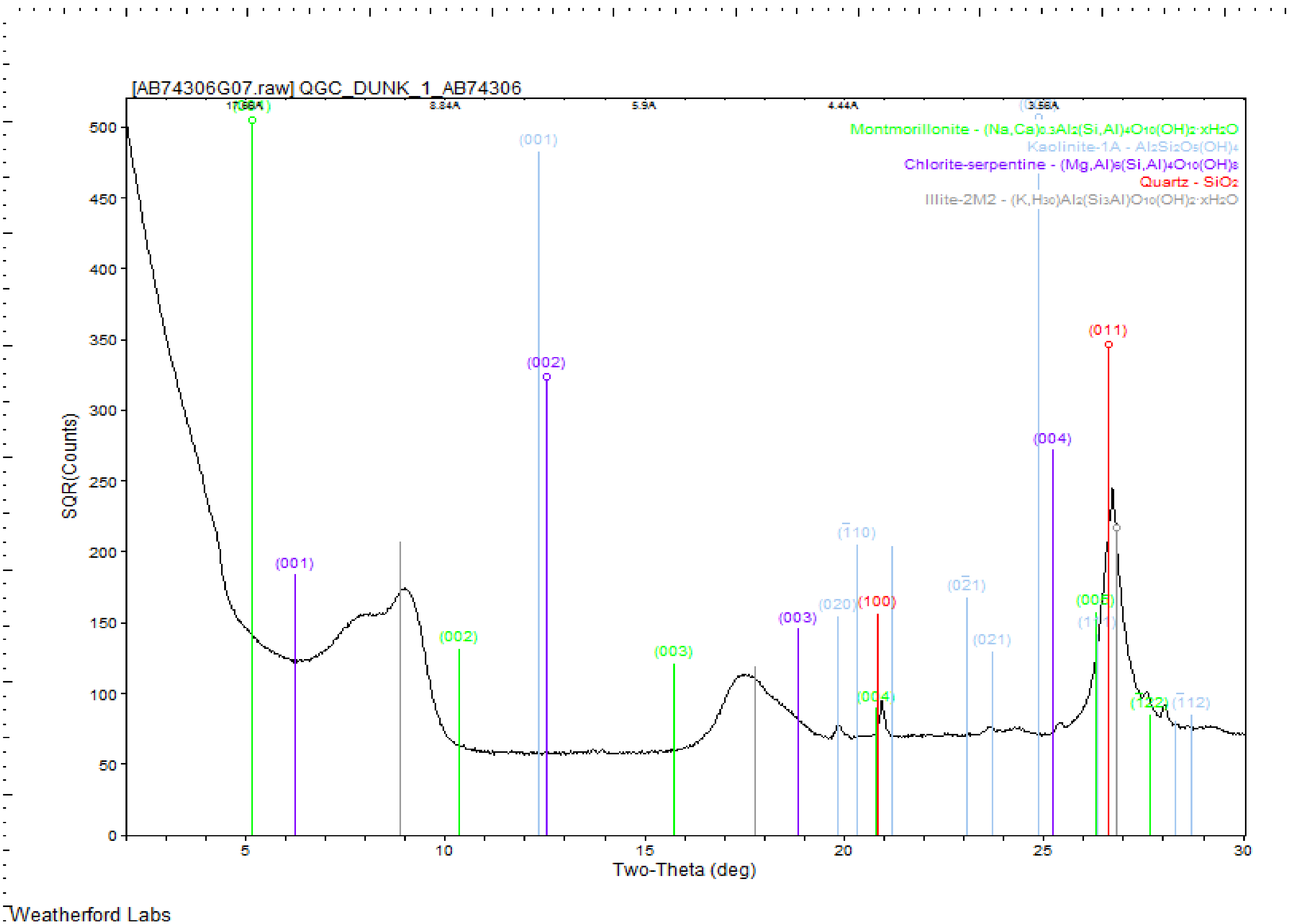
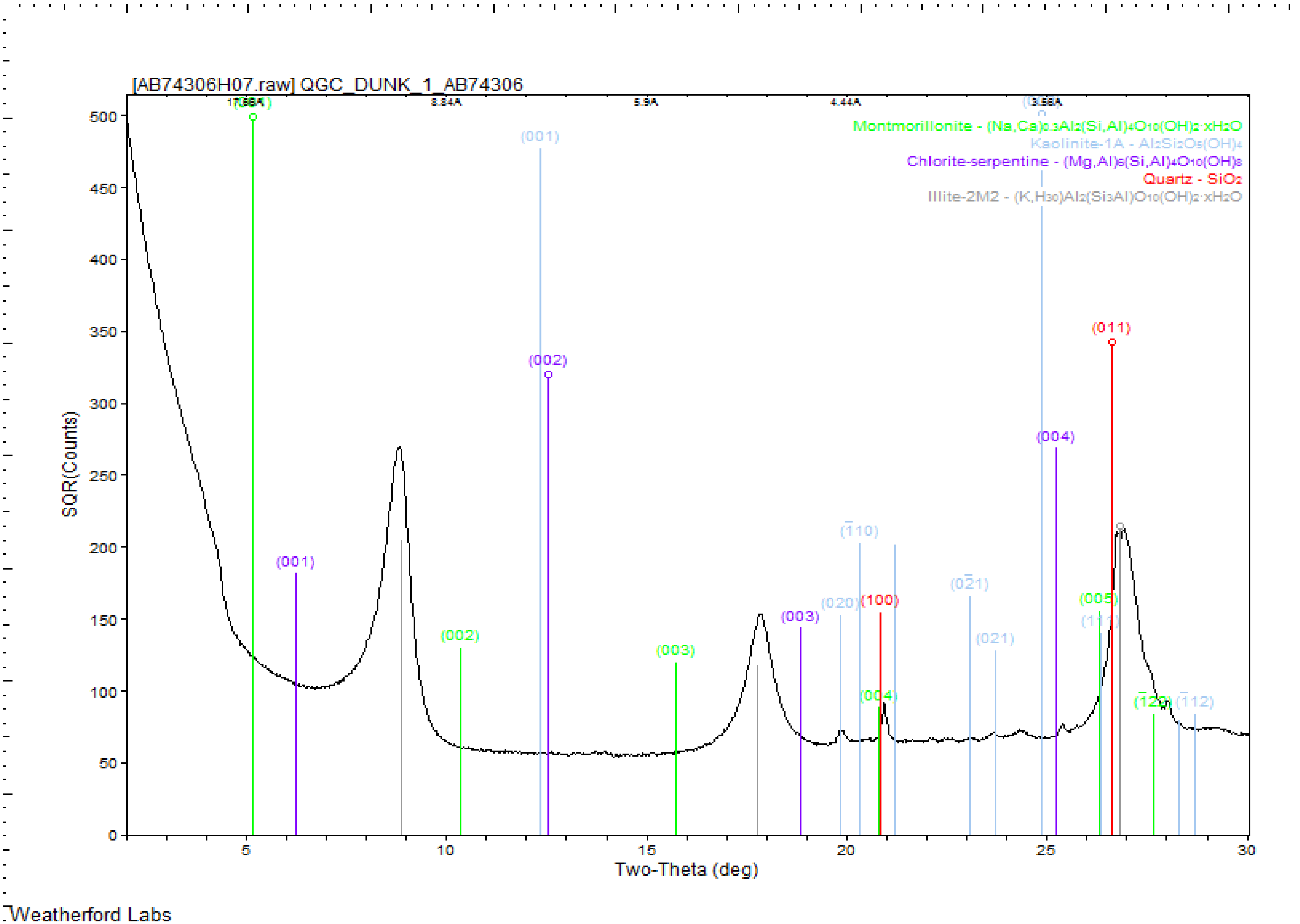
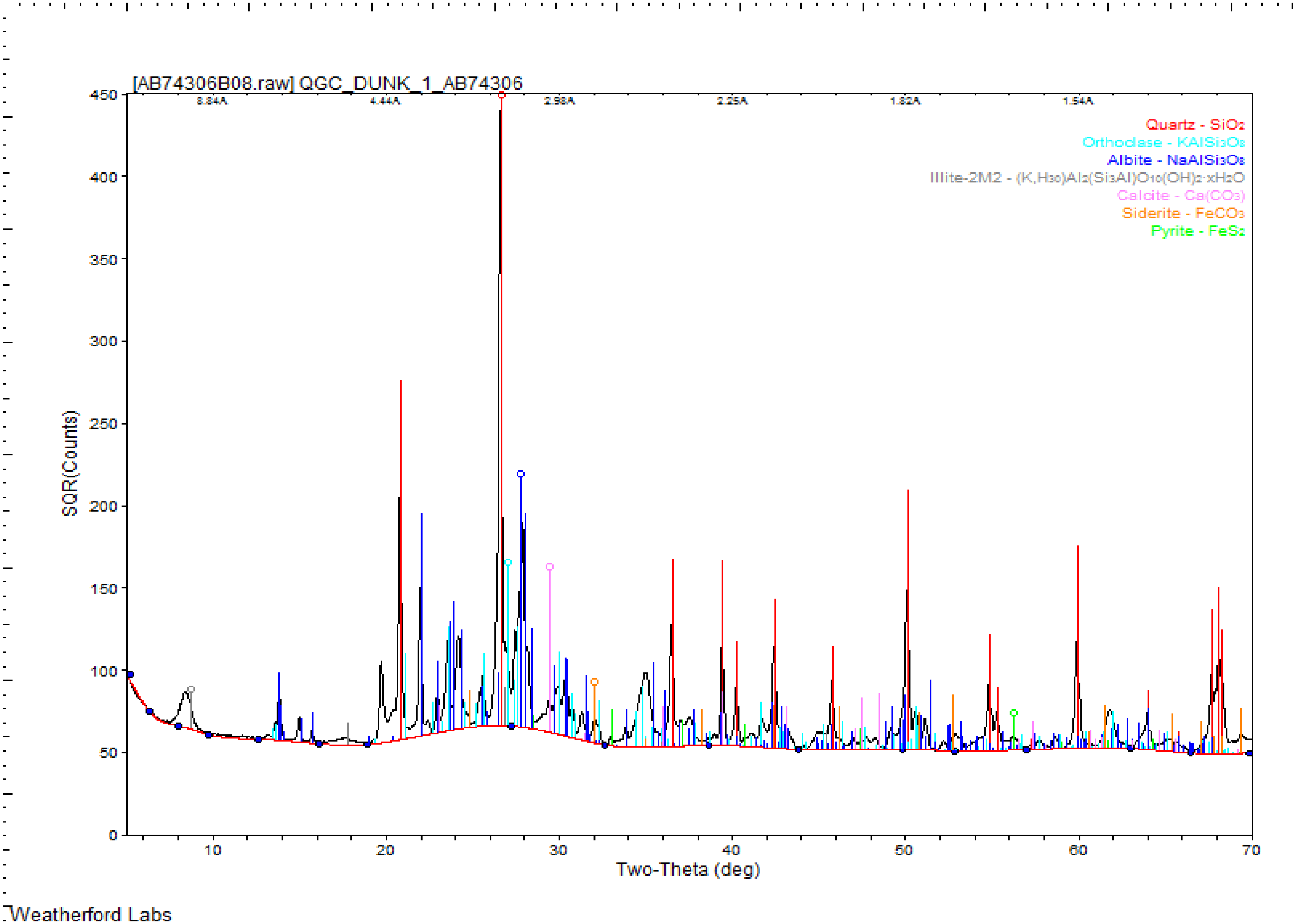
4.44A
2.98A
2.25A
1.82A
1.54A
Quartz - SiO2
Orthoclase - KAlSi3O8
Albite - NaAlSi3O8
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
Calcite - Ca(CO3)
Siderite - FeCO3
Pyrite - FeS2
SQR(Counts)
400
350
300
250
200
150
100
50
0
10
20
30
40
50
60
70
Two-Theta (deg)
Weatherford Labs



[AB74306G07.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs


[AB74306H07.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
8.84A
5.9A
4.44A
3.56A
(001)
(002)
(003)
(004)
(011)
(100)
(020)
(110)
(021)
(005)
(112)
Weatherford Labs



[AB74306B08.raw] QGC_DUNK_1_AB74306
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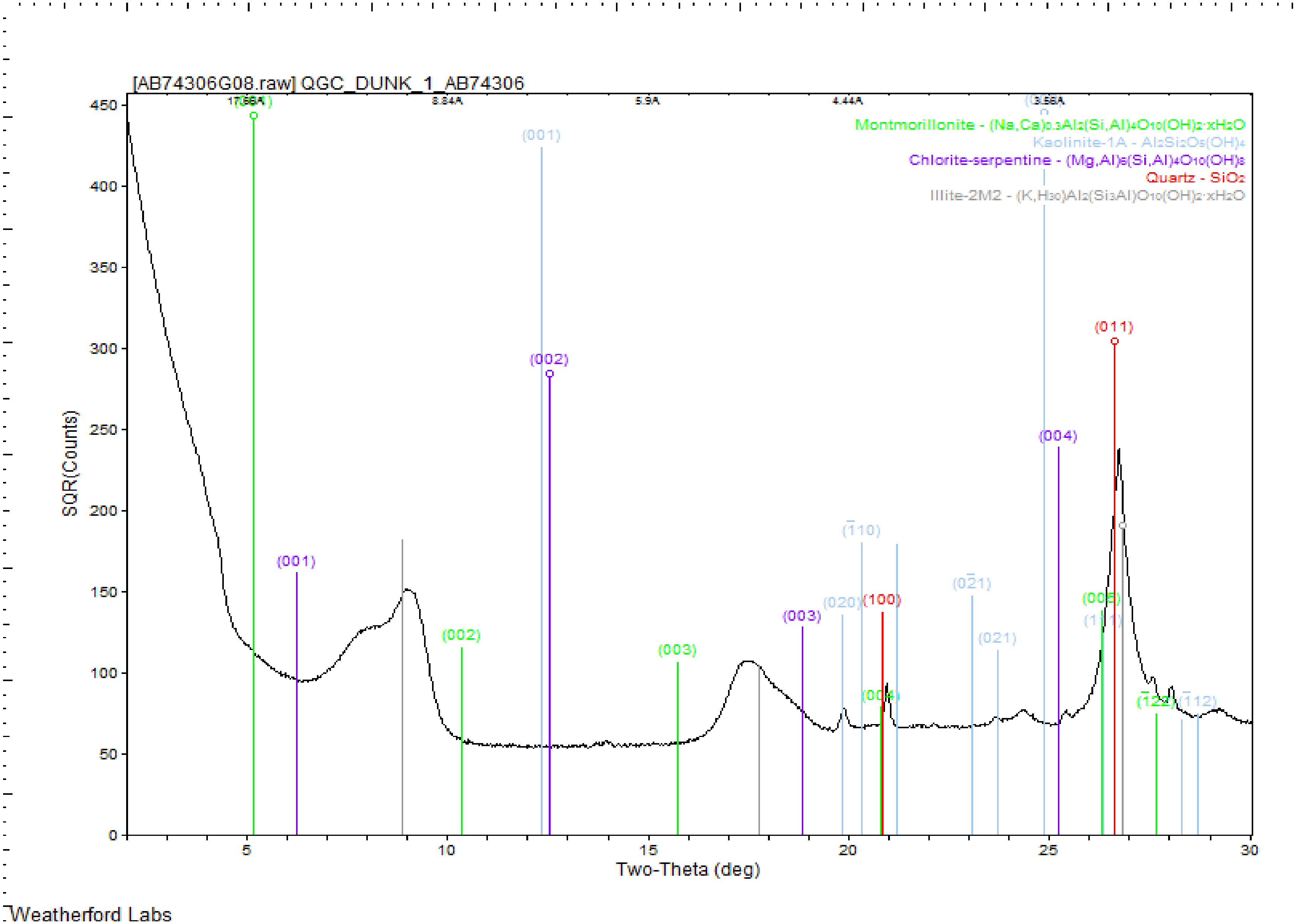
4.44A
2.98A
2.25A
1.82A
1.54A
Quartz - SiO2
Orthoclase - KAlSi3O8
Albite - NaAlSi3O8
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
Calcite - Ca(CO3)
Siderite - FeCO3
Pyrite - FeS2
SQR(Counts)
0
50
100
150
200
250
300
350
400
450
10
20
30
40
50
60
70
Two-Theta (deg)
Weatherford Labs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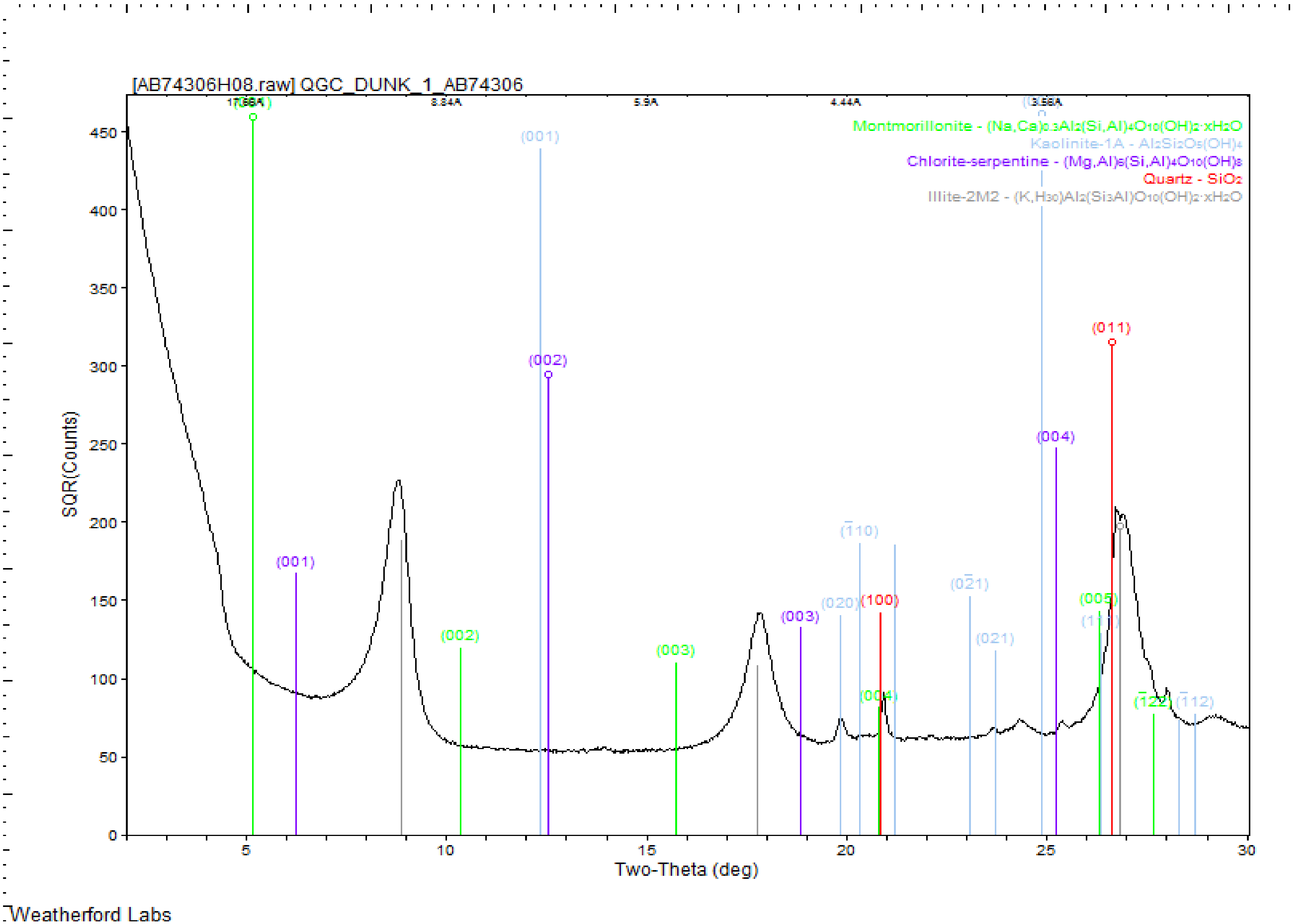
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs



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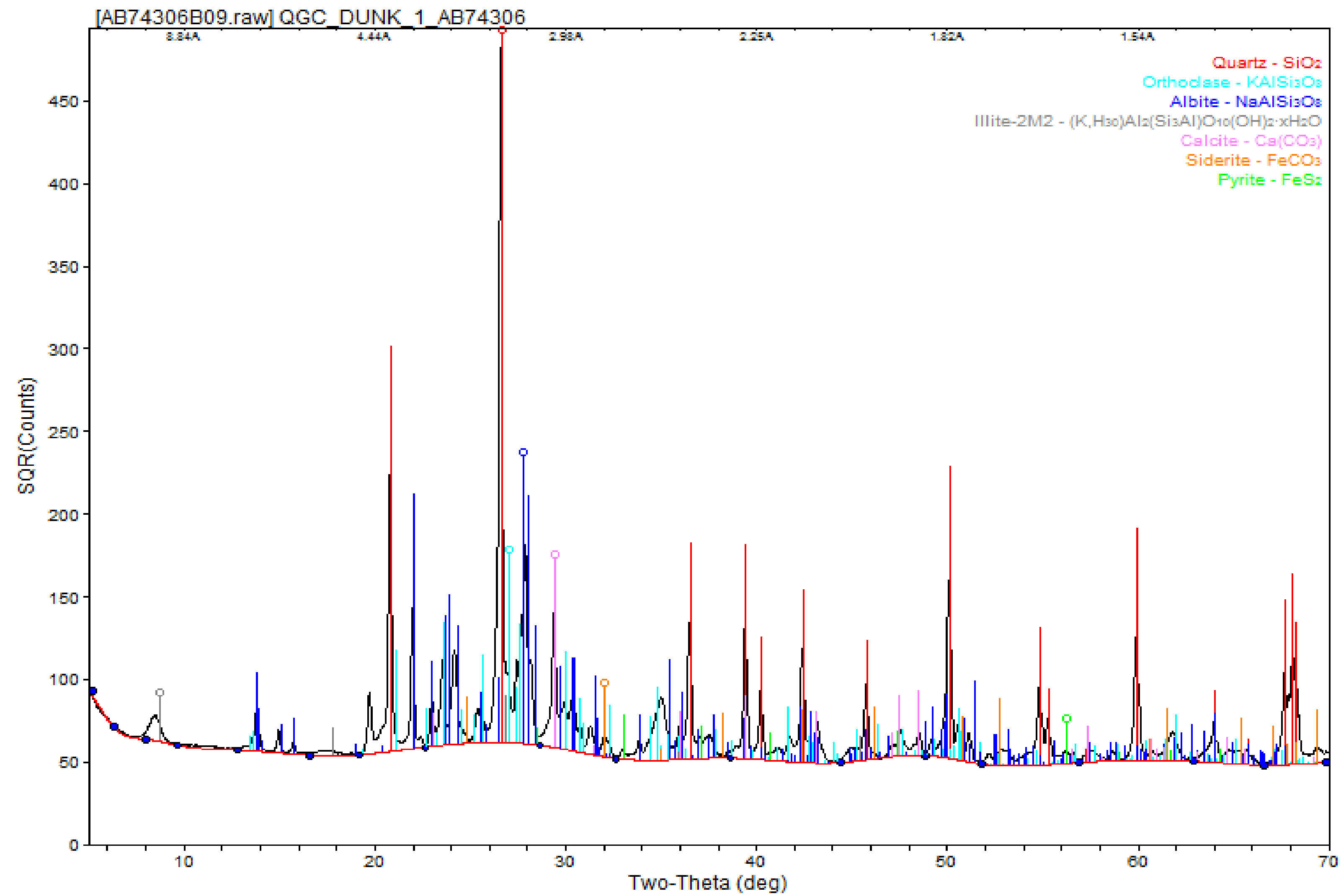


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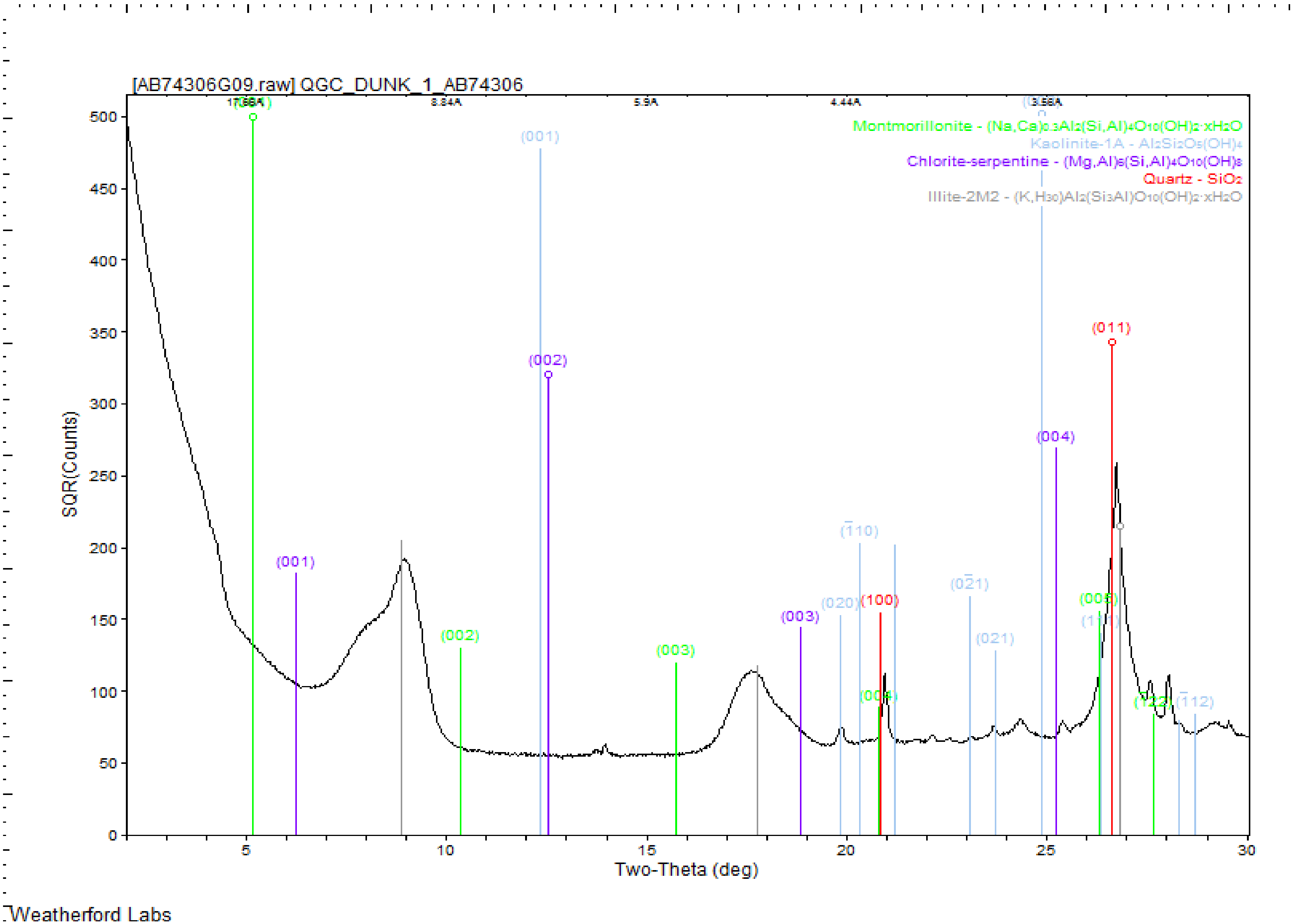
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Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
8.84A
5.9A
4.44A
3.56A
(001)
(002)
(003)
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(011)
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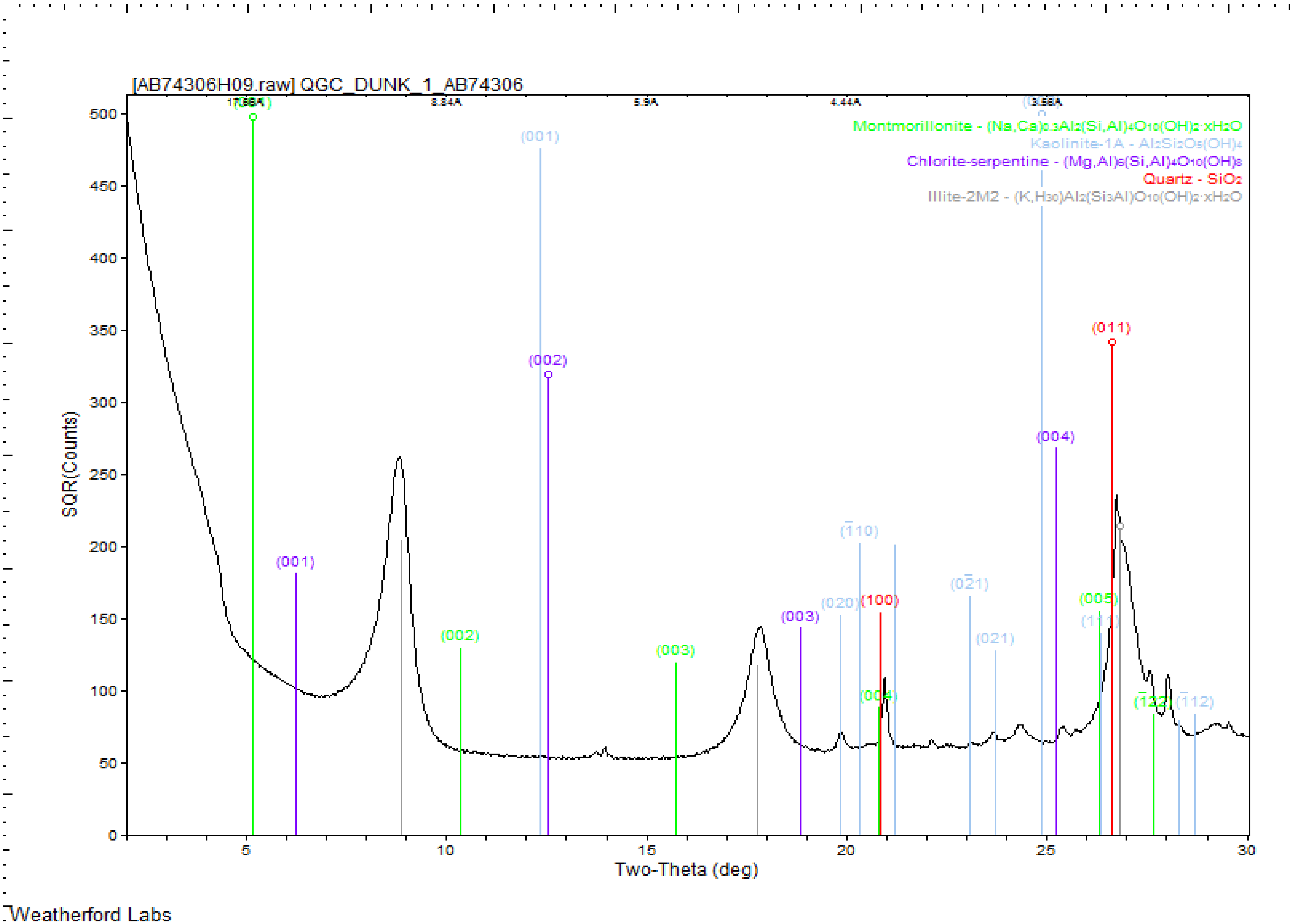
Weatherford Labs

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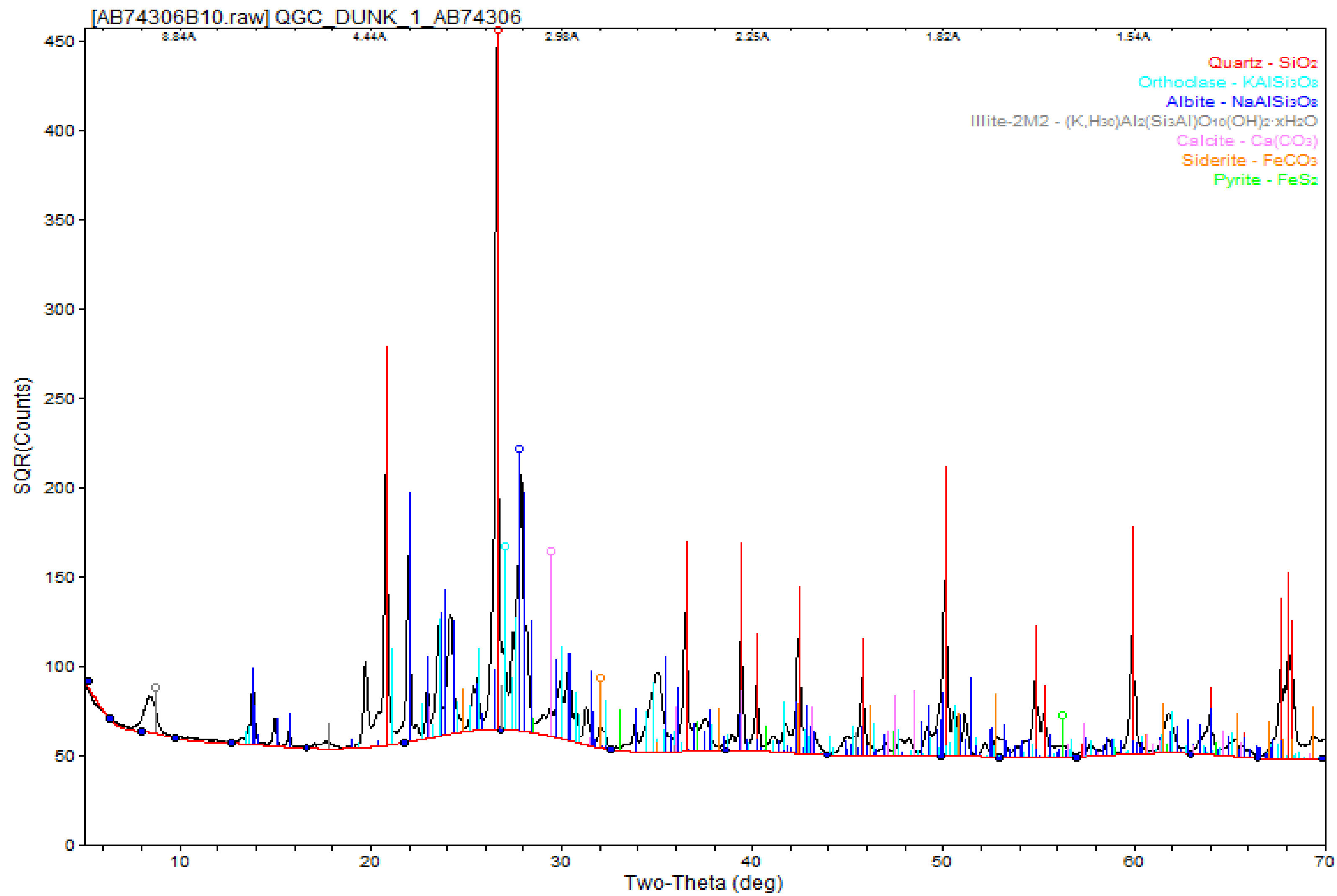


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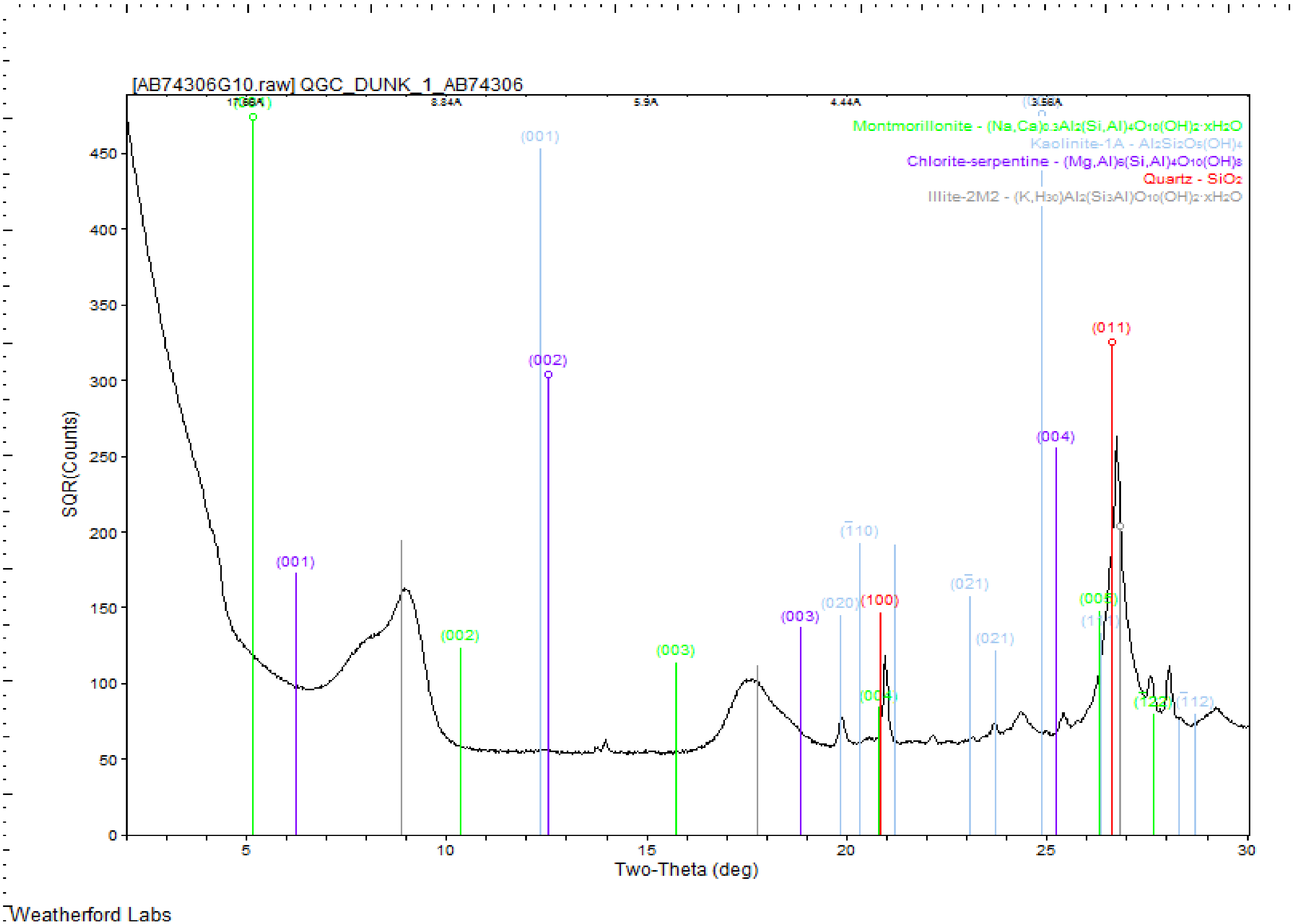

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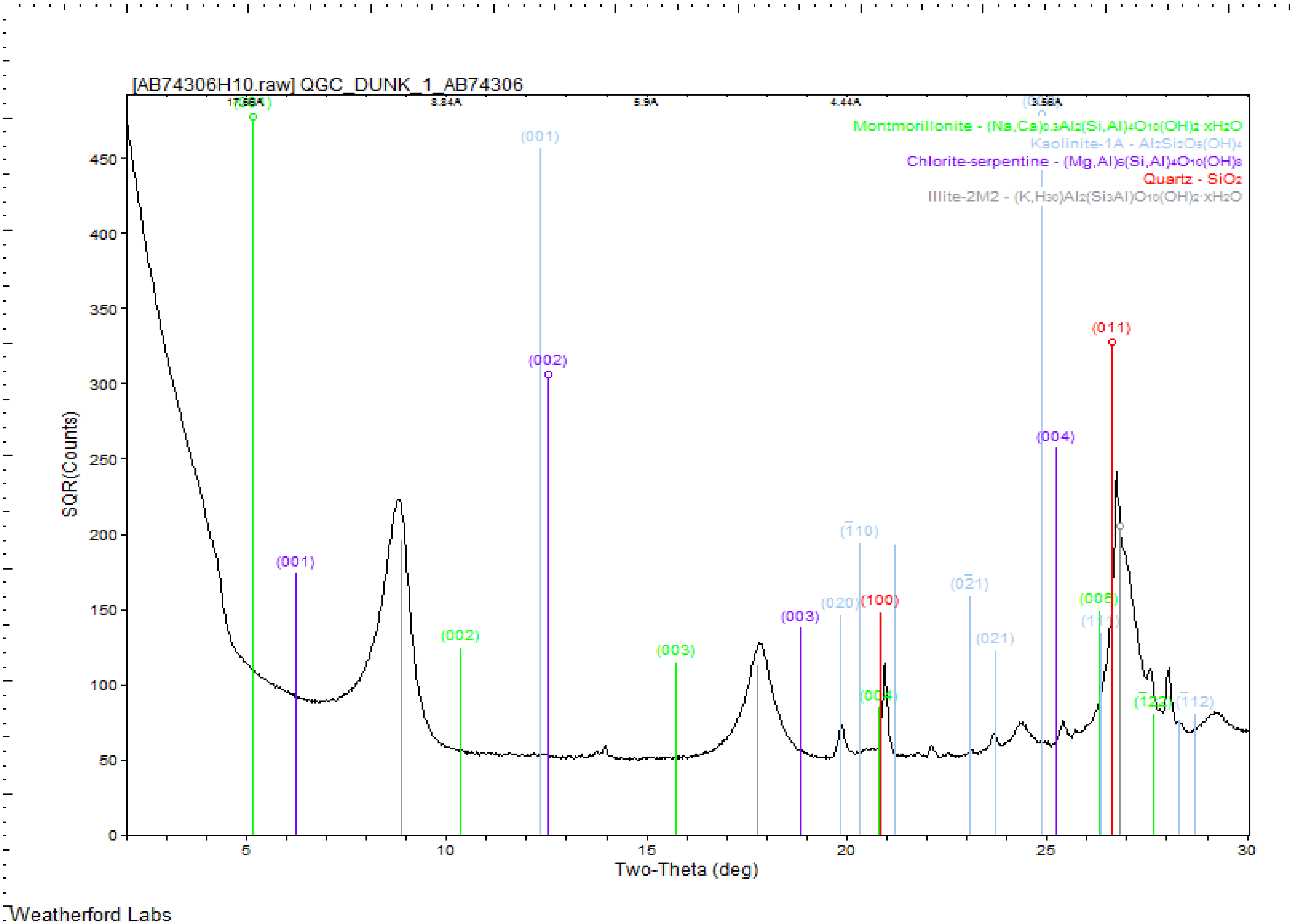

[AB74306H10.raw] QGC_DUNK_1_AB74306
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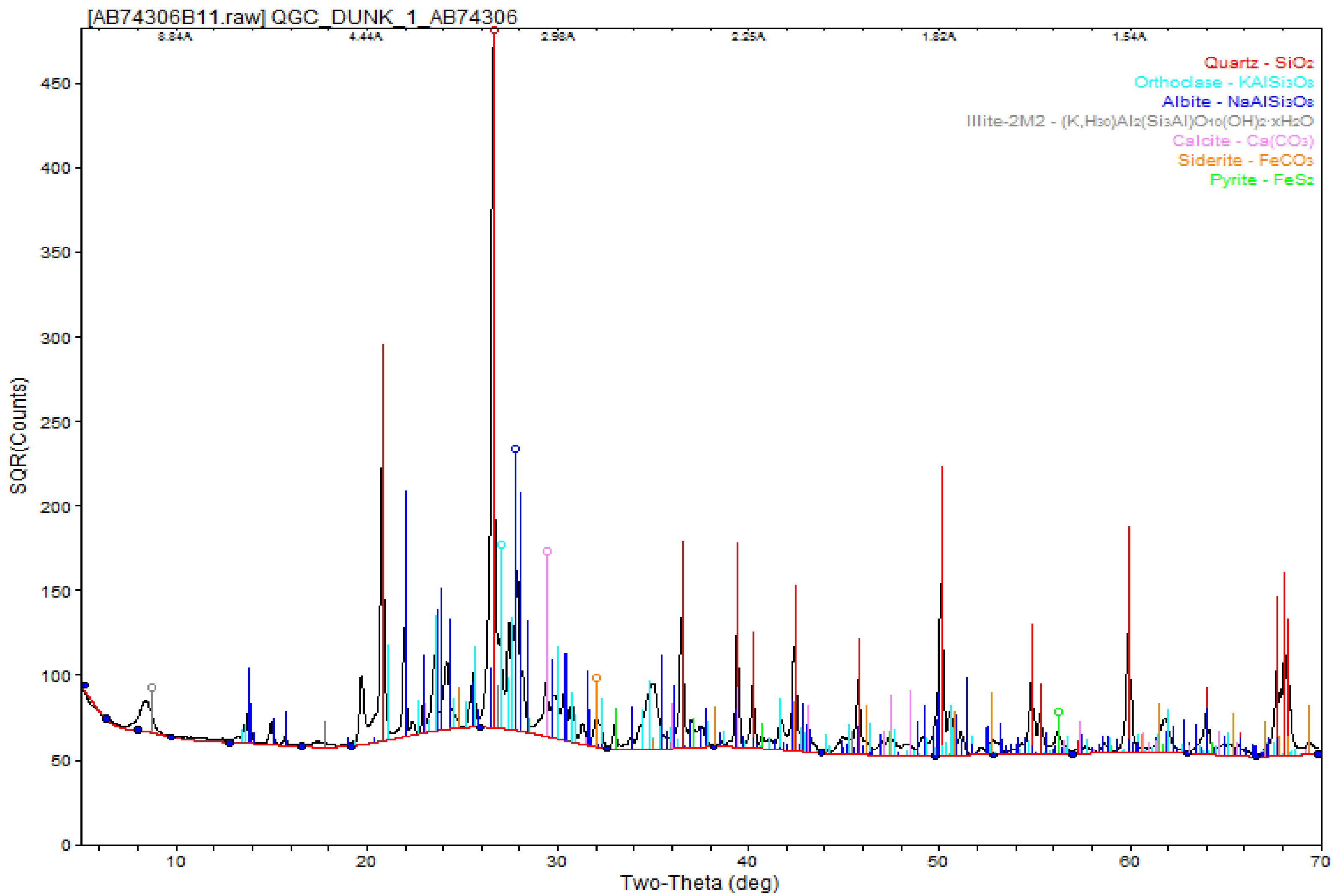
5.9A
4.44A
3.56A
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs

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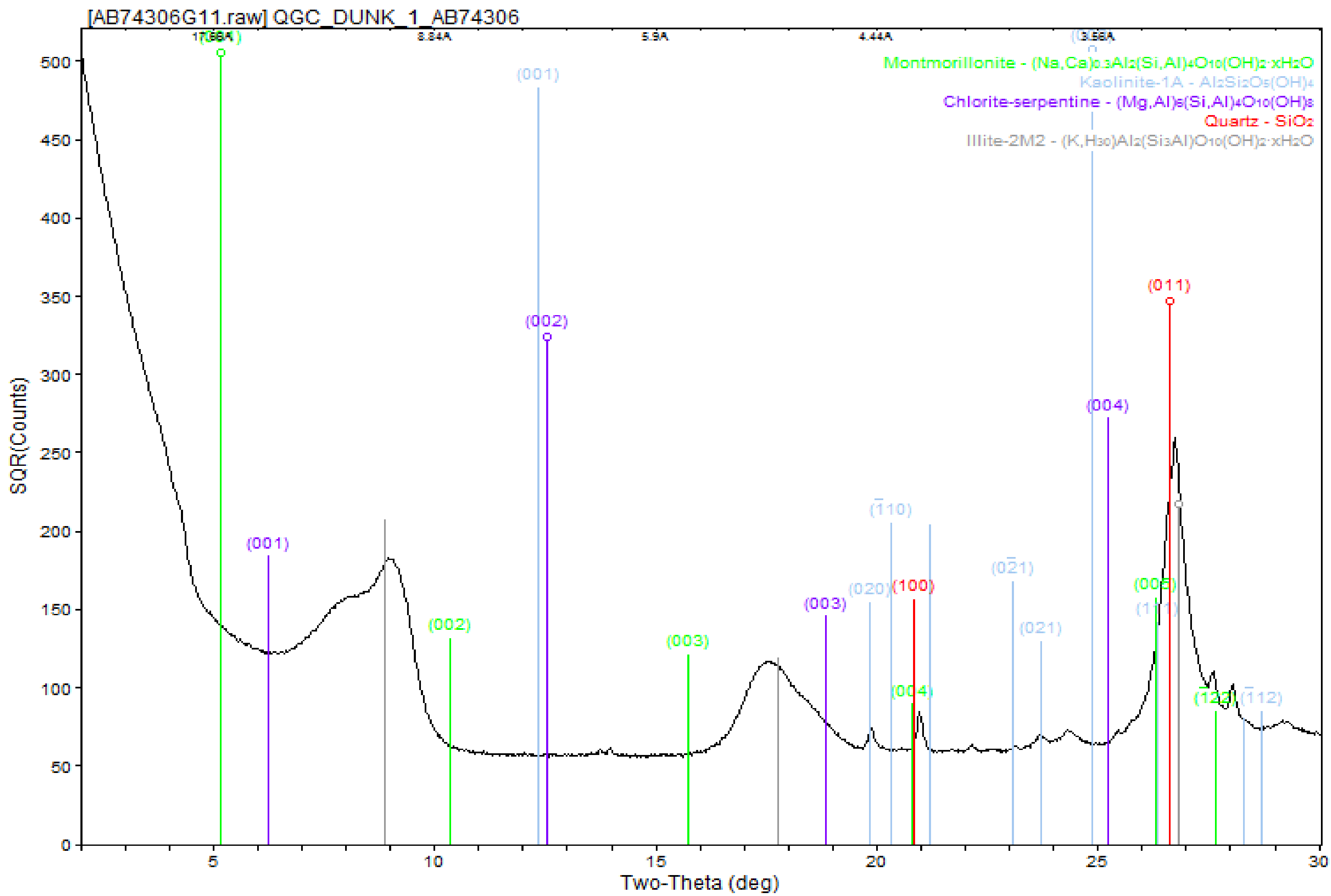


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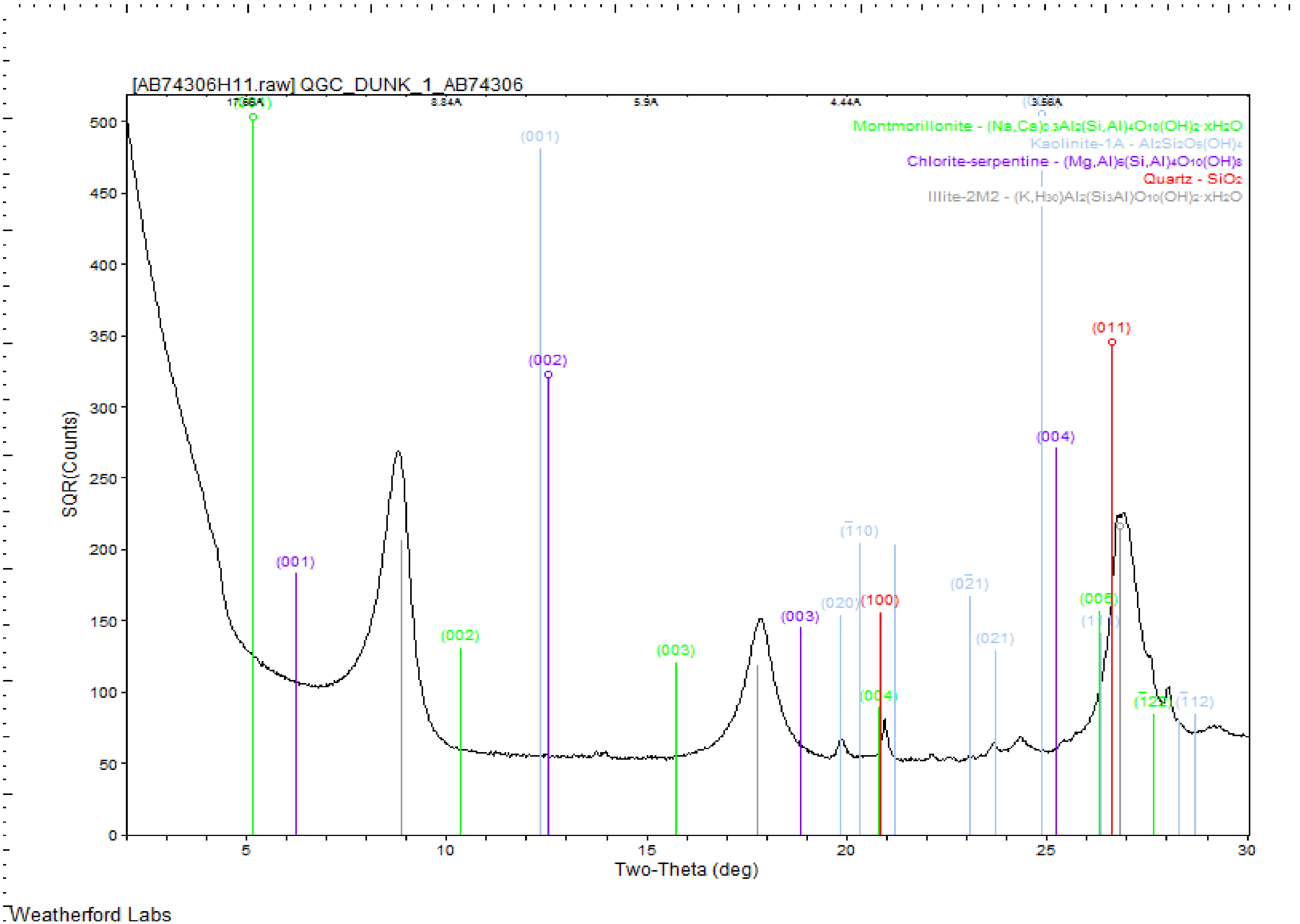
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Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
8.84A
5.9A
4.44A
3.56A
(001)
(002)
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(004)
(005)
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(100)
(020)
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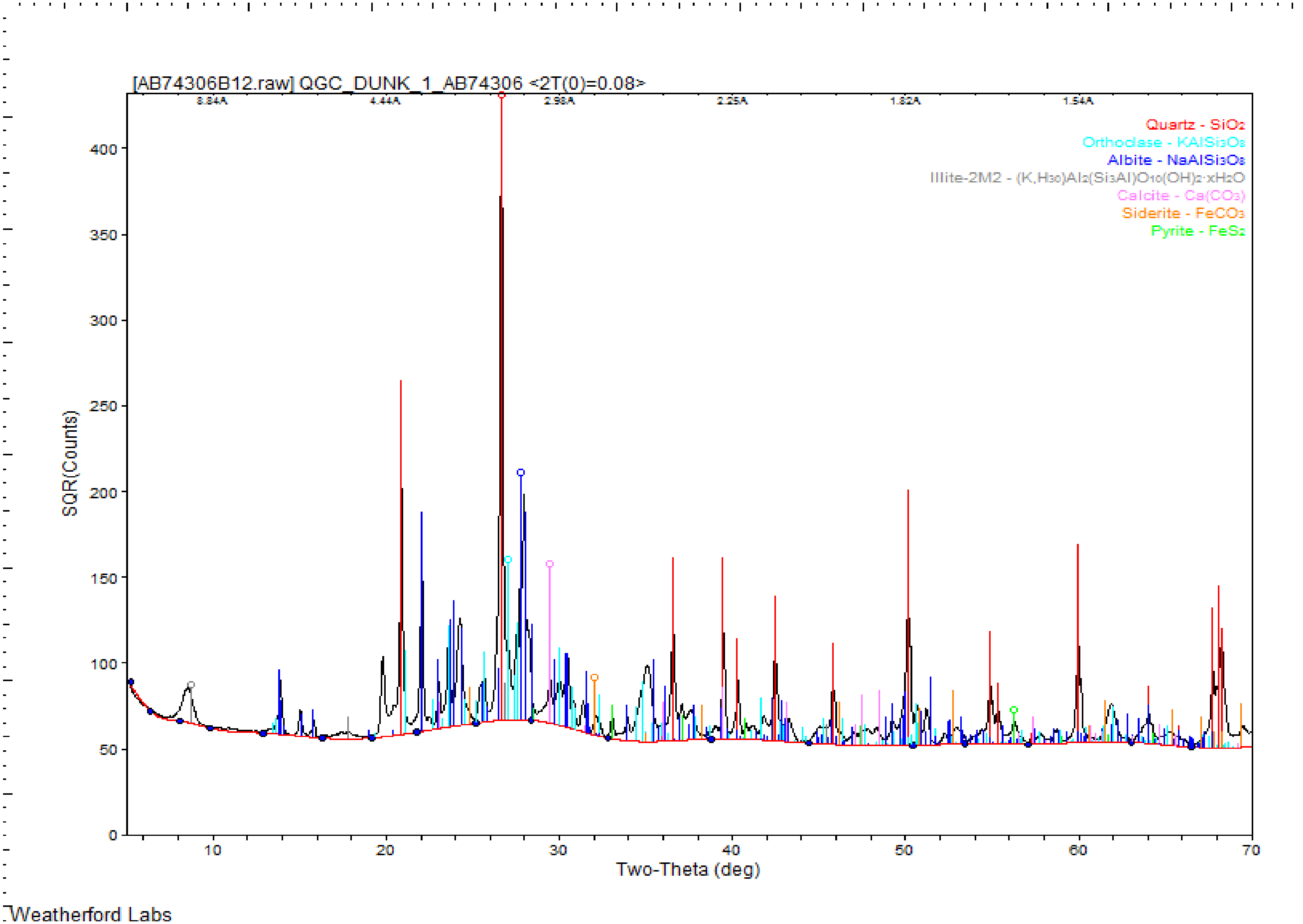
Weatherford Labs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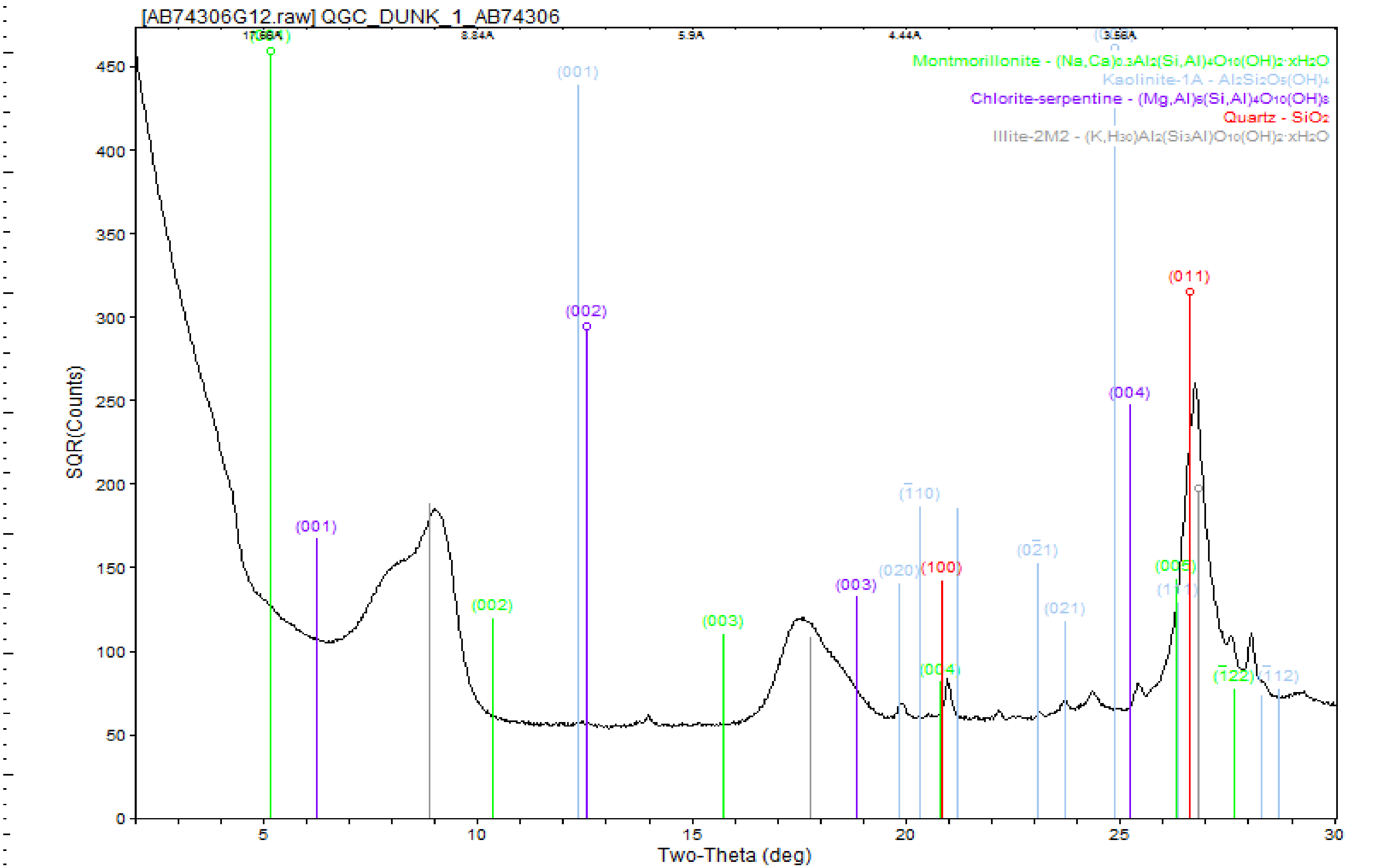
Quartz - SiO2
Orthoclase - KAlSi3O8
Albite - NaAlSi3O8
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
Calcite - Ca(CO3)
Siderite - FeCO3
Pyrite - FeS2
SQR(Counts)
Two-Theta (deg)
Weatherford Labs



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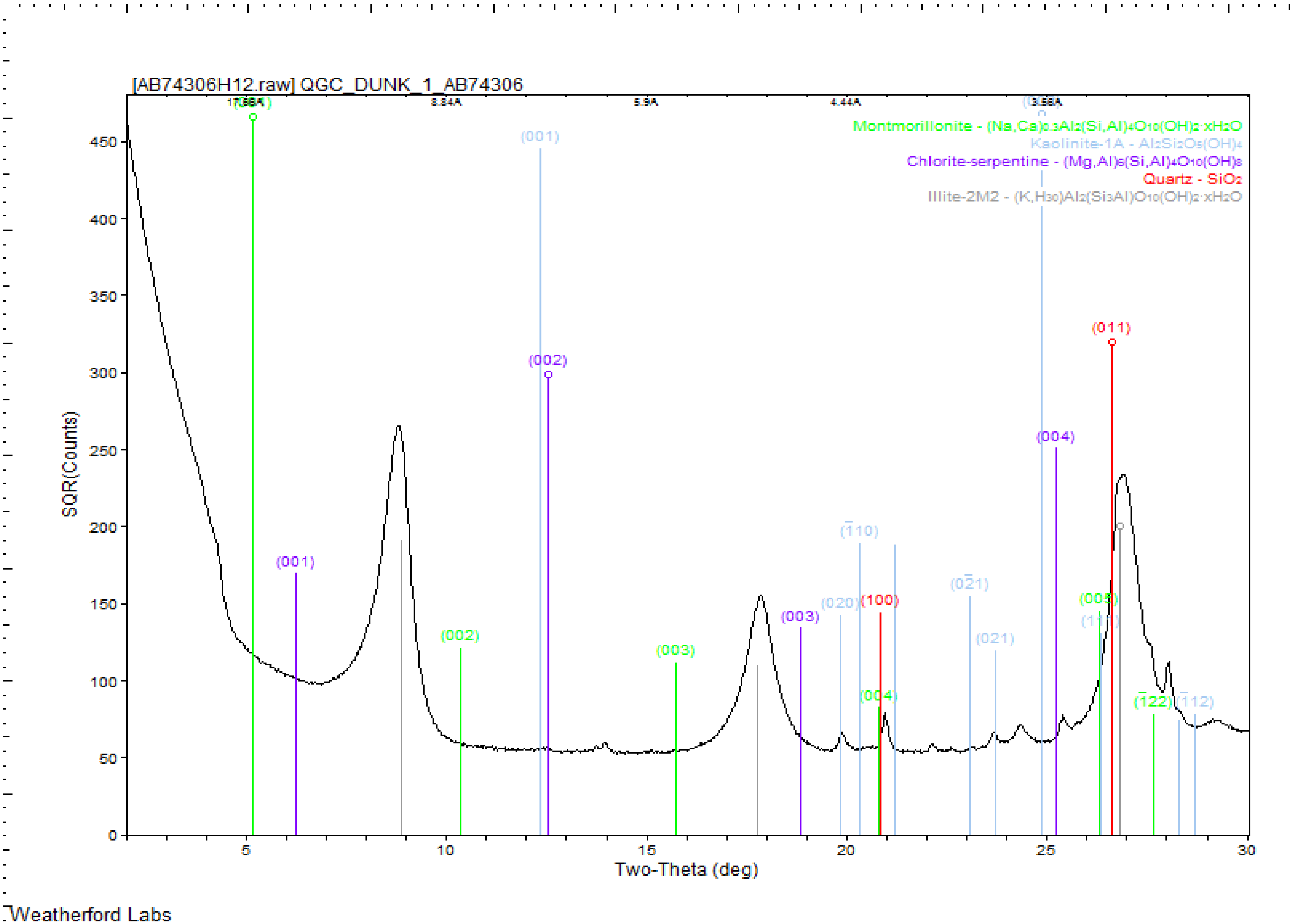
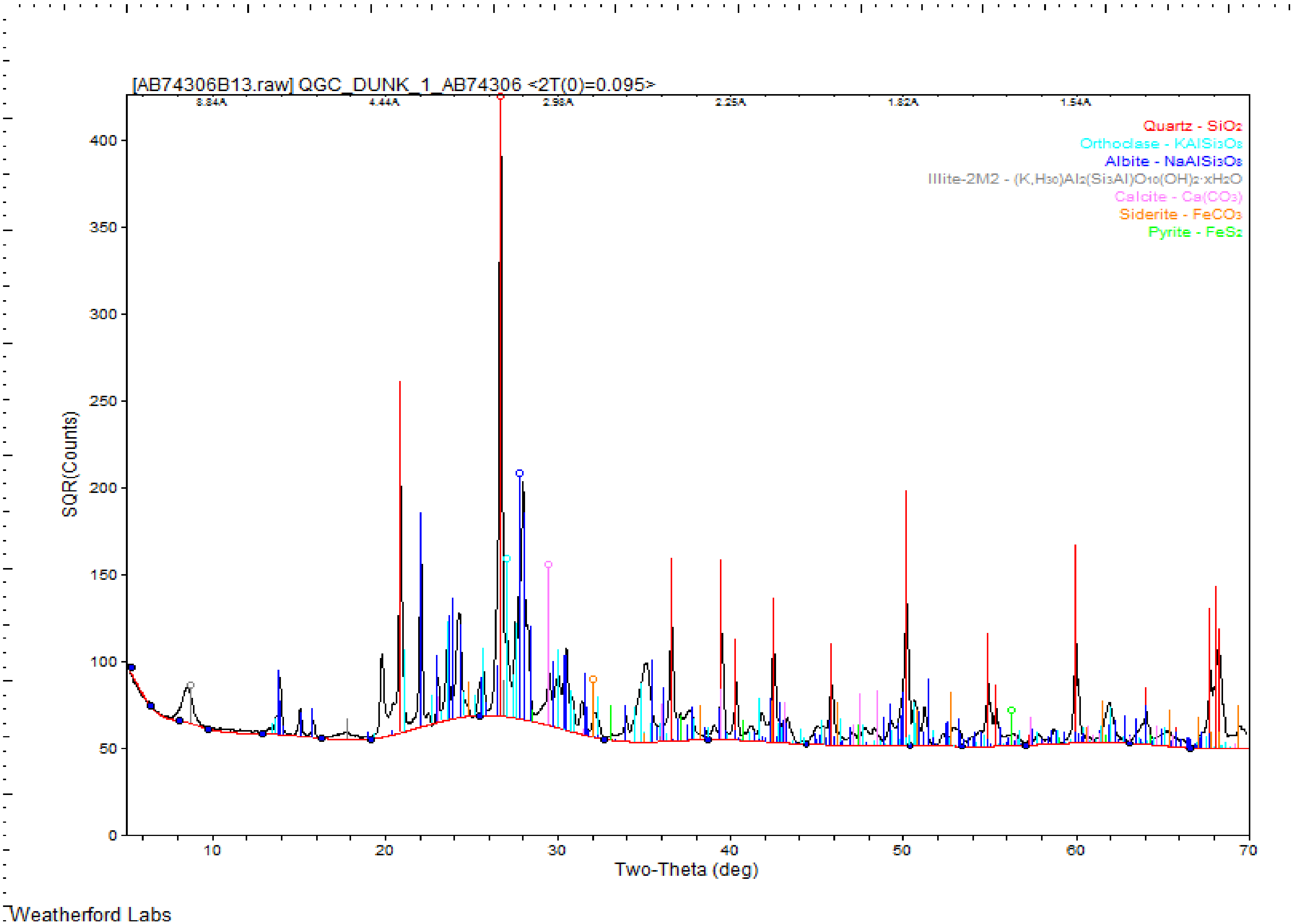
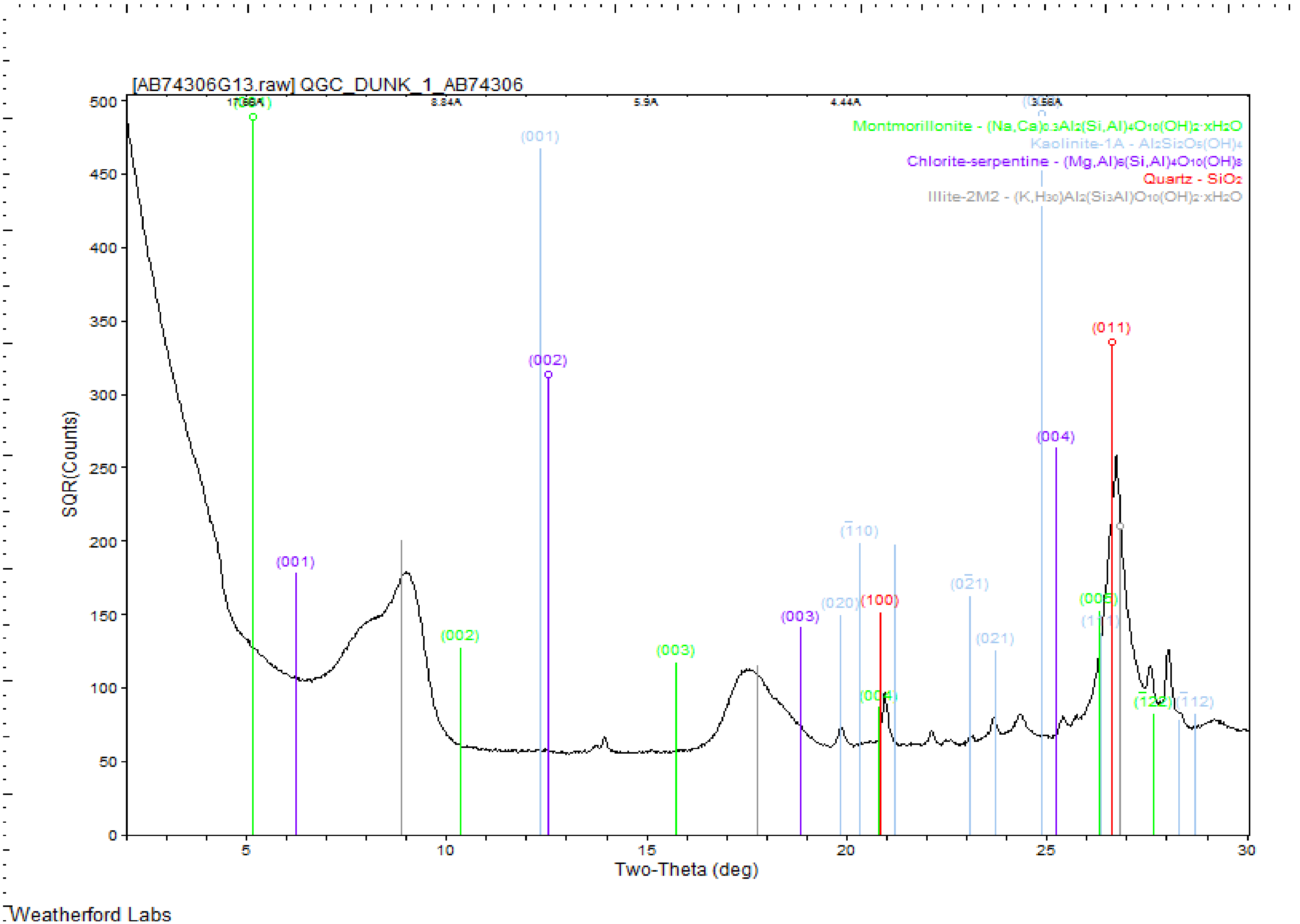
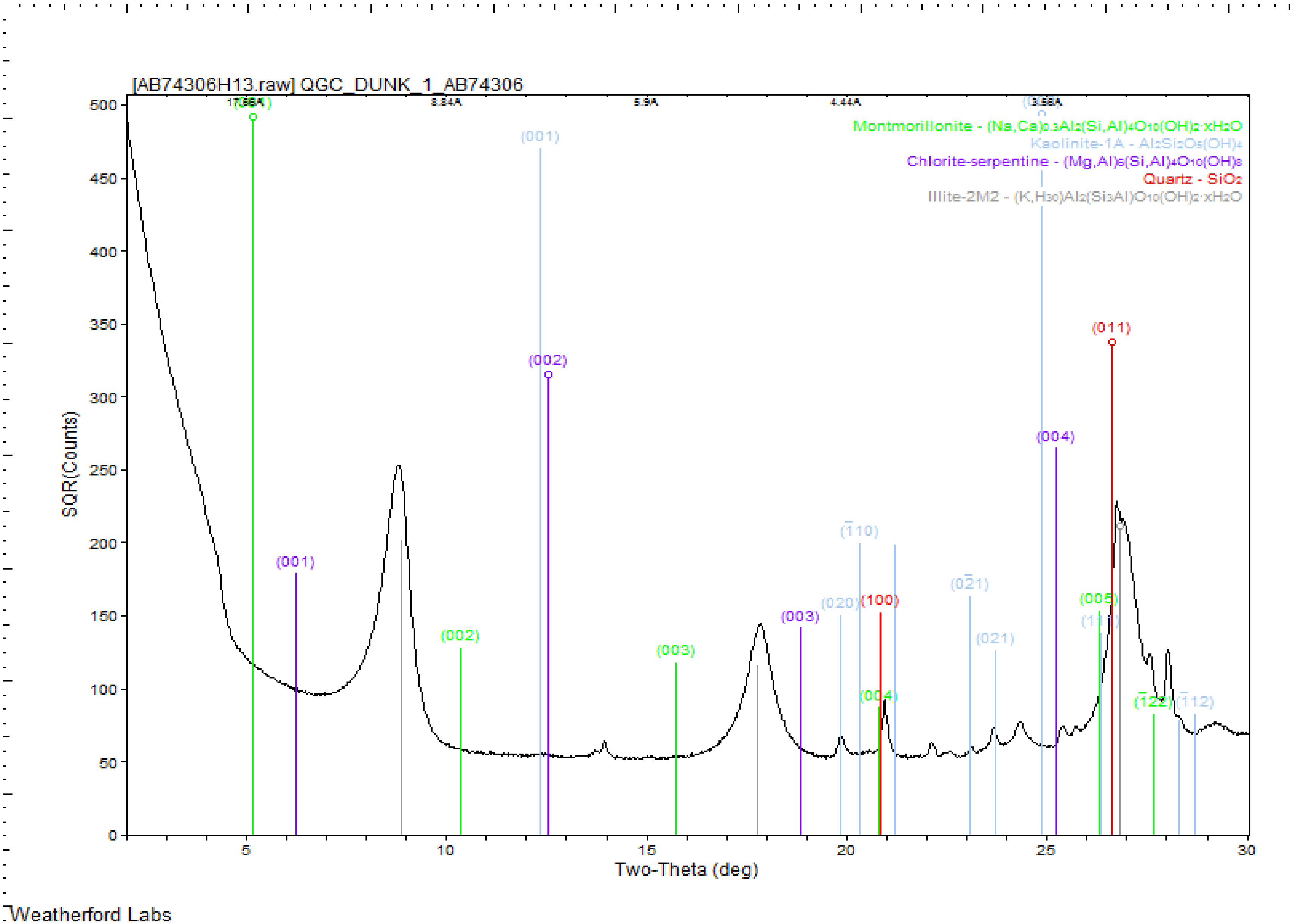

[AB74306H12.raw] QGC_DUNK_1_AB74306
17.66A
8.84A
5.9A
4.44A
3.56A
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
(001)
(002)
(003)
(004)
(005)
(011)
(100)
(020)
(021)
(112)
(122)
Weatherford Labs

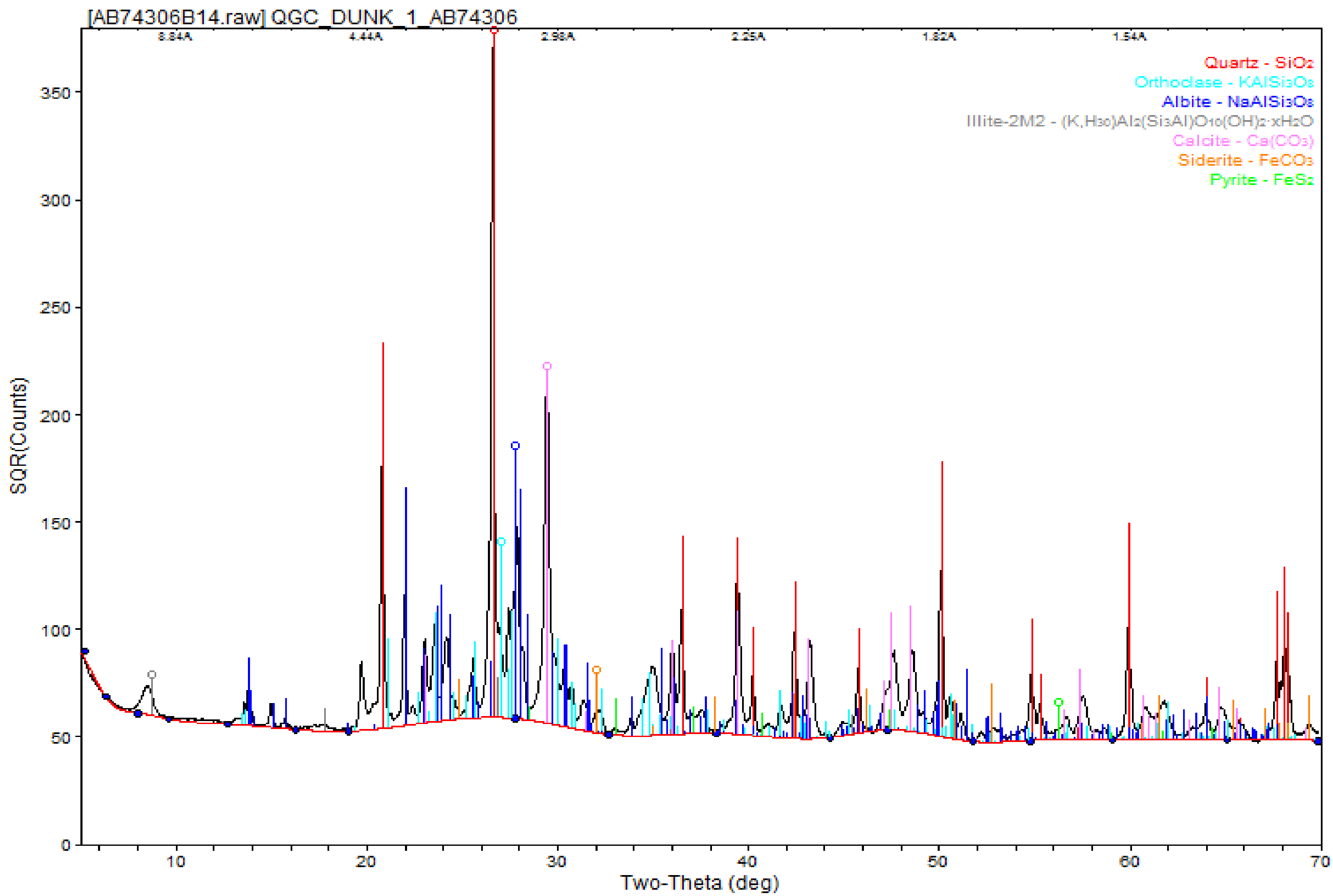



Weatherford Labs

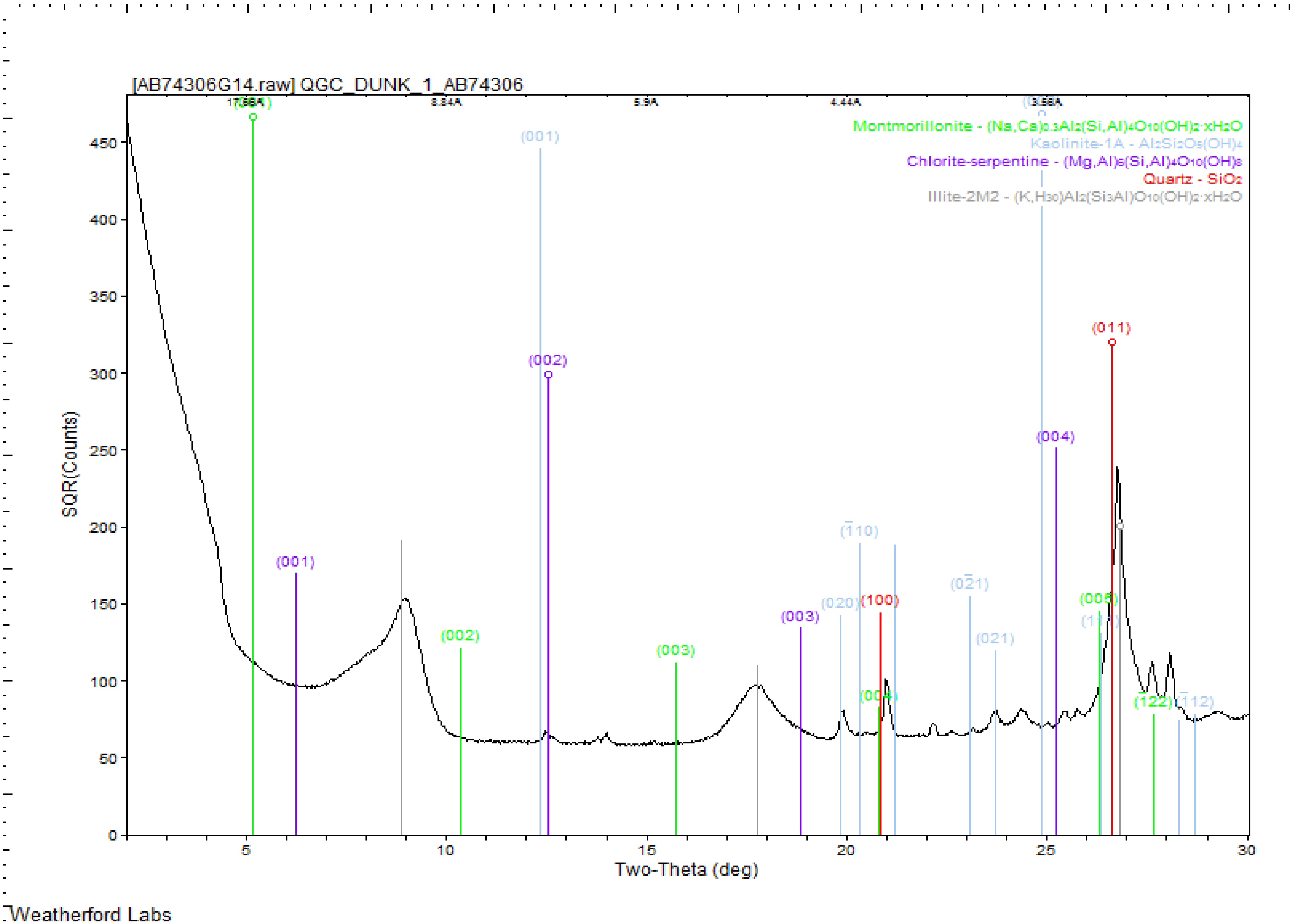


Weatherford Labs

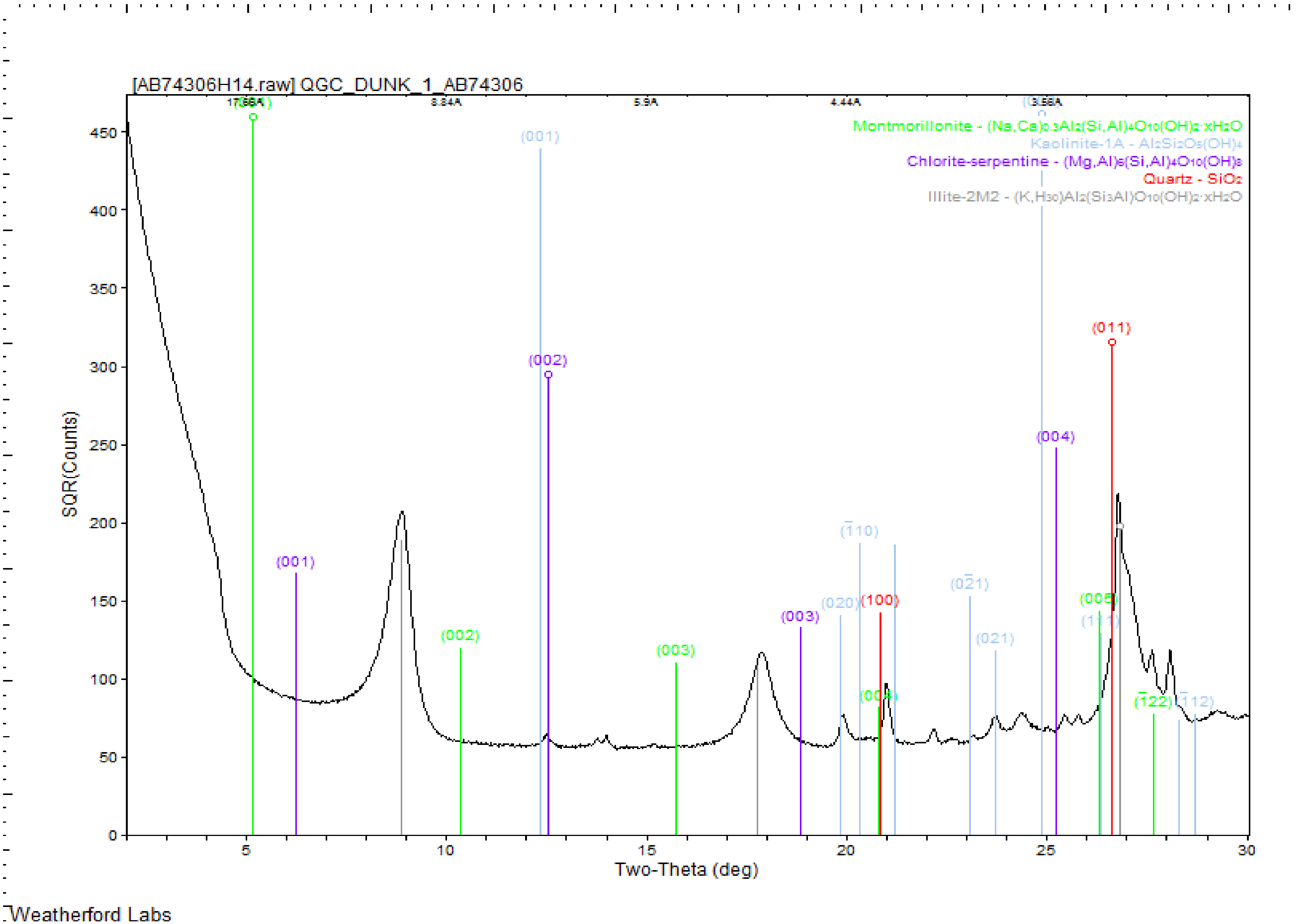

[AB74306H13.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
8.84A
5.9A
4.44A
3.58A
(001)
(002)
(003)
(004)
(005)
(011)
(100)
(020)
(021)
(110)
Weatherford Labs



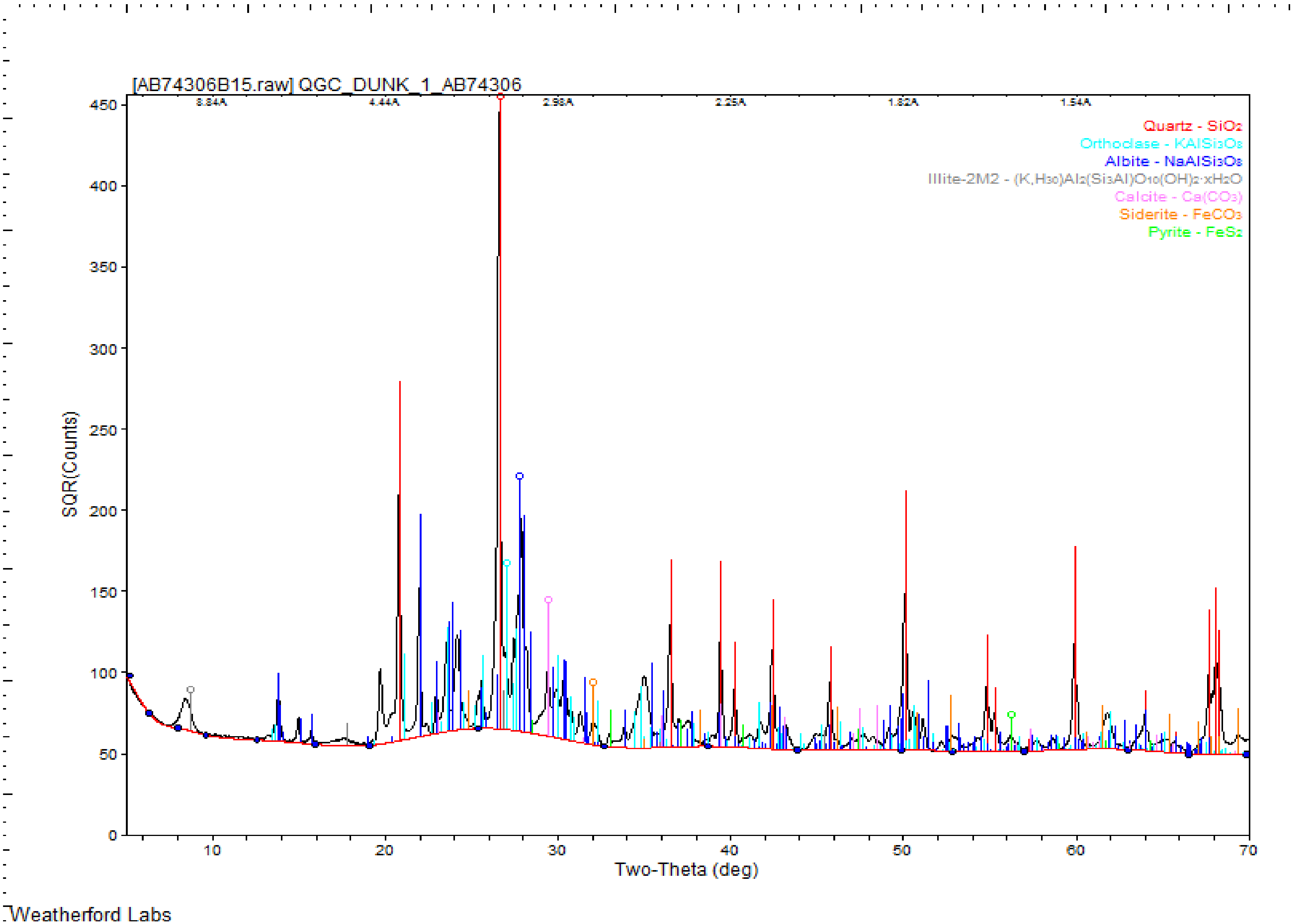

Weatherford Labs

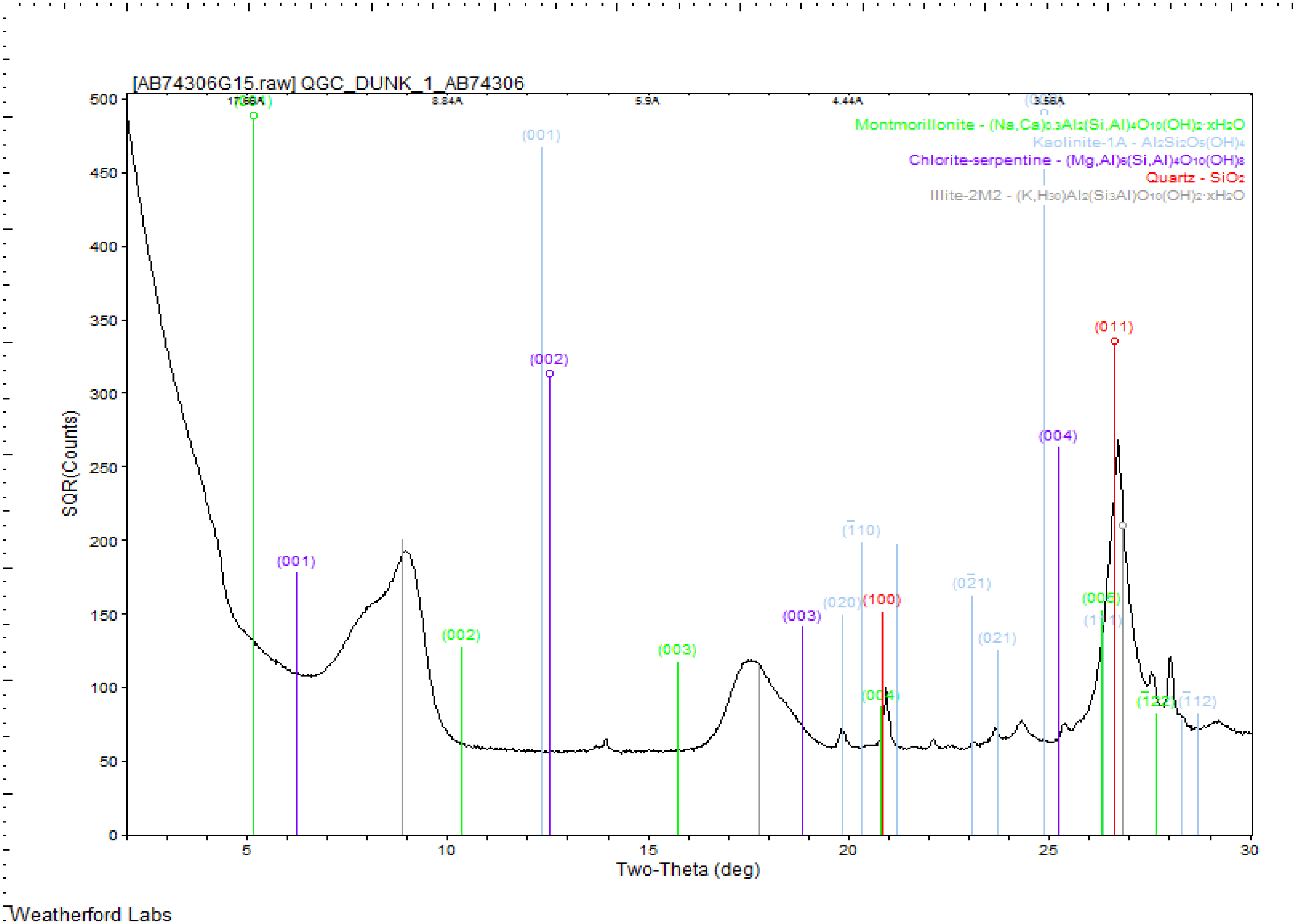


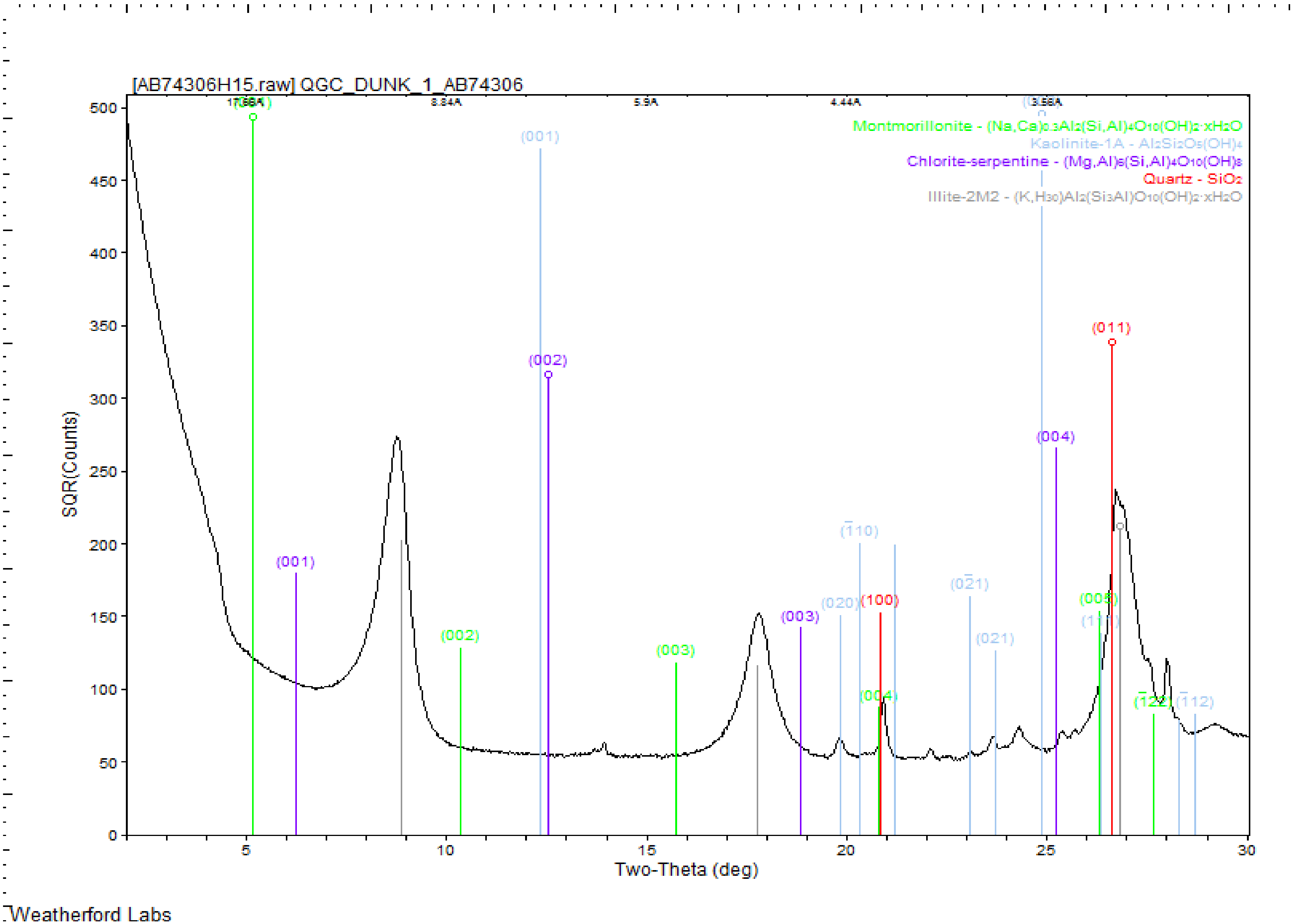
[AB74306G14.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs



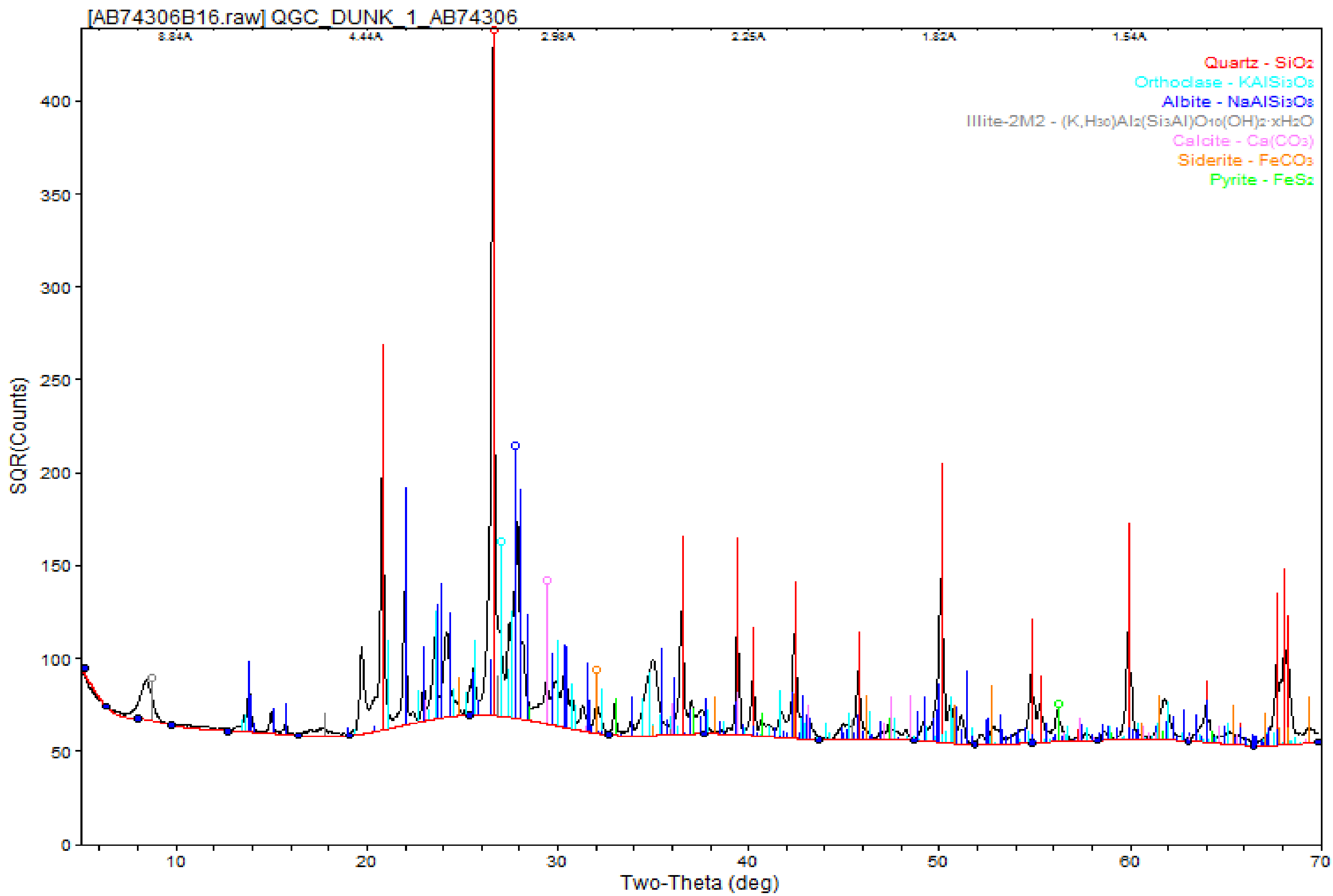
[AB74306H14.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs


[AB74306B15.raw] QGC_DUNK_1_AB74306
8.84A
4.44A
2.98A
2.25A
1.82A
1.54A
Quartz - $SiO_2$
Orthoclase - $KAlSi_3O_8$
Albite - $NaAlSi_3O_8$
Illite-2M2 - $(K,H_3O)Al_2(Si_3Al)O_{10}(OH)_2 \cdot xH_2O$
Calcite - $Ca(CO_3)$
Siderite - $FeCO_3$
Pyrite - $FeS_2$
SQR(Counts)
0
50
100
150
200
250
300
350
400
450
10
20
30
40
50
60
70
Two-Theta (deg)
Weatherford Labs

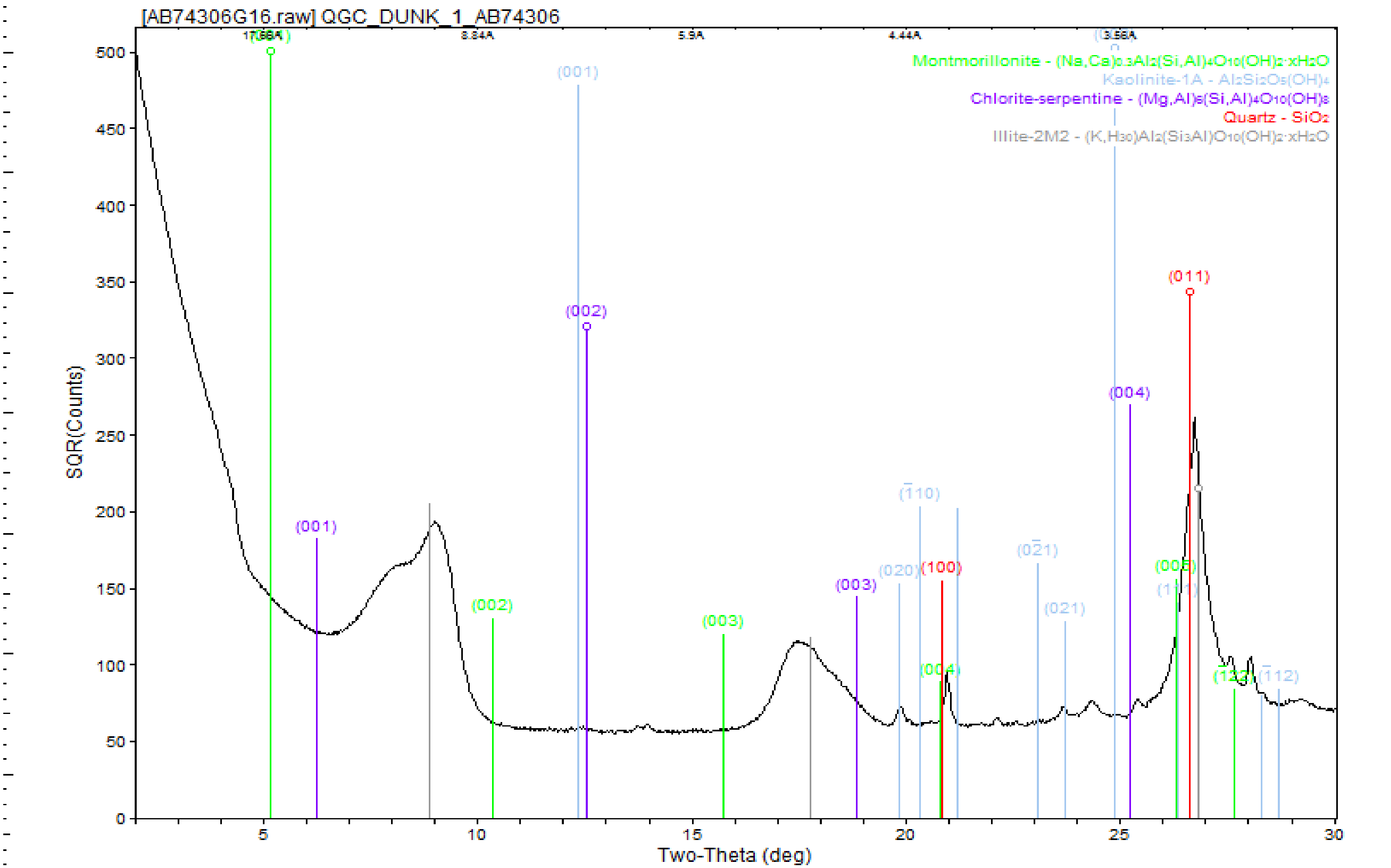

[AB74306G15.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
8.84A
5.9A
4.44A
3.56A
Weatherford Labs



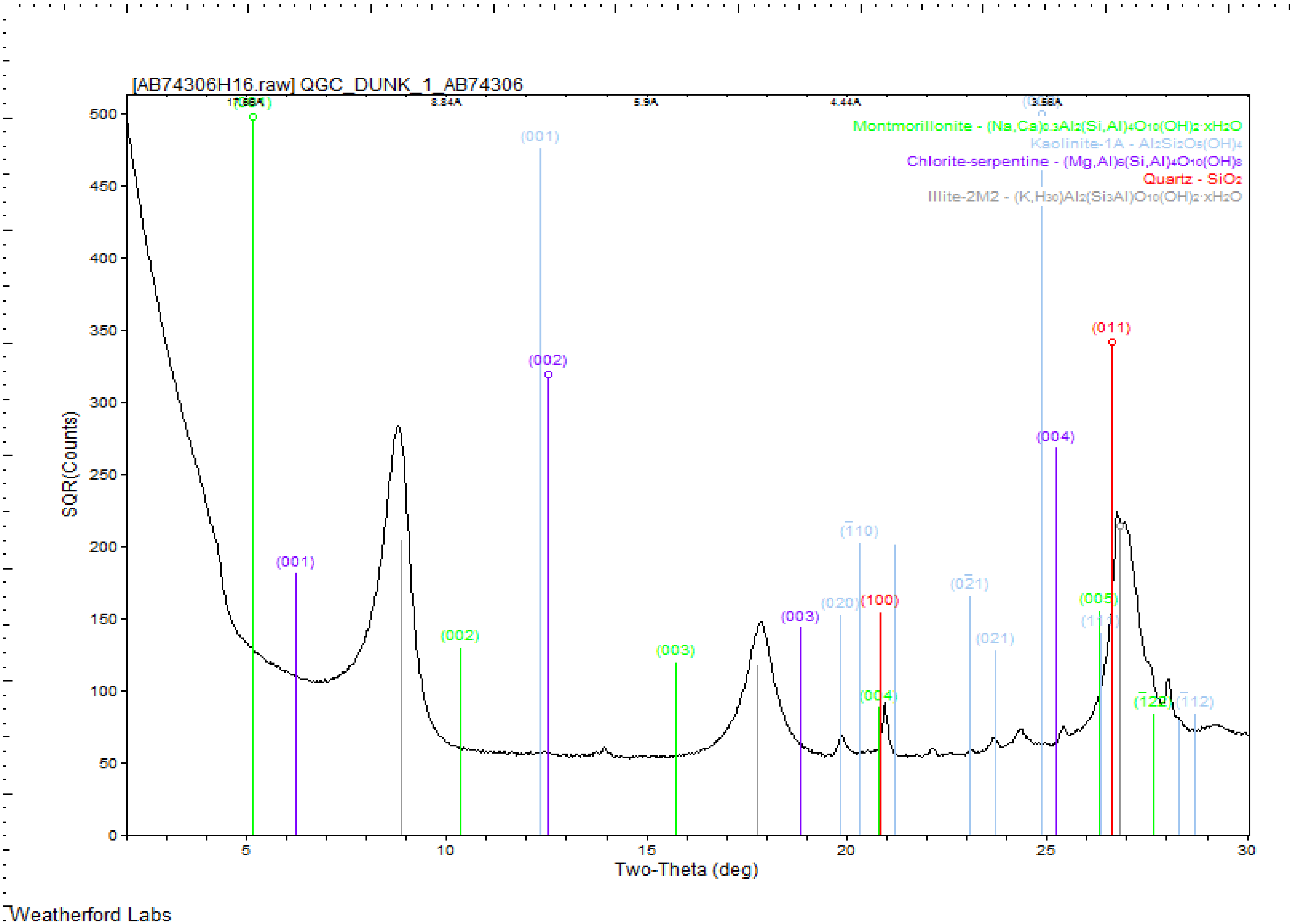
[AB74306H15.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
8.84A
5.9A
4.44A
3.56A
SQR(Counts)
Two-Theta (deg)
Weatherford Labs



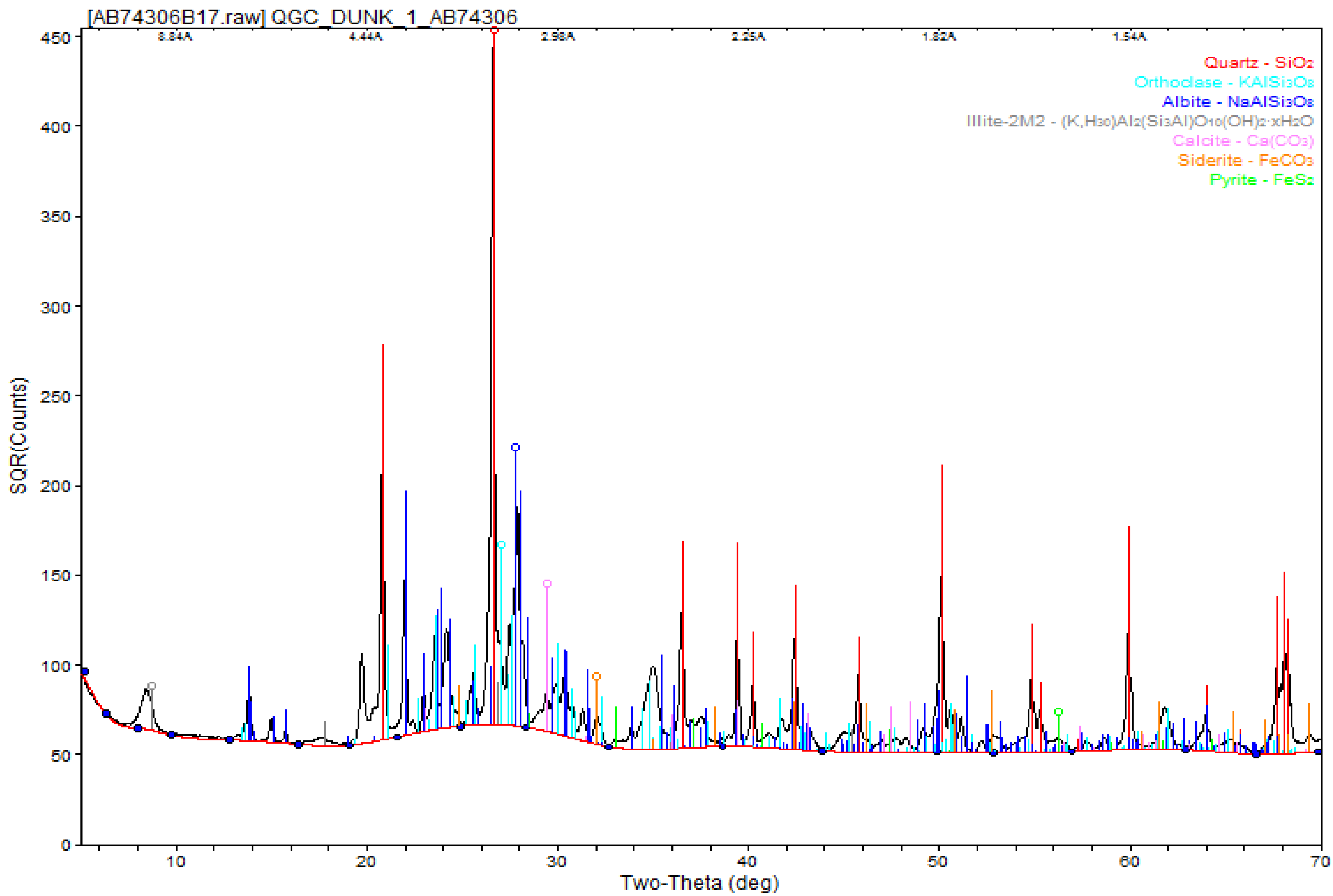

Weatherford Labs




Weatherford Labs




Weatherford Labs



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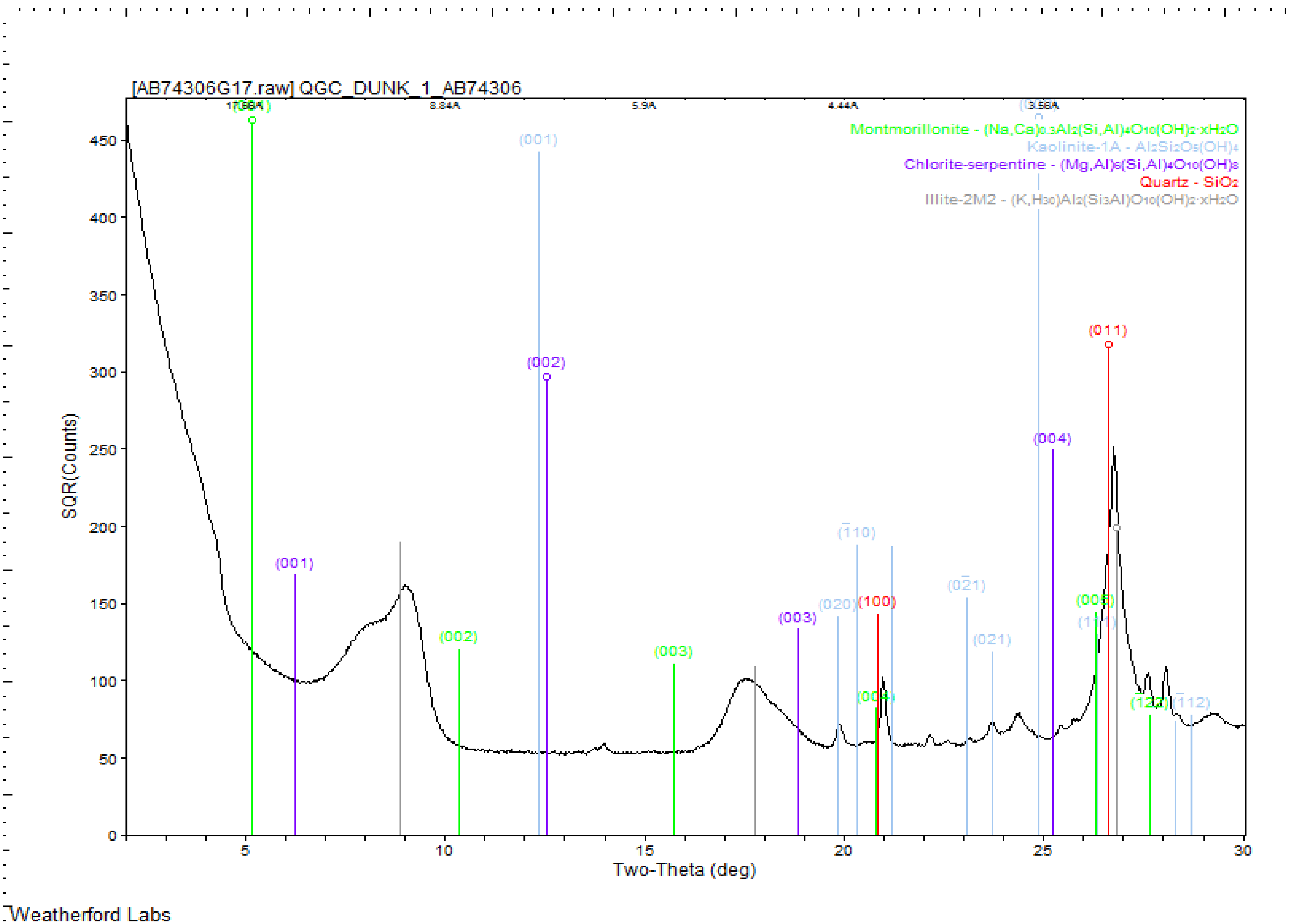
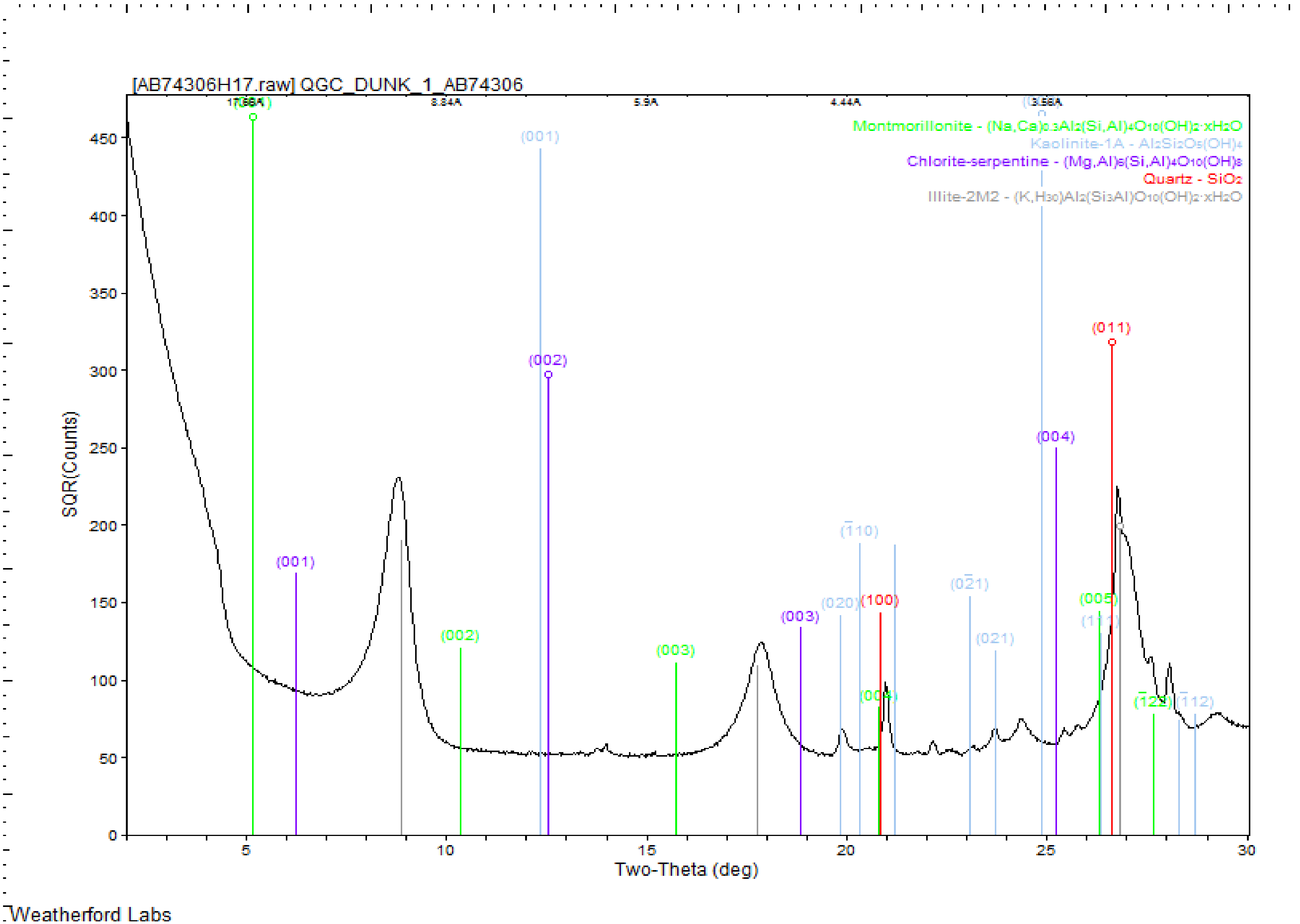



Weatherford Labs

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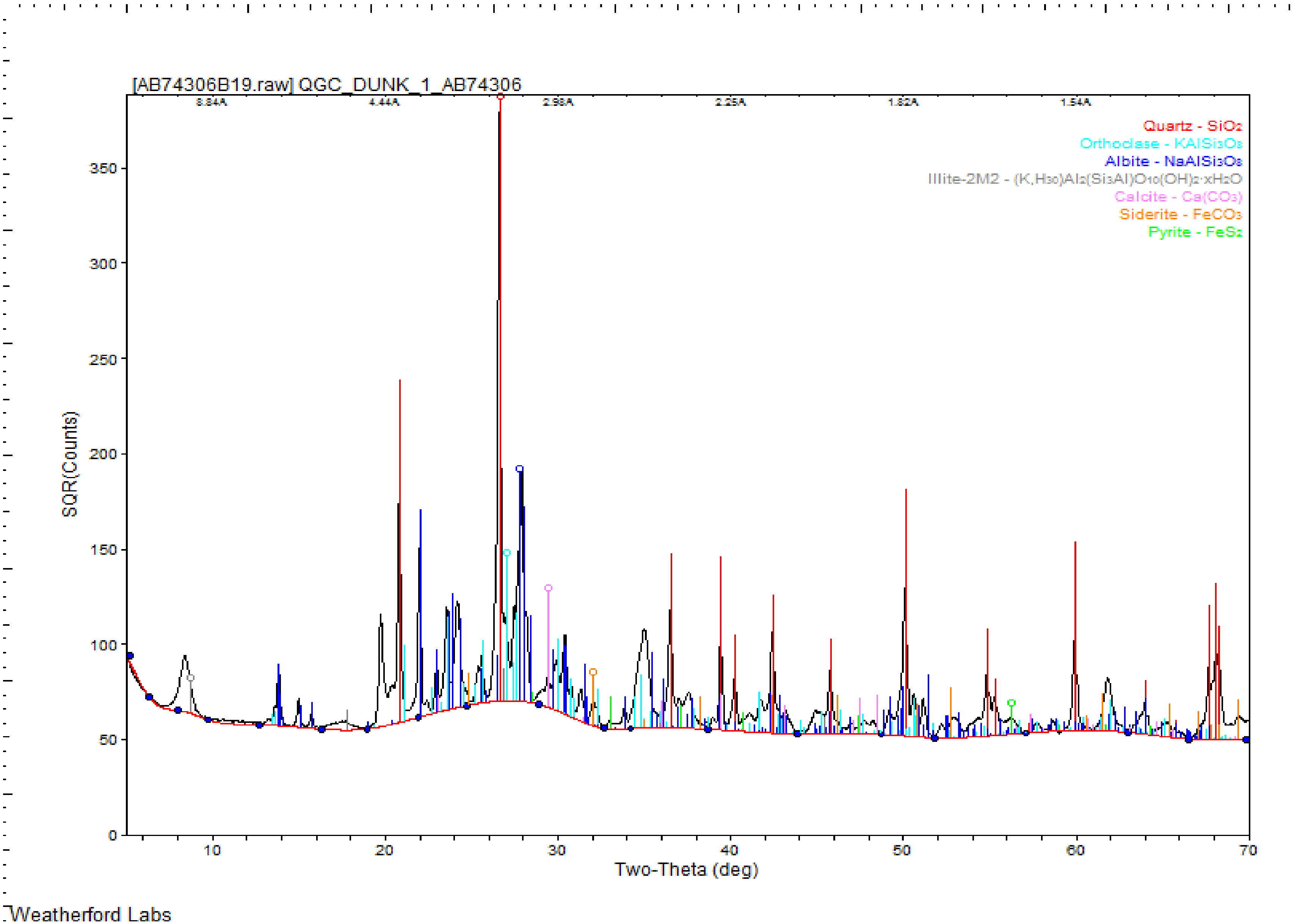


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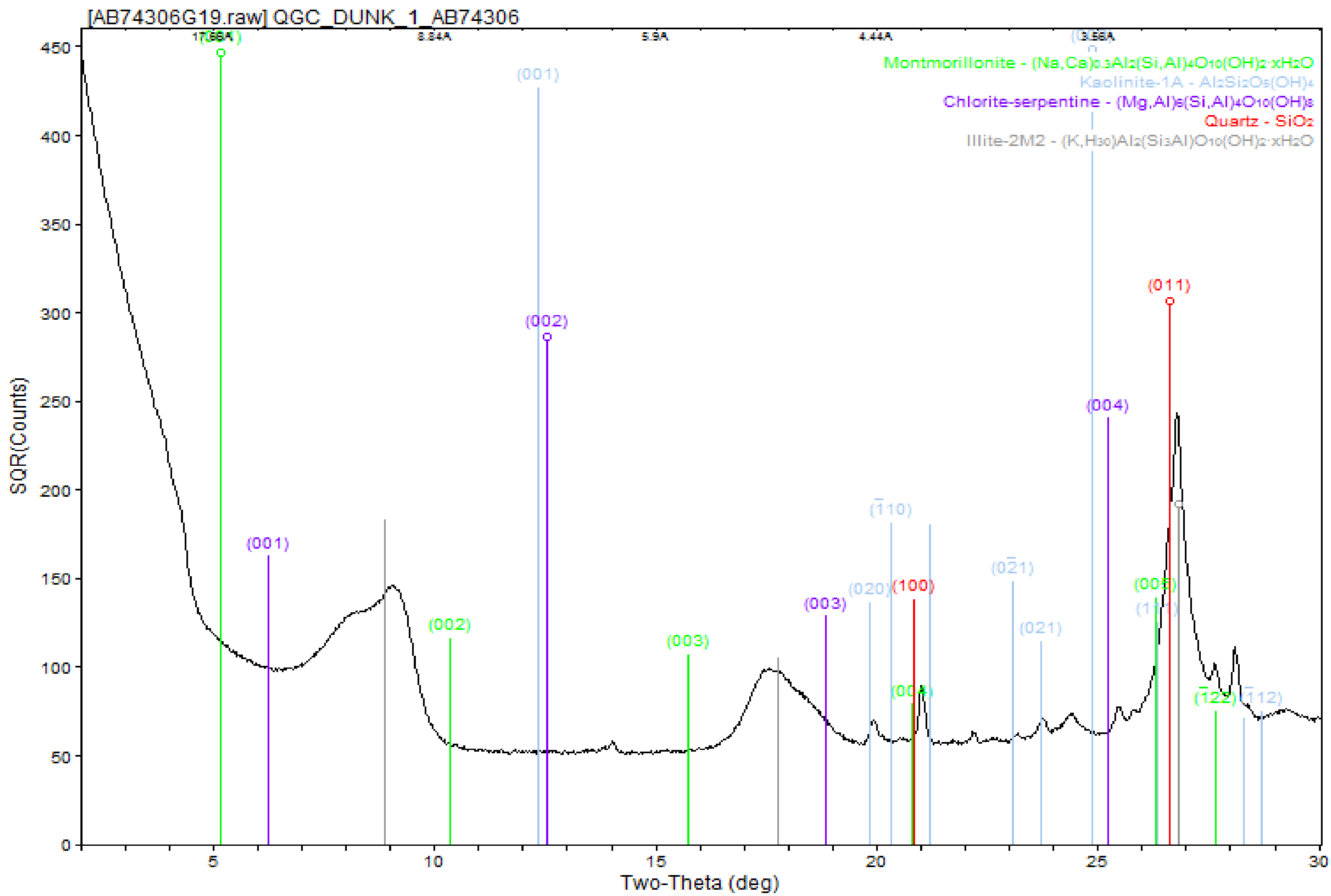
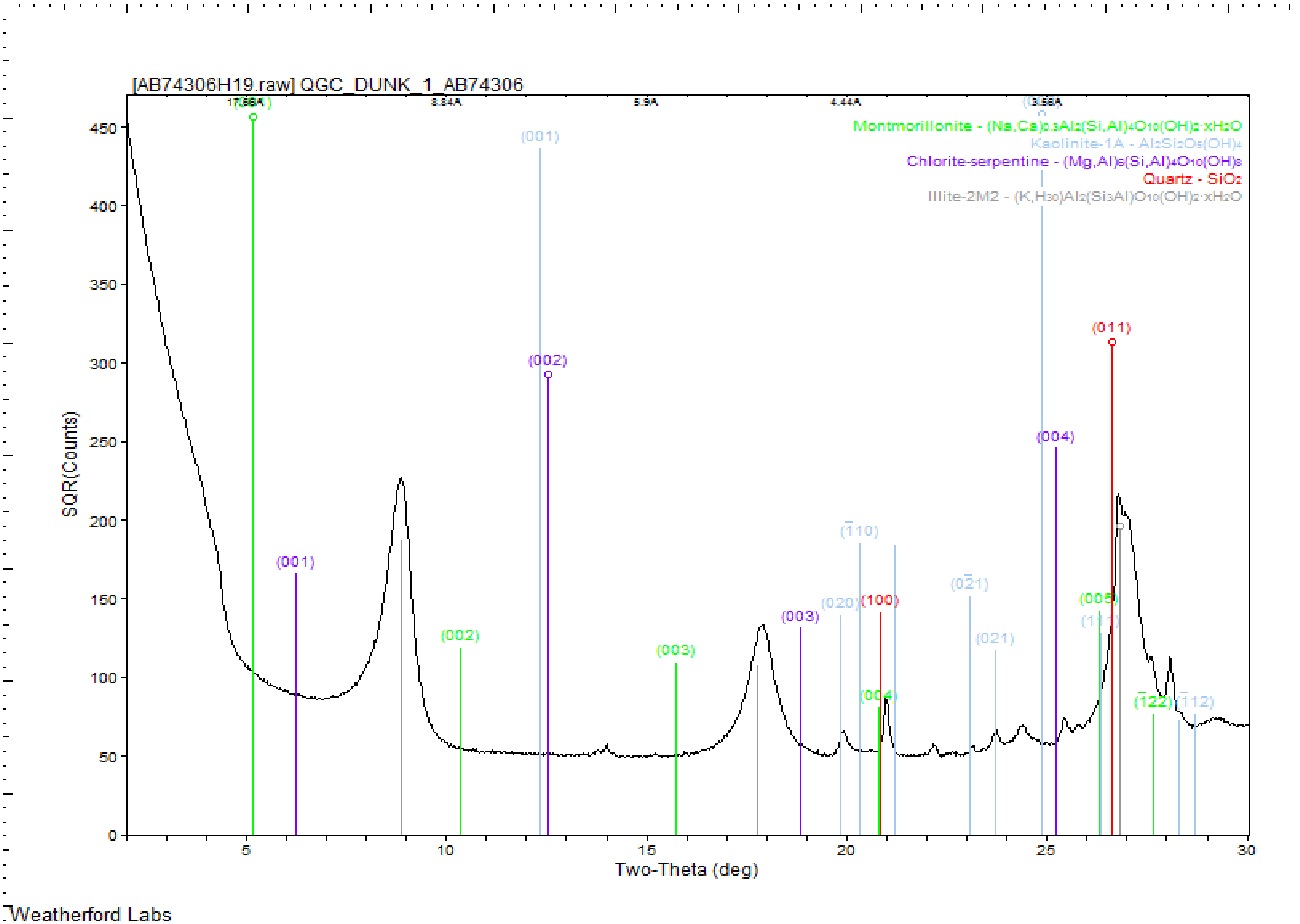
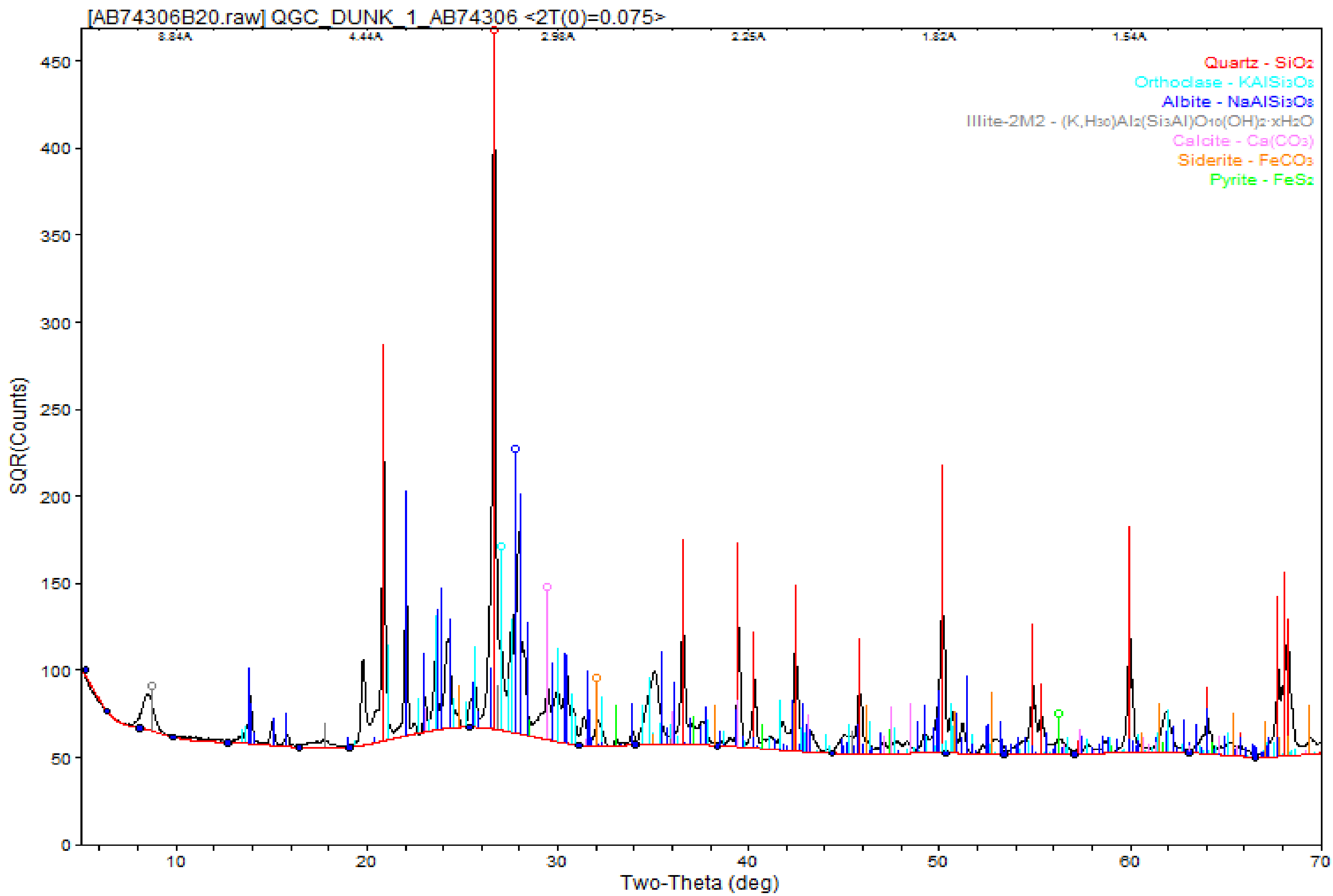


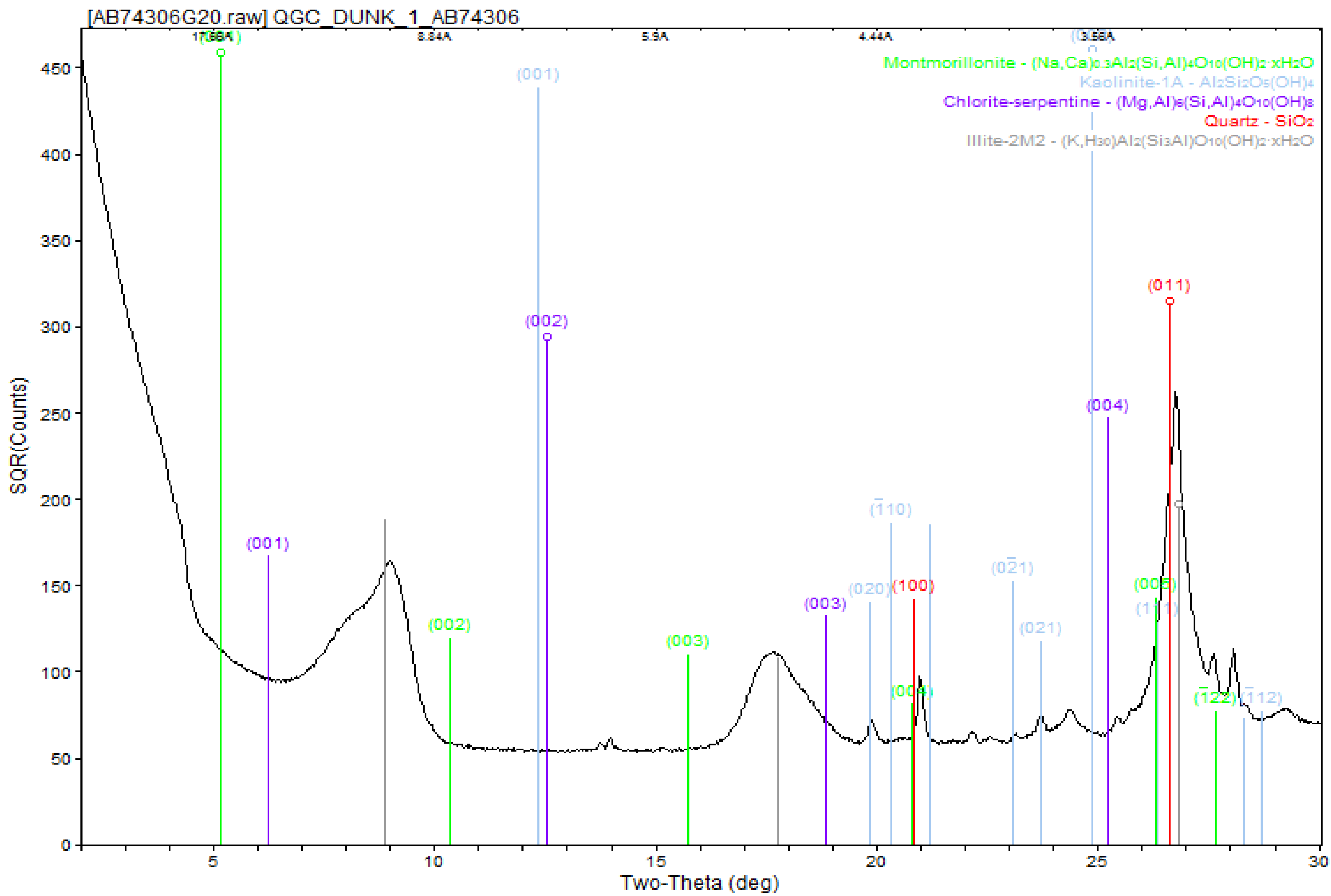

Weatherford Labs



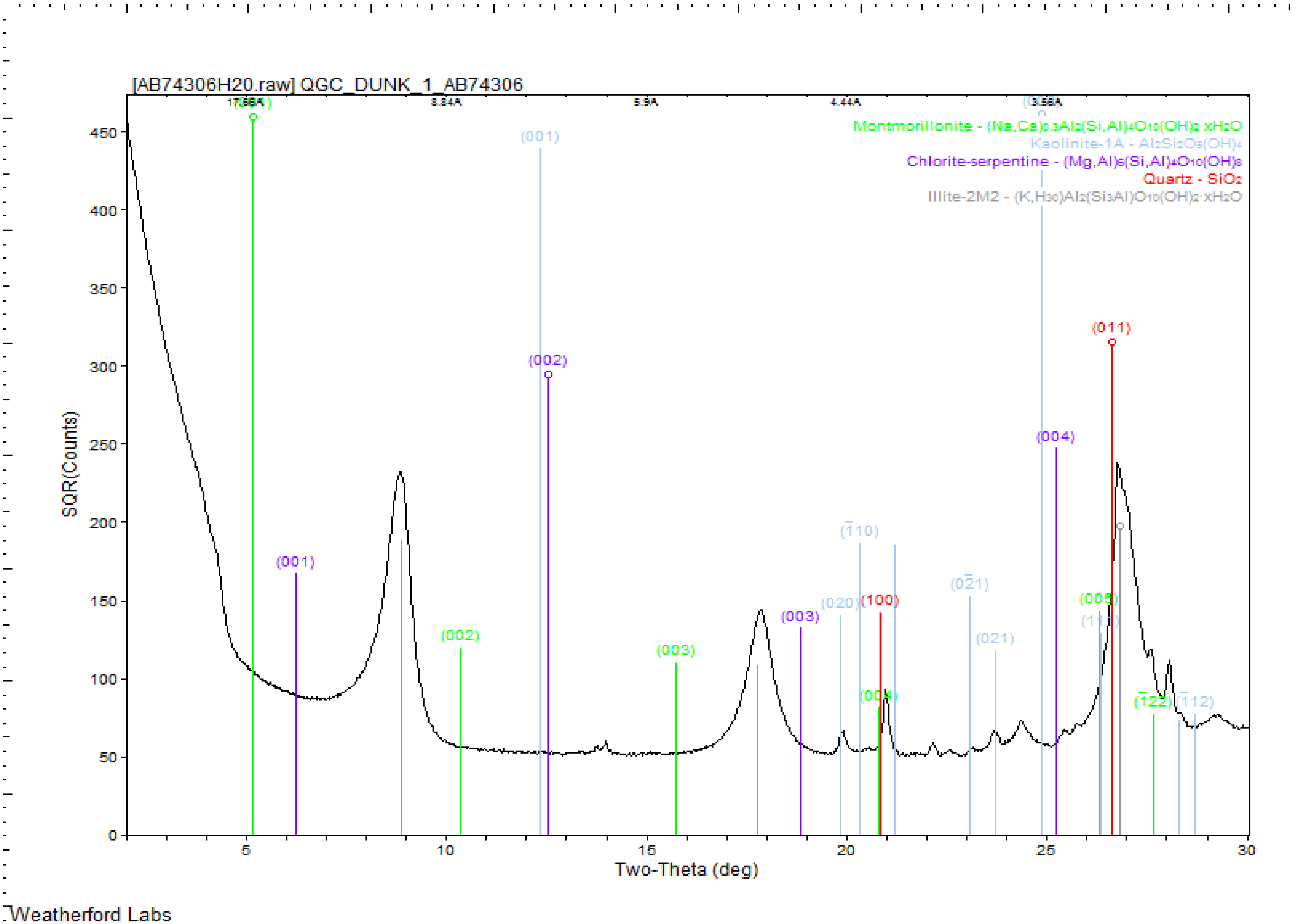
[AB74306H19.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs



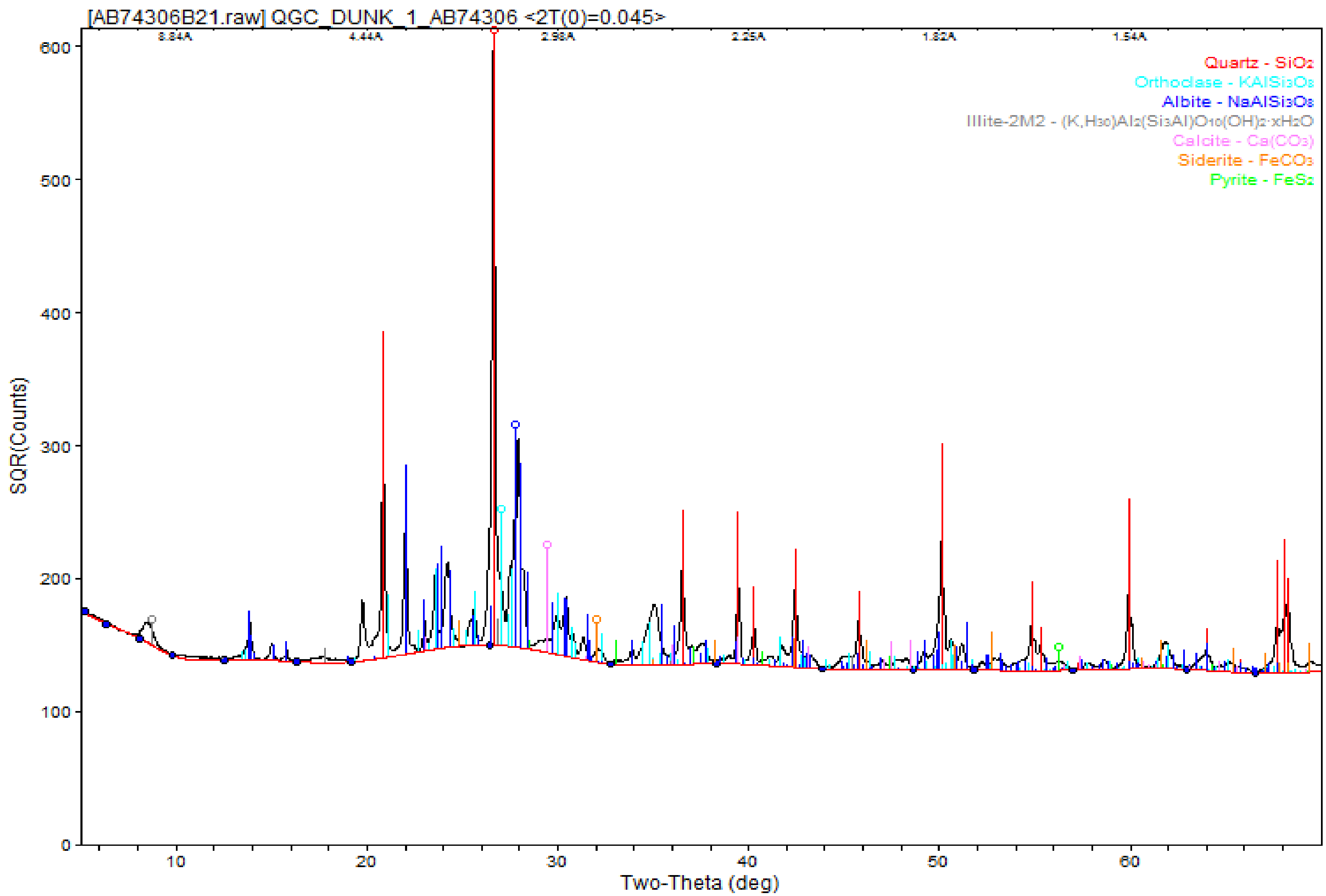
Weatherford Labs



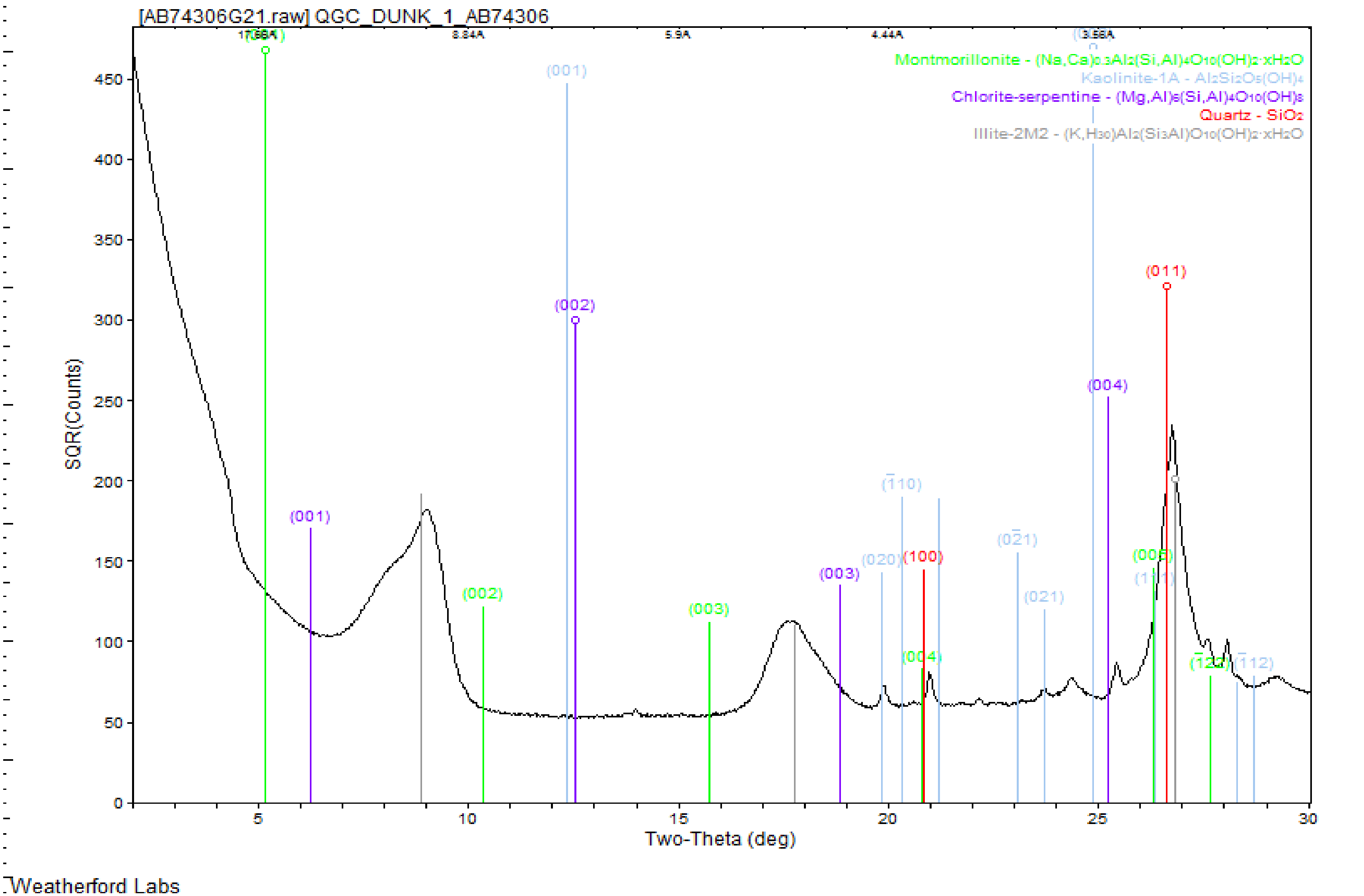

Weatherford Labs

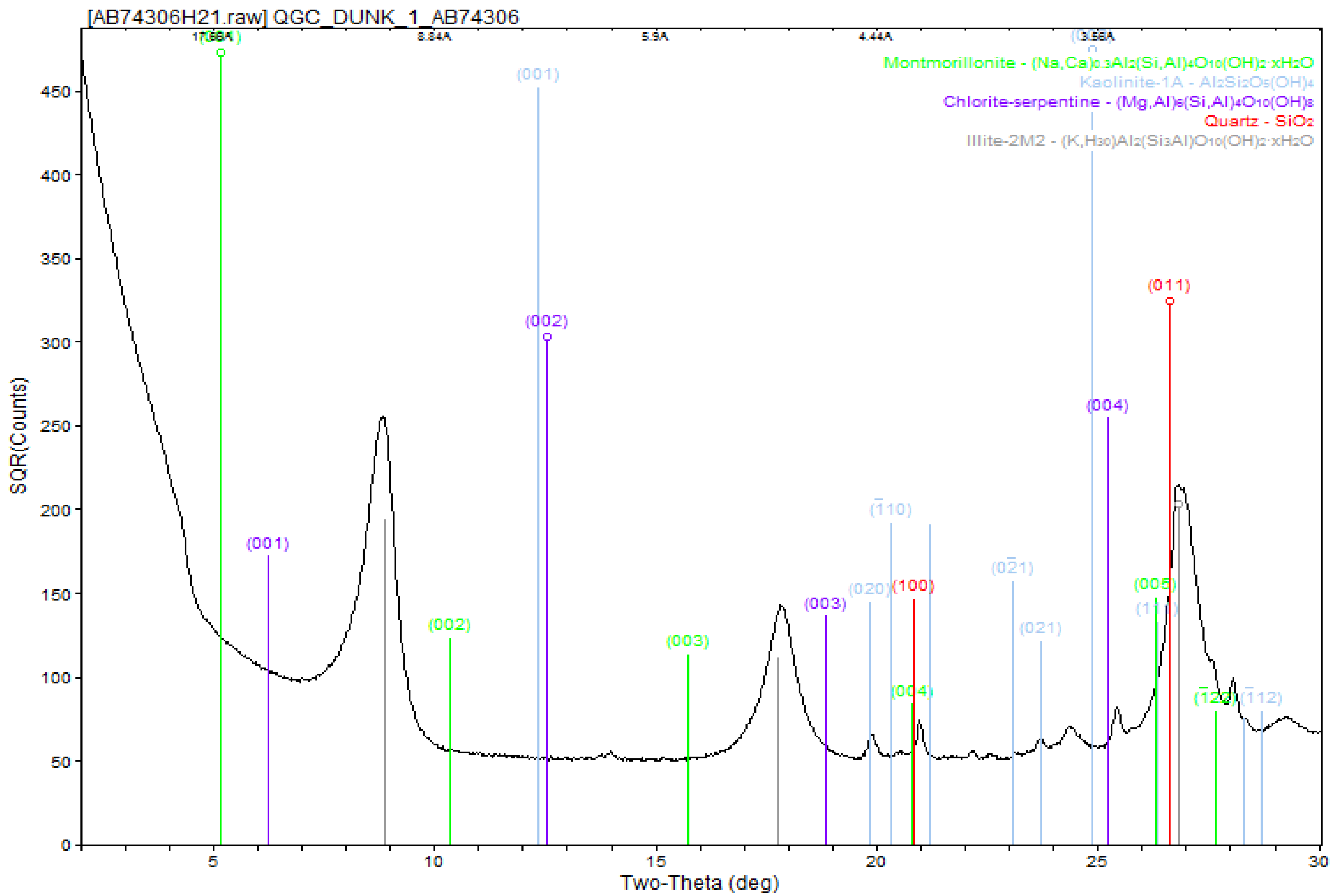


Weatherford Labs

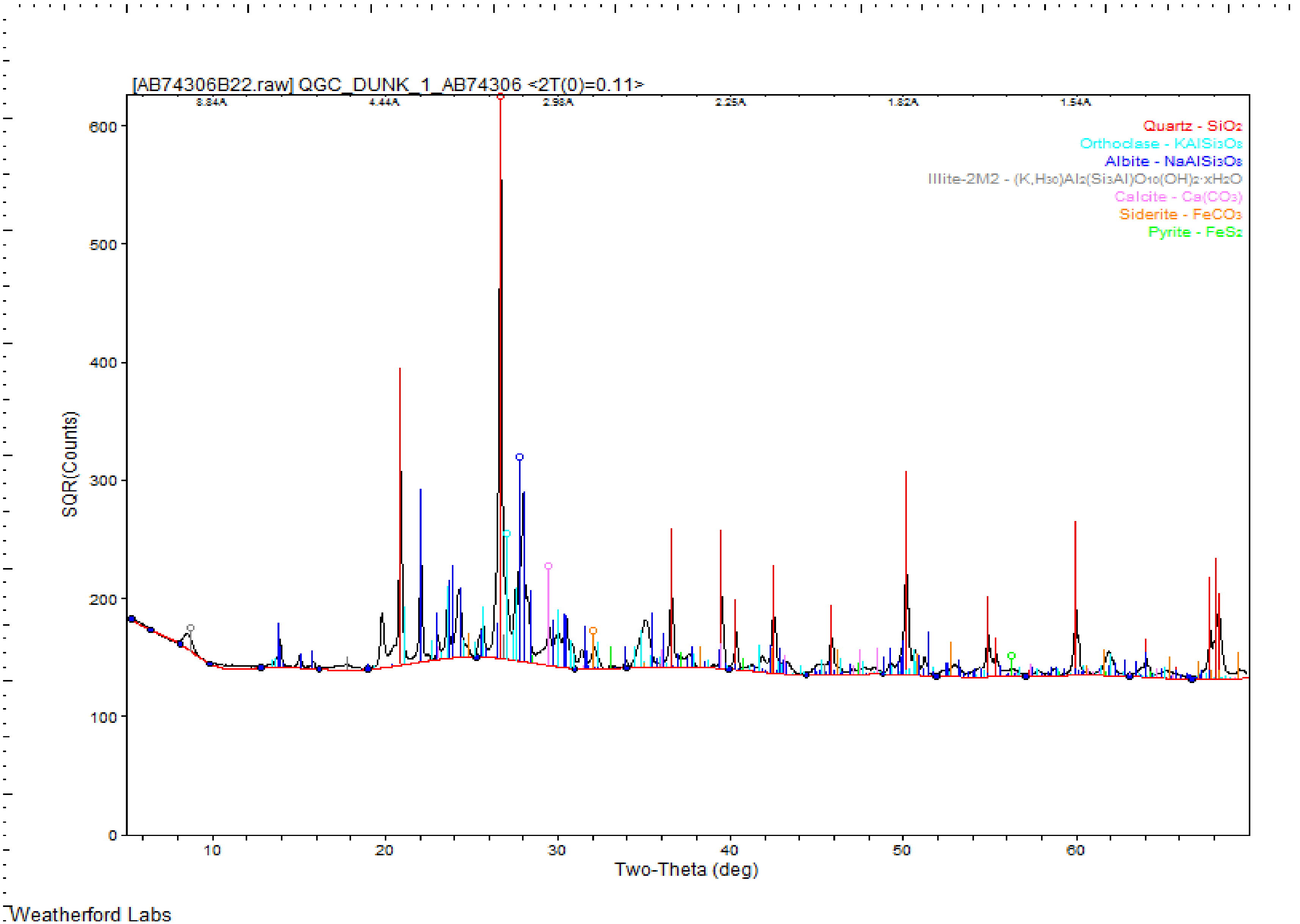



Weatherford Labs

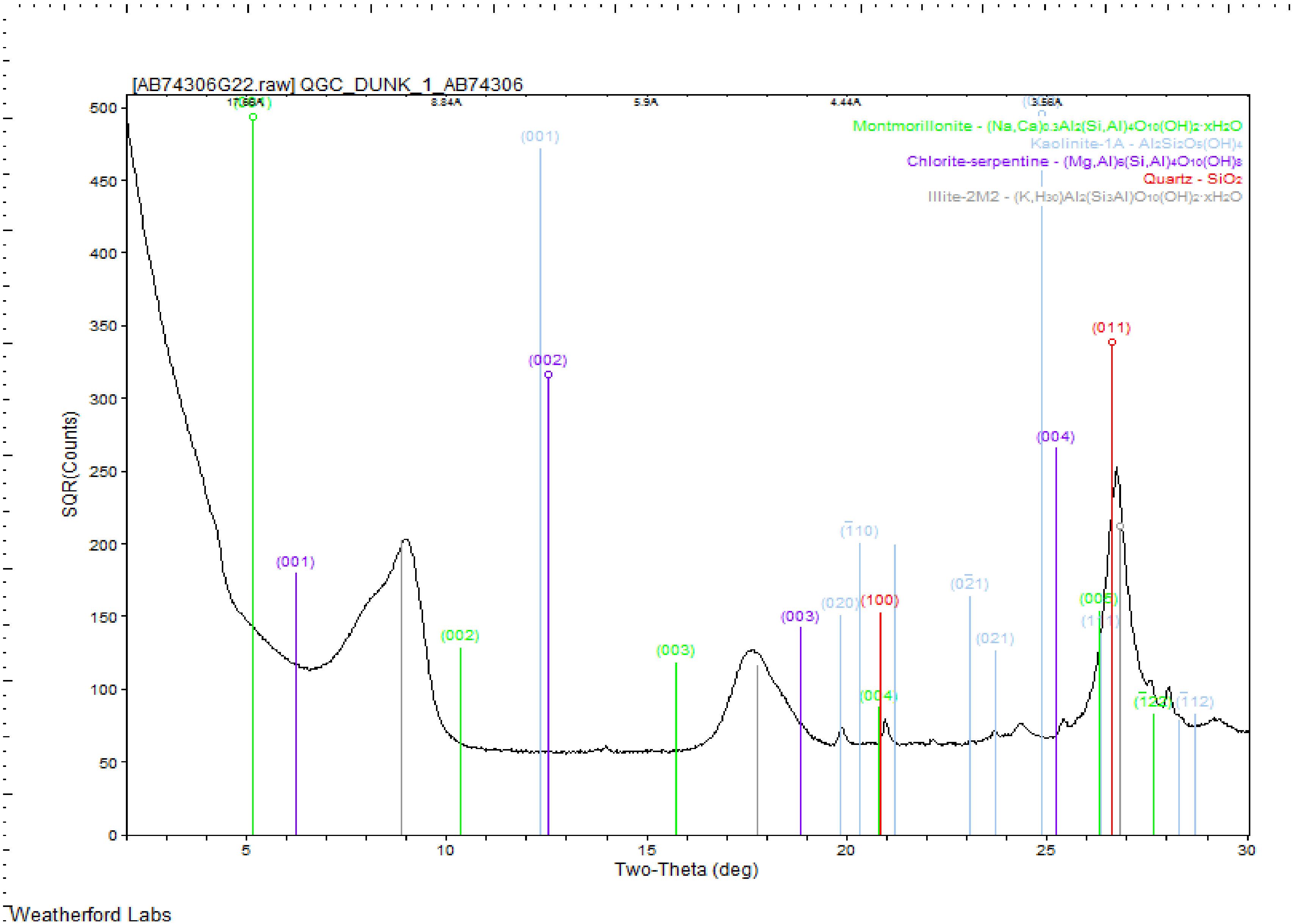

[AB74306G21.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs

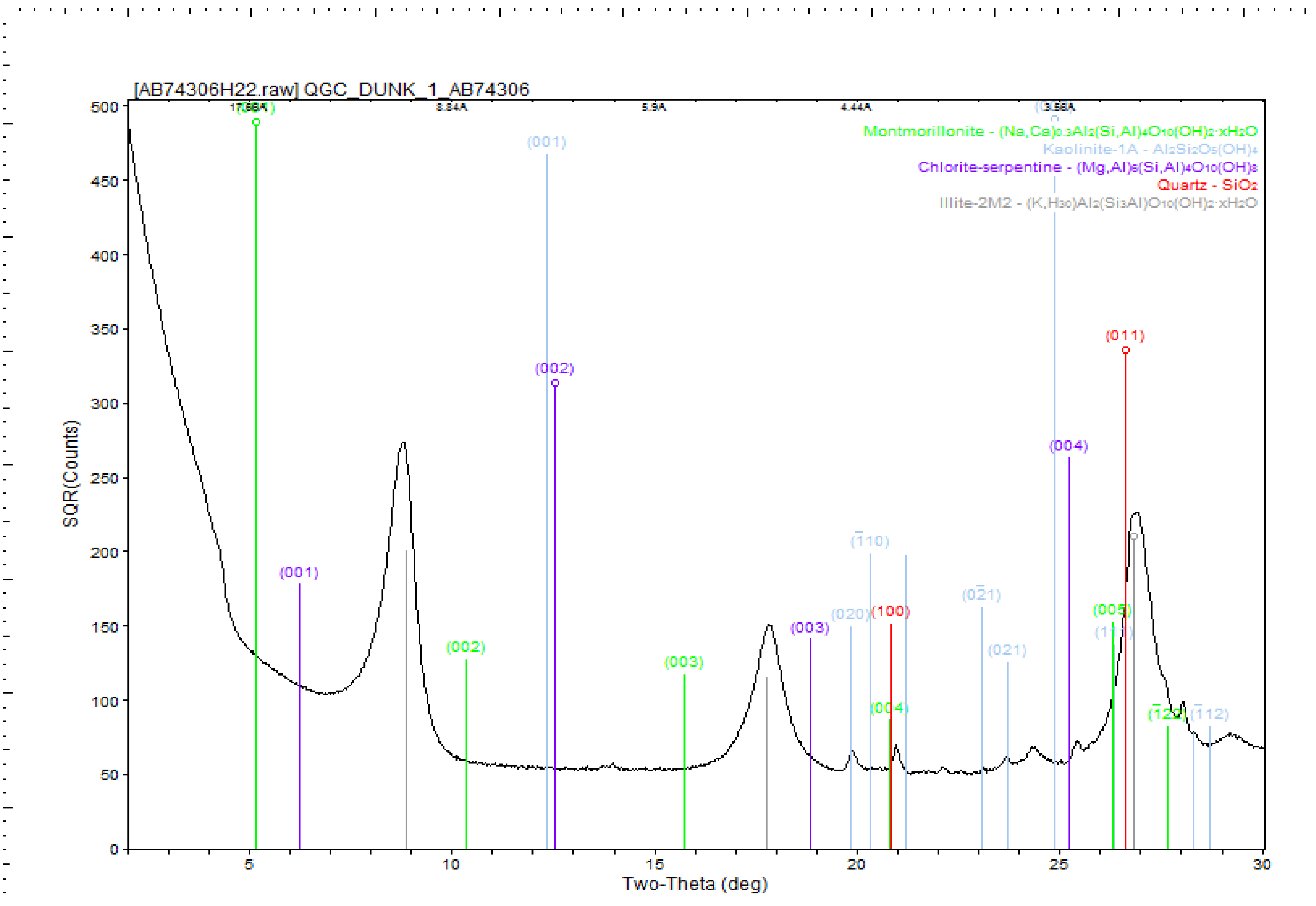



Weatherford Labs

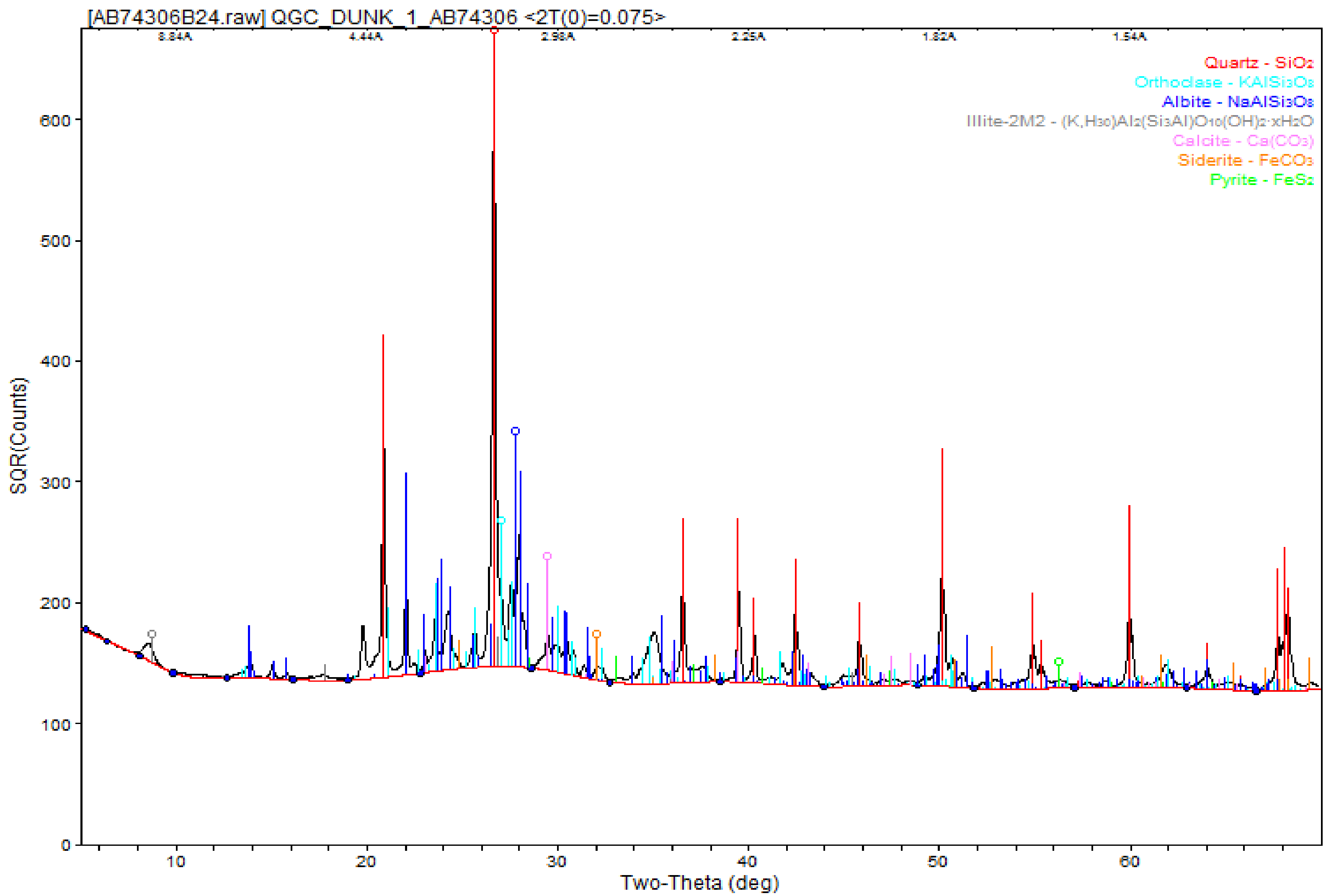



Weatherford Labs

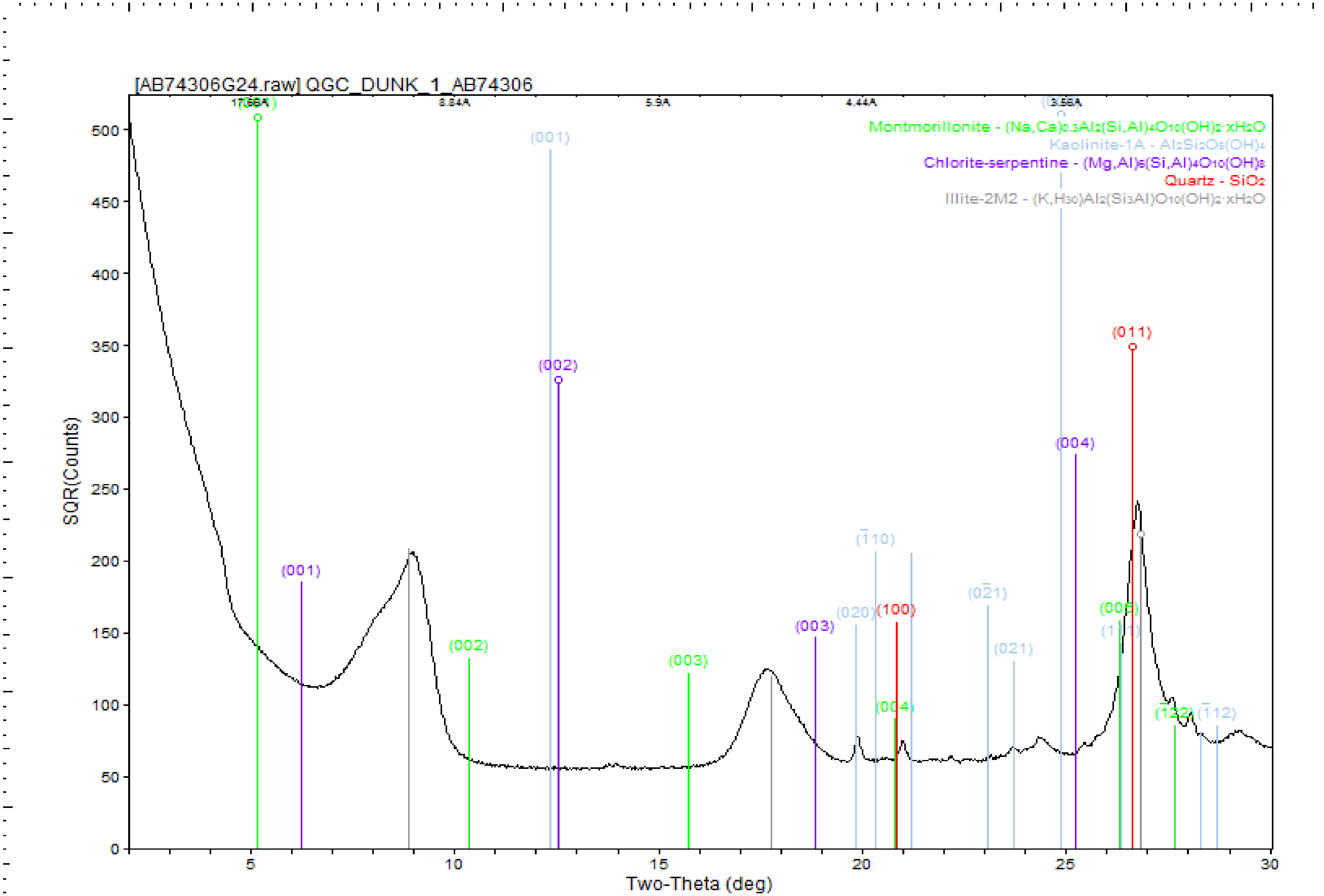

[AB74306G22.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
8.84A
5.9A
4.44A
3.56A
(001)
(002)
(003)
(004)
(005)
(011)
(100)
(110)
(020)
(021)
(112)
Weatherford Labs



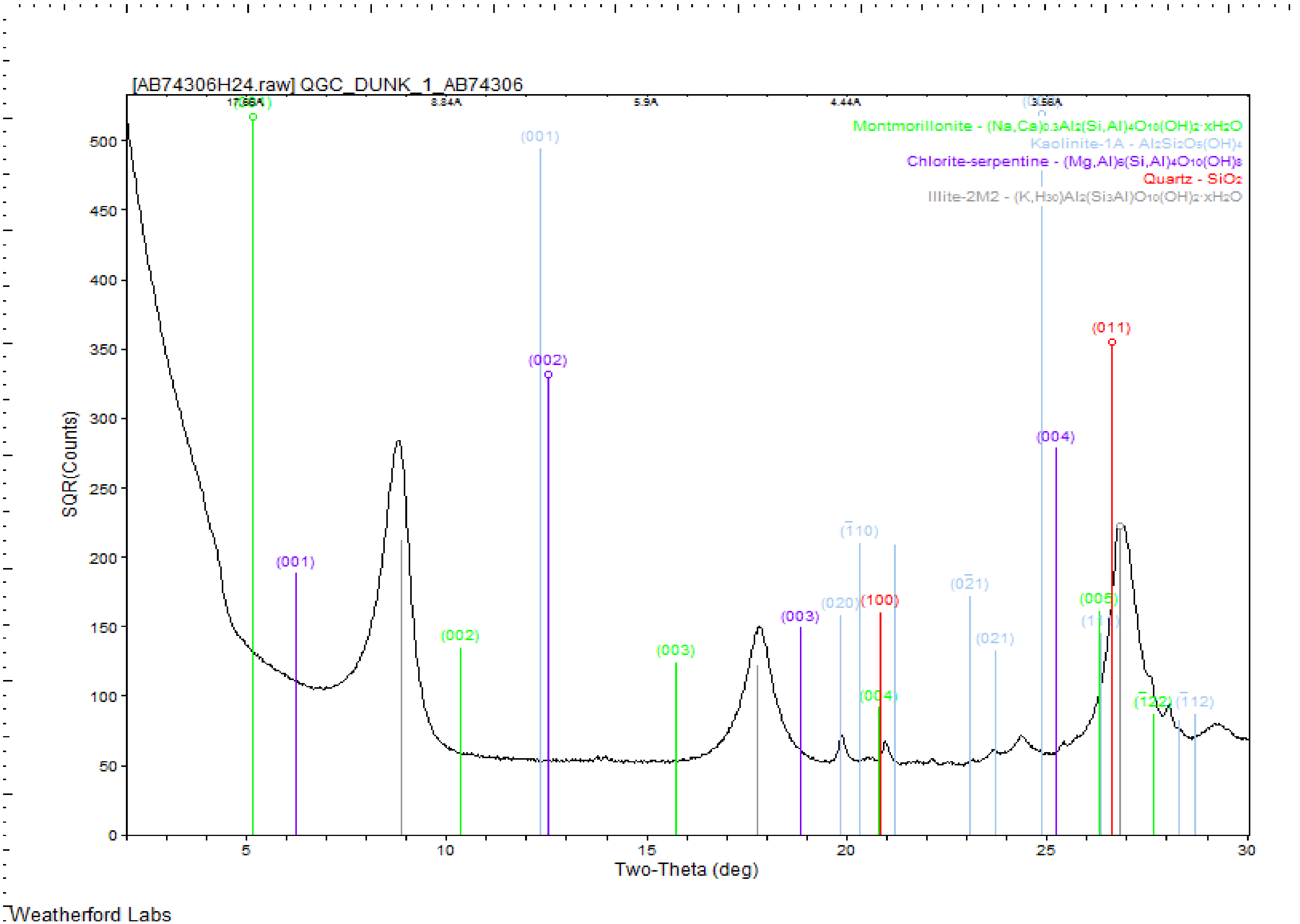

Weatherford Labs



Weatherford Labs



Weatherford Labs

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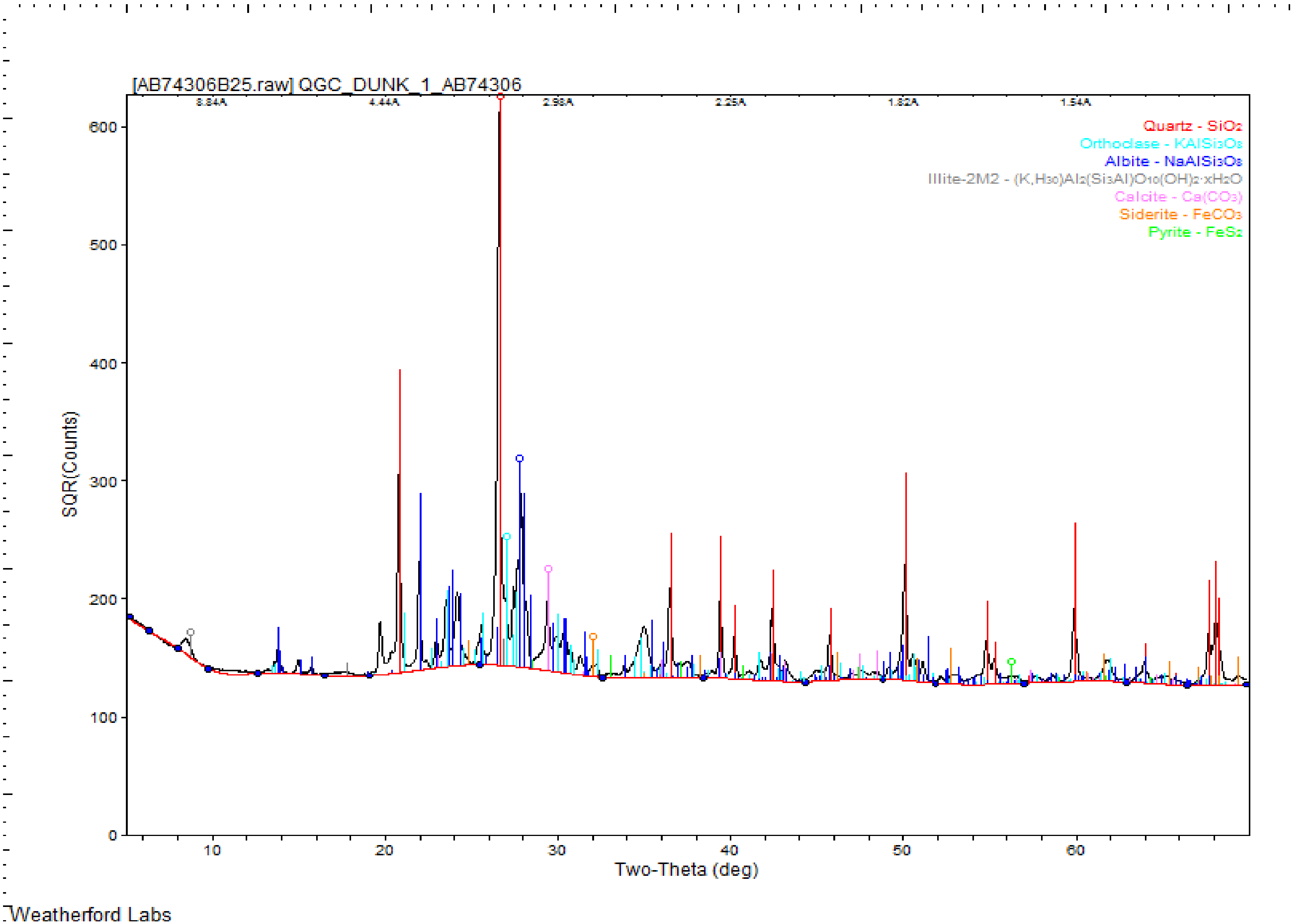


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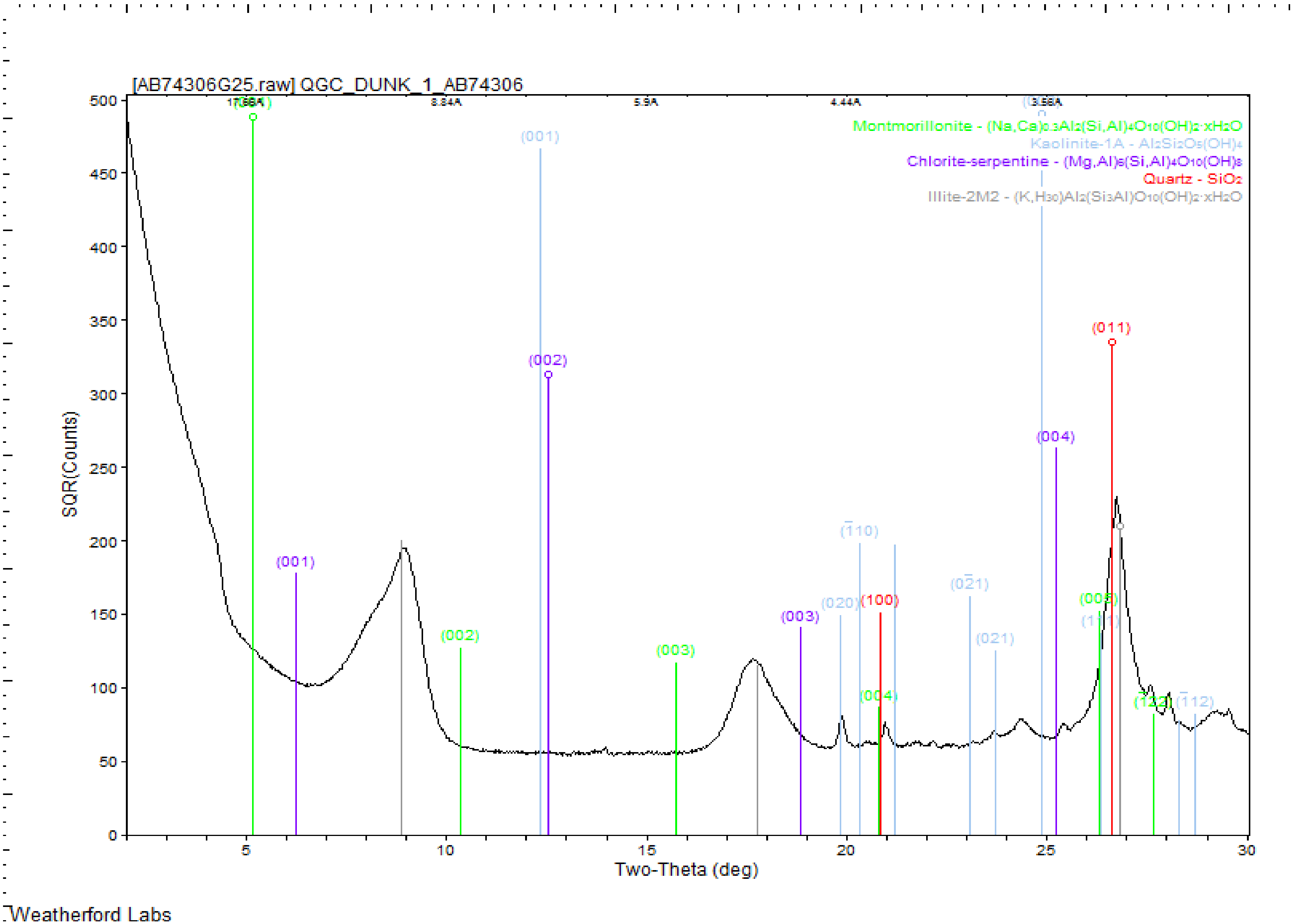


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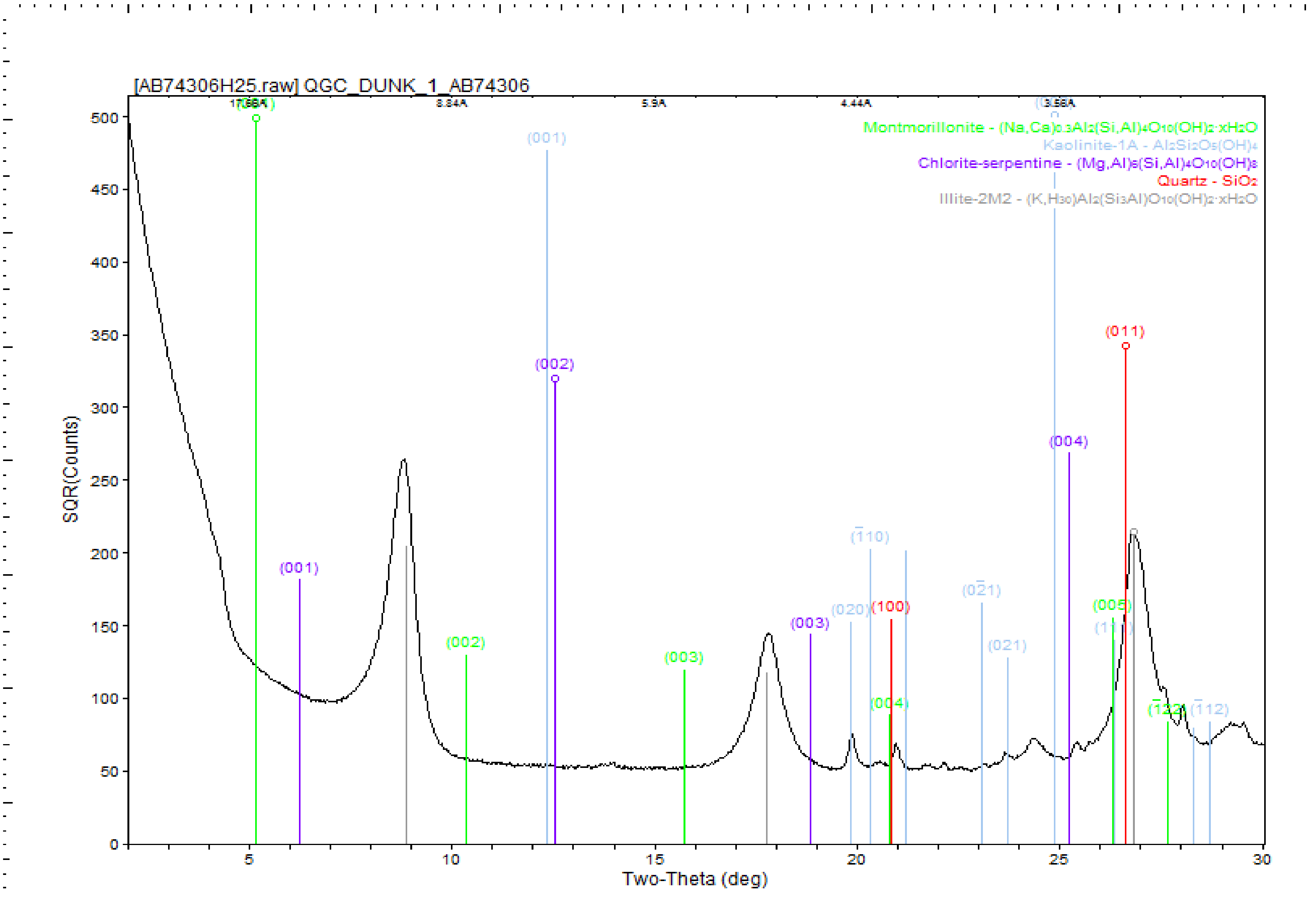


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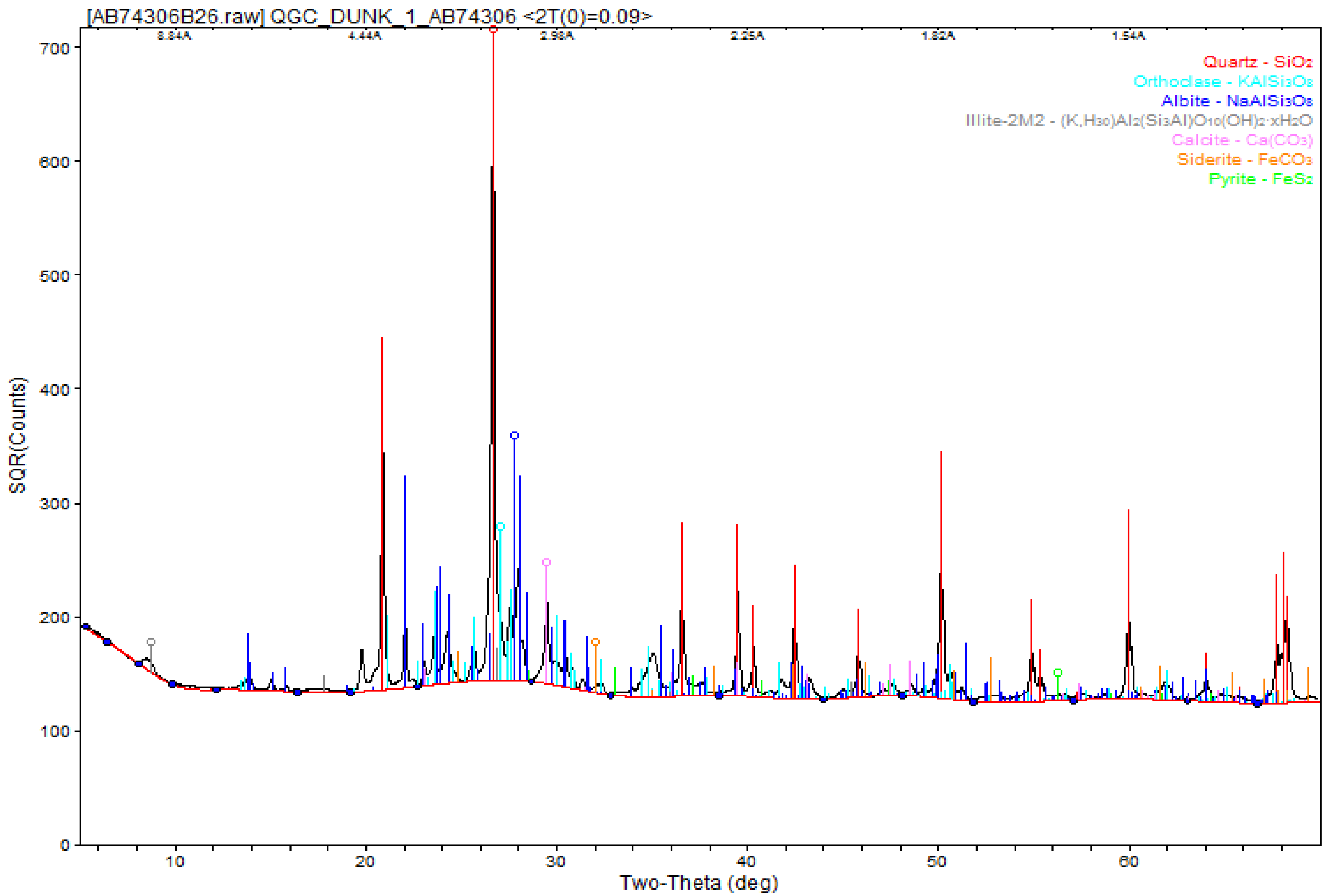
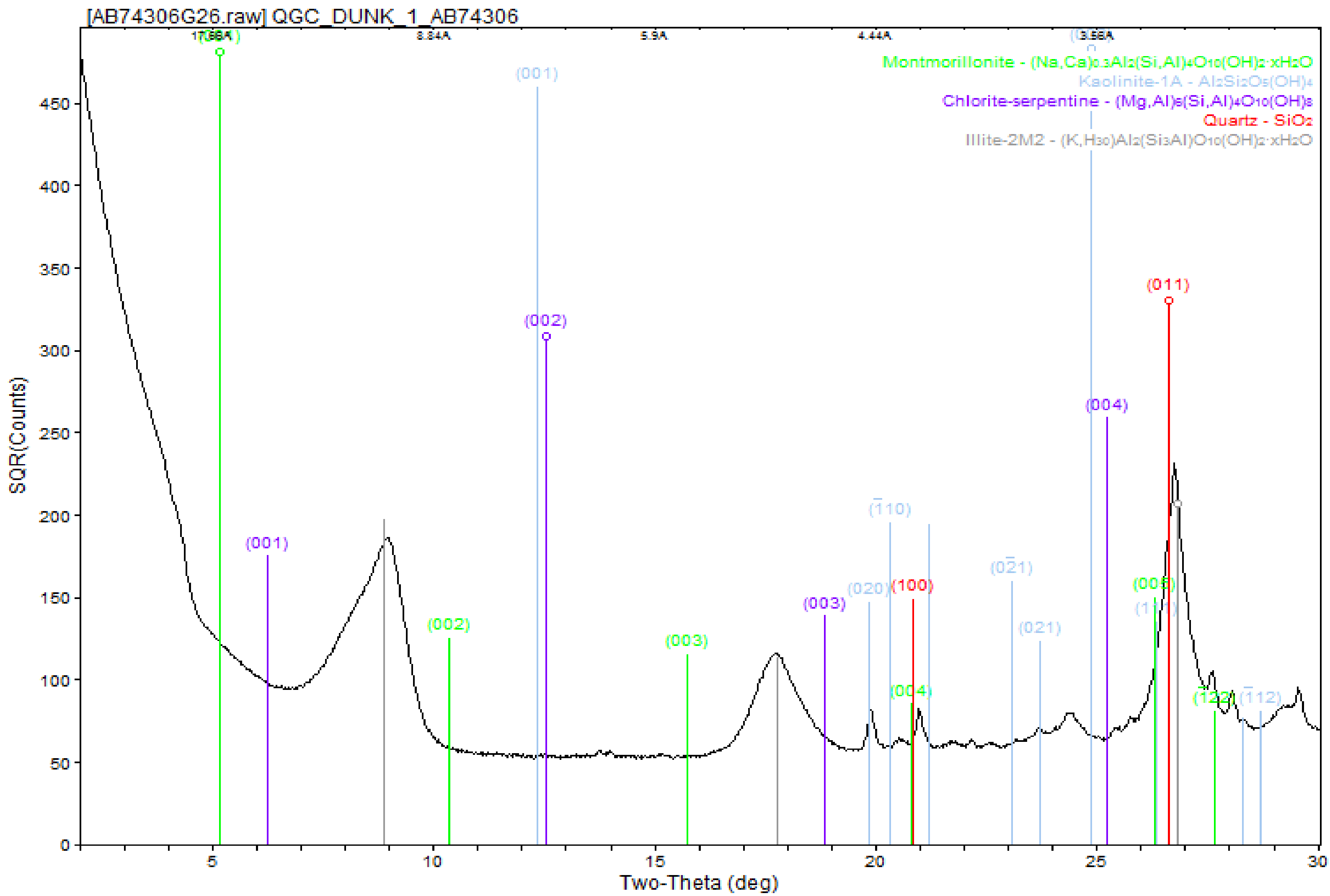
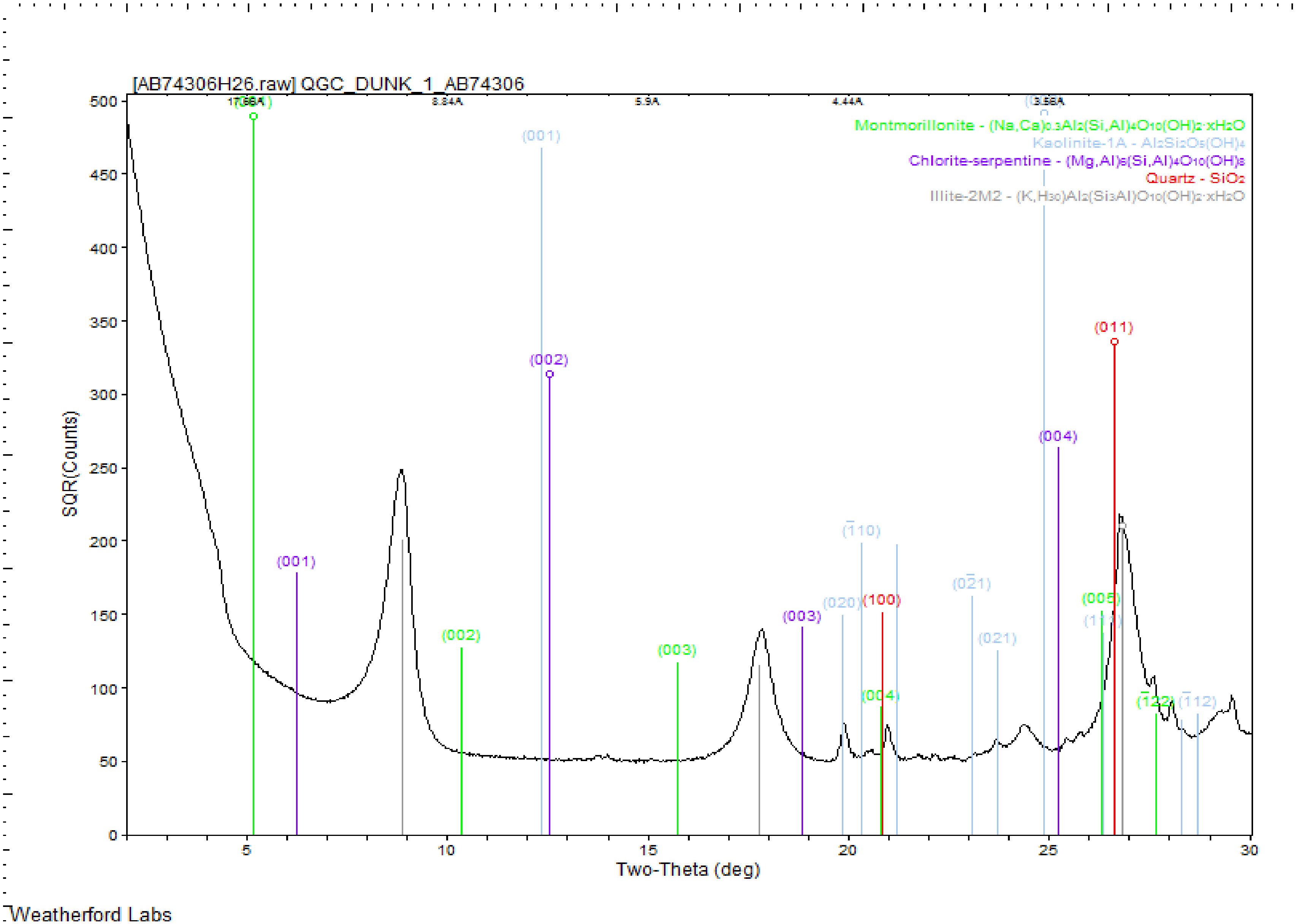



Weatherford Labs




Weatherford Labs

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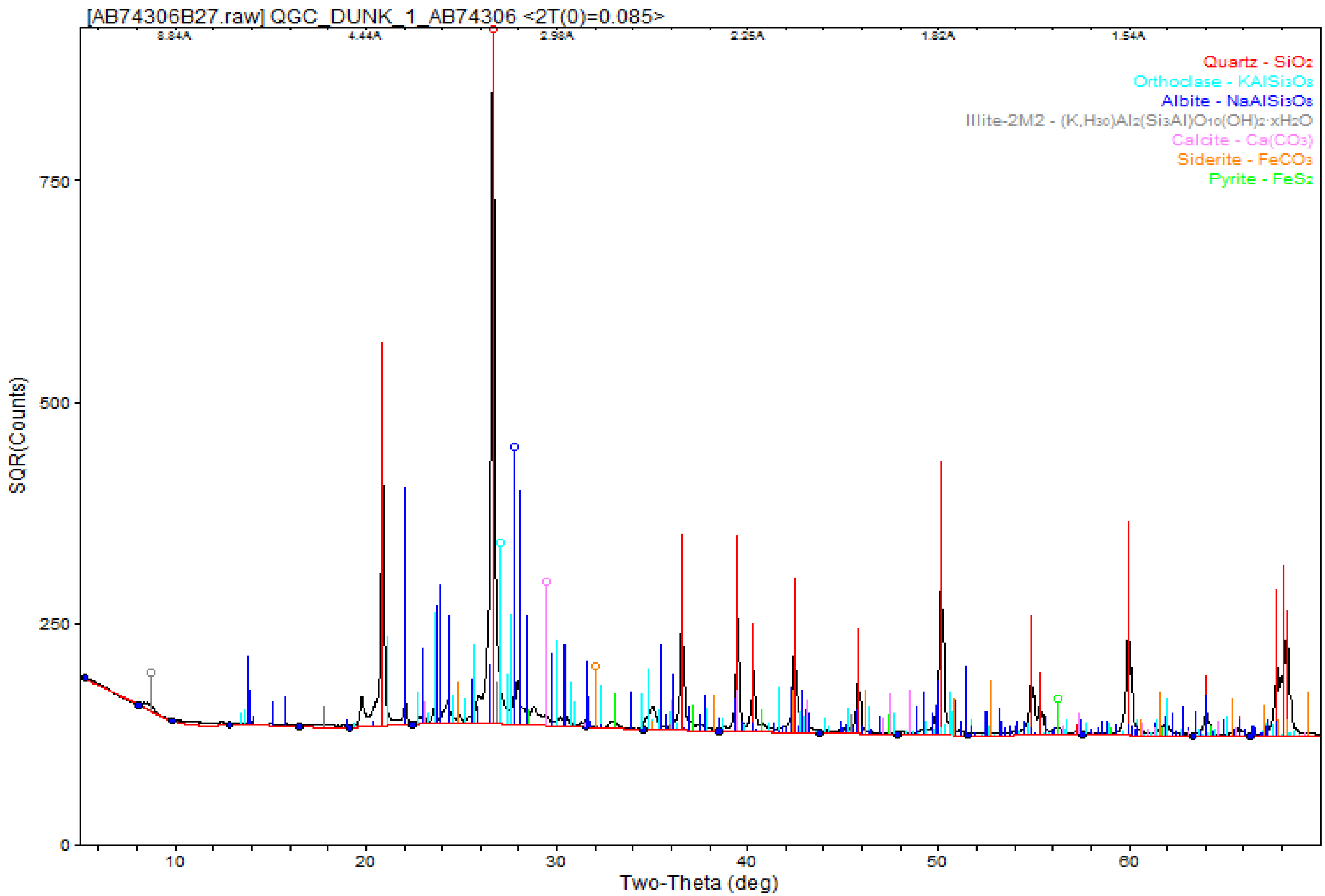
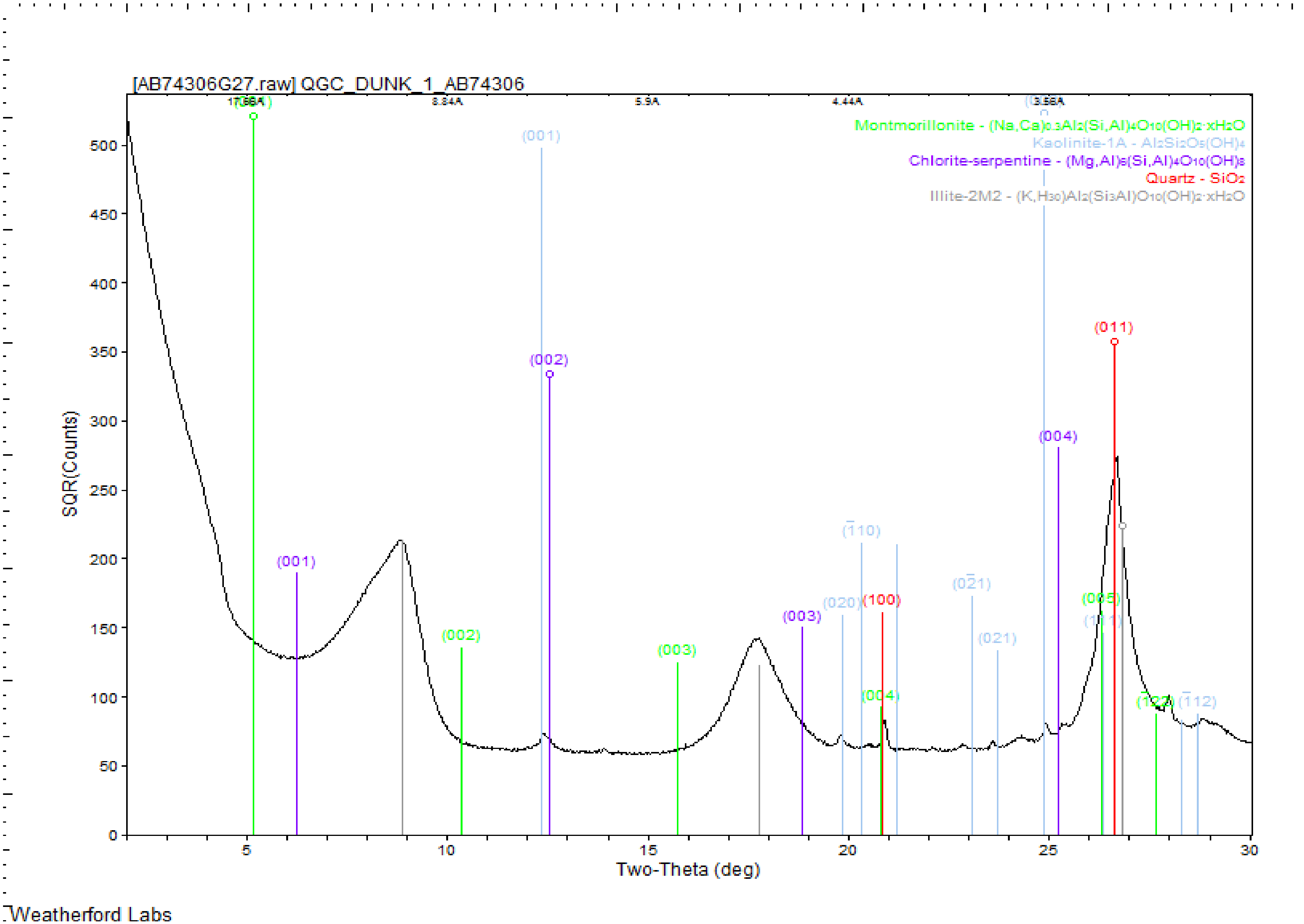
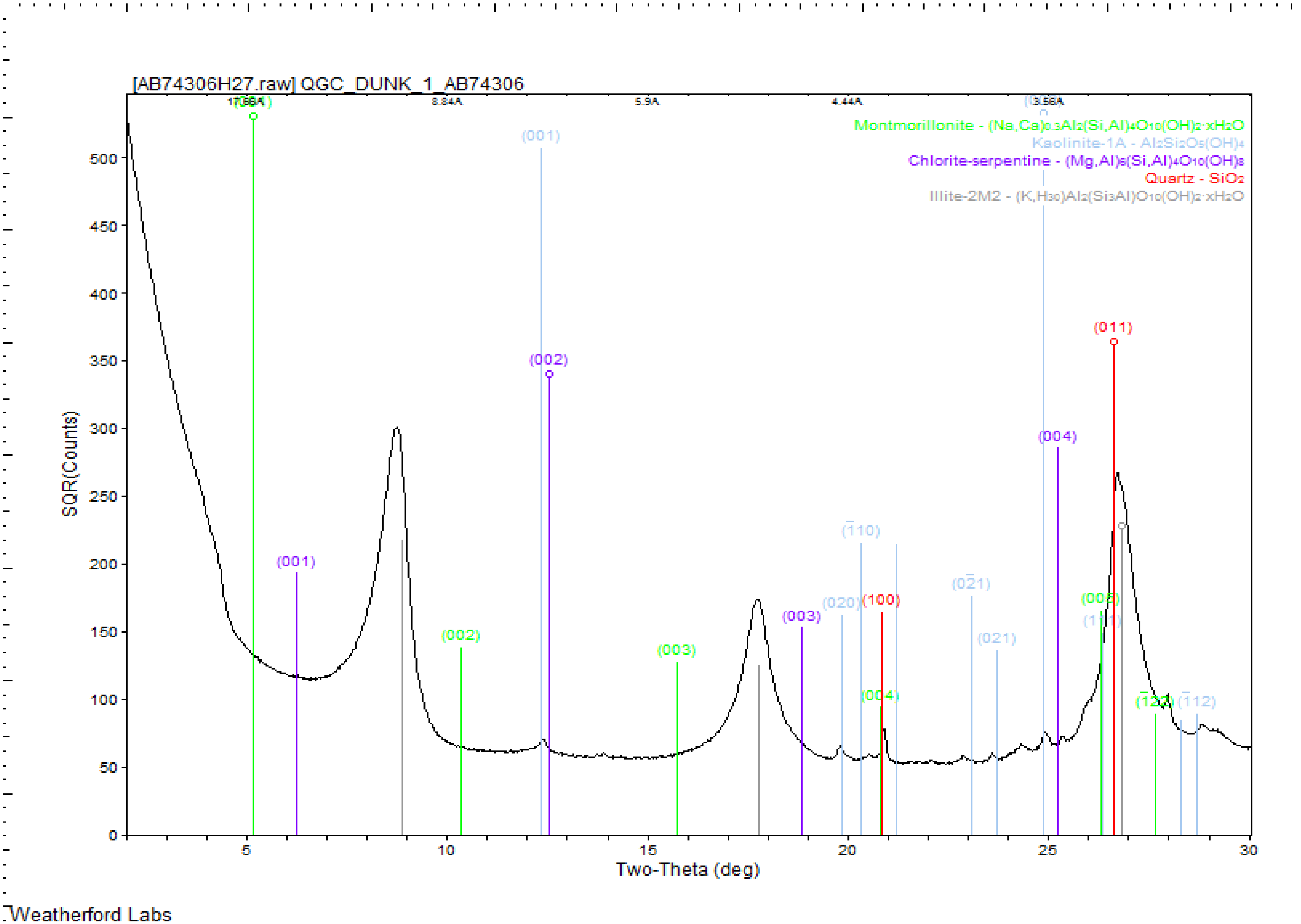


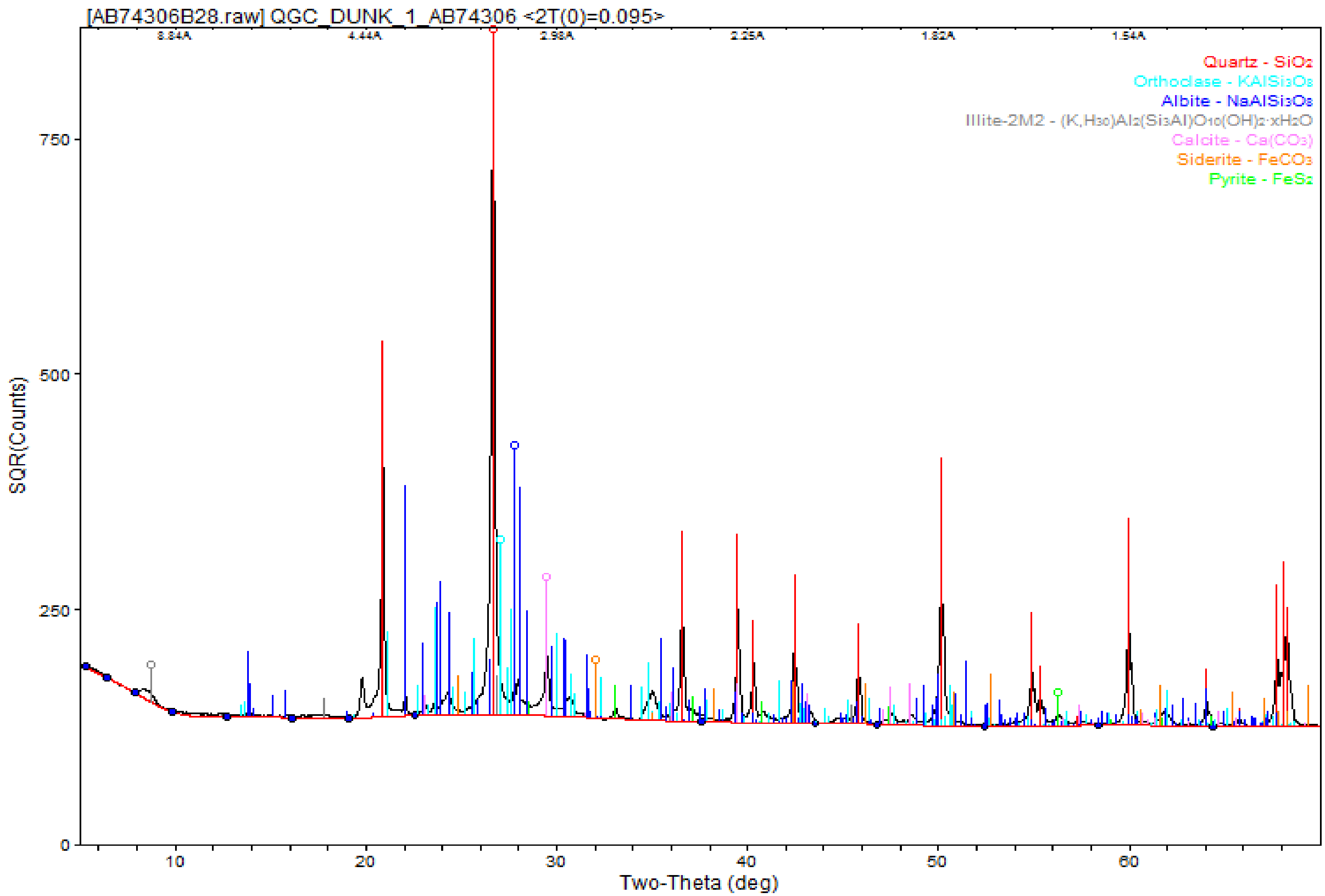

Weatherford Labs



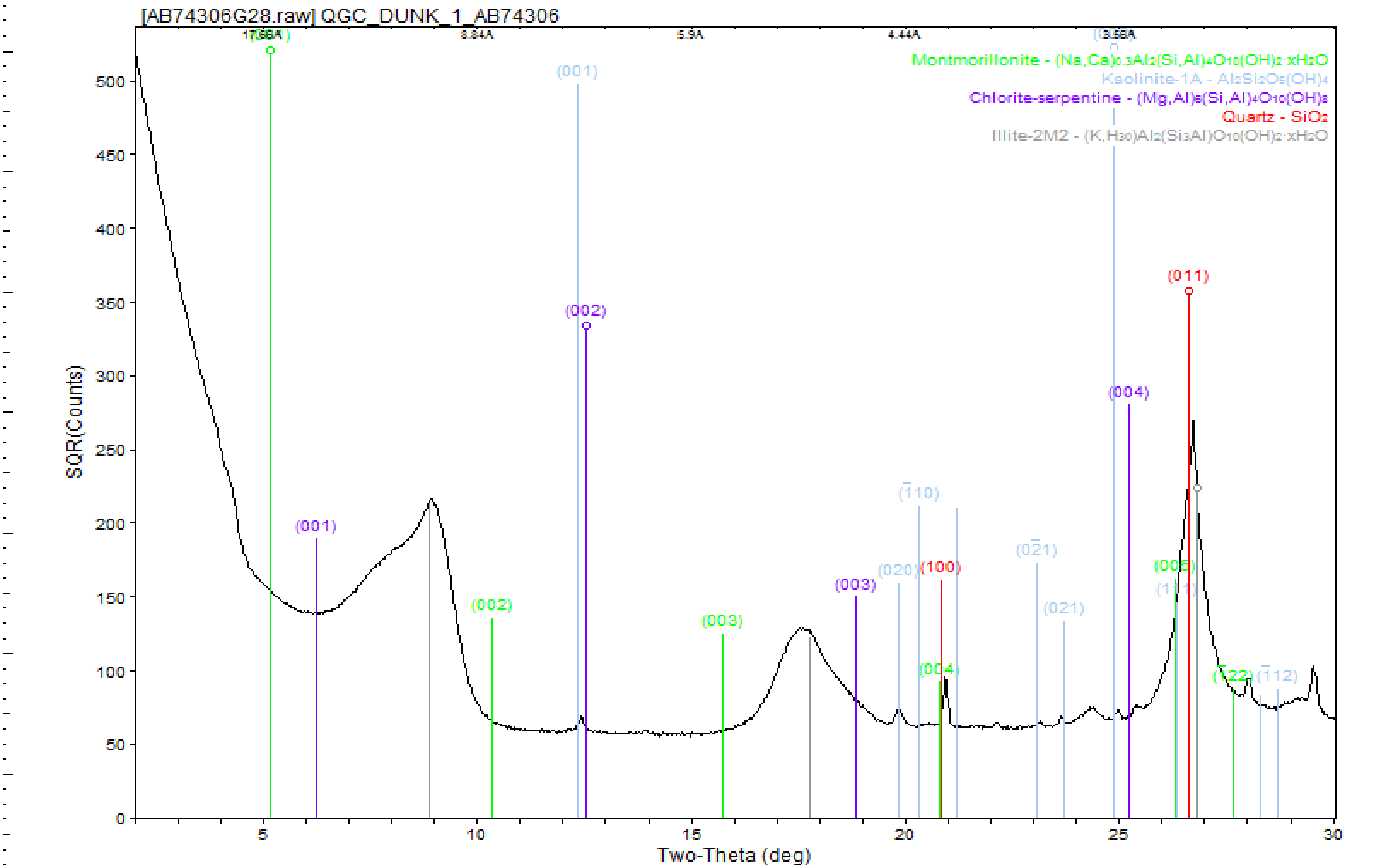
[AB74306G27.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs



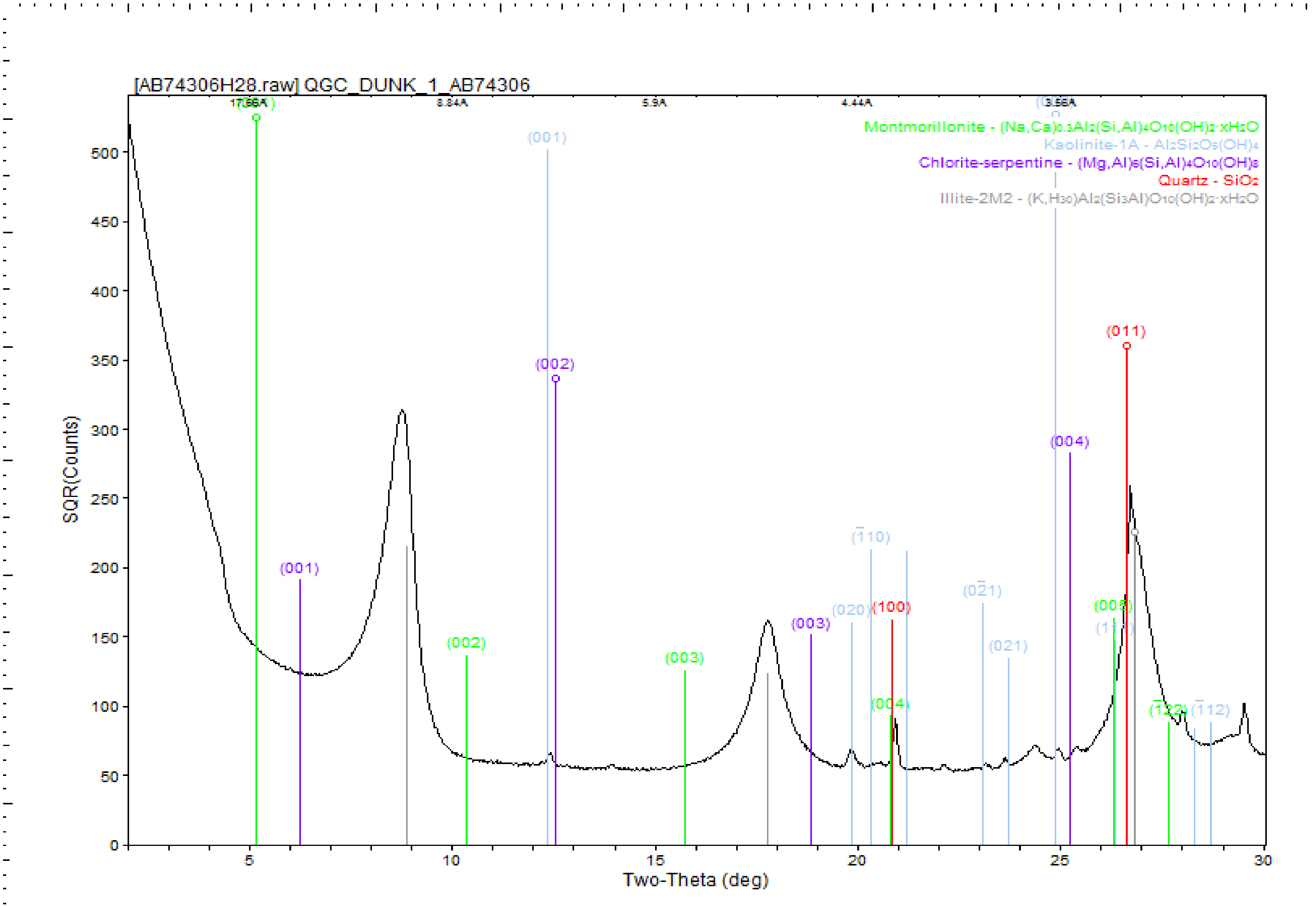
Weatherford Labs



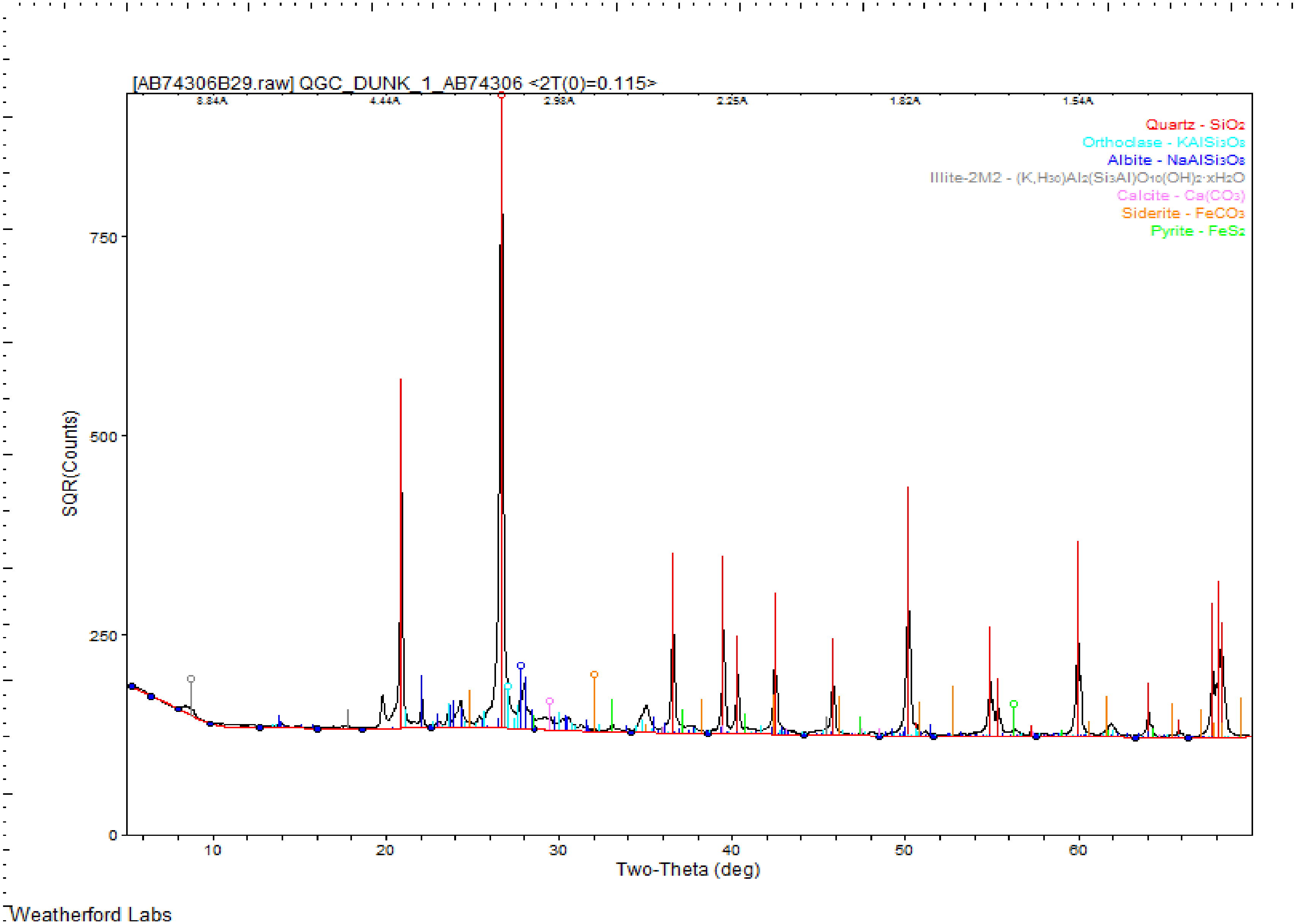

Weatherford Labs



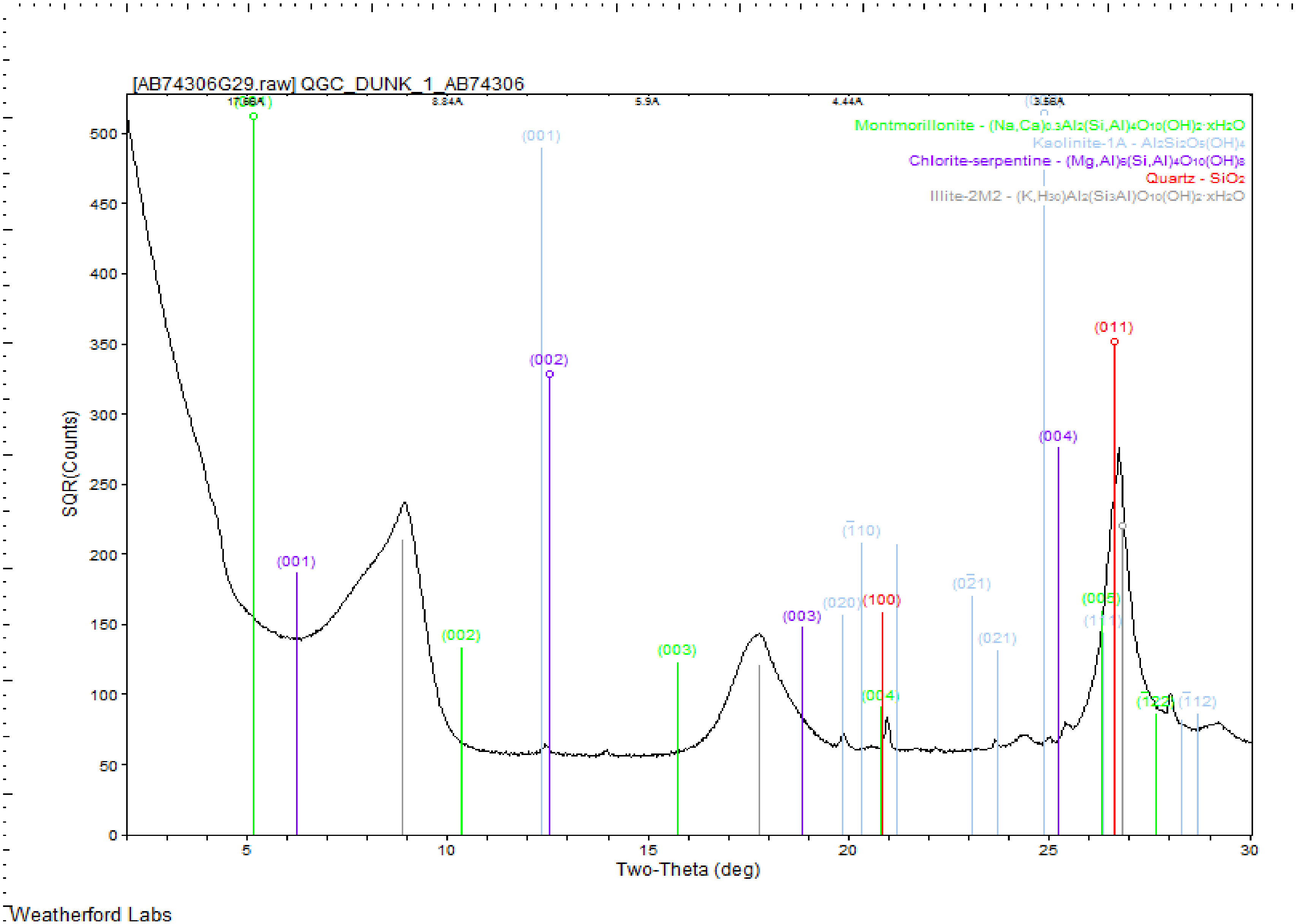

Weatherford Labs

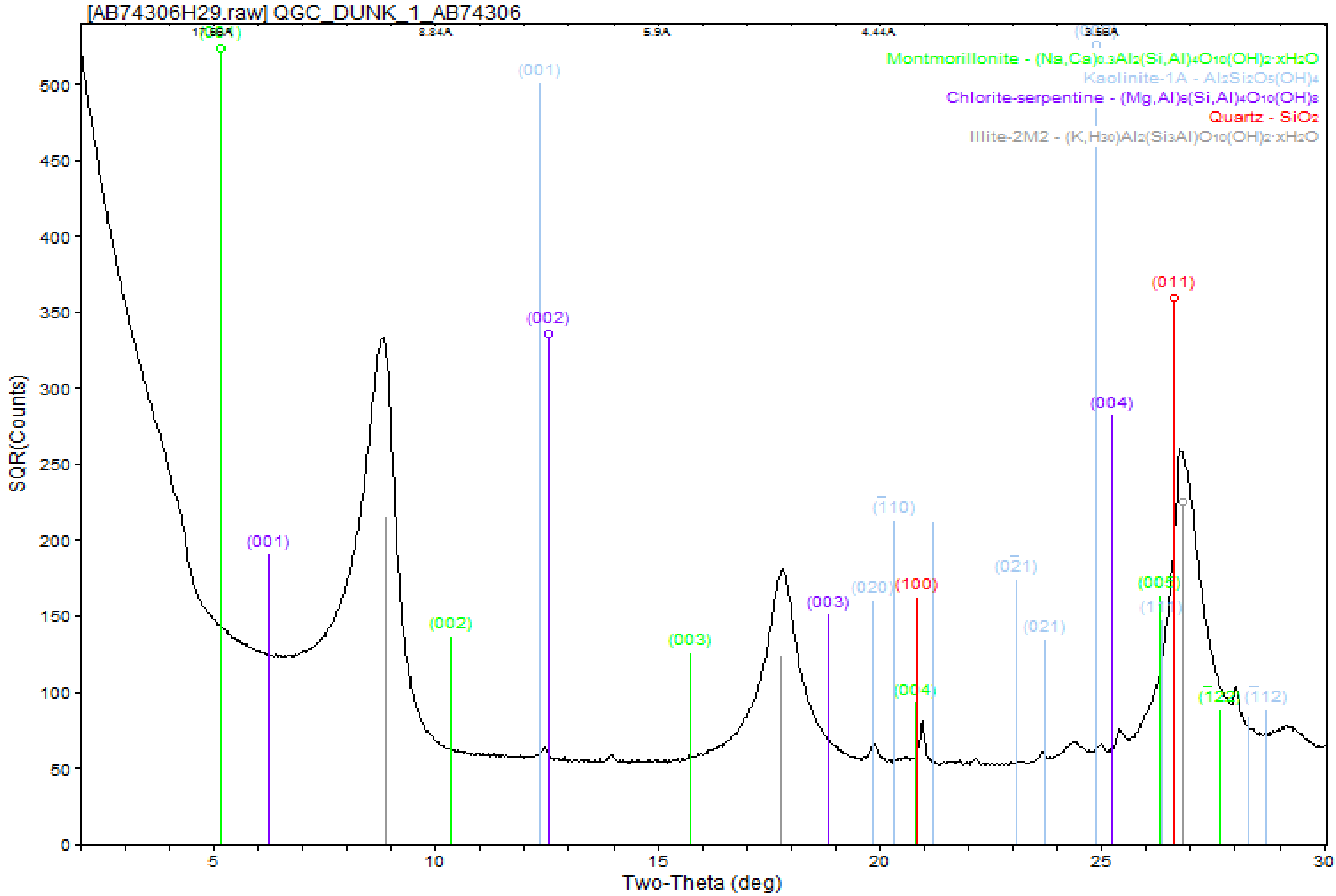


Weatherford Labs

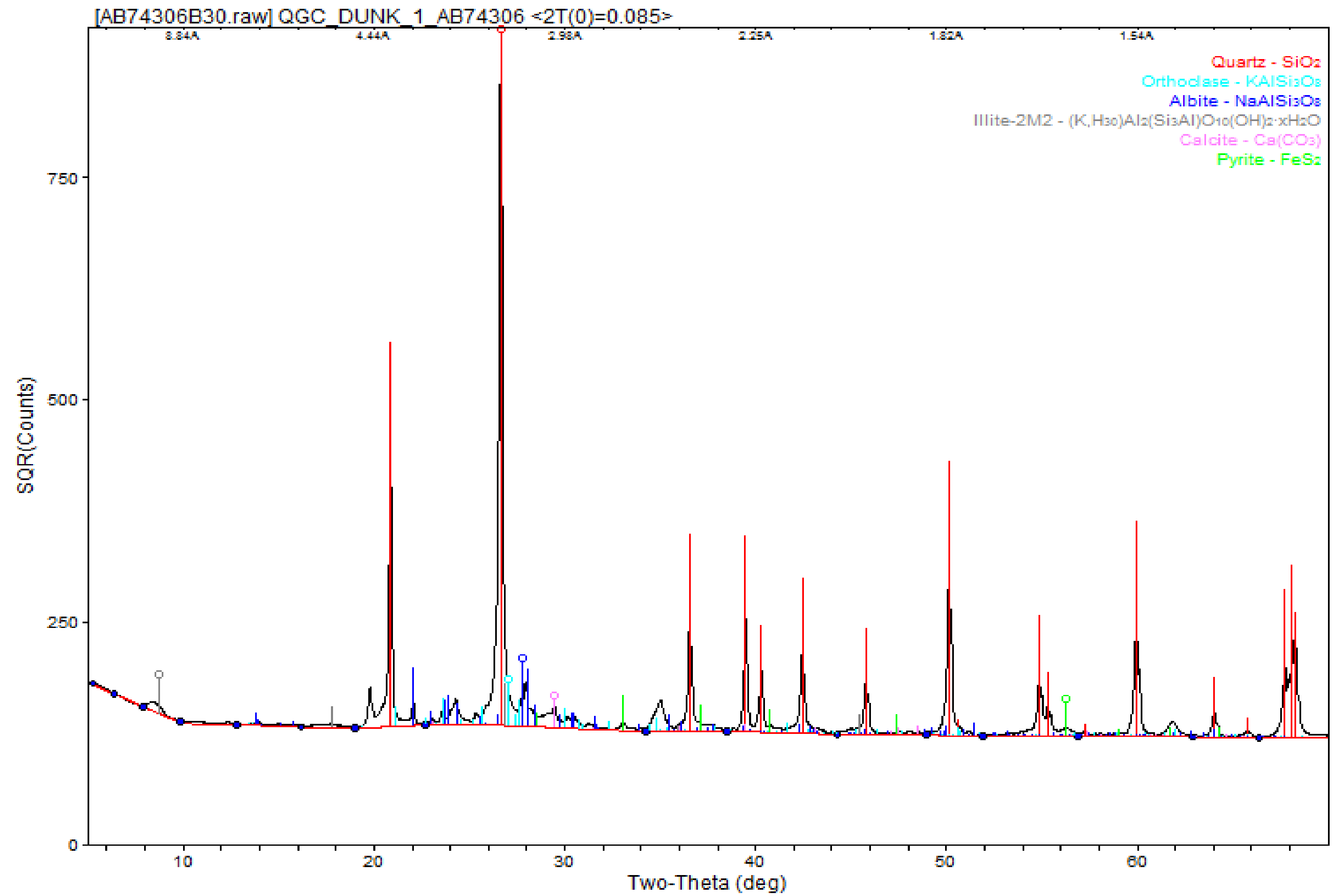



Weatherford Labs

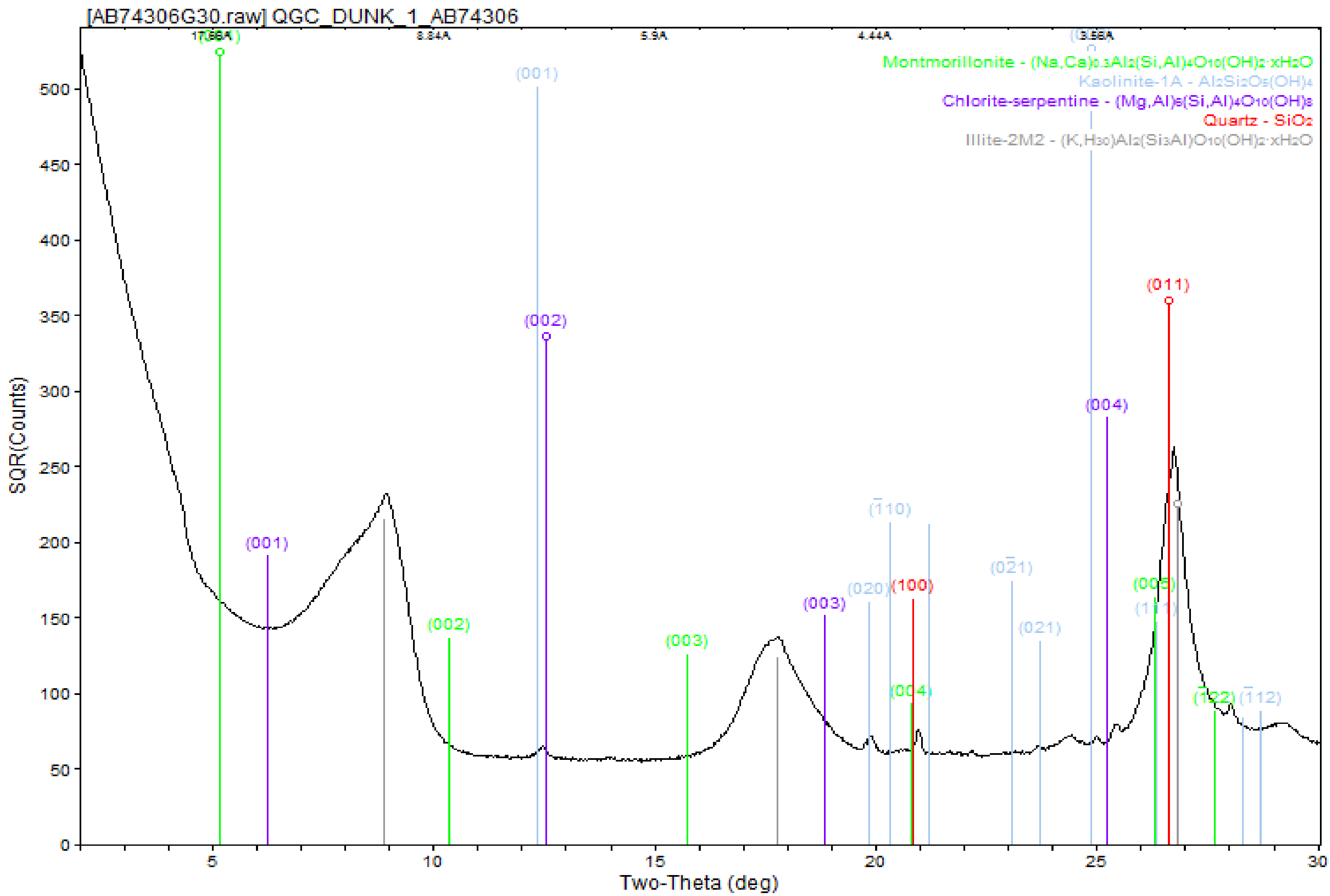

[AB74306G29.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs



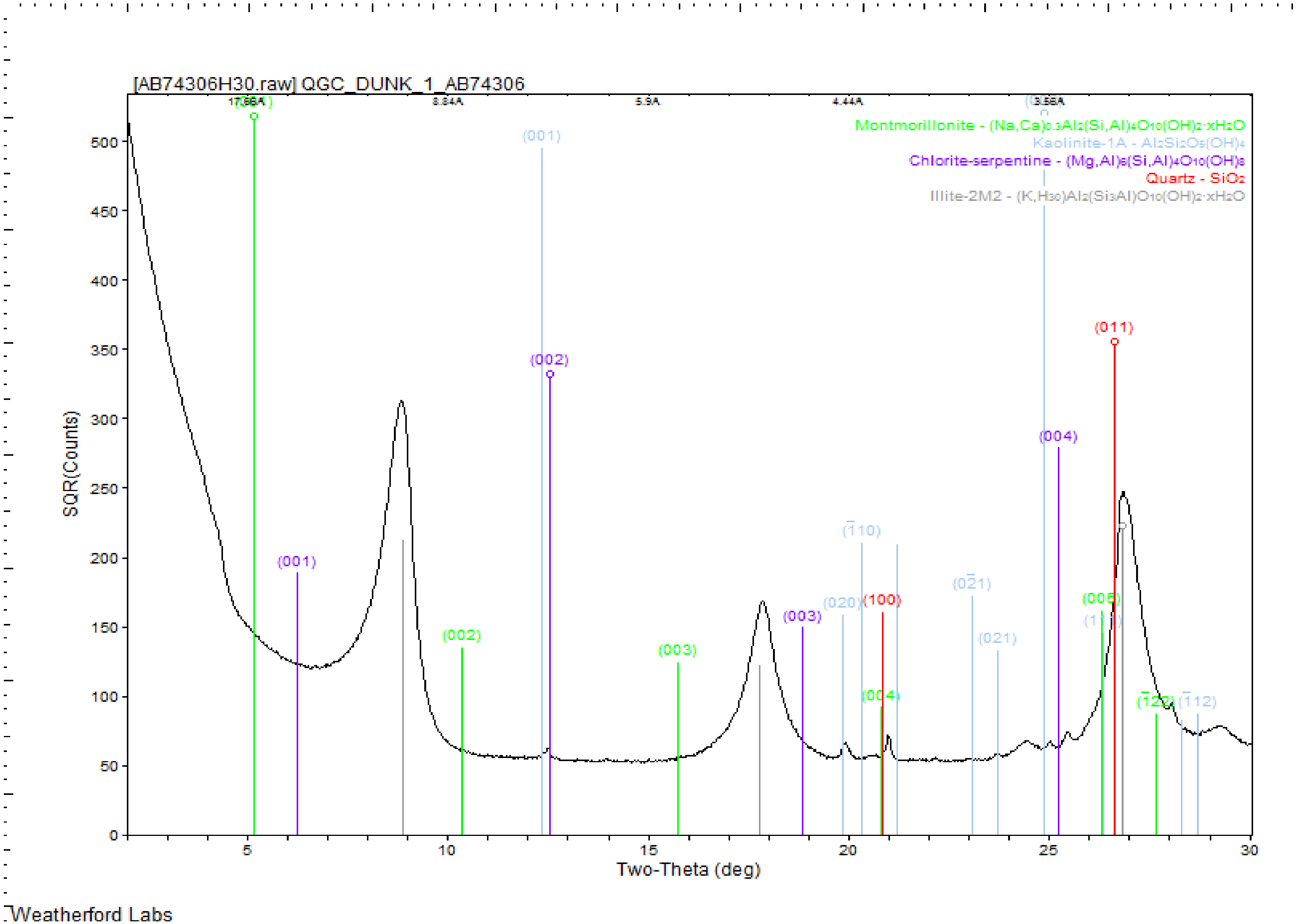
Weatherford Labs

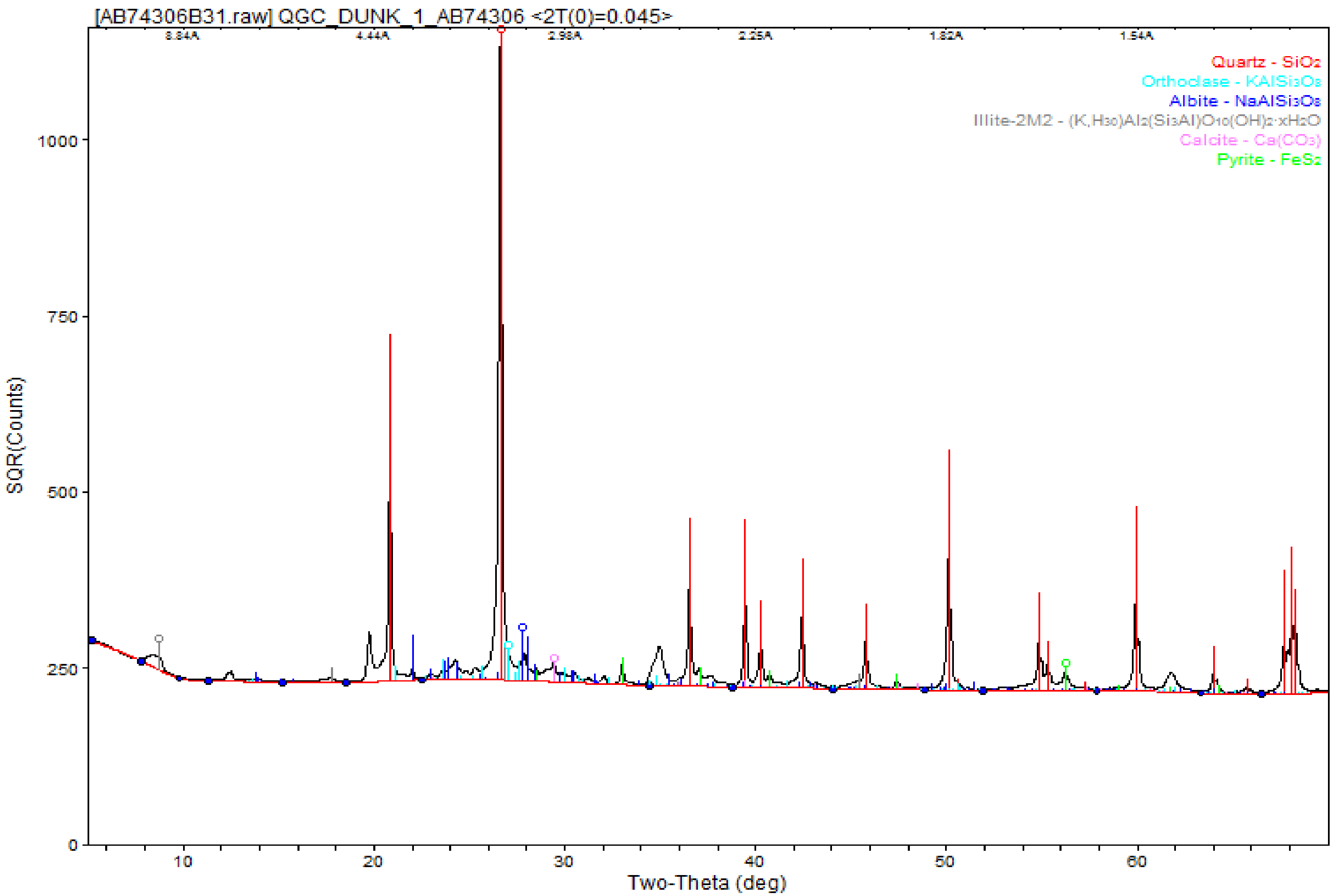



Weatherford Labs

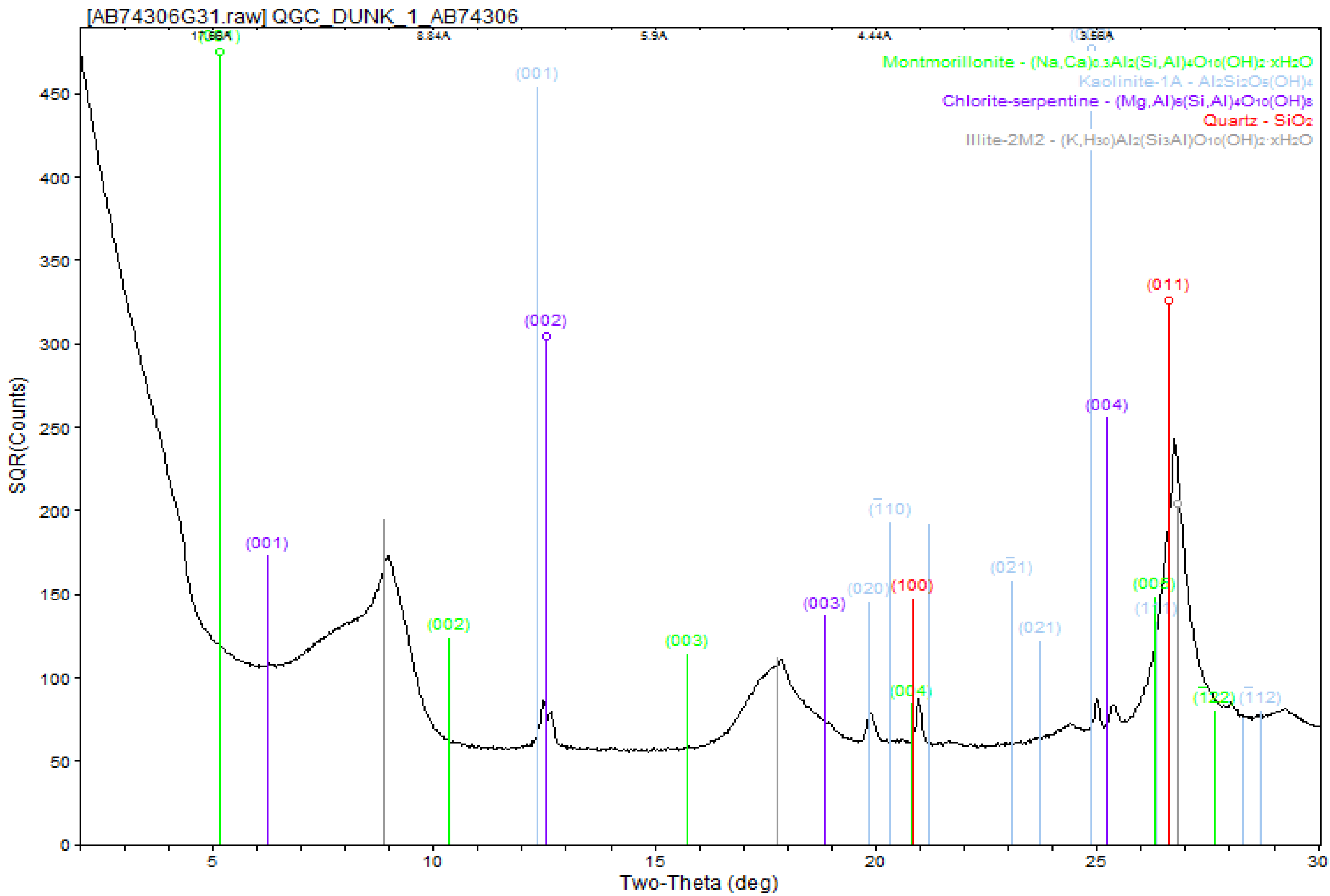



Weatherford Labs


[AB74306H30.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs




Weatherford Labs

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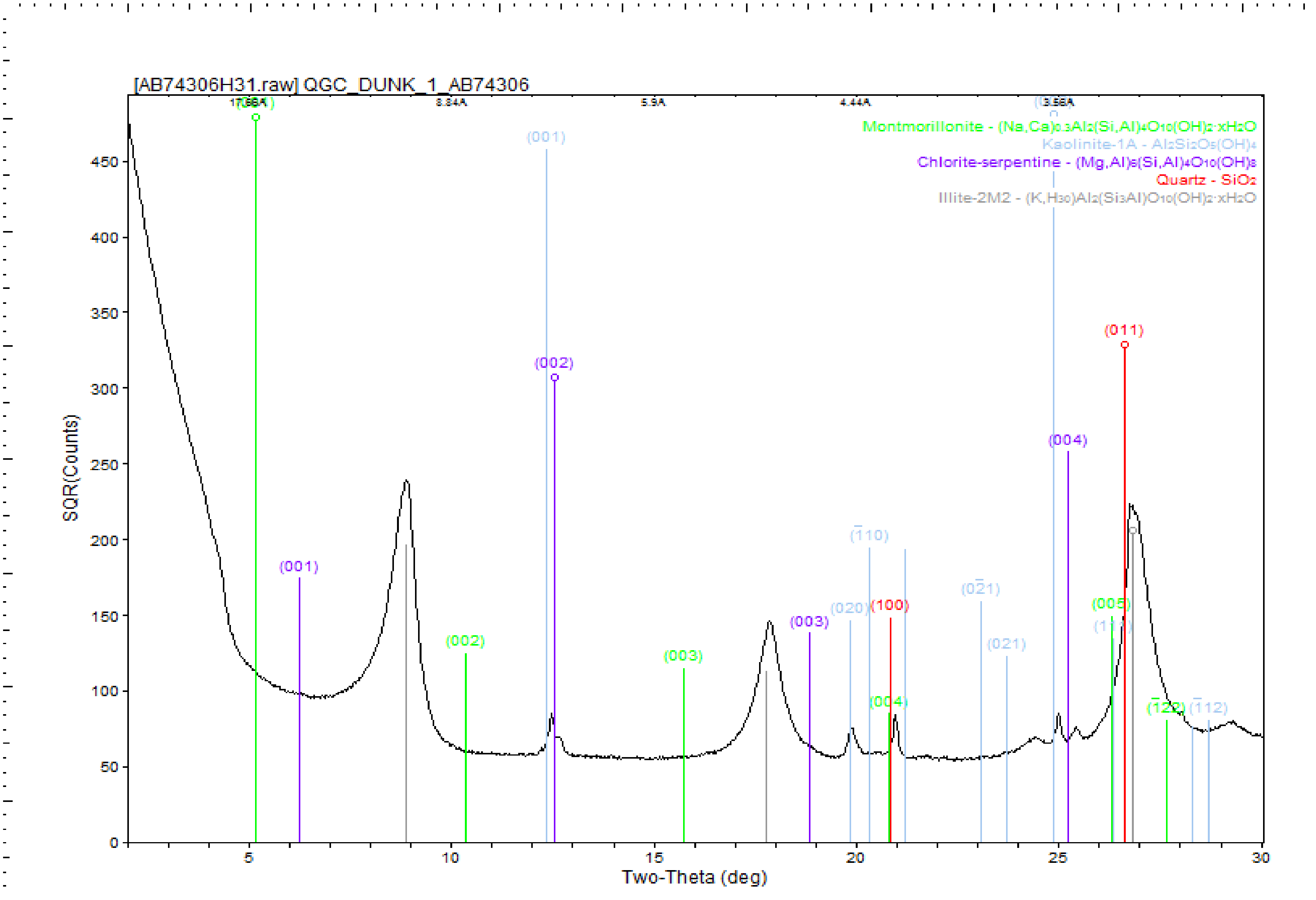
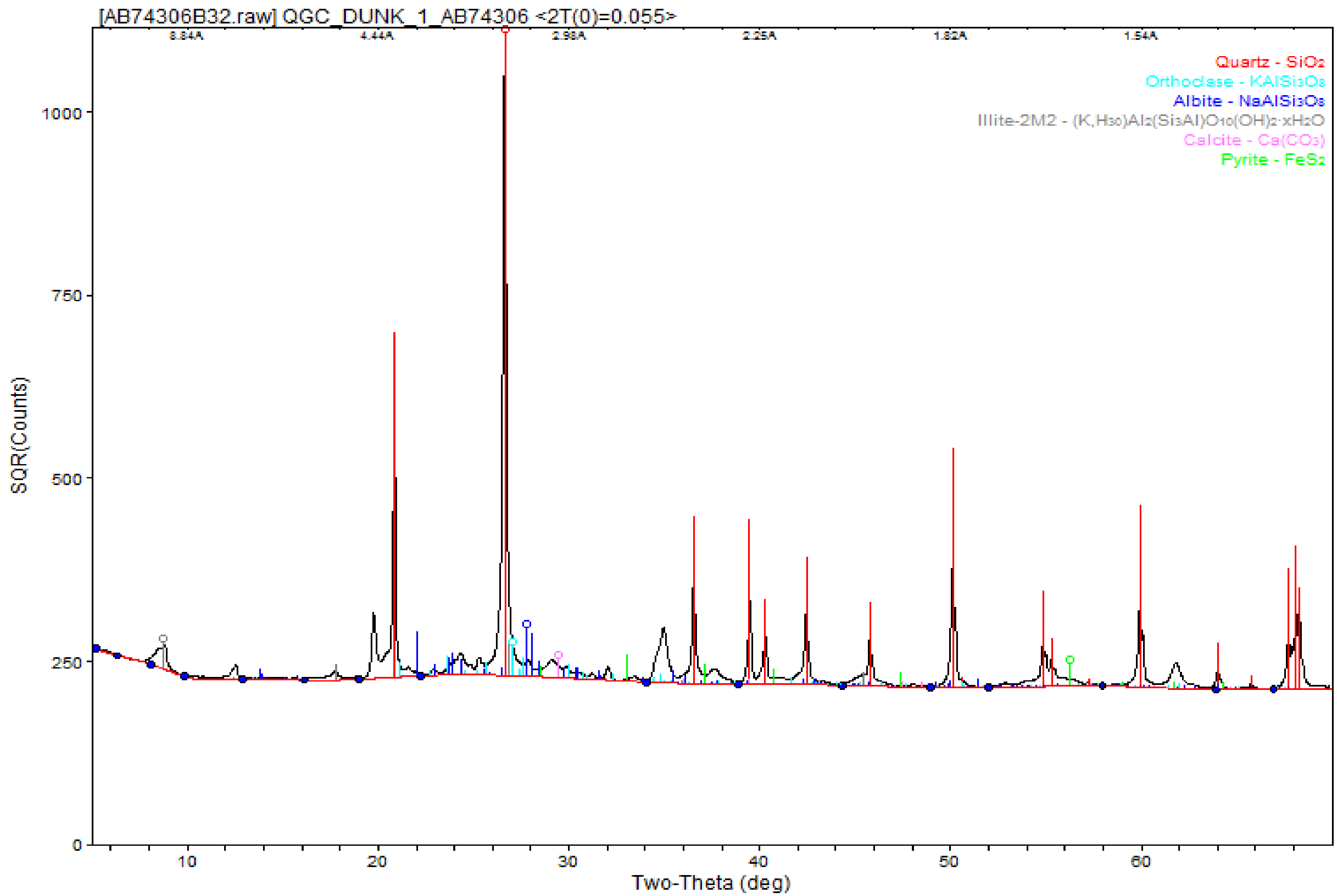
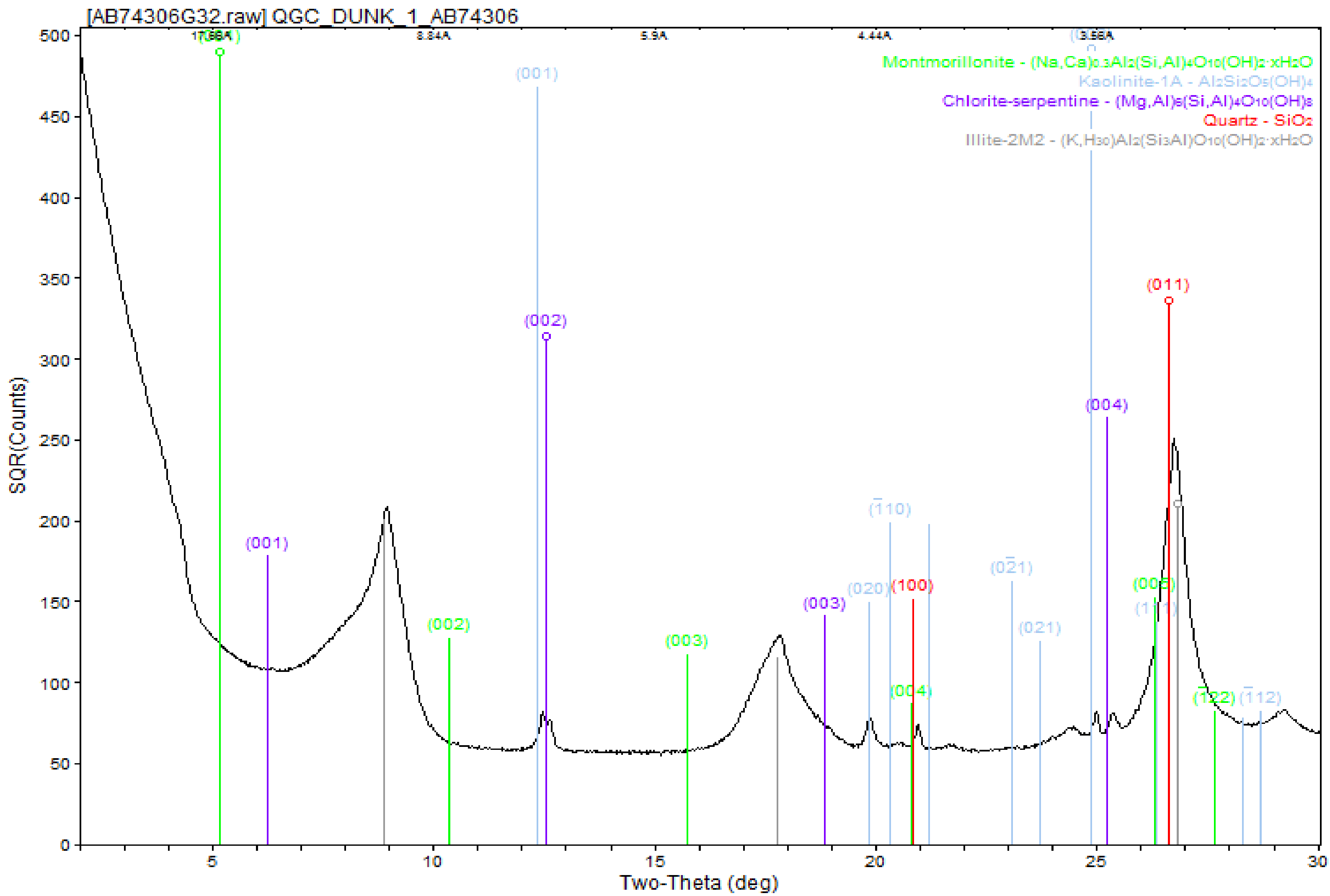


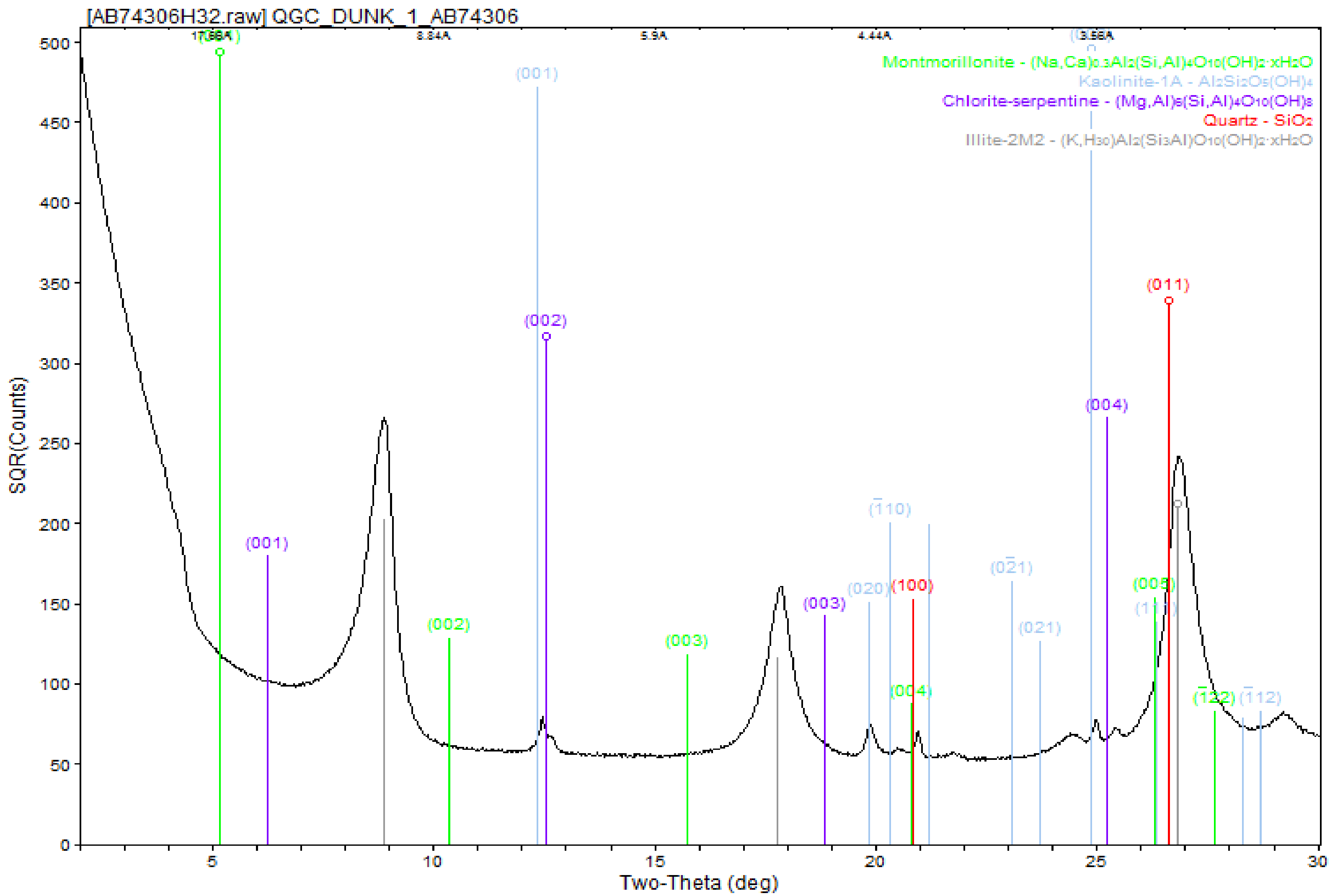

Weatherford Labs




Weatherford Labs




Weatherford Labs

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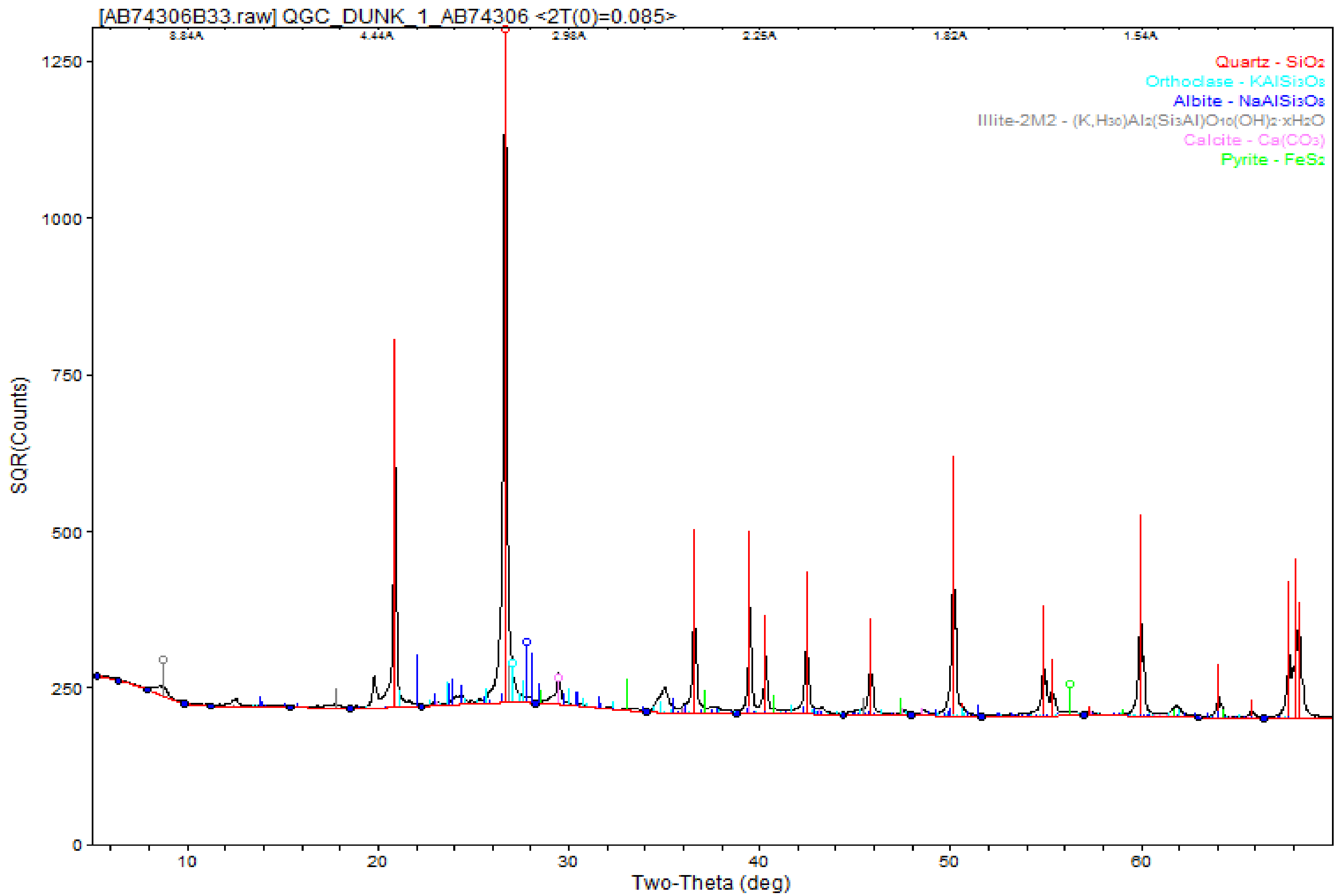


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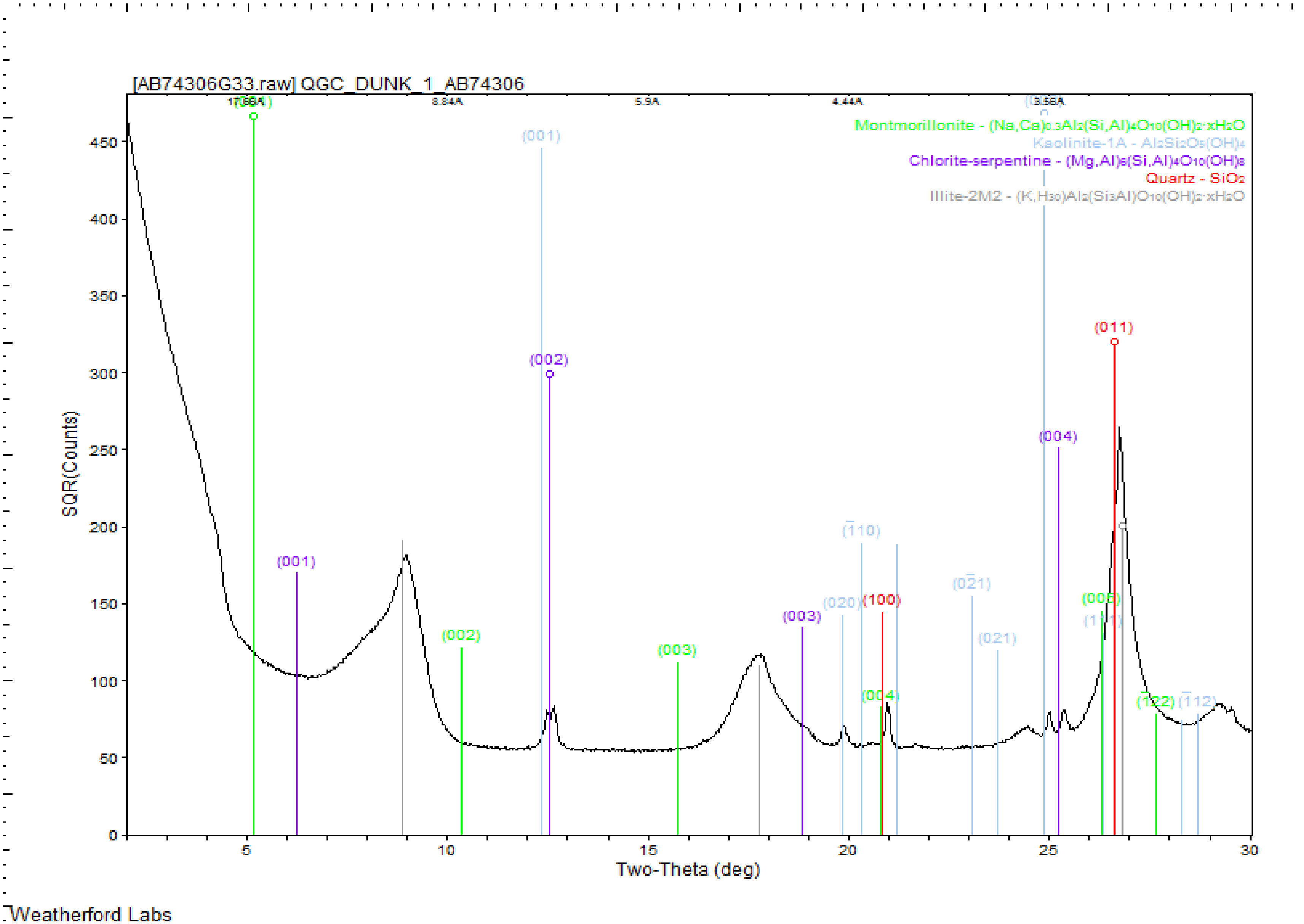


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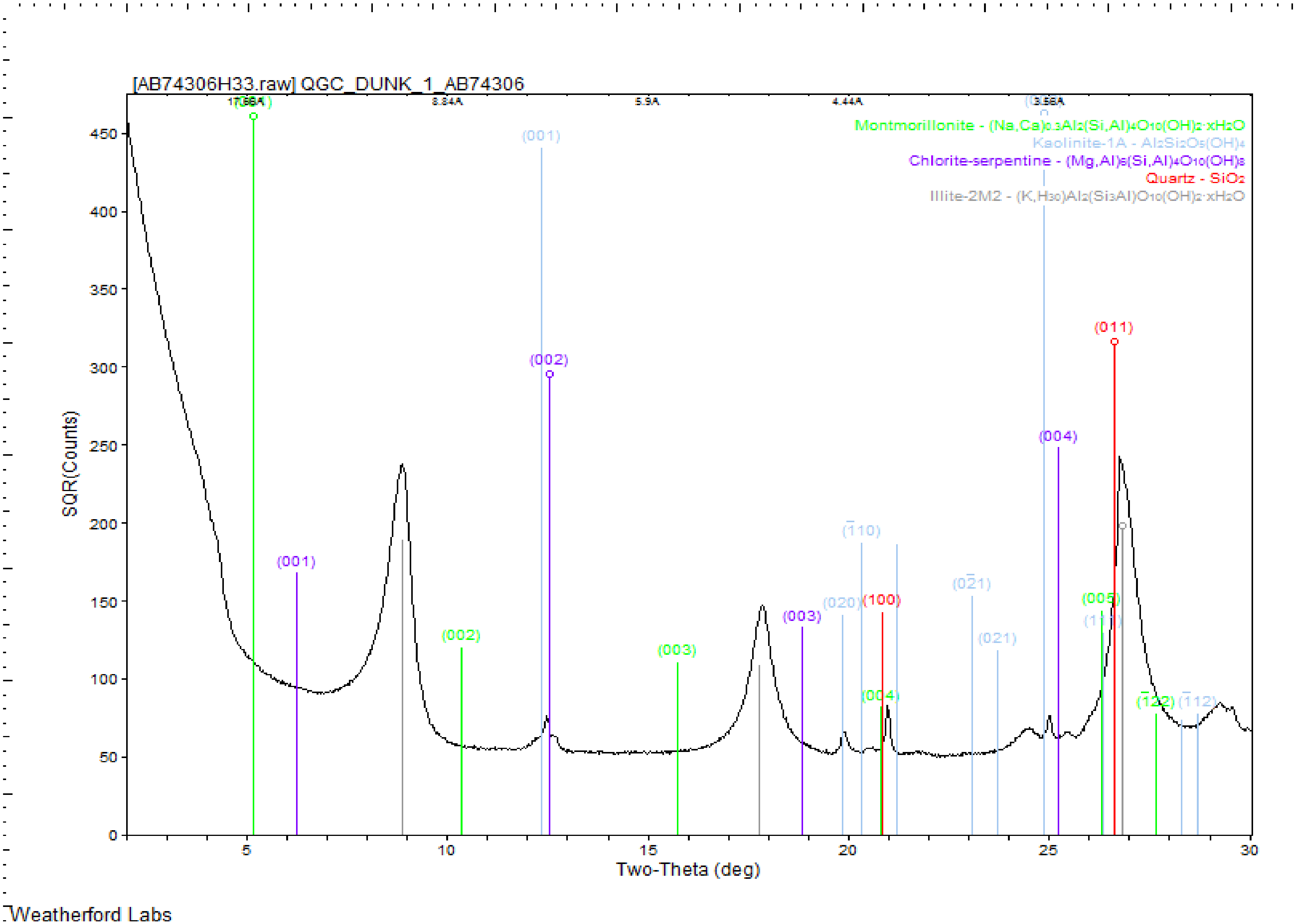


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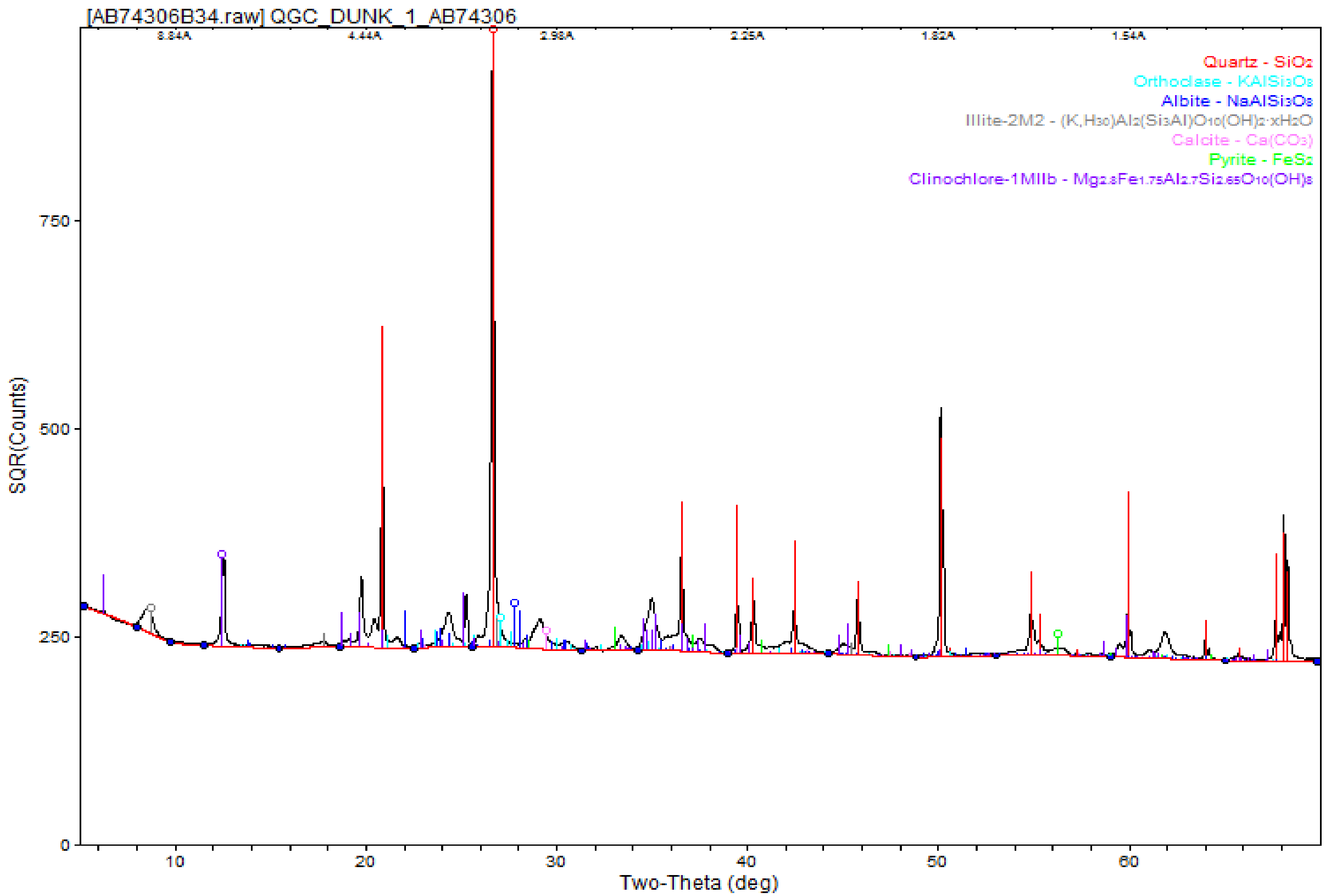


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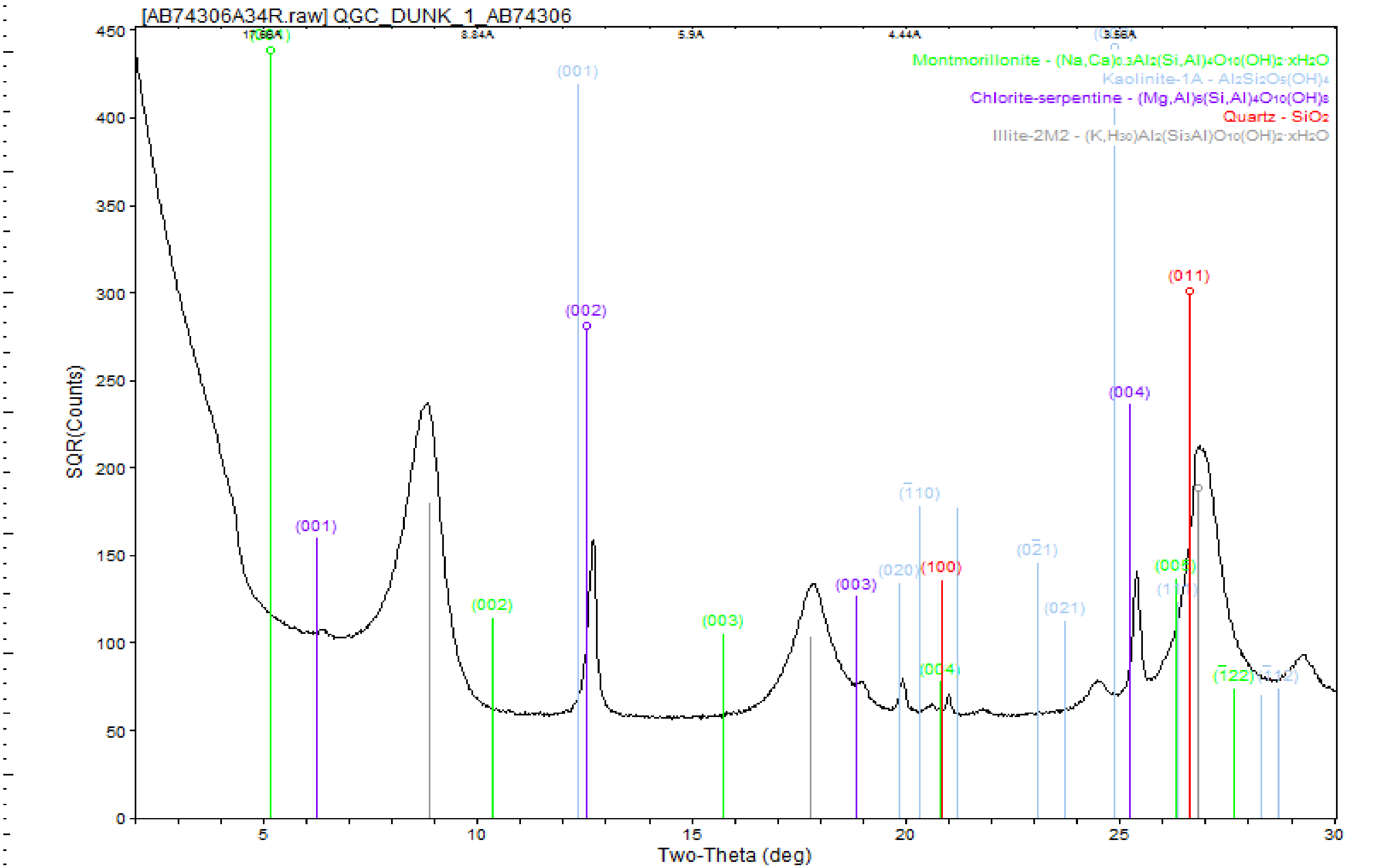


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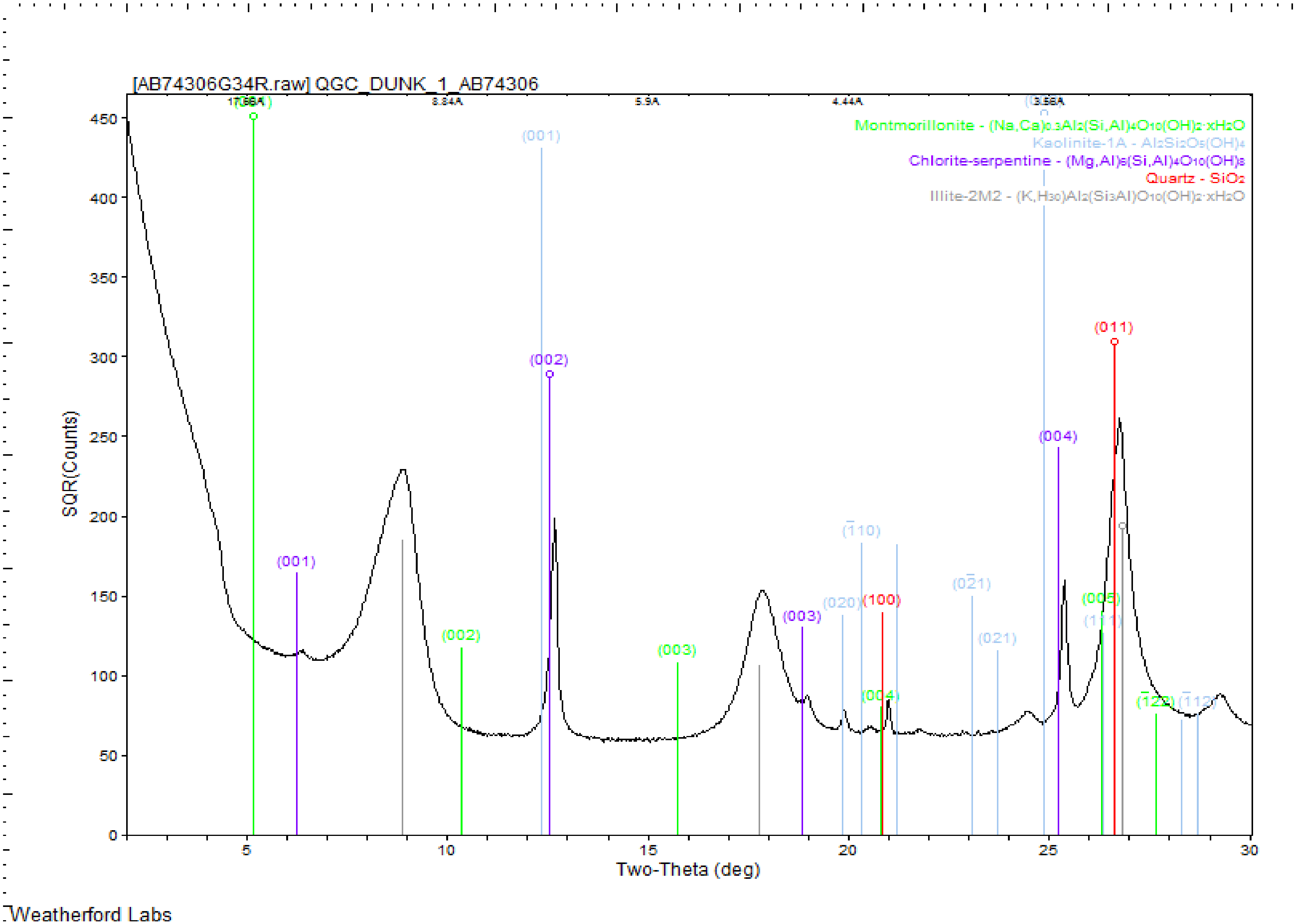

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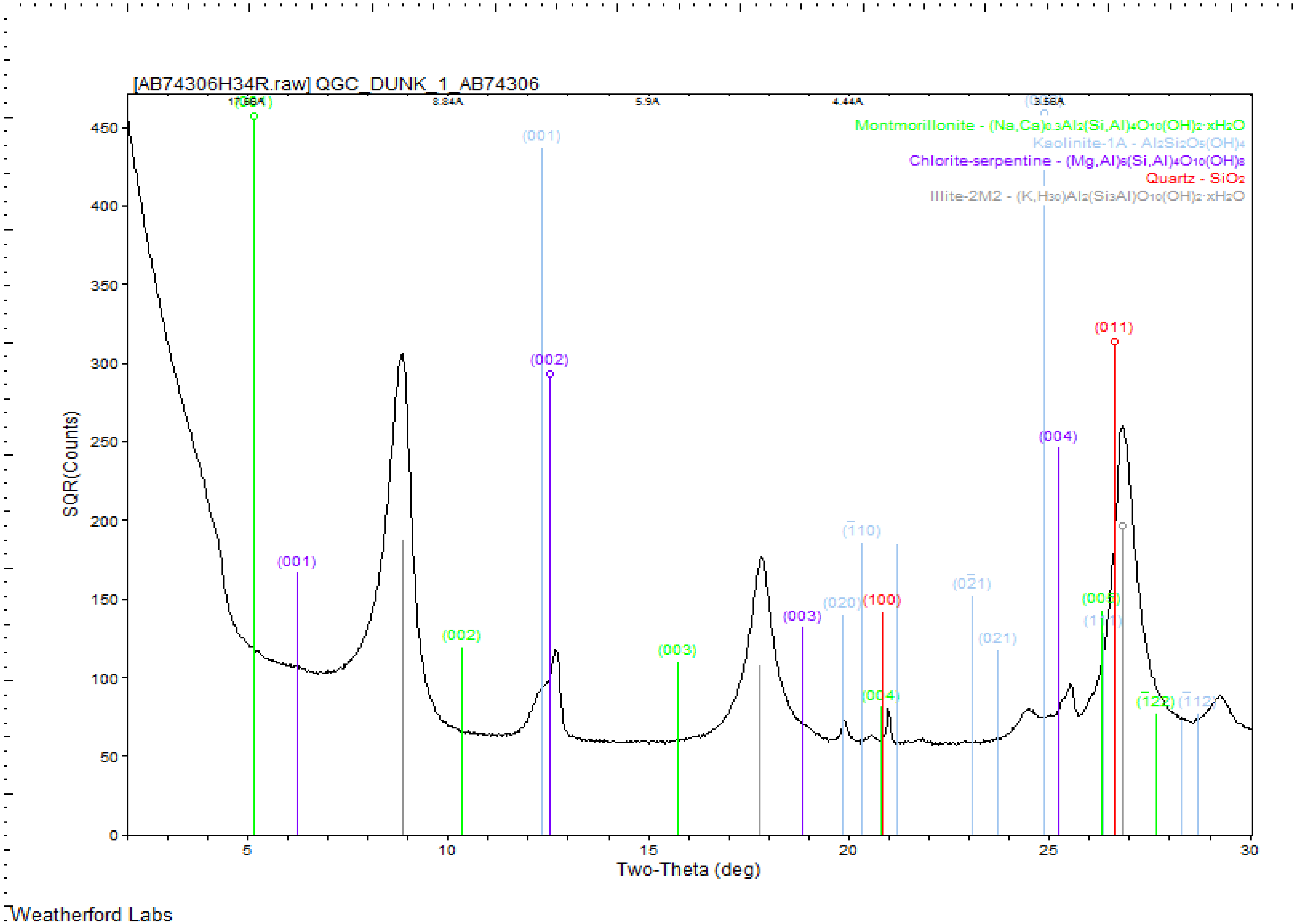
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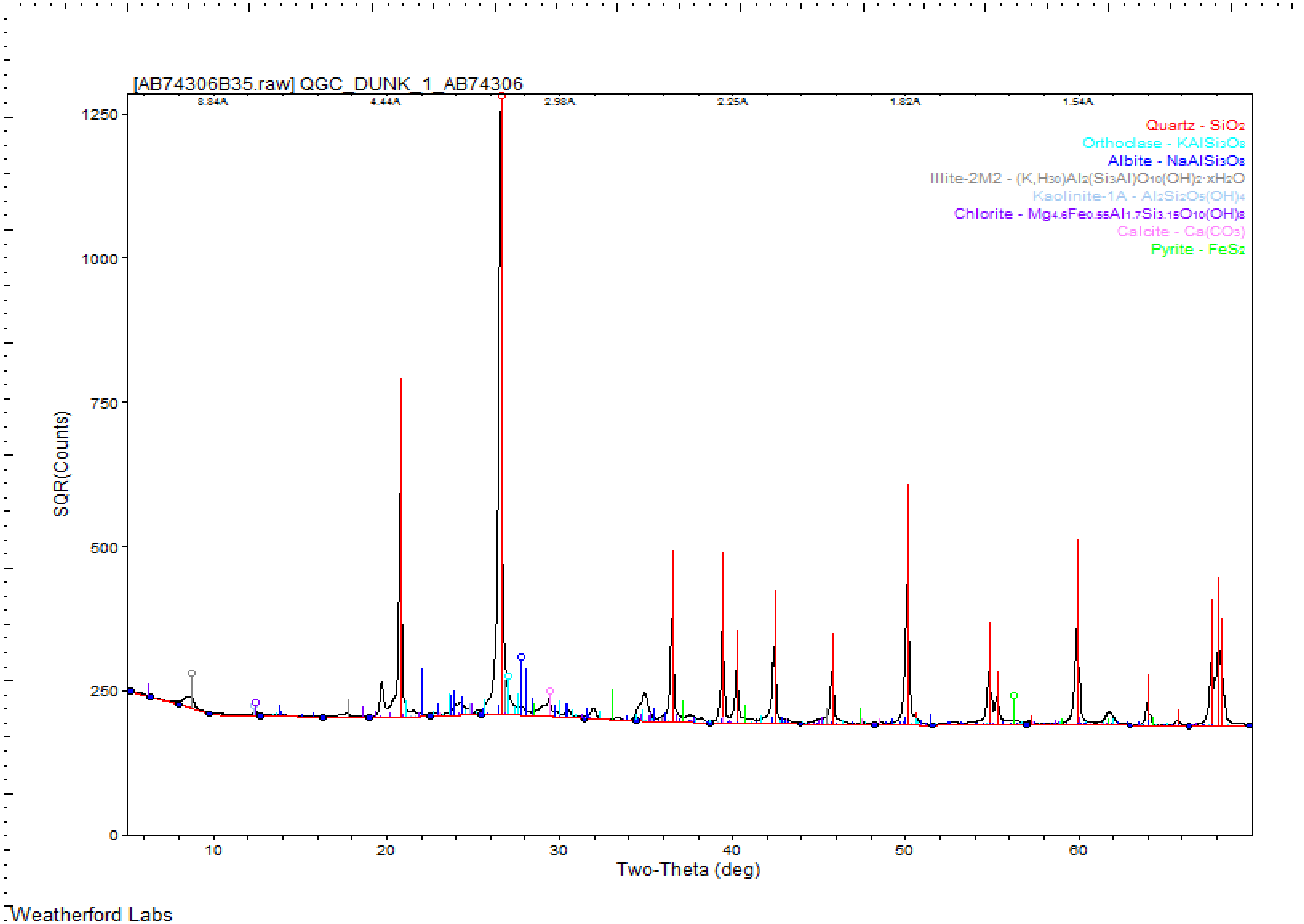
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs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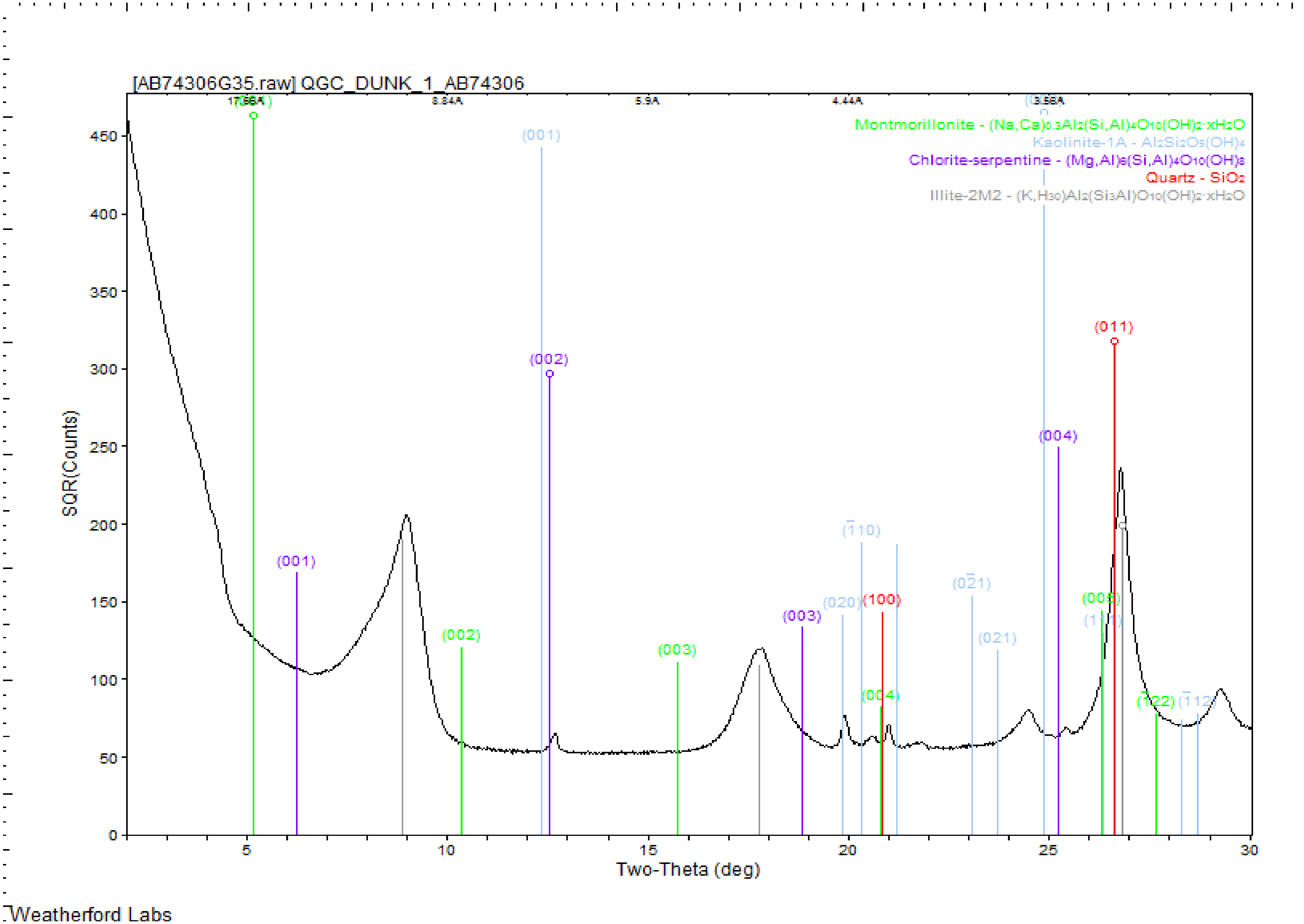
8.84A
4.44A
2.98A
2.25A
1.82A
1.54A
Quartz - SiO2
Orthoclase - KAlSi3O8
Albite - NaAlSi3O8
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite - Mg4.6Fe0.55Al1.7Si3.15O10(OH)8
Calcite - Ca(CO3)
Pyrite - FeS2
SQR(Counts)
1250
1000
750
500
250
0
10
20
30
40
50
60
Two-Theta (deg)
Weatherford Labs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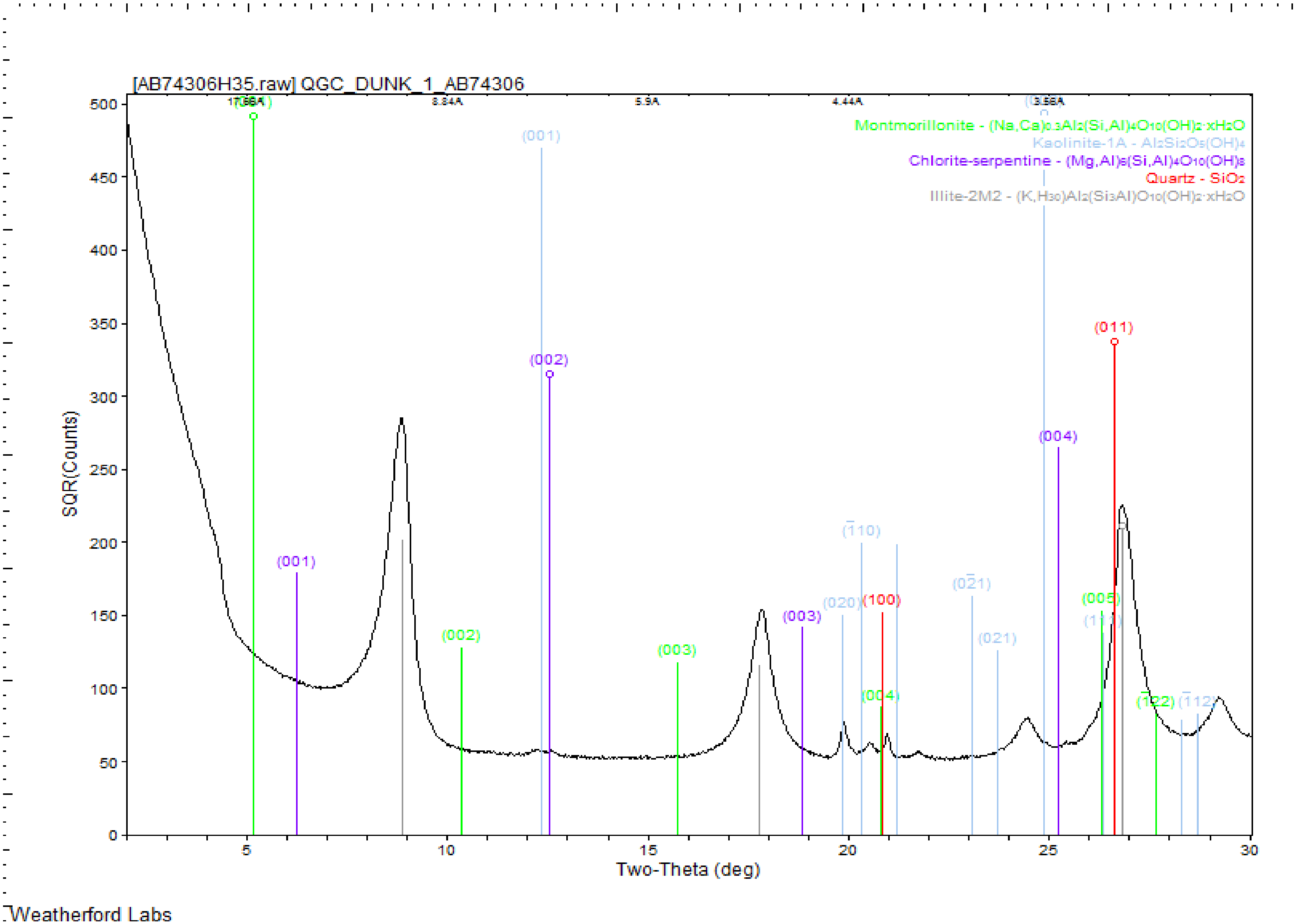
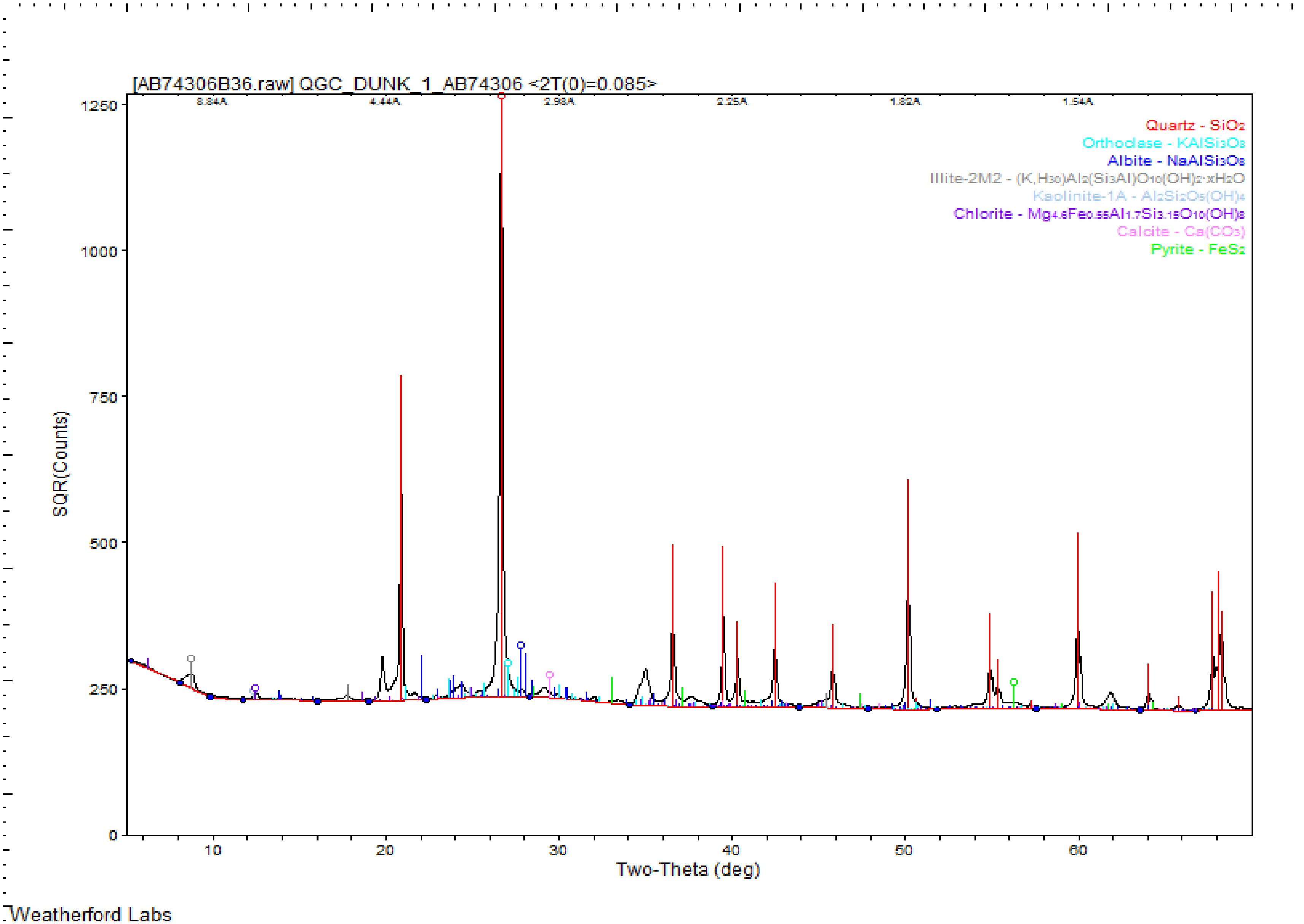
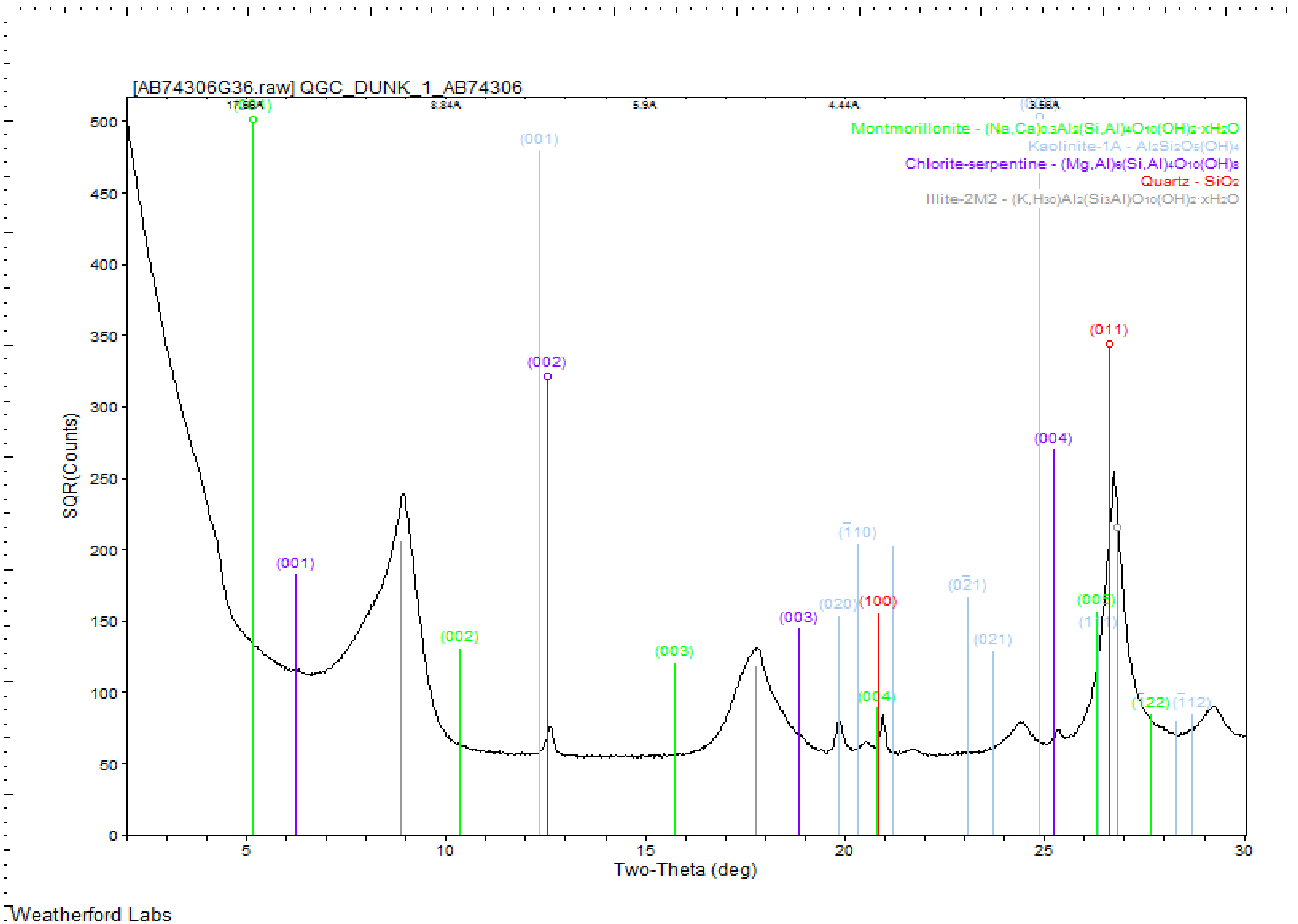
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs




Weatherford Labs




Weatherford Labs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5.9A
4.44A
3.56A
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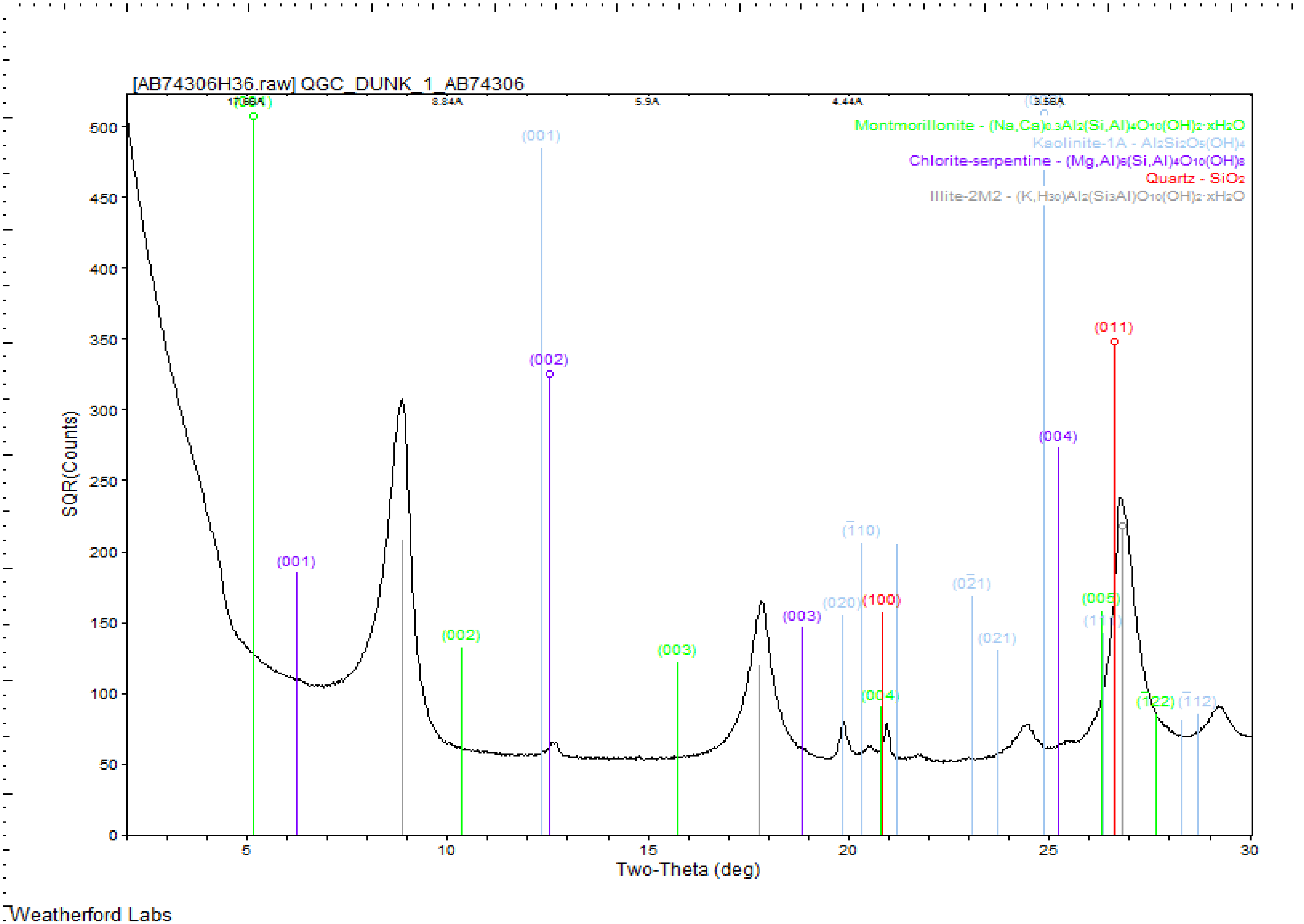
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs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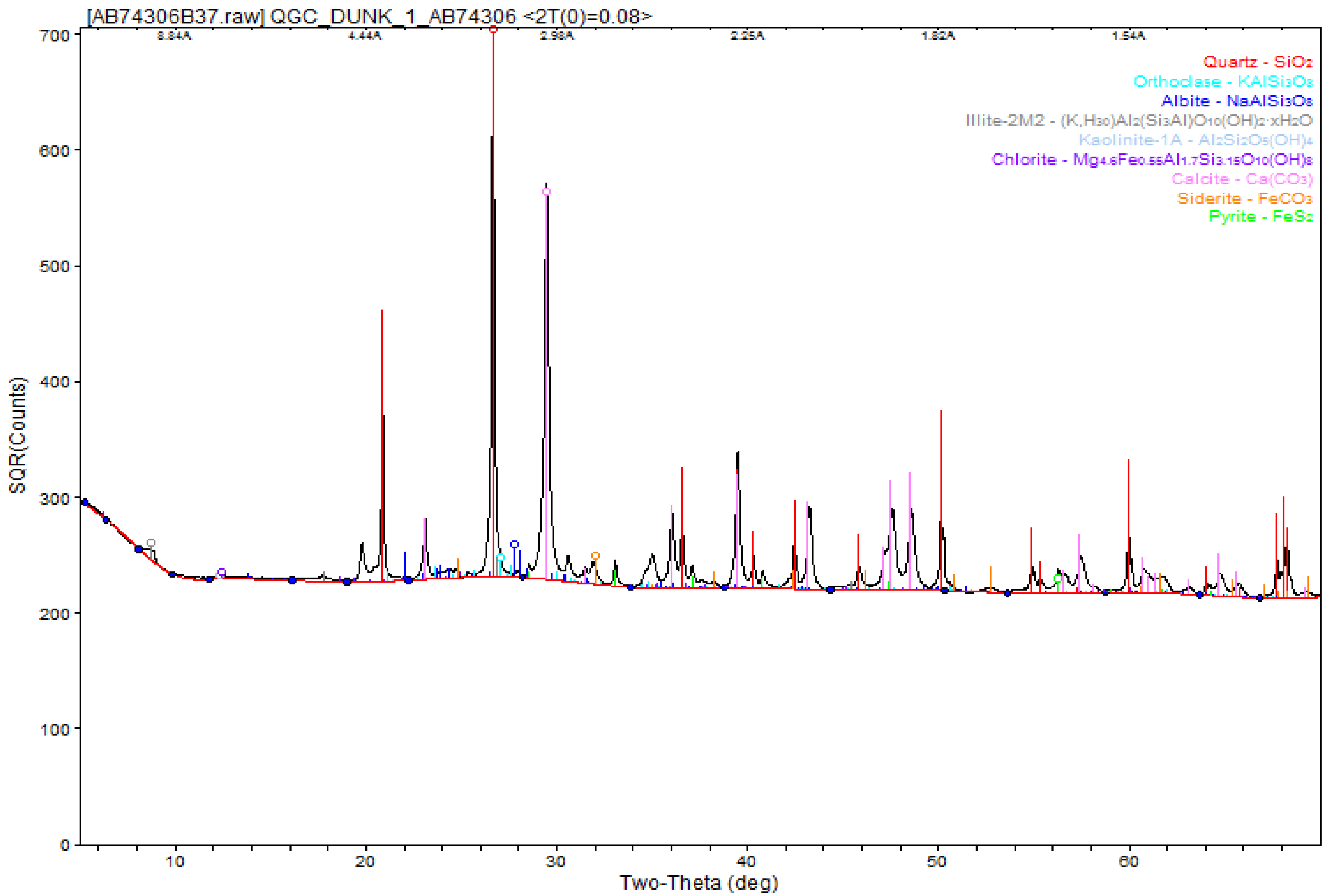
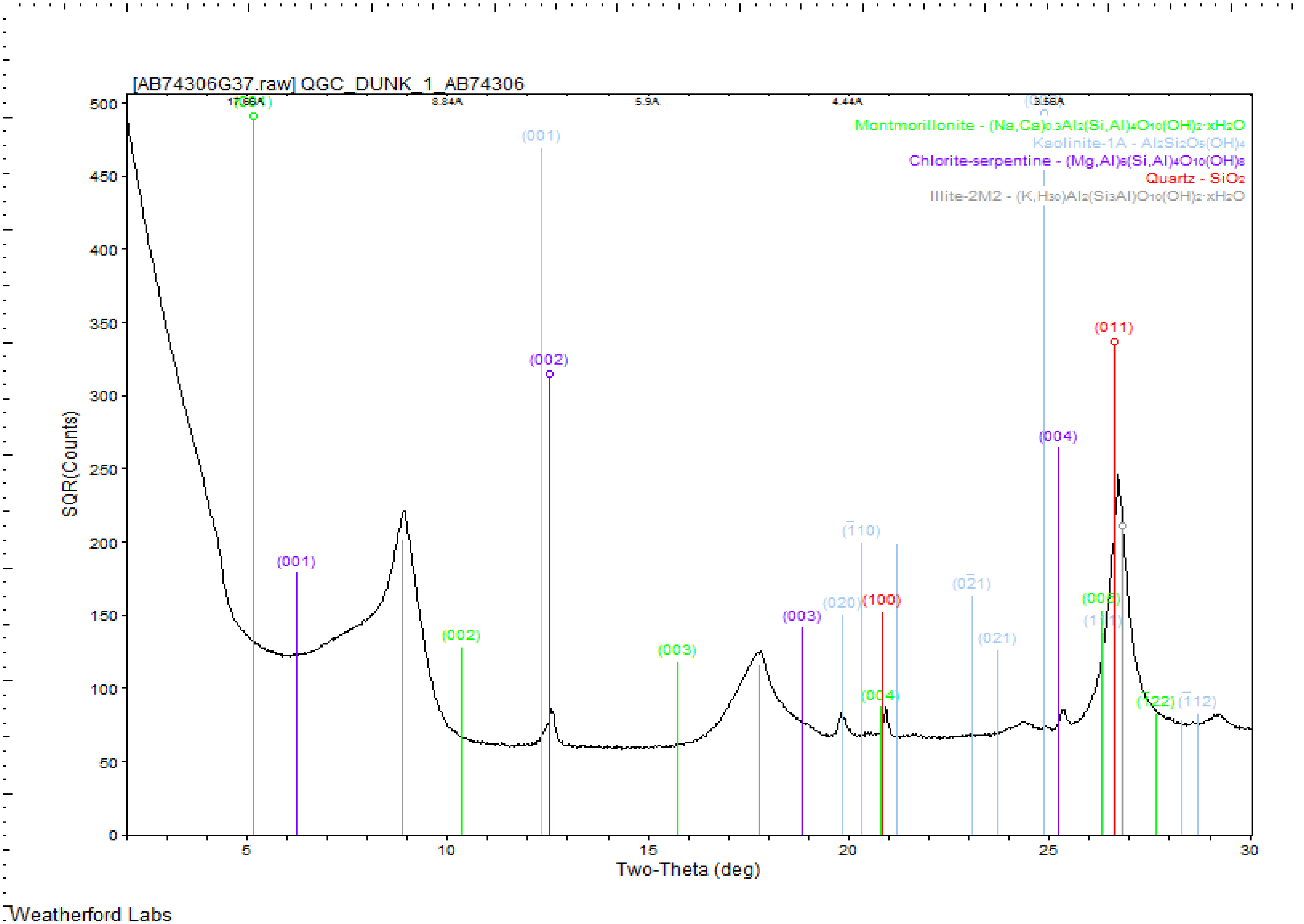
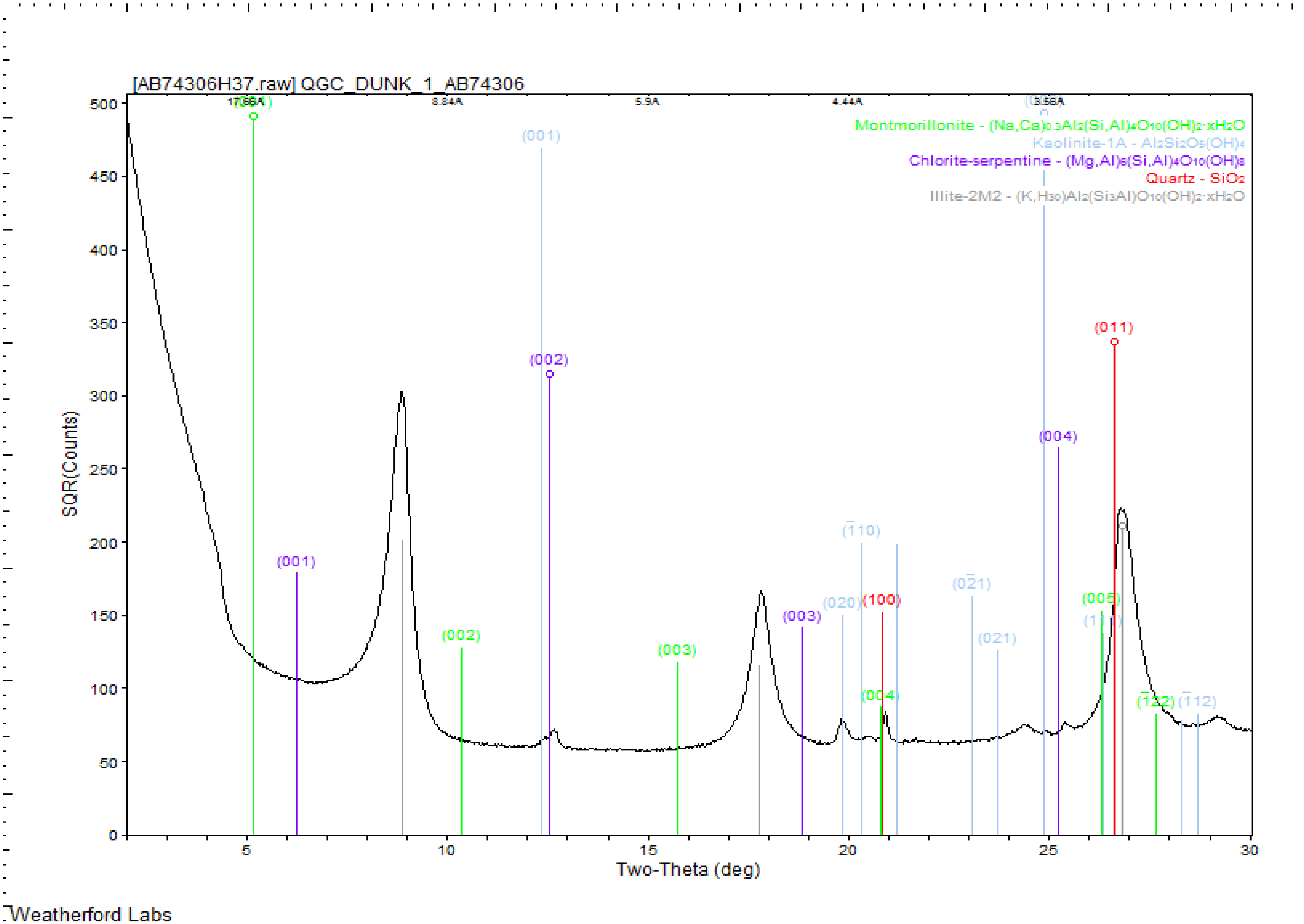
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs



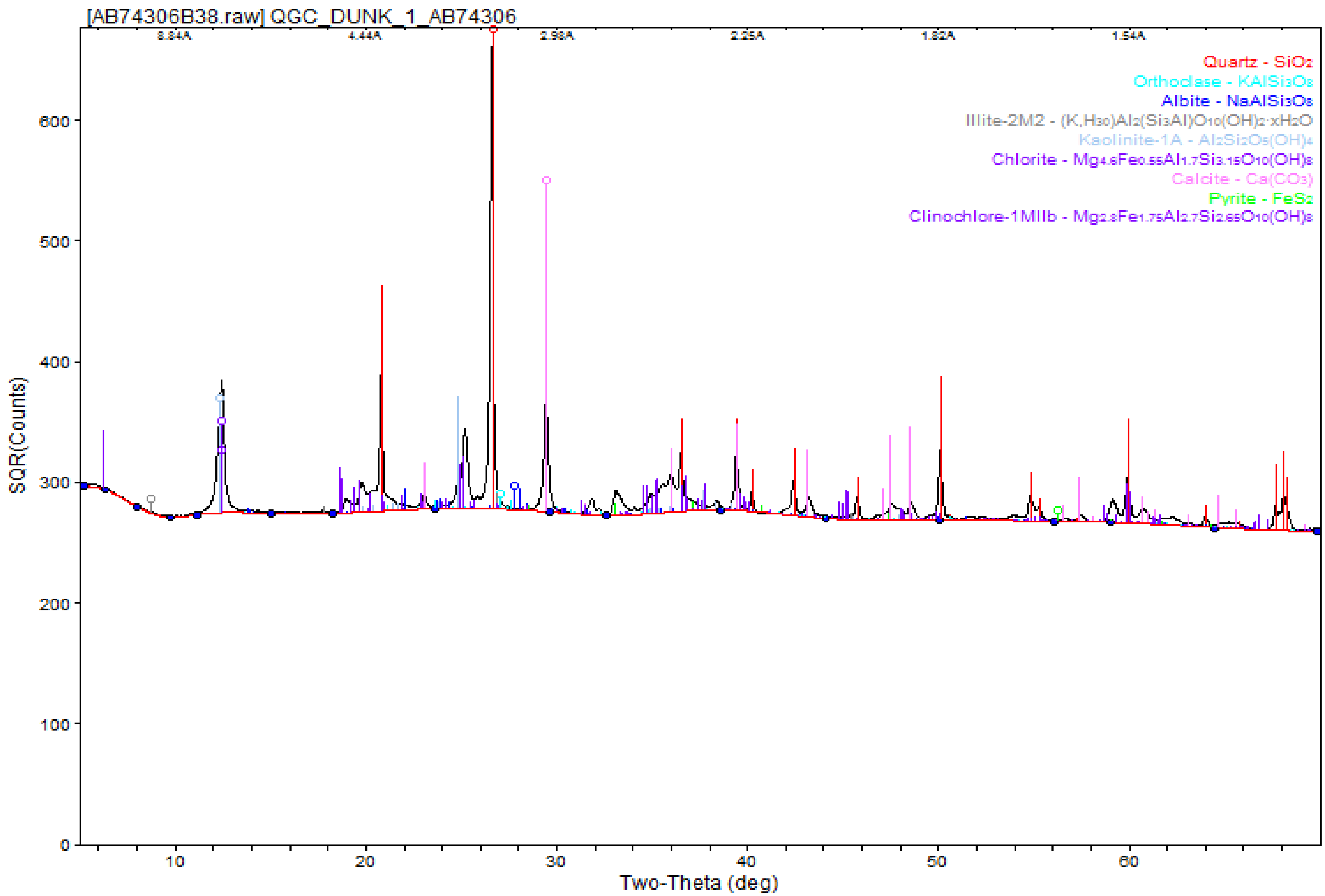

Weatherford Labs




Weatherford Labs



Weatherford Labs

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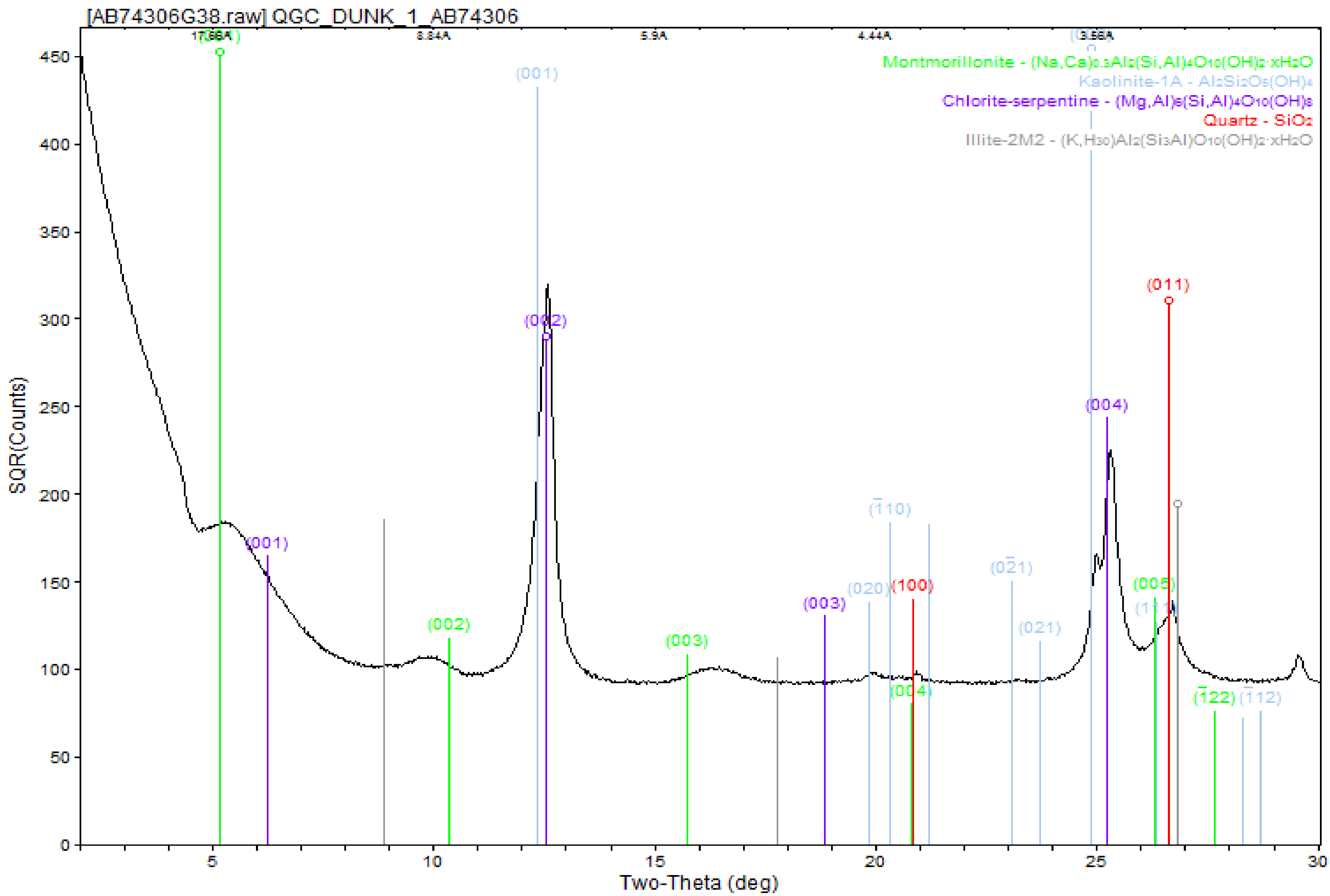

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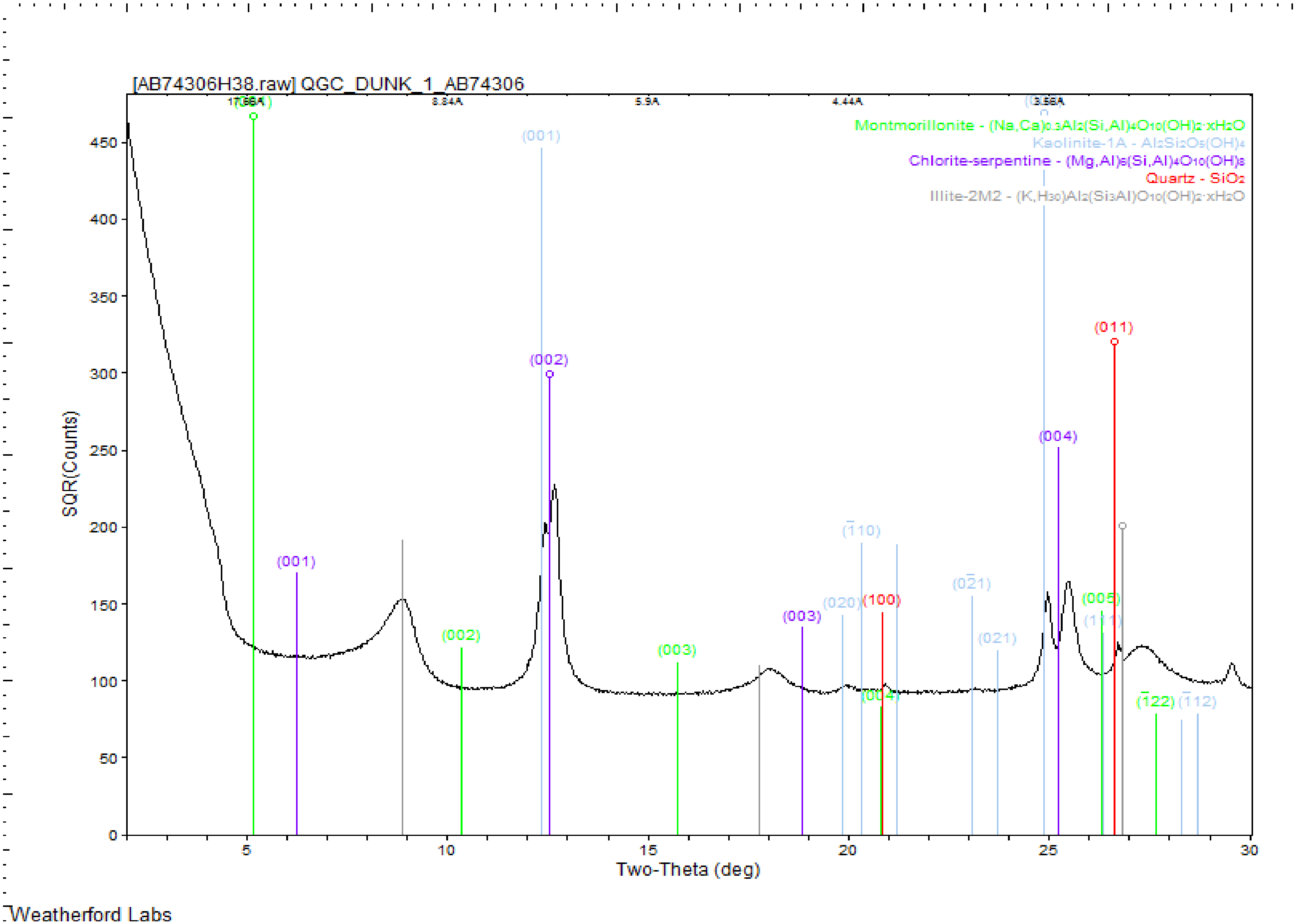


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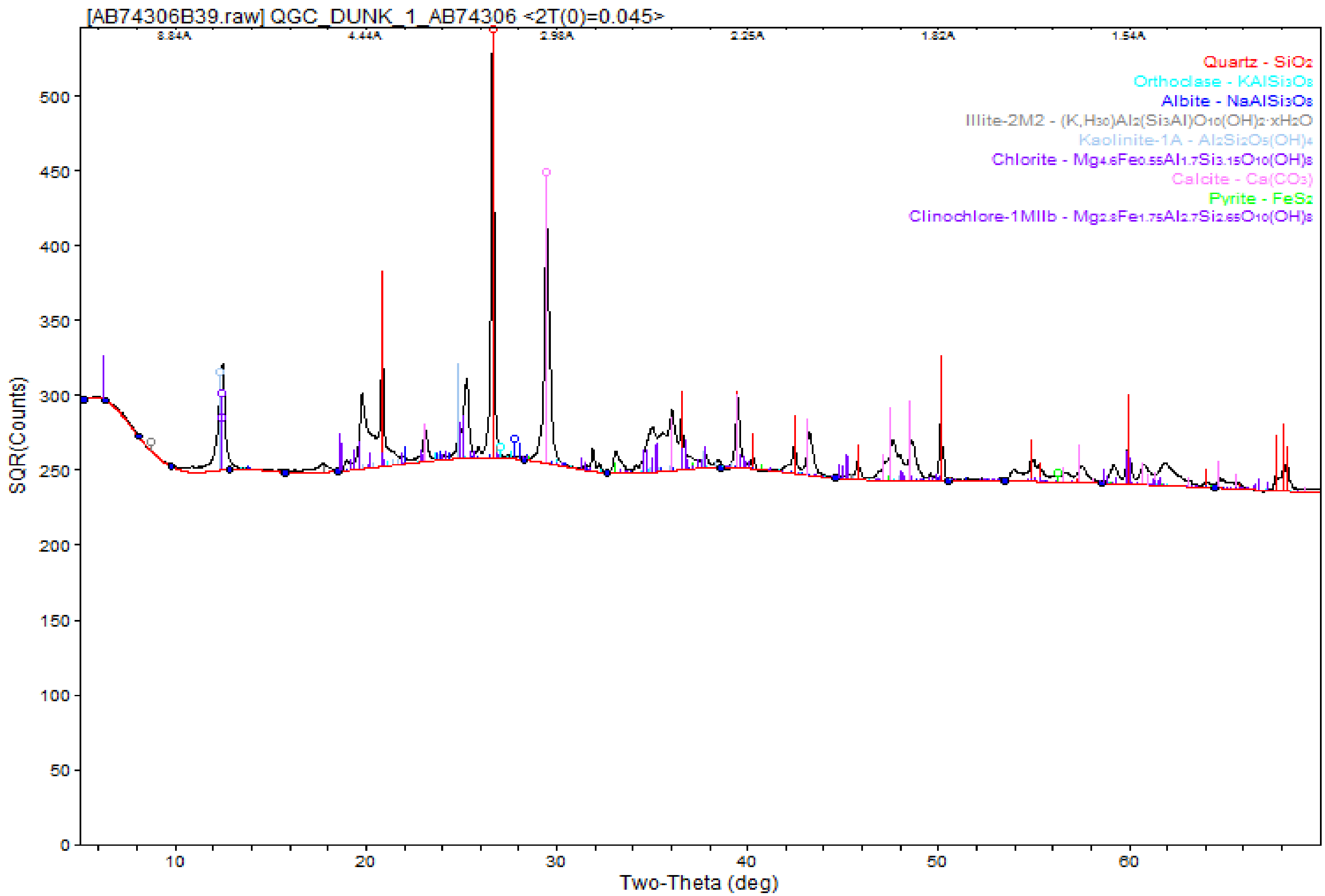


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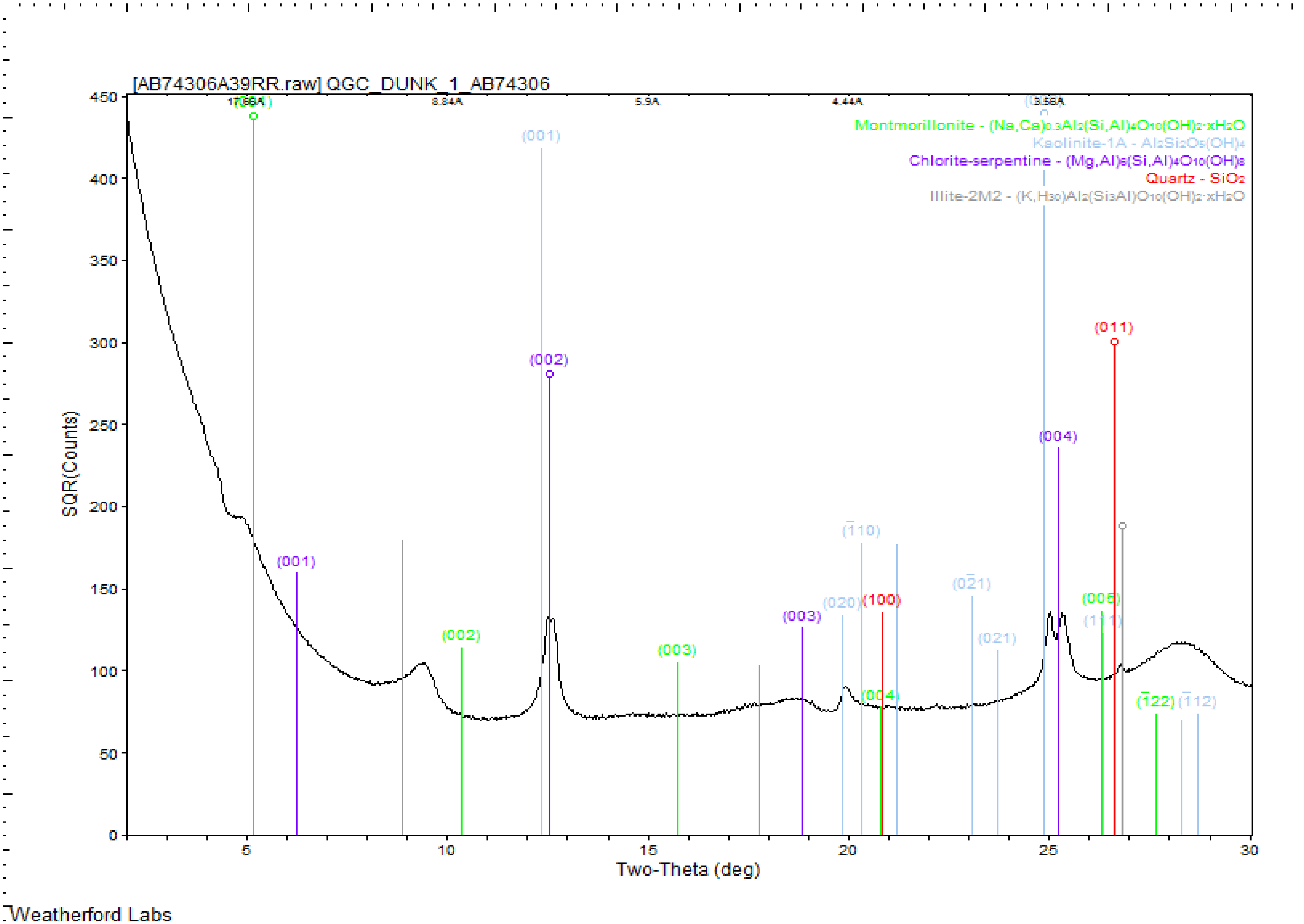
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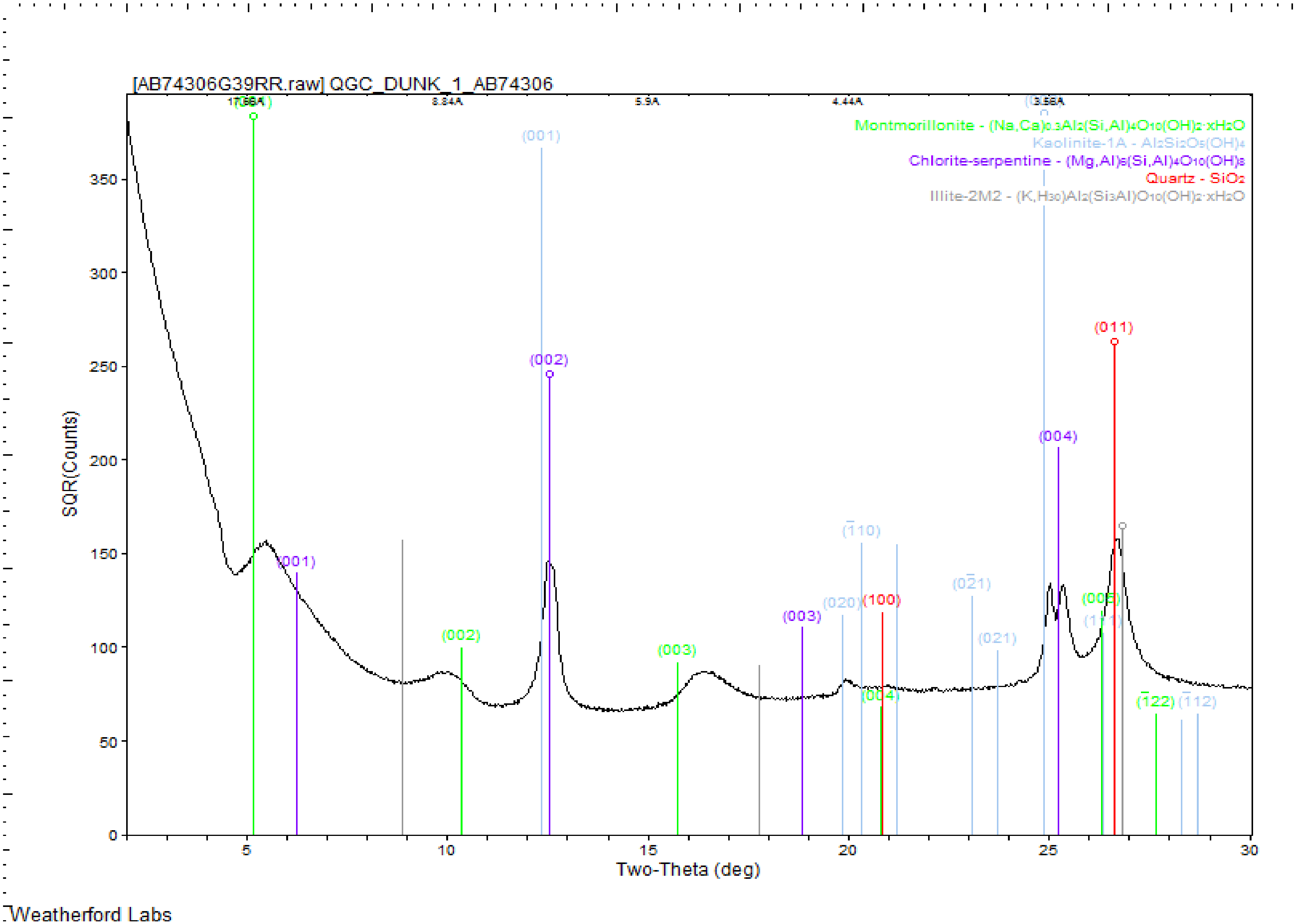
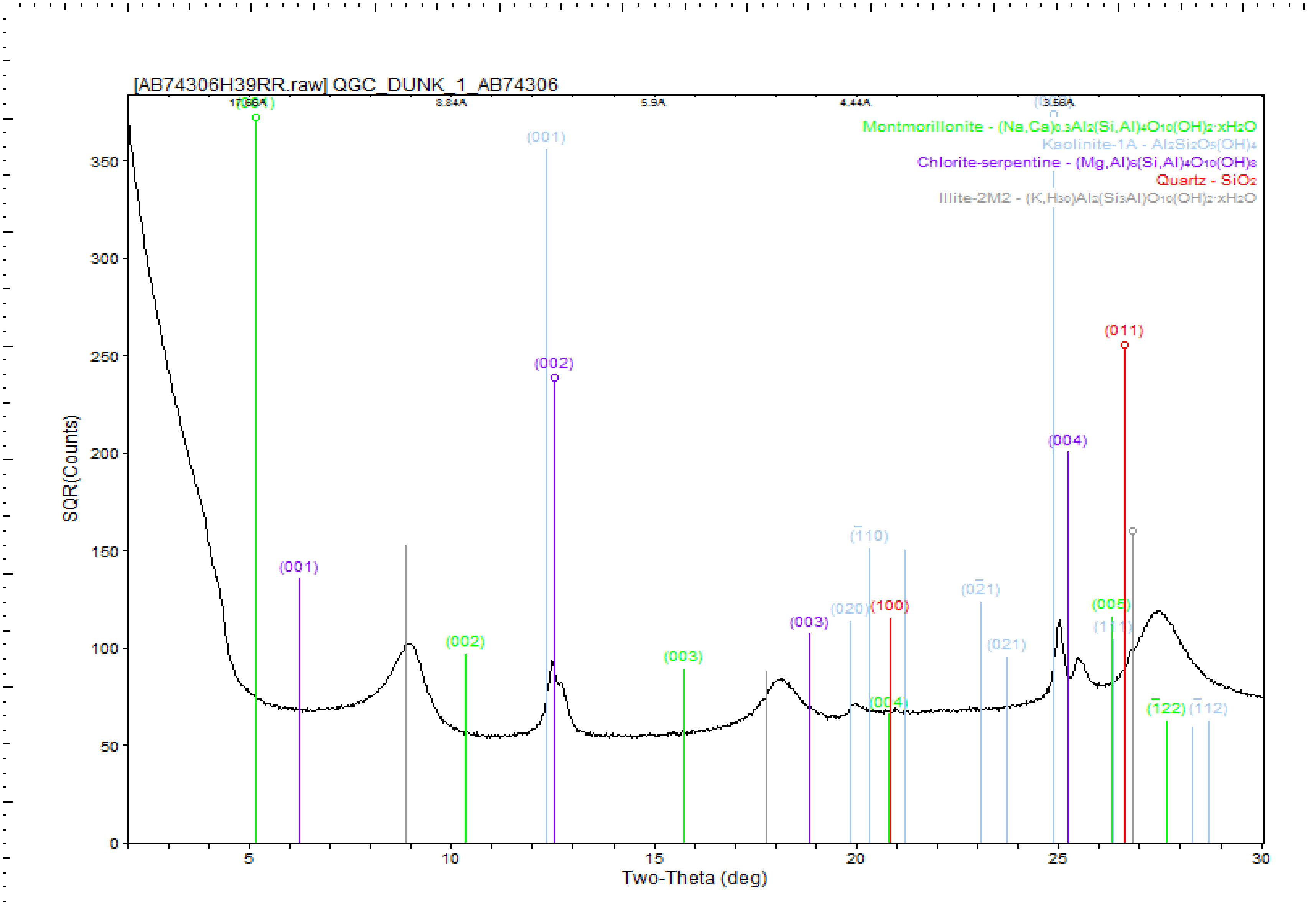
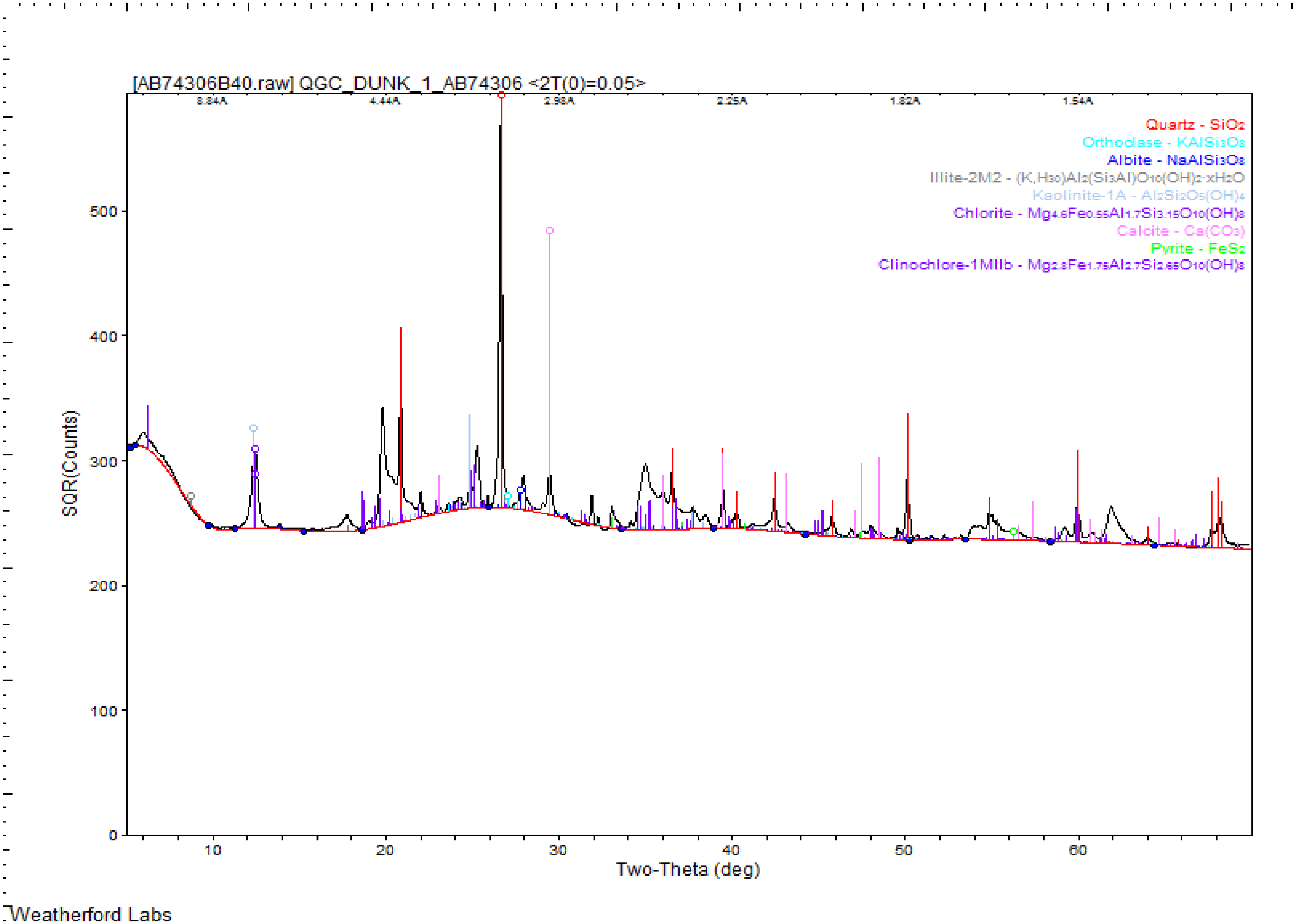
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs


[AB74306G39RR.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs




Weatherford Labs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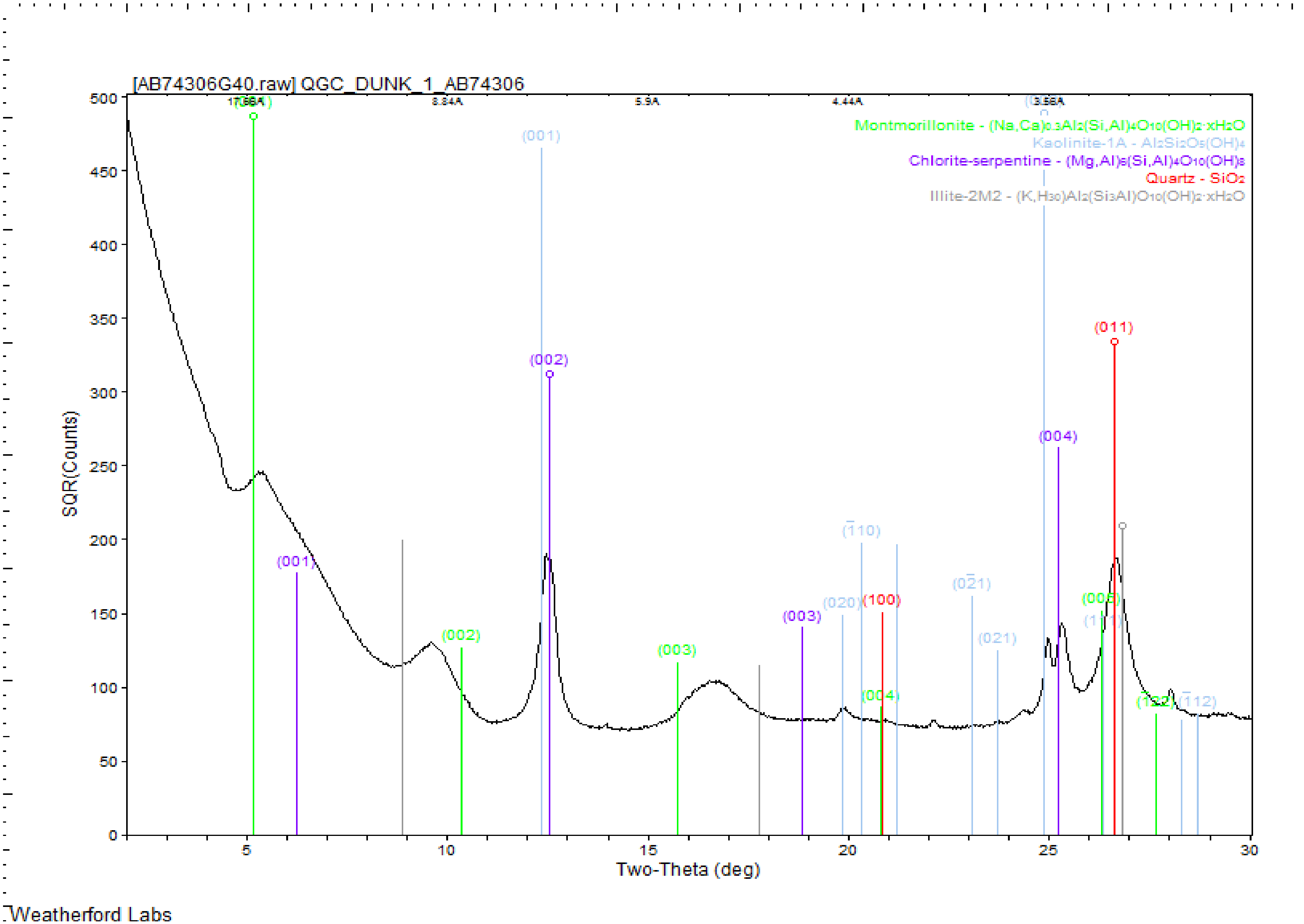
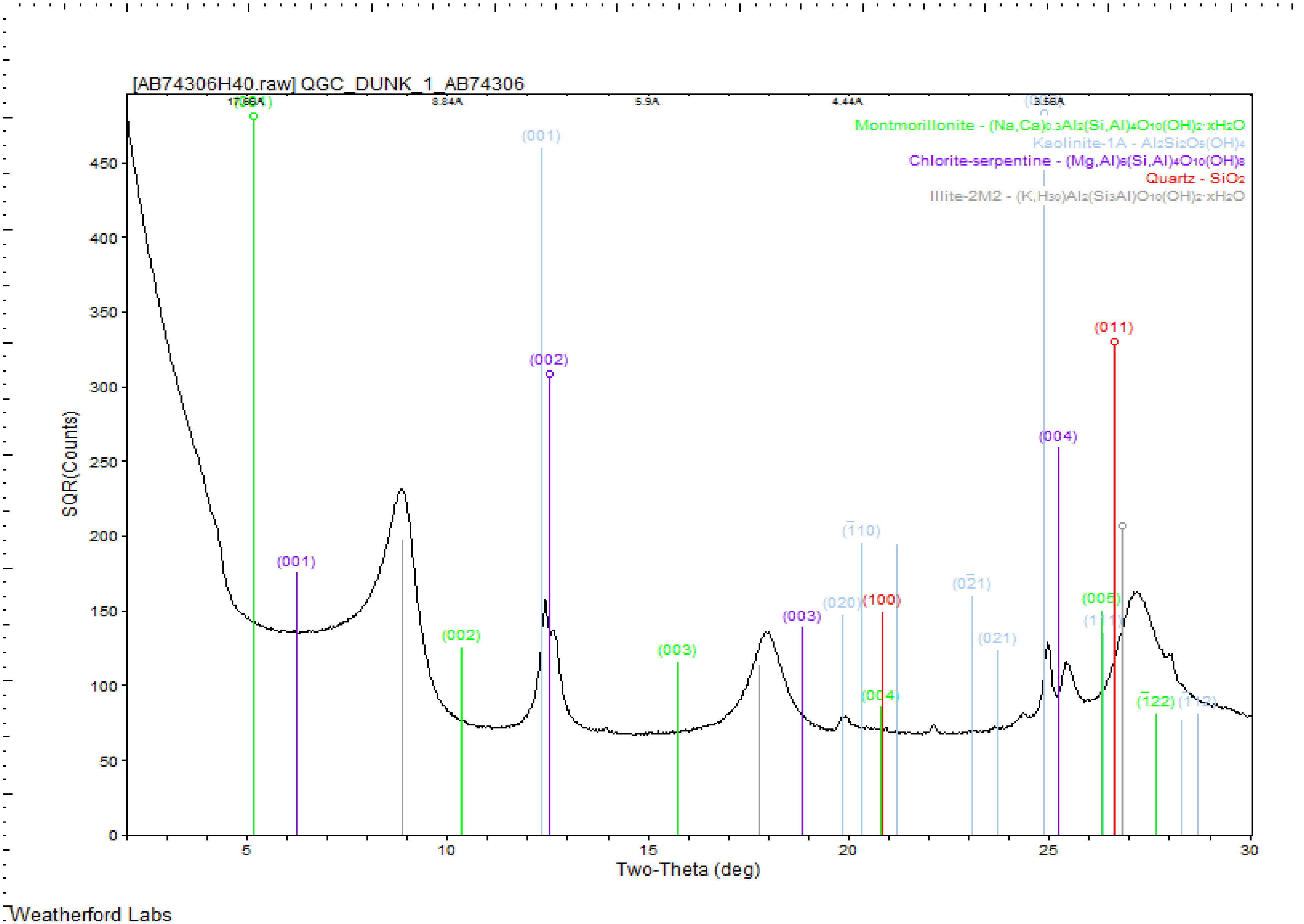
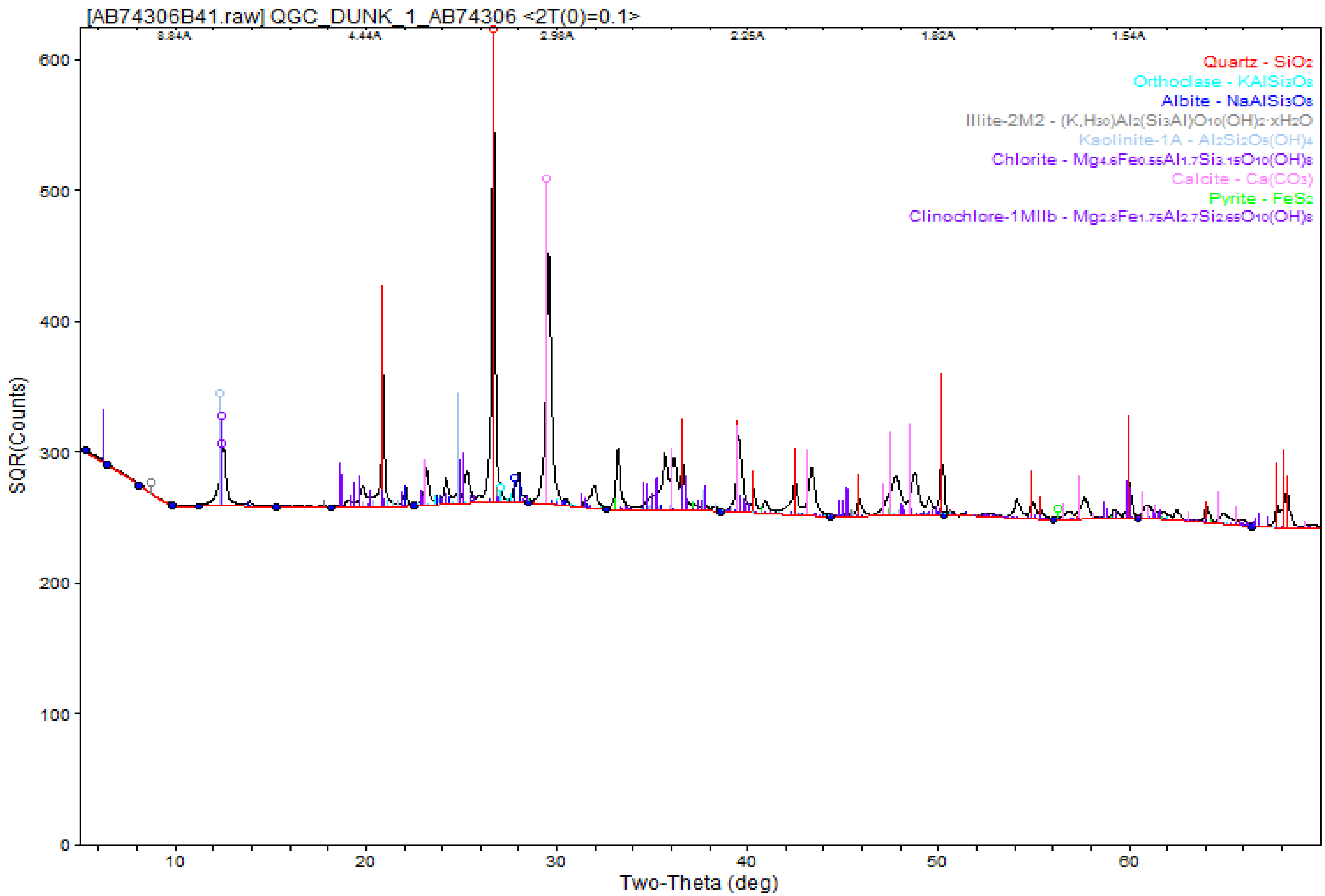
8.84A
4.44A
2.98A
2.25A
1.82A
1.54A
Quartz - SiO2
Orthoclase - KAlSi3O8
Albite - NaAlSi3O8
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite - Mg4.6Fe0.55Al1.7Si3.15O10(OH)8
Calcite - Ca(CO3)
Pyrite - FeS2
Clinochlore-1MIIb - Mg2.8Fe1.75Al2.7Si2.65O10(OH)8
SQR(Counts)
500
400
300
200
100
0
10
20
30
40
50
60
Two-Theta (deg)
Weatherford Labs



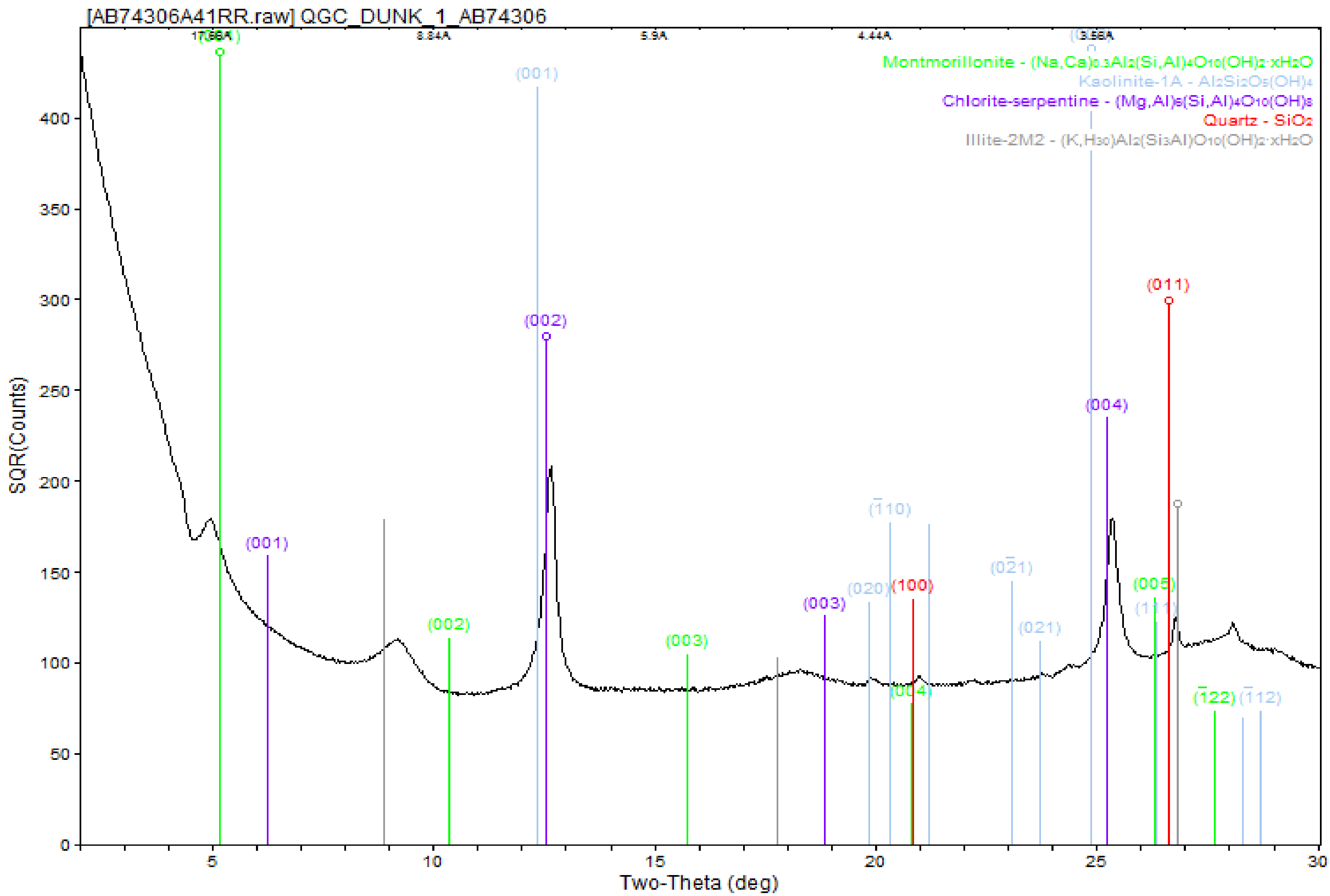
[AB74306G40.raw] QGC_DUNK_1_AB74306
Montmorillonite - (Na,Ca)0.3Al2(Si,Al)4O10(OH)2·xH2O
Kaolinite-1A - Al2Si2O5(OH)4
Chlorite-serpentine - (Mg,Al)6(Si,Al)4O10(OH)8
Quartz - SiO2
Illite-2M2 - (K,H3O)Al2(Si3Al)O10(OH)2·xH2O
SQR(Counts)
Two-Theta (deg)
Weatherford Labs



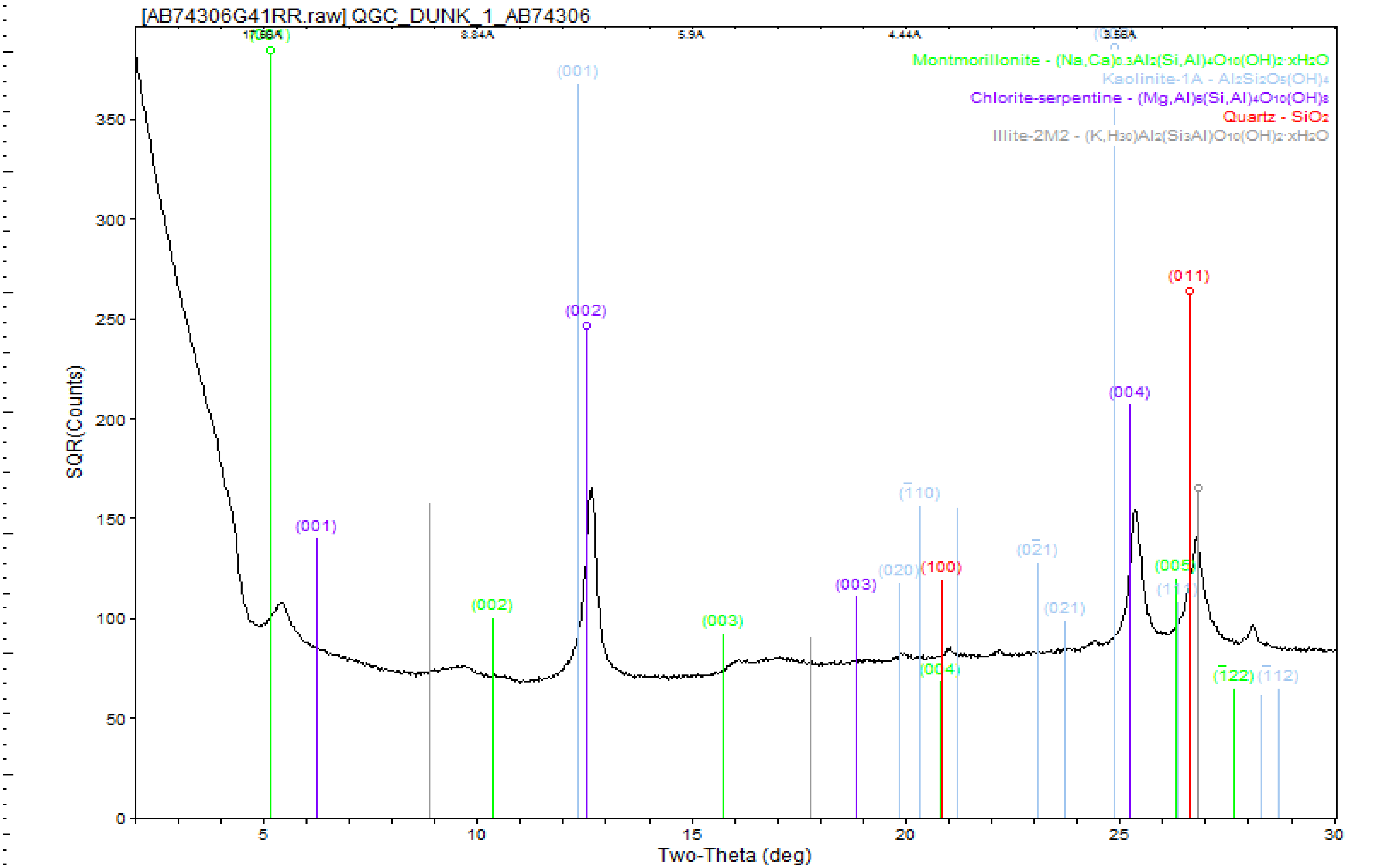

Weatherford Labs



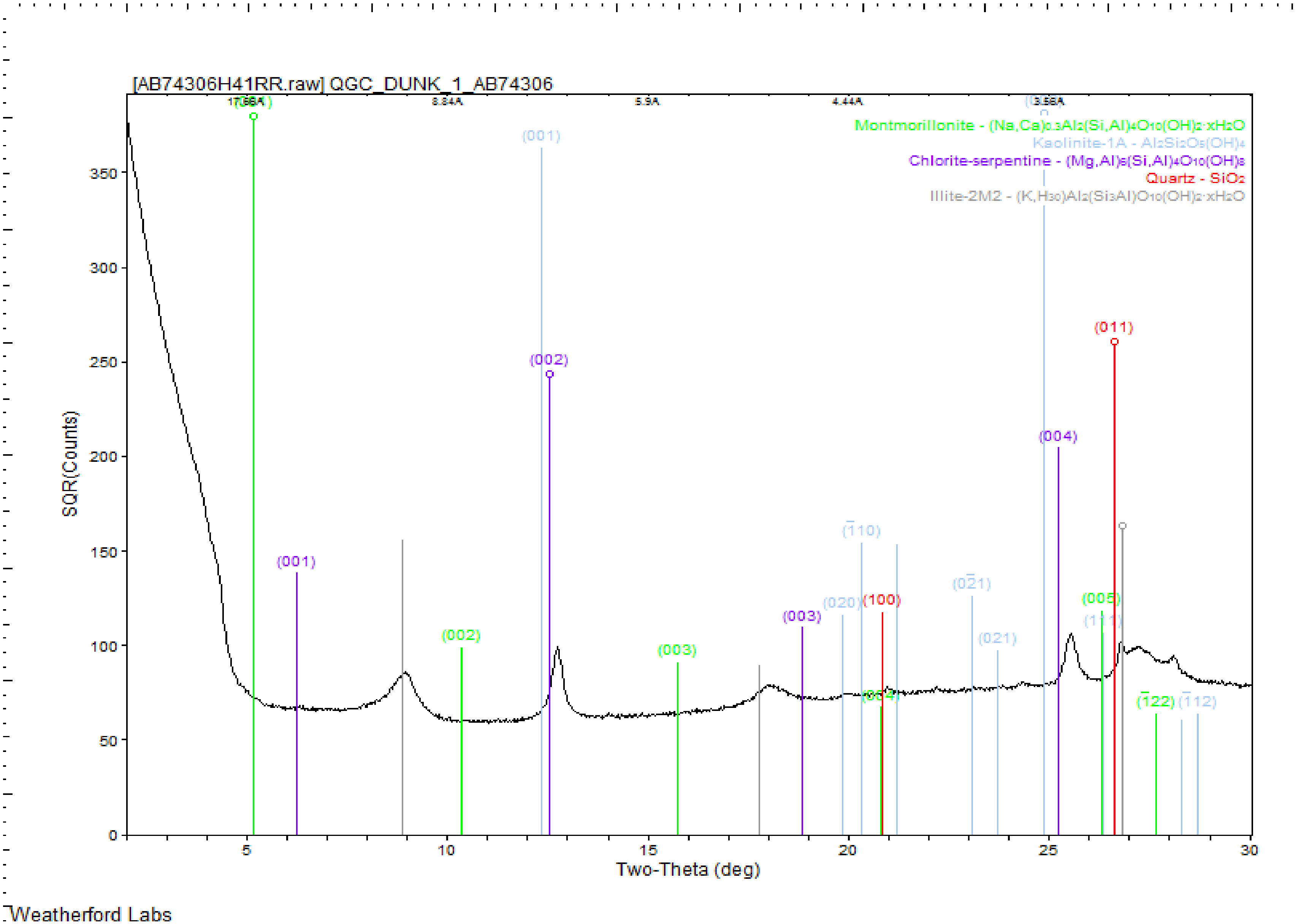

Weatherford Labs



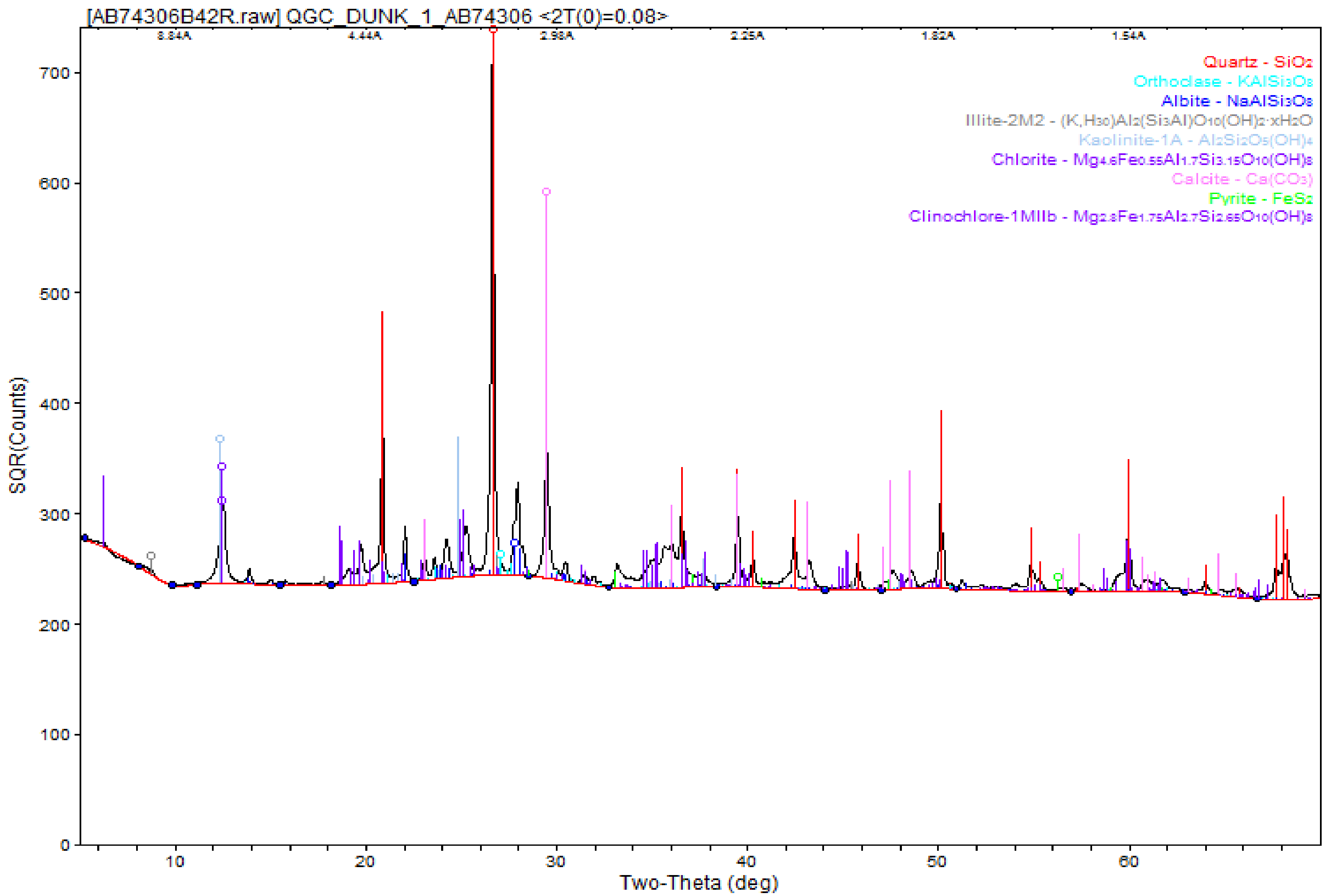
Weatherford Labs




Weatherford Labs




Weatherford Labs

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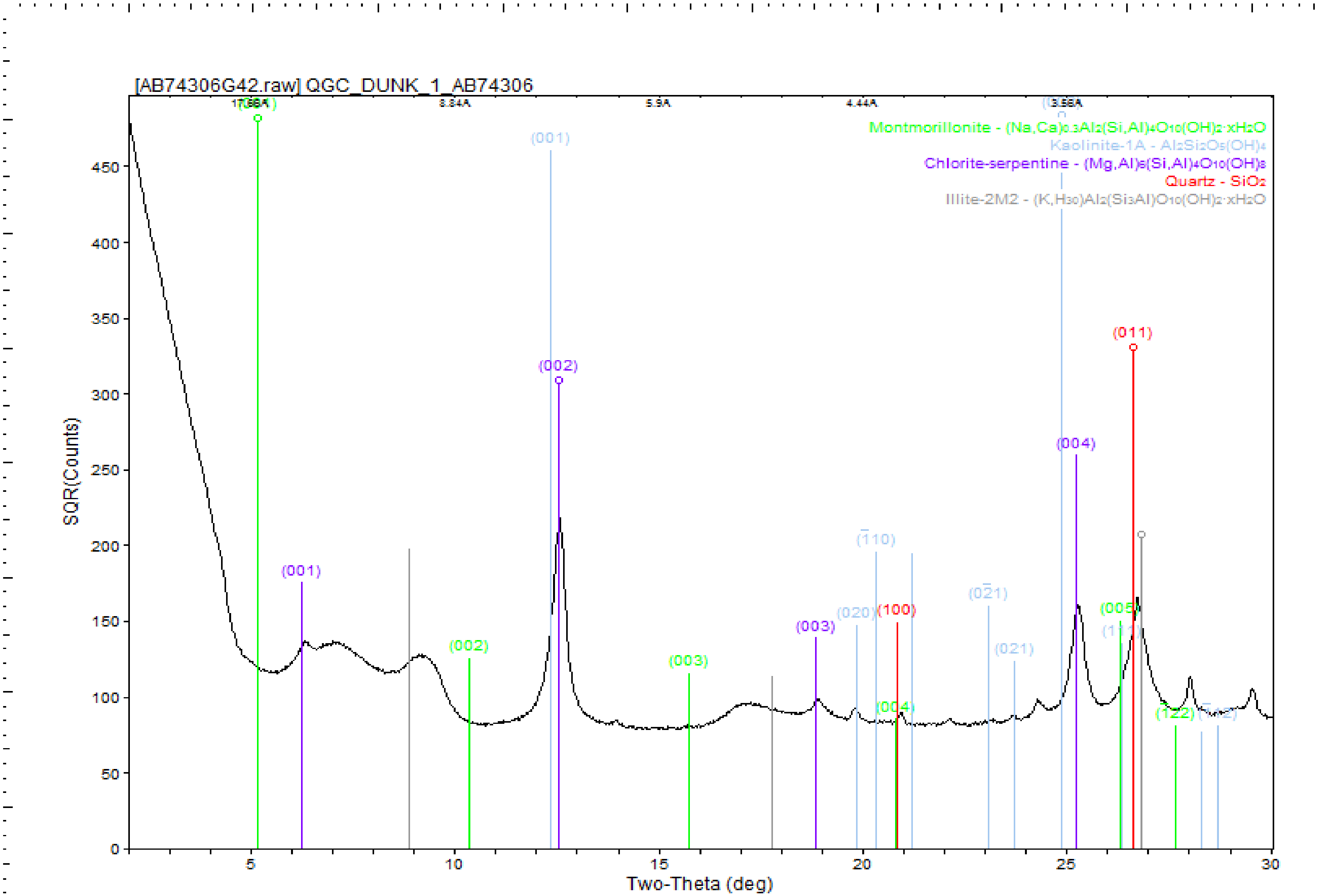


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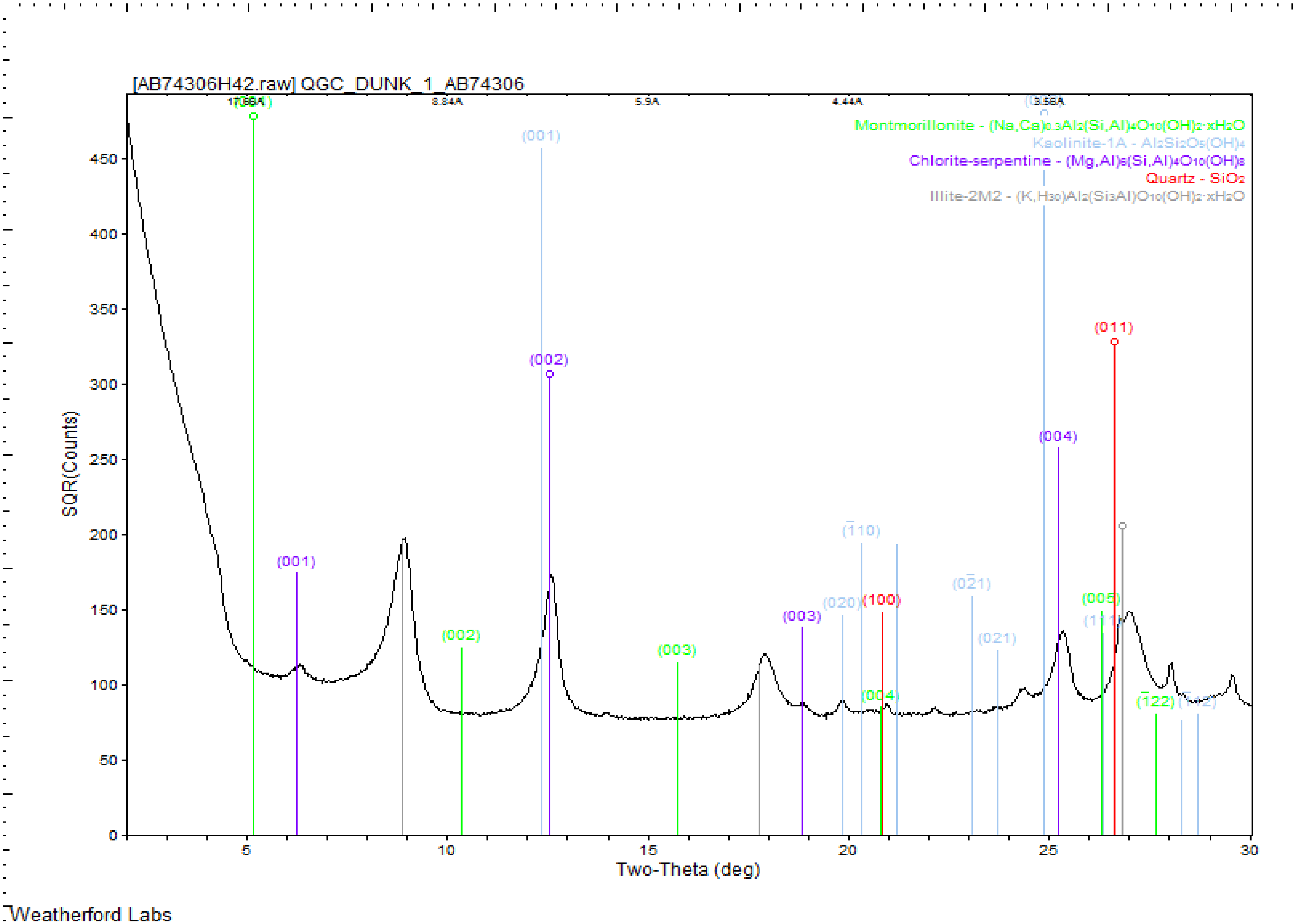


Weatherford Labs

# APPENDIX C

# THIN SECTION MODAL ANALYSIS AND PHOTOMICROGRAPHS WITH DESCRIPTIONS

**THIN SECTION MODAL ANALYSIS**

**QGC - A BG Group Business**
**Dunk 1**
**Surat Basin**
**Queensland, Australia**
**Weatherford Labs File No.: AB-74306**
**Sample Type: Rotary Sidewall / Analyst: A. Schwartz**

| DEPTH: (Meters) | 2813.00 | 2912.30 | 2920.70 | 2931.50 |
|---|---|---|---|---|
| SAMPLE NUMBER: | 43 SWC | 34 SWC | 33 SWC | 32 SWC |
| Formation: | Black Alley Shale | Upper Tinowon Ss | Upper Tinowon Ss | Upper Tinowon Ss |
| Grain Size Avg. (mm): | | 0.46 | 0.42 | 0.53 |
| Grain Size Range (mm): | | 0.02-2.43 | <0.01-1.56 | <0.01-1.63 |
| Sorting: | | Moderate | Moderate | Moderate |
| Fabric: | | Massive | Massive | Massive |
| Rock Name (Folk): | | Felds. Litharenite | Felds. Litharenite | Felds. Litharenite |
| ***FRAMEWORK GRAINS*** | | | | |
| ***Quartz*** | | **27.75** | **21.50** | **28.00** |
| Monocrystalline | | 26.00 | 20.50 | 26.25 |
| Polycrystalline | | 1.75 | 1.00 | 1.75 |
| Meta-Quartzite | | 0.00 | 0.00 | 0.00 |
| ***Feldspar*** | | **23.75** | **25.25** | **21.50** |
| K-Feldspar | | 2.25 | 1.50 | 4.25 |
| Plagioclase | | 21.50 | 23.75 | 17.25 |
| ***Lithic Fragments*** | | **18.00** | **19.50** | **15.75** |
| Plutonic-Granitic | | 0.00 | 0.00 | 0.00 |
| Volcanic-Tuff/Glass | | 4.50 | 3.25 | 4.50 |
| Volcanic-Felsic | | 0.25 | 0.00 | 0.25 |
| Volcanic-Interm./Mafic | | 3.00 | 4.50 | 2.25 |
| Metamorphic-Schist | | 0.00 | 0.00 | tr |
| Metamorphic-Phyllite/Slate | | 0.00 | 0.00 | 0.00 |
| Chert | | 7.75 | 8.75 | 7.25 |
| Mudstone | | 1.50 | 1.50 | 0.50 |
| Carbonate | | 0.00 | 0.00 | 0.00 |
| Siltstone/Sandstone | | 1.00 | 1.50 | 1.00 |
| Conglomerate | | 0.00 | 0.00 | 0.00 |
| ***Accessory Grains*** | | **tr** | **0.75** | **1.00** |
| Muscovite | | tr | 0.75 | 1.00 |
| Biotite | | 0.00 | 0.00 | 0.00 |
| Heavy Minerals* | | tr | tr | tr |
| ***ENVIRON. INDICATORS*** | | **0.00** | **0.00** | **0.00** |
| Plant Fragments/Organics | | 0.00 | 0.00 | 0.00 |
| Glauconite | | 0.00 | 0.00 | 0.00 |
| Chamosite | | 0.00 | 0.00 | 0.00 |
| Fossil Fragments | | 0.00 | 0.00 | 0.00 |
| Phosphatic Grains | | 0.00 | 0.00 | 0.00 |
| ***DETRITAL MATRIX*** | | **1.75** | **2.00** | **1.75** |
| Clay Matrix-Laminar | | 0.00 | 0.00 | 0.00 |
| Clay Matrix-Pore filling | | 0.00 | 0.00 | 0.00 |
| Clay Matrix-Pore lining | | 0.00 | tr | 0.25 |
| Volcanic | | 1.75 | 2.00 | 1.50 |
| ***AUTHIGENIC CEMENTS*** | Sample not suitable for point count analysis; general thin section description performed instead | **13.75** | **13.00** | **11.50** |
| Illite, I/S-Pore lining | | 1.75 | 1.50 | 0.50 |
| Illite, I/S-Pore filling | | 3.50 | 4.75 | 2.75 |
| Chlorite-Pore lining | | 0.50 | 0.25 | 0.50 |
| Chlorite-Pore filling | | 0.00 | 0.75 | 0.00 |
| Kaolinite | | tr | 0.50 | 1.25 |
| Quartz Overgrowths | | 1.50 | 2.25 | 2.75 |
| Feldspar Overgrowths | | 0.50 | 1.00 | 0.50 |
| Microquartz/Opal-CT** | | tr | 0.25 | 0.50 |
| Calcite | | 6.00 | 1.75 | 2.75 |
| Fe-Calcite | | 0.00 | tr | tr |
| Dolomite | | 0.00 | 0.00 | 0.00 |
| Ankerite | | 0.00 | tr | 0.00 |
| Siderite | | 0.00 | 0.00 | 0.00 |
| Pyrite | | tr | tr | tr |
| Ti-Oxides | | 0.00 | tr | 0.00 |
| Fe-Oxides | | 0.00 | 0.00 | 0.00 |
| Hydrocarbon | | 0.00 | 0.00 | 0.00 |
| ***REPLACEMENTS*** | | **8.75** | **7.00** | **8.25** |
| Illite, I/S, Sericite | | 0.50 | 1.00 | 1.50 |
| Chlorite | | 1.00 | 0.00 | 0.75 |
| Kaolinite | | 0.25 | 0.25 | 0.50 |
| Quartz | | 0.25 | tr | tr |
| Feldspar | | 1.00 | 1.00 | 1.75 |
| Microquartz | | 0.00 | 0.00 | 0.25 |
| Calcite | | 4.25 | 2.75 | 2.25 |
| Fe-Calcite | | 0.00 | tr | 0.25 |
| Dolomite | | 0.00 | 0.25 | 0.00 |
| Ankerite | | 0.50 | 0.25 | 0.00 |
| Siderite | | 1.00 | 0.75 | 0.75 |
| Pyrite | | tr | 0.50 | tr |
| Ti-Oxides | | 0.00 | 0.25 | 0.25 |
| Fe-Oxides | | 0.00 | 0.00 | 0.00 |
| Apatite | | 0.00 | 0.00 | 0.00 |
| Hydrocarbon | | 0.00 | 0.00 | tr |
| ***POROSITY*** | | **6.25** | **11.00** | **12.25** |
| Intergranular | | 0.25 | tr | 0.25 |
| Intragranular/Moldic | | 3.25 | 6.75 | 8.75 |
| Microscopic | | 2.75 | 4.00 | 3.25 |
| Transgranular/Grain Fracture | | 0.00 | 0.25 | 0.00 |
| **TOTAL:** | | **100.00** | **100.00** | **100.00** |

* Apatite, Garnet, Epidote, Metamorphic Chlorite, Pyroxene, Rutile, Sphene, Tourmaline, and Zircon

**THIN SECTION MODAL ANALYSIS**

**QGC - A BG Group Business**
**Dunk 1**
**Surat Basin**
**Queensland, Australia**
**Weatherford Labs File No.: AB-74306**
**Sample Type: Rotary Sidewall / Analyst: A. Schwartz**

| DEPTH: (Meters) | 3005.00 | 3006.80 | 3007.90 | 3008.80 |
|---|---|---|---|---|
| SAMPLE NUMBER: | 21 SWC | 24 SWC | 23 SWC | 22 SWC |
| Formation: | Overston Ss | Overston Ss | Overston Ss | Overston Ss |
| Grain Size Avg. (mm): | 0.71 | 1.08 | 0.39 | 0.74 |
| Grain Size Range (mm): | 0.05-8.74 | <0.01-4.79 | <0.01-1.94 | <0.01-7.94 |
| Sorting: | Very Poor | Moderate-Poor | Moderate-Poor | Poor |
| Fabric: | Massive | Mass.; Stylolites | Mass.; Burrowed | Mass.; Stylolites |
| Rock Name (Folk): | Sublitharenite | Sublitharenite | Felds. Litharenite | Felds. Litharenite |
| ***FRAMEWORK GRAINS*** | | | | |
| ***Quartz*** | **63.50** | **55.50** | **48.00** | **49.50** |
| Monocrystalline | 34.75 | 40.75 | 41.75 | 40.75 |
| Polycrystalline | 19.75 | 14.75 | 6.25 | 7.75 |
| Meta-Quartzite | 9.00 | 0.00 | 0.00 | 1.00 |
| ***Feldspar*** | **2.75** | **5.50** | **8.75** | **6.50** |
| K-Feldspar | tr | tr | 1.00 | 0.50 |
| Plagioclase | 2.75 | 5.50 | 7.75 | 6.00 |
| ***Lithic Fragments*** | **12.00** | **9.25** | **11.00** | **17.75** |
| Plutonic-Granitic | 0.00 | 0.00 | 0.00 | 0.00 |
| Volcanic-Tuff/Glass | 3.50 | 1.75 | 0.75 | 3.25 |
| Volcanic-Felsic | 0.25 | 0.00 | 0.00 | 0.00 |
| Volcanic-Interm./Mafic | 1.00 | 1.25 | 1.00 | 1.25 |
| Metamorphic-Schist | 0.00 | 0.00 | 0.00 | 0.50 |
| Metamorphic-Phyllite/Slate | 0.00 | 0.00 | 0.00 | 0.00 |
| Chert | 6.00 | 4.25 | 6.75 | 4.75 |
| Mudstone | 1.25 | 1.75 | 1.75 | 1.75 |
| Carbonate | 0.00 | 0.00 | 0.00 | 0.00 |
| Siltstone/Sandstone | tr | 0.25 | 0.75 | 6.25 |
| Conglomerate | 0.00 | 0.00 | 0.00 | 0.00 |
| ***Accessory Grains*** | **0.25** | **0.25** | **3.00** | **1.75** |
| Muscovite | 0.25 | 0.25 | 1.75 | 1.50 |
| Biotite | 0.00 | tr | 0.75 | tr |
| Heavy Minerals* | tr | 0.00 | 0.50 | 0.25 |
| ***ENVIRON. INDICATORS*** | **0.00** | **0.25** | **tr** | **0.25** |
| Plant Fragments/Organics | 0.00 | 0.25 | tr | 0.25 |
| Glauconite | 0.00 | 0.00 | 0.00 | 0.00 |
| Chamosite | 0.00 | 0.00 | 0.00 | 0.00 |
| Fossil Fragments | 0.00 | 0.00 | 0.00 | 0.00 |
| Phosphatic Grains | 0.00 | 0.00 | 0.00 | 0.00 |
| ***DETRITAL MATRIX*** | **0.00** | **4.25** | **0.75** | **1.25** |
| Clay Matrix-Laminar | 0.00 | 4.00 | tr | 0.50 |
| Clay Matrix-Pore filling | 0.00 | 0.00 | 0.75 | 0.00 |
| Clay Matrix-Pore lining | 0.00 | 0.25 | tr | 0.75 |
| Volcanic | 0.00 | 0.00 | 0.00 | 0.00 |
| ***AUTHIGENIC CEMENTS*** | **8.50** | **5.00** | **12.75** | **8.25** |
| Illite, I/S-Pore lining | tr | 0.50 | 1.25 | 1.00 |
| Illite, I/S-Pore filling | 1.25 | 2.25 | 1.25 | 1.00 |
| Chlorite-Pore lining | 0.00 | tr | tr | 0.00 |
| Chlorite-Pore filling | 0.50 | tr | 0.00 | 0.00 |
| Kaolinite | tr | tr | tr | tr |
| Quartz Overgrowths | 6.75 | 1.75 | 9.25 | 5.25 |
| Feldspar Overgrowths | tr | tr | 0.25 | tr |
| Microquartz/Opal-CT** | 0.00 | tr | 0.00 | 0.75 |
| Calcite | 0.00 | 0.50 | tr | 0.00 |
| Fe-Calcite | 0.00 | 0.00 | 0.00 | 0.00 |
| Dolomite | 0.00 | 0.00 | 0.00 | 0.00 |
| Ankerite | 0.00 | tr | 0.00 | 0.00 |
| Siderite | 0.00 | 0.00 | 0.00 | 0.00 |
| Pyrite | tr | tr | 0.50 | 0.25 |
| Ti-Oxides | 0.00 | 0.00 | 0.00 | 0.00 |
| Fe-Oxides | 0.00 | 0.00 | 0.00 | 0.00 |
| Hydrocarbon | 0.00 | 0.00 | 0.25 | 0.00 |
| ***REPLACEMENTS*** | **4.75** | **11.25** | **6.00** | **5.25** |
| Illite, I/S, Sericite | 2.75 | 2.25 | 3.00 | 3.00 |
| Chlorite | 0.50 | tr | tr | 0.00 |
| Kaolinite | 0.50 | tr | 0.50 | tr |
| Quartz | tr | tr | 0.75 | 0.25 |
| Feldspar | 0.25 | tr | tr | tr |
| Microquartz | tr | 0.50 | 0.00 | 0.50 |
| Calcite | 0.00 | 6.00 | 1.00 | 1.00 |
| Fe-Calcite | 0.00 | 0.00 | 0.00 | 0.00 |
| Dolomite | 0.00 | 0.00 | 0.00 | 0.00 |
| Ankerite | 0.25 | 2.00 | 0.25 | 0.25 |
| Siderite | 0.00 | 0.00 | 0.00 | 0.00 |
| Pyrite | 0.50 | 0.50 | tr | 0.25 |
| Ti-Oxides | 0.00 | tr | 0.00 | 0.00 |
| Fe-Oxides | 0.00 | 0.00 | 0.25 | 0.00 |
| Apatite | 0.00 | 0.00 | 0.00 | 0.00 |
| Hydrocarbon | tr | tr | 0.25 | 0.00 |
| ***POROSITY*** | **8.25** | **8.75** | **9.75** | **9.50** |
| Intergranular | tr | 0.50 | 0.25 | 1.50 |
| Intragranular/Moldic | 5.75 | 5.50 | 7.00 | 6.00 |
| Microscopic | 2.25 | 2.75 | 2.50 | 2.00 |
| Transgranular/Grain Fracture | 0.25 | tr | tr | 0.00 |
| **TOTAL:** | **100.00** | **100.00** | **100.00** | **100.00** |

* Apatite, Garnet, Epidote, Metamorphic Chlorite, Pyroxene, Rutile, Sphene, Tourmaline, and Zircon

THIN SECTION MODAL ANALYSIS

**QGC - A BG Group Business**
**Dunk 1**
**Surat Basin**
**Queensland, Australia**
**Weatherford Labs File No.: AB-74306**
**Sample Type: Rotary Sidewall / Analyst: A. Schwartz**

| DEPTH: (Meters) | 3061.00 | 3075.00 | 3076.47 | 3081.43 |
|---|---|---|---|---|
| SAMPLE NUMBER: | 12 SWC | 11 SWC | 10 SWC | 9 SWC |
| Formation: | Lorelle Ss | Lorelle Ss | Lorelle Ss | Lorelle Ss |
| Grain Size Avg. (mm): | 0.39 | 0.71 | 0.53 | 2.36 |
| Grain Size Range (mm): | <0.01-3.42 | <0.01-8.70 | <0.01-3.31 | 0.02-4.18 |
| Sorting: | Moderate | Poor | Moderate | Moderate |
| Fabric: | Mass.; Stylolites | Lam. to Mass. | Massive | Massive |
| Rock Name (Folk): | Sublith./Litharenite | Litharenite | Sublitharenite | Quartzarenite |
| | | | | |
| ***FRAMEWORK GRAINS*** | | | | |
| ***Quartz*** | **47.75** | **46.50** | **50.50** | **61.25** |
| Monocrystalline | 37.75 | 34.00 | 45.25 | 6.00 |
| Polycrystalline | 9.50 | 12.50 | 4.50 | 55.25 |
| Meta-Quartzite | 0.50 | 0.00 | 0.75 | 0.00 |
| ***Feldspar*** | **3.75** | **0.25** | **0.25** | **0.00** |
| K-Feldspar | 1.25 | 0.25 | 0.25 | 0.00 |
| Plagioclase | 2.50 | tr | tr | 0.00 |
| ***Lithic Fragments*** | **12.25** | **20.75** | **13.25** | **0.25** |
| Plutonic-Granitic | 0.00 | 0.00 | 0.00 | 0.00 |
| Volcanic-Tuff/Glass | 1.75 | 4.50 | 3.25 | 0.00 |
| Volcanic-Felsic | 0.25 | 0.00 | 0.00 | 0.00 |
| Volcanic-Interm./Mafic | 0.75 | 0.00 | 0.75 | 0.00 |
| Metamorphic-Schist | 2.50 | 3.25 | 2.25 | 0.00 |
| Metamorphic-Phyllite/Slate | 0.25 | 0.25 | tr | 0.00 |
| Chert | 3.00 | 7.25 | 5.50 | 0.25 |
| Mudstone | 0.50 | 0.50 | 0.25 | 0.00 |
| Carbonate | 0.00 | 0.00 | 0.00 | 0.00 |
| Siltstone/Sandstone | 3.25 | 5.00 | 1.25 | 0.00 |
| Conglomerate | 0.00 | 0.00 | 0.00 | 0.00 |
| ***Accessory Grains*** | **2.00** | **2.50** | **2.00** | **0.50** |
| Muscovite | 2.00 | 2.25 | 1.75 | 0.50 |
| Biotite | 0.00 | 0.00 | tr | 0.00 |
| Heavy Minerals* | tr | 0.25 | 0.25 | tr |
| ***ENVIRON. INDICATORS*** | **1.75** | **0.50** | **tr** | **tr** |
| Plant Fragments/Organics | 1.75 | 0.50 | tr | tr |
| Glauconite | 0.00 | 0.00 | tr | 0.00 |
| Chamosite | 0.00 | 0.00 | tr | 0.00 |
| Fossil Fragments | 0.00 | 0.00 | 0.00 | 0.00 |
| Phosphatic Grains | 0.00 | 0.00 | 0.00 | 0.00 |
| ***DETRITAL MATRIX*** | **13.75** | **11.50** | **2.00** | **0.00** |
| Clay Matrix-Laminar | 0.50 | 4.50 | 0.00 | 0.00 |
| Clay Matrix-Pore filling | 1.50 | 2.00 | 0.00 | 0.00 |
| Clay Matrix-Pore lining | 11.75 | 0.50 | 0.50 | 0.00 |
| Volcanic | 0.00 | 4.50 | 1.50 | 0.00 |
| ***AUTHIGENIC CEMENTS*** | **4.75** | **7.25** | **16.50** | **6.50** |
| Illite, I/S-Pore lining | 1.00 | 5.50 | 1.25 | 0.50 |
| Illite, I/S-Pore filling | 0.25 | 0.25 | 2.00 | 4.50 |
| Chlorite-Pore lining | 0.00 | 0.00 | 0.00 | tr |
| Chlorite-Pore filling | 0.25 | 0.00 | 0.00 | 0.00 |
| Kaolinite | 0.00 | 0.00 | tr | 0.00 |
| Quartz Overgrowths | 1.50 | 1.00 | 10.75 | 1.50 |
| Feldspar Overgrowths | 0.00 | 0.00 | tr | 0.00 |
| Microquartz/Opal-CT** | tr | 0.50 | 0.75 | tr |
| Calcite | 0.00 | 0.00 | 1.75 | 0.00 |
| Fe-Calcite | 0.00 | 0.00 | 0.00 | 0.00 |
| Dolomite | 0.00 | 0.00 | 0.00 | 0.00 |
| Ankerite | 0.00 | 0.00 | 0.00 | 0.00 |
| Siderite | 0.25 | 0.00 | 0.00 | 0.00 |
| Pyrite | 1.50 | tr | tr | tr |
| Ti-Oxides | 0.00 | 0.00 | 0.00 | 0.00 |
| Fe-Oxides | 0.00 | 0.00 | 0.00 | 0.00 |
| Hydrocarbon | 0.00 | 0.00 | 0.00 | tr |
| ***REPLACEMENTS*** | **7.50** | **5.00** | **8.00** | **14.50** |
| Illite, I/S, Sericite | 2.25 | 1.50 | 2.25 | 12.25 |
| Chlorite | 0.25 | 0.50 | 0.00 | 1.75 |
| Kaolinite | 1.00 | 0.75 | 0.75 | tr |
| Quartz | tr | 0.25 | 2.00 | 0.25 |
| Feldspar | tr | 0.00 | 0.00 | 0.00 |
| Microquartz | 0.00 | 0.00 | 0.25 | 0.00 |
| Calcite | tr | 0.00 | 1.75 | 0.00 |
| Fe-Calcite | 0.75 | 0.00 | 0.00 | 0.00 |
| Dolomite | 0.00 | 0.00 | 0.25 | 0.00 |
| Ankerite | 0.25 | 0.50 | 0.25 | 0.00 |
| Siderite | 1.75 | 1.50 | 0.50 | tr |
| Pyrite | 1.00 | tr | tr | tr |
| Ti-Oxides | 0.25 | 0.00 | 0.00 | tr |
| Fe-Oxides | tr | 0.00 | 0.00 | 0.25 |
| Apatite | 0.00 | 0.00 | 0.00 | 0.00 |
| Hydrocarbon | 0.00 | 0.00 | 0.00 | 0.00 |
| ***POROSITY*** | **6.50** | **5.75** | **7.50** | **17.00** |
| Intergranular | 0.00 | tr | 0.50 | 1.00 |
| Intragranular/Moldic | 1.50 | 2.00 | 5.00 | 7.75 |
| Microscopic | 5.00 | 3.75 | 2.00 | 8.25 |
| Transgranular/Grain Fracture | 0.00 | tr | 0.00 | tr |
| **TOTAL:** | **100.00** | **100.00** | **100.00** | **100.00** |

* Apatite, Garnet, Epidote, Metamorphic Chlorite, Pyroxene, Rutile, Sphene, Tourmaline, and Zircon

**THIN SECTION MODAL ANALYSIS**

**QGC - A BG Group Business**
**Dunk 1**
**Surat Basin**
**Queensland, Australia**
**Weatherford Labs File No.: AB-74306**
**Sample Type: Rotary Sidewall / Analyst: A. Schwartz**

| DEPTH: (Meters) | 3083.00 | 3085.33 | 3093.00 | 3112.78 |
|---|---|---|---|---|
| SAMPLE NUMBER: | 8 SWC | 7 SWC | 6 SWC | 5 SWC |
| Formation: | Lorelle Ss | Lorelle Ss | Lorelle Ss | Lorelle Ss |
| Grain Size Avg. (mm): | 0.34 | 3.58 | 0.39 | |
| Grain Size Range (mm): | <0.01-1.75 | <0.01-14.52 | <0.01-11.89 | |
| Sorting: | Moderate | Very Poor | Poor | |
| Fabric: | Mass.; Bioturbated | Mass.; Stylolites | Lam.; Disturb.; Stylol. | |
| Rock Name (Folk): | Sublitharenite | Litharenite | Litharenite | |
| | | | | |
| ***FRAMEWORK GRAINS*** | | | | |
| ***Quartz*** | 51.75 | 54.50 | 25.00 | |
| Monocrystalline | 45.75 | 26.25 | 21.25 | |
| Polycrystalline | 5.50 | 9.00 | 3.50 | |
| Meta-Quartzite | 0.50 | 19.25 | 0.25 | |
| ***Feldspar*** | 0.25 | 0.00 | 2.00 | |
| K-Feldspar | 0.25 | 0.00 | 1.50 | |
| Plagioclase | tr | 0.00 | 0.50 | |
| ***Lithic Fragments*** | 10.75 | 27.25 | 6.75 | |
| Plutonic-Granitic | 0.75 | 0.00 | 0.00 | |
| Volcanic-Tuff/Glass | 2.75 | 18.75 | 1.50 | |
| Volcanic-Felsic | 0.00 | 0.00 | 0.00 | |
| Volcanic-Interm./Mafic | 0.25 | 0.00 | 0.00 | |
| Metamorphic-Schist | 2.25 | 3.50 | 3.00 | |
| Metamorphic-Phyllite/Slate | 0.00 | 0.00 | 0.25 | |
| Chert | 3.50 | 2.25 | 1.00 | |
| Mudstone | 0.25 | 0.00 | 0.00 | |
| Carbonate | 0.00 | 0.00 | 0.00 | |
| Siltstone/Sandstone | 1.00 | 2.75 | 1.00 | |
| Conglomerate | 0.00 | 0.00 | 0.00 | |
| ***Accessory Grains*** | 1.25 | 1.00 | 0.25 | |
| Muscovite | 1.00 | 0.75 | 0.25 | |
| Biotite | 0.25 | 0.25 | 0.00 | |
| Heavy Minerals* | tr | tr | 0.00 | |
| ***ENVIRON. INDICATORS*** | 1.00 | 1.00 | 36.00 | |
| Plant Fragments/Organics | 0.75 | 1.00 | 3.25 | |
| Glauconite | 0.00 | 0.00 | 0.00 | |
| Chamosite | 0.00 | 0.00 | 0.00 | |
| Fossil Fragments | 0.25 | 0.00 | 32.75 | |
| Phosphatic Grains | 0.00 | 0.00 | 0.00 | |
| ***DETRITAL MATRIX*** | 2.25 | 3.25 | 4.50 | |
| Clay Matrix-Laminar | 0.00 | 2.25 | 4.00 | |
| Clay Matrix-Pore filling | 2.25 | 1.00 | 0.50 | |
| Clay Matrix-Pore lining | 0.00 | 0.00 | 0.00 | |
| Volcanic | 0.00 | 0.00 | 0.00 | |
| ***AUTHIGENIC CEMENTS*** | 12.75 | 4.75 | 8.00 | Sample not suitable for point count analysis; general thin section description performed instead |
| Illite, I/S-Pore lining | 1.00 | tr | tr | |
| Illite, I/S-Pore filling | 3.00 | 2.75 | 0.50 | |
| Chlorite-Pore lining | 0.00 | 0.00 | 0.00 | |
| Chlorite-Pore filling | 0.00 | 0.00 | 0.00 | |
| Kaolinite | tr | 0.00 | 0.00 | |
| Quartz Overgrowths | 8.50 | 2.00 | 0.25 | |
| Feldspar Overgrowths | 0.00 | 0.00 | 0.00 | |
| Microquartz/Opal-CT** | tr | 0.00 | 0.00 | |
| Calcite | 0.00 | 0.00 | 6.50 | |
| Fe-Calcite | 0.00 | 0.00 | 0.00 | |
| Dolomite | 0.00 | 0.00 | 0.00 | |
| Ankerite | tr | 0.00 | 0.00 | |
| Siderite | tr | 0.00 | 0.00 | |
| Pyrite | 0.25 | tr | 0.75 | |
| Ti-Oxides | 0.00 | 0.00 | 0.00 | |
| Fe-Oxides | 0.00 | 0.00 | 0.00 | |
| Hydrocarbon | 0.00 | 0.00 | 0.00 | |
| ***REPLACEMENTS*** | 7.25 | 4.00 | 16.25 | |
| Illite, I/S, Sericite | 1.75 | 2.75 | 1.25 | |
| Chlorite | 0.00 | 0.00 | 0.00 | |
| Kaolinite | 0.25 | 0.00 | 0.00 | |
| Quartz | 2.50 | 0.25 | 0.00 | |
| Feldspar | 0.00 | 0.00 | 0.00 | |
| Microquartz | 0.00 | 0.00 | tr | |
| Calcite | 0.75 | 0.00 | 9.75 | |
| Fe-Calcite | 0.00 | 0.00 | 0.00 | |
| Dolomite | 0.00 | 0.00 | 0.50 | |
| Ankerite | 0.50 | tr | 0.50 | |
| Siderite | 1.25 | 0.50 | 2.75 | |
| Pyrite | 0.25 | 0.25 | 1.50 | |
| Ti-Oxides | 0.00 | 0.25 | 0.00 | |
| Fe-Oxides | 0.00 | 0.00 | 0.00 | |
| Apatite | 0.00 | 0.00 | tr | |
| Hydrocarbon | 0.00 | 0.00 | 0.00 | |
| ***POROSITY*** | 12.75 | 4.25 | 1.25 | |
| Intergranular | 1.50 | 0.50 | 0.00 | |
| Intragranular/Moldic | 8.25 | 1.00 | tr | |
| Microscopic | 3.00 | 2.75 | 1.25 | |
| Transgranular/Grain Fracture | tr | 0.00 | 0.00 | |
| **TOTAL:** | 100.00 | 100.00 | 100.00 | |

* Apatite, Garnet, Epidote, Metamorphic Chlorite, Pyroxene, Rutile, Sphene, Tourmaline, and Zircon

**THIN SECTION MODAL ANALYSIS**

**QGC - A BG Group Business**
**Dunk 1**
**Surat Basin**
**Queensland, Australia**
**Weatherford Labs File No.: AB-74306**
**Sample Type: Rotary Sidewall / Analyst: A. Schwartz**

| | | | | |
|---|---|---|---|---|
| **DEPTH: (Meters)** | **3116.00** | **3120.00** | **3126.00** | **3133.75** |
| **SAMPLE NUMBER:** | **4 SWC** | **3 SWC** | **2 SWC** | **1 SWC** |
| **Formation:** | **Lorelle Ss** | **Lorelle Ss** | **Lorelle Ss** | **Lorelle Ss** |
| **Grain Size Avg. (mm):** | | | | |
| **Grain Size Range (mm):** | | | | |
| **Sorting:** | | | | |
| **Fabric:** | | | | |
| **Rock Name (Folk):** | | | | |
| ***FRAMEWORK GRAINS*** | | | | |
| ***Quartz*** | | | | |
| Monocrystalline | | | | |
| Polycrystalline | | | | |
| Meta-Quartzite | | | | |
| ***Feldspar*** | | | | |
| K-Feldspar | | | | |
| Plagioclase | | | | |
| ***Lithic Fragments*** | | | | |
| Plutonic-Granitic | | | | |
| Volcanic-Tuff/Glass | | | | |
| Volcanic-Felsic | | | | |
| Volcanic-Interm./Mafic | | | | |
| Metamorphic-Schist | | | | |
| Metamorphic-Phyllite/Slate | | | | |
| Chert | | | | |
| Mudstone | | | | |
| Carbonate | | | | |
| Siltstone/Sandstone | | | | |
| Conglomerate | | | | |
| ***Accessory Grains*** | | | | |
| Muscovite | | | | |
| Biotite | | | | |
| Heavy Minerals* | | | | |
| ***ENVIRON. INDICATORS*** | | | | |
| Plant Fragments/Organics | | | | |
| Glauconite | | | | |
| Chamosite | | | | |
| Fossil Fragments | | | | |
| Phosphatic Grains | | | | |
| ***DETRITAL MATRIX*** | | | | |
| Clay Matrix-Laminar | | | | |
| Clay Matrix-Pore filling | | | | |
| Clay Matrix-Pore lining | | | | |
| Volcanic | | | | |
| ***AUTHIGENIC CEMENTS*** | Sample not suitable for point count analysis; general thin section description performed instead | Sample not suitable for point count analysis; general thin section description performed instead | Sample not suitable for point count analysis; general thin section description performed instead | Sample not suitable for point count analysis; general thin section description performed instead |
| Illite, I/S-Pore lining | | | | |
| Illite, I/S-Pore filling | | | | |
| Chlorite-Pore lining | | | | |
| Chlorite-Pore filling | | | | |
| Kaolinite | | | | |
| Quartz Overgrowths | | | | |
| Feldspar Overgrowths | | | | |
| Microquartz/Opal-CT** | | | | |
| Calcite | | | | |
| Fe-Calcite | | | | |
| Dolomite | | | | |
| Ankerite | | | | |
| Siderite | | | | |
| Pyrite | | | | |
| Ti-Oxides | | | | |
| Fe-Oxides | | | | |
| Hydrocarbon | | | | |
| ***REPLACEMENTS*** | | | | |
| Illite, I/S, Sericite | | | | |
| Chlorite | | | | |
| Kaolinite | | | | |
| Quartz | | | | |
| Feldspar | | | | |
| Microquartz | | | | |
| Calcite | | | | |
| Fe-Calcite | | | | |
| Dolomite | | | | |
| Ankerite | | | | |
| Siderite | | | | |
| Pyrite | | | | |
| Ti-Oxides | | | | |
| Fe-Oxides | | | | |
| Apatite | | | | |
| Hydrocarbon | | | | |
| ***POROSITY*** | | | | |
| Intergranular | | | | |
| Intragranular/Moldic | | | | |
| Microscopic | | | | |
| Transgranular/Grain Fracture | | | | |
| **TOTAL:** | | | | |

* Apatite, Garnet, Epidote, Metamorphic Chlorite, Pyroxene, Rutile, Sphene, Tourmaline, and Zircon

**THIN SECTION MODAL ANALYSIS**

**QGC - A BG Group Business**
**Dunk 1**
**Surat Basin**
**Queensland, Australia**
**Weatherford Labs File No.: AB-74306**
**Sample Type: Conventional / Analyst: A. Schwartz**

| DEPTH: (Meters) | 2872.08 | 2877.04 | 2878.05 | 2887.10 |
|---|---|---|---|---|
| SAMPLE NUMBER: | 1-3P | 1-8P | 1-10P | 1-19P |
| Formation: | Tinowon Ss | Tinowon Ss | Tinowon Ss | Tinowon Ss |
| Grain Size Avg. (mm): | | 0.27 | 0.49 | 0.49 |
| Grain Size Range (mm): | | <0.01-1.14 | <0.01-3.42 | 0.02-7.03 |
| Sorting: | | Moderate | Poor - Mod. Well | Very Poor |
| Fabric: | | Massive | Massive | Massive |
| Rock Name (Folk): | | Lithic Arkose | Lithic Arkose | Litharenite |
| ***FRAMEWORK GRAINS*** | | | | |
| ***Quartz*** | | **11.00** | **16.25** | **14.00** |
| Monocrystalline | | 9.75 | 12.25 | 13.00 |
| Polycrystalline | | 1.25 | 2.75 | 0.25 |
| Meta-Quartzite | | 0.00 | 1.25 | 0.75 |
| ***Feldspar*** | | **34.75** | **32.00** | **2.00** |
| K-Feldspar | | 3.00 | 1.25 | 0.75 |
| Plagioclase | | 31.75 | 30.75 | 1.25 |
| ***Lithic Fragments*** | | **15.00** | **17.25** | **12.25** |
| Plutonic-Granitic | | 0.00 | 0.00 | 0.00 |
| Volcanic-Tuff/Glass | | 0.50 | 4.75 | 2.50 |
| Volcanic-Felsic | | 0.75 | 0.00 | 0.00 |
| Volcanic-Interm./Mafic | | 5.75 | 3.00 | 1.25 |
| Metamorphic-Schist | | 1.00 | 2.00 | 3.25 |
| Metamorphic-Phyllite/Slate | | 0.00 | 0.00 | 0.00 |
| Chert | | 5.50 | 5.50 | 4.00 |
| Mudstone | | 1.25 | 0.50 | 0.25 |
| Carbonate | | 0.00 | 0.00 | 0.00 |
| Siltstone/Sandstone | | 0.25 | 1.50 | 1.00 |
| Conglomerate | | 0.00 | 0.00 | 0.00 |
| ***Accessory Grains*** | | **3.00** | **1.25** | **tr** |
| Muscovite | | 0.75 | tr | tr |
| Biotite | | 2.25 | 1.25 | tr |
| Heavy Minerals* | | tr | tr | tr |
| ***ENVIRON. INDICATORS*** | | **1.50** | **0.50** | **38.50** |
| Plant Fragments/Organics | | 1.00 | 0.25 | 0.25 |
| Glauconite | | 0.00 | 0.00 | 0.00 |
| Chamosite | | 0.50 | 0.25 | tr |
| Fossil Fragments | | 0.00 | 0.00 | 38.25 |
| Phosphatic Grains | | 0.00 | tr | 0.00 |
| ***DETRITAL MATRIX*** | | **20.00** | **1.75** | **0.00** |
| Clay Matrix-Laminar | | 0.00 | 0.00 | 0.00 |
| Clay Matrix-Pore filling | | 6.00 | tr | 0.00 |
| Clay Matrix-Pore lining | | 0.00 | 0.00 | 0.00 |
| Volcanic | | 14.00 | 1.75 | 0.00 |
| ***AUTHIGENIC CEMENTS*** | Sample not suitable for point count analysis; general thin section description performed instead | **3.75** | **18.25** | **23.00** |
| Illite, I/S-Pore lining | | tr | tr | tr |
| Illite, I/S-Pore filling | | 2.75 | 0.50 | 1.75 |
| Chlorite-Pore lining | | 0.00 | 0.00 | 0.25 |
| Chlorite-Pore filling | | 0.00 | 0.00 | 0.00 |
| Kaolinite | | 0.00 | 0.00 | 0.00 |
| Quartz Overgrowths | | tr | tr | 0.00 |
| Feldspar Overgrowths | | 0.75 | 0.25 | 0.00 |
| Microquartz/Opal-CT** | | tr | 0.00 | 0.00 |
| Calcite | | 0.00 | 14.00 | 20.75 |
| Fe-Calcite | | 0.00 | 0.00 | 0.00 |
| Dolomite | | 0.00 | 0.00 | 0.00 |
| Ankerite | | 0.00 | 0.00 | 0.00 |
| Siderite | | 0.00 | 2.25 | 0.00 |
| Pyrite | | 0.25 | 1.25 | 0.25 |
| Ti-Oxides | | 0.00 | 0.00 | 0.00 |
| Fe-Oxides | | 0.00 | 0.00 | 0.00 |
| Zeolites | | 0.00 | 0.00 | 0.00 |
| ***REPLACEMENTS*** | | **8.00** | **12.25** | **9.50** |
| Illite, I/S, Sericite | | 2.50 | 1.00 | 0.25 |
| Chlorite | | 0.00 | tr | tr |
| Kaolinite | | 0.00 | 0.00 | 0.00 |
| Quartz | | 0.00 | 0.00 | 0.00 |
| Feldspar | | 0.00 | 0.00 | 0.00 |
| Microquartz | | tr | 0.00 | 0.00 |
| Calcite | | 1.00 | 7.75 | 7.25 |
| Fe-Calcite | | 0.50 | tr | 0.00 |
| Dolomite | | 0.00 | 0.00 | 0.00 |
| Ankerite | | 2.25 | 0.50 | 0.50 |
| Siderite | | 0.75 | 2.25 | 1.00 |
| Pyrite | | 1.00 | 0.75 | 0.50 |
| Ti-Oxides | | 0.00 | 0.00 | 0.00 |
| Fe-Oxides | | 0.00 | 0.00 | 0.00 |
| Apatite | | 0.00 | 0.00 | 0.00 |
| Hydrocarbon | | 0.00 | 0.00 | 0.00 |
| ***POROSITY*** | | **3.00** | **0.50** | **0.75** |
| Intergranular | | 0.00 | 0.00 | 0.00 |
| Intragranular/Moldic | | 0.00 | tr | 0.00 |
| Microscopic | | 3.00 | 0.50 | 0.75 |
| Transgranular/Grain Fracture | | 0.00 | 0.00 | 0.00 |
| **TOTAL:** | | **100.00** | **100.00** | **100.00** |

* Apatite, Garnet, Epidote, Metamorphic Chlorite, Pyroxene, Rutile, Sphene, Tourmaline, and Zircon

**THIN SECTION MODAL ANALYSIS**

**QGC - A BG Group Business**
**Dunk 1**
**Surat Basin**
**Queensland, Australia**
**Weatherford Labs File No.: AB-74306**
**Sample Type: Conventional / Analyst: A. Schwartz**

| | | | | |
|---|---|---|---|---|
| **DEPTH: (Meters)** | **2888.12** | **2895.09** | **2896.07** | **2897.06** |
| **SAMPLE NUMBER:** | **1-20P** | **1-27P** | **1-28P** | **2-2P** |
| **Formation:** | **Tinowon Ss** | **Upper Tinowon Ss** | **Upper Tinowon Ss** | **Upper Tinowon Ss** |
| **Grain Size Avg. (mm):** | **0.34** | **0.07/0.49** | **0.34** | **0.42** |
| **Grain Size Range (mm):** | **<0.01-1.18** | **<0.01-1.37** | **<0.01-1.25** | **<0.01-1.82** |
| **Sorting:** | **Moderate** | **Moderate to Poor** | **Moderately Well** | **Moderate** |
| **Fabric:** | **Massive** | **Lam. to Massive** | **Massive** | **Massive** |
| **Rock Name (Folk):** | **Felds. Litharenite** | **Lithic Arkose** | **Lithic Arkose** | **Lithic Arkose** |
| ***FRAMEWORK GRAINS*** | | | | |
| ***Quartz*** | **26.00** | **21.00** | **18.75** | **26.25** |
| Monocrystalline | 22.00 | 17.50 | 16.50 | 24.75 |
| Polycrystalline | 3.75 | 3.50 | 2.25 | 1.50 |
| Meta-Quartzite | 0.25 | 0.00 | 0.00 | 0.00 |
| ***Feldspar*** | **13.25** | **30.75** | **29.75** | **25.00** |
| K-Feldspar | 1.25 | 2.00 | 0.25 | 1.25 |
| Plagioclase | 12.00 | 28.75 | 29.50 | 23.75 |
| ***Lithic Fragments*** | **21.75** | **15.25** | **20.50** | **13.00** |
| Plutonic-Granitic | 0.00 | tr | 0.00 | 0.00 |
| Volcanic-Tuff/Glass | 5.50 | 4.25 | 3.00 | 2.50 |
| Volcanic-Felsic | 0.00 | 0.00 | 0.00 | 0.00 |
| Volcanic-Interm./Mafic | 5.50 | 2.75 | 8.50 | 5.75 |
| Metamorphic-Schist | 0.00 | 1.00 | 1.00 | 0.00 |
| Metamorphic-Phyllite/Slate | 0.25 | tr | 0.00 | 0.00 |
| Chert | 8.25 | 3.75 | 5.50 | 3.50 |
| Mudstone | 1.75 | 2.00 | 1.75 | 0.50 |
| Carbonate | 0.00 | 0.00 | 0.00 | 0.00 |
| Siltstone/Sandstone | 0.50 | 1.50 | 0.75 | 0.75 |
| Conglomerate | 0.00 | 0.00 | 0.00 | 0.00 |
| ***Accessory Grains*** | **1.00** | **1.00** | **1.00** | **0.25** |
| Muscovite | 0.50 | 0.75 | 0.75 | 0.25 |
| Biotite | 0.50 | 0.25 | 0.25 | 0.00 |
| Heavy Minerals* | tr | tr | tr | tr |
| ***ENVIRON. INDICATORS*** | **0.25** | **0.50** | **0.75** | **1.00** |
| Plant Fragments/Organics | 0.25 | 0.00 | 0.00 | 0.25 |
| Glauconite | 0.00 | 0.00 | 0.00 | 0.00 |
| Chamosite | 0.00 | 0.50 | 0.75 | 0.75 |
| Fossil Fragments | 0.00 | 0.00 | 0.00 | 0.00 |
| Phosphatic Grains | 0.00 | 0.00 | 0.00 | 0.00 |
| ***DETRITAL MATRIX*** | **7.25** | **13.00** | **5.00** | **4.00** |
| Clay Matrix-Laminar | 0.00 | 0.00 | 0.00 | 0.00 |
| Clay Matrix-Pore filling | tr | 1.00 | 1.00 | 0.25 |
| Clay Matrix-Pore lining | 0.00 | 0.00 | 0.00 | 0.00 |
| Volcanic | 7.25 | 12.00 | 4.00 | 3.75 |
| ***AUTHIGENIC CEMENTS*** | **10.75** | **10.25** | **10.75** | **10.00** |
| Illite, I/S-Pore lining | 2.25 | 0.25 | 3.50 | 2.00 |
| Illite, I/S-Pore filling | tr | 5.25 | 3.50 | 4.25 |
| Chlorite-Pore lining | 0.00 | 0.00 | tr | tr |
| Chlorite-Pore filling | 0.00 | 0.00 | 0.00 | 0.00 |
| Kaolinite | 0.00 | 0.00 | 0.00 | 0.25 |
| Quartz Overgrowths | 0.75 | 0.75 | 1.50 | 1.75 |
| Feldspar Overgrowths | 0.50 | 1.00 | 2.25 | 0.75 |
| Microquartz/Opal-CT** | 3.25 | tr | 0.00 | 0.25 |
| Calcite | 2.75 | 0.00 | 0.00 | 0.75 |
| Fe-Calcite | 0.00 | 0.25 | tr | 0.00 |
| Dolomite | 0.00 | 0.00 | 0.00 | 0.00 |
| Ankerite | 0.25 | 0.00 | 0.00 | 0.00 |
| Siderite | 0.00 | 0.00 | 0.00 | 0.00 |
| Pyrite | 1.00 | 2.75 | tr | tr |
| Ti-Oxides | 0.00 | 0.00 | 0.00 | 0.00 |
| Fe-Oxides | 0.00 | 0.00 | 0.00 | 0.00 |
| Zeolites | 0.00 | 0.00 | 0.00 | 0.00 |
| ***REPLACEMENTS*** | **17.50** | **4.25** | **7.00** | **7.50** |
| Illite, I/S, Sericite | 1.25 | 0.50 | 2.50 | 1.25 |
| Chlorite | 0.00 | tr | tr | 0.50 |
| Kaolinite | 0.00 | 0.00 | 0.00 | 0.00 |
| Quartz | 0.00 | 0.00 | 0.25 | 0.75 |
| Feldspar | 0.00 | 0.25 | 2.50 | 2.00 |
| Microquartz | 0.00 | tr | 0.00 | 0.00 |
| Calcite | 11.75 | 1.75 | 0.25 | 2.50 |
| Fe-Calcite | 0.50 | 0.25 | tr | tr |
| Dolomite | 0.00 | 0.00 | 0.00 | 0.00 |
| Ankerite | 1.00 | tr | tr | tr |
| Siderite | 1.50 | 0.00 | 1.25 | 0.25 |
| Pyrite | 1.50 | 1.25 | tr | 0.25 |
| Ti-Oxides | 0.00 | 0.25 | 0.25 | 0.00 |
| Fe-Oxides | 0.00 | 0.00 | 0.00 | 0.00 |
| Apatite | 0.00 | 0.00 | 0.00 | 0.00 |
| Hydrocarbon | 0.00 | 0.00 | 0.00 | 0.00 |
| ***POROSITY*** | **2.25** | **4.00** | **6.50** | **13.00** |
| Intergranular | 0.00 | tr | 0.25 | 0.75 |
| Intragranular/Moldic | 0.75 | 2.00 | 2.75 | 9.00 |
| Microscopic | 1.50 | 2.00 | 3.50 | 3.25 |
| Transgranular/Grain Fracture | 0.00 | 0.00 | tr | tr |
| **TOTAL:** | **100.00** | **100.00** | **100.00** | **100.00** |

* Apatite, Garnet, Epidote, Metamorphic Chlorite, Pyroxene, Rutile, Sphene, Tourmaline, and Zircon

**THIN SECTION MODAL ANALYSIS**

**QGC - A BG Group Business**
**Dunk 1**
**Surat Basin**
**Queensland, Australia**
**Weatherford Labs File No.: AB-74306**
**Sample Type: Conventional / Analyst: A. Schwartz**

| DEPTH: (Meters) | 2898.51 | 2901.06 | 2902.49 | 2905.56 |
|---|---|---|---|---|
| SAMPLE NUMBER: | 21 | 2-6P | 25 | 28 |
| Formation: | Upper Tinowon Ss | Upper Tinowon Ss | Upper Tinowon Ss | Upper Tinowon Ss |
| Grain Size Avg. (mm): | 0.32 | 0.41 | 0.36 | 0.32 |
| Grain Size Range (mm): | <0.01-1.94 | <0.01-2.09 | <0.01-1.29 | <0.01-0.95 |
| Sorting: | Mod. to Mod. Well | Moderate | Moderate | Moderately Well-Well |
| Fabric: | Mass.; Coarse. Upward | Massive | Massive | Massive |
| Rock Name (Folk): | Lithic Arkose | Lithic Arkose | Lithic Arkose | Lithic Arkose |
| ***FRAMEWORK GRAINS*** | | | | |
| ***Quartz*** | 17.50 | 24.75 | 16.25 | 12.00 |
| Monocrystalline | 14.75 | 22.75 | 13.50 | 11.00 |
| Polycrystalline | 2.50 | 2.00 | 2.25 | 1.00 |
| Meta-Quartzite | 0.25 | tr | 0.50 | tr |
| ***Feldspar*** | 33.50 | 26.75 | 29.00 | 29.25 |
| K-Feldspar | 1.00 | 3.75 | 0.75 | 2.75 |
| Plagioclase | 32.50 | 23.00 | 28.25 | 26.50 |
| ***Lithic Fragments*** | 17.75 | 22.25 | 21.00 | 21.25 |
| Plutonic-Granitic | 0.00 | 0.25 | 0.00 | 0.00 |
| Volcanic-Tuff/Glass | 7.50 | 1.75 | 5.50 | 5.00 |
| Volcanic-Felsic | 0.00 | 0.00 | 0.00 | 0.00 |
| Volcanic-Interm./Mafic | 3.00 | 9.00 | 4.50 | 5.50 |
| Metamorphic-Schist | 0.50 | 0.75 | 0.50 | 0.50 |
| Metamorphic-Phyllite/Slate | 0.00 | 0.00 | tr | 0.50 |
| Chert | 4.25 | 8.50 | 5.75 | 7.25 |
| Mudstone | 1.00 | tr | 3.25 | 1.00 |
| Carbonate | 0.00 | 0.00 | 0.00 | 0.00 |
| Siltstone/Sandstone | 1.50 | 2.00 | 1.50 | 1.50 |
| Conglomerate | 0.00 | 0.00 | 0.00 | 0.00 |
| ***Accessory Grains*** | 1.50 | 1.75 | 1.25 | 0.75 |
| Muscovite | 0.75 | 1.50 | 0.75 | 0.50 |
| Biotite | 0.50 | tr | 0.50 | 0.25 |
| Heavy Minerals* | 0.25 | 0.25 | tr | tr |
| ***ENVIRON. INDICATORS*** | 0.50 | tr | 1.25 | 0.75 |
| Plant Fragments/Organics | 0.25 | tr | 1.00 | tr |
| Glauconite | 0.00 | 0.00 | 0.00 | 0.00 |
| Chamosite | 0.25 | tr | 0.25 | 0.75 |
| Fossil Fragments | 0.00 | 0.00 | 0.00 | 0.00 |
| Phosphatic Grains | 0.00 | 0.00 | 0.00 | 0.00 |
| ***DETRITAL MATRIX*** | 6.75 | 2.50 | 7.00 | 6.25 |
| Clay Matrix-Laminar | 0.25 | 0.25 | 0.25 | 0.00 |
| Clay Matrix-Pore filling | 1.25 | tr | 2.00 | 0.75 |
| Clay Matrix-Pore lining | 0.50 | 0.00 | 1.25 | 0.50 |
| Volcanic | 4.75 | 2.25 | 3.50 | 5.00 |
| ***AUTHIGENIC CEMENTS*** | 8.75 | 10.25 | 7.00 | 7.50 |
| Illite, I/S-Pore lining | 1.00 | 2.25 | 0.50 | 1.50 |
| Illite, I/S-Pore filling | 5.00 | 4.50 | 2.50 | 2.00 |
| Chlorite-Pore lining | 0.25 | 0.00 | 0.50 | 0.50 |
| Chlorite-Pore filling | 0.00 | 0.00 | 0.25 | 0.75 |
| Kaolinite | 0.00 | 0.00 | 0.00 | 0.00 |
| Quartz Overgrowths | 0.75 | 1.50 | 0.75 | 0.50 |
| Feldspar Overgrowths | 1.50 | 0.75 | 1.75 | 0.75 |
| Microquartz/Opal-CT** | tr | 0.50 | 0.00 | 1.25 |
| Calcite | 0.25 | tr | 0.00 | tr |
| Fe-Calcite | 0.00 | 0.00 | 0.00 | 0.25 |
| Dolomite | 0.00 | 0.00 | 0.00 | 0.00 |
| Ankerite | 0.00 | 0.00 | 0.00 | tr |
| Siderite | 0.00 | 0.00 | 0.00 | tr |
| Pyrite | tr | 0.75 | 0.25 | tr |
| Ti-Oxides | tr | 0.00 | 0.50 | 0.00 |
| Fe-Oxides | 0.00 | 0.00 | 0.00 | 0.00 |
| Zeolites | 0.00 | 0.00 | 0.00 | 0.00 |
| ***REPLACEMENTS*** | 5.00 | 4.75 | 5.50 | 9.50 |
| Illite, I/S, Sericite | 1.50 | 1.25 | 1.50 | 0.50 |
| Chlorite | 0.00 | tr | 0.50 | 1.75 |
| Kaolinite | 0.00 | 0.00 | 0.00 | 0.00 |
| Quartz | 0.00 | 0.00 | 0.00 | 1.00 |
| Feldspar | 1.75 | 1.25 | 1.50 | 2.00 |
| Microquartz | 0.25 | 0.00 | 1.00 | 0.25 |
| Calcite | 0.25 | 0.50 | 0.25 | 1.00 |
| Fe-Calcite | tr | 0.00 | tr | 0.50 |
| Dolomite | 0.00 | 0.00 | 0.00 | 0.00 |
| Ankerite | 0.00 | 0.00 | tr | 0.75 |
| Siderite | 0.75 | 1.75 | 0.25 | 1.50 |
| Pyrite | tr | tr | tr | tr |
| Ti-Oxides | 0.50 | tr | 0.50 | 0.25 |
| Fe-Oxides | 0.00 | 0.00 | 0.00 | 0.00 |
| Apatite | 0.00 | 0.00 | 0.00 | 0.00 |
| Hydrocarbon | 0.00 | 0.00 | 0.00 | 0.00 |
| ***POROSITY*** | 8.75 | 7.00 | 11.75 | 12.75 |
| Intergranular | tr | 0.25 | 1.25 | 0.75 |
| Intragranular/Moldic | 6.00 | 3.50 | 8.00 | 9.75 |
| Microscopic | 2.75 | 3.25 | 2.50 | 2.25 |
| Transgranular/Grain Fracture | tr | tr | 0.00 | 0.00 |
| **TOTAL:** | 100.00 | 100.00 | 100.00 | 100.00 |

* Apatite, Garnet, Epidote, Metamorphic Chlorite, Pyroxene, Rutile, Sphene, Tourmaline, and Zircon

THIN SECTION MODAL ANALYSIS

**QGC - A BG Group Business**
**Dunk 1**
**Surat Basin**
**Queensland, Australia**
**Weatherford Labs File No.: AB-74306**
**Sample Type: Conventional / Analyst: A. Schwartz**

| DEPTH: (Meters) | 2906.05 | 2907.04 | 2908.50 | 2910.05 |
|---|---|---|---|---|
| SAMPLE NUMBER: | 2-12P | 2-13P | 31 | 2-16P |
| Formation: | Upper Tinowon Ss | Upper Tinowon Ss | Upper Tinowon Ss | Upper Tinowon Ss |
| Grain Size Avg. (mm): | 0.44 | 0.36 | 0.38 | 0.46 |
| Grain Size Range (mm): | <0.01-1.71 | <0.01-1.33 | <0.01-2.01 | <0.01-1.64 |
| Sorting: | Moderate | Moderate | Poor | Moderate to Poor |
| Fabric: | Mass.; Stylolites | Massive | Massive | Massive |
| Rock Name (Folk): | Lithic Arkose | Lithic Arkose | Lithic Ark./Feld. Lith. | Feld. Litharenite |
| ***FRAMEWORK GRAINS*** | | | | |
| ***Quartz*** | 16.75 | 17.75 | 20.25 | 25.25 |
| Monocrystalline | 16.50 | 15.25 | 17.75 | 21.25 |
| Polycrystalline | 0.25 | 2.25 | 2.50 | 3.50 |
| Meta-Quartzite | 0.00 | 0.25 | tr | 0.50 |
| ***Feldspar*** | 26.25 | 26.00 | 23.25 | 21.25 |
| K-Feldspar | 2.25 | 0.50 | 2.00 | 2.00 |
| Plagioclase | 24.00 | 25.50 | 21.25 | 19.25 |
| ***Lithic Fragments*** | 18.50 | 22.00 | 23.50 | 23.50 |
| Plutonic-Granitic | 0.00 | 0.75 | 0.00 | 0.50 |
| Volcanic-Tuff/Glass | 5.50 | 8.00 | 6.50 | 8.25 |
| Volcanic-Felsic | 0.00 | 0.00 | 0.00 | 0.00 |
| Volcanic-Interm./Mafic | 3.75 | 4.00 | 4.75 | 5.25 |
| Metamorphic-Schist | 0.25 | 0.00 | 1.25 | 0.50 |
| Metamorphic-Phyllite/Slate | 0.25 | 0.25 | 0.00 | 0.00 |
| Chert | 5.50 | 5.75 | 6.50 | 6.50 |
| Mudstone | 1.25 | 1.25 | 1.75 | 1.00 |
| Carbonate | 0.00 | 0.00 | 0.00 | 0.00 |
| Siltstone/Sandstone | 2.00 | 2.00 | 2.75 | 1.50 |
| Conglomerate | 0.00 | 0.00 | 0.00 | 0.00 |
| ***Accessory Grains*** | 0.75 | 1.50 | 1.25 | 1.25 |
| Muscovite | 0.50 | 1.00 | 1.00 | 1.00 |
| Biotite | 0.00 | 0.50 | 0.25 | 0.25 |
| Heavy Minerals* | 0.25 | tr | tr | tr |
| ***ENVIRON. INDICATORS*** | 0.50 | 0.75 | 0.75 | 0.00 |
| Plant Fragments/Organics | 0.00 | 0.00 | tr | 0.00 |
| Glauconite | 0.00 | 0.00 | 0.00 | 0.00 |
| Chamosite | 0.50 | 0.75 | 0.75 | 0.00 |
| Fossil Fragments | 0.00 | 0.00 | 0.00 | 0.00 |
| Phosphatic Grains | 0.00 | 0.00 | 0.00 | 0.00 |
| ***DETRITAL MATRIX*** | 4.25 | 3.00 | 8.50 | 4.75 |
| Clay Matrix-Laminar | 1.50 | 0.00 | tr | 0.00 |
| Clay Matrix-Pore filling | 0.25 | 0.75 | 0.50 | 0.25 |
| Clay Matrix-Pore lining | 0.00 | 0.00 | 0.00 | 0.00 |
| Volcanic | 2.50 | 2.25 | 8.00 | 4.50 |
| ***AUTHIGENIC CEMENTS*** | 15.50 | 10.75 | 9.00 | 8.75 |
| Illite, I/S-Pore lining | 0.25 | 2.00 | 2.50 | 1.00 |
| Illite, I/S-Pore filling | 1.50 | 4.75 | 4.00 | 5.50 |
| Chlorite-Pore lining | 0.00 | tr | tr | 0.50 |
| Chlorite-Pore filling | 0.00 | 0.00 | 0.00 | 0.00 |
| Kaolinite | 0.00 | 0.00 | 0.00 | 0.00 |
| Quartz Overgrowths | tr | 0.75 | 1.25 | 0.75 |
| Feldspar Overgrowths | 0.50 | 2.25 | 0.25 | 0.50 |
| Microquartz/Opal-CT** | 0.00 | 0.50 | 0.25 | 0.25 |
| Calcite | 10.00 | tr | 0.00 | tr |
| Fe-Calcite | 3.25 | tr | 0.00 | 0.00 |
| Dolomite | 0.00 | 0.00 | 0.00 | 0.00 |
| Ankerite | 0.00 | 0.00 | 0.00 | tr |
| Siderite | 0.00 | 0.00 | 0.25 | 0.00 |
| Pyrite | tr | 0.50 | 0.50 | 0.25 |
| Ti-Oxides | 0.00 | tr | 0.00 | 0.00 |
| Fe-Oxides | 0.00 | 0.00 | 0.00 | tr |
| Zeolites | 0.00 | 0.00 | 0.00 | 0.00 |
| ***REPLACEMENTS*** | 13.75 | 7.75 | 6.00 | 5.50 |
| Illite, I/S, Sericite | 0.50 | 1.50 | 1.25 | 1.00 |
| Chlorite | tr | 0.00 | tr | 0.25 |
| Kaolinite | 0.00 | 0.00 | 0.00 | 0.00 |
| Quartz | 0.00 | 0.50 | tr | tr |
| Feldspar | 0.25 | 2.25 | 0.75 | 2.00 |
| Microquartz | 0.00 | 0.25 | 0.25 | 0.00 |
| Calcite | 8.50 | 0.25 | 1.00 | 0.75 |
| Fe-Calcite | 3.75 | tr | tr | tr |
| Dolomite | 0.00 | 0.00 | 0.00 | 0.00 |
| Ankerite | 0.25 | 0.75 | tr | tr |
| Siderite | 0.50 | 1.25 | 1.75 | 1.25 |
| Pyrite | tr | tr | 0.50 | tr |
| Ti-Oxides | 0.00 | 1.00 | 0.25 | 0.25 |
| Fe-Oxides | 0.00 | 0.00 | 0.25 | tr |
| Apatite | 0.00 | 0.00 | 0.00 | 0.00 |
| Hydrocarbon | 0.00 | 0.00 | 0.00 | 0.00 |
| ***POROSITY*** | 3.75 | 10.50 | 7.50 | 9.75 |
| Intergranular | 0.00 | 0.25 | tr | 0.25 |
| Intragranular/Moldic | 3.00 | 7.00 | 4.25 | 6.00 |
| Microscopic | 0.75 | 3.25 | 3.25 | 3.50 |
| Transgranular/Grain Fracture | 0.00 | tr | 0.00 | 0.00 |
| **TOTAL:** | 100.00 | 100.00 | 100.00 | 100.00 |

* Apatite, Garnet, Epidote, Metamorphic Chlorite, Pyroxene, Rutile, Sphene, Tourmaline, and Zircon

**THIN SECTION MODAL ANALYSIS**

**QGC - A BG Group Business**
**Dunk 1**
**Surat Basin**
**Queensland, Australia**
**Weatherford Labs File No.: AB-74306**
**Sample Type: Conventional / Analyst: A. Schwartz**

| DEPTH: (Meters) | 2912.50 | 2914.04 | 2916.04 | 2919.05 |
|---|---|---|---|---|
| SAMPLE NUMBER: | 35 | 2-20P | 2-23P | 2-26P |
| Formation: | Upper Tinowon Ss | Upper Tinowon Ss | Upper Tinowon Ss | Upper Tinowon Ss |
| Grain Size Avg. (mm): | 0.24 | 0.38 | 0.30 | 0.45 |
| Grain Size Range (mm): | <0.01-0.95 | 0.04-2.55 | <0.01-2.09 | <0.01-1.79 |
| Sorting: | Moderate to Well | Poor | Well to Poor | Moderately Well |
| Fabric: | Massive | Massive | Massive | Massive |
| Rock Name (Folk): | Lithic Arkose | Lithic Arkose | Lithic Arkose | Lithic Arkose |
| ***FRAMEWORK GRAINS*** | | | | |
| ***Quartz*** | **14.50** | **28.25** | **23.75** | **16.50** |
| Monocrystalline | 12.00 | 26.75 | 21.50 | 14.75 |
| Polycrystalline | 2.50 | 1.50 | 1.75 | 1.25 |
| Meta-Quartzite | tr | tr | 0.50 | 0.50 |
| ***Feldspar*** | **32.50** | **23.00** | **29.50** | **30.25** |
| K-Feldspar | 0.75 | 1.25 | 1.25 | 2.00 |
| Plagioclase | 31.75 | 21.75 | 28.25 | 28.25 |
| ***Lithic Fragments*** | **22.75** | **18.75** | **18.25** | **18.50** |
| Plutonic-Granitic | 0.00 | 0.00 | 0.00 | 0.00 |
| Volcanic-Tuff/Glass | 7.75 | 4.00 | 3.50 | 3.50 |
| Volcanic-Felsic | 0.00 | 0.00 | 0.00 | 0.00 |
| Volcanic-Interm./Mafic | 5.75 | 4.25 | 4.00 | 3.75 |
| Metamorphic-Schist | 0.00 | 0.25 | 0.50 | 0.00 |
| Metamorphic-Phyllite/Slate | 0.75 | 0.25 | 0.25 | 0.25 |
| Chert | 4.75 | 6.75 | 7.75 | 8.00 |
| Mudstone | 0.25 | 0.75 | 1.25 | 1.00 |
| Carbonate | 0.00 | 0.00 | 0.00 | 0.00 |
| Siltstone/Sandstone | 3.50 | 2.50 | 1.00 | 2.00 |
| Conglomerate | 0.00 | 0.00 | 0.00 | 0.00 |
| ***Accessory Grains*** | **2.50** | **0.25** | **0.75** | **0.75** |
| Muscovite | 1.25 | 0.25 | 0.25 | 0.25 |
| Biotite | 0.50 | 0.00 | 0.50 | 0.50 |
| Heavy Minerals* | 0.75 | tr | tr | tr |
| ***ENVIRON. INDICATORS*** | **0.50** | **tr** | **tr** | **0.00** |
| Plant Fragments/Organics | tr | 0.00 | tr | 0.00 |
| Glauconite | 0.00 | 0.00 | 0.00 | 0.00 |
| Chamosite | 0.50 | tr | 0.00 | 0.00 |
| Fossil Fragments | 0.00 | 0.00 | 0.00 | 0.00 |
| Phosphatic Grains | 0.00 | 0.00 | 0.00 | 0.00 |
| ***DETRITAL MATRIX*** | **4.50** | **3.00** | **2.50** | **2.00** |
| Clay Matrix-Laminar | 1.75 | 0.00 | 0.00 | 0.00 |
| Clay Matrix-Pore filling | 0.00 | 0.00 | 0.50 | 0.75 |
| Clay Matrix-Pore lining | 0.00 | 0.00 | 0.00 | 0.00 |
| Volcanic | 2.75 | 3.00 | 2.00 | 1.25 |
| ***AUTHIGENIC CEMENTS*** | **12.75** | **8.50** | **10.25** | **12.00** |
| Illite, I/S-Pore lining | 1.75 | 1.00 | 1.00 | 1.00 |
| Illite, I/S-Pore filling | 10.50 | 5.75 | 5.25 | 5.00 |
| Chlorite-Pore lining | 0.00 | 0.50 | 0.75 | 1.00 |
| Chlorite-Pore filling | 0.00 | 0.25 | 0.00 | tr |
| Kaolinite | 0.00 | 0.00 | 0.00 | 0.00 |
| Quartz Overgrowths | 0.25 | 0.50 | 0.75 | 1.50 |
| Feldspar Overgrowths | 0.25 | tr | 1.00 | 0.50 |
| Microquartz/Opal-CT** | 0.00 | 0.50 | 1.00 | tr |
| Calcite | 0.00 | tr | 0.00 | 3.00 |
| Fe-Calcite | 0.00 | 0.00 | 0.00 | 0.00 |
| Dolomite | 0.00 | 0.00 | 0.00 | 0.00 |
| Ankerite | 0.00 | tr | tr | 0.00 |
| Siderite | 0.00 | 0.00 | 0.00 | 0.00 |
| Pyrite | tr | tr | 0.25 | tr |
| Ti-Oxides | 0.00 | 0.00 | 0.25 | 0.00 |
| Fe-Oxides | 0.00 | 0.00 | 0.00 | 0.00 |
| Zeolites | 0.00 | 0.00 | 0.00 | 0.00 |
| ***REPLACEMENTS*** | **3.50** | **6.75** | **5.75** | **8.25** |
| Illite, I/S, Sericite | 1.50 | 1.50 | 0.50 | 1.00 |
| Chlorite | tr | tr | 0.50 | 0.75 |
| Kaolinite | 0.00 | 0.00 | 0.00 | 0.00 |
| Quartz | 0.00 | 0.25 | 0.25 | 0.00 |
| Feldspar | tr | 1.00 | 2.00 | 2.50 |
| Microquartz | 0.00 | 0.25 | 0.00 | 0.00 |
| Calcite | 0.75 | 0.75 | 0.00 | 2.50 |
| Fe-Calcite | tr | tr | 0.25 | tr |
| Dolomite | 0.00 | 0.00 | 0.00 | 0.00 |
| Ankerite | tr | 0.50 | 0.25 | 0.50 |
| Siderite | 1.00 | 2.25 | 1.00 | 0.75 |
| Pyrite | tr | tr | 0.25 | tr |
| Ti-Oxides | 0.25 | 0.25 | 0.50 | 0.25 |
| Fe-Oxides | 0.00 | 0.00 | 0.25 | 0.00 |
| Apatite | 0.00 | 0.00 | 0.00 | 0.00 |
| Hydrocarbon | 0.00 | 0.00 | 0.00 | 0.00 |
| ***POROSITY*** | **6.50** | **11.50** | **9.25** | **11.75** |
| Intergranular | tr | 0.25 | 0.25 | 0.50 |
| Intragranular/Moldic | 1.50 | 8.00 | 6.00 | 8.25 |
| Microscopic | 5.00 | 3.25 | 2.75 | 3.00 |
| Transgranular/Grain Fracture | 0.00 | tr | 0.25 | tr |
| **TOTAL:** | **100.00** | **100.00** | **100.00** | **100.00** |

* Apatite, Garnet, Epidote, Metamorphic Chlorite, Pyroxene, Rutile, Sphene, Tourmaline, and Zircon

**THIN SECTION MODAL ANALYSIS**

**QGC - A BG Group Business**
**Dunk 1**
**Surat Basin**
**Queensland, Australia**
**Weatherford Labs File No.: AB-74306**
**Sample Type: Conventional / Analyst: A. Schwartz**

| | | |
|---|---|---|
| **DEPTH: (Meters)** | **2922.04** | **2924.21** |
| **SAMPLE NUMBER:** | **2-29P** | **2-32P** |
| **Formation:** | **Upper Tinowon Ss** | **Upper Tinowon Ss** |
| **Grain Size Avg. (mm):** | **0.70** | **0.52** |
| **Grain Size Range (mm):** | **<0.01-1.67** | **<0.01-1.53** |
| **Sorting:** | **Moderate** | **Moderate** |
| **Fabric:** | **Massive** | **Massive** |
| **Rock Name (Folk):** | **Lithic Arkose** | **Lithic Arkose** |
| | | |
| ***FRAMEWORK GRAINS*** | | |
| ***Quartz*** | **25.00** | **18.75** |
| Monocrystalline | 24.50 | 17.50 |
| Polycrystalline | 0.50 | 1.25 |
| Meta-Quartzite | 0.00 | 0.00 |
| ***Feldspar*** | **28.00** | **26.75** |
| K-Feldspar | 0.75 | 0.25 |
| Plagioclase | 27.25 | 26.50 |
| ***Lithic Fragments*** | **19.50** | **15.00** |
| Plutonic-Granitic | 0.00 | 0.00 |
| Volcanic-Tuff/Glass | 6.25 | 5.00 |
| Volcanic-Felsic | 0.00 | 0.00 |
| Volcanic-Interm./Mafic | 4.25 | 1.75 |
| Metamorphic-Schist | 0.00 | 1.00 |
| Metamorphic-Phyllite/Slate | 0.50 | 0.00 |
| Chert | 6.75 | 4.75 |
| Mudstone | 0.75 | 1.00 |
| Carbonate | 0.00 | 0.00 |
| Siltstone/Sandstone | 1.00 | 1.50 |
| Conglomerate | 0.00 | 0.00 |
| ***Accessory Grains*** | **0.50** | **1.75** |
| Muscovite | 0.25 | 1.25 |
| Biotite | 0.25 | 0.25 |
| Heavy Minerals* | tr | 0.25 |
| ***ENVIRON. INDICATORS*** | **tr** | **0.25** |
| Plant Fragments/Organics | tr | 0.00 |
| Glauconite | 0.00 | 0.00 |
| Chamosite | 0.00 | 0.25 |
| Fossil Fragments | 0.00 | 0.00 |
| Phosphatic Grains | 0.00 | 0.00 |
| ***DETRITAL MATRIX*** | **5.50** | **2.75** |
| Clay Matrix-Laminar | 0.00 | 0.00 |
| Clay Matrix-Pore filling | 0.50 | 0.25 |
| Clay Matrix-Pore lining | 0.00 | 0.00 |
| Volcanic | 5.00 | 2.50 |
| ***AUTHIGENIC CEMENTS*** | **8.75** | **15.25** |
| Illite, I/S-Pore lining | 5.50 | 7.50 |
| Illite, I/S-Pore filling | 0.75 | 1.00 |
| Chlorite-Pore lining | 0.00 | 0.75 |
| Chlorite-Pore filling | 0.00 | 0.50 |
| Kaolinite | 0.00 | 0.00 |
| Quartz Overgrowths | 1.75 | 1.50 |
| Feldspar Overgrowths | 0.25 | 1.75 |
| Microquartz/Opal-CT** | 0.00 | 0.00 |
| Calcite | 0.50 | 2.25 |
| Fe-Calcite | 0.00 | 0.00 |
| Dolomite | 0.00 | 0.00 |
| Ankerite | 0.00 | 0.00 |
| Siderite | 0.00 | 0.00 |
| Pyrite | tr | tr |
| Ti-Oxides | 0.00 | 0.00 |
| Fe-Oxides | 0.00 | 0.00 |
| Zeolites | 0.00 | 0.00 |
| ***REPLACEMENTS*** | **4.75** | **8.00** |
| Illite, I/S, Sericite | 1.00 | 0.75 |
| Chlorite | 0.00 | 0.25 |
| Kaolinite | 0.00 | 0.00 |
| Quartz | 0.00 | 0.25 |
| Feldspar | 1.00 | 1.50 |
| Microquartz | 0.50 | 0.25 |
| Calcite | 0.25 | 3.50 |
| Fe-Calcite | 0.00 | tr |
| Dolomite | 0.00 | 0.00 |
| Ankerite | 0.25 | 0.25 |
| Siderite | 1.25 | 1.00 |
| Pyrite | 0.25 | 0.25 |
| Ti-Oxides | 0.25 | tr |
| Fe-Oxides | 0.00 | 0.00 |
| Apatite | 0.00 | 0.00 |
| Hydrocarbon | 0.00 | 0.00 |
| ***POROSITY*** | **8.00** | **11.50** |
| Intergranular | tr | 0.50 |
| Intragranular/Moldic | 5.00 | 7.00 |
| Microscopic | 3.00 | 3.75 |
| Transgranular/Grain Fracture | 0.00 | 0.25 |
| **TOTAL:** | **100.00** | **100.00** |

* Apatite, Garnet, Epidote, Metamorphic Chlorite, Pyroxene, Rutile, Sphene, Tourmaline, and Zircon

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2813.00 METERS**
**SAMPLE NUMBER: 43-SWC**

**PLATE 1**

| | |
|---|---|
| **Lithology:** | Welded Tuff |
| **Texture:** | Ash flow consisting predominately of plagioclase and microquartz |
| **Particle Size Range:** | <0.01mm-0.73mm |
| **Average Grain Size:** | N/A |
| **Visual Sorting:** | N/A |
| **Compaction:** | Low |
| **Detrital Grains / Allochems:** | |
| **Major:** | Intact silt-sized crystals of plagioclase, quartz, and volcanic glass |
| **Minor:** | Potassium feldspar, tuffaceous volcanic fragments, mudstone fragments (?), and metamorphic schistose fragments |
| **Accessory:** | Muscovite, biotite, organic fragments, and tourmaline |
| **Matrix:** | The matrix consists of welded tuffaceous material and minor amounts of alteration clay minerals; XRD analysis indicates that clay minerals account for 3% (by weight), with measured clays types mainly including mixed-layer illite/smectite (2%), with minor to rare amounts of illite/mica (1%), chlorite (trace), and kaolinite (trace). |
| **Cement/Replacement:** | Minor authigenic illitic clay occurs as a pore-filling and replacement of altered grains; rare replacement kaolinite, microcrystalline quartz cement occurs as part of the matrix and as rare coating on preserved grains; rare calcite and Fe-calcite replace dissolved feldspars; rare siderite occurs within secondary pores; rare pyrite replacement of detrital grains; and rare Ti-oxide coating of original particles |
| **Porosity Types:** | Minor micropores associated with clay minerals and partially dissolved grains and rare secondary intragranular pores associated with partially dissolved crystals |
| **Porosity (RCA):** | 8.7% |
| **Permeability (RCA):** | 0.0047mD |
| **Grain Density (RCA):** | 2.61gm/cc |

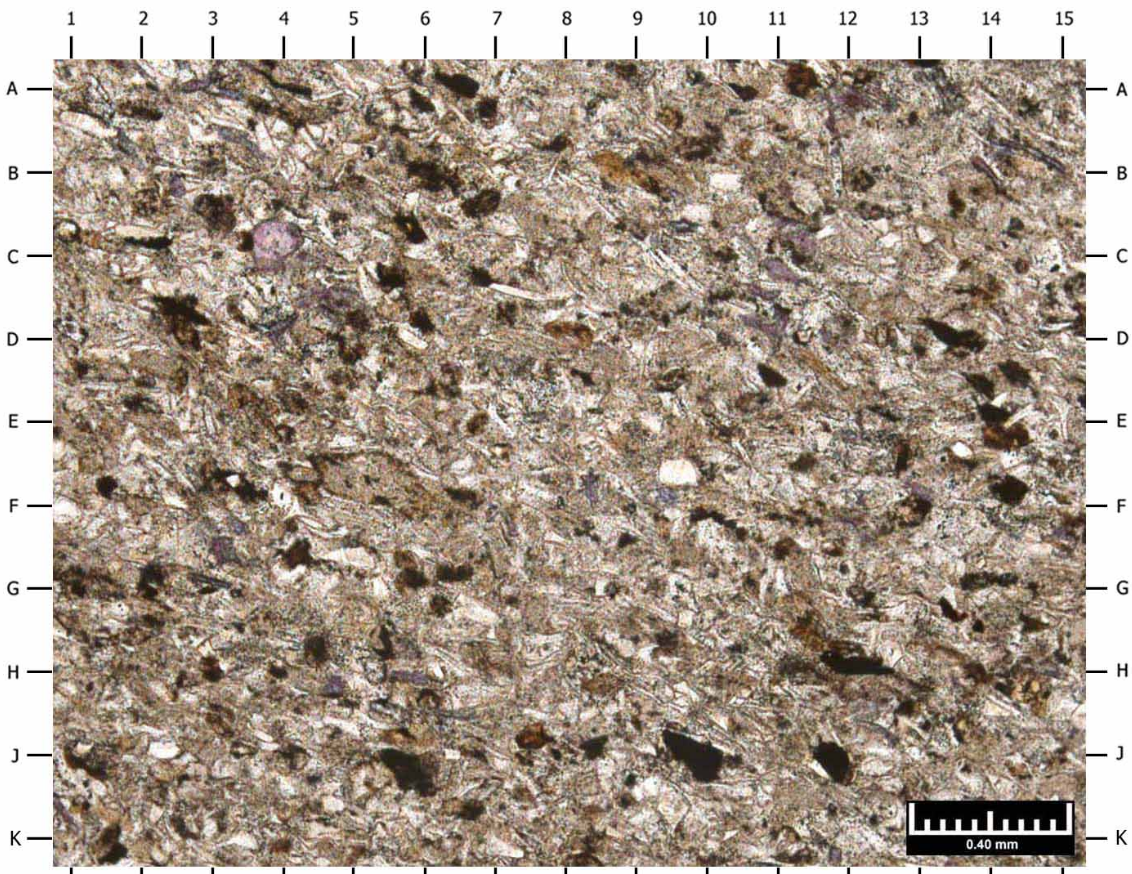
**Magnification:** A: 50X B: 200X

A) Survey photomicrograph A depicts the generally massive texture of this welded tuff. Subangular to subrounded plagioclase feldspar (F1, EF9.5), volcanic fragments (CD5), and mudstone fragments (AB8.8) are the dominant lithic types observed. Organic fragments (black; EF1.5, D13.5, J10) are scattered throughout the tuffaceous matrix.

B) This photomicrograph provides a magnified view of the area near F10 in Photo A. Authigenic ferroan calcite (DE2, DE6.5) occurs as replacement of less stable material. Microcrystalline quartz (B1.5, D11, JK9) occurs within the matrix material.

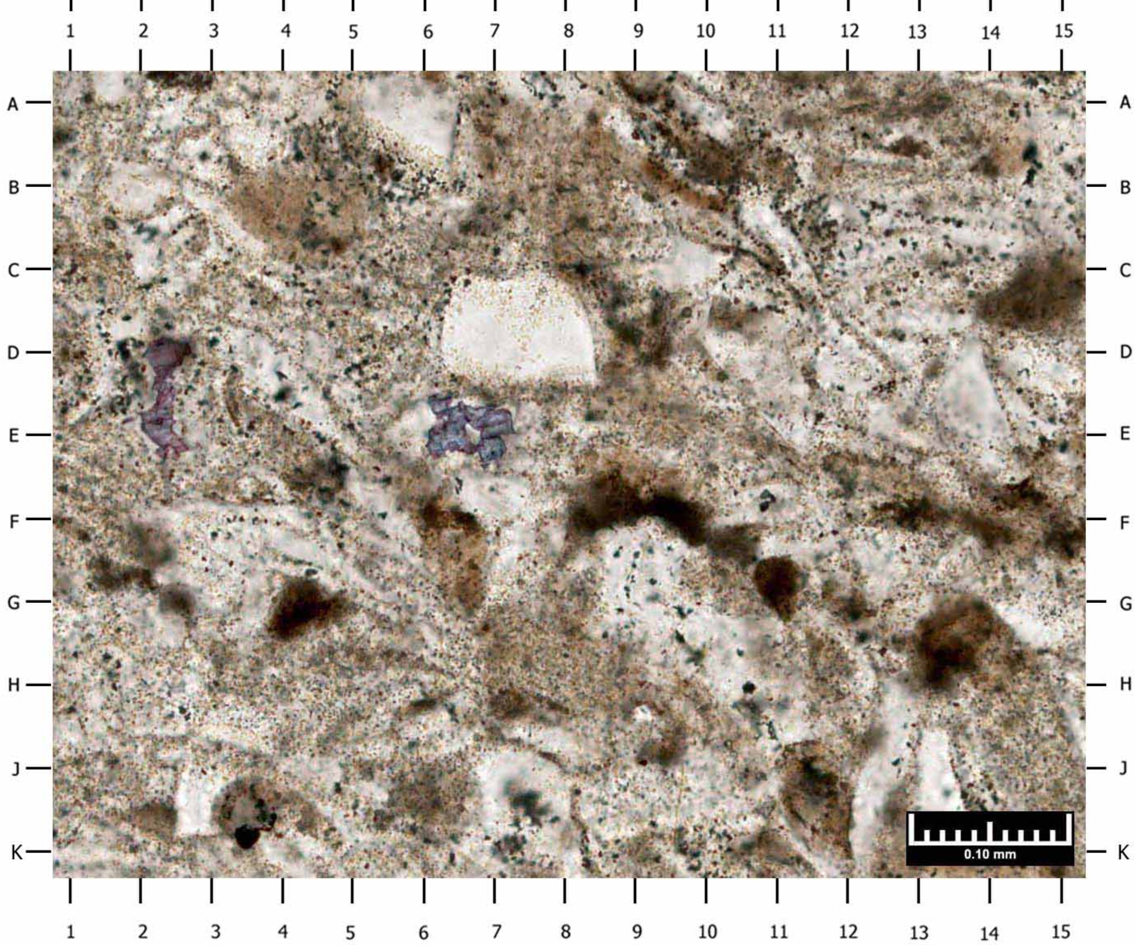
**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

**2813.0m**
**Plate 1**




**A**

**50X**




**B**

**200X**

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2872.08 METERS**
**SAMPLE NUMBER: 1-3P-DS**

**PLATE 2**

| | |
|---|---|
| **Lithology*:** | Slightly organic, argillaceous packstone |
| **Sedimentary Fabric:** | Laminated; microstylolites |
| **Particle Size Range:** | <0.01mm-12.92mm |
| **Average Grain Size:** | N/A |
| **Visual Sorting:** | Poor |
| **Compaction:** | High |
| **Framework Grains:** | |
| **Major:** | Calcareous brachiopods fragments and spines, monocrystalline quartz, and organic fragments |
| **Minor:** | Potassium feldspar, chert, tuffaceous volcanic fragments, mudstone fragments, metamorphic schistose fragments, and metaquartzite |
| **Accessory:** | Glauconite, pyroxene and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | The matrix consists of laminar, grain-supporting detrital matrix clays intermixed with common organic material and calcareous fossil fragments; XRD analysis indicates that clay minerals account for 23% (by weight), although higher values visually estimated in thin section. Measured clays types mainly include mixed-layer illite/smectite (20%), with minor amounts of illite/mica (2%), chlorite (1%), and rare kaolinite |
| **Cement/Replacement:** | Abundant authigenic calcite occurs as a replacement of calcareous allochems and detrital silt/sand sized grains, and as rare intergranular cement; minor pyrite occurs as intergranular cement and as partial replacement of organic fragments and other unstable grains; siderite occurs as a rare replacement mineral of detrital matrix clays and argillaceous fragments; minor to rare authigenic illitic clay replaces dissolved grains and matrix material; rare quartz replacement |
| **Porosity Types:** | Minor micropores associated with clay minerals and partially dissolved grains represent the only visible form of porosity |
| **Porosity (RCA):** | N/A |
| **Permeability (RCA):** | N/A |
| **Grain Density (RCA):** | N/A |

* Dunham (1962) classification based on visual estimate of sample constituents

**Magnification: A: 50X** **B: 200X**

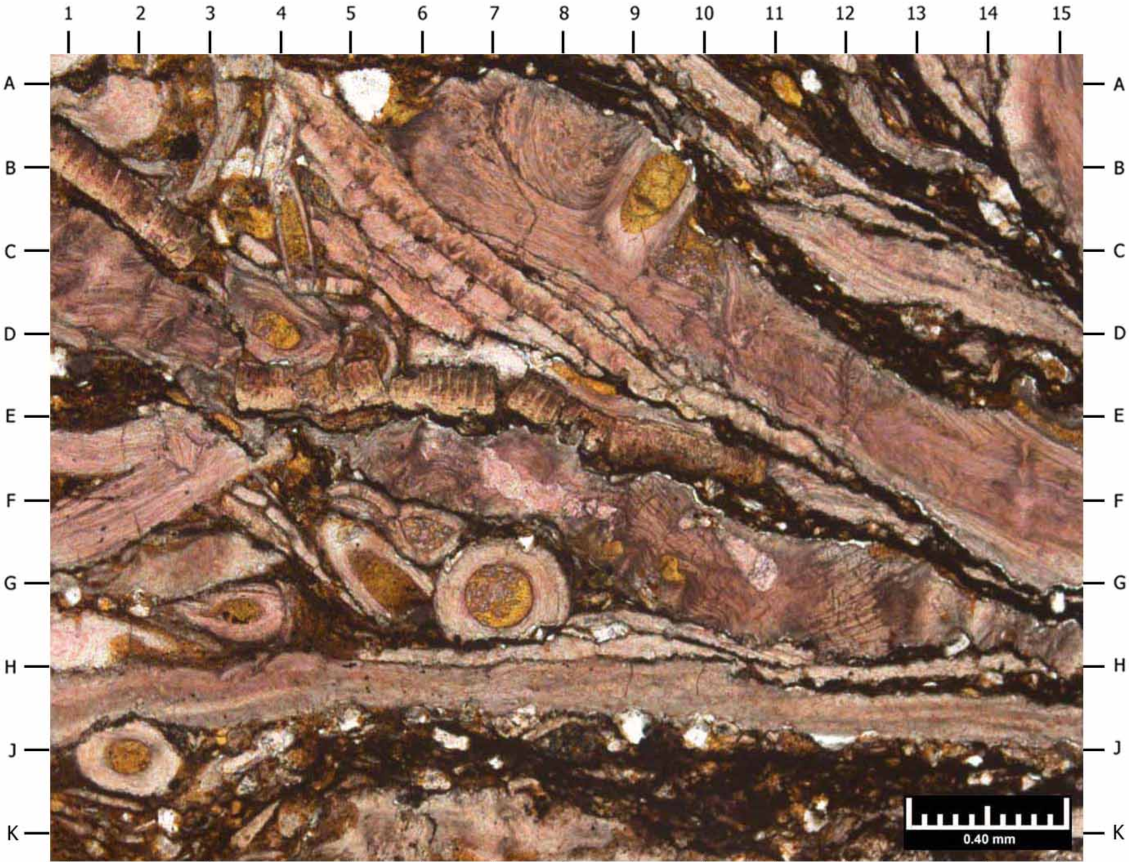
A) Survey photomicrograph A depicts the abundant amount of calcite (stained red) occurring as replacement and as cement. Organic-rich clays are also common (A10.5-C15, A7-E15, JK4-15). Brachiopod spines (D4, G7.5, J2) and fragments (B7-F15, HJ1-15, EF2) represent the dominant detrital constituent.

B) This photomicrograph provides a magnified view of the area near DE4 in Photo A. Possible siderite (yellow; AB8, EF7) occurs as replacement and fills the interior of the recrystallized fossil fragments.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

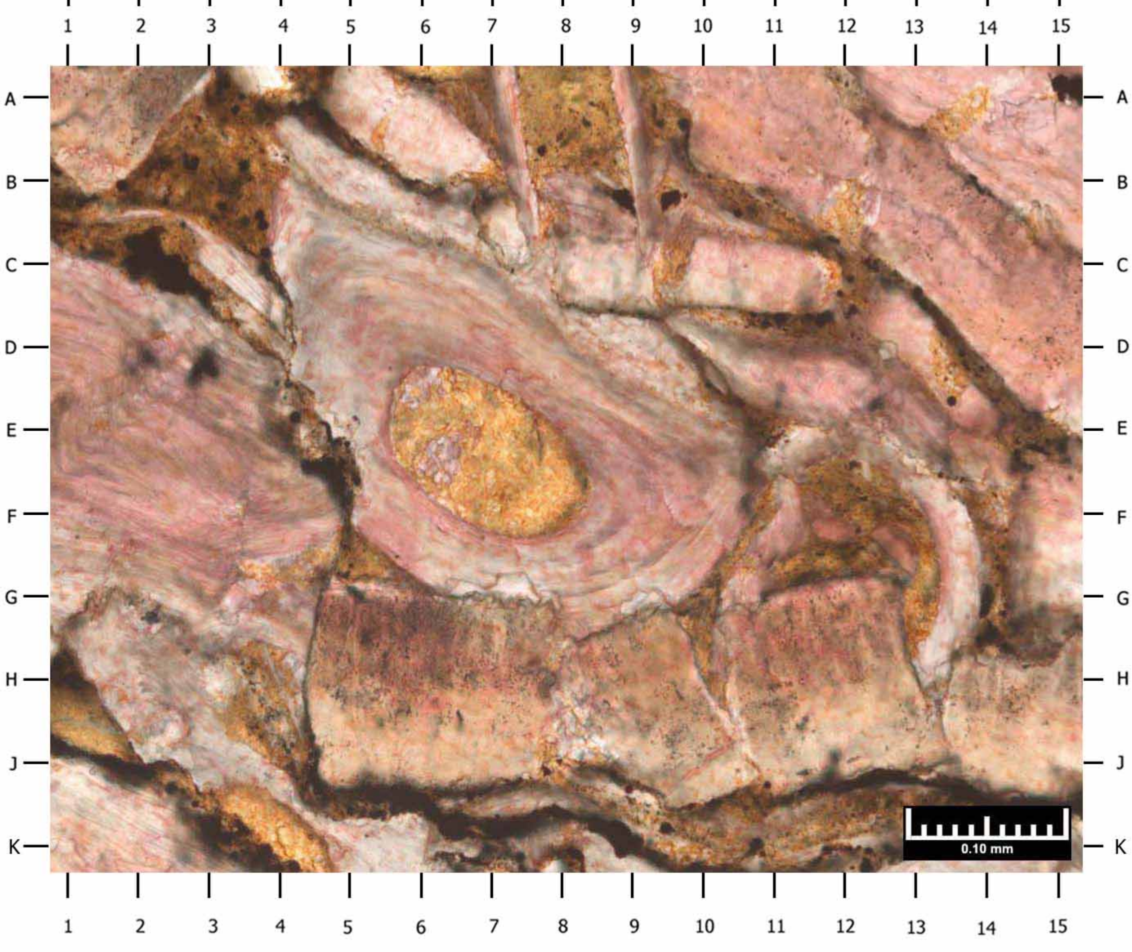
2872.1m
Plate 2

Weatherford
LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2877.04 METERS**
**SAMPLE NUMBER: 1_8P-DS**

**PLATE 3**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm -1.14mm |
| **Average Grain Size:** | 0.27mm |
| **Compaction:** | Very high |
| **Sorting:** | Poor |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar |
| **Minor:** | Monocrystalline quartz, potassium feldspar, chert, mudstone fragments, siltstone fragments, volcanic rock fragments, metamorphic rock fragments, siltstone fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, chamosite, tourmaline, and zircon |
| **Clay Content:** | |
| **Detrital Matrix:** | Common amounts of volcanic ash intermixed with minor to trace amounts of detrital clays |
| **Authigenic Clay:** | Minor to trace amounts of illite and smectite |
| **Cement/Replacement:** | Quartz and feldspar overgrowths; microquartz; Fe-dolomite, Fe-calcite, siderite, and pyrite replacement |
| **Porosity Types:** | Micropores associated with clays |
| **Porosity (RCA):** | 5.9% |
| **Permeability (RCA):** | 0.0098mD |
| **Grain Density (RCA):** | 2.70gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

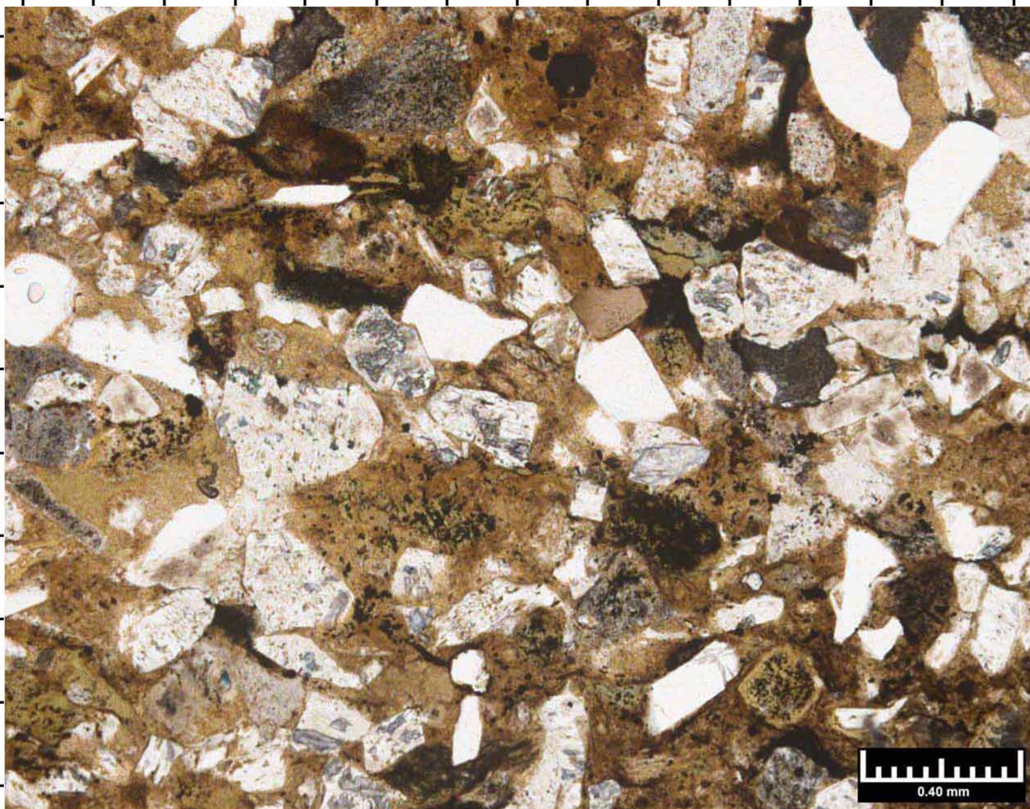
A) Survey photomicrograph A depicts the massive fabric of this lithic arkose Common amounts of clays (likely volcanic ash) occlude primary pores; however micropores are associated with these clays. Fine to medium sand-sized quartz (D1, C14, HJ10.5) and plagioclase (B3.5, CD14.5, F4.5) grains compose the majority of the detrital constituents.

B) This photomicrograph provides a magnified view of the area near D2 in Photo A. Pyrite (black; E14.5, GH9.2) occurs as replacement of less stable matrix material. Ferroan dolomite (stained blue) partially replaces an unstable lithic grain (DE8).

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

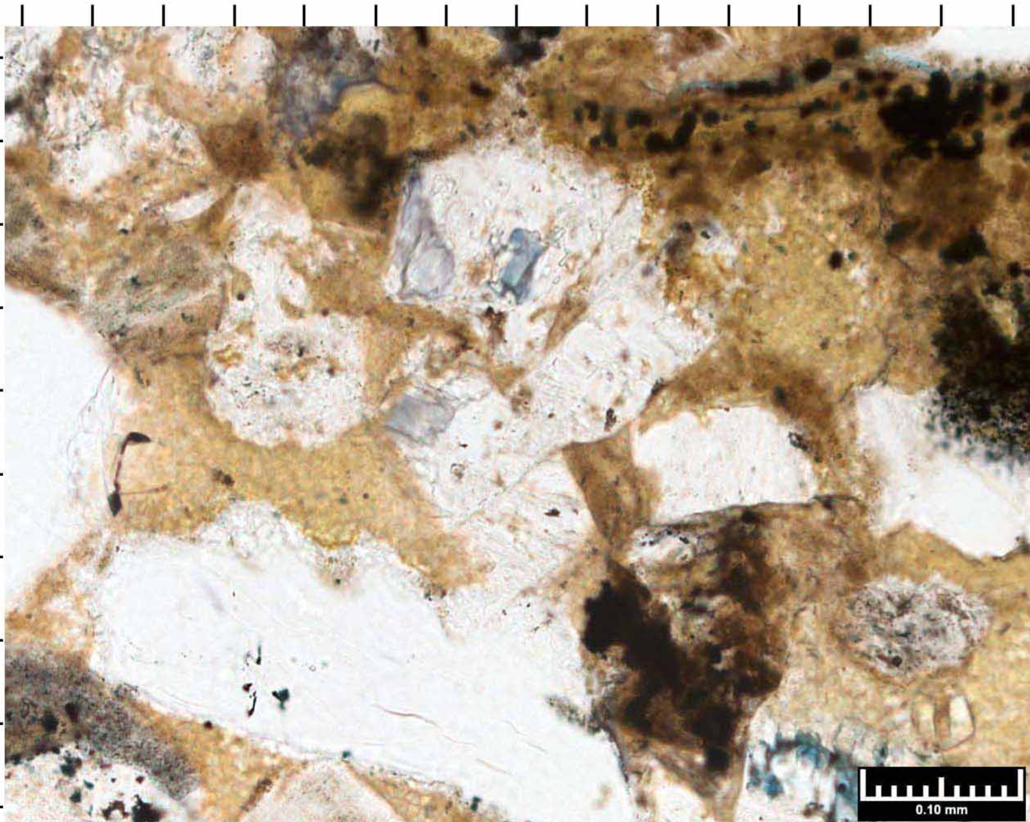
2877.0m
Plate 3

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2878.05 METERS**
**SAMPLE NUMBER: 1_10P-DS**

**PLATE 4**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-3.42mm |
| **Average Grain Size:** | 0.49mm |
| **Compaction:** | Low |
| **Sorting:** | Poor to moderately well |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar, monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic rock fragments, mudstone fragments, siltstone fragments, metaquartzite, metamorphic rock fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, phosphatic grains, chamosite, organic material, and zircon |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of chlorite and kaolinite |
| **Cement/Replacement:** | Common amounts of calcite occurring as replacement and cement; quartz and feldspar overgrowths; and Fe-dolomite replacement; siderite and pyrite |
| **Porosity Types:** | Micropores associated with clays; rare secondary intragranular pores |
| **Porosity (RCA):** | 3.3% |
| **Permeability (RCA):** | 0.0040mD |
| **Grain Density (RCA):** | 2.75gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

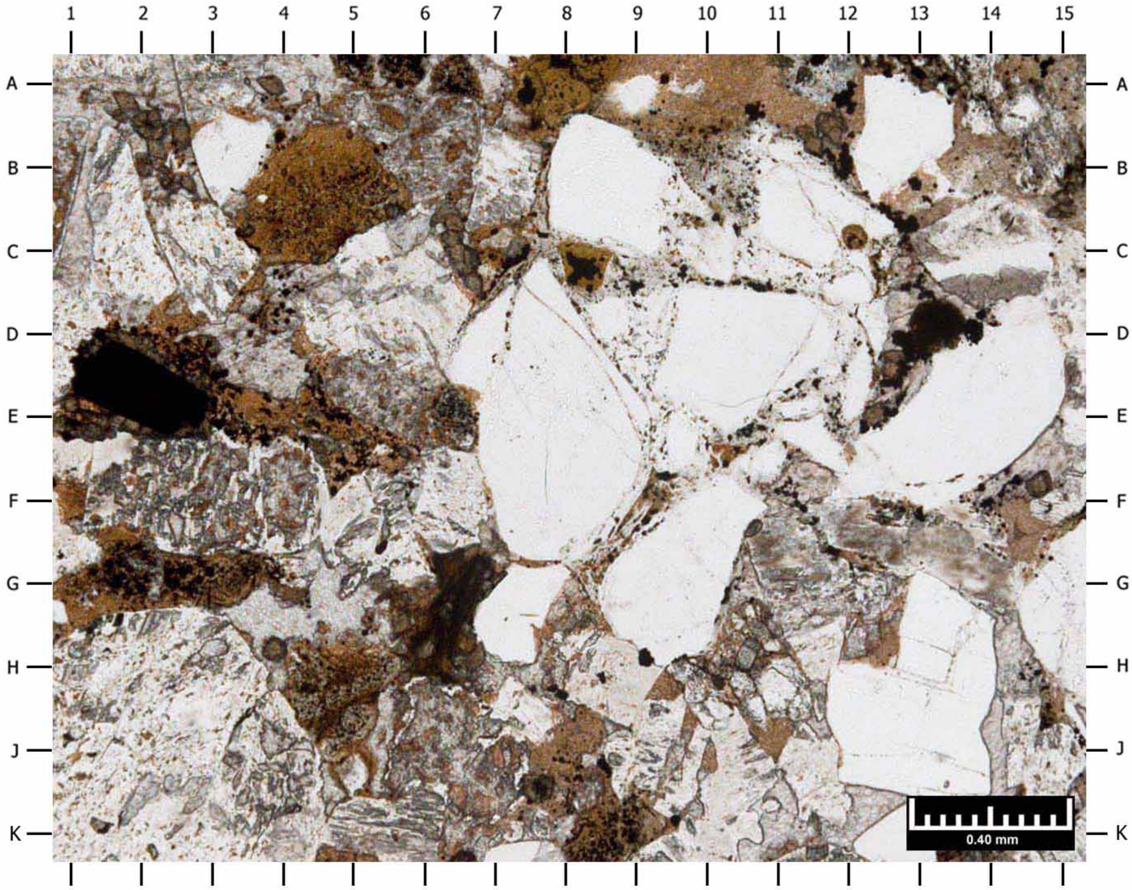
A) The detrital constituents in this massive, lithic arkose include monocrystalline quartz grains (AB12.9, B8.5, E7.5, E13.5, HJ13), plagioclase feldspar (C1.5, JK10.5, H8.8), and chert fragments (C14). Well-developed quartz overgrowths (CD8, EF13) precipitate in optical continuity with host detrital grains.

B) This photomicrograph provides a magnified view of the area near CD7 in Photo A. Ferroan dolomite (stained blue; AB8.5, B5-E6) and pyrite (black; DE13) occur as replacement of susceptible material.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

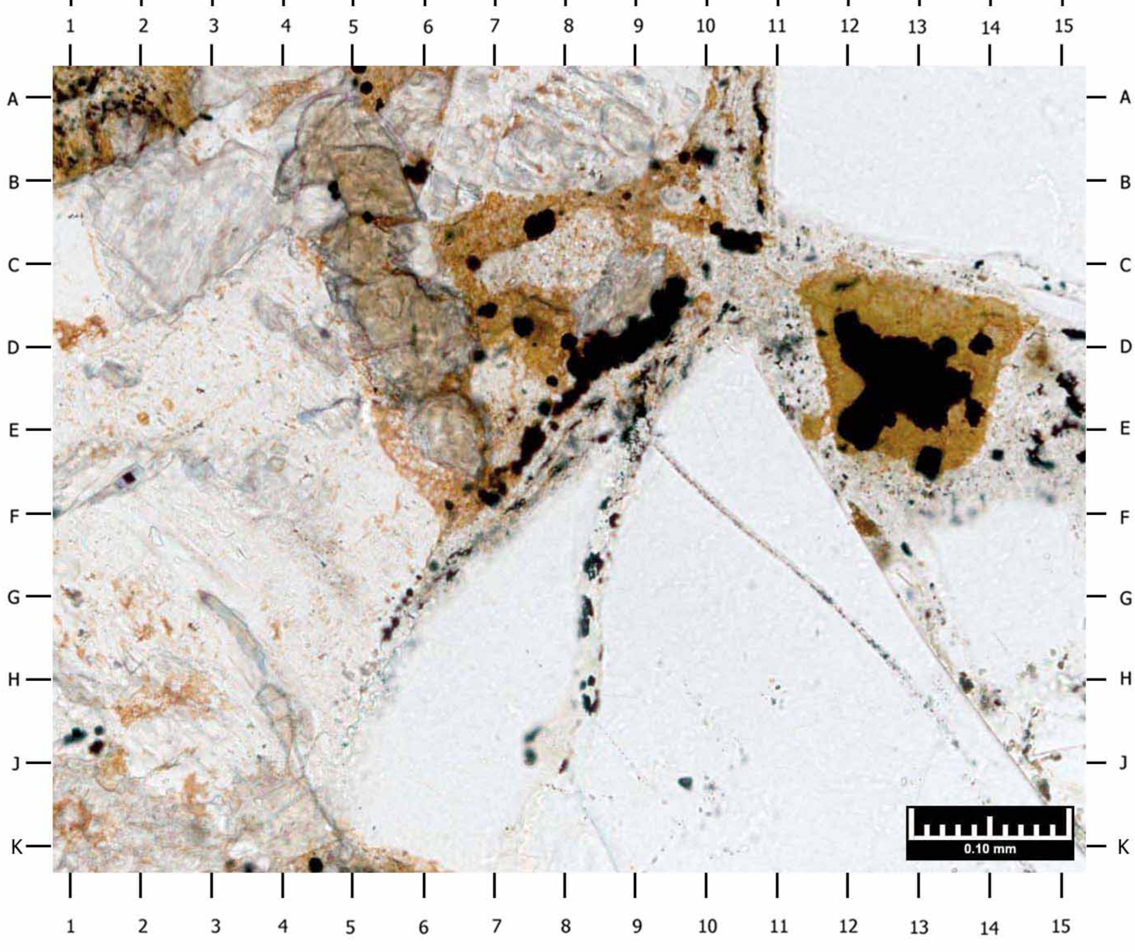
2878.1m
Plate 4

Weatherford LABORATORIES




A

50X




B

200X

## THIN SECTION DESCRIPTION
## SAMPLE DEPTH: 2887.10 METERS
## SAMPLE NUMBER: 1_19P-DS

## PLATE 5

| | |
|---|---|
| **Lithology*:** | Litharenite |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | 0.02mm-7.03mm |
| **Average Grain Size:** | 0.49mm |
| **Compaction:** | Low |
| **Sorting:** | Very poor |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz |
| **Minor:** | Plagioclase feldspar, potassium feldspar, chert, volcanic fragments, calcareous fossil fragments (brachiopods shells and spines), mudstone rock fragments, siltstone fragments, metaquartzite, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | No detrital clays observed |
| **Authigenic Clay:** | Minor amounts of illite, chlorite, and kaolinite |
| **Cement/Replacement:** | Calcite replacement and cement, Fe-dolomite, pyrite, and rare siderite |
| **Porosity Types:** | Rare amounts of micropores associated with clays |
| **Porosity (RCA):** | 1.8% |
| **Permeability (RCA):** | 0.017mD |
| **Grain Density (RCA):** | 2.71gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

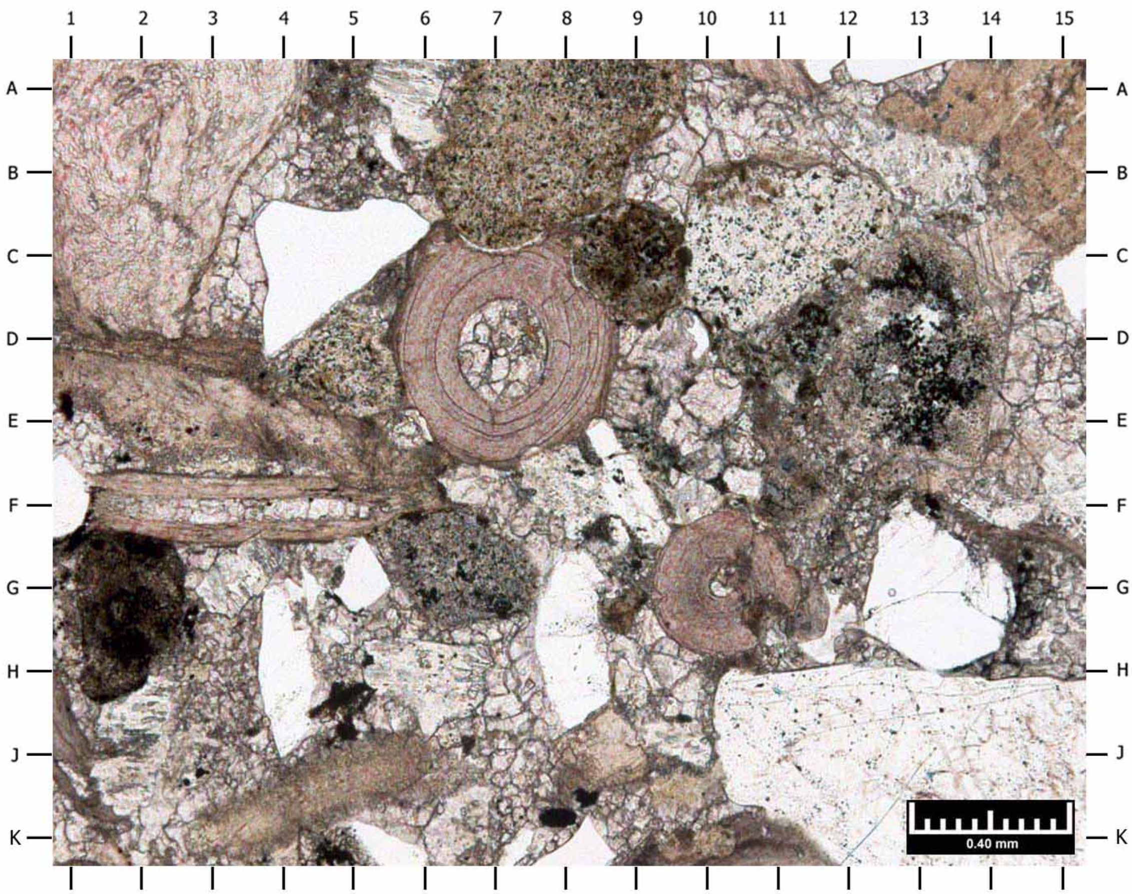
A) General photomicrograph A displays detrital quartz grains (C4.5, F1, H4, G13.5), brachiopod spines (C-F7, F-H10), calcareous shell fragments (EF2-5) and altered volcanic fragments (DE13). Abundant amounts of calcite (stained red) occur as replacement of susceptible material and interparticle cement.

B) This photomicrograph provides a magnified view of the area near EF5.5 in Photo A, highlighting the bands of the brachiopod spine. Pyrite (black specks; AB1, J11.9) replaces unstable material.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

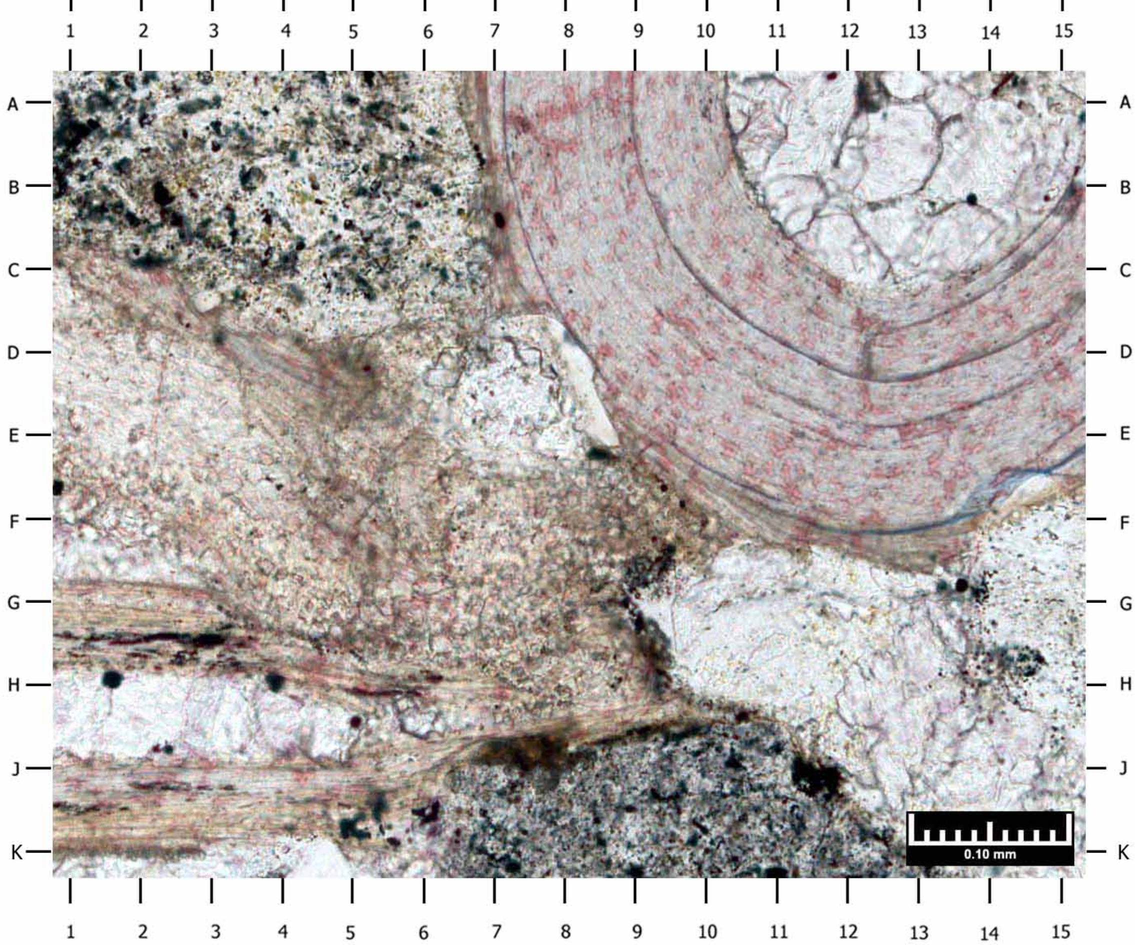
2887.1m
Plate 5

Weatherford
LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2888.12 METERS**
**SAMPLE NUMBER: 1_20P-DS**

**PLATE 6**

| | |
|---|---|
| **Lithology*:** | Feldspathic litharenite |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-1.18mm |
| **Average Grain Size:** | 0.34mm |
| **Compaction:** | Low to moderate |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz |
| **Minor:** | Plagioclase feldspar, polycrystalline quartz, metaquartzite, potassium feldspar, chert, volcanic fragments, fossil fragments, metamorphic rock fragments, siltstone fragments, and mudstone rock fragments |
| **Accessory:** | Muscovite mica, biotite mica, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor altered volcanic clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite and chlorite |
| **Cement/Replacement:** | Common calcite, quartz overgrowths, feldspar overgrowths, Fe-dolomite, microquartz, Fe-calcite, sericite, siderite and pyrite |
| **Porosity Types:** | Micropores associated with clays; and secondary intragranular pores associated with leached grains |
| **Porosity (RCA):** | 5.0% |
| **Permeability (RCA):** | 0.0063mD |
| **Grain Density (RCA):** | 2.70gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

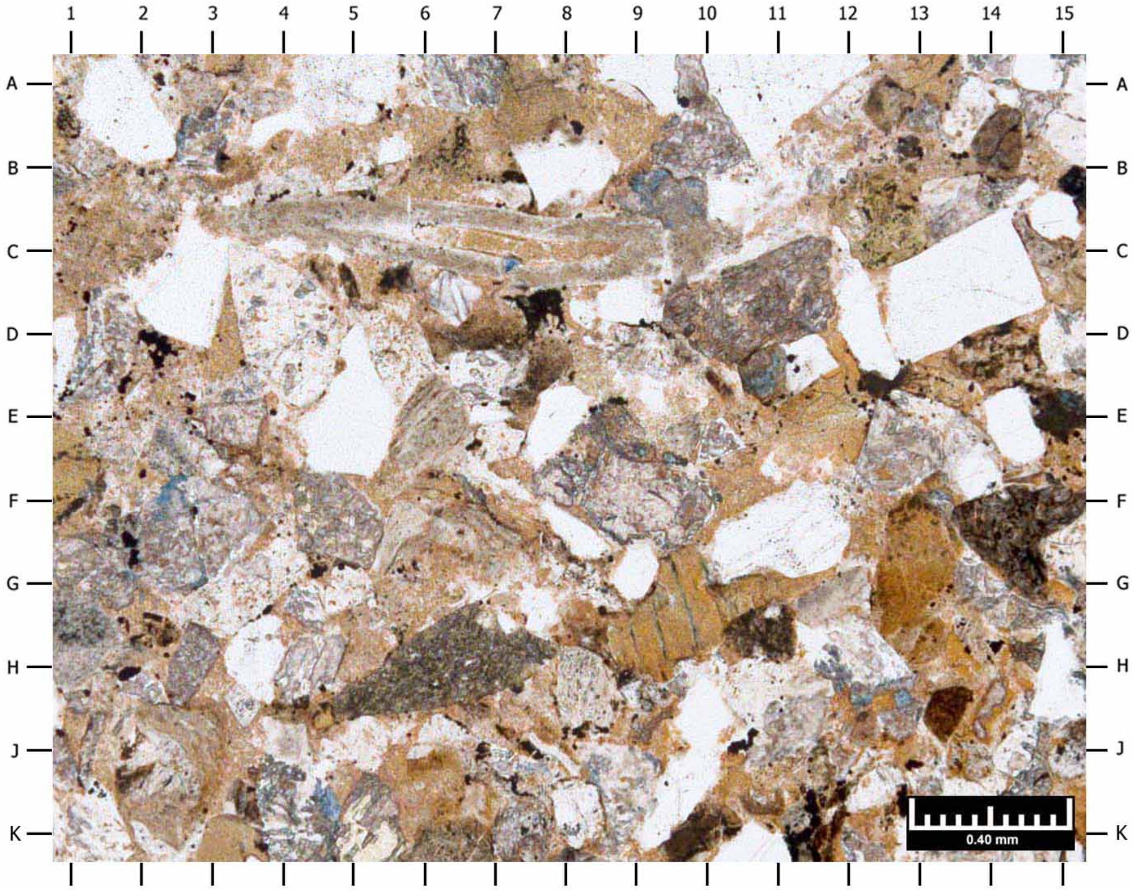
A) This low magnification photomicrograph provides a general overview of this massive feldspathic litharenite. Detrital quartz grains are observed (AB1.5, CD13.5, E5). Remnants of dissolved feldspars/lithic fragments (FG2.5, JK4, HJ12) contain intragranular pores (blue epoxy). Detrital volcanic clays (stained yellow) fill intergranular areas. A chert replaced fossil fragment occurs at BC3-C9.

B) This photomicrograph provides a magnified view of the area near EF8 in Photo A. Ferroan dolomite (stained blue; EF13, F14.8) and pyrite (black; C11.8, CD5, EF3.2) occur as replacement of susceptible material.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

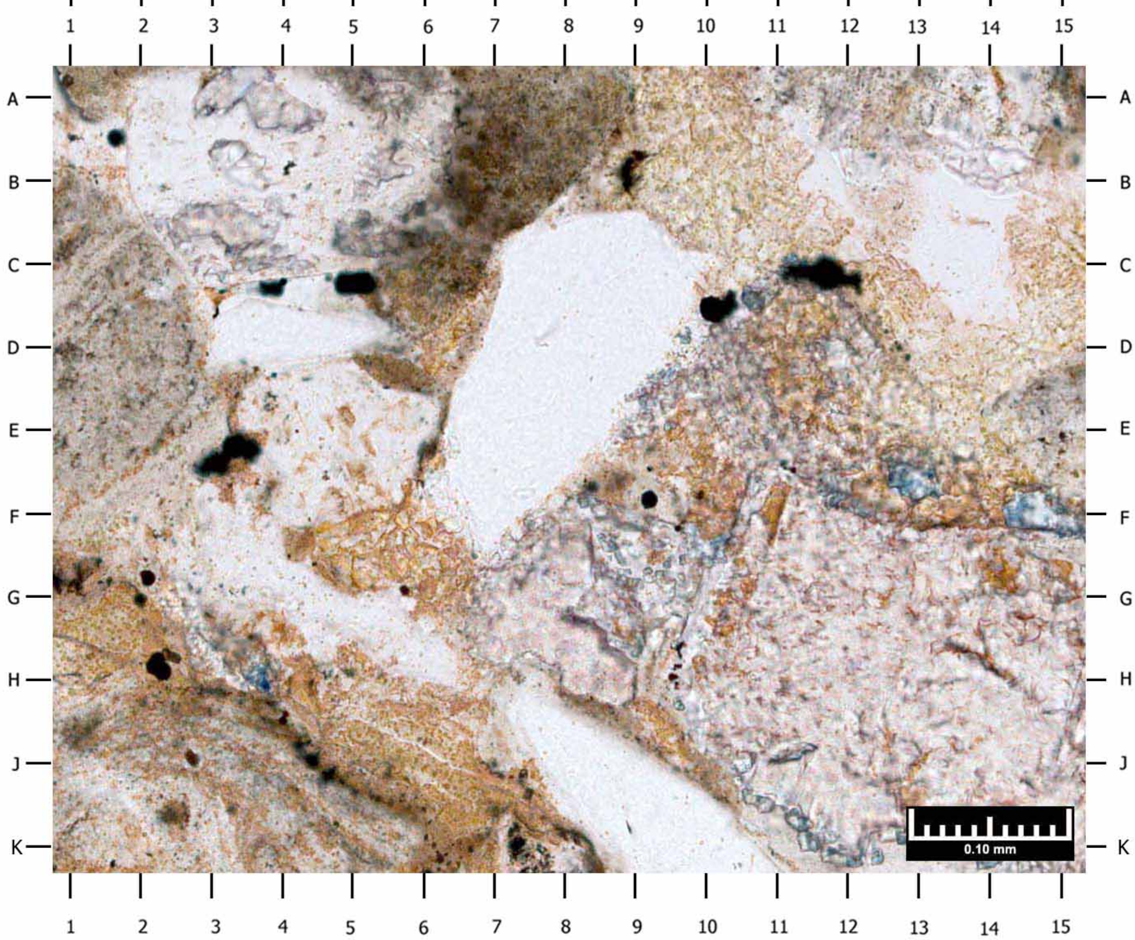
2888.1m
Plate 6

Weatherford
LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2895.09 METERS**
**SAMPLE NUMBER: 1_27P-DS**

**PLATE 7**

| | |
|---|---|
| **Lithology*:** | Lithic Arkose |
| **Sedimentary Fabric:** | Laminated to massive |
| **Grain Size Range:** | <0.01mm-1.37mm |
| **Average Grain Size:** | 0.07/0.49mm |
| **Compaction:** | Low to moderate |
| **Sorting:** | Moderate to poor |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar, monocrystalline quartz and volcanic rock fragments |
| **Minor:** | Polycrystalline quartz, potassium feldspar, chert, mudstone rock fragments, siltstone fragments, granitic fragments, and metamorphic rock fragments |
| **Accessory:** | Muscovite mica, biotite mica, tourmaline, and zircon |
| **Clay Content:** | |
| **Detrital Matrix:** | Common amounts of volcanic clays |
| **Authigenic Clay:** | Minor amounts of illite |
| **Cement/Replacement:** | Feldspar overgrowths, quartz overgrowths, Fe-calcite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, and primary intergranular pores |
| **Porosity (RCA):** | 5.9% |
| **Permeability (RCA):** | 0.020mD |
| **Grain Density (RCA):** | 2.67gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

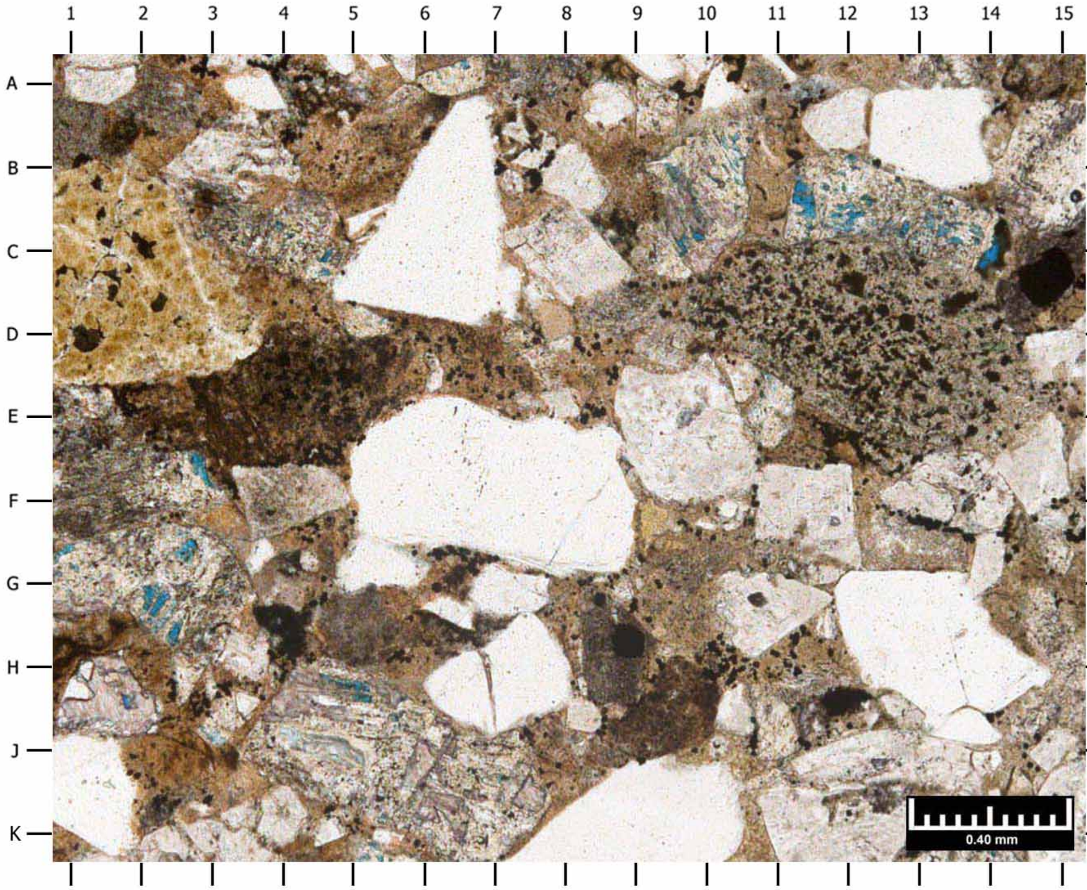
A) This laminated to massive lithic arkose contains abundant amounts of detrital plagioclase and quartz grains (C6, F7, JK9), with lesser amounts of chert (BC8) and calcite-replaced lithic fragments (stained red; B10, HJ1.5). Intragranular pores occur within leached lithic fragments (blue epoxy; BC11.2, C14, EF2.5, GH2.2).

B) This photomicrograph provides a magnified view of the area near C9 in Photo A. Calcite (stained red; A12-DE13) and pyrite (black; DE14.5, HJ6, JK8) occur as replacement of less stable material. Secondary intragranular pores (AB12.5, C13, CD12) are present.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

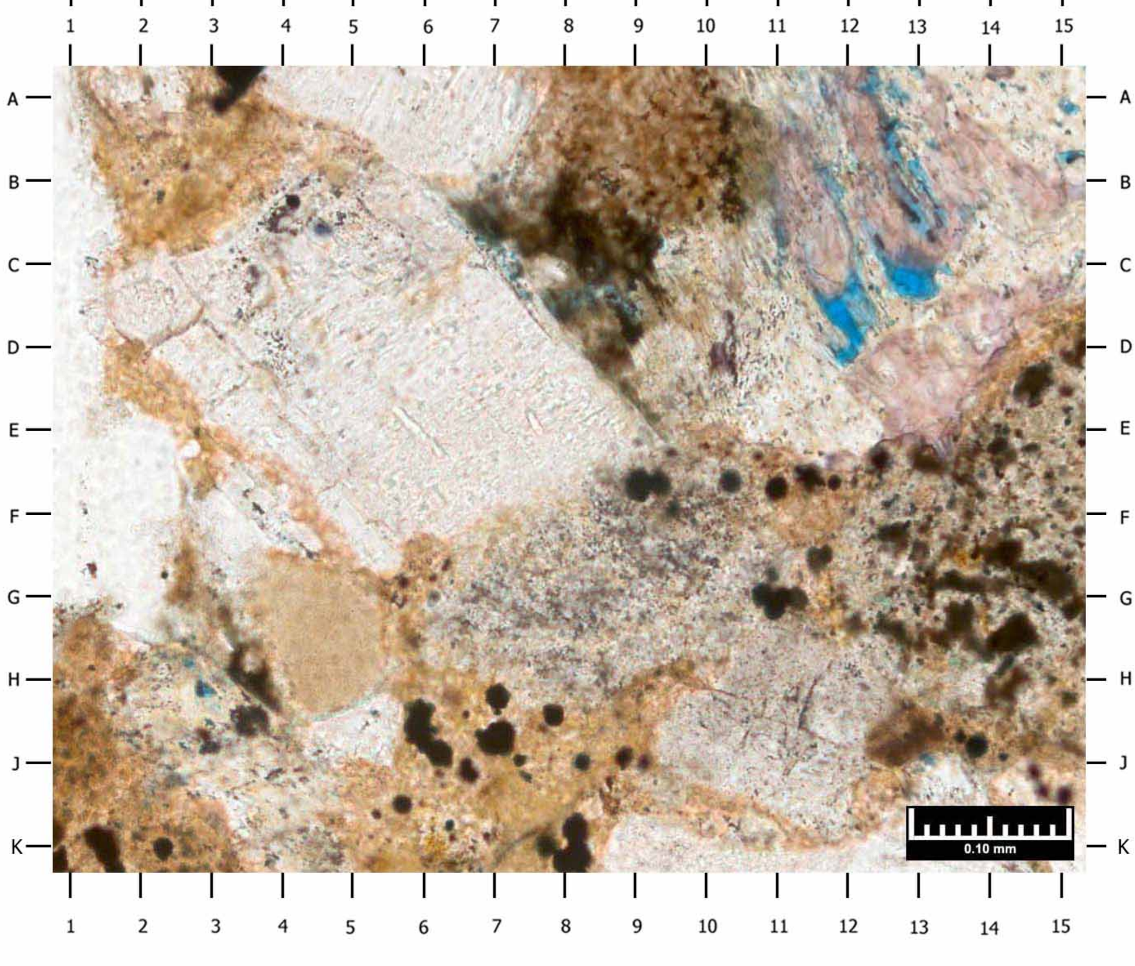
2895.1m
Plate 7

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2896.07 METERS**
**SAMPLE NUMBER: 1_28P-DS**

**PLATE 8**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-1.25mm |
| **Average Grain Size:** | 0.34mm |
| **Compaction:** | Low to moderate |
| **Sorting:** | Moderately well |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, chamosite, and apatite |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite and chlorite |
| **Cement/Replacement:** | Feldspar overgrowths, quartz overgrowths, calcite, Fe-calcite, Fe-dolomite, siderite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, rare primary intergranular pores, and trace amounts of grain fracture pores |
| **Porosity (RCA):** | 10.6% |
| **Permeability (RCA):** | 0.023mD |
| **Grain Density (RCA):** | 2.65gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

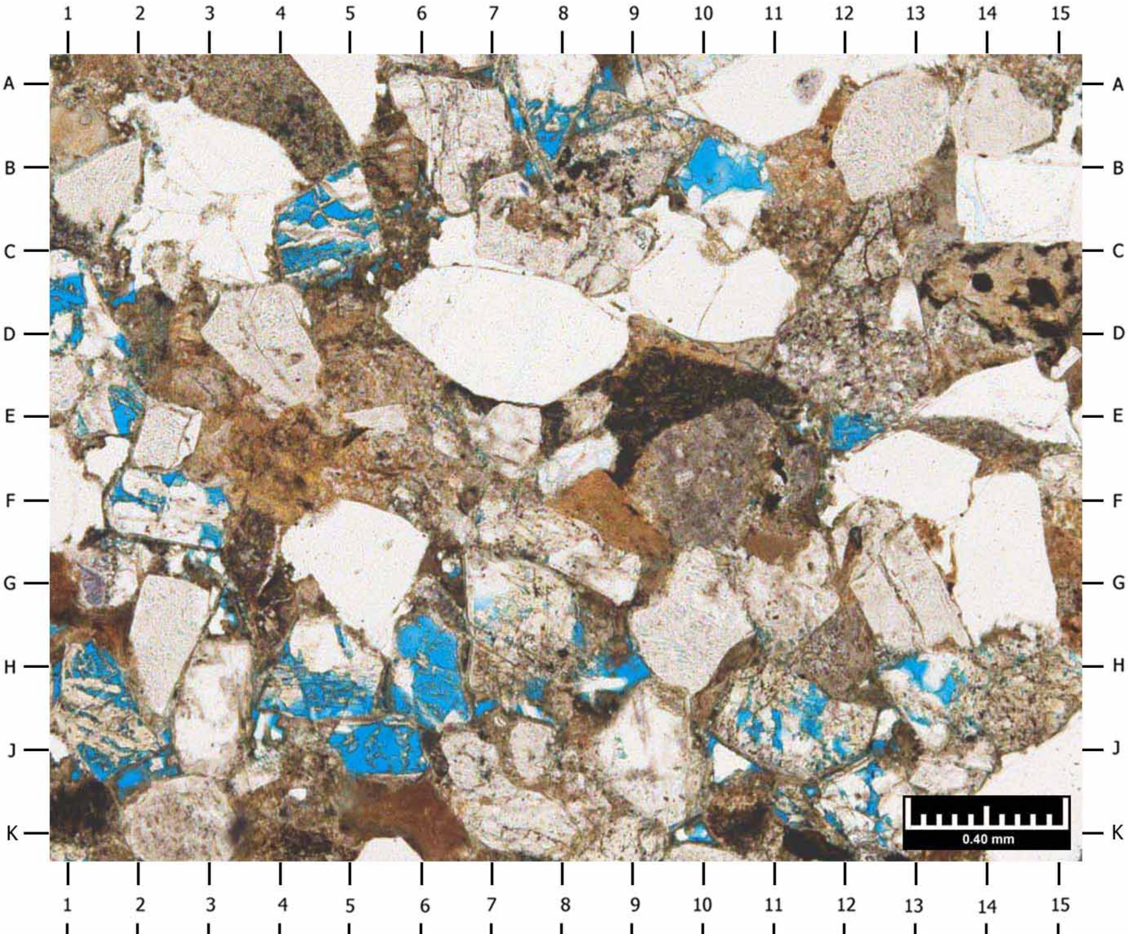
A) This low magnification photomicrograph illustrates the massive, moderately well sorted lithic arkose. Volcanic rock fragments (CD14.5), chert (AB12, DE1, G13), monocrystalline quartz (A5, CD10, FG14), and mudstone fragments (G12, EF8) are the main detrital grain types observed. Quartz overgrowths (F11.2, EF13.2) precipitate on host detrital grains. Secondary intragranular pores (blue epoxy; BC4.5, HJ13, HJ5), associated with dissolution, represent the dominant pore type.

B) This photomicrograph provides a magnified view of the area near BC7.5 in Photo A. Intragranular pores (blue epoxy; A6, B8) occur within partially dissolved feldspar/lithic fragments and rare primary pores occur between detrital grains (EF1.5, DE13). A very rare primary intergranular pore is also observed (DE7). Pyrite replaces unstable material (black; BC9.5, D12.5).

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

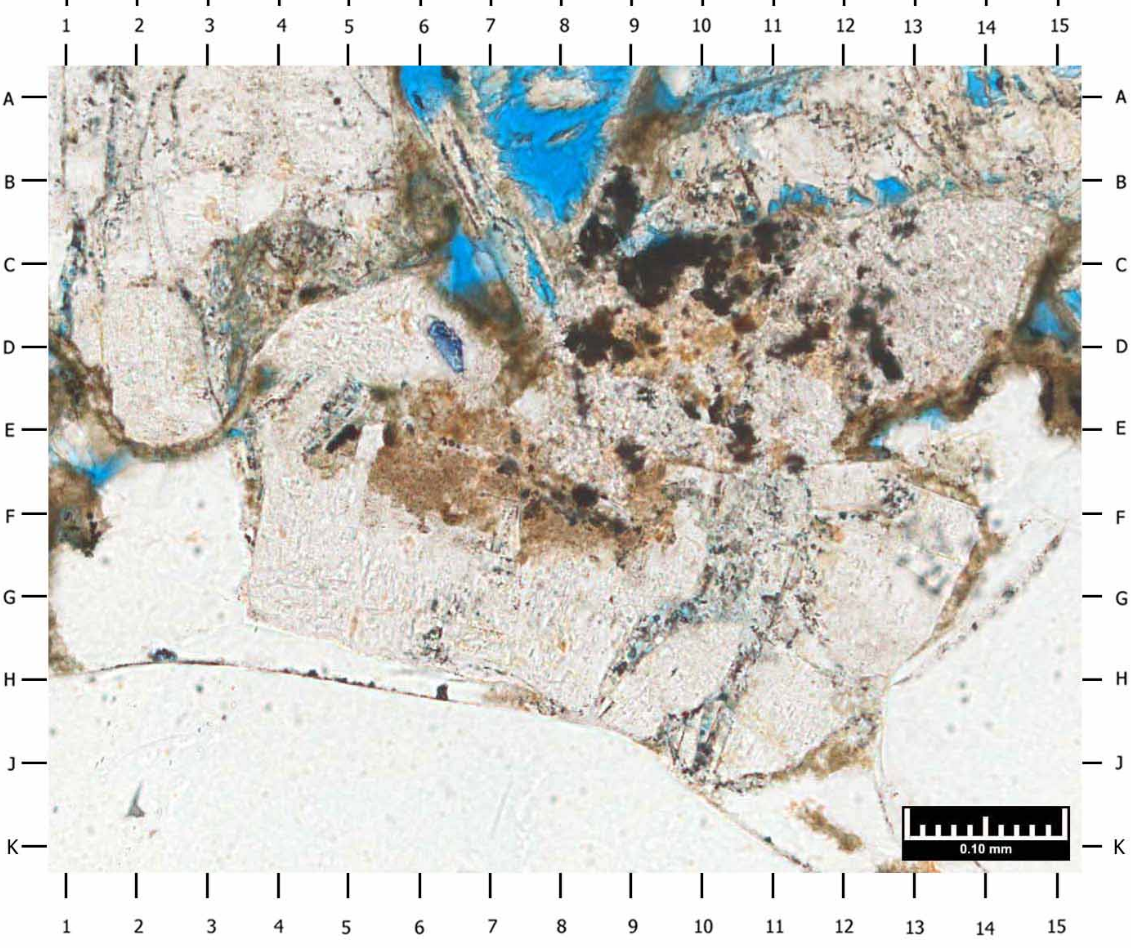
2896.1m
Plate 8

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2897.06 METERS**
**SAMPLE NUMBER: 2_2P-DS**

**PLATE 9**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-7.94mm |
| **Average Grain Size:** | 0.74mm |
| **Compaction:** | Moderate |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, chamosite, tourmaline, organic material, and zircon |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite and chlorite |
| **Cement/Replacement:** | Feldspar overgrowths, quartz overgrowths, microquartz, calcite, Fe-calcite, Fe-dolomite, siderite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, rare primary intergranular pores, and trace amounts of grain fracture pores |
| **Porosity (RCA):** | 11.9% |
| **Permeability (RCA):** | 0.062mD |
| **Grain Density (RCA):** | 2.65gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) Plagioclase feldspar (D5, H13, K13) and volcanic fragments (F14.5, J3) are the main lithic types observed within this moderately sorted lithic arkose. Monocrystalline quartz is common (BC4, C14, HJ11). Incipient quartz overgrowths (C2.2, H1, CD15) precipitate on host detrital grains. Authigenic calcite (stained red) cements fills intergranular areas (C7.5, D4-EF3, D15, EF10-K9). Secondary intragranular pores occur within partially altered grains (blue epoxy; E11-13).

B) This photomicrograph provides a magnified view of the area near D7 in Photo A, depicting minor amounts of pore occluding clays intermixed with rare amounts of organic material (G3.5-K1, A10). Calcite (stained red) occurs as cement and replacement.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2897.1m
Plate 9

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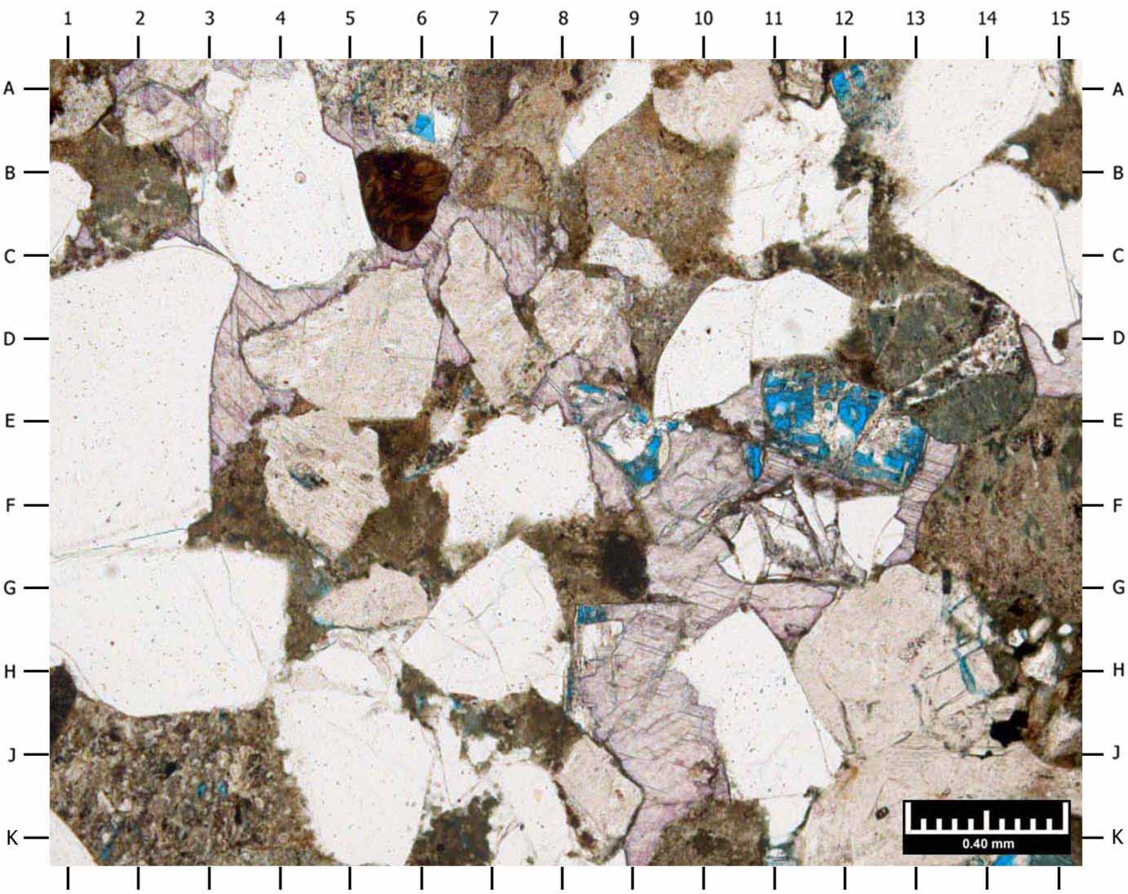
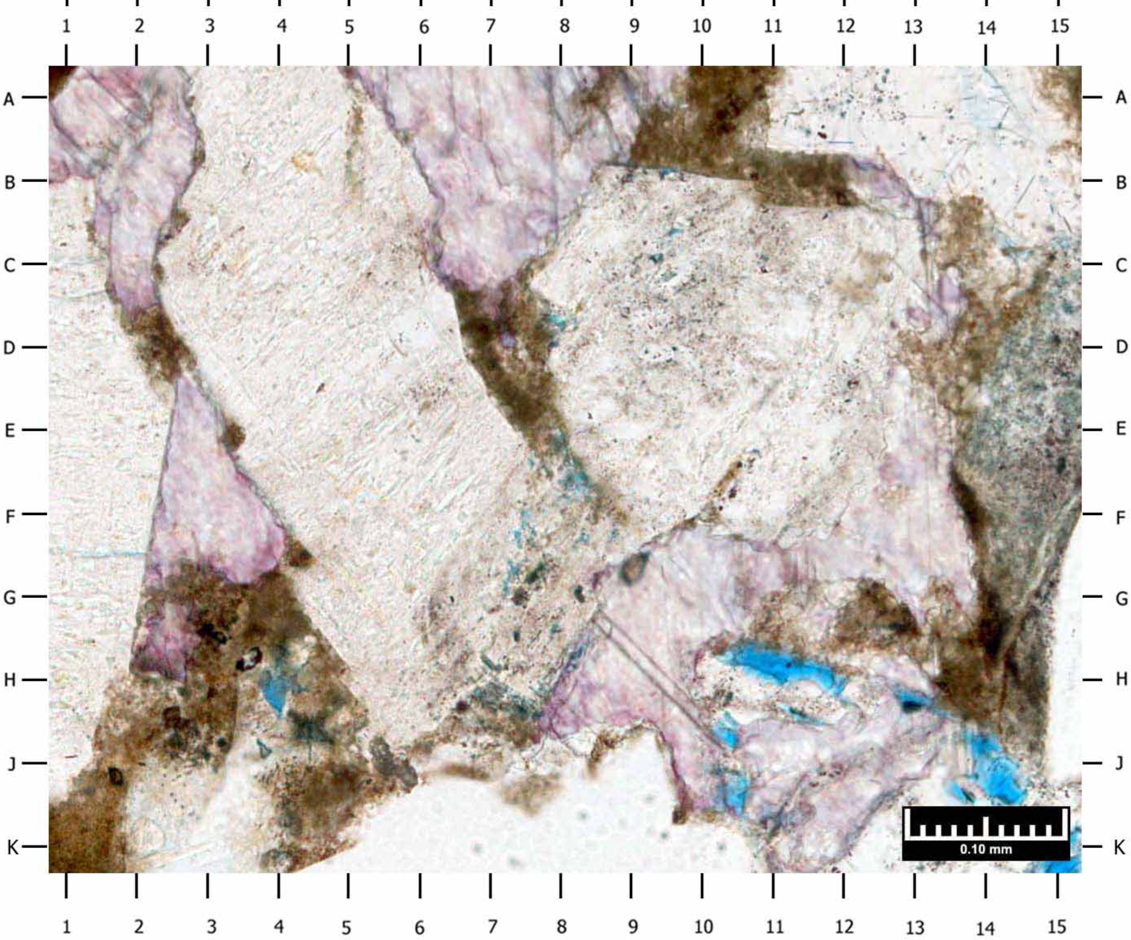



A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2898.51 METERS**
**SAMPLE NUMBER: 21-RCA**

**PLATE 10**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive; coarse upwards |
| **Grain Size Range:** | <0.01mm-1.94mm |
| **Average Grain Size:** | 0.32mm |
| **Compaction:** | Moderate to high |
| **Sorting:** | Moderate to moderately well |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metaquartzite, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, chamosite, tourmaline, organic material, and zircon |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite and chlorite |
| **Cement/Replacement:** | Feldspar overgrowths, quartz overgrowths, microquartz, calcite, Fe-calcite, siderite, Ti-oxide, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, rare primary intergranular pores, and trace amounts of grain fracture pores |
| **Porosity (RCA):** | N/A |
| **Permeability (RCA):** | N/A |
| **Grain Density (RCA):** | N/A |

*Folk classification based on visual estimate of sample constituents

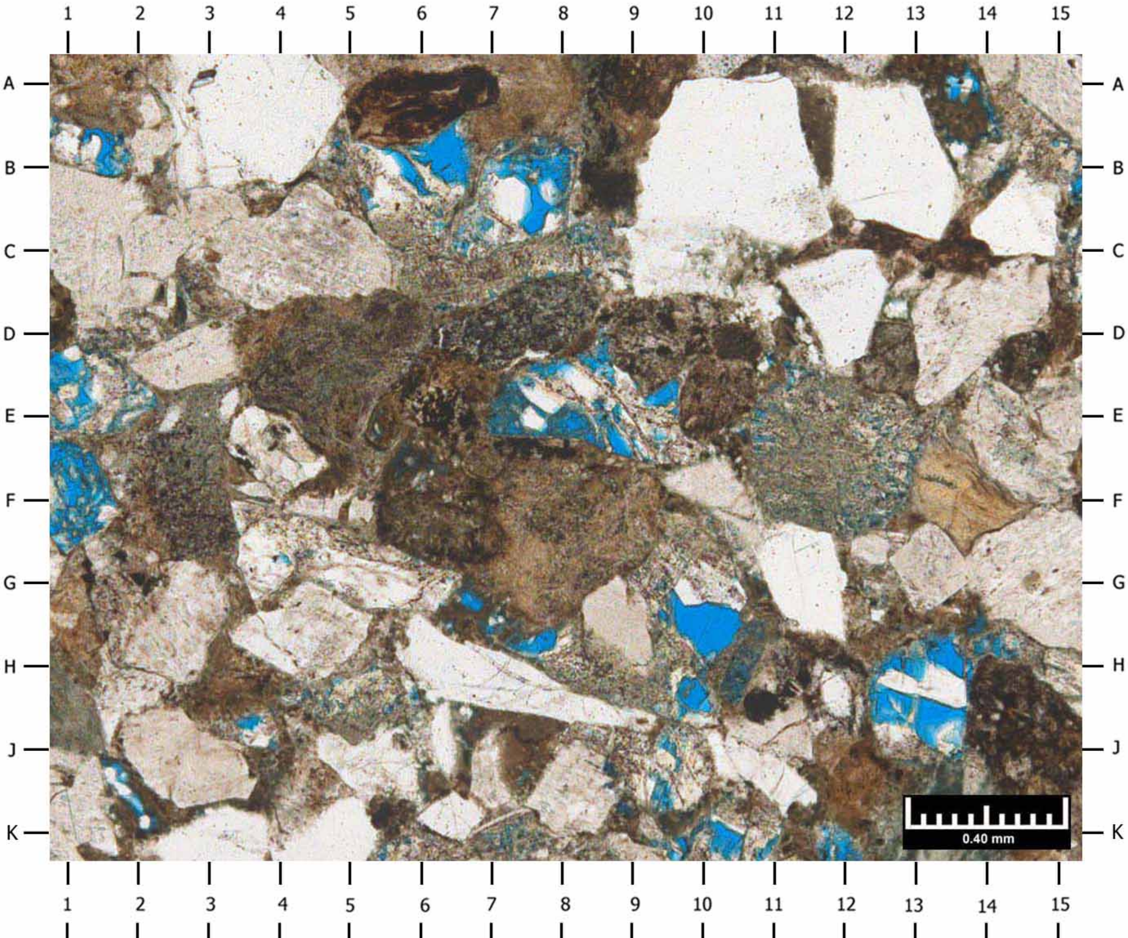
**Magnification:** A: 50X B: 200X

A) The massive fabric of this lithic arkose is depicted in this survey photomicrograph. Detrital plagioclase feldspar (C4, G15, J2.5) and quartz grains (AB4, B12.5, G11.9) are the dominant grain types, with lesser amounts of volcanic fragments (EF12) and chert. Authigenic clays (H1, HJ3.5) locally fill primary intergranular areas.

B) This photomicrograph provides a detailed view of the area near H13.5 in Photo A. An unstable lithic fragment has been altered to clay (EF9-J15). Leached feldspar/lithic grains contain intragranular pores (blue epoxy; DJ6).

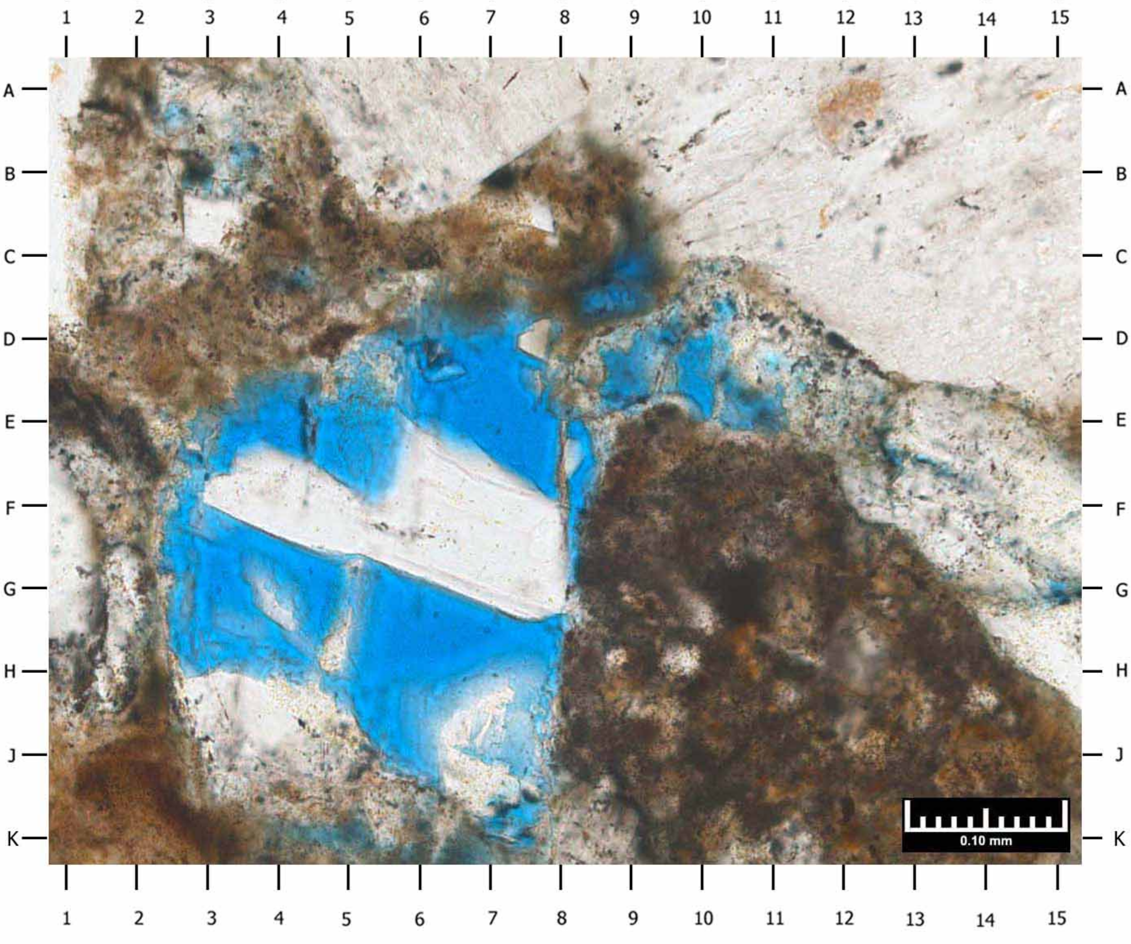
QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2898.5m
Plate 10




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2901.06 METERS**
**SAMPLE NUMBER: 2_6P-DS**

**PLATE 11**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-2.09mm |
| **Average Grain Size:** | 0.41mm |
| **Compaction:** | Moderate |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, granitic fragments, mudstone rock fragments, siltstone fragments, metaquartzite, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, chamosite, tourmaline, and organic material |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite clays |
| **Cement/Replacement:** | Feldspar overgrowths and replacement, quartz overgrowths, microquartz, calcite, siderite, Ti-oxide, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, primary intergranular pores, and trace amounts of grain fracture pores |
| **Porosity (RCA):** | 8.3% |
| **Permeability (RCA):** | 0.17mD |
| **Grain Density (RCA):** | 2.65gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

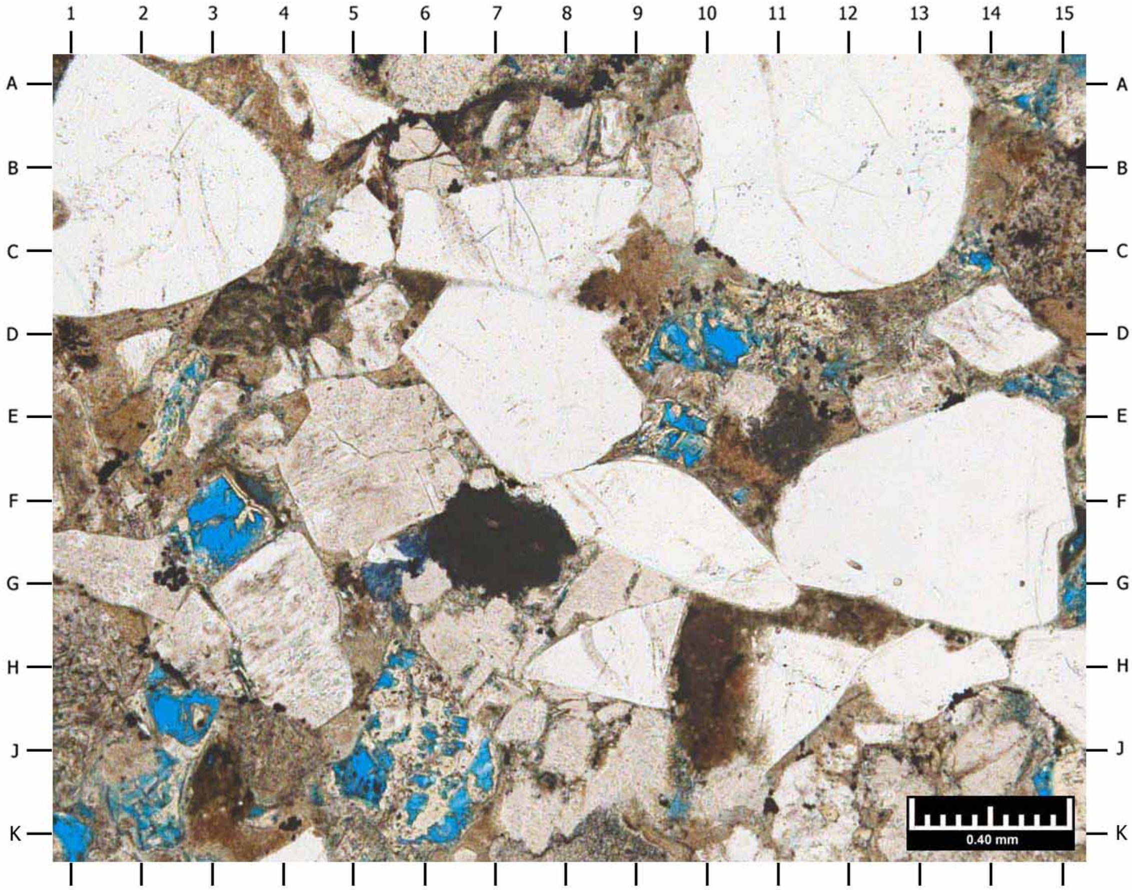
A) This general photomicrograph illustrates the moderately sorted, moderately compacted, massive fabric of this lithic arkose. Quartz (B12, D7, F13) and volcanic fragments (J6) are the most common detrital constituents. Secondary intragranular pores (blue epoxy; D9.5, EF9.5, F3.5, HJ2.5, J6) are the dominant pore type.

B) This photomicrograph provides a magnified view of the area near FG4.5 in Photo A. Ferroan dolomite is observed (stained blue; EF14, G12). The outside rim of a dissolved grain occurs at B2-E5.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

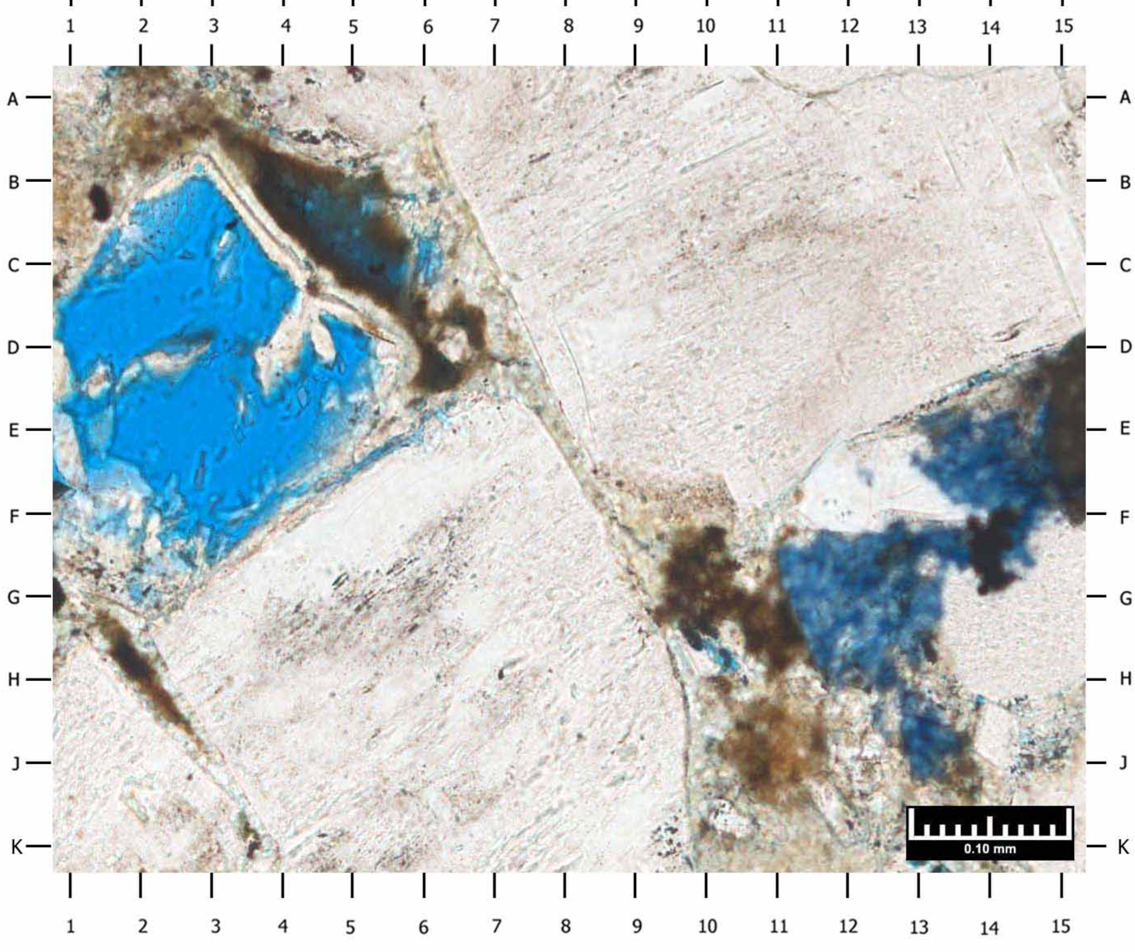
2901.1m
Plate 11

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2902.49 METERS**
**SAMPLE NUMBER: 25-RCA**

**PLATE 12**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-1.29mm |
| **Average Grain Size:** | 0.36mm |
| **Compaction:** | Moderate to high |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, metaquartzite, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, chamosite, tourmaline, apatite, and organic material |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite and chlorite |
| **Cement/Replacement:** | Feldspar overgrowths and replacement, quartz overgrowths, microquartz, calcite, Fe-calcite, siderite, Ti-oxide, Fe-dolomite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, and primary intergranular pores |
| **Porosity (RCA):** | N/A |
| **Permeability (RCA):** | N/A |
| **Grain Density (RCA):** | N/A |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

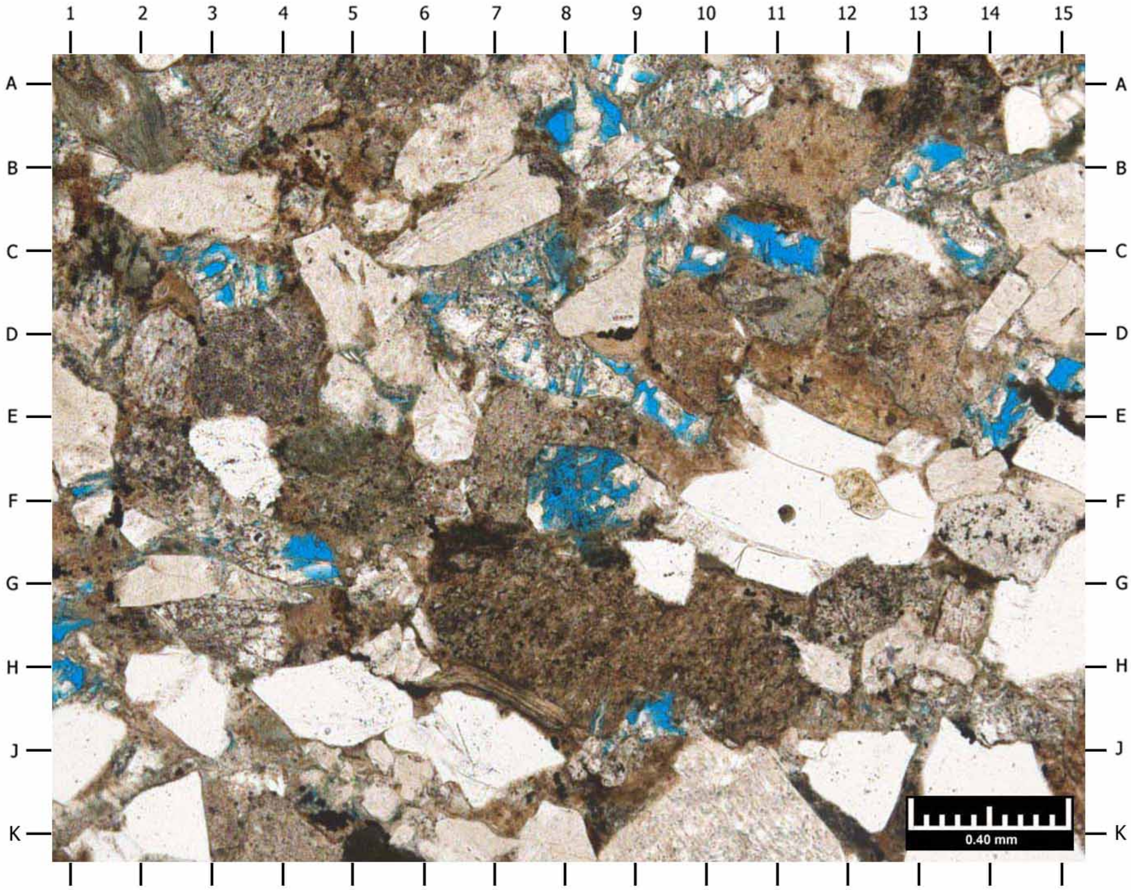
A) Survey photomicrograph A depicts the massive fabric of this lithic arkose. Plagioclase feldspar (BC3, BC15, K8) represents the dominant detrital grain type with lesser amounts of quartz grains (AB14.5, C12.5, F11, K2), volcanic fragments (EF2, F14.5), and mudstone fragments (G8). Secondary intragranular pores are the dominant pore type (blue epoxy; CD3, EF8, B13).

B) This detailed view of the area near BC3 in Photo A displays a partially dissolved grain containing intragranular pores (FG4-GH11). Authigenic clay locally fills intergranular pores (D1-K6.5).

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

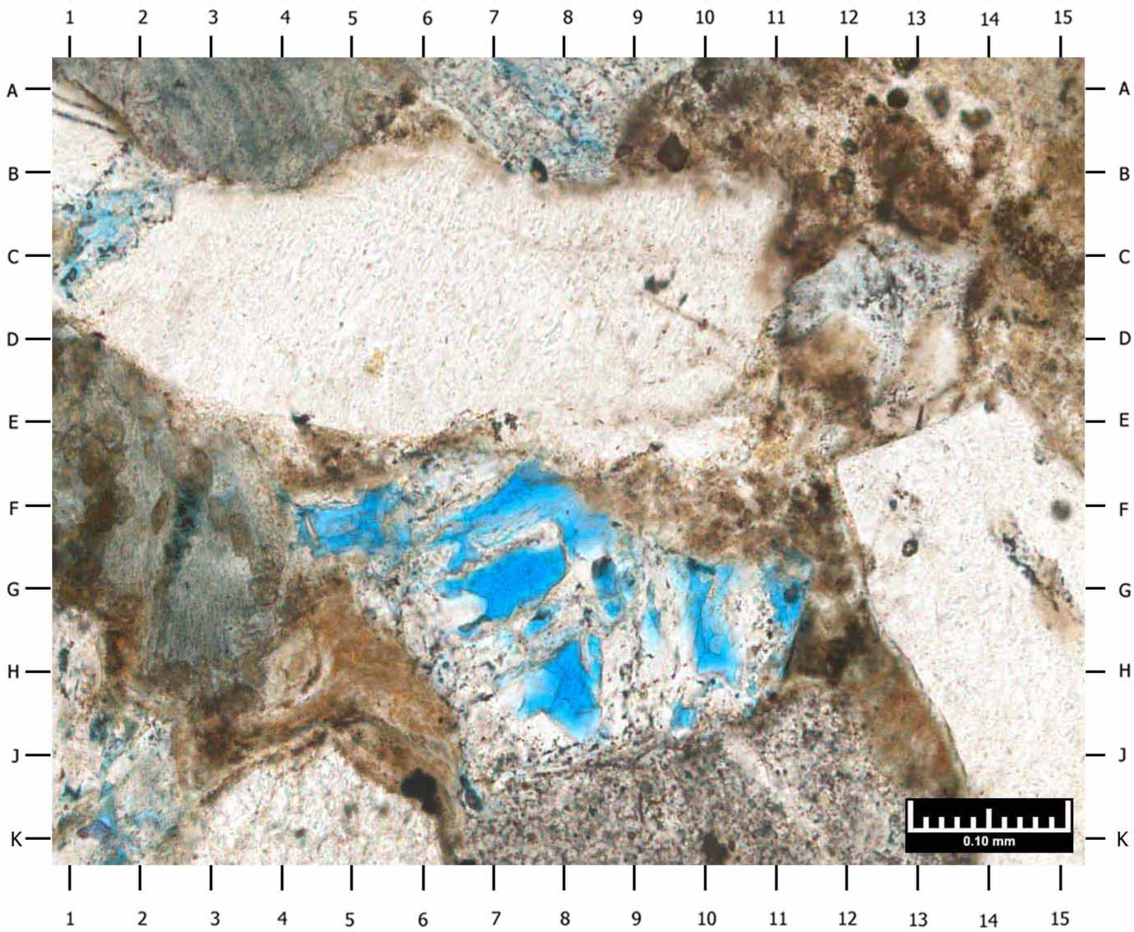
2902.5m
Plate 12

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2905.56 METERS**
**SAMPLE NUMBER: 28-RCA**

**PLATE 13**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-0.95mm |
| **Average Grain Size:** | 0.32mm |
| **Compaction:** | Moderate to high |
| **Sorting:** | Moderately well to well |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, metaquartzite, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, chamosite, tourmaline, zircon, and organic material |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite and chlorite |
| **Cement/Replacement:** | Feldspar overgrowths and replacement, quartz overgrowths, microquartz, calcite, Fe-calcite, siderite, Ti-oxide, Fe-dolomite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, and primary intergranular pores |
| **Porosity (RCA):** | N/A |
| **Permeability (RCA):** | N/A |
| **Grain Density (RCA):** | N/A |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) Plagioclase feldspar (BC4, HJ4.5, FG14.5), volcanic fragments (BC6, C13, K6), and quartz (GH7) dominate the grain fraction of this lithic arkose. Primary (blue epoxy; DE15, HJ3.2) and secondary (D1.5, B12, G8.5) pores are observed. Authigenic clay (HJ6) locally fills intergranular areas. Authigenic calcite (stained red) occurs as replacement (BC1.5, D4, F9) and cement (AB2.2).

B) This high magnification photomicrograph details the area near EF7.5 in Photo A. A rare primary pore is observed (D14). Remnants of a significantly dissolved lithic fragment occurs at G12-K11.

**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

**2905.6m**
**Plate 13**

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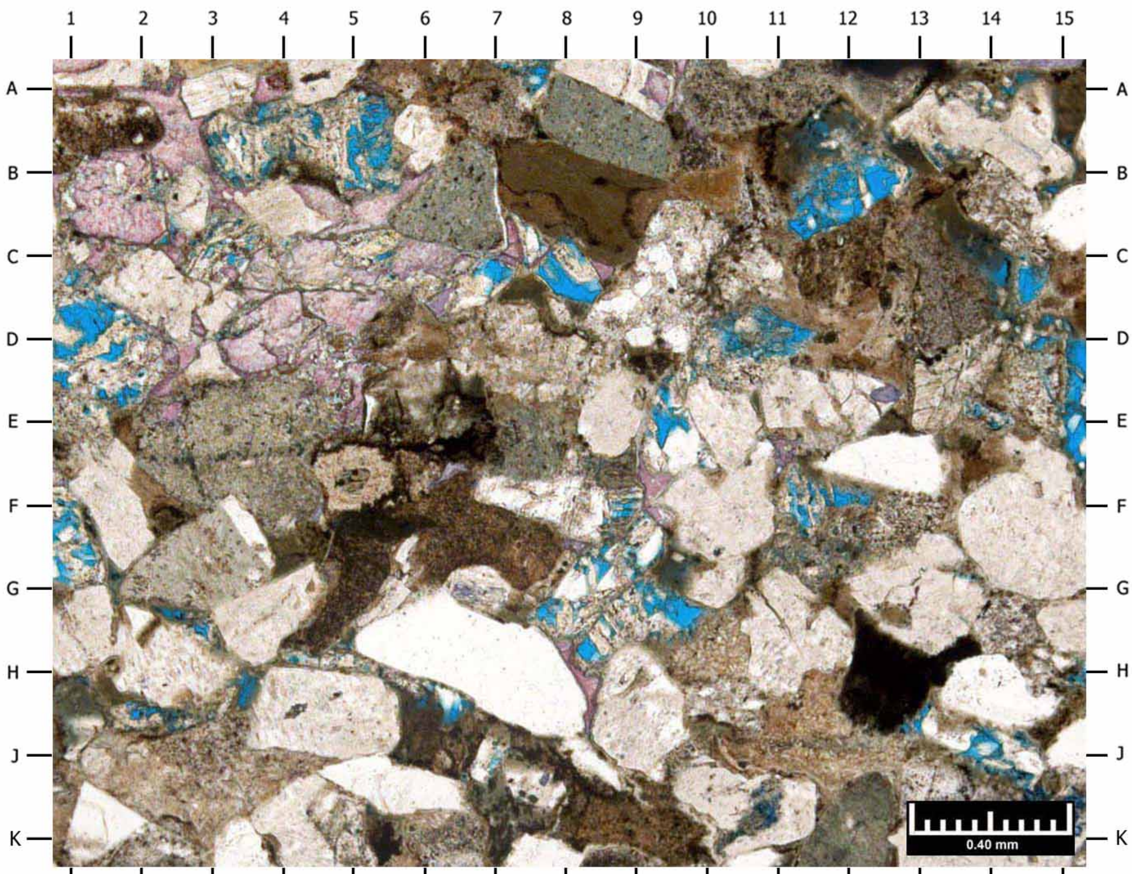
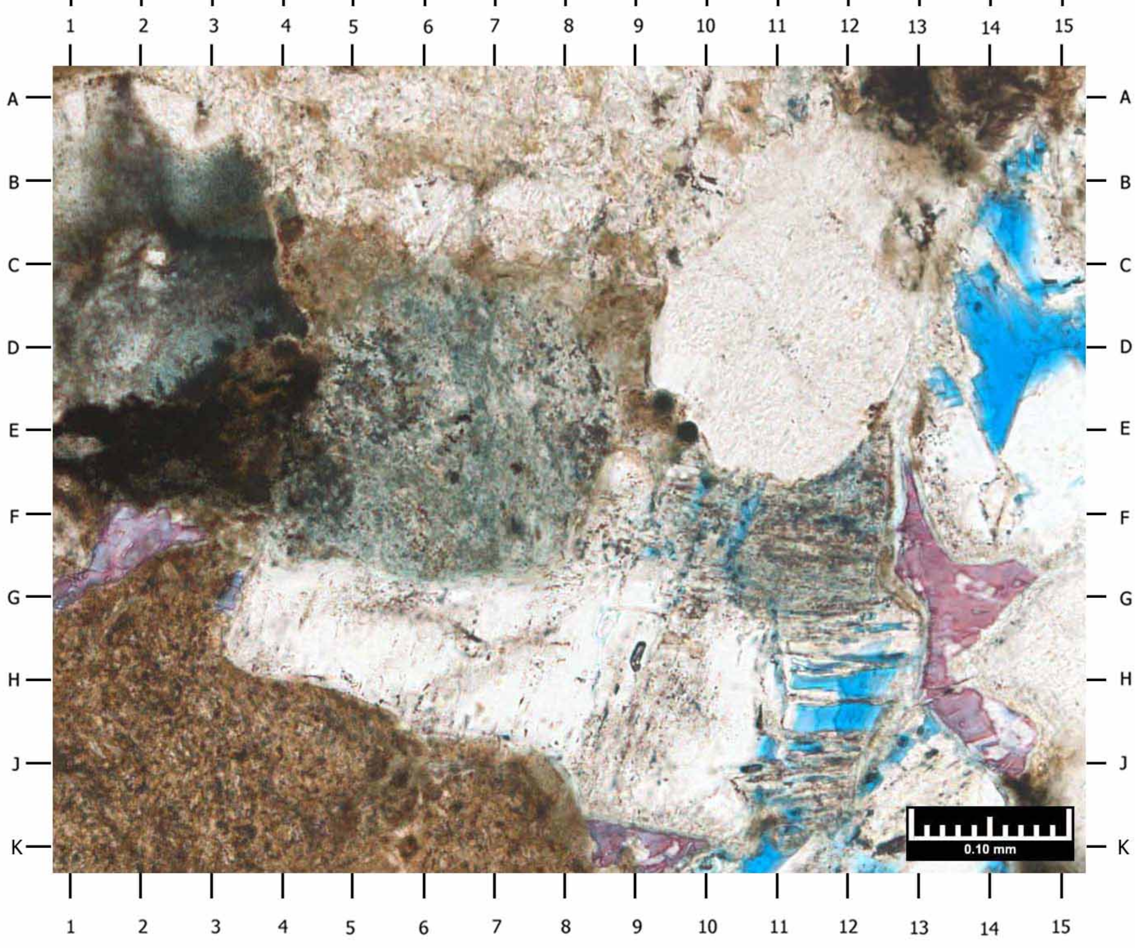



**A**

**50X**




**B**

**200X**

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2906.05 METERS**
**SAMPLE NUMBER: 2_12P-DS**

**PLATE 14**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive; stylolites |
| **Grain Size Range:** | <0.01mm-1.71mm |
| **Average Grain Size:** | 0.44mm |
| **Compaction:** | Very high |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, chamosite, tourmaline, and zircon |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite clays |
| **Cement/Replacement:** | Calcite cement and replacement, feldspar overgrowths and replacement, quartz overgrowths, Fe-calcite, siderite, Fe-dolomite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains and micropores associated with clays and leached grains |
| **Porosity (RCA):** | 4.5% |
| **Permeability (RCA):** | 0.0047mD |
| **Grain Density (RCA):** | 2.66gm/cc |

*Folk classification based on visual estimate of sample constituents

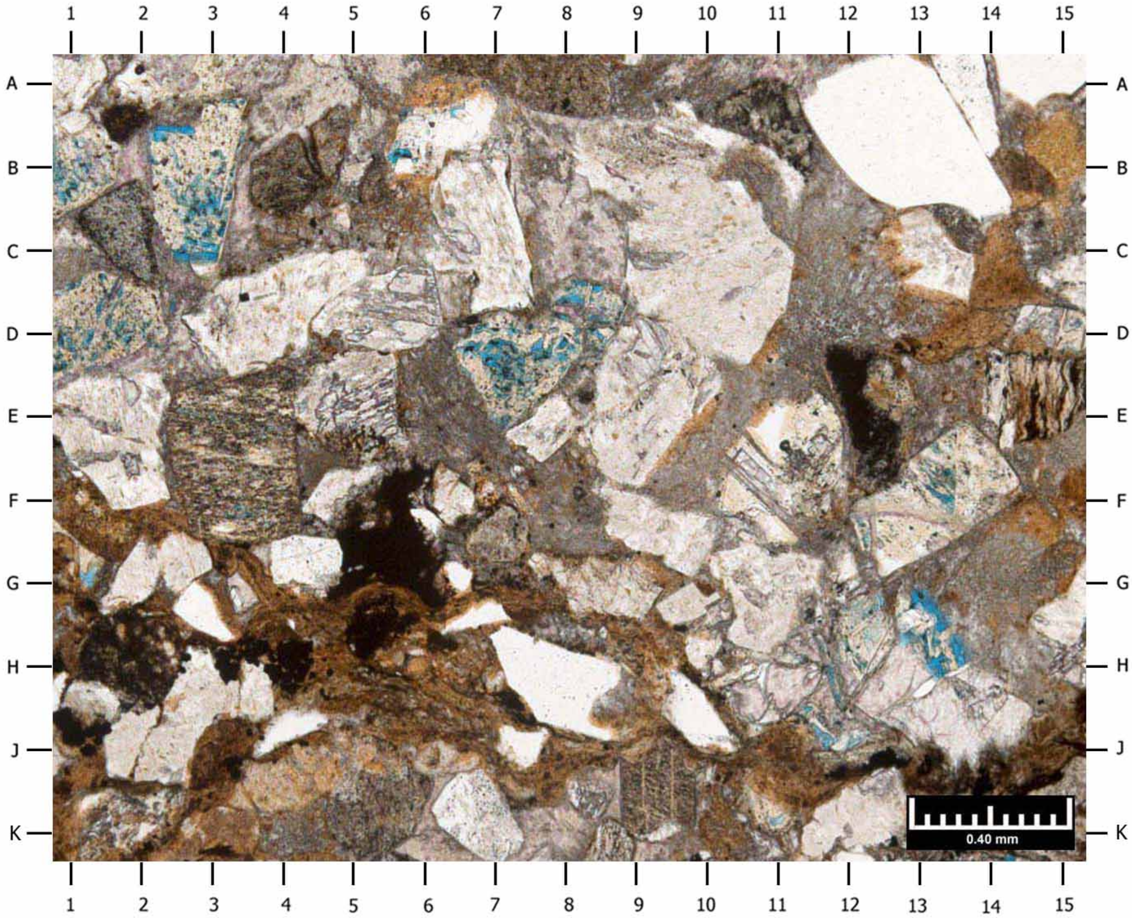
**Magnification:** A: 50X B: 200X

A) General photomicrograph A displays the massive texture of this lithic arkose. Secondary dissolution pores (blue epoxy; AB2.2, DE7, GH13.5) are the dominant pore type. Calcite (stained red) occurs as cement (B1.8). Altered feldspar/lithic grains are observed (B3, D1.5, EF3.5, JK4, C14, B15). Pyrite (black; HJ1, H4, J12.5) replaces unstable material.

B) This photomicrograph provides a magnified view of the area near HJ12 in Photo A. Calcite replaces unstable material (stained red). Authigenic clays (FK2, HJ8-15) are a result of altered feldspar grains.

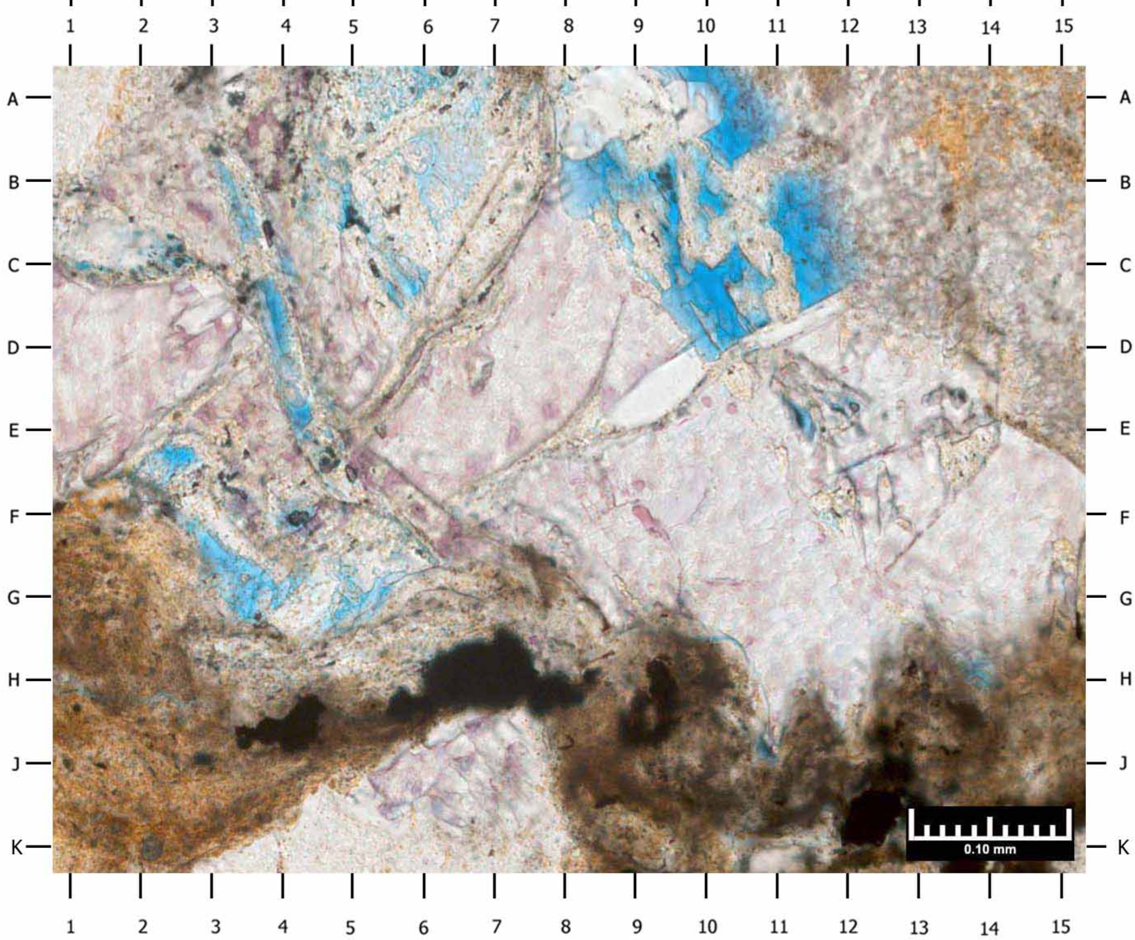
QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2906.1m
Plate 14




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2907.04 METERS**
**SAMPLE NUMBER: 2_13P-DS**

**PLATE 15**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-1.33mm |
| **Average Grain Size:** | 0.36mm |
| **Compaction:** | Moderate to high |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, mudstone rock fragments, siltstone fragments, metaquartzite, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, chamosite, and zircon |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite and chlorite |
| **Cement/Replacement:** | Feldspar overgrowths and replacement, quartz overgrowths, microquartz, calcite, Fe-calcite, siderite, Ti-oxide, Fe-dolomite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, primary intergranular pores, and grain fracture pores |
| **Porosity (RCA):** | 12.4% |
| **Permeability (RCA):** | 0.055mD |
| **Grain Density (RCA):** | 2.65gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) This general overview represents the massive fabric of this lithic arkose. Plagioclase feldspar (AB11, G4, JK10.5), quartz (B3, CD14.5), and volcanic rock fragments (BC13, E5, J12) are the dominant detrital constituents. Secondary dissolution pores (blue epoxy; A13, DE9.5, J8, K5) represent the dominant pore type.

B) This photomicrograph provides a detailed view of the area near G10 in Photo A. Pyrite (black; H5.8) and calcite (stained red; FG14.5) occur as replacements of less stable material.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2907.0m
Plate 15

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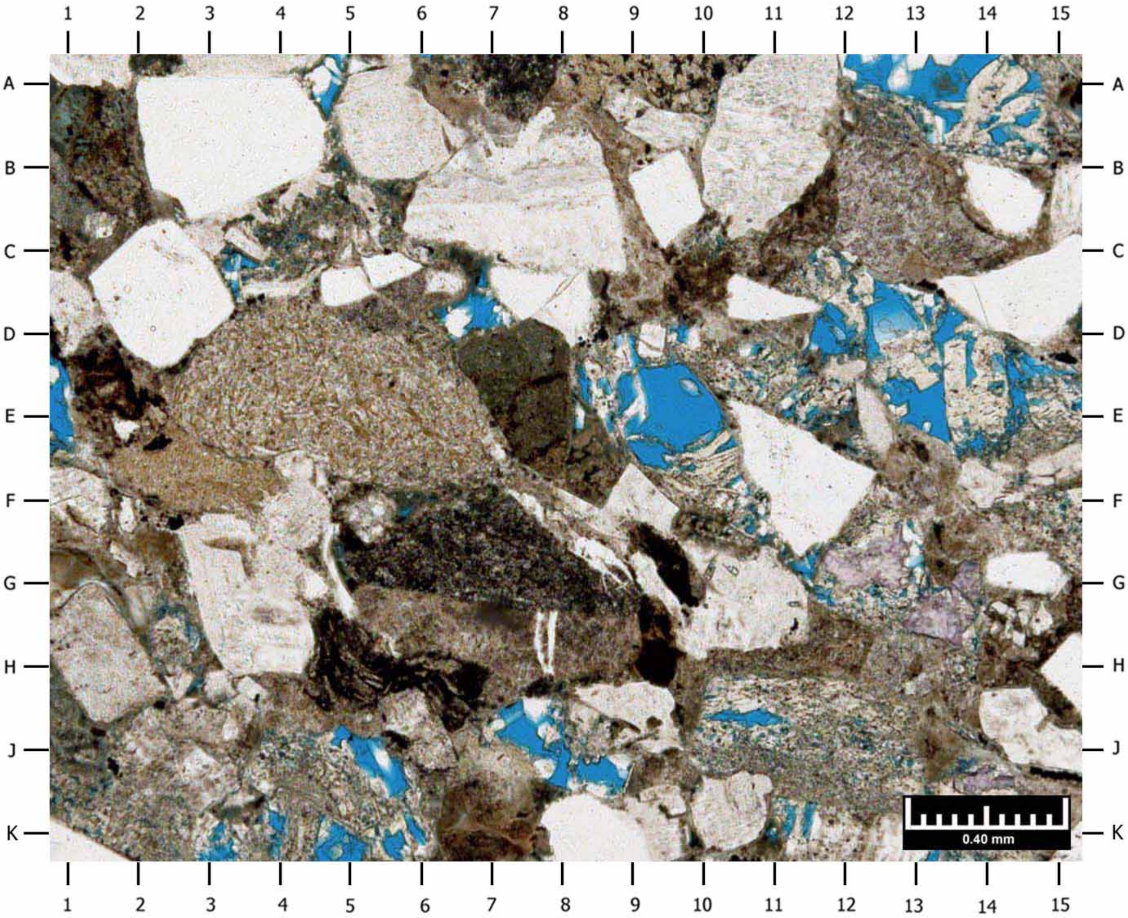
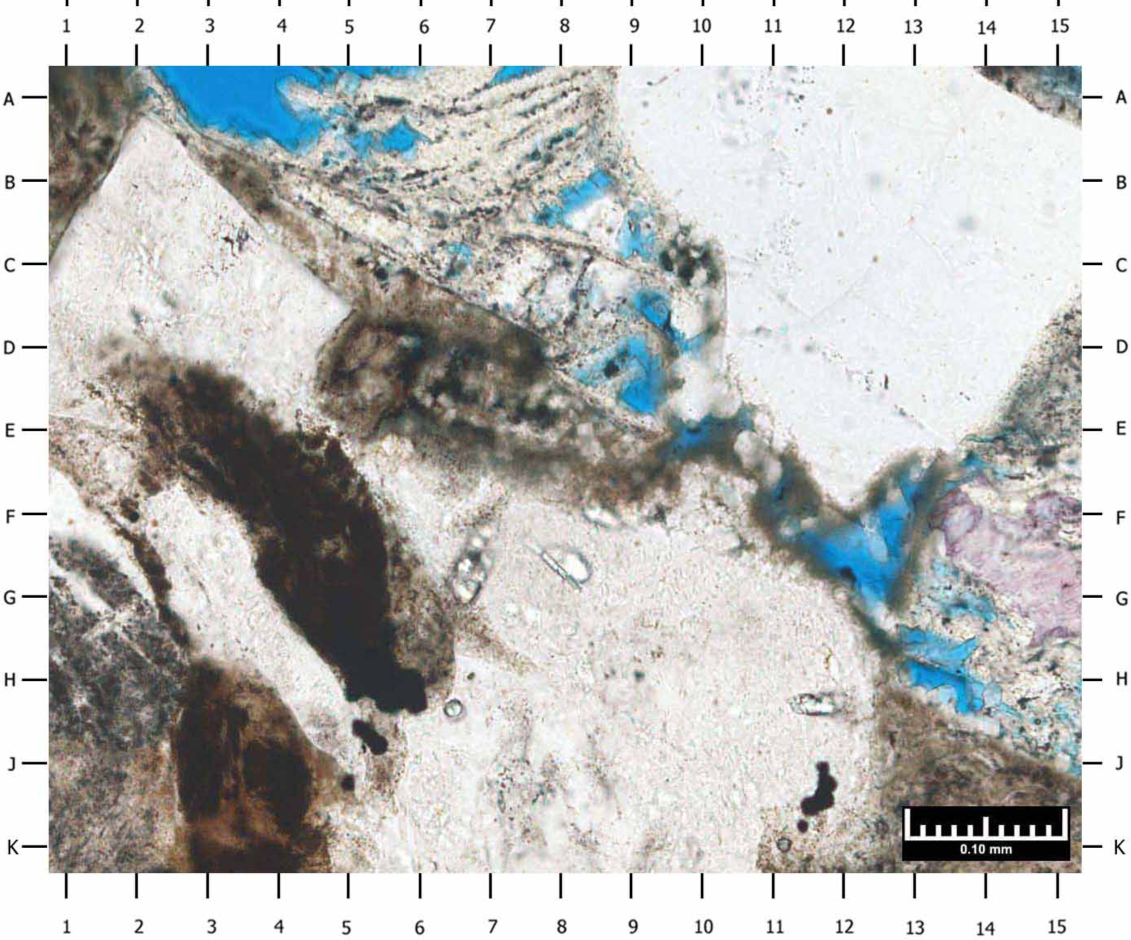



A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2908.50 METERS**
**SAMPLE NUMBER: 31-RCA**

**PLATE 16**

| | |
|---|---|
| **Lithology*:** | Lithic arkose/feldspathic litharenite |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-2.01mm |
| **Average Grain Size:** | 0.38mm |
| **Compaction:** | Very high |
| **Sorting:** | Poor |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, metaquartzite, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, chamosite, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite and chlorite |
| **Cement/Replacement:** | Feldspar overgrowths and replacement, quartz overgrowths, microquartz, calcite, Fe-calcite, siderite, Ti-oxide, Fe-oxide, Fe-dolomite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, and primary intergranular pores |
| **Porosity (RCA):** | 10.1% |
| **Permeability (RCA):** | 0.051mD |
| **Grain Density (RCA):** | 2.65gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) This photomicrograph provides a general overview of this poorly sorted lithic arkose/'feldspathic litharenite. Volcanic clays (stained yellow; BC1, H6-K7, EF15) fill primary intergranular pores. Plagioclase feldspar (AB1, B12, J9) and quartz (A5, CD8, EF2) are the dominant detrital grains present.

B) This photomicrograph provides a magnified view of the area near BC2.5 in Photo A. Pyrite (black; AB6, BC6.2, CD8) occurs as replacement of less stable material. A possible tourmaline fragment occurs at G5.1.

**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

**2908.5m**
**Plate 16**

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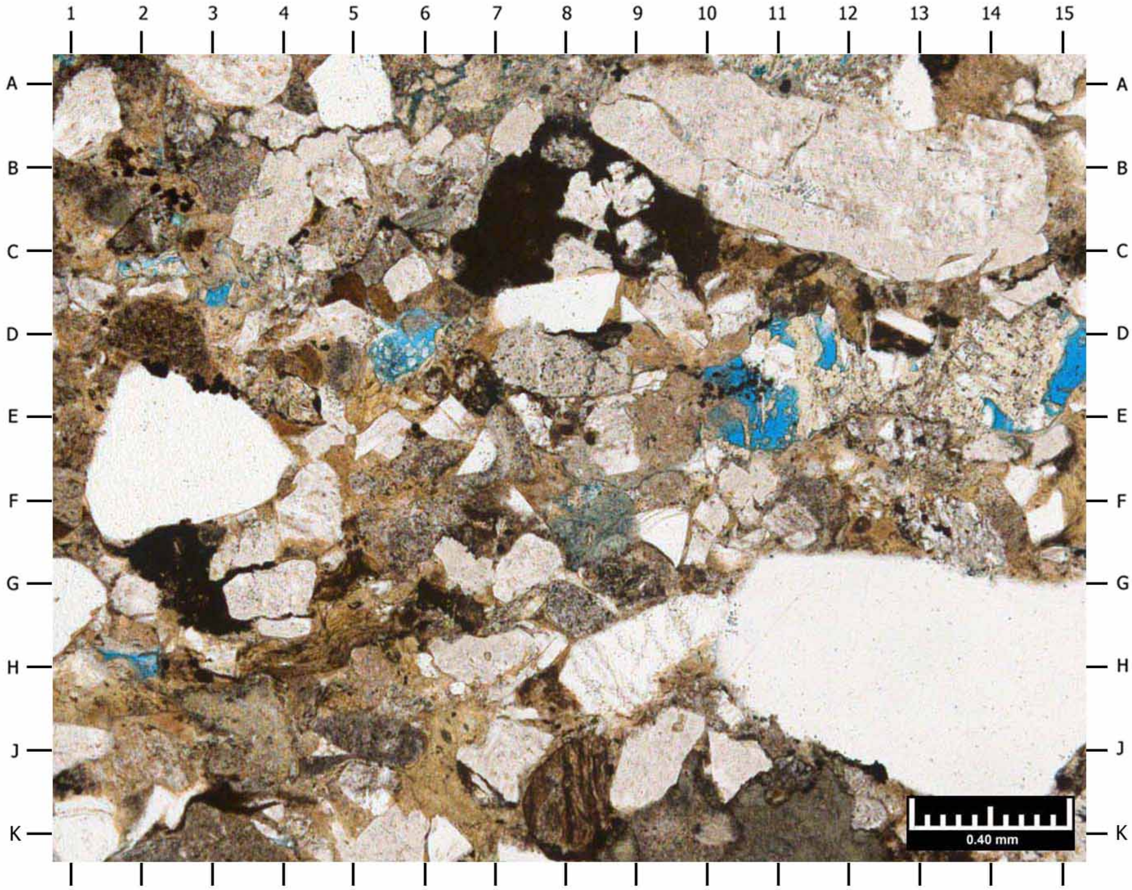
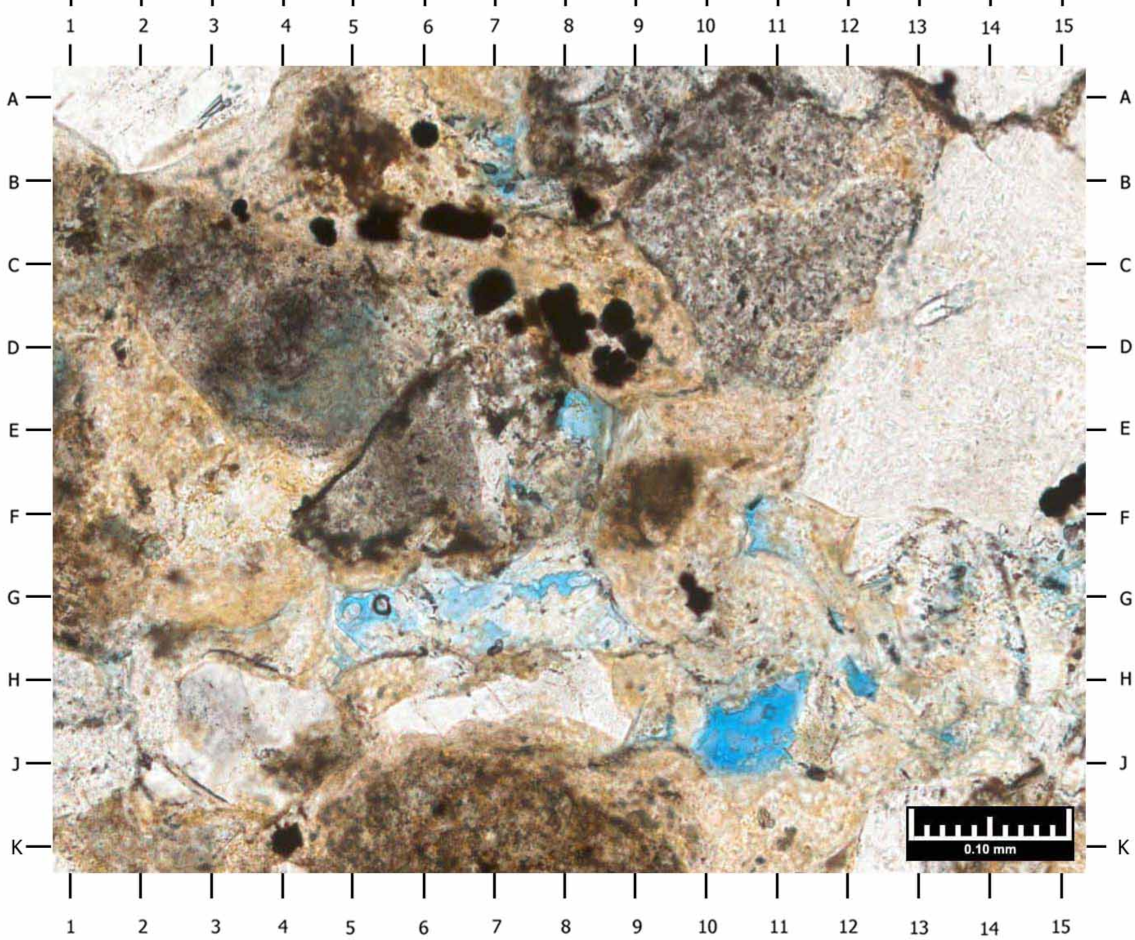



**A**

**50X**




**B**

**200X**

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2910.05 METERS**
**SAMPLE NUMBER: 2_16P-DS**

**PLATE 17**

| | |
|---|---|
| **Lithology*:** | Feldspathic litharenite |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-1.64mm |
| **Average Grain Size:** | 0.46mm |
| **Compaction:** | Moderate |
| **Sorting:** | Moderate to poor |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, metaquartzite, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite and chlorite |
| **Cement/Replacement:** | Feldspar overgrowths and replacement, quartz overgrowths, microquartz, calcite, Fe-calcite, siderite, Ti-oxide, Fe-oxide, Fe-dolomite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, and primary intergranular pores |
| **Porosity (RCA):** | 11.3% |
| **Permeability (RCA):** | 0.073mD |
| **Grain Density (RCA):** | 2.65gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) Survey photomicrograph A depicts the massive fabric of this feldspathic litharenite. Minor amounts of clays (likely volcanic ash) occlude primary pores; however micropores are associated with these clays. Fine to medium sand-sized quartz (DB12.5, E1) and plagioclase (AB2.5) grains compose the majority of the detrital constituents.

B) This photomicrograph provides a magnified view of the area near E3.5 in Photo A. Pyrite (black; FG10, AB1.5) occurs as replacement of less stable matrix material. Micropores (blue epoxy; A14.5, C13) associated with leached feldspar grains are observed.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2910.1m
Plate 17

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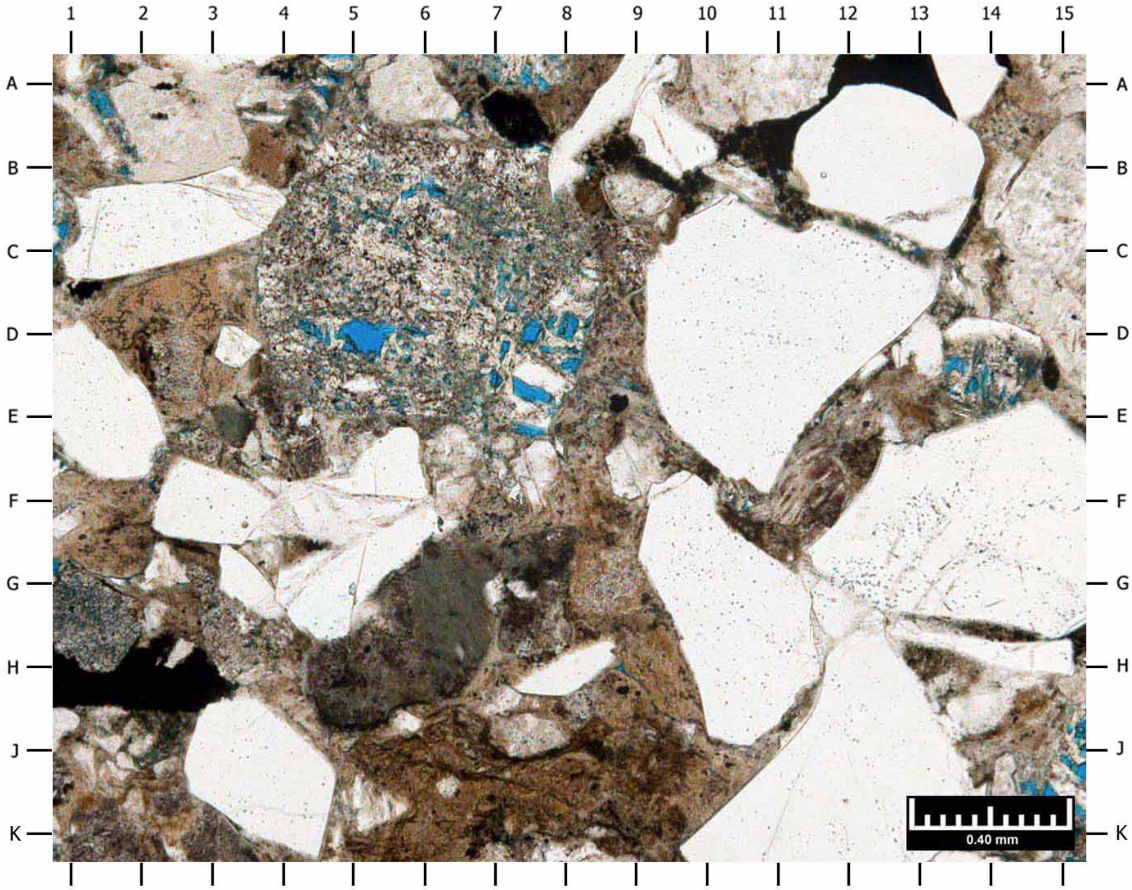
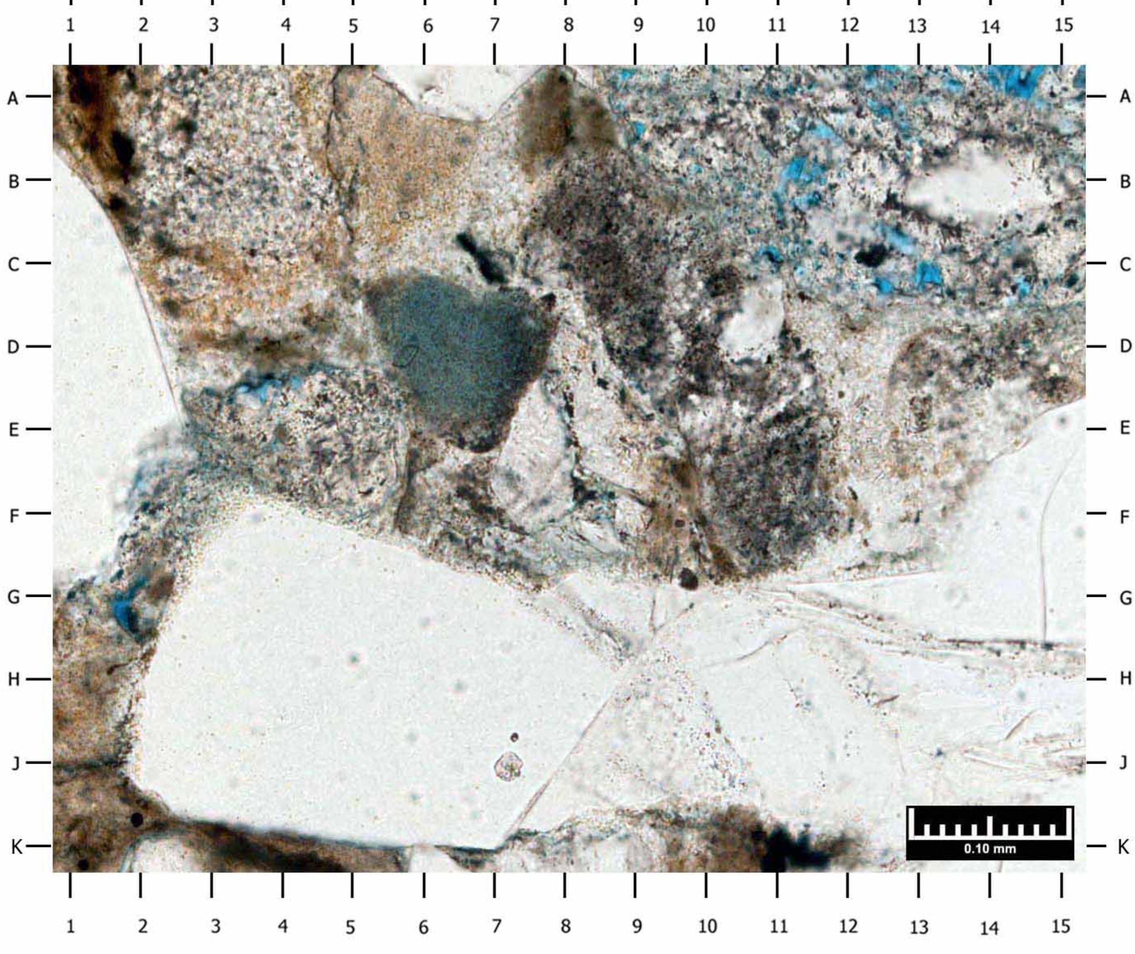



A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2912.30 METERS**
**SAMPLE NUMBER: 34-SWC**

**PLATE 18**

| | |
|---|---|
| **Lithology*:** | Feldspathic litharenite |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm -2.43mm |
| **Average Grain Size:** | 0.46mm |
| **Compaction:** | Very high |
| **Sorting:** | Poor |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz |
| **Minor:** | Plagioclase feldspar, potassium feldspar, chert, mudstone fragments, siltstone fragments, volcanic rock fragments/tuff, and polycrystalline quartz |
| **Accessory:** | Muscovite mica and heavy minerals |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor to trace amounts of detrital clays (visual estimate) |
| **Authigenic Clay:** | Minor to trace amounts of illite and kaolinite (visual estimate) |
| **Cement/Replacement:** | Quartz and feldspar overgrowths; minor calcite replacement; rare dolomite/Fe-dolomite, pyrite, and siderite (visual estimate) |
| **Porosity Types:** | Primary intergranular pores, secondary intragranular pores associated with leached grains, and micropores associated with clays |
| **Porosity (RCA):** | 9.0% |
| **Permeability (RCA):** | 0.023mD |
| **Grain Density (RCA):** | 2.64gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) Survey photomicrograph A depicts the generally massive fabric of this feldspathic litharenite. Secondary dissolution pores (blue epoxy; CD7, E11, FG6, HJ9) are associated with unstable feldspar grains and lithic fragments. Calcite (stained red; AB14.2, CD13, EF14) cements detrital grains and fills intergranular areas. Quartz overgrowths (EF3.5, DE4, B13.5) precipitate on host detrital grains.

B) This photomicrograph provides a magnified view of the area near EF8 in Photo A, depicting secondary intragranular pores (JK3.5, K8, JK14). Lithic fragments (DE5-15, J1-15) and quartz (B2) dominates the grain fraction. Authigenic clays intermixed with chert fill primary pores (A9-DE1).

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2912.3m
Plate 18

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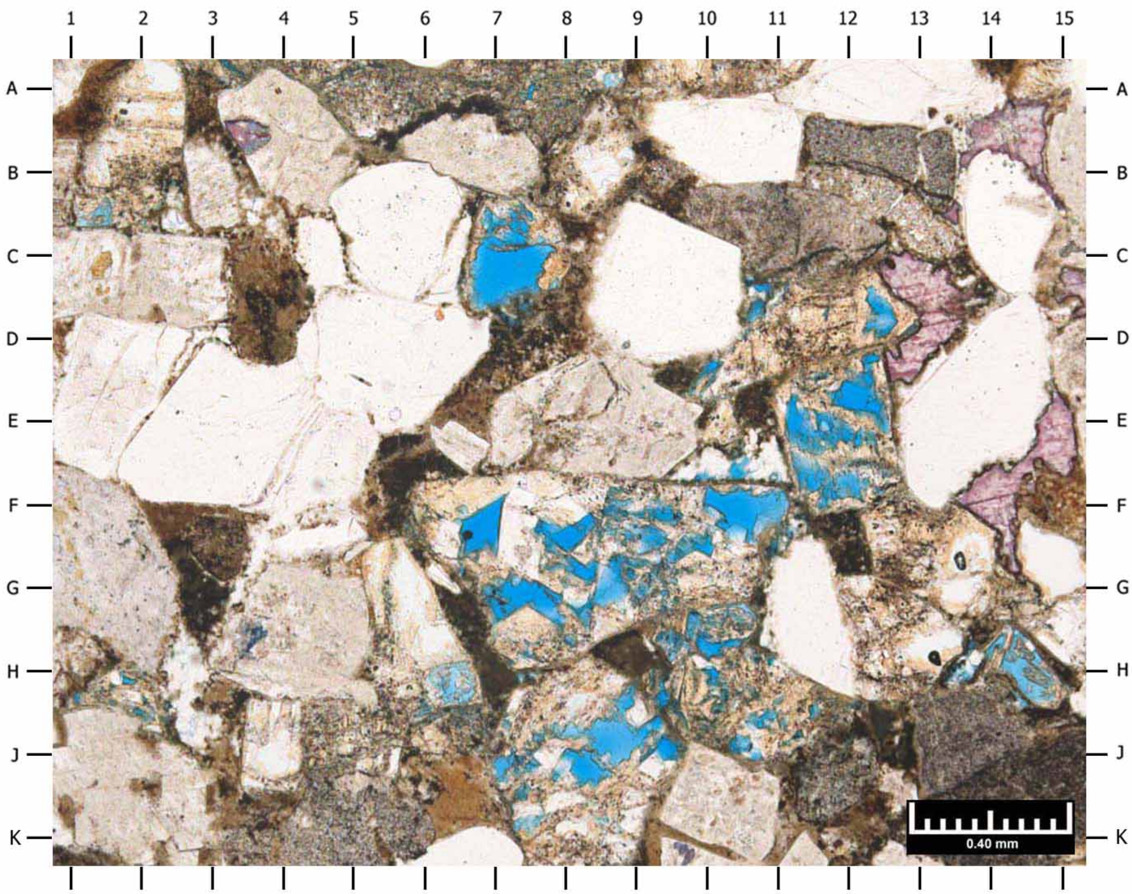
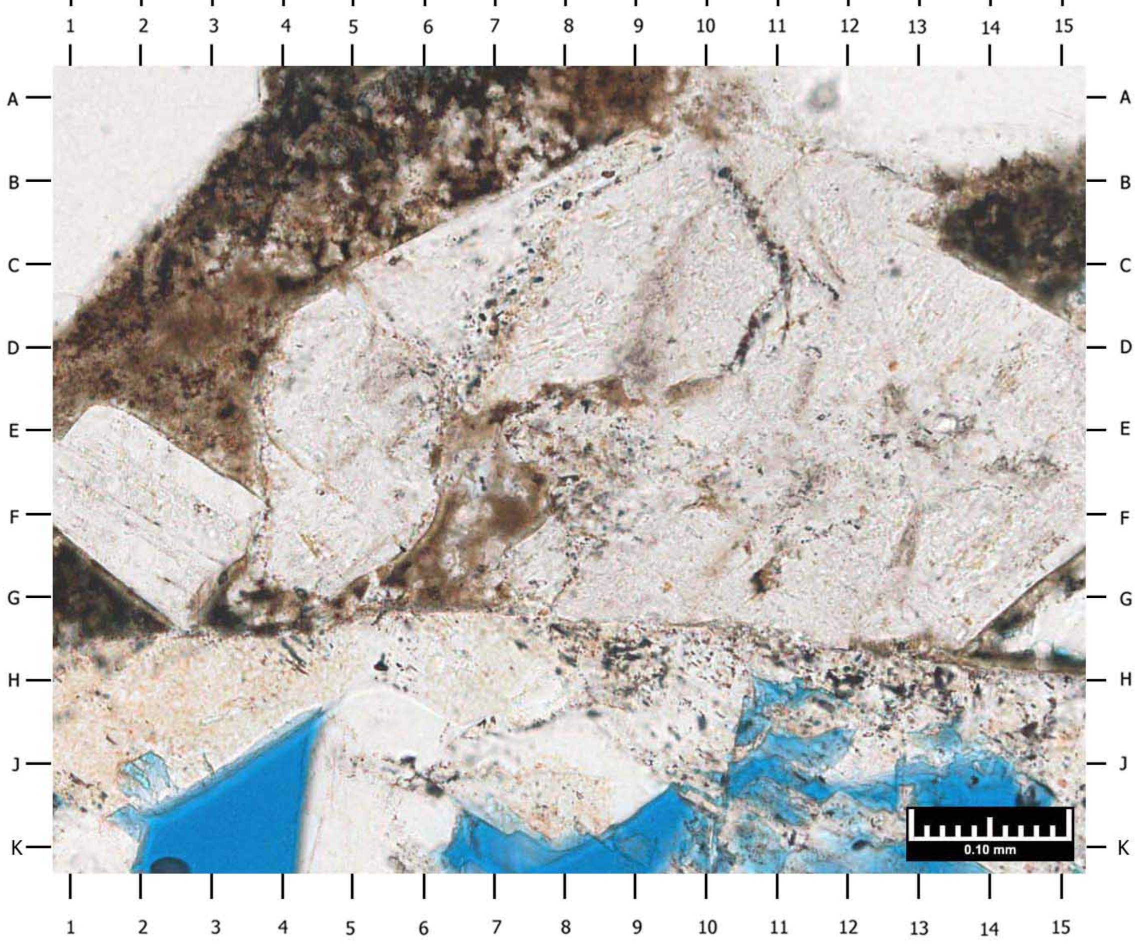



A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2912.50 METERS**
**SAMPLE NUMBER: 35-RCA**

**PLATE 19**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-0.95mm |
| **Average Grain Size:** | 0.24mm |
| **Compaction:** | High |
| **Sorting:** | Moderate to well |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, metaquartzite, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, zircon, organic material, chamosite, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite clays |
| **Cement/Replacement:** | Feldspar overgrowths and replacement, quartz overgrowths, calcite, Fe-calcite, siderite, Ti-oxide, Fe-dolomite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, and primary intergranular pores |
| **Porosity (RCA):** | N/A |
| **Permeability (RCA):** | N/A |
| **Grain Density (RCA):** | N/A |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

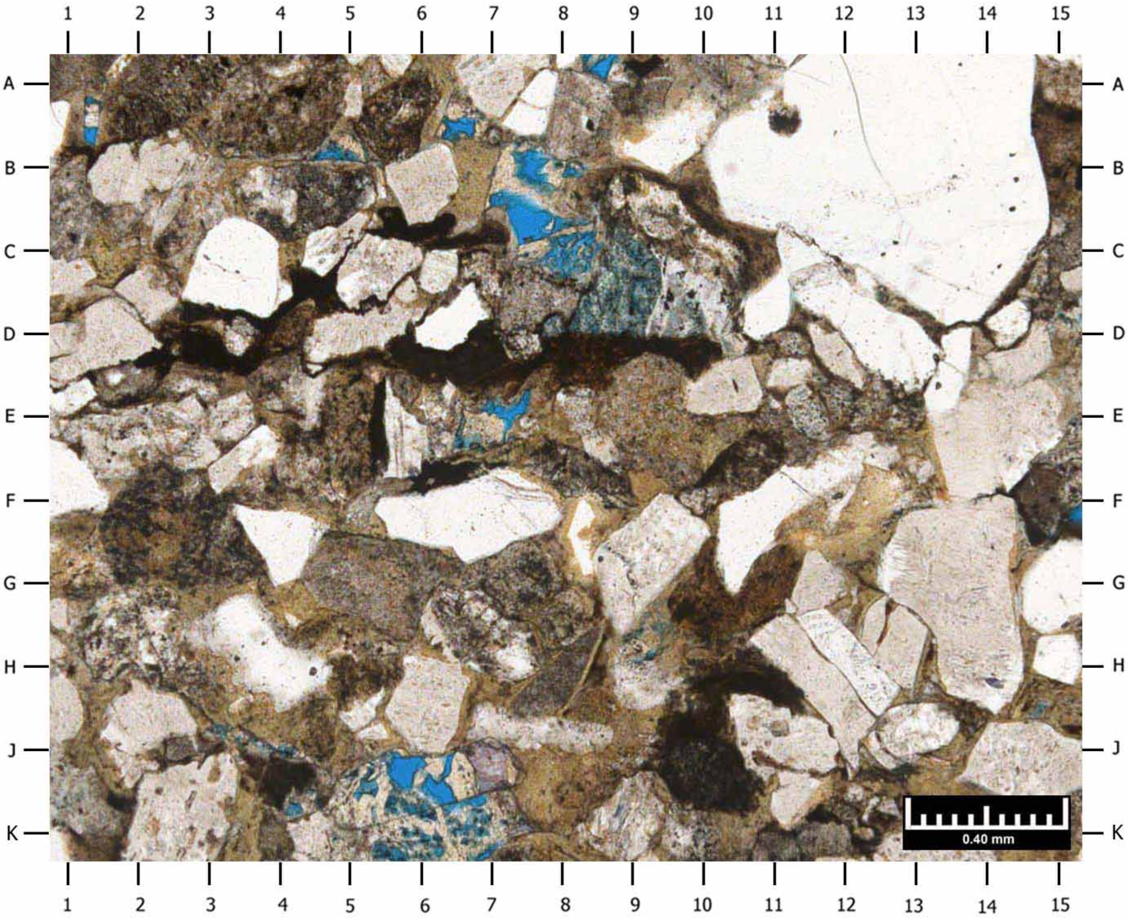
A) The low magnification view provided by photomicrograph A depicts the generally massive fabric of this lithic arkose. Detrital grains include plagioclase (B2, G13.5, K2.5), quartz (B13, CD3) and altered lithic fragments (AB3.5, CD9.5, K9). Intragranular dissolution pores (blue epoxy; AB1.2, BC7.5, JK6) are the dominant pore type represented in this photomicrograph. Partially pyritized organic material is observed (black; DE2-10).

B) This photomicrograph provides a magnified view of the area near DE10.2 in Photo A. Secondary intragranular pores associated with leached grains (A1-D5.5) dominate the pore system. Rare primary intergranular pores (BC9.2) also contribute to the overall porosity.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

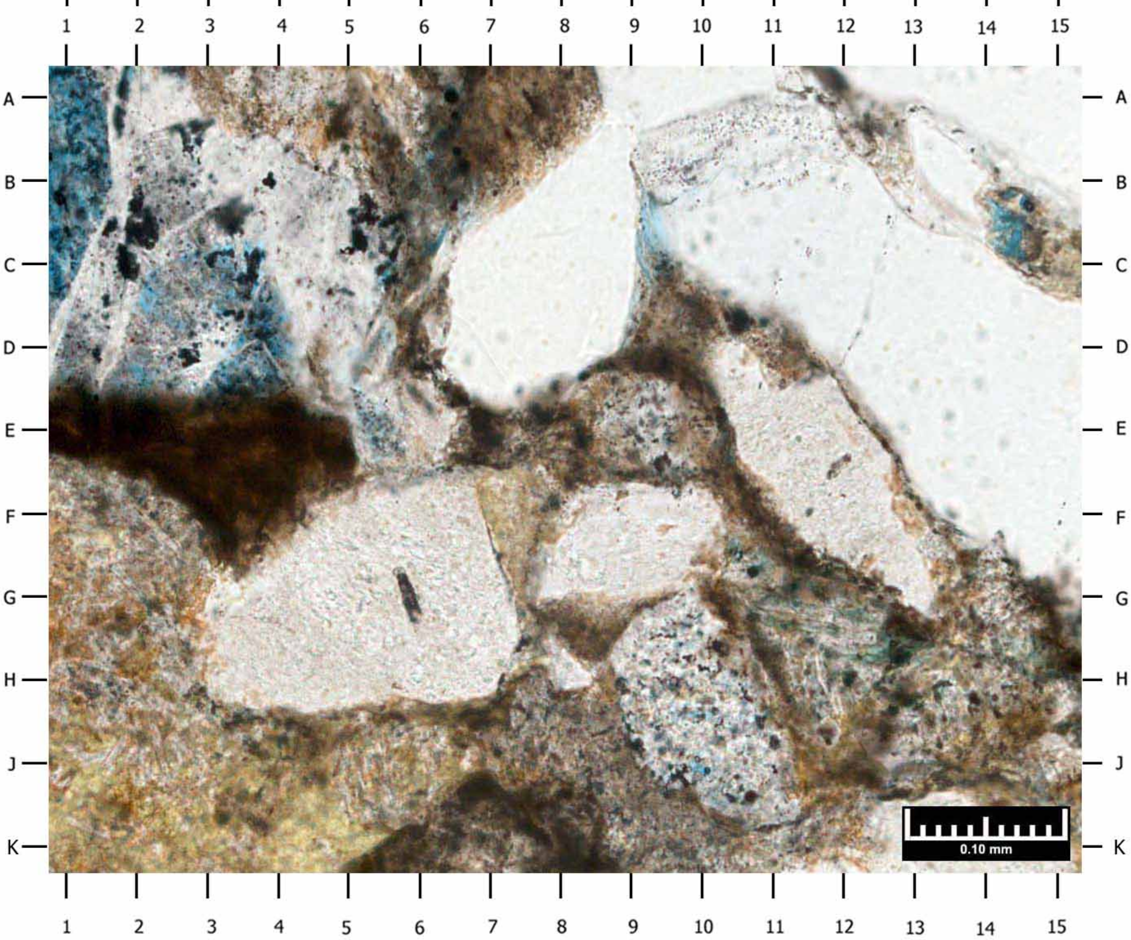
2912.5m
Plate 19

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**Weatherford Labs File No.: AB-74306**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2914.04 METERS**
**SAMPLE NUMBER: 2_20P-DS**

**PLATE 20**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-2.55mm |
| **Average Grain Size:** | 0.38mm |
| **Compaction:** | High |
| **Sorting:** | Poor |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, metaquartzite, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, zircon, chamosite, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite clays |
| **Cement/Replacement:** | Feldspar overgrowths and replacement, quartz overgrowths, calcite, Fe-calcite, siderite, Ti-oxide, Fe-dolomite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, and primary intergranular pores, and grain fracture pores |
| **Porosity (RCA):** | 13.1% |
| **Permeability (RCA):** | 0.11mD |
| **Grain Density (RCA):** | 2.65gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) The low magnification view provided by photomicrograph A depicts the generally massive fabric of this lithic arkose. Grain coating clays (C4.2, D5) slightly reduce the intergranular areas. Minor amounts of authigenic calcite (stained red; C15, E14) occur as a replacement of unstable grains.

B) This magnified view of the area near DE13 in Photo A depicts secondary intragranular pores associated with leached to partially calcite-replaced grains (A15-JK7). Micropores (blue epoxy; A1-E15) are associated with authigenic clays from altered feldspar grains.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2914.0m
Plate 20

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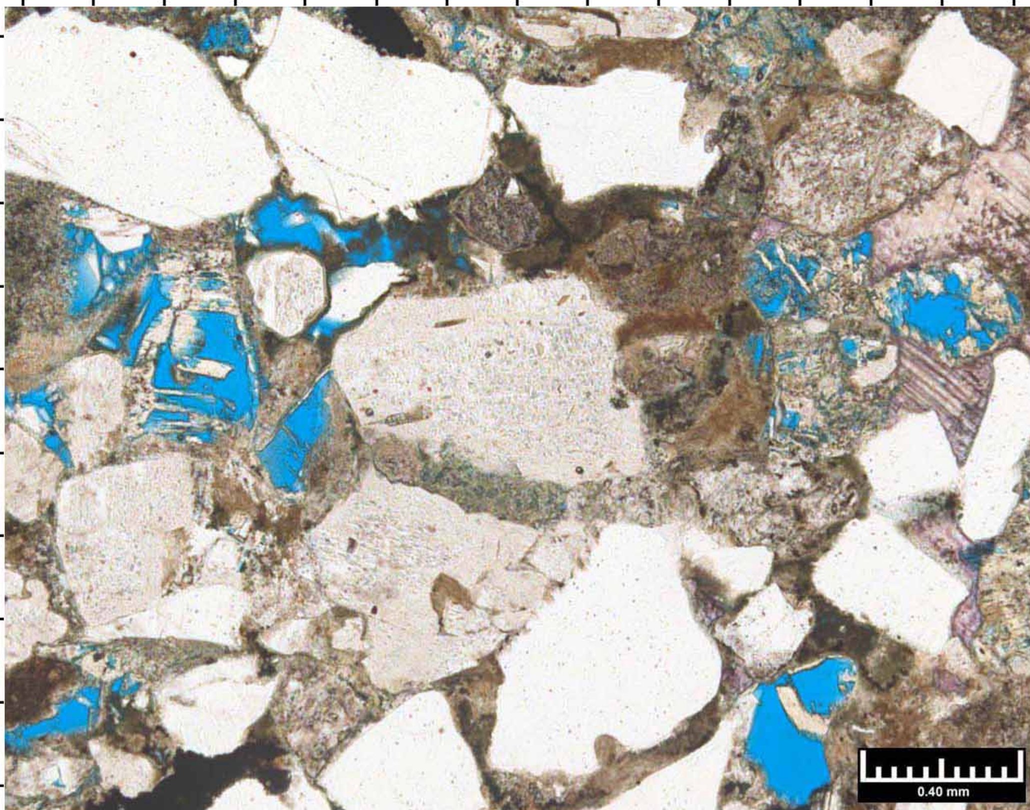
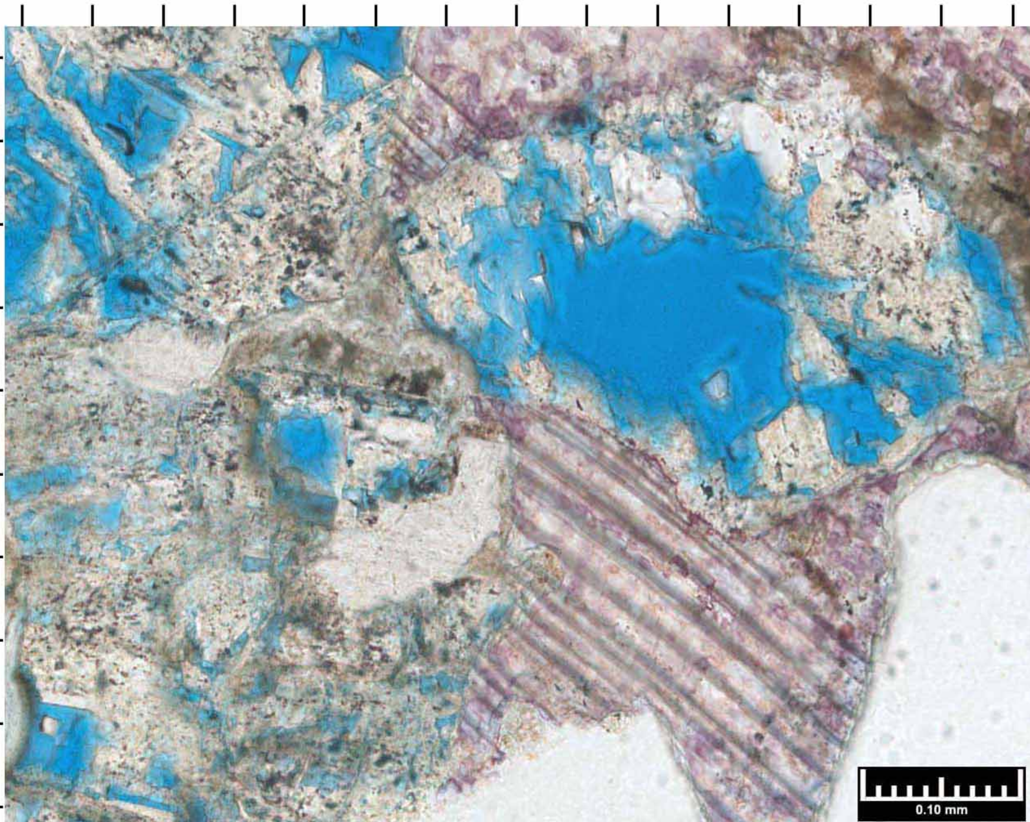



A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2916.04 METERS**
**SAMPLE NUMBER: 2_23P-DS**

**PLATE 21**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-2.09mm |
| **Average Grain Size:** | 0.30mm |
| **Compaction:** | High |
| **Sorting:** | Well to poor |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, metaquartzite, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, zircon, organic material, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite and chlorite |
| **Cement/Replacement:** | Feldspar overgrowths and replacement, quartz overgrowths, microquartz, Fe-calcite, siderite, Ti-oxide, Fe-oxide, Fe-dolomite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, primary intergranular pores, and grain fracture pores |
| **Porosity (RCA):** | 10.8% |
| **Permeability (RCA):** | 0.044mD |
| **Grain Density (RCA):** | 2.65gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) The detrital constituents in this massive lithic arkose include monocrystalline quartz grains (BC12, DE6, J4), plagioclase feldspar (A10, DE2, EF10), and volcanic fragments (DE10, K2). Authigenic calcite occurs as replacement of less stable material.

B) This photomicrograph provides a magnified view of the area near FG2 in Photo A. Calcite (stained red; C11, C6.5, F9, G7) and pyrite (black; DE1.5) occur as replacement of susceptible material. The pores (blue epoxy) in this photo are likely a result of feldspar dissolution.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2916.0m
Plate 21

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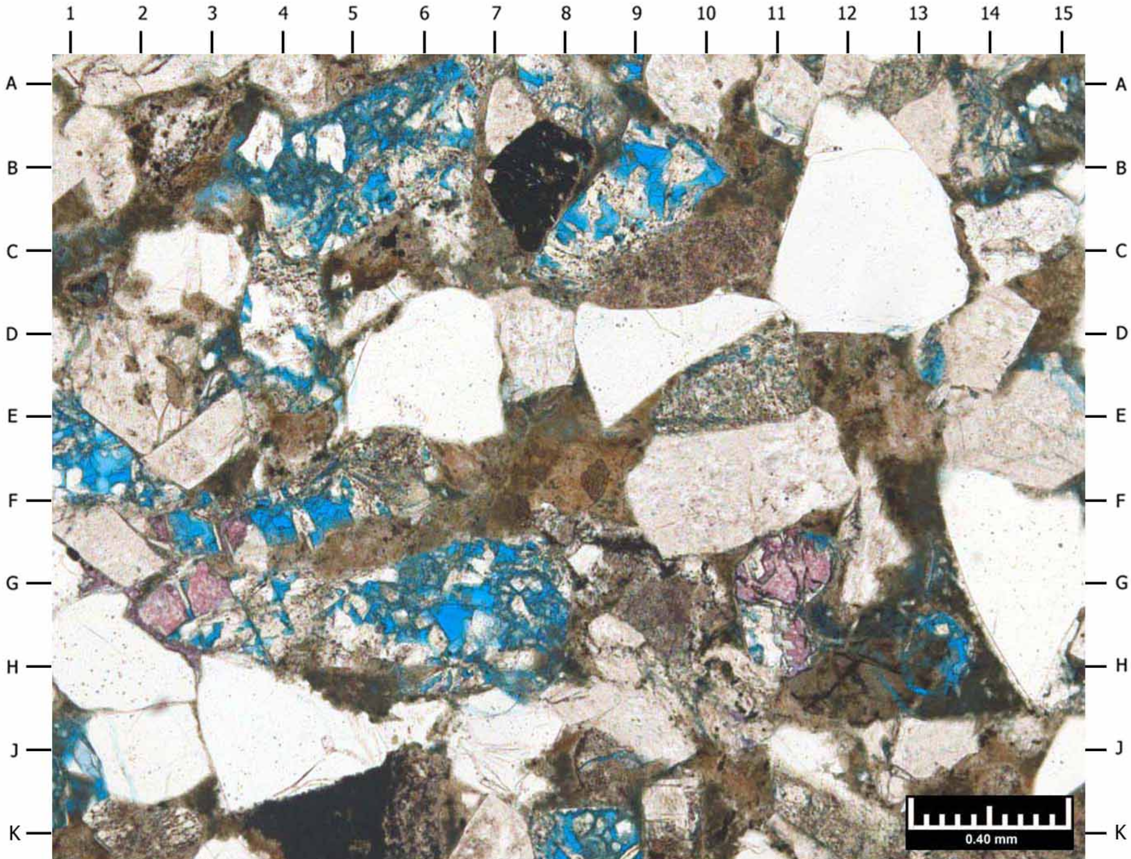
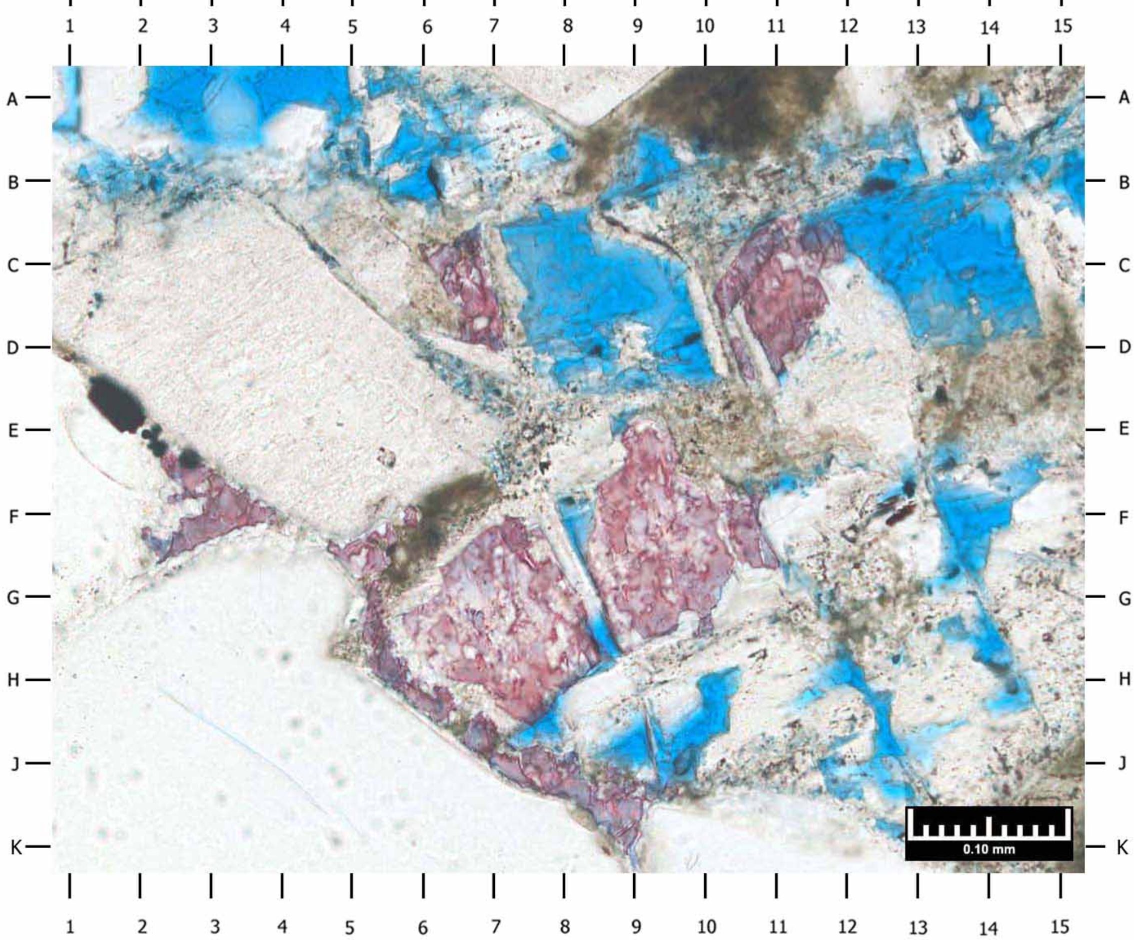



A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2919.05 METERS**
**SAMPLE NUMBER: 2_26P-DS**

**PLATE 22**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-1.79mm |
| **Average Grain Size:** | 0.45mm |
| **Compaction:** | Low |
| **Sorting:** | Moderately well |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, metaquartzite, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, and zircon |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite and chlorite |
| **Cement/Replacement:** | Feldspar overgrowths, quartz overgrowths, microquartz, Fe-calcite, siderite, Ti-oxide, Fe-oxide, Fe-dolomite, calcite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, primary intergranular pores, and grain fracture pores |
| **Porosity (RCA):** | 11.8% |
| **Permeability (RCA):** | 0.040mD |
| **Grain Density (RCA):** | 2.65gm/cc |

*Folk classification based on visual estimate of sample constituents

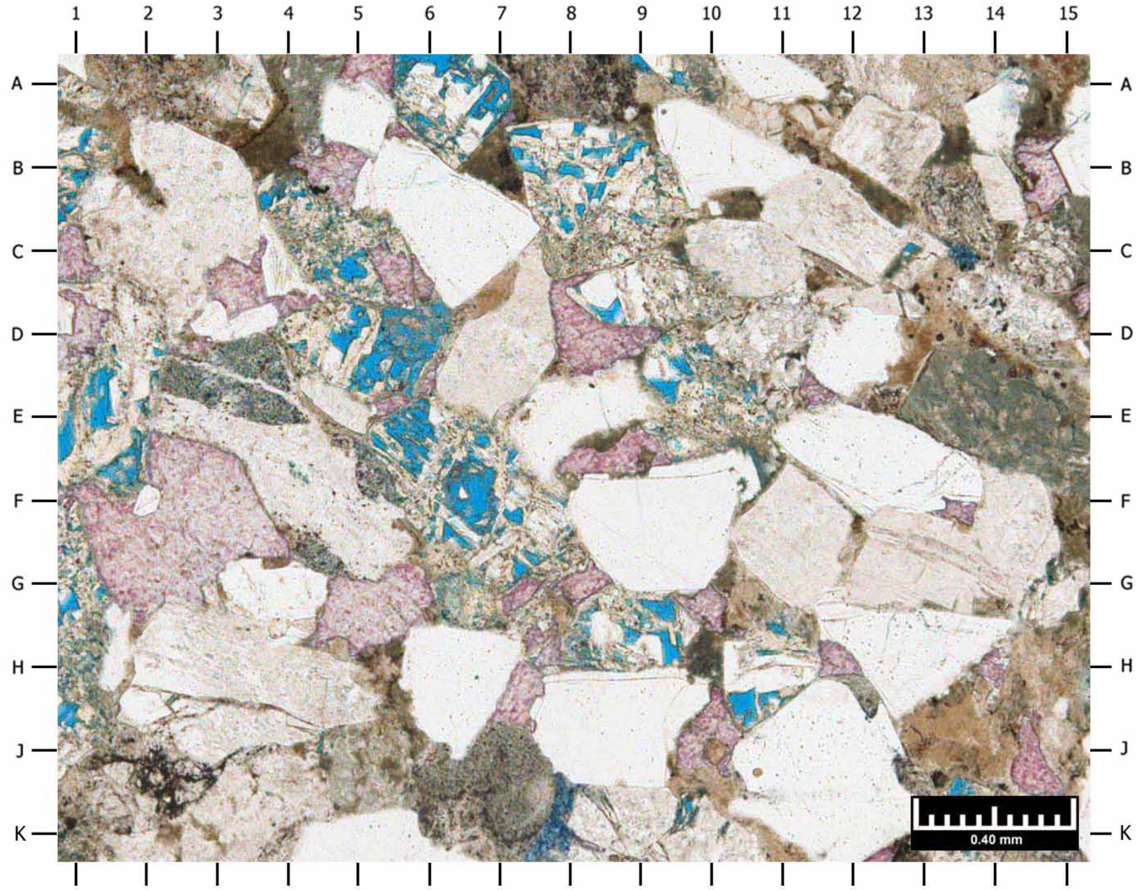
**Magnification:** A: 50X B: 200X

A) General photomicrograph A depicts massive fabric of this lithic arkose. Quartz overgrowths (BC6, EF10, H8.5) precipitate on host detrital grains. Calcite (stained red) occurs as replacement (CD3, FG2, H12) and cement (CD3). Intragranular dissolution pores are common (blue epoxy; AB6, D5, F6.5, HJ10.5).

B) The area near BC5 in Photo A is provided in this high magnification photomicrograph. Quartz overgrowth cement (C7.5, C11.2) and calcite cement (G2-JK5) bind detrital grains together. Remnants of a dissolved grain occur at F4.

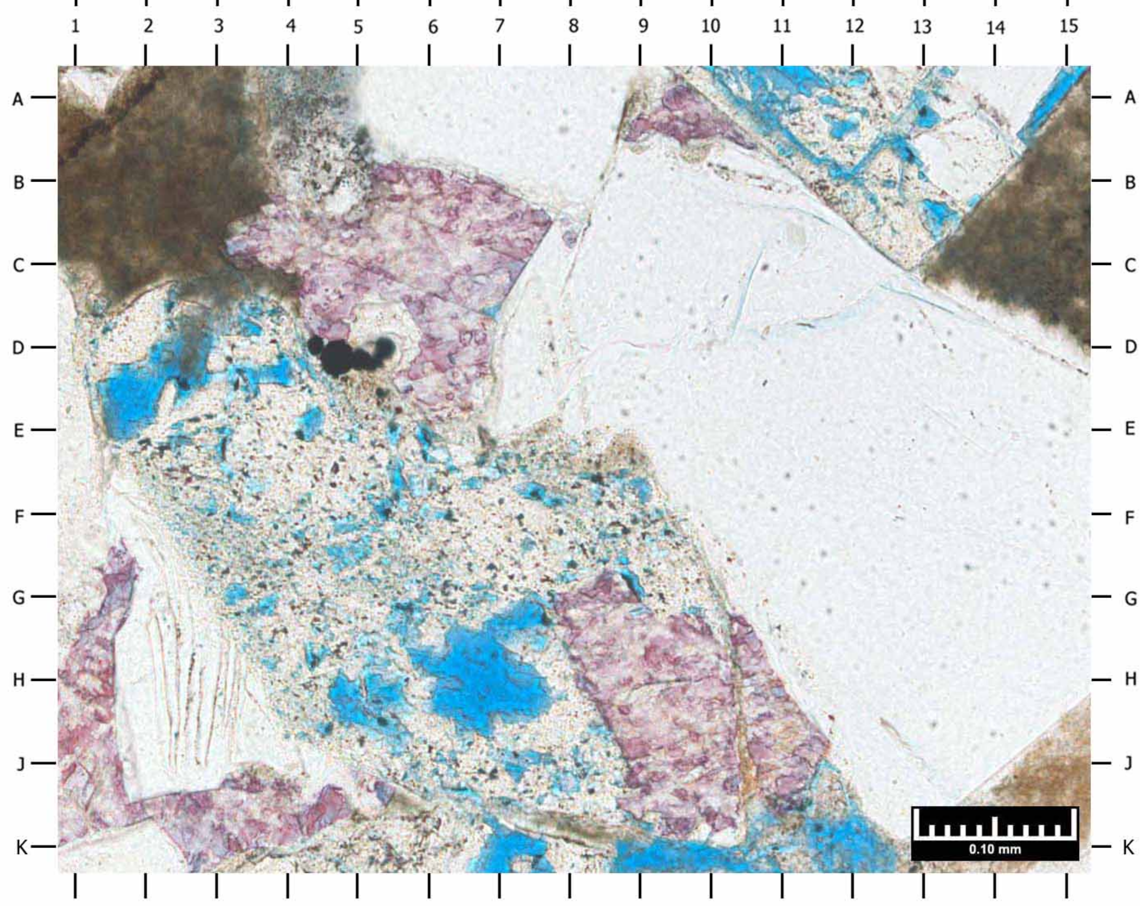
QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2919.1m
Plate 22




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2920.70 METERS**
**SAMPLE NUMBER: 33-SWC**

**PLATE 23**

| | |
|---|---|
| **Lithology*:** | Feldspathic litharenite |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-1.56mm |
| **Average Grain Size:** | 0.42mm |
| **Compaction:** | High |
| **Sorting:** | Moderate to poor |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz |
| **Minor:** | Plagioclase feldspar, potassium feldspar, chert, volcanic rock fragments, mudstone fragments, siltstone fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, organic material, zircon, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays (visual estimate) |
| **Authigenic Clay:** | Minor amounts of chlorite and kaolinite (visual estimate) |
| **Cement/Replacement:** | Quartz and feldspar overgrowths; minor calcite and Fe-dolomite replacement; rare siderite, dolomite, pyrite, and Ti-oxide |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains and micropores associated with clays; rare primary intergranular pores and fracture pores |
| **Porosity (RCA):** | 11.7% |
| **Permeability (RCA):** | 0.038mD |
| **Grain Density (RCA):** | 2.63gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) The detrital constituents in this massive feldspathic litharenite include monocrystalline quartz grains (AB7.5, AB14, JK3.5), calcite replaced lithic fragments (stained red; CD6.5, DE11), and compacted volcanic fragments (BC11, H6.5). Calcite also occurs as pore-filling cement (stained red; J3, JK5). Intragranular pores (blue epoxy; AB4, FG11, JK7, HJ15) associated with dissolution are the dominant pore type, with lesser amounts of primary intergranular pores (DE9).

B) This photomicrograph provides a magnified view of the area near EF12 in Photo A, depicting secondary intragranular pores within partially leached lithics (GH4.5, HJ1, K1). Quartz (F13) occurs as replacement of less stable material.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2920.7m
Plate 23

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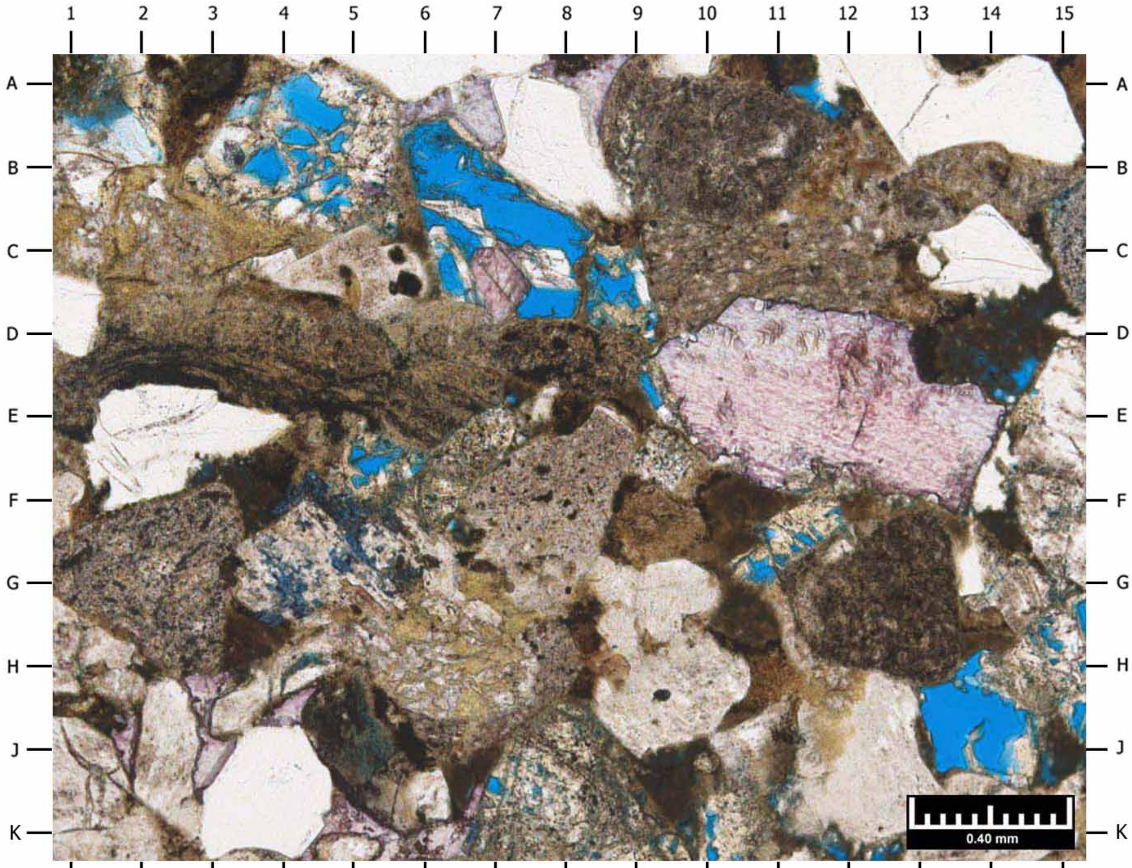
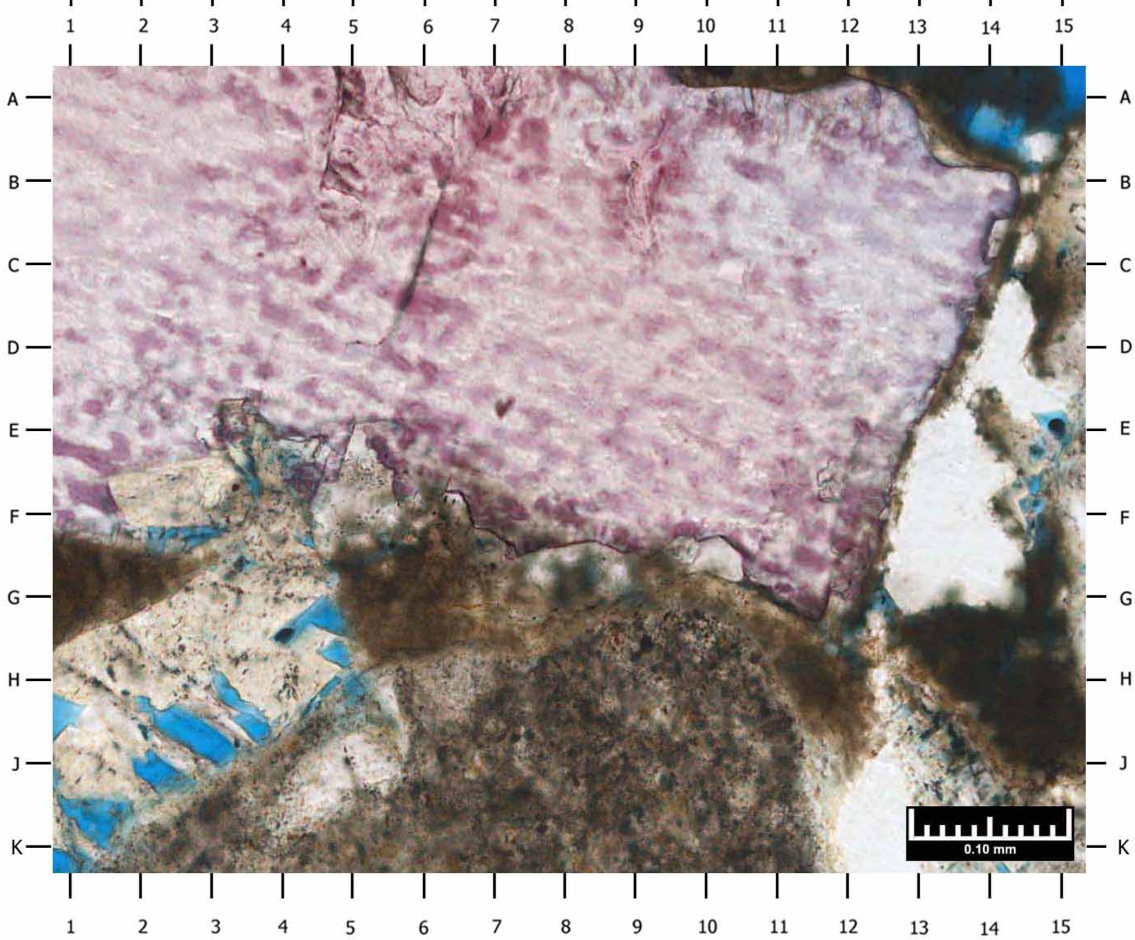



A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2922.04 METERS**
**SAMPLE NUMBER: 2_29P-DS**

**PLATE 24**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-1.67mm |
| **Average Grain Size:** | 0.70mm |
| **Compaction:** | Moderate |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, zircon, and organic material |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite clays |
| **Cement/Replacement:** | Feldspar overgrowths and replacement, quartz overgrowths, microquartz, siderite, Ti-oxide, Fe-oxide, Fe-dolomite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, and primary intergranular pores |
| **Porosity (RCA):** | 11.4% |
| **Permeability (RCA):** | 0.13mD |
| **Grain Density (RCA):** | 2.65gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) The detrital constituents in this massive feldspathic lithic arkose include monocrystalline quartz grains (D4, CD10.5, JK11), plagioclase feldspar (B14), and chert fragments (G4). Well-developed quartz overgrowths (CD5.5, CD2.5) precipitate in optical continuity with host detrital grains.

B) This photomicrograph provides a magnified view of the area near DE8.5 in Photo A. Intragranular dissolution pores (blue epoxy; DE5.5, HJ7.5, JK14.5) are the dominant pore type within this sample.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2922.0m
Plate 24

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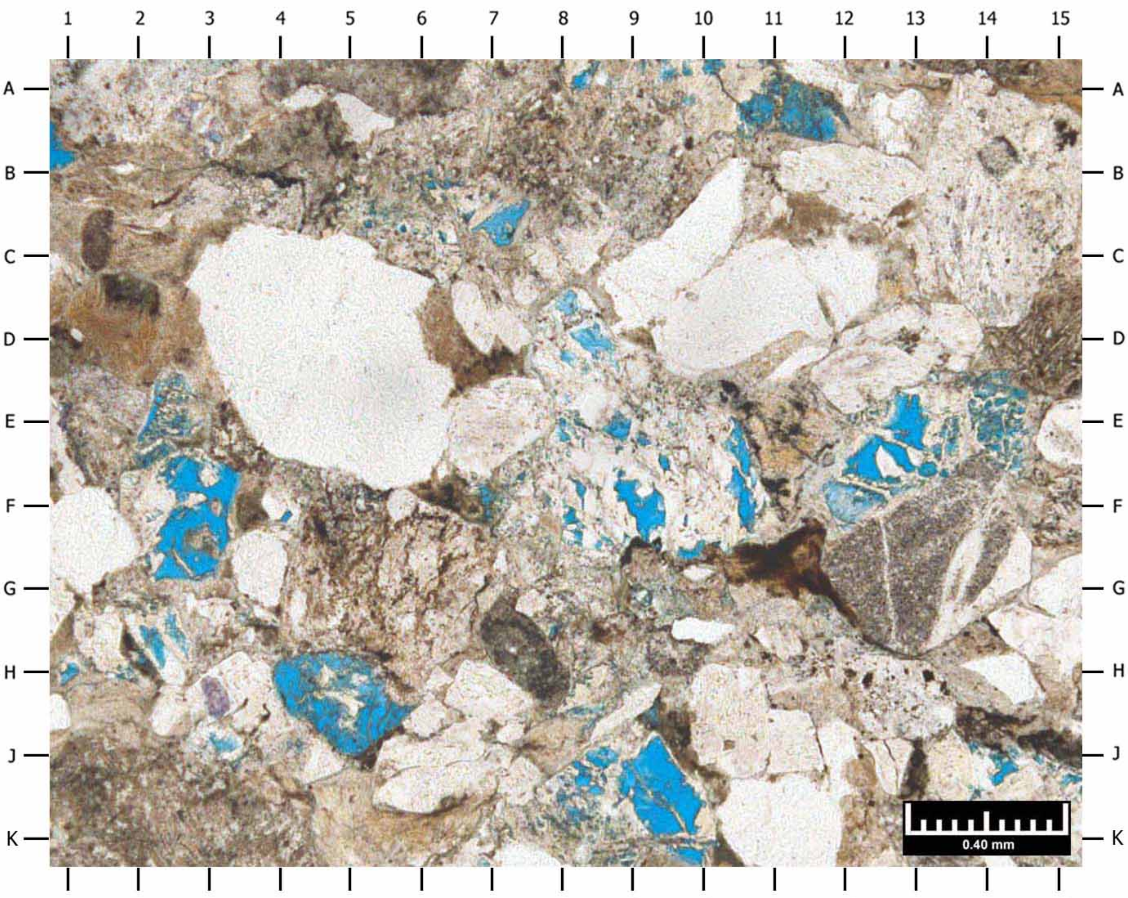
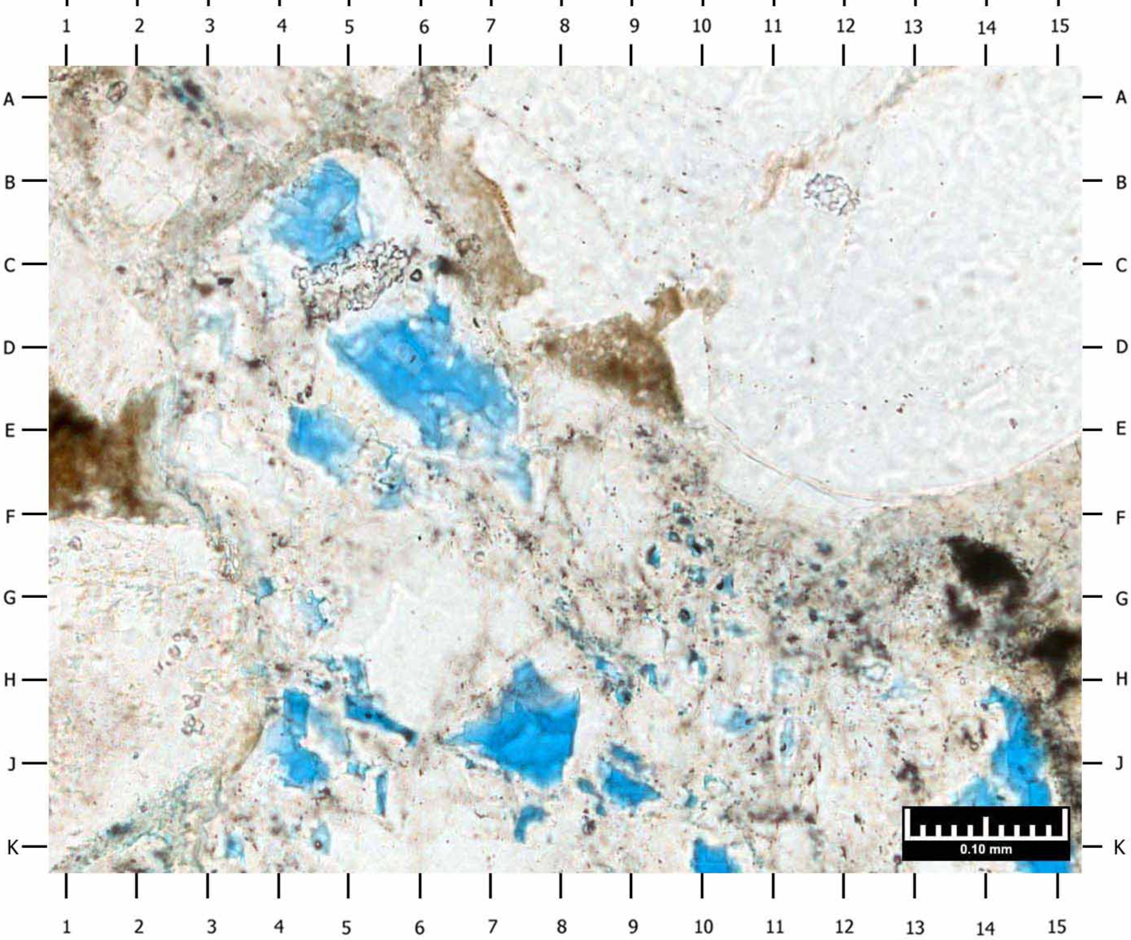



A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2924.21 METERS**
**SAMPLE NUMBER: 2_32P-DS**

**PLATE 25**

| | |
|---|---|
| **Lithology*:** | Lithic arkose |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-1.53mm |
| **Average Grain Size:** | 0.52mm |
| **Compaction:** | High |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Plagioclase feldspar and monocrystalline quartz |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, metamorphic rock fragments, mudstone rock fragments, siltstone fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, chamosite, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite/smectite and chlorite |
| **Cement/Replacement:** | Feldspar overgrowths and replacement, quartz overgrowths, calcite, microquartz, Fe-calcite, siderite, Ti-oxide, Fe-dolomite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, primary intergranular pores, and grain fracture pores |
| **Porosity (RCA):** | 10.9% |
| **Permeability (RCA):** | 0.051mD |
| **Grain Density (RCA):** | 2.64gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) Survey photomicrograph A depicts the massive fabric of this lithic arkose. Detrital quartz (B3, CD4.5, CD12, H7, HJ11.5) and altered lithic grains (B12, F3) are abundant. Minor amounts of clays occlude primary pores; however micropores are associated with these clays. Calcite (stained red; H4) and chlorite (B12.5) occur as replacement of susceptible material. Intragranular pores (blue epoxy; A5, C3, EF8, K3 are associated with partial dissolution of unstable grains. Authigenic quartz overgrowths are common (AB1.8, CD3.5, HJ10.9, DE13).

C) This photomicrograph provides a magnified view of the area near DE9 in Photo A, highlighting quartz cement (C10.5-E6, GH14) binding detrital grains together. Authigenic clays locally fill intergranular area (A12, HJ9, G-K1).

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2924.2m
Plate 25

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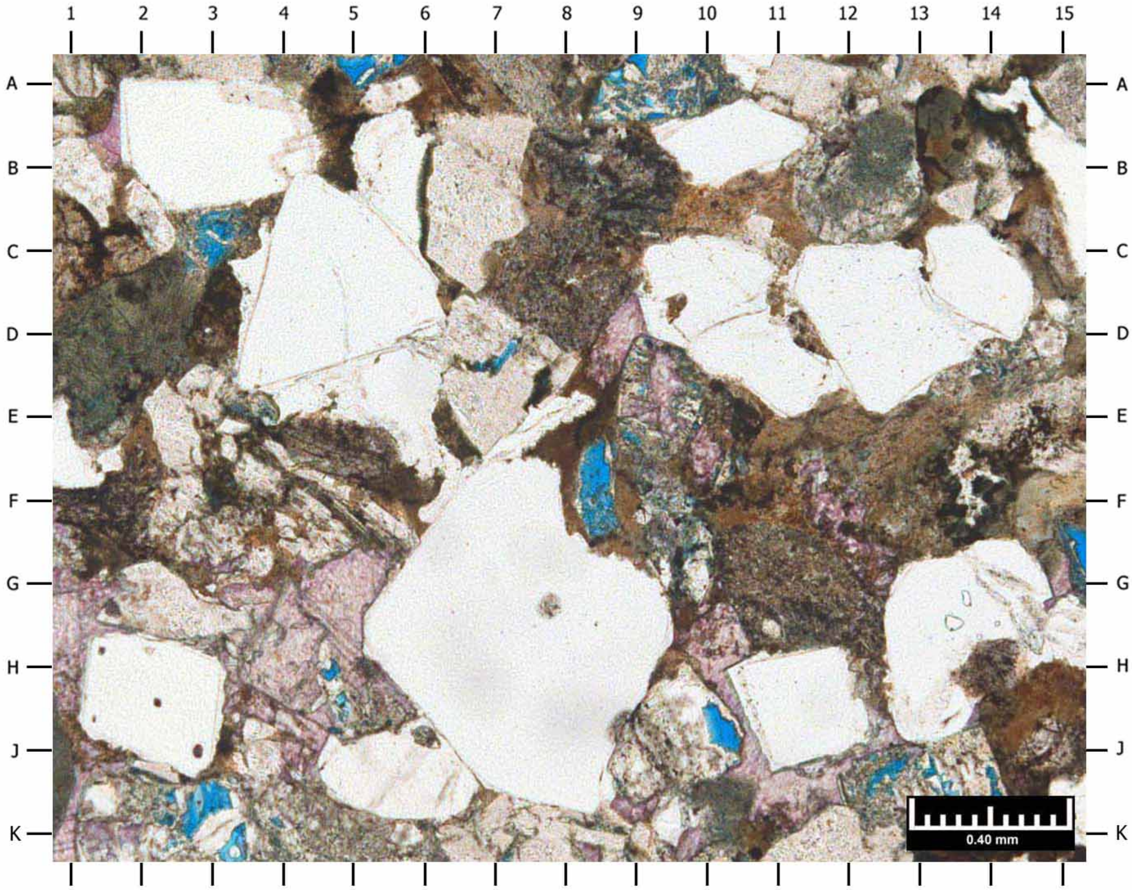
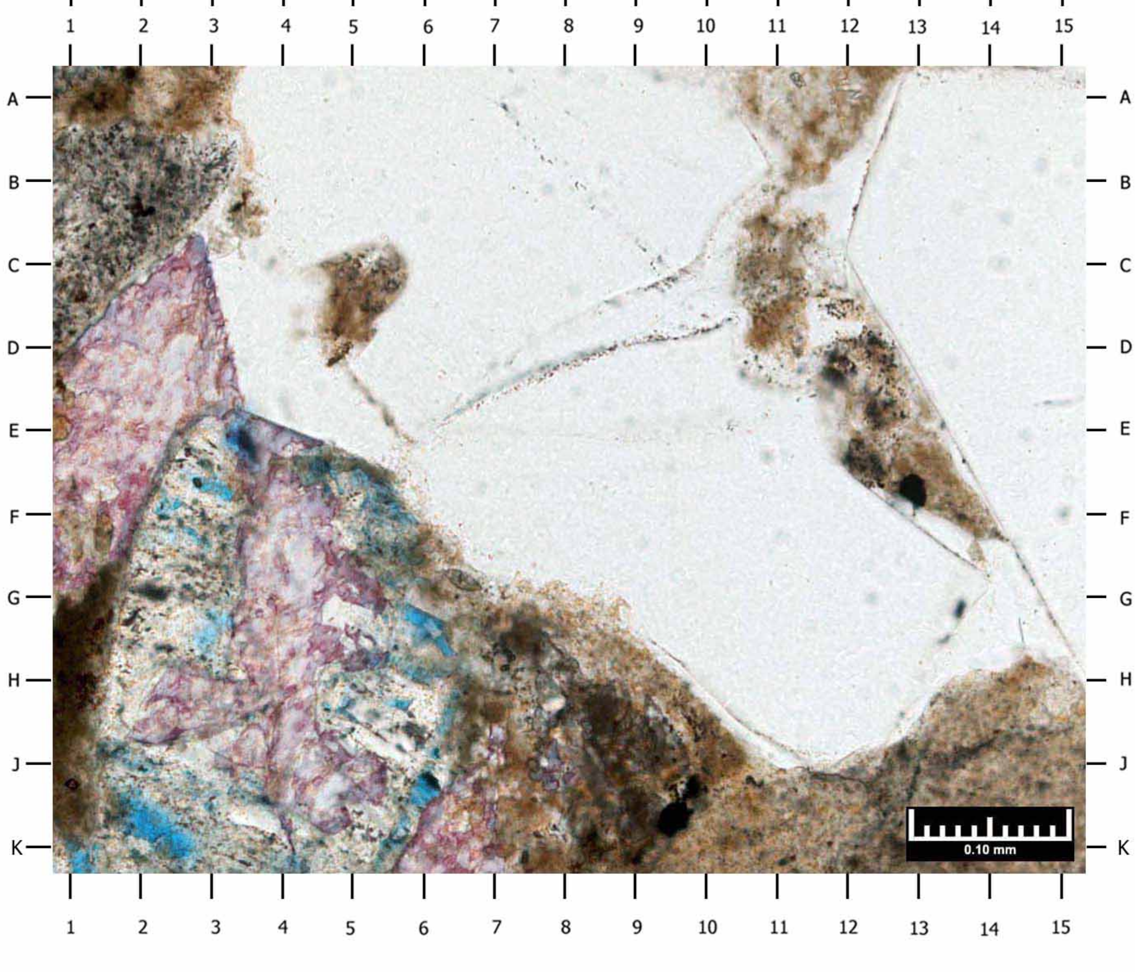



A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 2931.50 METERS**
**SAMPLE NUMBER: 32-SWC**

**PLATE 26**

| | |
|---|---|
| **Lithology*:** | Feldspathic litharenite |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-1.63mm |
| **Average Grain Size:** | 0.53mm |
| **Compaction:** | Very high |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz |
| **Minor:** | Plagioclase feldspar, potassium feldspar, chert, volcanic fragments, mudstone rock fragments, siltstone fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica and zircon |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays (visual estimate) |
| **Authigenic Clay:** | Minor amounts of illite and kaolinite (visual estimate) |
| **Cement/Replacement:** | Quartz overgrowths, calcite, pyrite, and rare siderite (visual estimate) |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains and micropores associated with clays; rare primary intergranular pores |
| **Porosity (RCA):** | 11.0% |
| **Permeability (RCA):** | 0.069mD |
| **Grain Density (RCA):** | 2.63gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) General photomicrograph A displays abundant, relatively large detrital quartz grains (B3, E4, G2.5, E9.5, GH13) and altered volcanic fragments (AB14.5, D5, JK12). Authigenic quartz overgrowths (CD2.2, FG3, F7.2, CD9) and calcite cement (stained red; CD1, EF6-G9) bind grains together. Intragranular pores (blue epoxy; C6, CD11.2, EF13, HJ9) are associated with leached lithic grains.

B) This photomicrograph provides a magnified view of the area near H9 in Photo A, highlighting the intragranular pores. Overgrowths rim detrital quartz grains (A7-BC9, A13-BC9, DE11, GH14.5).

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

2931.5m
Plate 26

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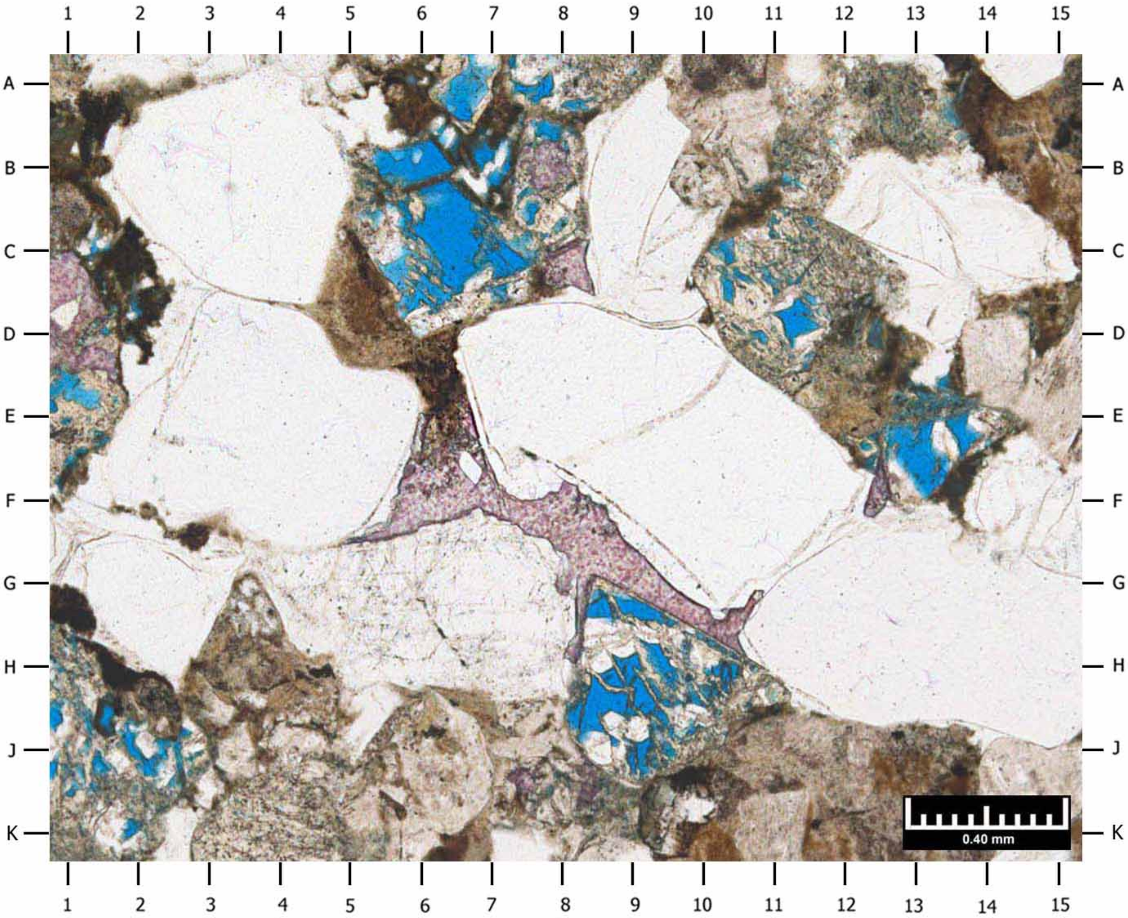
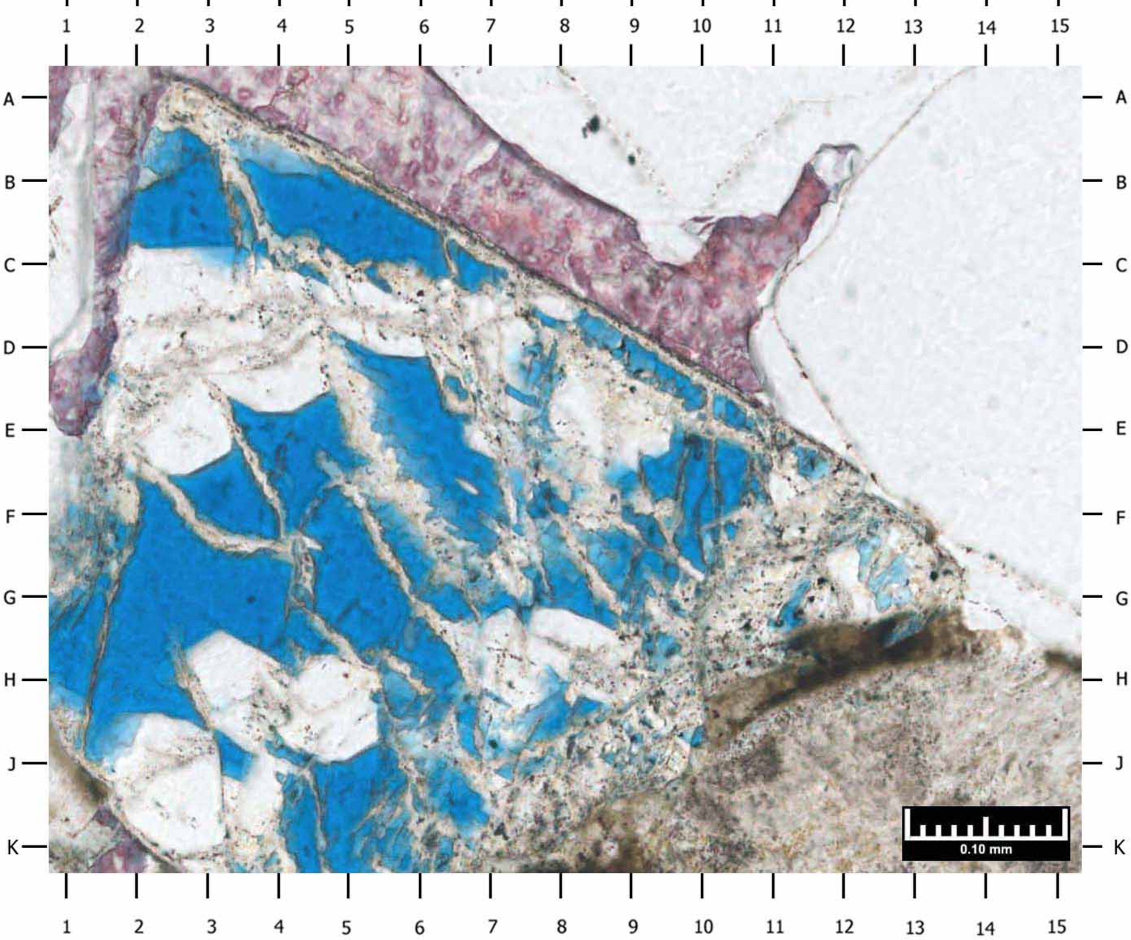



A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3005.00 METERS**
**SAMPLE NUMBER: 21-SWC**

**PLATE 27**

| | |
|---|---|
| **Lithology*:** | Sublitharenite |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | 0.05mm-8.74mm |
| **Average Grain Size:** | 0.71mm |
| **Compaction:** | High |
| **Sorting:** | Very poor |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz and polycrystalline quartz |
| **Minor:** | Plagioclase feldspar, potassium feldspar, chert, volcanic fragments, and mudstone rock fragments |
| **Accessory:** | Muscovite mica and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | No detrital clays observed |
| **Authigenic Clay:** | Minor amounts of illite and chlorite (visual estimate) |
| **Cement/Replacement:** | Quartz overgrowths, sericite, and rare siderite and pyrite (visual estimate) |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains and micropores associated with clays; rare primary intergranular pores |
| **Porosity (RCA):** | N/A |
| **Permeability (RCA):** | N/A |
| **Grain Density (RCA):** | N/A |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) This low magnification photomicrograph provides a general overview of this very poorly sorted sublitharenite. Large detrital quartz grains are observed (F6, C13, J13, JK9). Remnants of dissolved feldspars/lithic fragments (AB2-D2, HJ5) contain intragranular pores (blue epoxy).

B) This photomicrograph provides a magnified view of the area near BC3 in Photo A. A leached feldspar, possible lithic fragment, occurs at A7-K1. Authigenic clay is also observed (CD6-G4).

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

3005.0m
Plate 27

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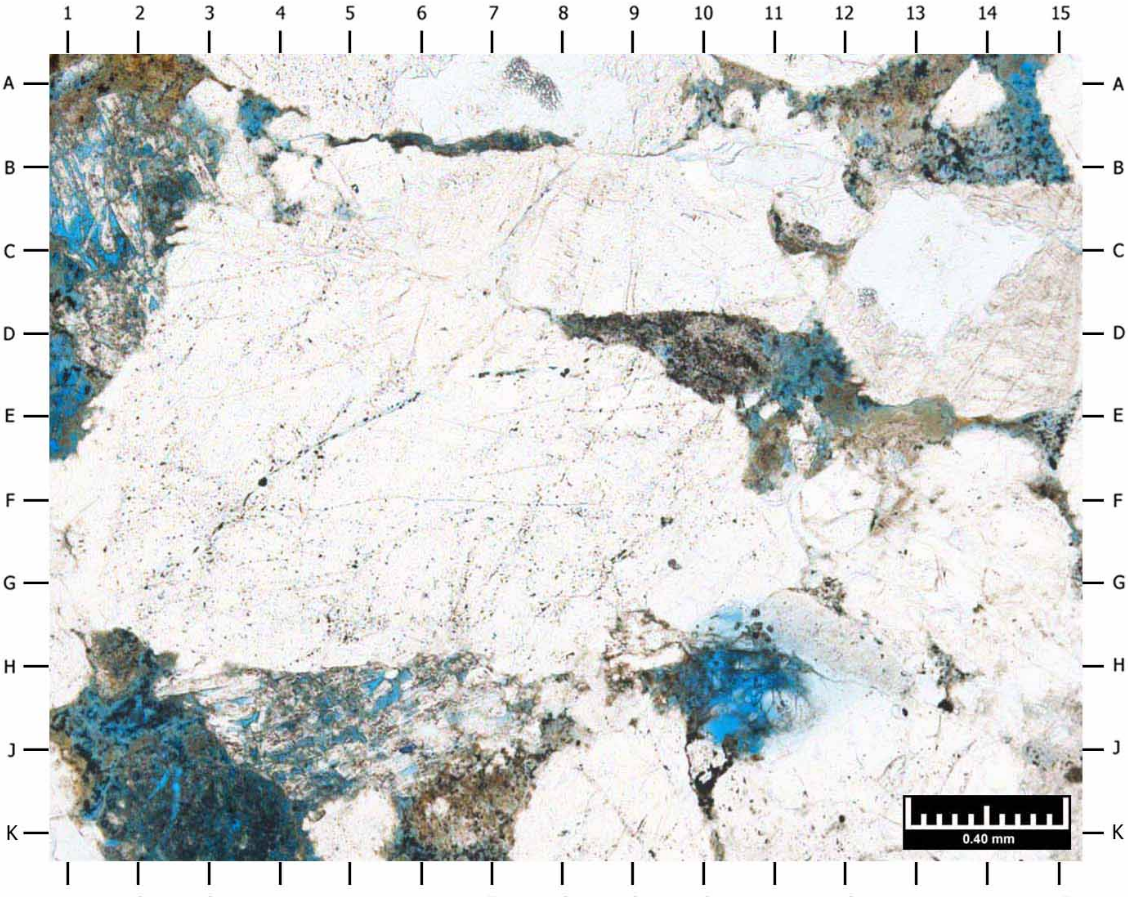
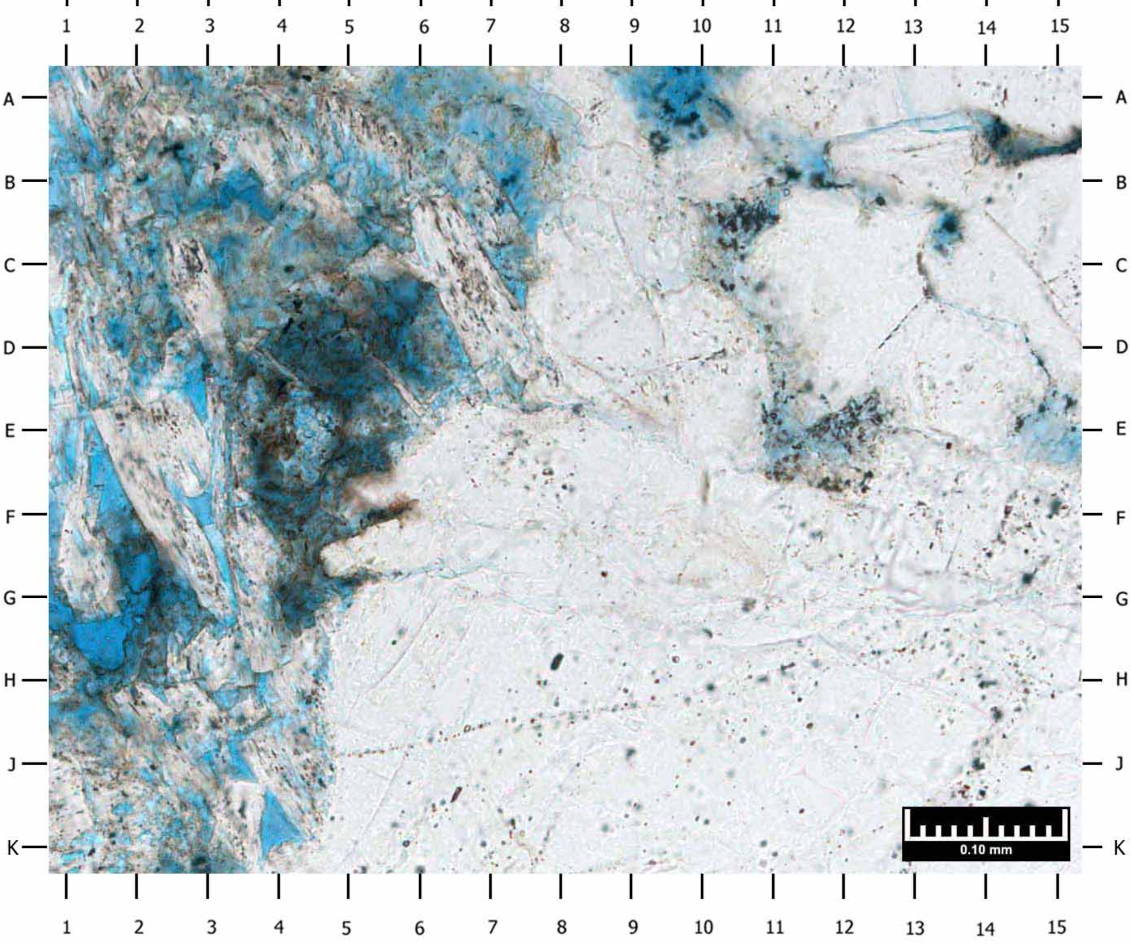



A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3006.80 METERS**
**SAMPLE NUMBER: 24-SWC**

**PLATE 28**

| | |
|---|---|
| **Lithology*:** | Sublitharenite |
| **Sedimentary Fabric:** | Massive; clay/organic-rich stylolites |
| **Grain Size Range:** | <0.01mm-4.79mm |
| **Average Grain Size:** | 1.08mm |
| **Compaction:** | Very high |
| **Sorting:** | Moderate to poor |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz and polycrystalline quartz |
| **Minor:** | Plagioclase feldspar, chert, volcanic fragments, mudstone rock fragments |
| **Accessory:** | Muscovite mica, biotite mica, and organic material |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays (visual estimate) |
| **Authigenic Clay:** | Minor amounts of illite (visual estimate) |
| **Cement/Replacement:** | Quartz overgrowths, Fe-dolomite, and calcite; trace pyrite (visual estimate) |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, and primary intergranular pores |
| **Porosity (RCA):** | 12.6% |
| **Permeability (RCA):** | 0.49mD |
| **Grain Density (RCA):** | 2.67gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) This very highly compacted sublitharenite contains abundant amounts of detrital quartz grains, with lesser amounts of chert (JK11.5, HJ2.5) and calcite-replaced lithic fragments (stained red; CD2). Organic filled stylolites (F1-DE15) are observed. Intragranular pores occur within a leached lithic fragment (DE1-4).

B) This photomicrograph provides a magnified view of the area near EF5 in Photo A, highlighting a portion of the clay/organic-rich stylolite. Calcite (stained red; A1-C3.2) and ferroan dolomite (stained blue; K4-13) occur as replacement of less stable material. Secondary intragranular pores (AB1.2, C3-F1) are present.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

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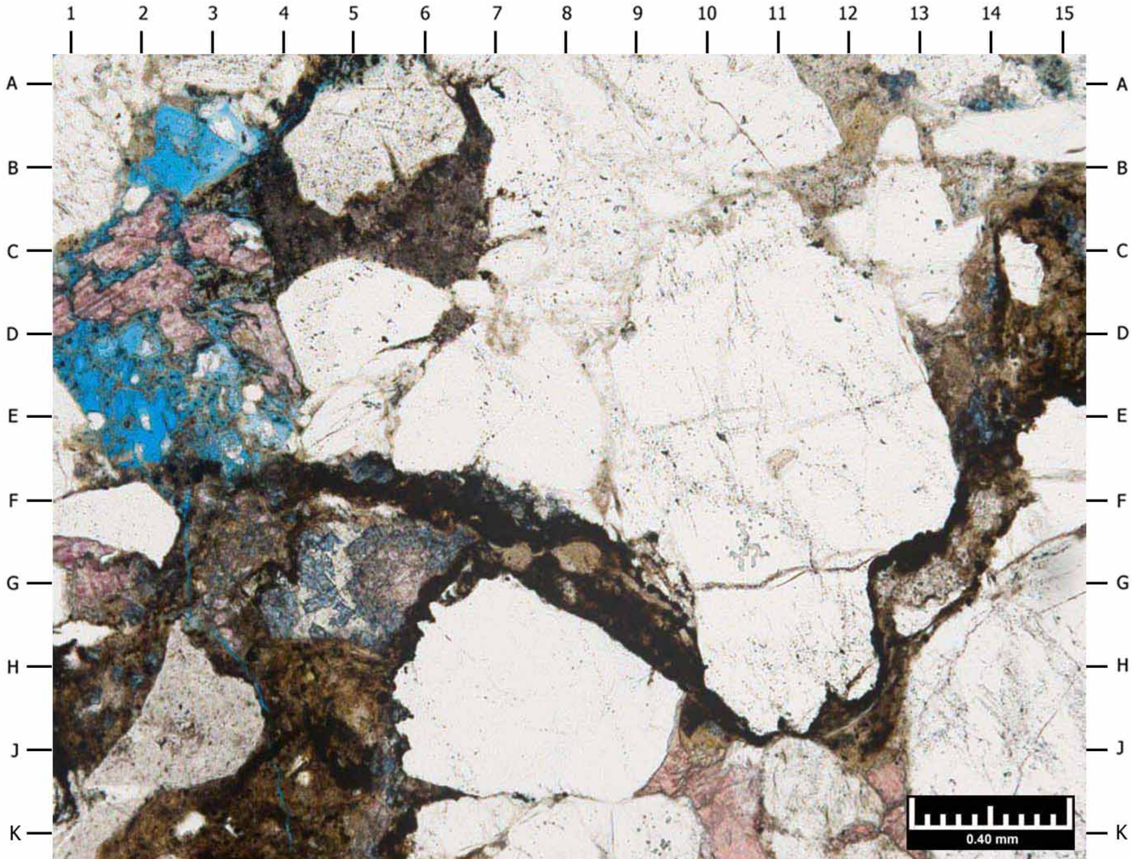
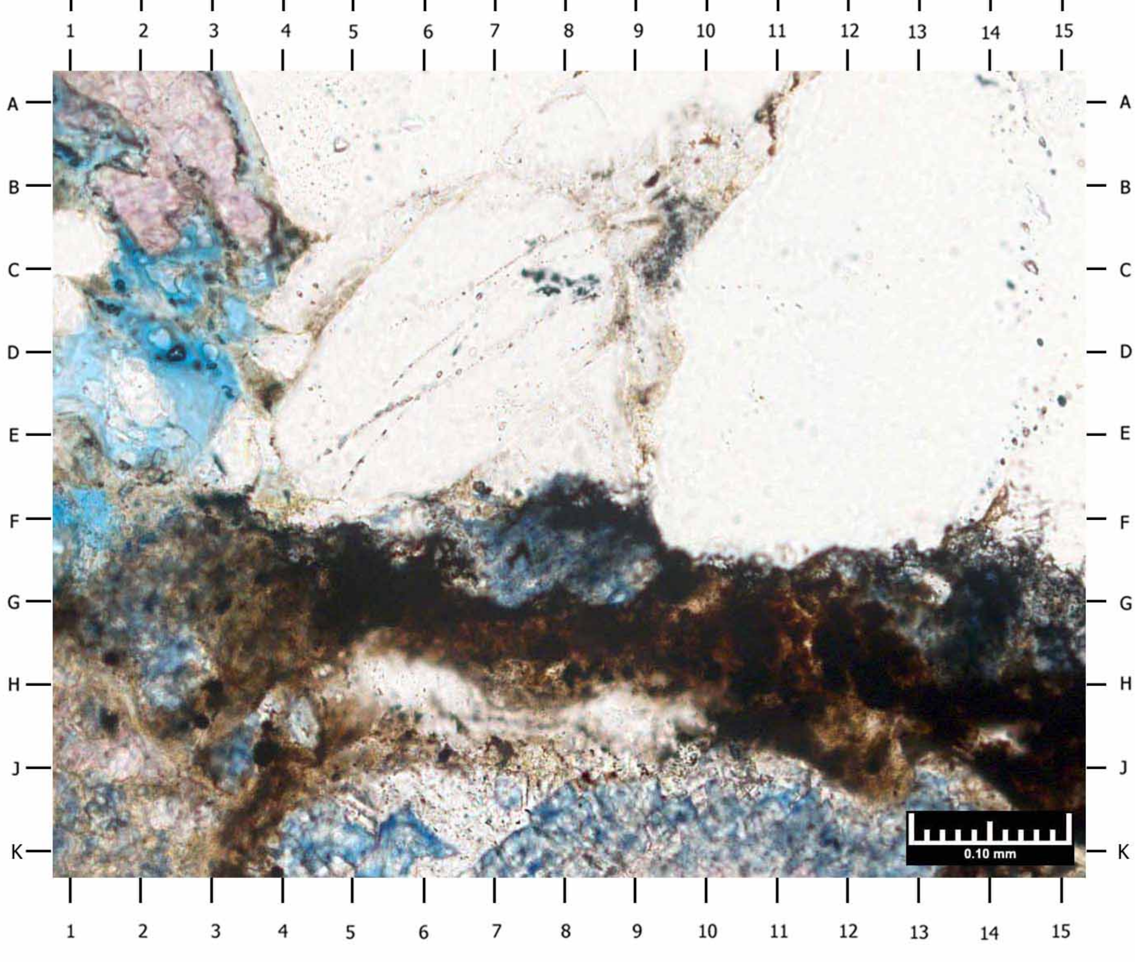
3006.8m
Plate 28




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3007.90 METERS**
**SAMPLE NUMBER: 23-SWC**

**PLATE 29**

| | |
|---|---|
| **Lithology*:** | Feldspathic litharenite |
| **Sedimentary Fabric:** | Massive; burrowed |
| **Grain Size Range:** | <0.01mm-1.94mm |
| **Average Grain Size:** | 0.39mm |
| **Compaction:** | High |
| **Sorting:** | Moderate to poor |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz and plagioclase feldspar |
| **Minor:** | Potassium feldspar, chert, volcanic fragments, mudstone rock fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, organic material, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Rare amounts of detrital clays (visual estimate) |
| **Authigenic Clay:** | Minor amounts of illite and smectite (visual estimate) |
| **Cement/Replacement:** | Quartz overgrowths, rare calcite and pyrite (visual estimate) |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, and very rare primary intergranular pores |
| **Porosity (RCA):** | 11.9% |
| **Permeability (RCA):** | 0.29mD |
| **Grain Density (RCA):** | 2.66gm/cc |

*Folk classification based on visual estimate of sample constituents

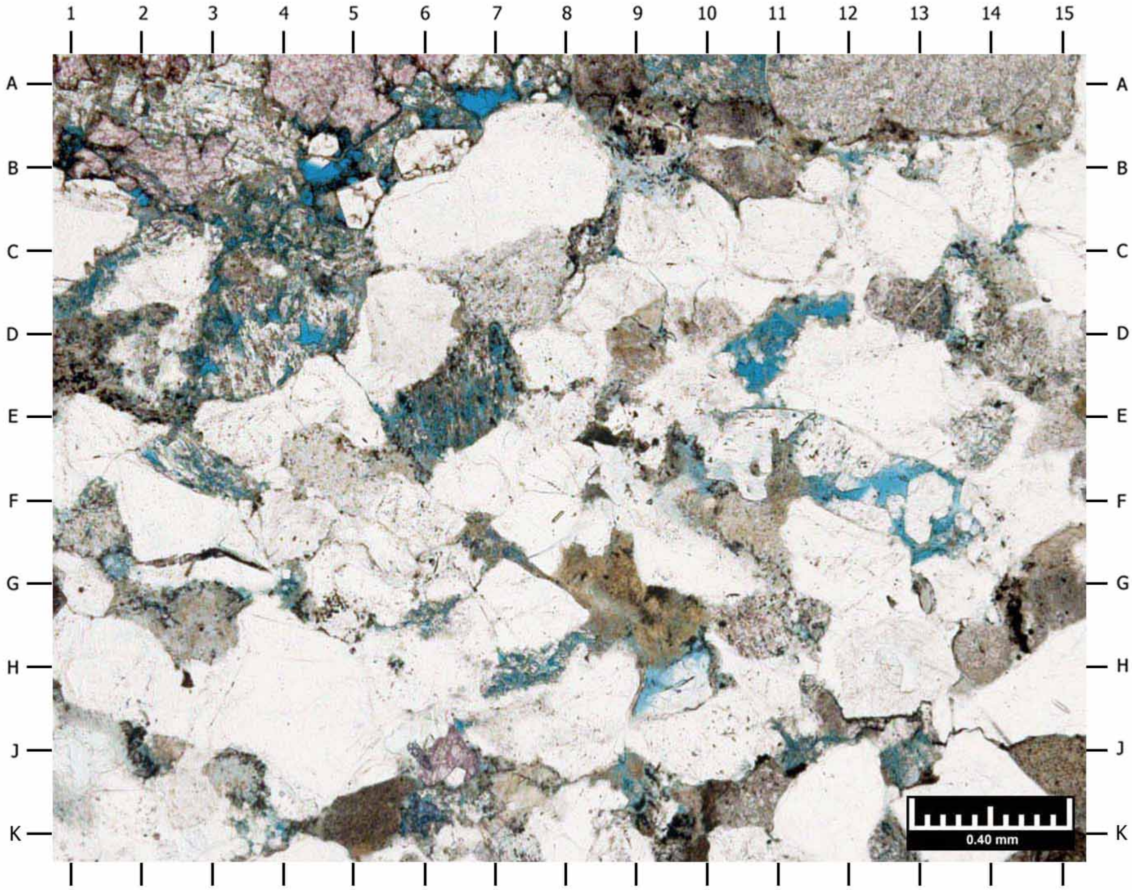
**Magnification:** A: 50X B: 200X

A) This low magnification microphotograph illustrates the massive, highly compacted fabric of this feldspathic litharenite. Volcanic rock fragments (CD12.8, GH11), chert (A11-15), and mudstone fragments (JK5) are the main lithic types observed. Monocrystalline quartz is dominant (BC7, DE12.5, HJ4). Quartz overgrowths (BC5.5, J3) commonly precipitate on host detrital grains. Calcite (stained red) occurs as replacement of labile grains/lithics (stained red; A1, A4.5, J6.2).

B) This photomicrograph provides a magnified view of the area near J7 in Photo A, depicting minor amounts of calcite (stained red; F6) replacing unstable grains. Intragranular pores (blue epoxy; A13-BC8) occur within partially dissolved feldspar/lithic fragments. A very rare primary intergranular pore is also observed (DE7). Ferroan dolomite (stained blue; J5) occurs as replacement of less stable material.

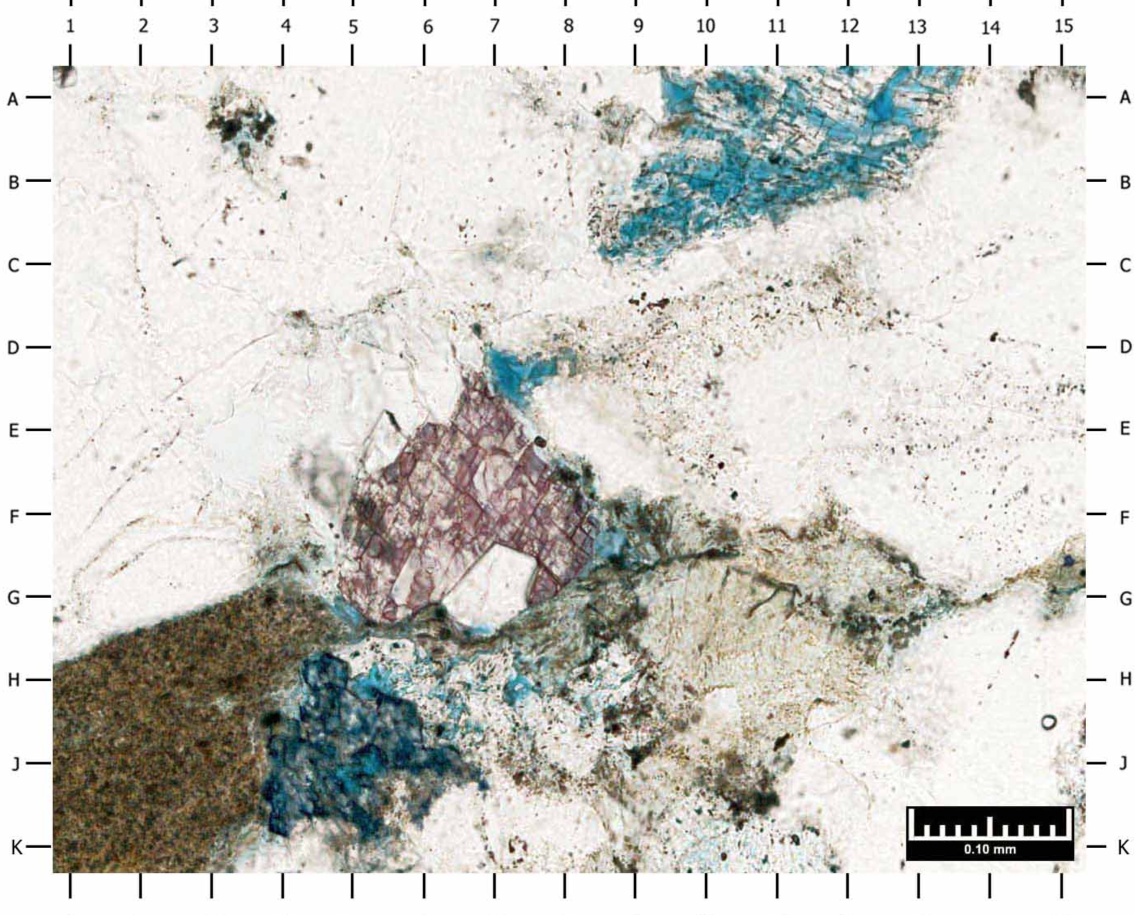
**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

**3007.9m**
**Plate 29**




**A**

**50X**




**B**

**200X**

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3008.80 METERS**
**SAMPLE NUMBER: 22-SWC**

**PLATE 30**

| | |
|---|---|
| **Lithology*:** | Feldspathic litharenite |
| **Sedimentary Fabric:** | Massive; stylolites |
| **Grain Size Range:** | <0.01mm-7.94mm |
| **Average Grain Size:** | 0.74mm |
| **Compaction:** | Very high |
| **Sorting:** | Very poor |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz |
| **Minor:** | Siltstone/sandstone fragments, plagioclase feldspar, potassium feldspar, chert, volcanic fragments, mudstone rock fragments, metaquartzite, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, organic material, zircon, staurolite, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Rare amounts of detrital clays (visual estimate) |
| **Authigenic Clay:** | Minor amounts of illite and smectite (visual estimate) |
| **Cement/Replacement:** | Quartz overgrowths and rare pyrite (visual estimate) |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains, micropores associated with clays and leached grains, and very rare primary intergranular pores |
| **Porosity (RCA):** | 10.5% |
| **Permeability (RCA):** | 0.33mD |
| **Grain Density (RCA):** | 2.65gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

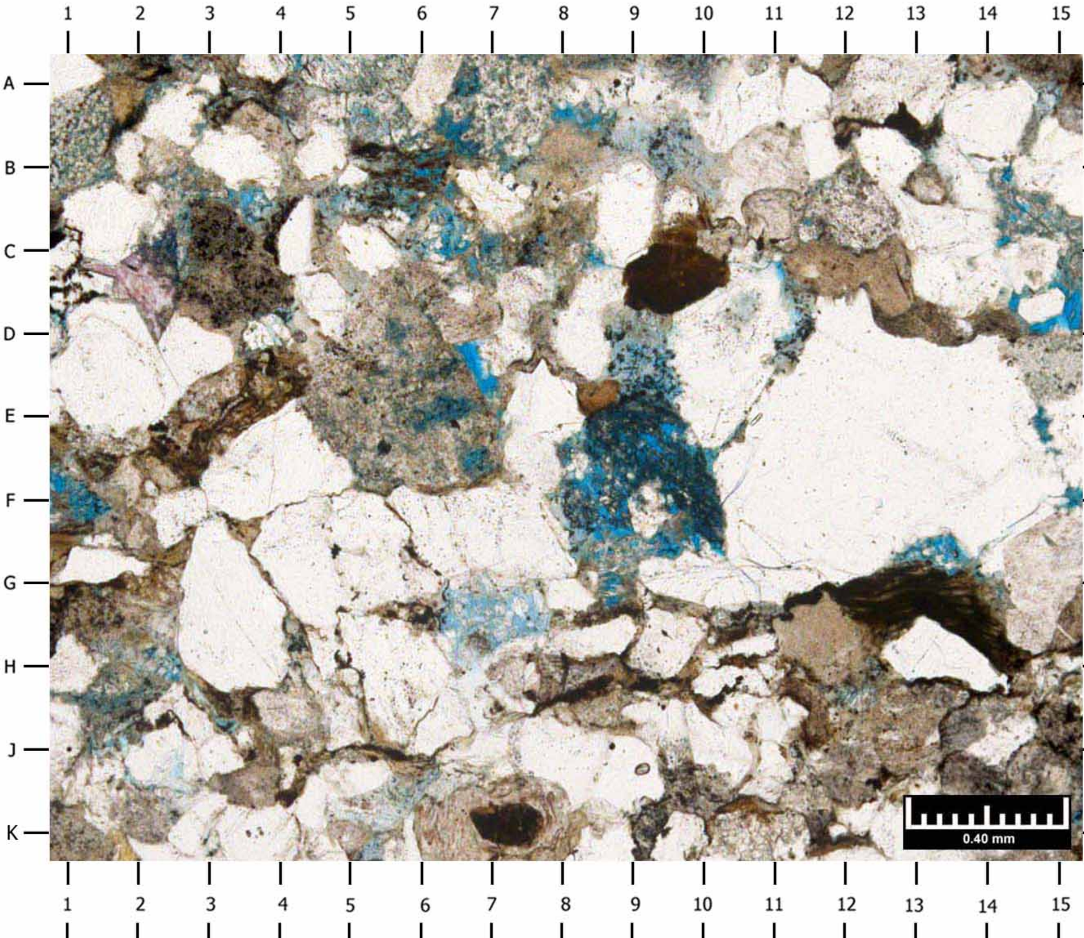
A) Mudstone fragments (CD12, GH11.5) and chert (E4.5, K11) are the main lithic types observed within this very poorly sorted feldspathic litharenite. Monocrystalline quartz is common (E12, DE1.5, GH3.5). Quartz overgrowths precipitate on host detrital grains (D1-E3). A zircon occurs at J9.1. Secondary intragranular pores occur within partially altered grains (blue epoxy; BC3.5, F9, GH7).

B) This photomicrograph provides a magnified view of the area near GH9 in Photo A, depicting minor amounts of pore occluding clays intermixed with rare amounts of organic material (EF7, H7.5-JK3, HJ9.5). Remnants of a dissolved feldspar grain are observed (D7).

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

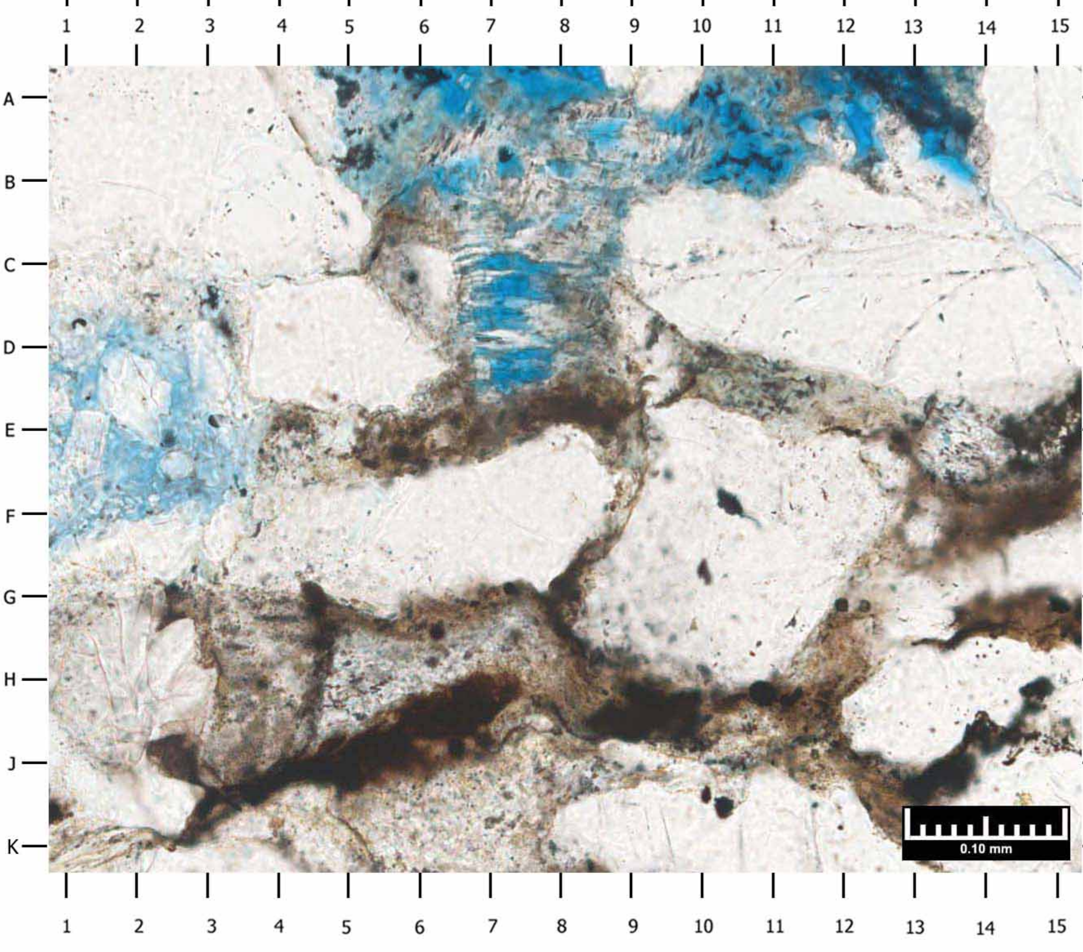
3008.8m
Plate 30

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3061.00 METERS**
**SAMPLE NUMBER: 12-SWC**

**PLATE 31**

| | |
|---|---|
| **Lithology*:** | Sublitharenite to litharenite |
| **Sedimentary Fabric:** | Massive; stylolites |
| **Grain Size Range:** | <0.01mm-3.42mm |
| **Average Grain Size:** | 0.39mm |
| **Compaction:** | Very high |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz |
| **Minor:** | Plagioclase feldspar, potassium feldspar, chert, metaquartzite, mudstone rock fragments, volcanic fragments, siltstone fragments, metamorphic fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Common amounts of detrital clays |
| **Authigenic Clay:** | Rare amounts of chlorite and kaolinite |
| **Cement/Replacement:** | Quartz overgrowths, pyrite, and siderite |
| **Porosity Types:** | Micropores associated with clays and leached grains, secondary intragranular pores associated with leached grains, and very rare primary intergranular pores |
| **Porosity (RCA):** | 4.0% |
| **Permeability (RCA):** | 0.020mD |
| **Grain Density (RCA):** | 2.68gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

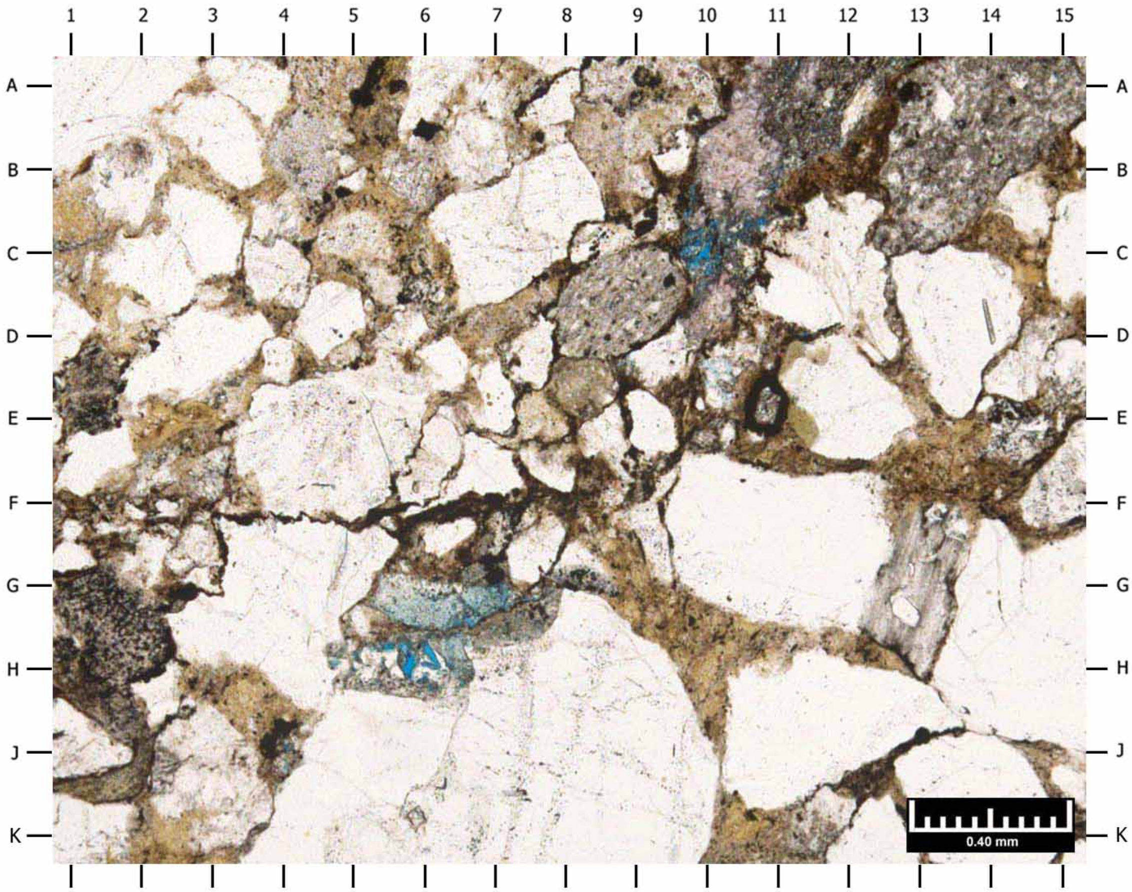
A) The massive fabric of this moderately sorted sublitharenite to litharenite is depicted in this survey photomicrograph. An organic stylolite occurs at AB10-HJ2. Detrital quartz grains (A1, G3.5, FG11) are the dominant grain type with lesser amounts of volcanic fragments (AB14, CD8.5) and chert (EF15). Feldspathic clays (stained yellow; BC2.5, H10, K11) fill primary intergranular areas.

B) This photomicrograph provides a detailed view of the area near GH6.5 in Photo A. A fractured quartz gain occurs at D2. Pyrite occurs as replacement (black; A12-DE11). Leached feldspar/lithic grains contain intragranular pores (blue epoxy; FG9, EF11, HJ6, HJ8).

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

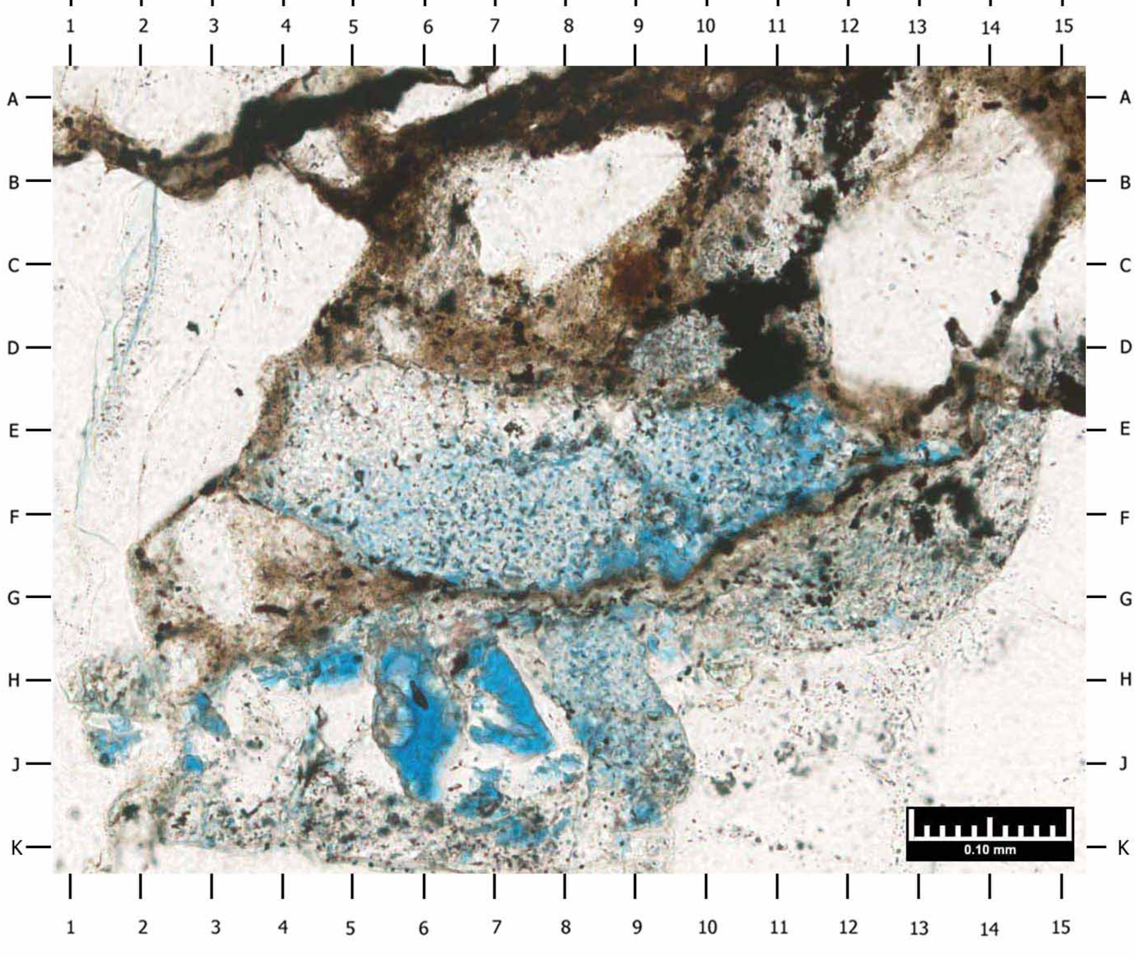
3061.0m
Plate 31

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3075.00 METERS**
**SAMPLE NUMBER: 11-SWC**

**PLATE 32**

| | |
|---|---|
| **Lithology*:** | Litharenite |
| **Sedimentary Fabric:** | Laminated to massive; stylolites |
| **Grain Size Range:** | <0.01mm-8.70mm |
| **Average Grain Size:** | 0.71mm |
| **Compaction:** | Very high |
| **Sorting:** | Poor |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz, polycrystalline quartz, and chert |
| **Minor:** | Plagioclase feldspar, potassium feldspar, volcanic fragments, metaquartzite, mudstone rock fragments, metamorphic fragments |
| **Accessory:** | Muscovite mica, organic material, zircon, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Common amounts of detrital clays |
| **Authigenic Clay:** | Minor amounts of illite and smectite |
| **Cement/Replacement:** | Quartz overgrowths, microquartz, and trace amounts of pyrite |
| **Porosity Types:** | Micropores associated with clays and leached grains, secondary intragranular pores associated with leached grains, and primary intergranular pores |
| **Porosity (RCA):** | 5.0% |
| **Permeability (RCA):** | 0.045mD |
| **Grain Density (RCA):** | 2.68gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

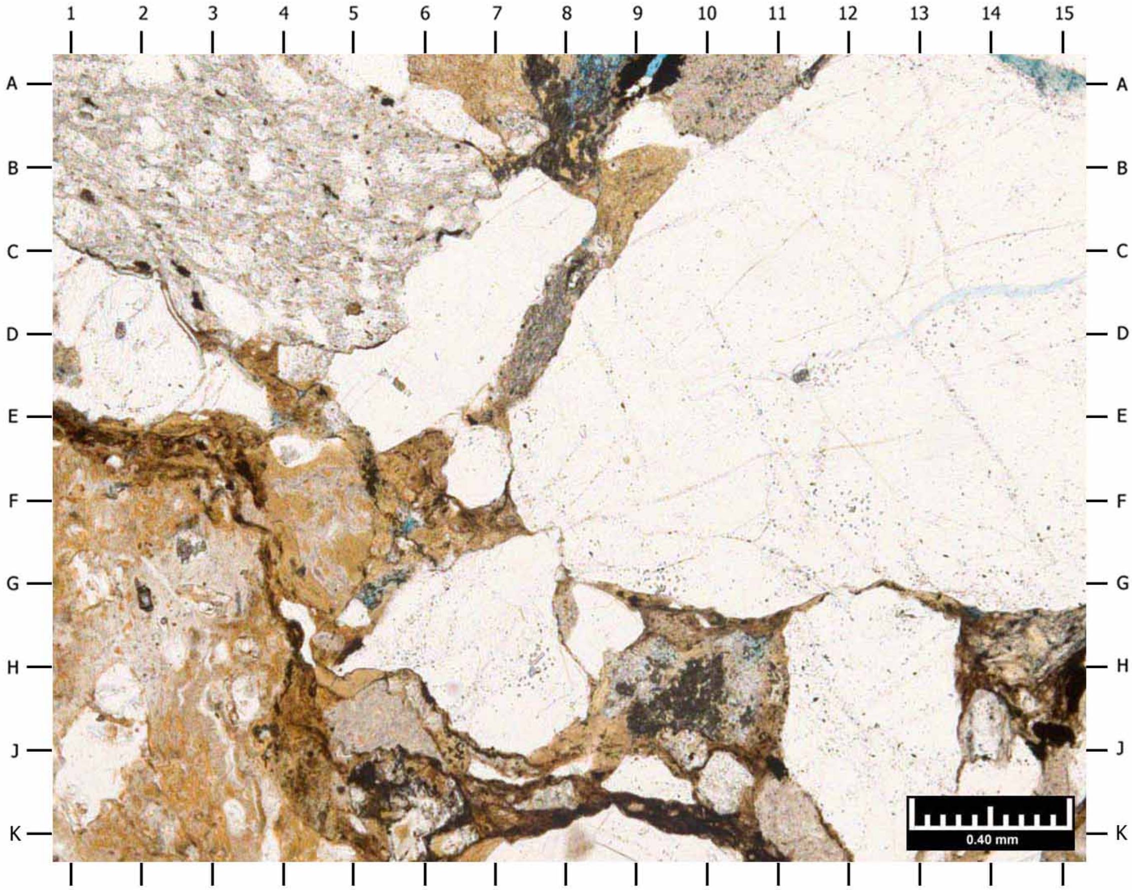
A) This general photomicrograph illustrates the poorly sorted, very highly compacted fabric of this litharenite. Quartz (D12, CD7, GH76, HJ12) and volcanic fragments (A1-6) are the most common detrital constituents. An organic filled stylolite occurs at E1-K11. Altered feldspathic clays fill intergranular areas (stained yellow; E1-K5)

B) This photomicrograph provides a magnified view of the area near DE3.5 in Photo A. Intragranular pores associated with partial dissolution are observed (G9). A rare intergranular pore is observed (blue epoxy; FG10). Splayed mica fragments occur at B2.5-EF4 and D5-G8.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

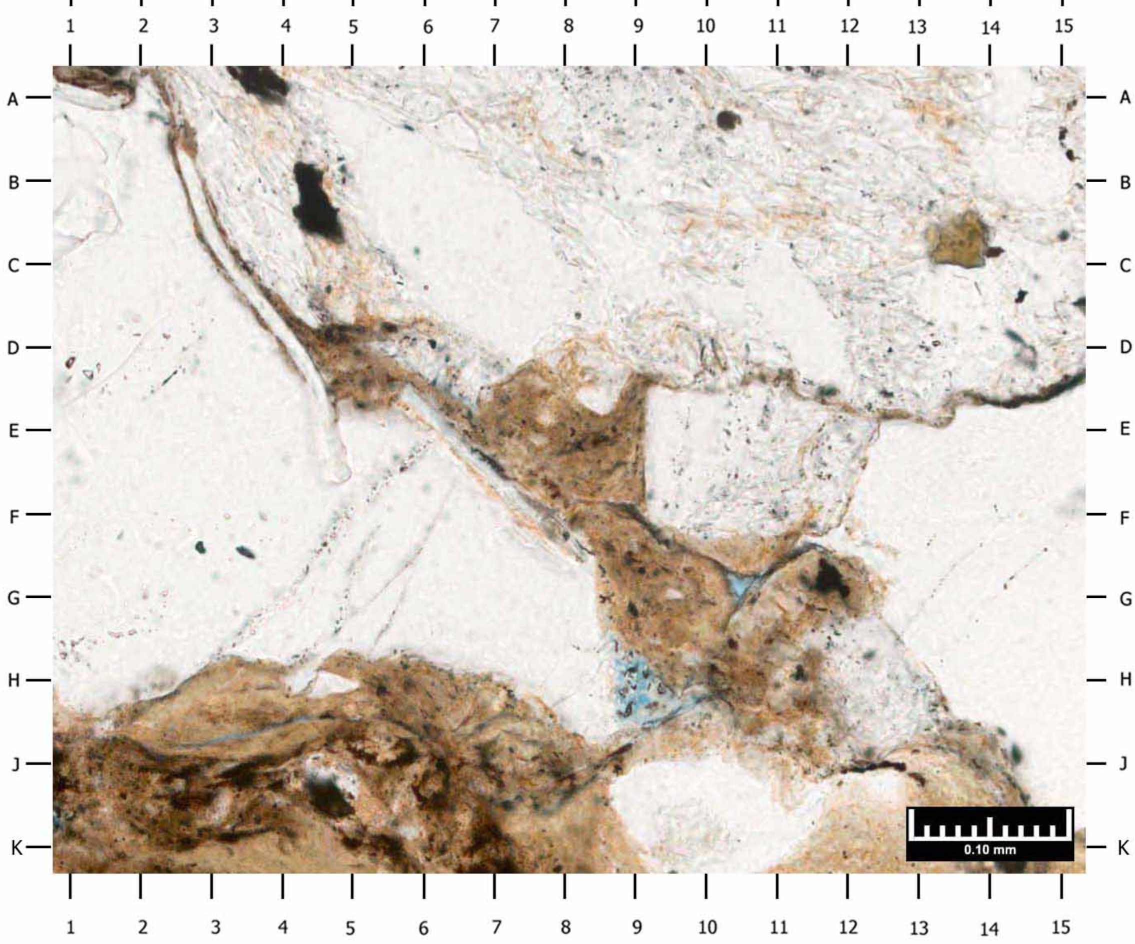
3075.0m
Plate 32

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3076.47 METERS**
**SAMPLE NUMBER: 10-SWC**

**PLATE 33**

| | |
|---|---|
| **Lithology*:** | Sublitharenite |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | <0.01mm-3.31mm |
| **Average Grain Size:** | 0.53mm |
| **Compaction:** | High |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz |
| **Minor:** | Plagioclase feldspar, potassium feldspar, chert, metaquartzite, mudstone rock fragments, siltstone fragments, volcanic fragments, metamorphic fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, organic material, glauconite, chamosite, and zircon |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Trace amounts of illite and smectite |
| **Cement/Replacement:** | Quartz overgrowths, calcite, microquartz, dolomite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains; micropores associated with clays and leached grains; and primary intergranular pores |
| **Porosity (RCA):** | 8.2% |
| **Permeability (RCA):** | 0.15mD |
| **Grain Density (RCA):** | 2.66gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

A) Survey photomicrograph A depicts the generally massive fabric of this sublitharenite. Partially pyritized material (black; FG2.5) and authigenic calcite (stained red; F15, GH13-K15) occur in minor amounts. Quartz grains (B3, DE12.5, J8) are the dominant detrital grain type with lesser amounts of mudstone fragments (AB12.5, HJ2). Primary intergranular pores are rare (blue epoxy; FG8, G9.5).

B) This detailed view of the area near C4 in Photo A displays quartz (B4, B10, D14, G8, JK3) as the prominent detrital grain type. Secondary pores are observed (DG1, GH14). Authigenic clay locally fills intergranular pores (CD8).

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

3076.5m
Plate 33

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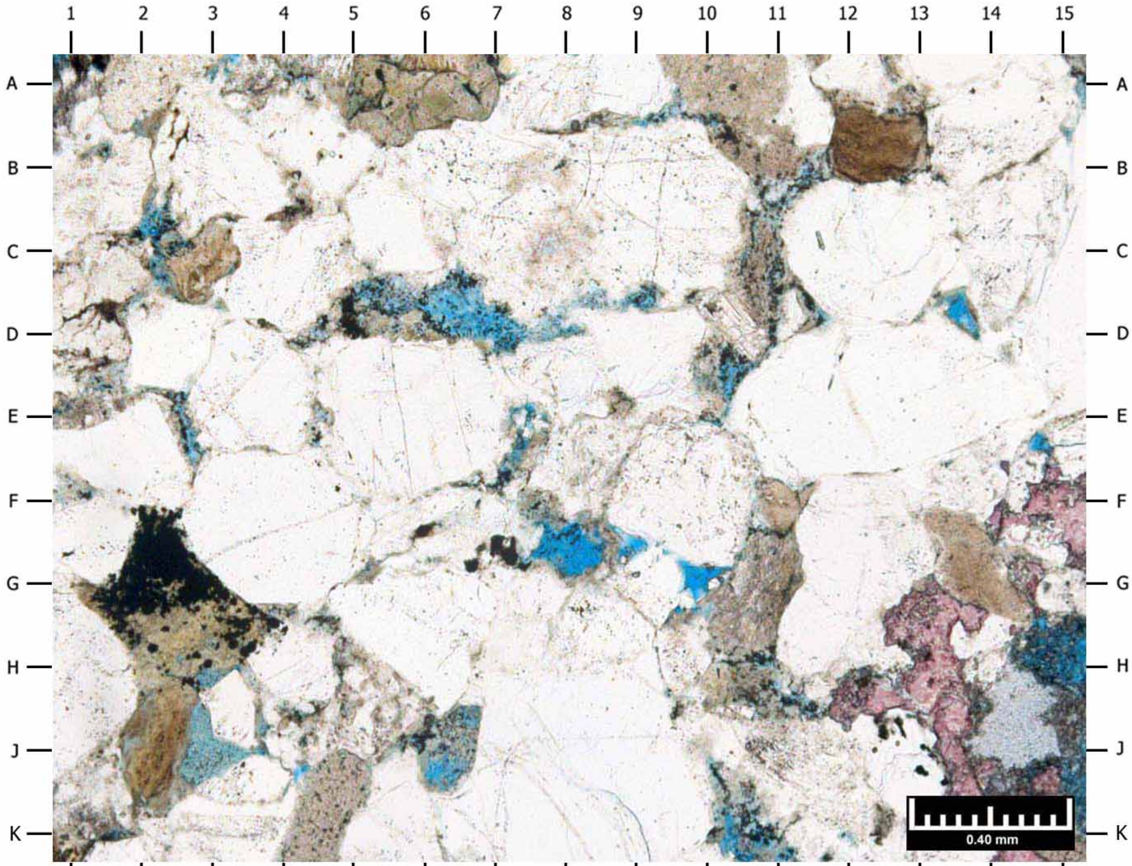
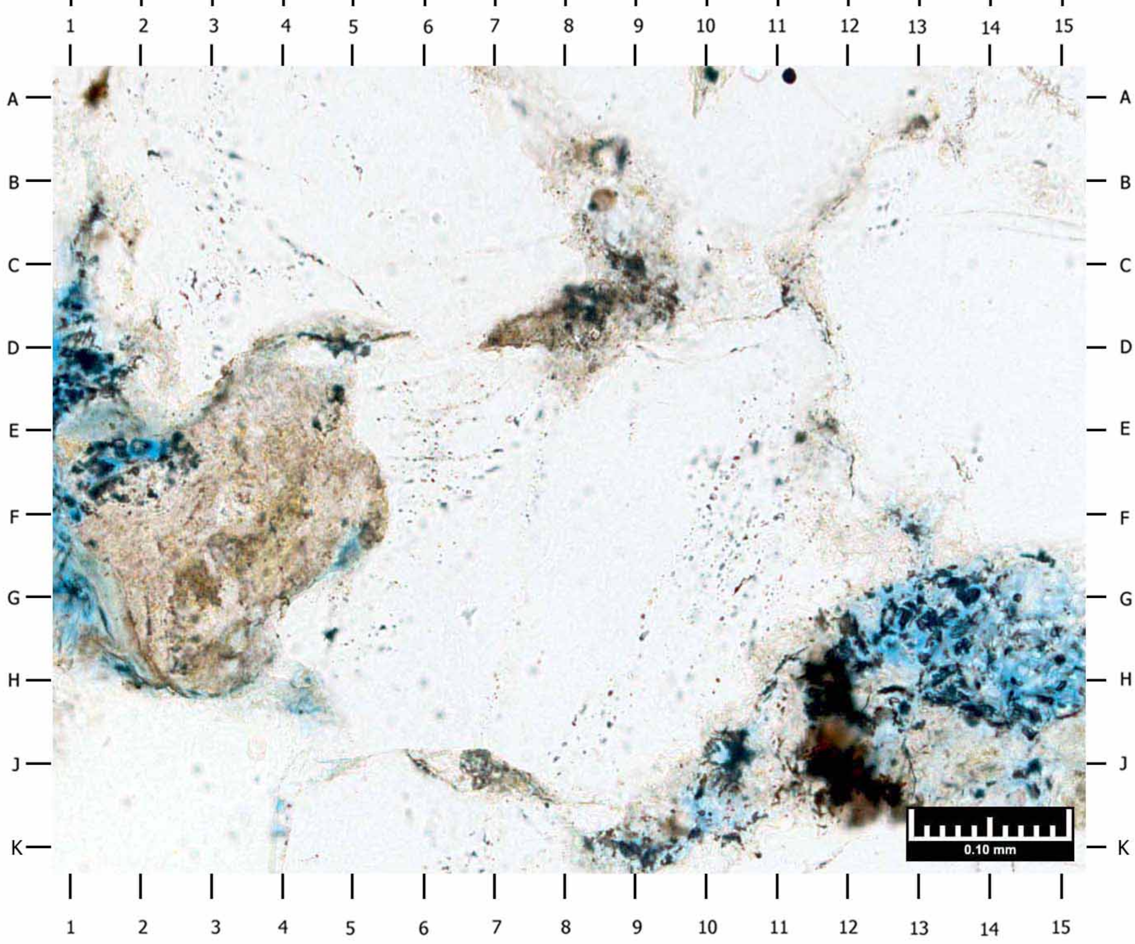



A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3081.43 METERS**
**SAMPLE NUMBER: 9-SWC**

**PLATE 34**

| | |
|---|---|
| **Lithology*:** | Quartzarenite |
| **Sedimentary Fabric:** | Massive |
| **Grain Size Range:** | 0.02mm-4.18mm |
| **Average Grain Size:** | 2.36mm |
| **Compaction:** | Low to moderate |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Polycrystalline quartz, monocrystalline quartz |
| **Minor:** | Chert |
| **Accessory:** | Muscovite mica, organic material, zircon, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | None observed |
| **Authigenic Clay:** | Minor amounts of illite and smectite; trace amounts of chlorite |
| **Cement/Replacement:** | Quartz overgrowths, pyrite, and microquartz |
| **Porosity Types:** | Micropores associated with clays and leached grains; secondary intragranular pores associated with leached grains; primary intergranular pore and trace grain fracture pores |
| **Porosity (RCA):** | 18.4% |
| **Permeability (RCA):** | N/A |
| **Grain Density (RCA):** | 2.70gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

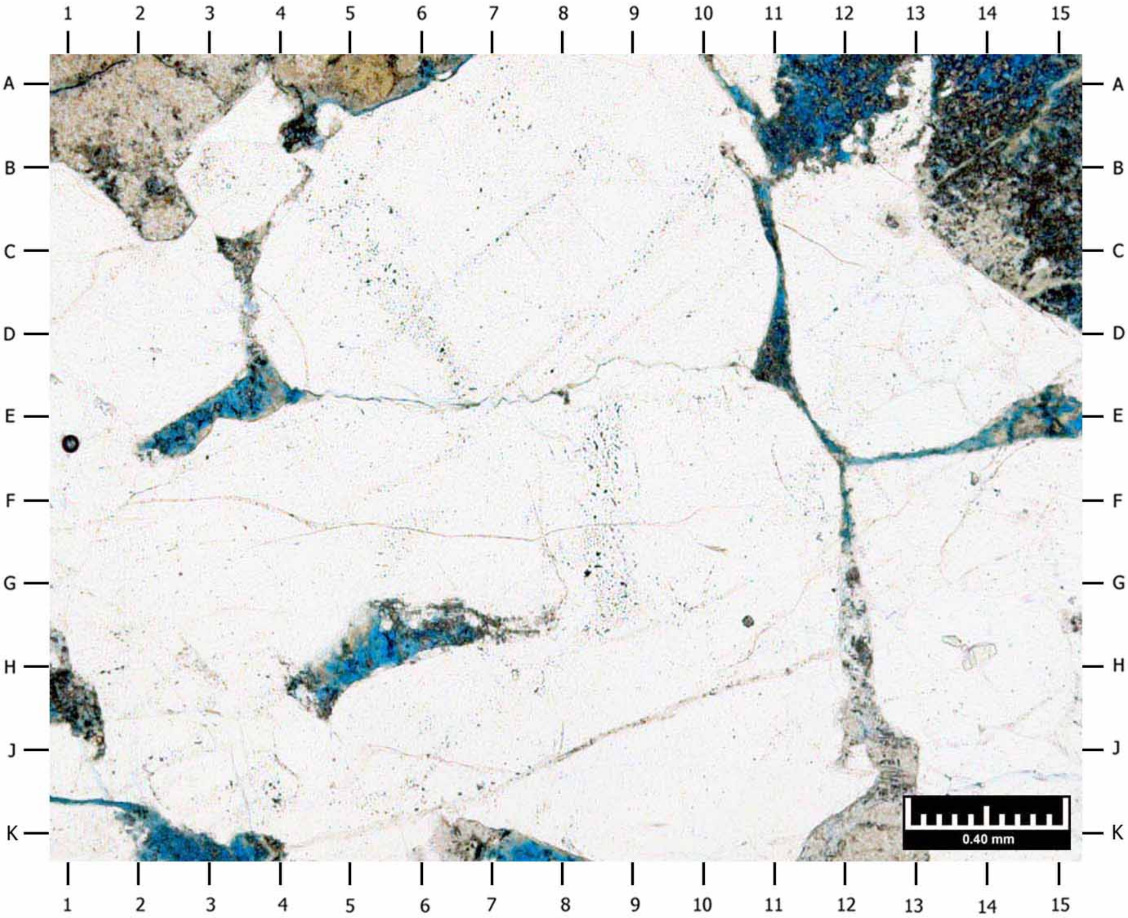
A) Relatively large quartz (most white grains; CD1, C8, D12.5, G14, F6) dominates the grain fraction of this quartzarenite. Primary (blue epoxy; E3, K3) and secondary (A12, A14, H6) pores are observed. Rare amounts of clay (FK12.5) locally fill intergranular areas.

B) This high magnification photomicrograph details the area near D14 in Photo A, highlighting part of a polycrystalline quartz grain (A1-FG14). Remnants of a mostly dissolved lithic fragment occurs at A5-G15.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

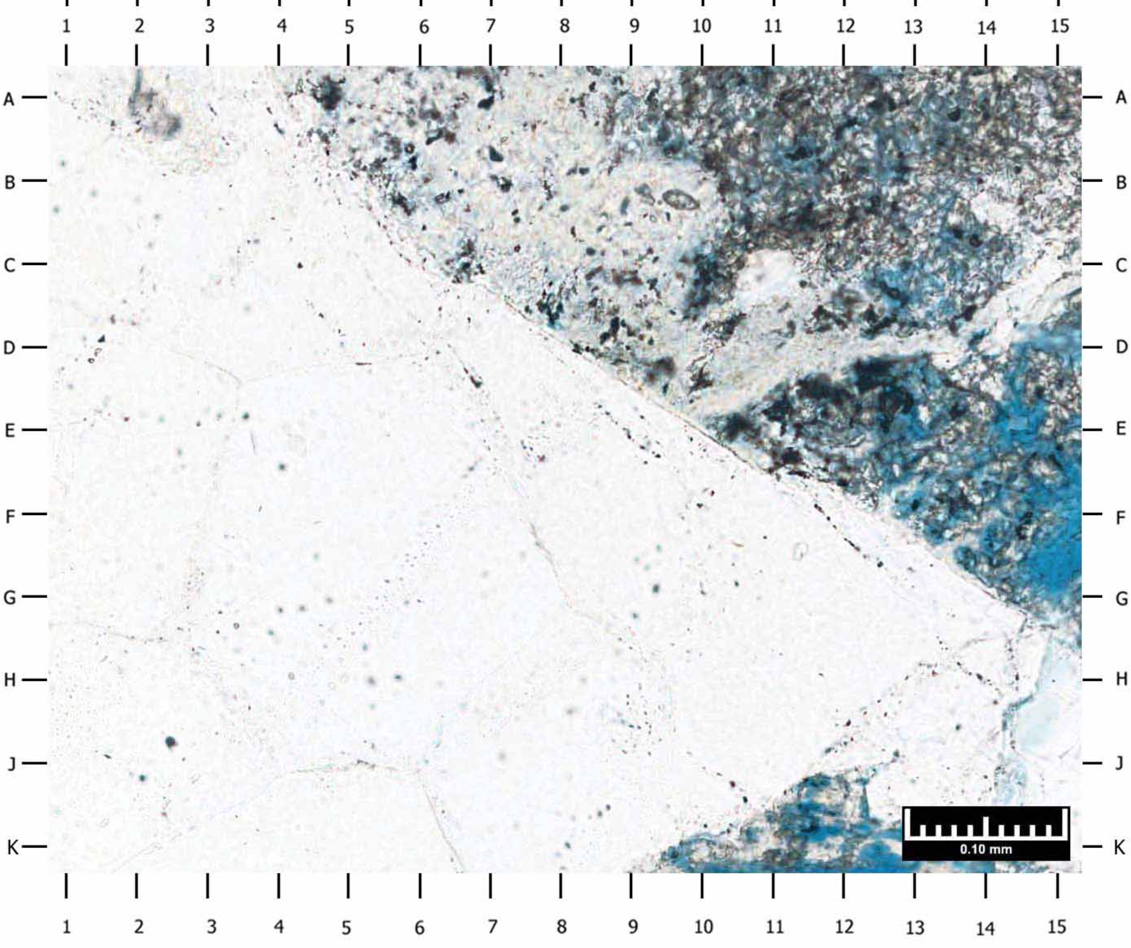
3081.4m
Plate 34

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3083.00 METERS**
**SAMPLE NUMBER: 8-SWC**

**PLATE 35**

| | |
|---|---|
| **Lithology*:** | Sublitharenite |
| **Sedimentary Fabric:** | Massive; bioturbated |
| **Grain Size Range:** | <0.01mm-1.75mm |
| **Average Grain Size:** | 0.34mm |
| **Compaction:** | High |
| **Sorting:** | Moderate |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz |
| **Minor:** | Volcanic rock fragments, metamorphic rock fragments, mudstone fragments, siltstone fragments, plagioclase feldspar, potassium feldspar, chert, metaquartzite, mudstone rock fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, biotite mica, organic material, fossil fragments, and rutile |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Trace amounts of illite/smectite and kaolinite |
| **Cement/Replacement:** | Quartz overgrowths, microquartz, Fe-dolomite, dolomite, siderite, and pyrite |
| **Porosity Types:** | Secondary intragranular pores associated with leached grains; primary intergranular pores; and micropores associated with clays and leached grains |
| **Porosity (RCA):** | 11.4% |
| **Permeability (RCA):** | 0.28mD |
| **Grain Density (RCA):** | 2.67gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

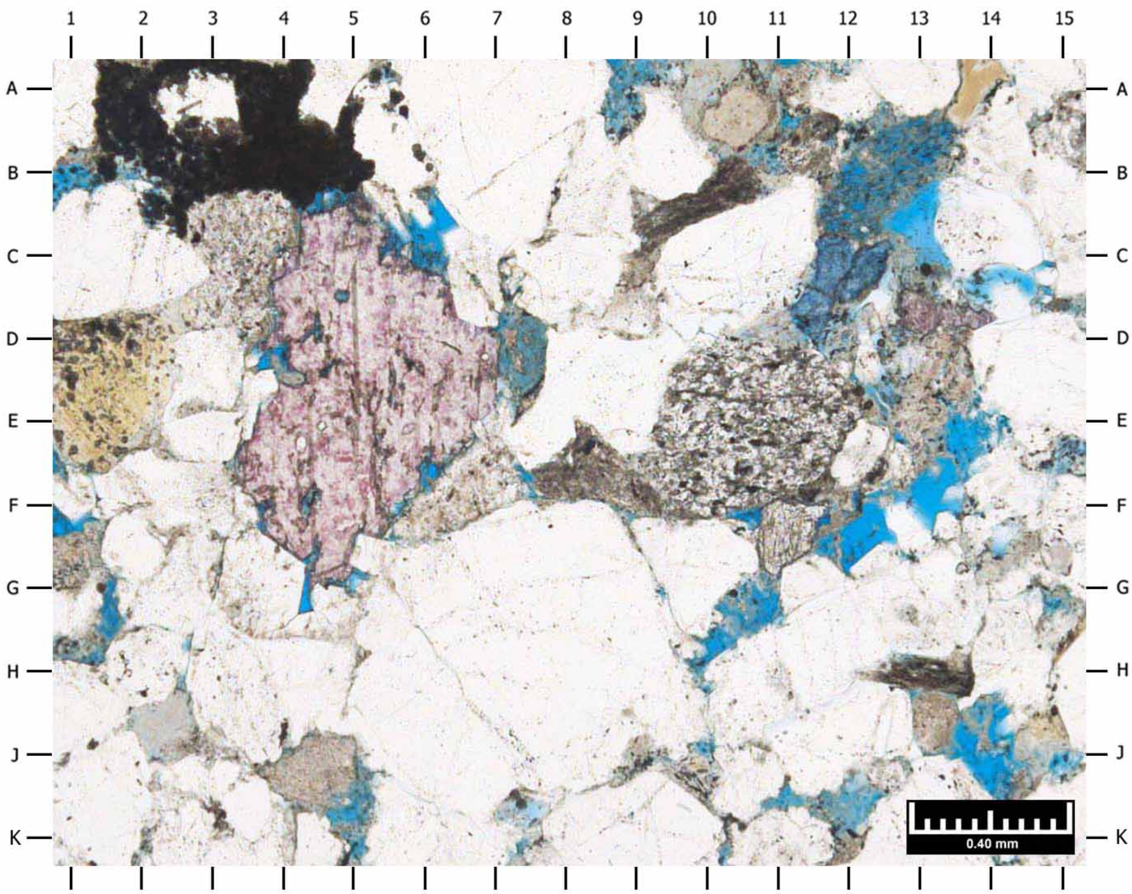
A) General photomicrograph A displays the massive texture of this sublitharenite. Primary intergranular pores (blue epoxy; BC13, FG12, F1, G4.5) and secondary dissolution pores (A9, DE7.2, J14) are the dominant pore types. Calcite (stained red) replaces an unstable lithic grain (E5). Altered feldspar grains are observed (stained yellow; A14, DE1.5). Pyrite (black; A2-B5) also replaces unstable material.

B) This photomicrograph provides a magnified view of the area near D3 in Photo A. Chert (A12-C6) and dolomite (E2, EF4.5, JK2) replace an unstable lithic fragment.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

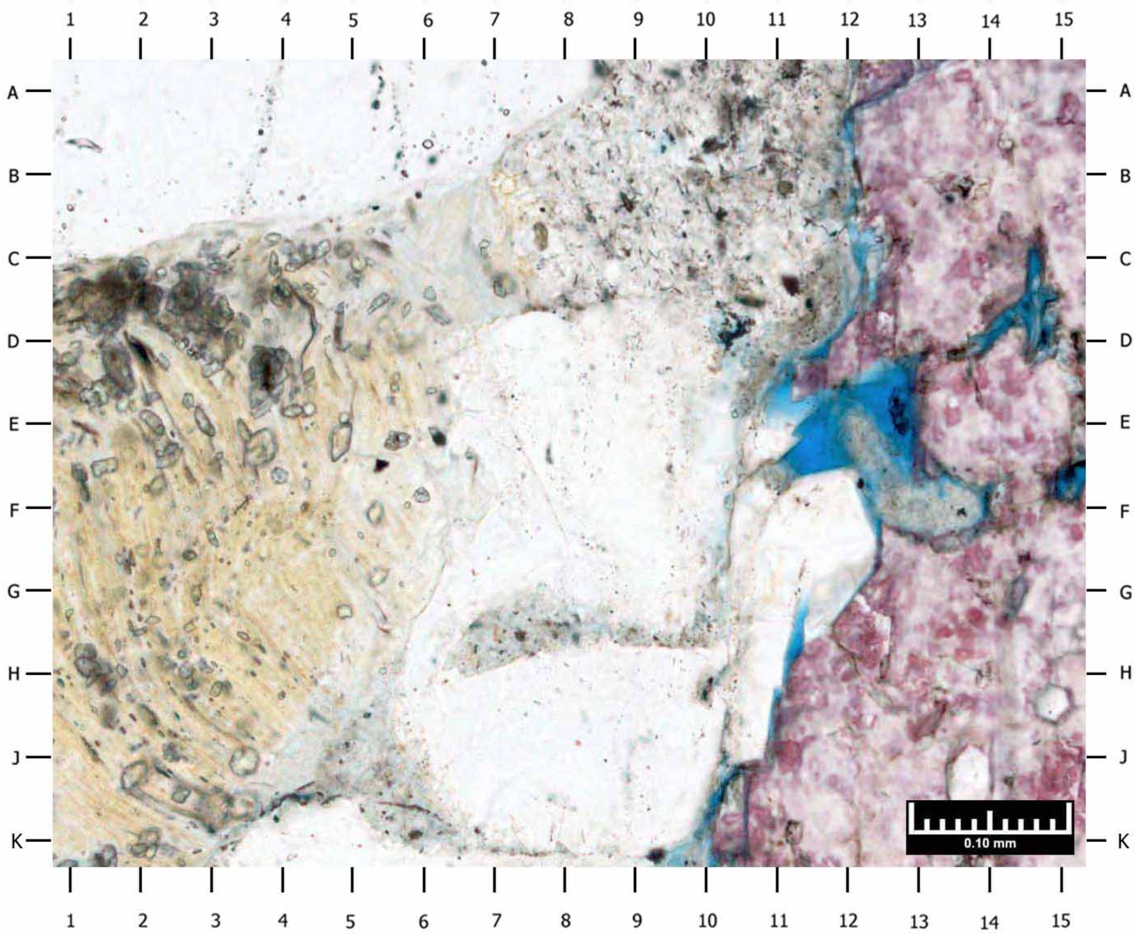
3083.0m
Plate 35

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3085.33 METERS**
**SAMPLE NUMBER: 7-SWC**

**PLATE 36**

| | |
|---|---|
| **Lithology*:** | Litharenite |
| **Sedimentary Fabric:** | Massive; stylolites |
| **Grain Size Range:** | <0.01mm-14.52mm |
| **Average Grain Size:** | 3.58mm |
| **Compaction:** | Very high |
| **Sorting:** | Very poor |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz, metaquartzite, volcanic rock fragments |
| **Minor:** | Chert, mudstone rock fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica, organic material, apatite, zircon, and tourmaline |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Trace amounts of illite and smectite |
| **Cement/Replacement:** | Quartz overgrowths and pyrite |
| **Porosity Types:** | Micropores associated with clays and leached grains; secondary intragranular pores associated with leached grains; and primary intergranular pores |
| **Porosity (RCA):** | 4.4% |
| **Permeability (RCA):** | 0.24mD |
| **Grain Density (RCA):** | 2.66gm/cc |

*Folk classification based on visual estimate of sample constituents

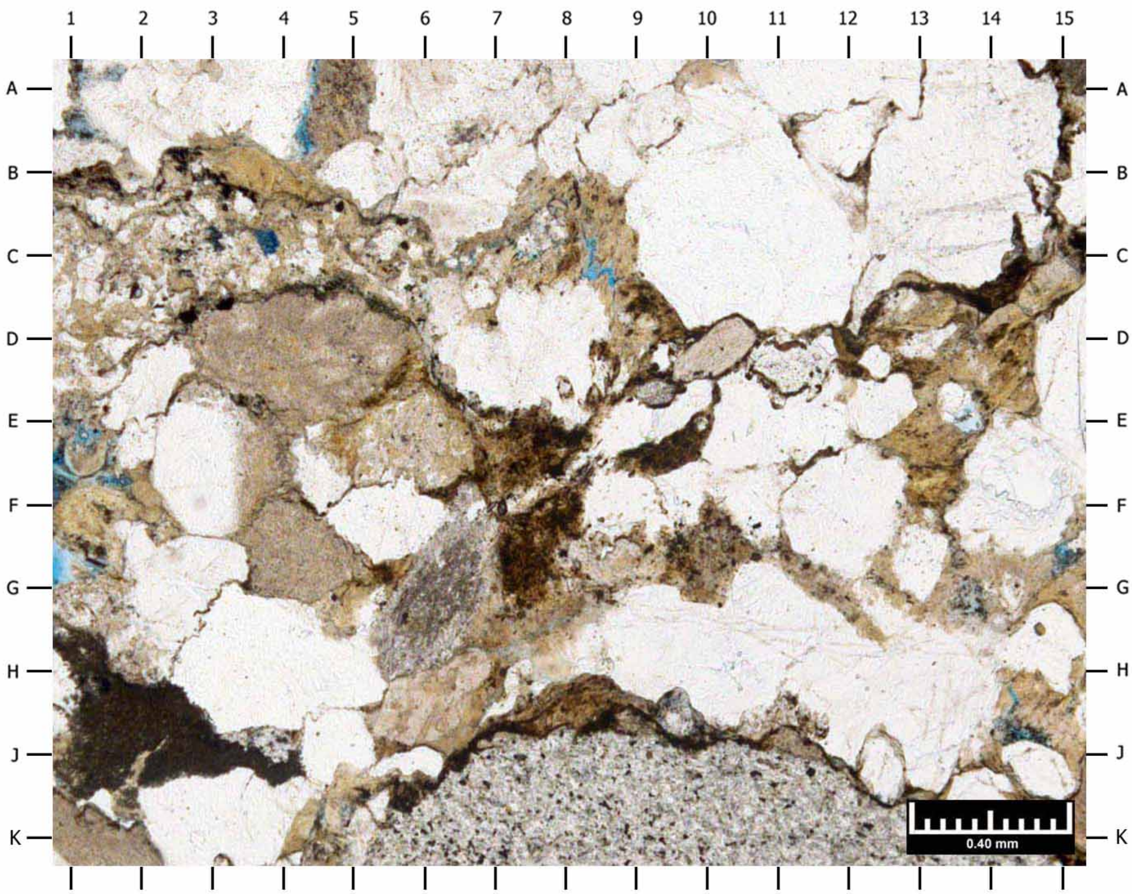
**Magnification:** A: 50X B: 200X

A) This general overview represents the very high compaction (stylolites; A15-DE6, JK6-15) in this massive sublitharenite. Quartz (BC10, EF2.5, H3.5, J11) and volcanic rock fragments (C3, DE4, EF13) are the dominant detrital constituents. Chert fragments (K9) are less common.

B) This detailed view of the area near HJ5.5 in Photo A displays sutured sand grains (EF4) which also indicates very high compaction. A thin fracture occurs at AB11-15 and may have been artificially induced during sample preparation. Pyrite replaces less stable material (black; G15, HJ12).

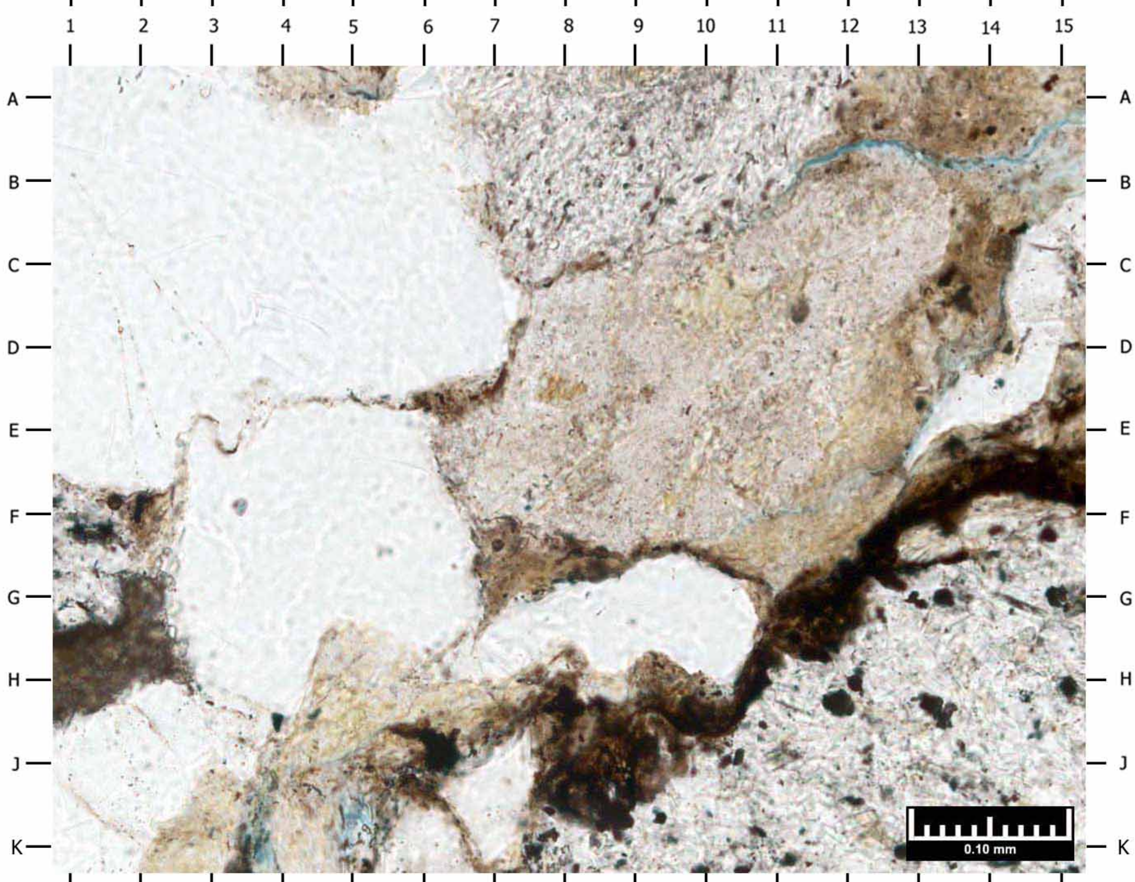
QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

3085.3m
Plate 36




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3093.00 METERS**
**SAMPLE NUMBER: 6-SWC**

**PLATE 37**

| | |
|---|---|
| **Lithology*:** | Litharenite |
| **Sedimentary Fabric:** | Vaguely disrupted laminations; stylolites |
| **Grain Size Range:** | <0.01mm-11.89mm |
| **Average Grain Size:** | 0.39mm |
| **Compaction:** | Very high |
| **Sorting:** | Poor |
| **Framework Grains:** | |
| **Major:** | Monocrystalline quartz, fossil fragments |
| **Minor:** | Plagioclase feldspar, potassium feldspar, volcanic fragments, metamorphic fragments, chert, metaquartzite, mudstone rock fragments, fossil fragments, siltstone fragments, and polycrystalline quartz |
| **Accessory:** | Muscovite mica and organic material |
| **Clay Content:** | |
| **Detrital Matrix:** | Minor amounts of detrital clays |
| **Authigenic Clay:** | Trace amounts of illite and smectite |
| **Cement/Replacement:** | Calcite, quartz overgrowths, and pyrite |
| **Porosity Types:** | Micropores associated with clays and leached grains; and secondary intragranular pores associated with leached grains |
| **Porosity (RCA):** | 1.4% |
| **Permeability (RCA):** | 0.028mD |
| **Grain Density (RCA):** | 2.71gm/cc |

*Folk classification based on visual estimate of sample constituents

**Magnification:** A: 50X B: 200X

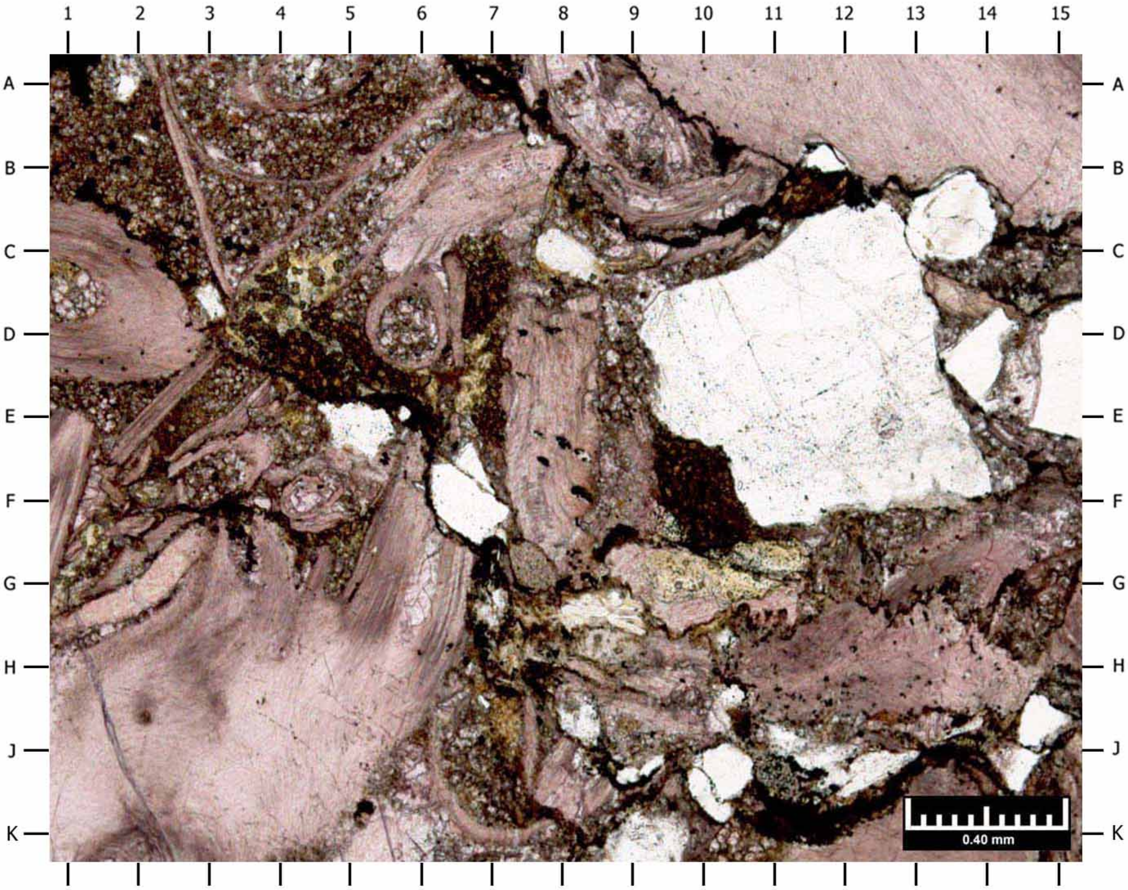
A) Abundant amounts of calcite (45%, by weight; stained red) occurs as cement and as replacement of fossil fragments (A2-CD3, E2, JK6.5), lithic grains (A9-B15, J3) and matrix material (AB1-B2). Organic stylolites (BC1-J15, A7-C15) occur along grain boundaries. Detrital quartz grains are observed (D11, F6.5, JK10).

B) This photomicrograph provides a magnified view of the area near C13 in Photo A, highlighting one of the stylolites (B1-E15). A quartz grain contains a few inclusions (DE10, FG10).

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

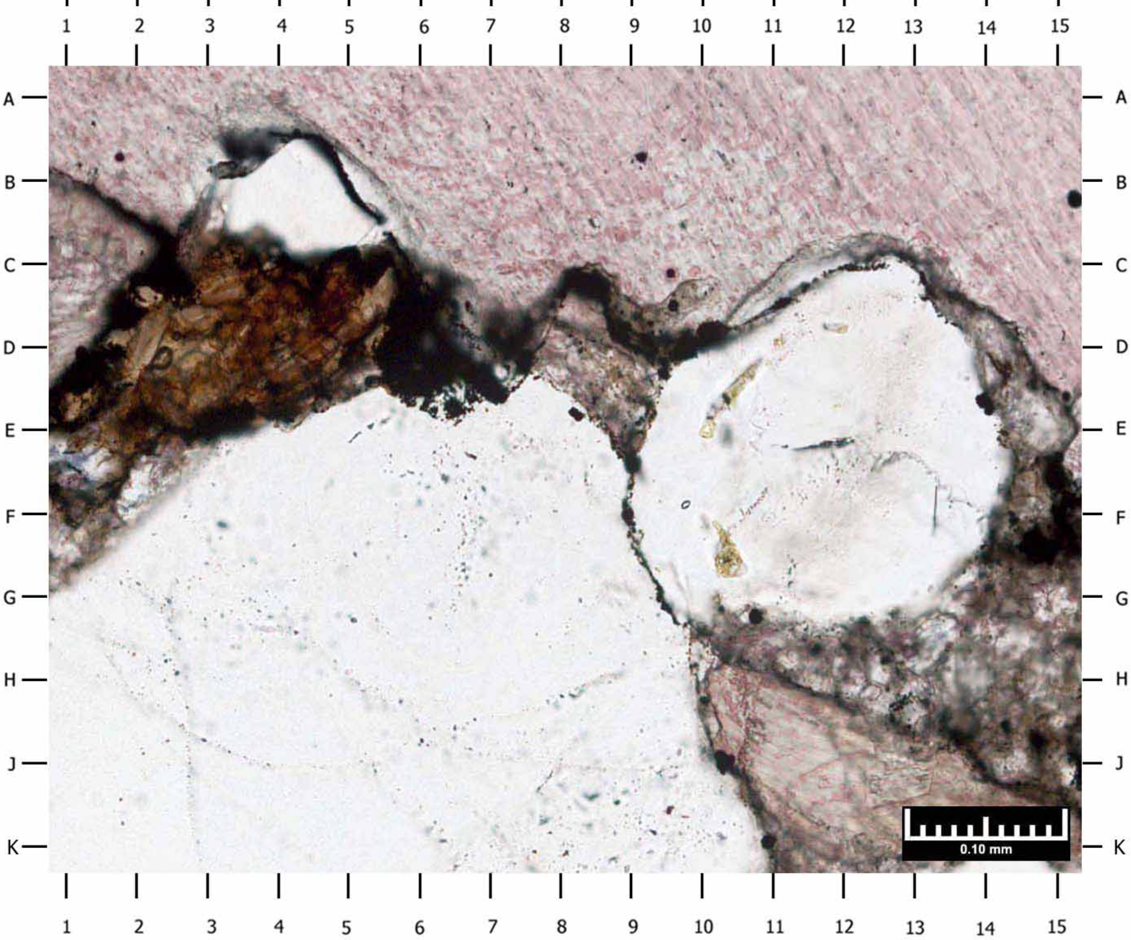
3093.0m
Plate 37

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3112.78 METERS**
**SAMPLE NUMBER: 5-SWC**

**PLATE 38**

**Lithology:** Basaltic conglomerate
**Sedimentary Fabric:** Massive; calcite/quartz-filled fractures; reworked; partially vesicular
**Particle Size Range:** 6.19mm>2.00cm
**Average Grain Size:** >2.00cm
**Visual Sorting:** Poor
**Compaction:** Low
**Detrital Grains / Allochems:**
**Major:** Andesitic volcanic clasts
**Minor:** N/A
**Accessory:** N/A
**Matrix:** No detrital clays are observed; however the majority of feldspar present are altered to authigenic clay; XRD analysis indicates that clay minerals account for 40% (by weight). Measured clays types mainly include chlorite (20%) and mixed-layer illite/smectite (12%), with minor amounts of kaolinite (8%), and rare illite (trace)
**Cement / Replacement:** Common authigenic calcite occurs as a replacement of dissolved crystals and as an intergranular cement within fractures; mixture of illitic and chloritic clay that occur as common replacement of abundant feldspar groundmass within large clasts and as pore-filling clay within scattered vesicles; minor pyrite occurs as partial replacement of unstable grains while marcasite occurs as rare intergranular cement; rare kaolinite replacement of vesicles and labile grains; rare microquartz infilling fractures
**Porosity Types:** Minor micropores associated with clay minerals and partially dissolved grains represent the only visible form of porosity
**Porosity (RCA):** 1.3%
**Permeability (RCA):** 0.0011mD
**Grain Density (RCA):** 2.76gm/cc

**Magnification:** A: 50X B: 200X

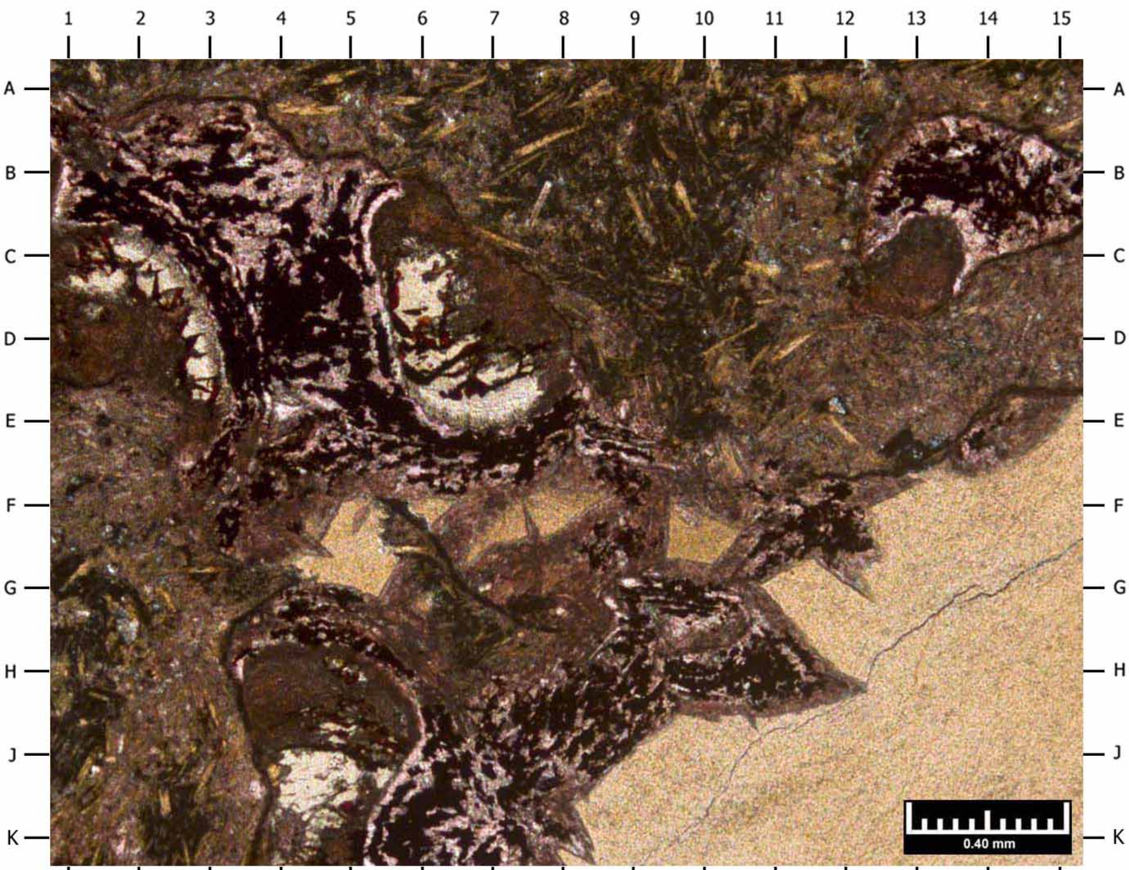
A) A basaltic conglomerate is depicted in general photomicrograph A. Abundant amounts of authigenic clay (A1-D15, C1-K1, GH7) occurs as a result of altered feldspar grains. Clay/microquartz replaced grains (E15-K9, FG5, F8, F10) are scattered throughout the matrix material. A thin fracture (FG15-K9.2) occurs within one of these grains. Authigenic calcite (stained red; AB1-E5, JK7) and pyrite (black) occurs as replacement of dissolved grains.

B) A closer look at the calcite replacement is depicted in this high magnification view of the area near EF6 in Photo A. Pyrite intermixed with hematite (black/brown; A1, AB1-C15, E1-4) replaces susceptible material. Micropores occur within the authigenic clay matrix and are the only pore type present.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

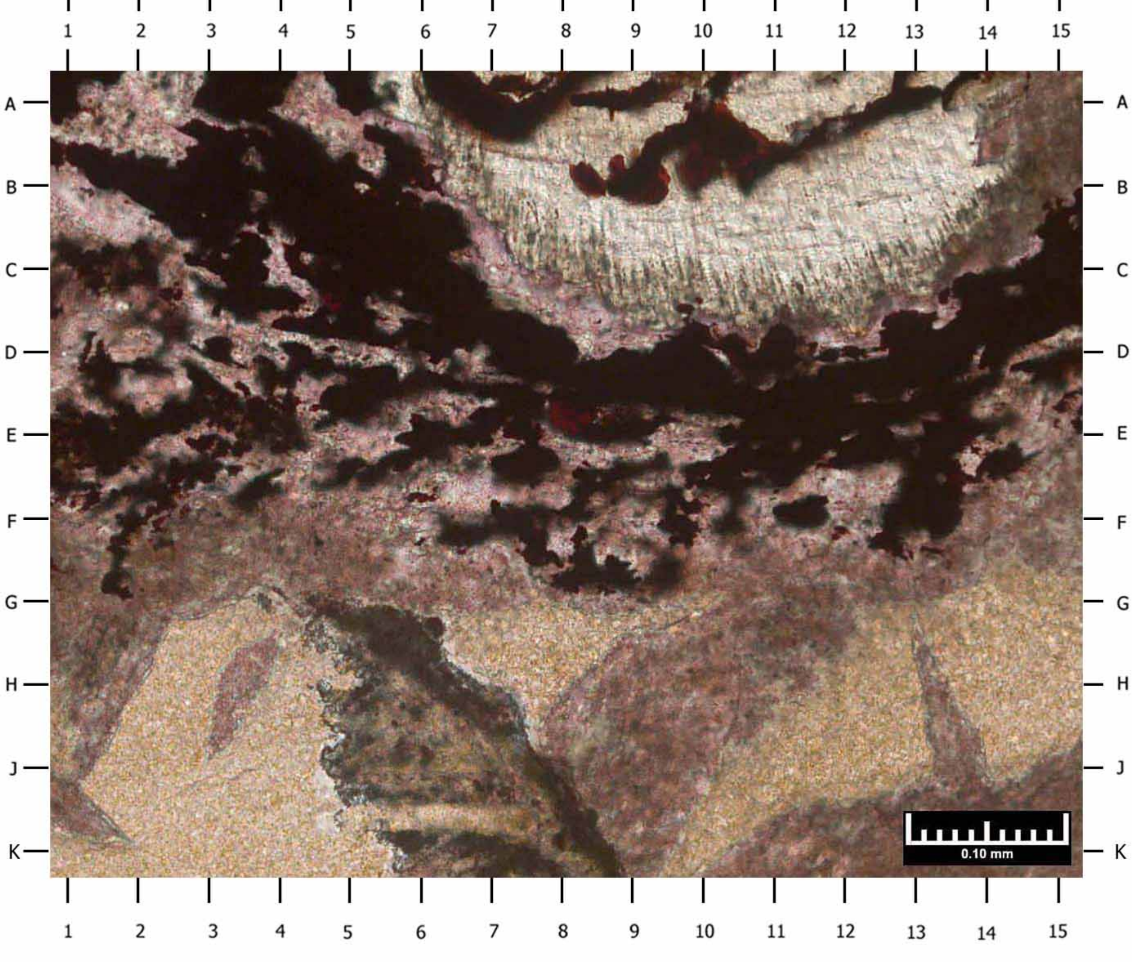
3112.8m
Plate 38

Weatherford LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3116.00 METERS**
**SAMPLE NUMBER: 4-SWC**

**PLATE 39**

| | |
|---|---|
| **Lithology:** | Altered basalt |
| **Texture:** | Aphanitic; multiple calcite-filled fractures |
| **Particle Size Range:** | N/A |
| **Average Grain Size:** | N/A |
| **Visual Sorting:** | N/A |
| **Compaction:** | Low |
| **Crystal Types:** | |
| **Major:** | Lath-like plagioclase crystals comprise the majority of the sample, most of which are altered to clay minerals |
| **Minor:** | Pyrite crystals are scattered throughout the groundmass |
| **Accessory:** | N/A |
| **Matrix:** | No detrital clays are observed; however the majority of feldspar present are altered to authigenic clay; XRD analysis indicates that clay minerals account for 60% (by weight). Measured clays types mainly include mixed-layer illite/smectite (42%) and chlorite (10%), with minor amounts of kaolinite (7%), and illite (1%). |
| **Cement/Replacement:** | Common authigenic calcite occurs as a replacement of dissolved feldspar crystals and as an intergranular cement within fractures; mixture of illitic and chloritic clay that occur as common replacement of abundant feldspars crystals and groundmass; minor microquartz occurs as partial replacement of unstable crystals; minor Fe-oxide replacement of labile minerals and pyrite |
| **Porosity Types:** | Minor micropores associated with clay minerals and partially dissolved grains represent the only visible form of porosity |
| **Porosity (RCA):** | 3.6% |
| **Permeability (RCA):** | 0.0058mD |
| **Grain Density (RCA):** | 2.67gm/cc |

**Magnification:** A: 50X B: 200X

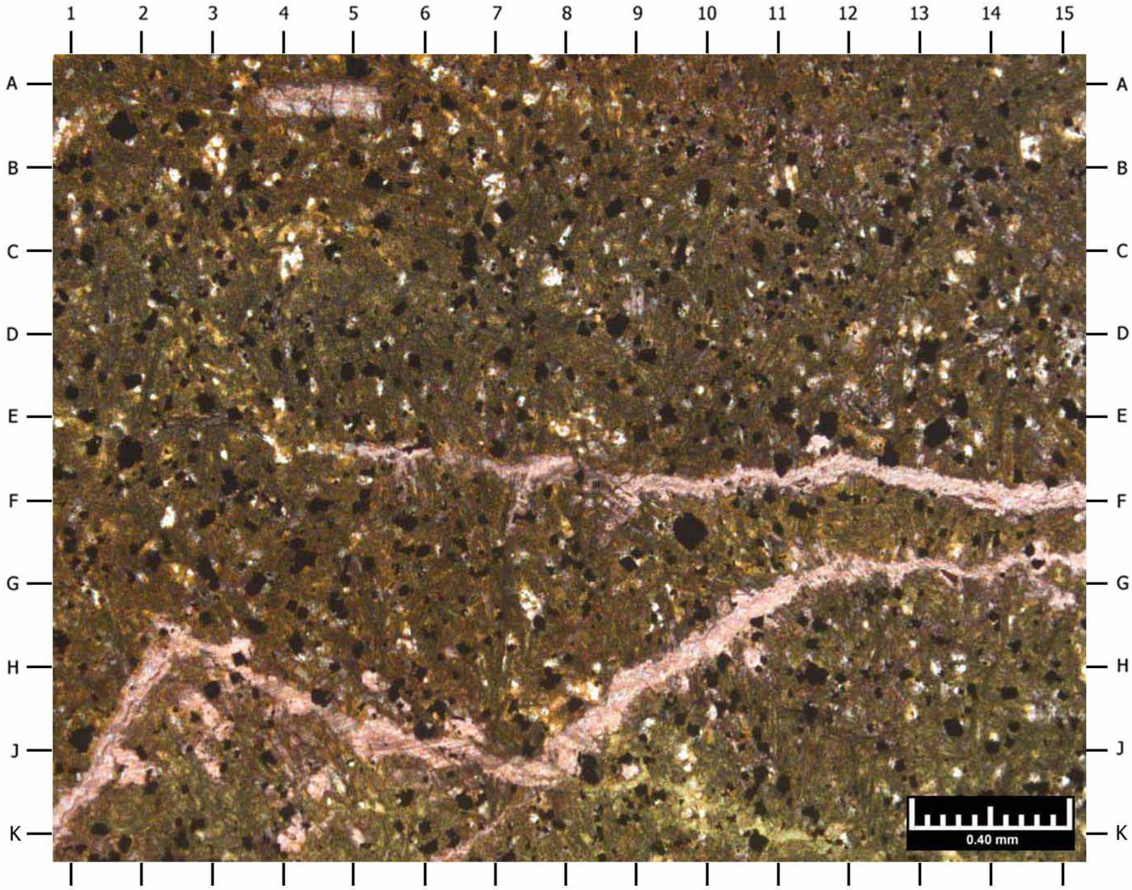
A) Calcite-filled fractures (stained red) are depicted in this survey photomicrograph of this aphanitic, altered basalt. Calcite also occurs as replacement of unstable crystals (AB4-5). Abundant amounts of altered volcanic clay compose the matrix material. Common amounts of pyrite crystals (black; AB1.8, EF13, FG10) are disseminated throughout this sample.

B) Detailed view of the area near G3 in Photo A, depicting part of one of the calcite-filled fractures (K4-14). Minor amounts of microquartz (AB6, HJ13.8) occur as replacement of unstable or dissolved crystals.

**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

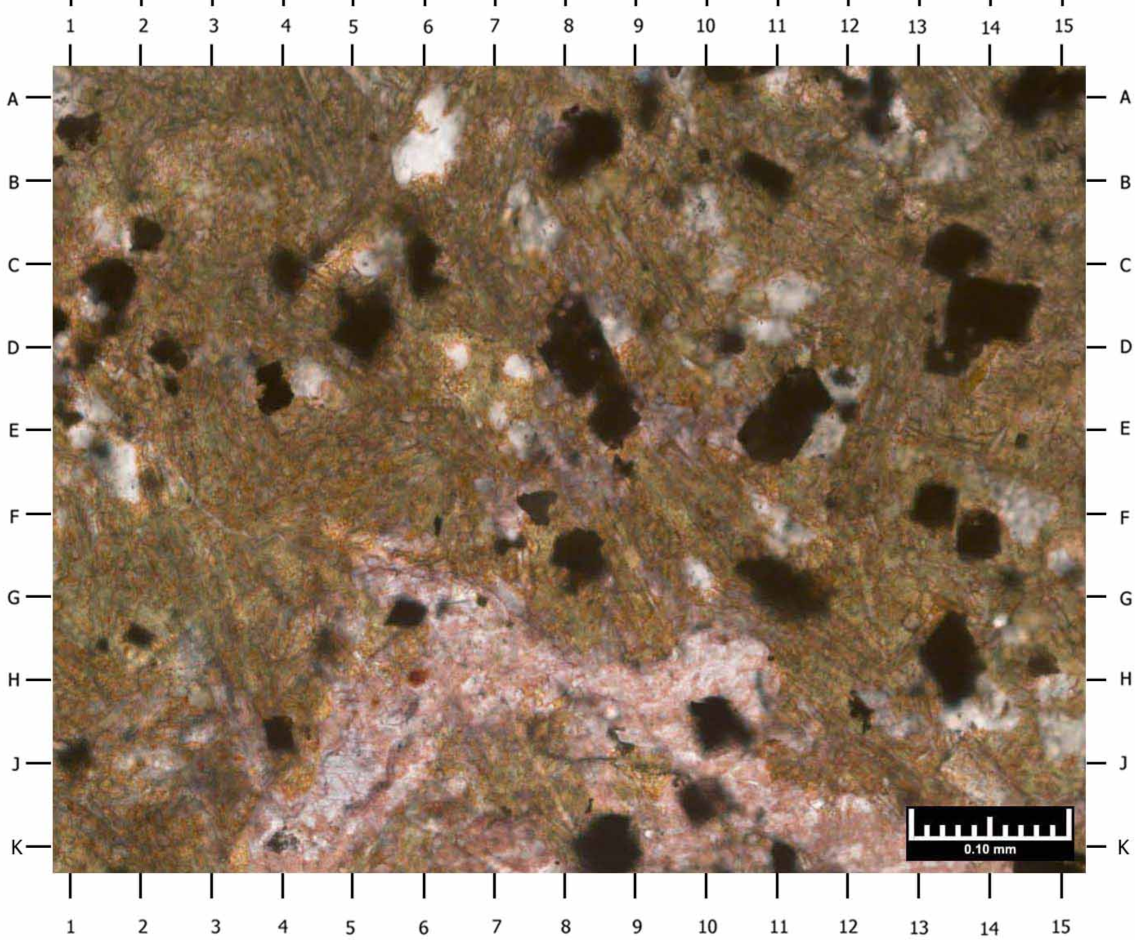
**3116.0m**
**Plate 39**

Weatherford LABORATORIES




**A**

**50X**




**B**

**200X**

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3120.00 METERS**
**SAMPLE NUMBER: 3-SWC**

**PLATE 40**

| | |
|---|---|
| **Lithology:** | Altered basalt |
| **Texture:** | Aphanitic; vesicular; fractures related to compaction |
| **Particle Size Range:** | N/A |
| **Average Grain Size:** | N/A |
| **Visual Sorting:** | N/A |
| **Compaction:** | Moderate |
| **Crystal Types:** | |
| **Major:** | Lath-like plagioclase crystals comprise the majority of the sample, most of which are altered to clay minerals |
| **Minor:** | Pyrite crystals are scattered throughout the groundmass |
| **Matrix:** | No detrital clays are observed; however the majority of feldspar present are altered to authigenic clay; XRD analysis indicates that clay minerals account for 74% (by weight). Measured clays types mainly include mixed-layer illite/smectite (59%) and chlorite (10%), with minor amounts of kaolinite (5%), and illite (trace). |
| **Cement/Replacement:** | Common authigenic calcite occurs as a replacement of dissolved feldspar crystals and as an intergranular cement within fractures; mixture of predominantly illite and minor chlorite occurring as common replacement of abundant feldspars crystals and groundmass, and less as vesicle-filling clay aggregates; minor microquartz occurs as partial replacement of unstable crystals and as a pore-filling cement within vesicles; minor Fe-oxide replacement of labile minerals and pyrite |
| **Porosity Types:** | Minor micropores associated with clay minerals and partially dissolved grains represent the only visible form of porosity |
| **Porosity (RCA):** | 4.8% |
| **Permeability (RCA):** | 0.098mD |
| **Grain Density (RCA):** | 2.58gm/cc |

**Magnification:** A: 50X B: 200X

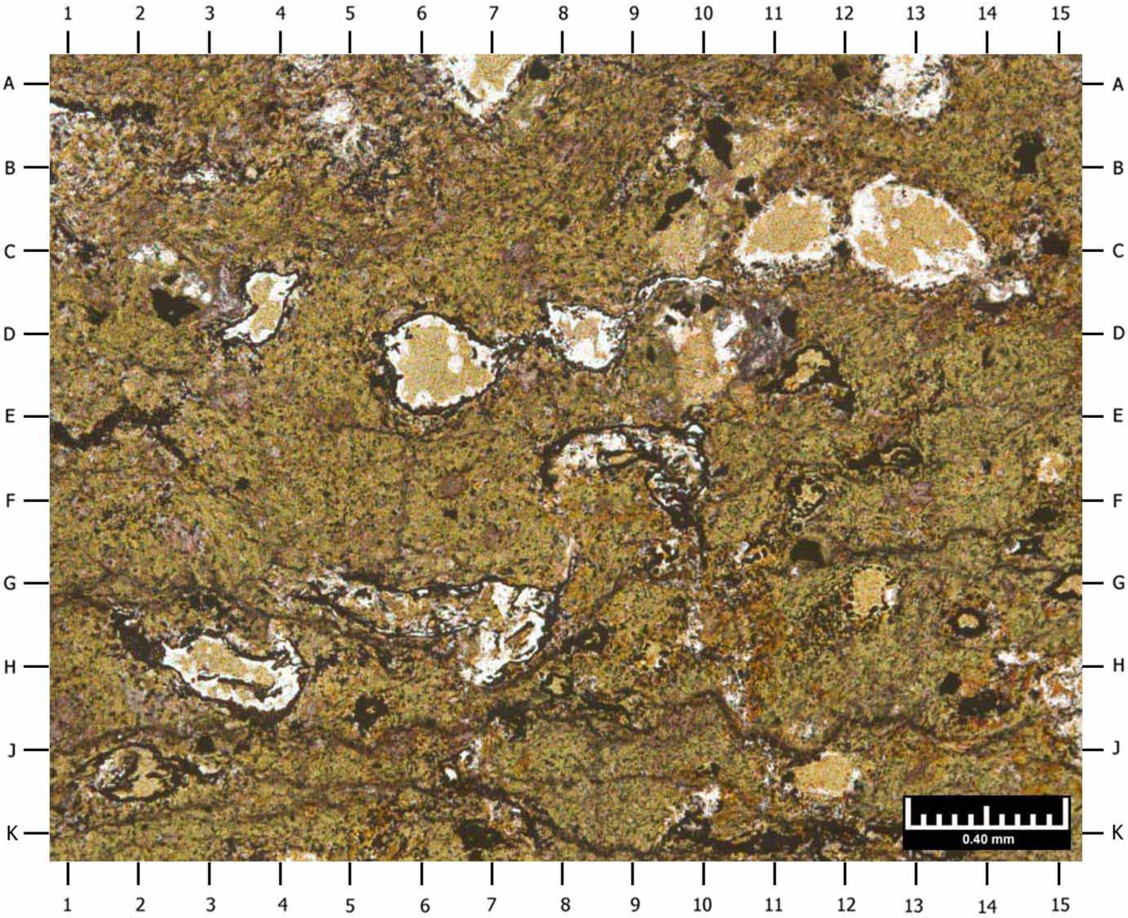
A) The low magnification view provided by photomicrograph A depicts the aphanitic, vesicular texture of this altered basalt. Abundant amounts of illite/smectite clay (stained yellow) occur as a result of altered feldspars. Microquartz occurs as a pore-filling within vesicles (A7, A13, CD3.8, C13, H3.5).

B) This magnified view of the area near D10 in Photo A provides an enhanced view of the authigenic clay matrix. Pyrite (black; D12.1, CD7.9, FG12-15), microquartz (A10-14, EF1.5, E9), and Fe-calcite (stained purple; C11-FG10) routinely fill vesicles associated with the gaseous formation of this rock.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

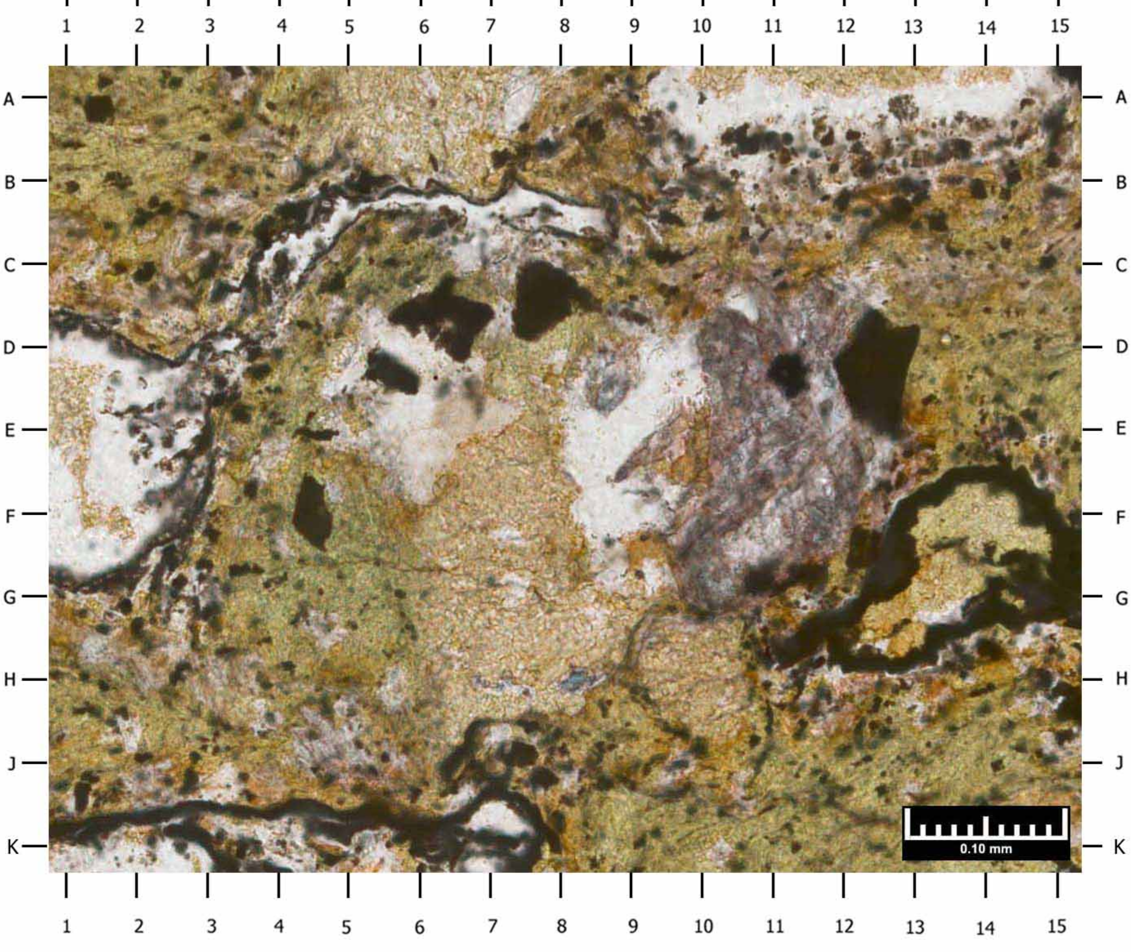
3120.0m
Plate 40

Weatherford
LABORATORIES




A

50X




B

200X

**QGC- A BG Group Business** **Weatherford Labs File No.: AB-74306**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3126.00 METERS**
**SAMPLE NUMBER: 2-SWC**

**PLATE 41**

**Lithology:** Basaltic conglomerate
**Sedimentary Fabric:** Massive; calcite/microquartz-filled fractures; reworked; partially vesicular
**Particle Size Range:** >2.00cm
**Average Grain Size:** N/A
**Visual Sorting:** Poor
**Compaction:** Low
**Detrital Grains / Allochems:**
**Major:** Andesitic volcanic fragments
**Minor:** N/A
**Accessory:** N/A
**Matrix:** No detrital clays are observed; however the majority of feldspar present are altered to authigenic clay; XRD analysis indicates that clay minerals account for 18% (by weight). Measured clays types mainly include mixed-layer illite/smectite (9%) and chlorite (8%), with minor amounts of kaolinite (1%), and illite (trace).
**Cement/Replacement:** Common authigenic calcite occurs as a replacement of dissolved crystals and as an intergranular cement within fractures; mixture of illitic and chloritic clay that occur as common replacement of abundant feldspar groundmass within large clasts and as pore-filling clay within scattered vesicles; common microquartz infilling fractures and rimming vesicles; minor pyrite occurs as partial replacement of unstable grains and as intergranular cement within vesicles; rare siderite crystals and Fe-oxides occurring as replacement of unstable minerals
**Porosity Types:** Minor micropores associated with clay minerals and partially dissolved grains represent the only visible form of porosity
**Porosity (RCA):** 2.3%
**Permeability (RCA):** N/A
**Grain Density (RCA):** 2.80gm/cc

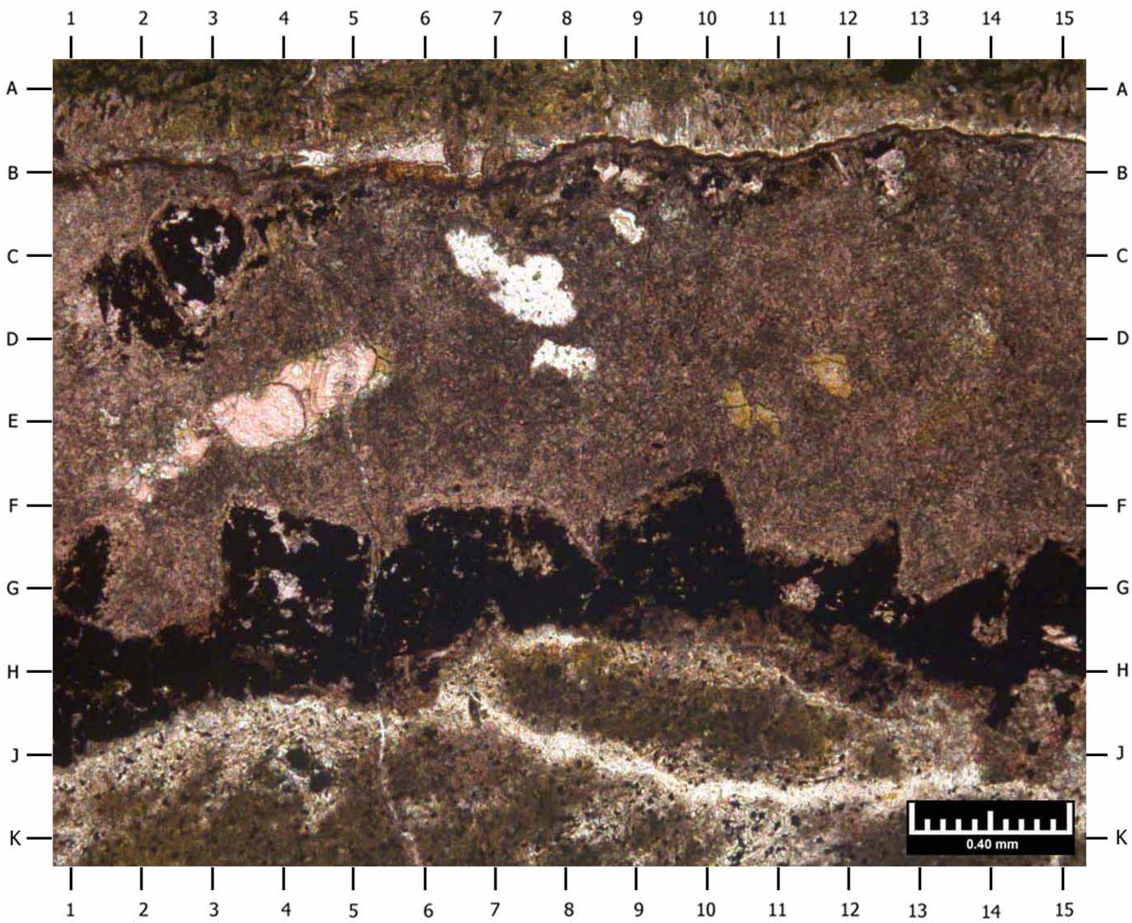
**Magnification:** A: 50X B: 200X

A) This survey photomicrograph depicts a calcite-filled fracture (stained red; AG1-15) within this basaltic conglomerate. A microquartz-filled fracture occurs at JK1-15. Microquartz replacement occurs at C6.5 and D7. Pyrite intermixed with hematite occur along the edge of the fracture (black; GJ1-GH15). Calcite replaces an unstable grain/crystal (DE4).

B) This photomicrograph provides a magnified view of the area near B5 in Photo A, highlighting the edge of the calcite-filled fracture. Microquartz occurs as replacement of susceptible material (EF4.2). Abundant authigenic clays comprise the matrix material (AD1-15). Pyrite/hematite (black; HJ1, H3.5, H5) occur as replacement.

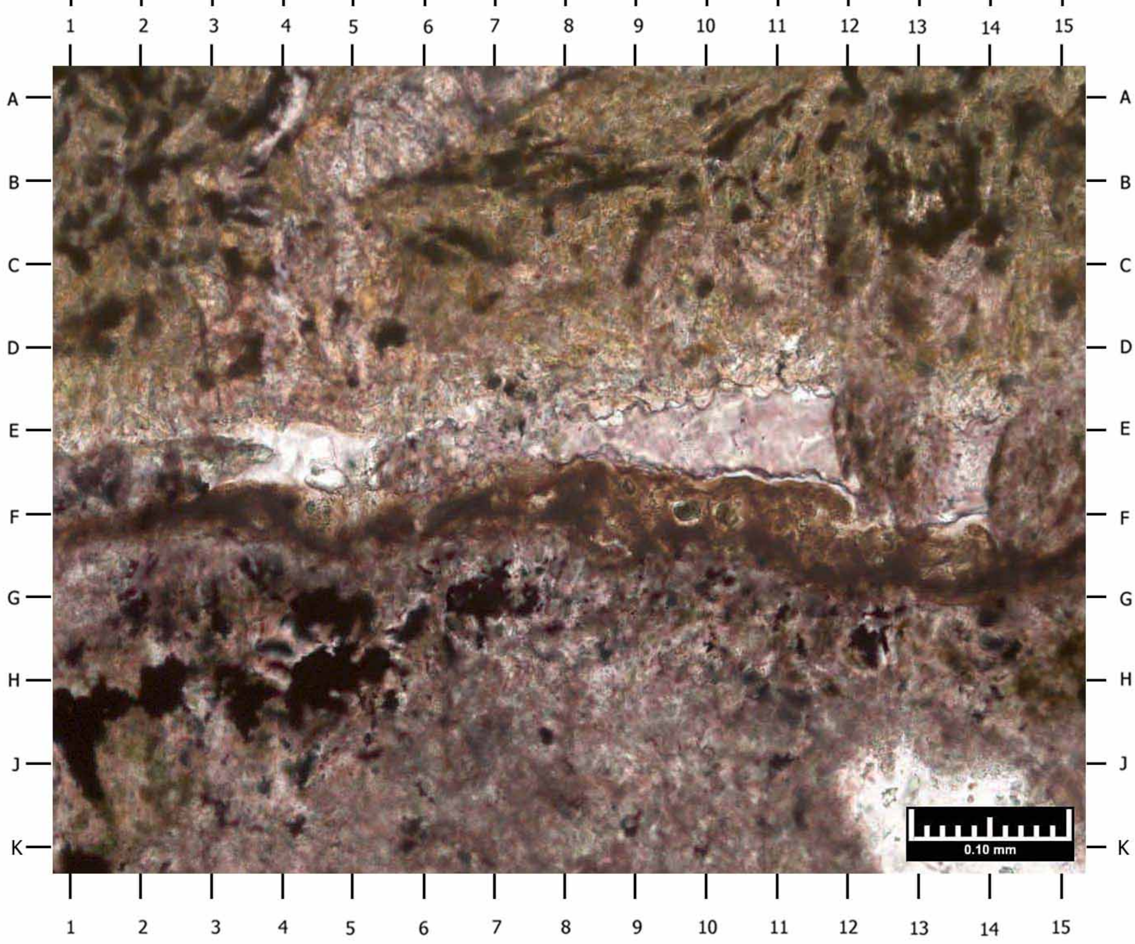
QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

3126.0m
Plate 41




A

50X




B

200X

**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**Weatherford Labs File No.: AB-74306**

**THIN SECTION DESCRIPTION**
**SAMPLE DEPTH: 3133.75 METERS**
**SAMPLE NUMBER: 1-SWC**

**PLATE 42**

| | |
|---|---|
| **Lithology:** | Basaltic conglomerate |
| **Sedimentary Fabric:** | Massive; microquartz/clay-filled vesicles; fractured; reworked |
| **Particle Size Range:** | >2.00cm |
| **Average Grain Size:** | N/A |
| **Visual Sorting:** | Poor |
| **Compaction:** | Low |
| **Detrital Grains / Allochems:** | |
| **Major:** | Andesitic volcanic fragments |
| **Minor:** | Tuffaceous grains and volcanic glass |
| **Accessory:** | N/A |
| **Matrix:** | No detrital clays are observed; however the majority of feldspar present are altered to authigenic clay; XRD analysis indicates that clay minerals account for 36% (by weight). Measured clays types mainly include mixed-layer illite/smectite (21%) and chlorite (14%), with minor amounts of kaolinite (1%), and illite (trace). |
| **Cement/Replacement:** | Common authigenic calcite occurs as a replacement of dissolved crystals and as an intergranular cement within fractures; mixture of illitic and chloritic clay that occur as common replacement of abundant feldspar groundmass within large clasts and as pore-filling clay within scattered vesicles; common microquartz infilling fractures and rimming vesicles; minor pyrite occurs as partial replacement of unstable grains and as intergranular cement within vesicles; rare Ti- and Fe-oxides occurring as replacement of unstable minerals |
| **Porosity Types:** | Minor micropores associated with clay minerals and partially dissolved grains represent the only visible form of porosity |
| **Porosity (RCA):** | 4.9% |
| **Permeability (RCA):** | 0.0059mD |
| **Grain Density (RCA):** | 2.73gm/cc |

**Magnification:** A: 50X B: 200X

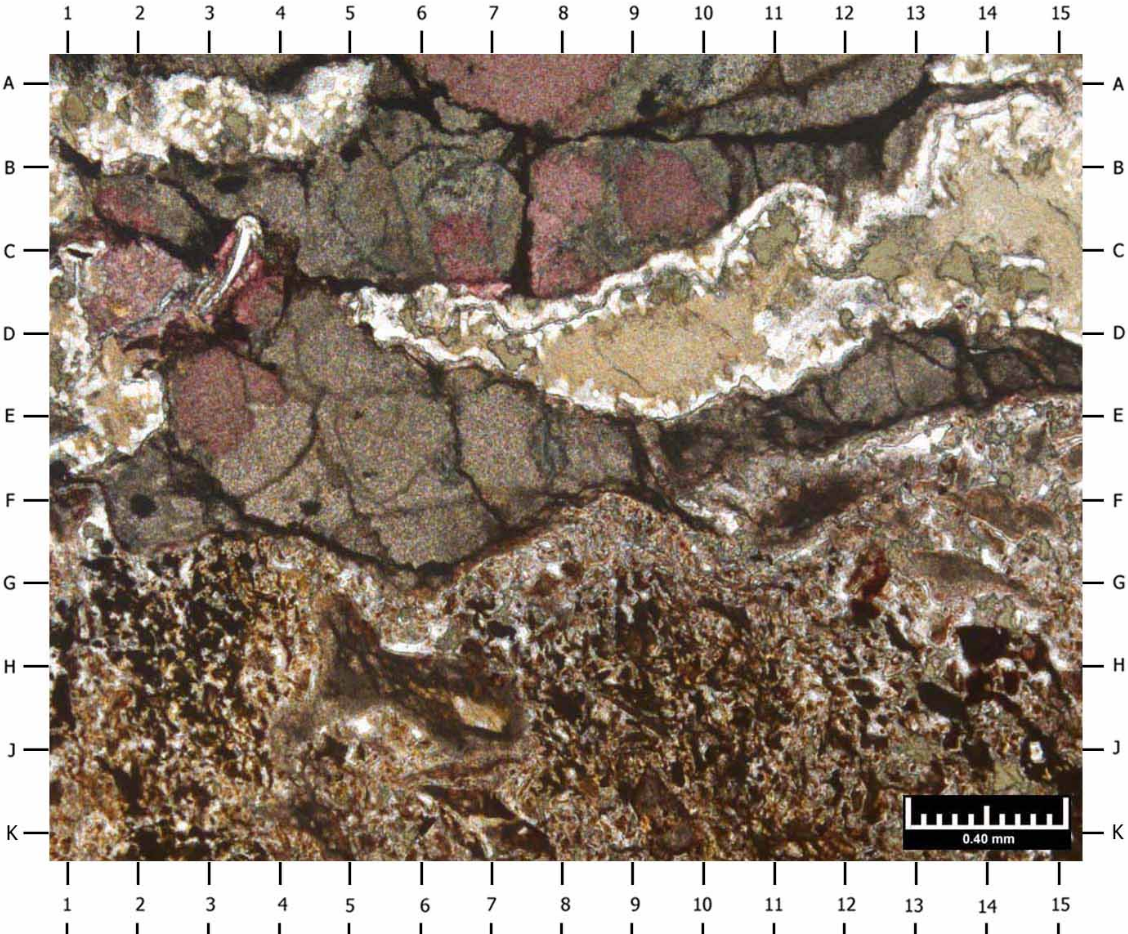
A) General photomicrograph A depicts large andesitic volcanic fragments (BC1-12, EF5) which is partially replaced by calcite (stained red). The fabric appears generally massive. Microquartz rims a clay-replaced vesicle (C5-15). Microquartz also occurs as possible replacement (AB1-5, DE1.5).

B) The area near FG6 in Photo A is provided in this high magnification photomicrograph. Microquartz occurs as replacement and exhibits cryptocrystalline rims (F1-EF15). A fracture is observed at DE1-BC15.

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

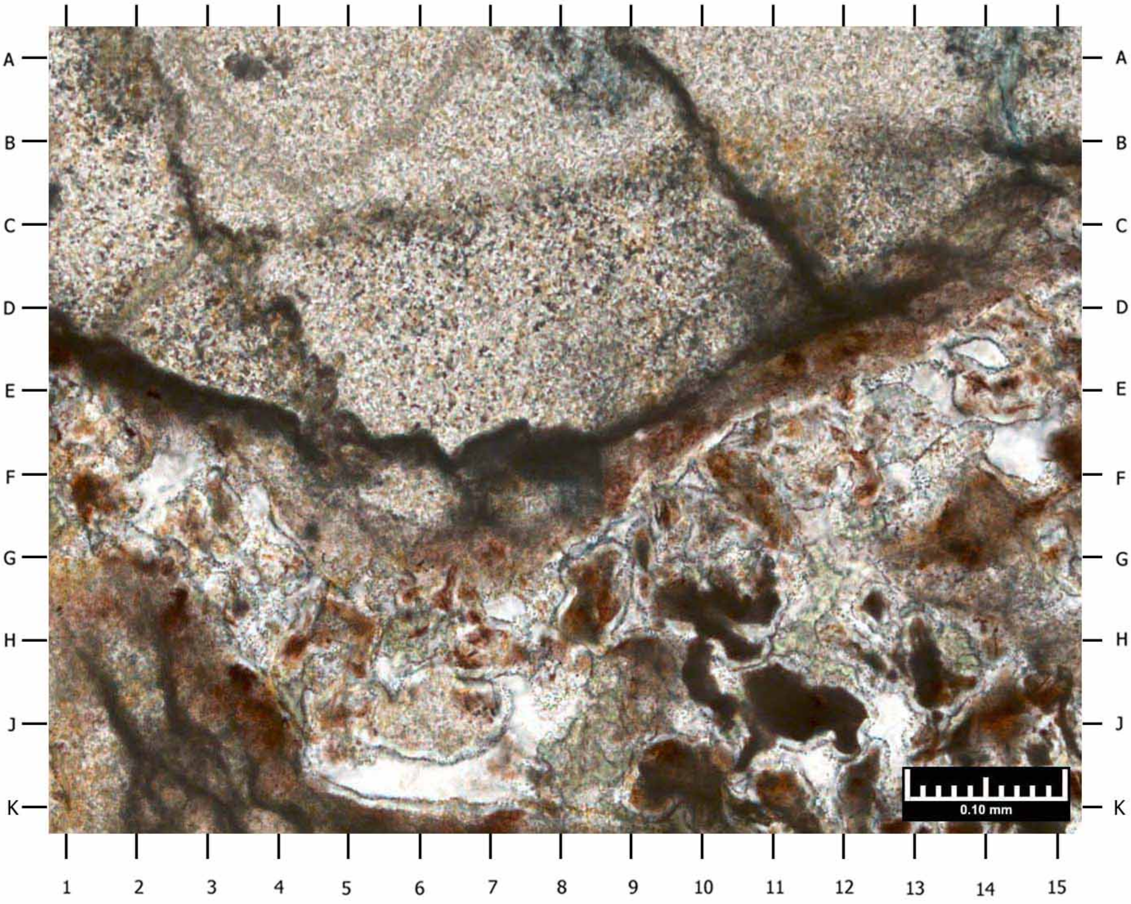
3133.8m
Plate 42






A

50X




B

200X

# APPENDIX D

## SCANNING ELECTRON MICROSCOPY PHOTOMICROGRAPHS AND DESCRIPTIONS

(Note the micron bar at the basal right of each photomicrograph for scale)

**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 2813.00 METERS**
**SAMPLE NUMBER: 43-SWC**

**PLATE 1**

Photo A is a general overview illustrating the generally massive texture of this welded tuff (based on thin section). Photo B is a high magnification view of the area centered near FG7 in Photo A. Authigenic albite and calcite cement occlude a possible pore in Photo B (C6-D3). A partially leached feldspar grain occurs at GH12-M7 in Photo B. Illite intermixed with microcrystalline quartz comprise the tuffaceous matrix material (Photo B; G1-M5, AB13.5/ Photo C; A1-M14). Quartz (Photo C; CD8, D7, EF2.8/ Photo D; FG2, H5) and albite (Photo C; BC5/ Photo D; F12) were detected using energy dispersive spectrometry (EDS). Pores are associated with clay minerals and partially dissolved feldspar grains.

**Magnification:** A: 200X B: 800X C: 2000X D: 4000X

**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

**2813.00m**
**Plate 1**

Weatherford
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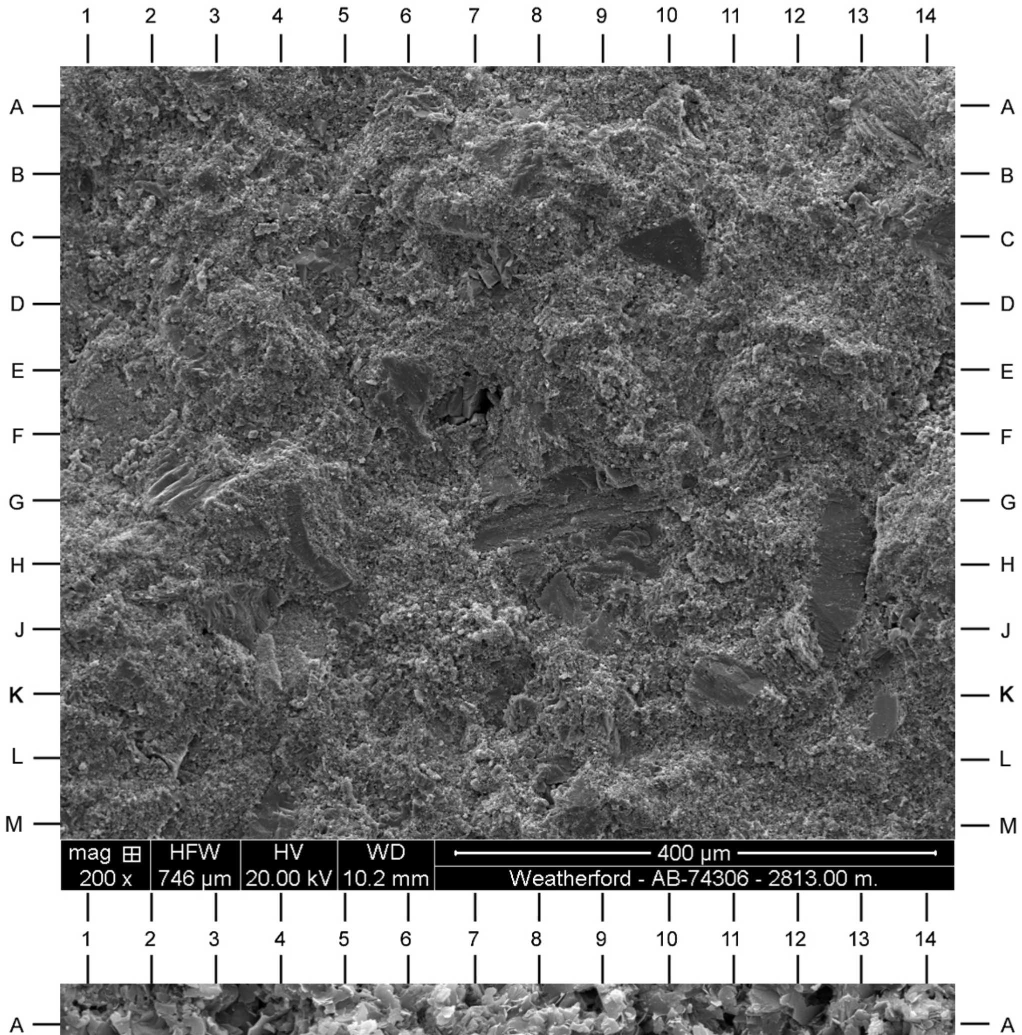
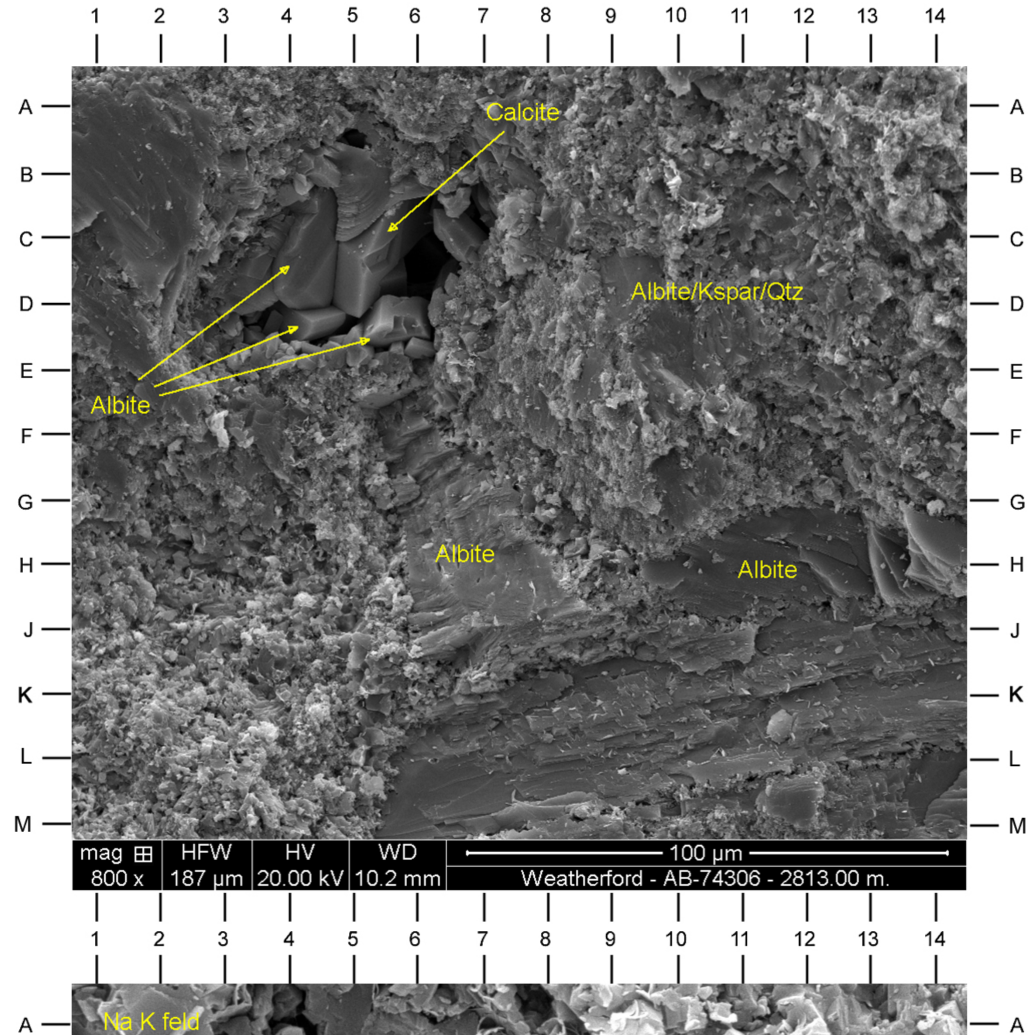
A



B
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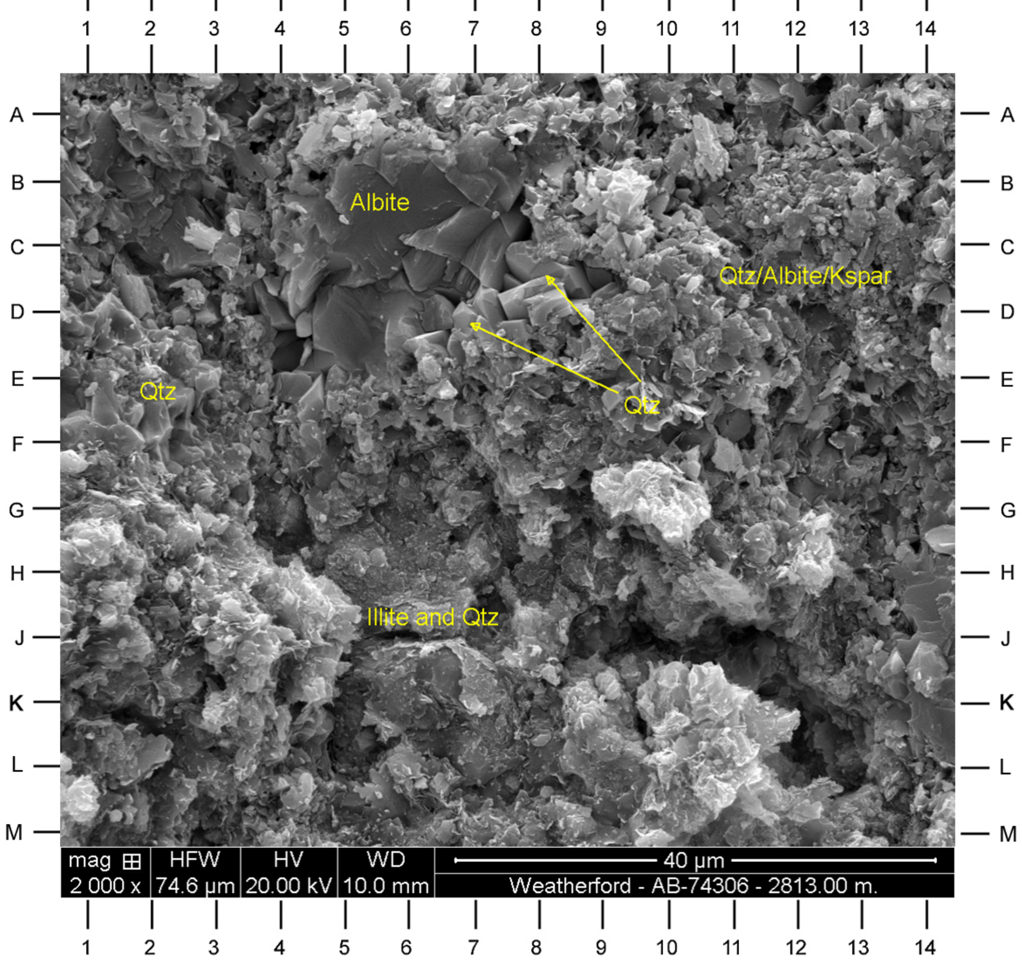
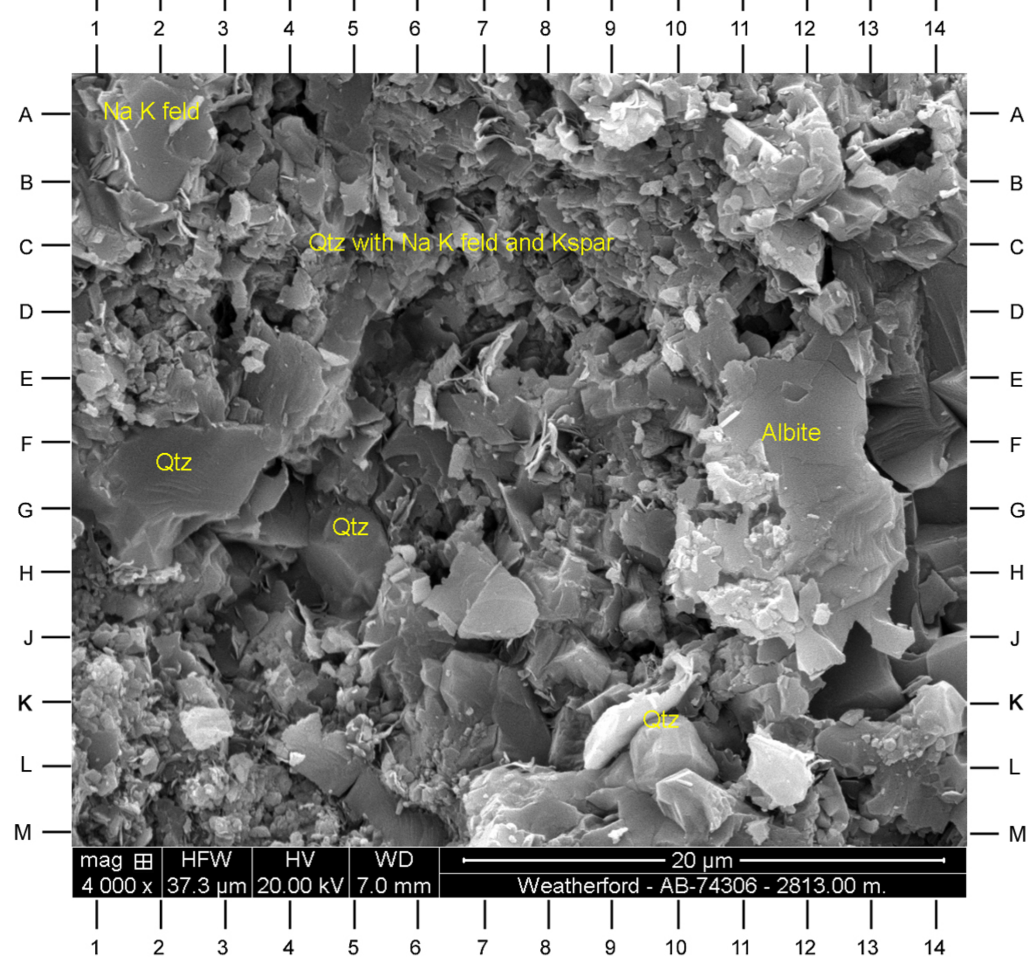



D


**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 2895.09 METERS**
**SAMPLE NUMBER: 1_27P-DS**

**PLATE 2**

These photomicrographs illustrate a massive lithic arkose (based on thin section). Photo B provides a high magnification view of the area FG7 in Photo A, highlighting a potassium feldspar grain (F9-M1) with quartz (L9) infilling a secondary pore. Detrital grains consist predominantly of plagioclase (Photo D; AF13.5) and potassium feldspar (Kspar; Photo B; K5/ Photo C; K8/ Photo D; H1) with lesser amounts of quartz grains (Photo B; K13). Potassium feldspar cement (Photo C; A1-C11) and incipient overgrowths (Photo C; J4-M1) slightly reduce the intergranular areas. Muscovite mica occurs at C7-14 in Photo B. The matrix material consists of mainly mixed layer illite/smectite, cryptocrystalline quartz, and illite. Pyrite framboids (Photo D; E8, G8.5, K6) occur as replacement of susceptible material. Micropores, between clay particles, are the dominant pore type in these photomicrographs. Secondary porosity occurs within a partially altered feldspar grain (Photo B; H2, J6, H9).

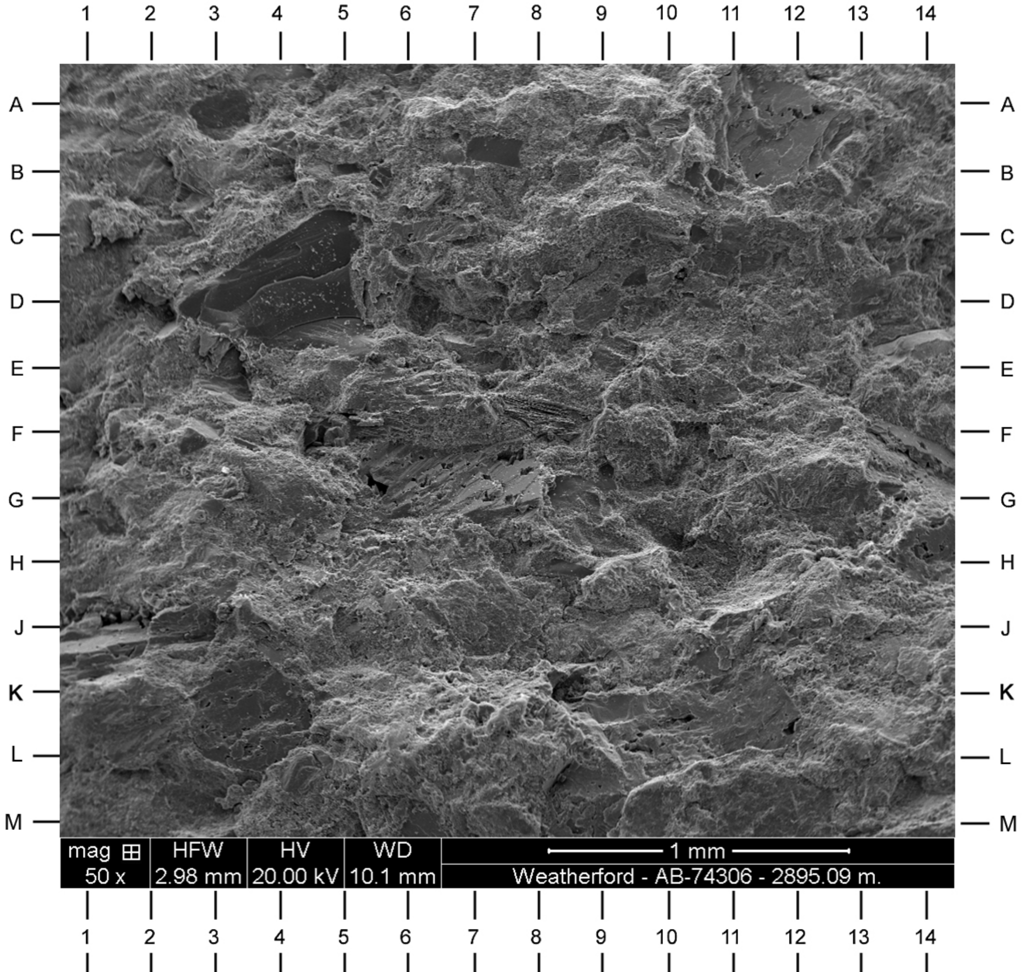
**Magnification:** A: 50X B: 300X C: 1000X D: 1100X

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

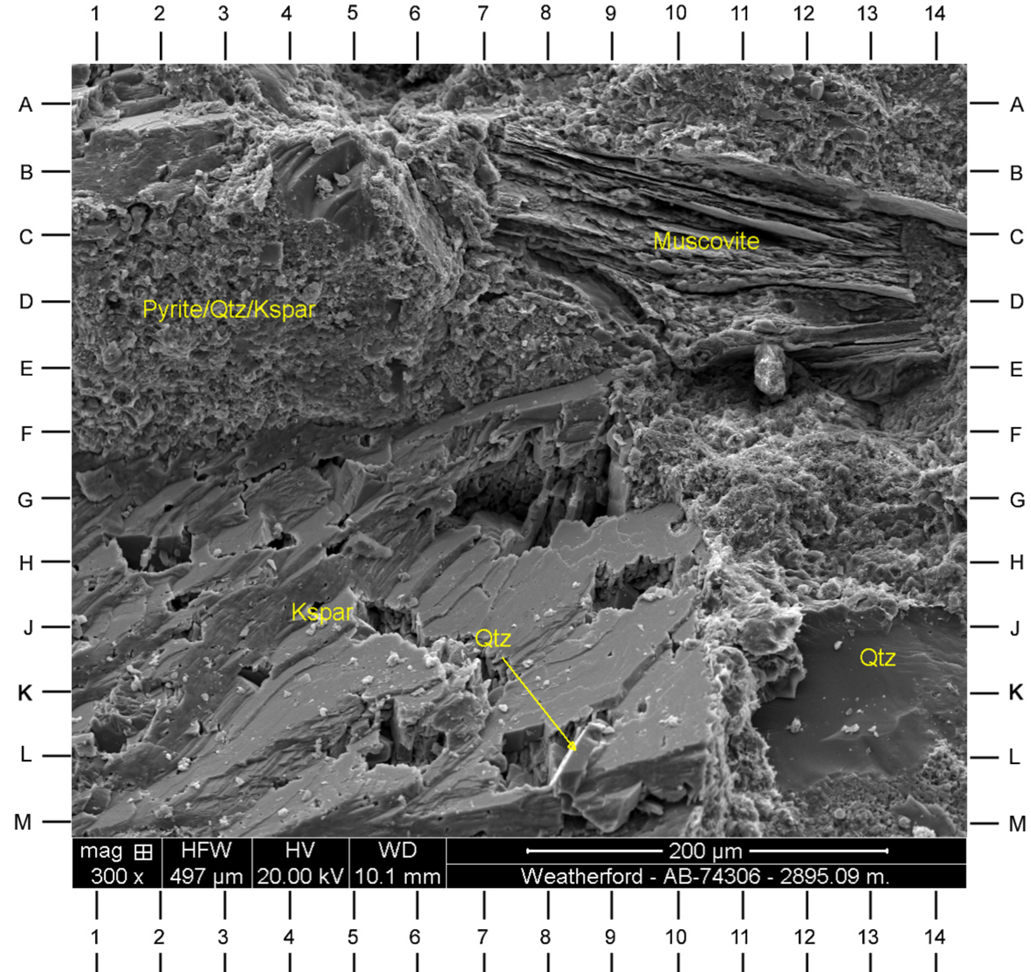
2895.09m
Plate 2

Weatherford LABORATORIES

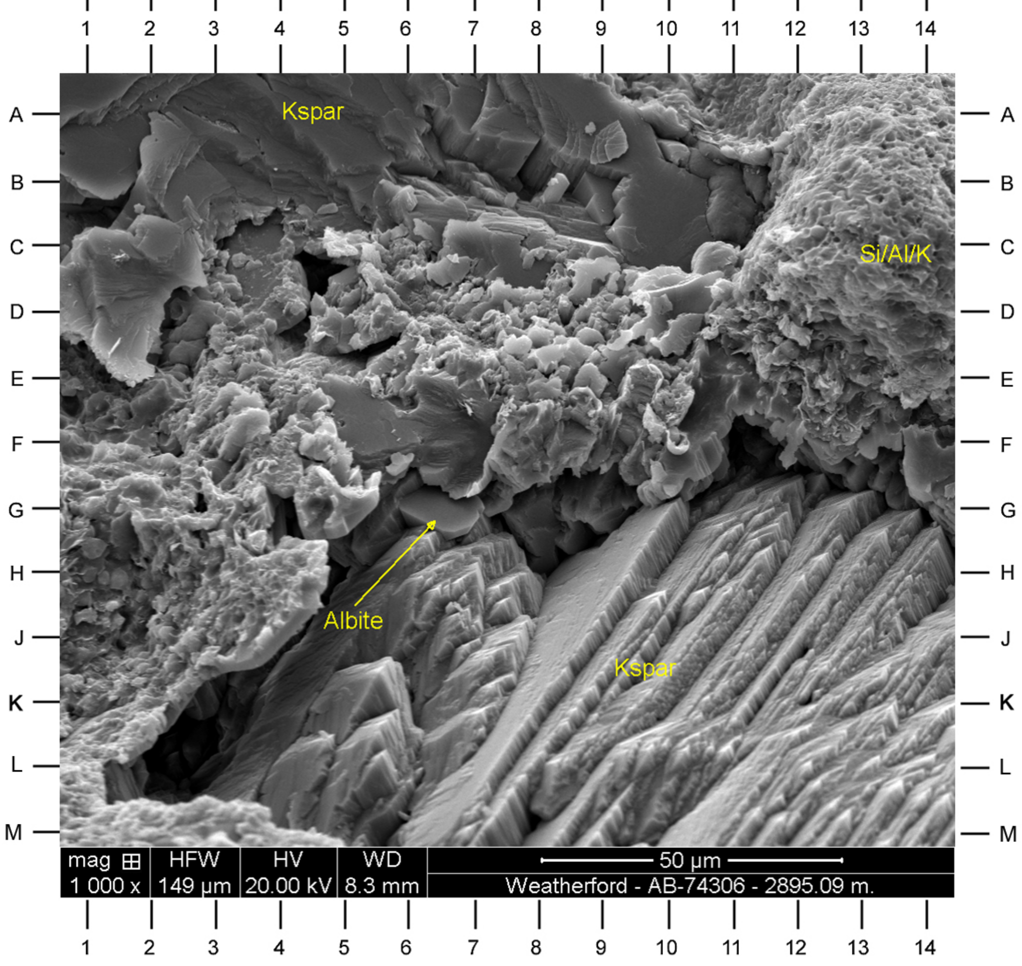
A



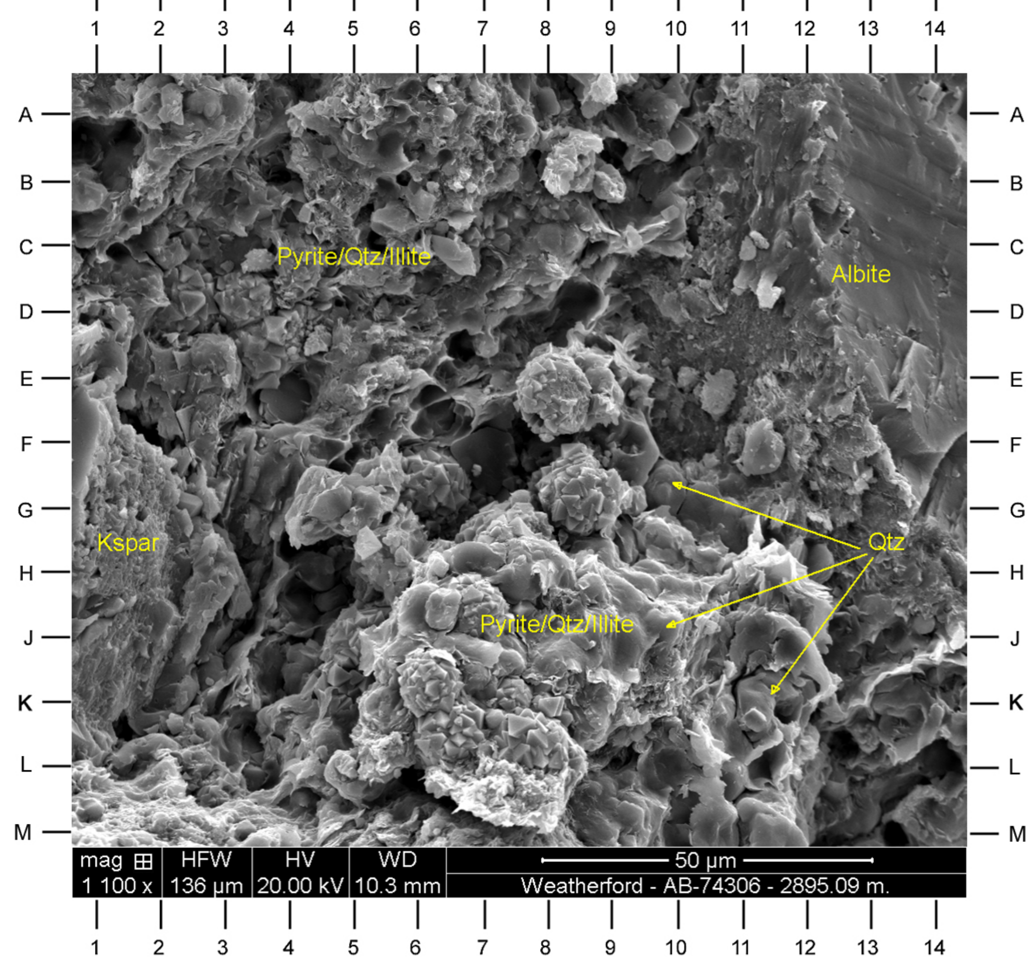

B




C




D



**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 2897.06 METERS**
**SAMPLE NUMBER: 2_2P-DS**

## PLATE 3

These photomicrographs depict a massive lithic arkose (based on thin section) composed of abundant amounts of detrital plagioclase feldspar (Photo B; CD2, E11, JK11/ Photo C; B11.5) and potassium feldspar (Photo B; D4, G4/ Photo D; B7, H12.5). Photo B is a high magnification view of the area centered near FG11 in Photo A. Grain-coating, fibrous illite/smectite clay is present (Photo C; C13.5-E9, C5, G11-K14/ Photo D; BC12-F10, E2, HJ11). Well-developed, euhedral quartz crystals (Photo B; A8-L6/ Photo C; E6, GH3, H7) occlude primary pores. Secondary dissolution/moldic pores (Photo B; C6-J5) represent the dominant pore type, with lesser amounts of micropores associated with clays and primary intergranular pores (Photo B; B10.5, K8).

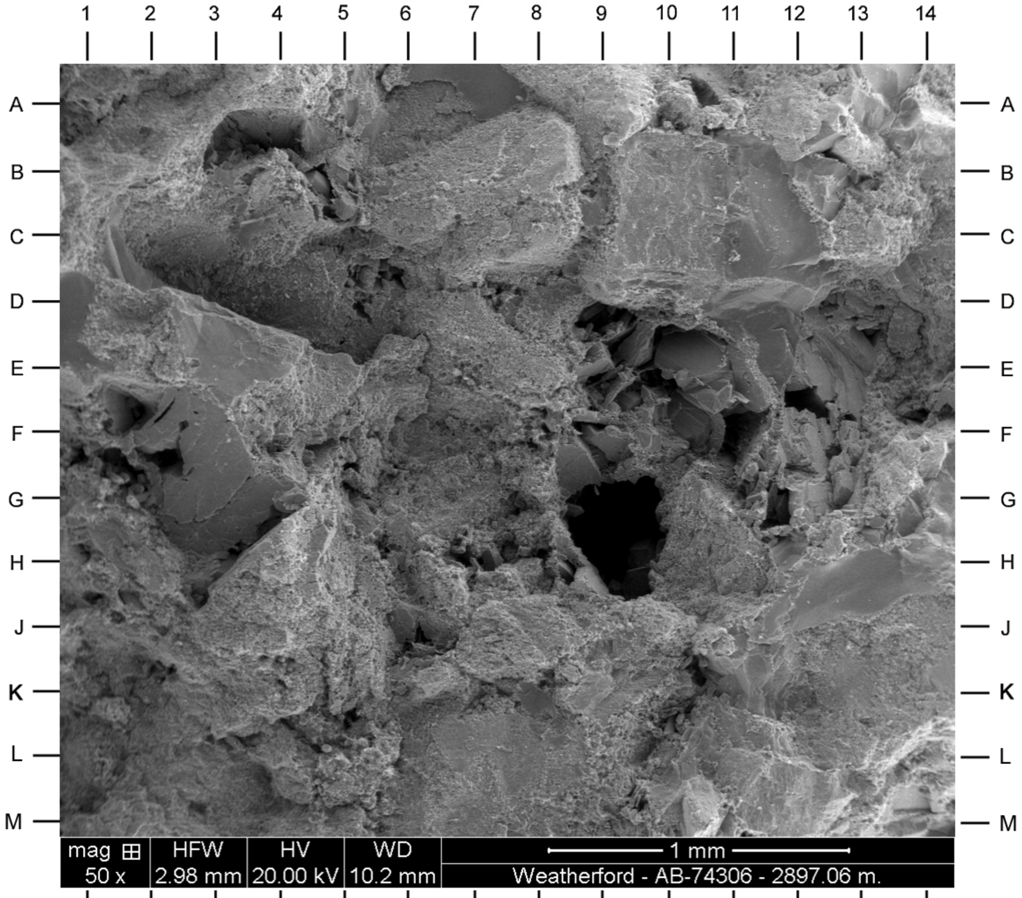
**Magnification:** A: 50X B: 250X C: 800X D: 1200X

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

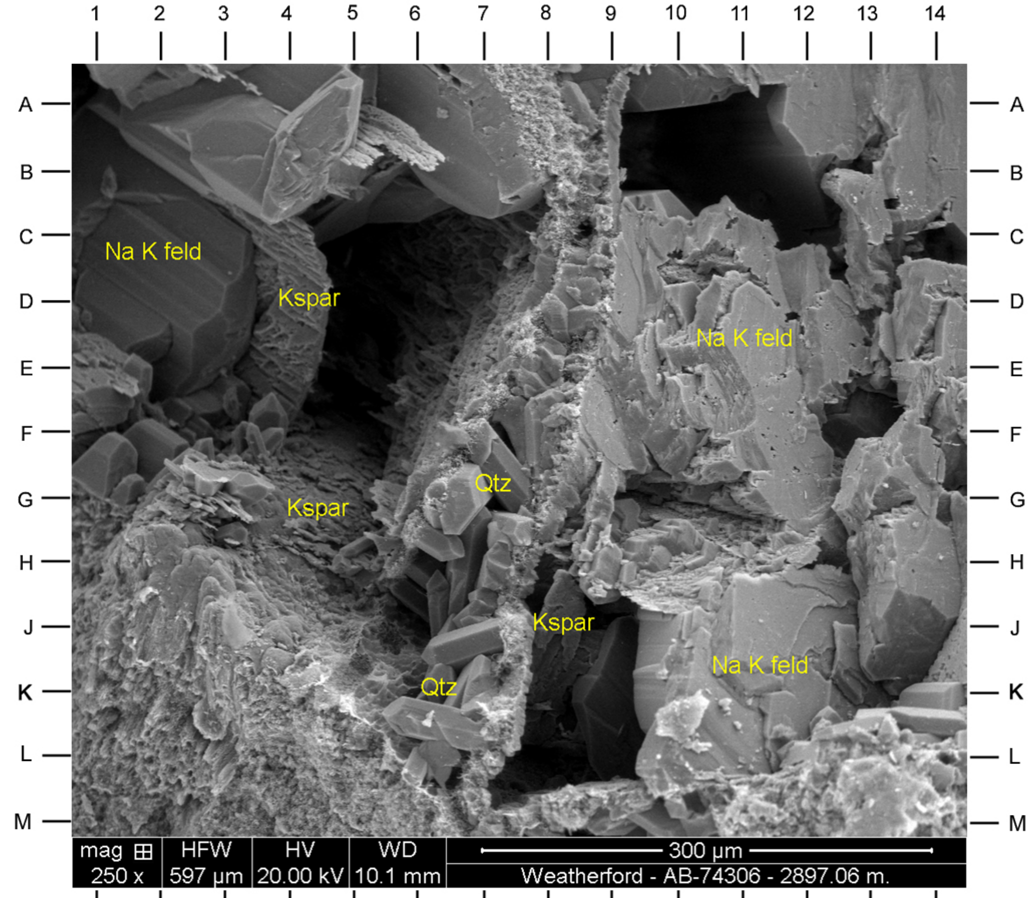
2897.06m
Plate 3

Weatherford LABORATORIES

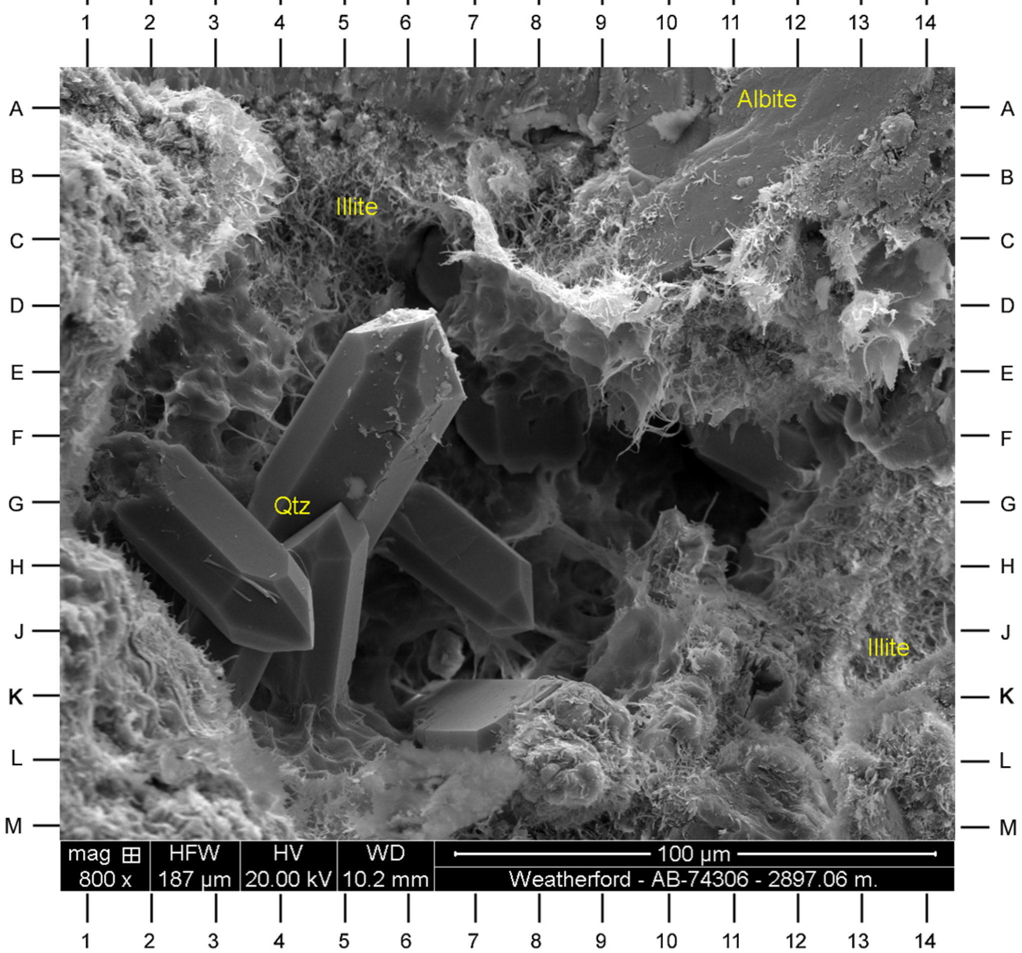
A



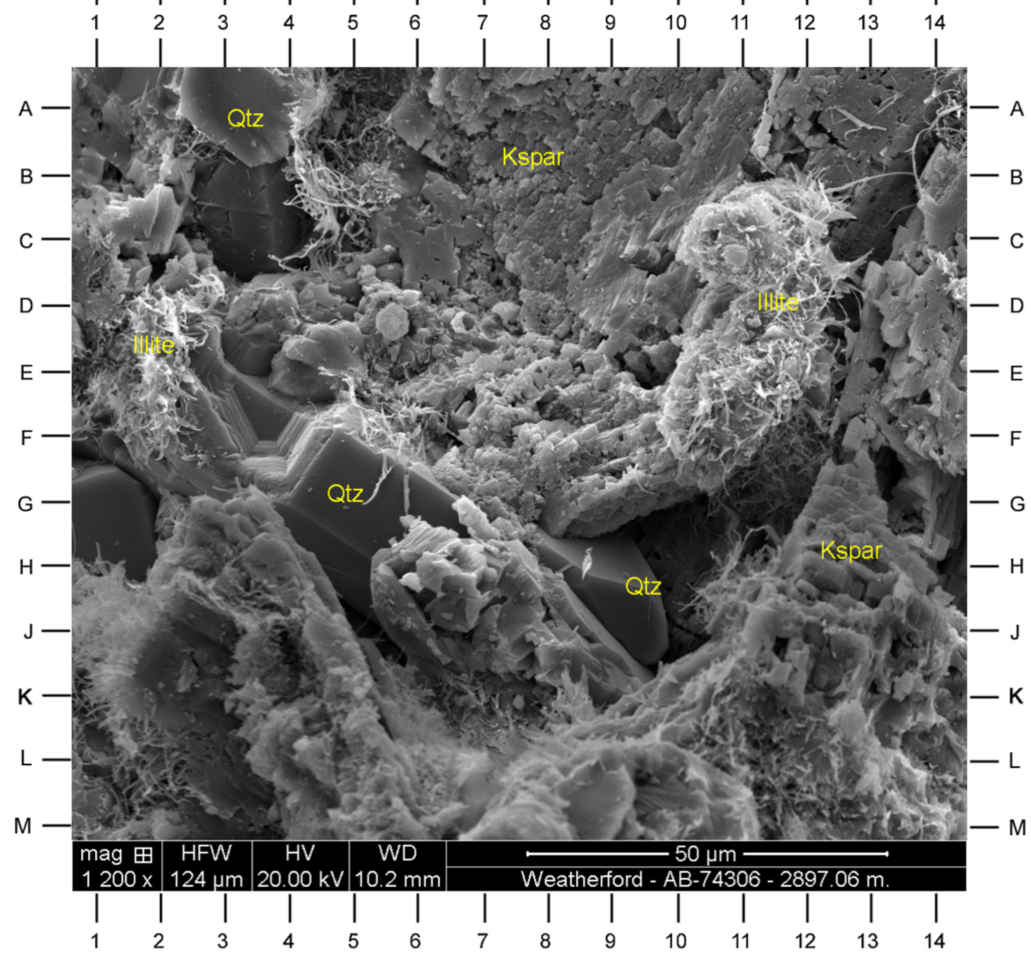

B




C




D



**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 2901.06 METERS**
**SAMPLE NUMBER: 2_6P-DS**

**PLATE 4**

These photos illustrate a moderately compacted lithic arkose. Photo B is a high magnification view of the area centered near FG7.5 in Photo A. Illite/siderite (Photo B; A7-D14, G9-M14) and illite/quartz (Photo C; A1-13, A1-G3/ Photo D; G9-M14) coat detrital grains. Authigenic quartz overgrowths fill intergranular areas (Photo C; DE5-11/ Photo D; E6, F11, JK8). Partially leached potassium feldspar grains (Photo B; A1-C6/ Photo C; GM7) contain secondary micropores. A rare primary pore is partially occluded by illite clay (F7-LM3). Micropores are also associated with the clays.

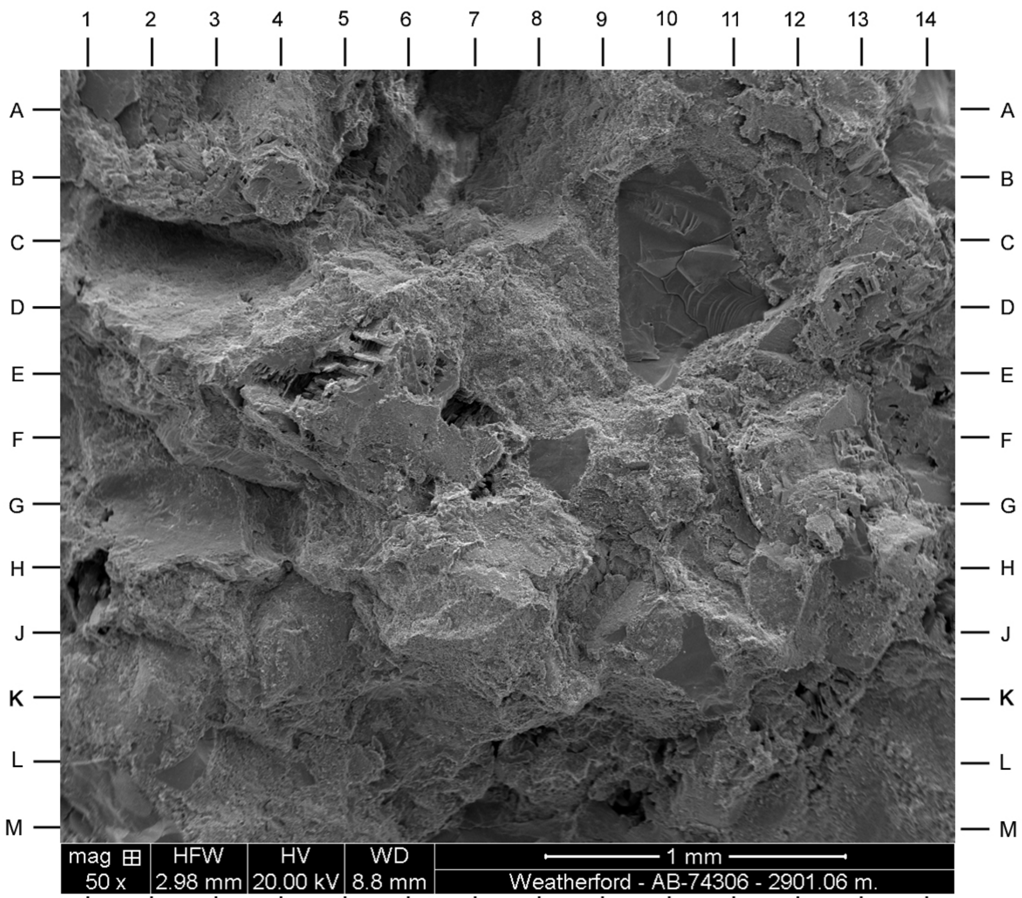
**Magnification:** A: 50X B: 400X C: 600X D: 800X

**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

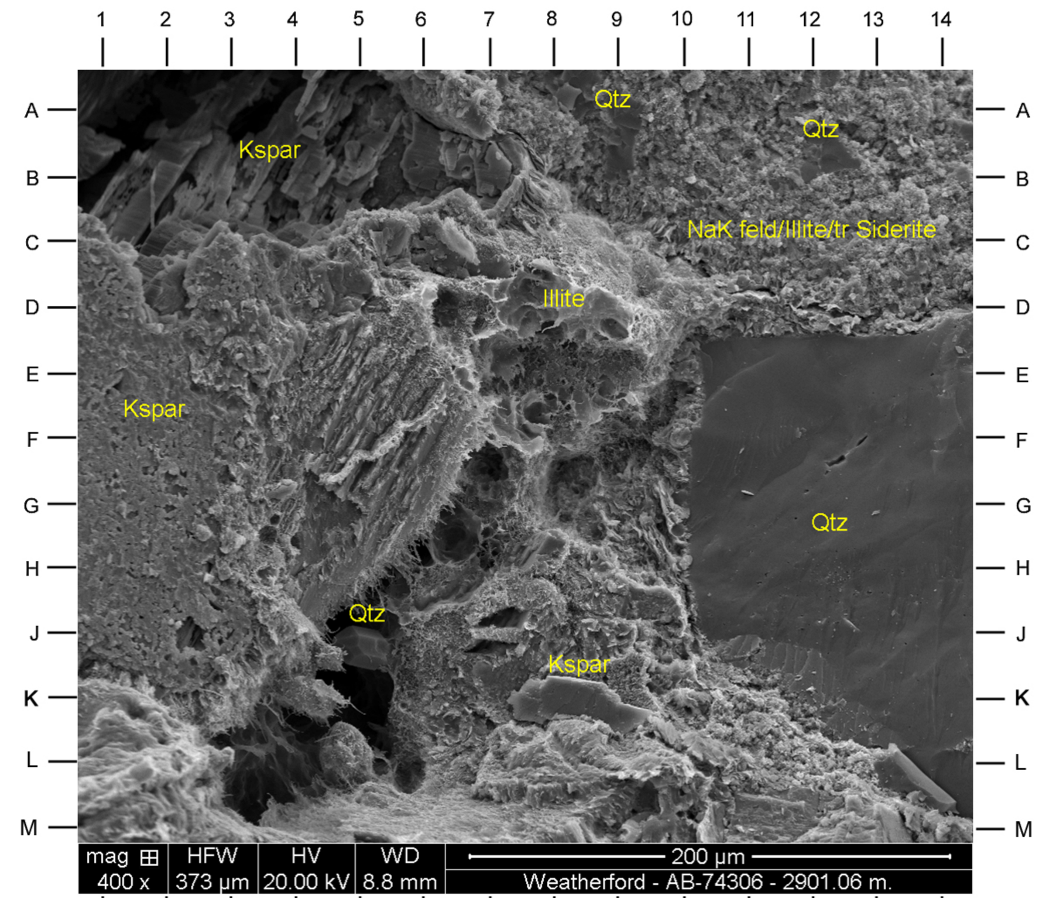
**2901.06m**
**Plate 4**

Weatherford LABORATORIES

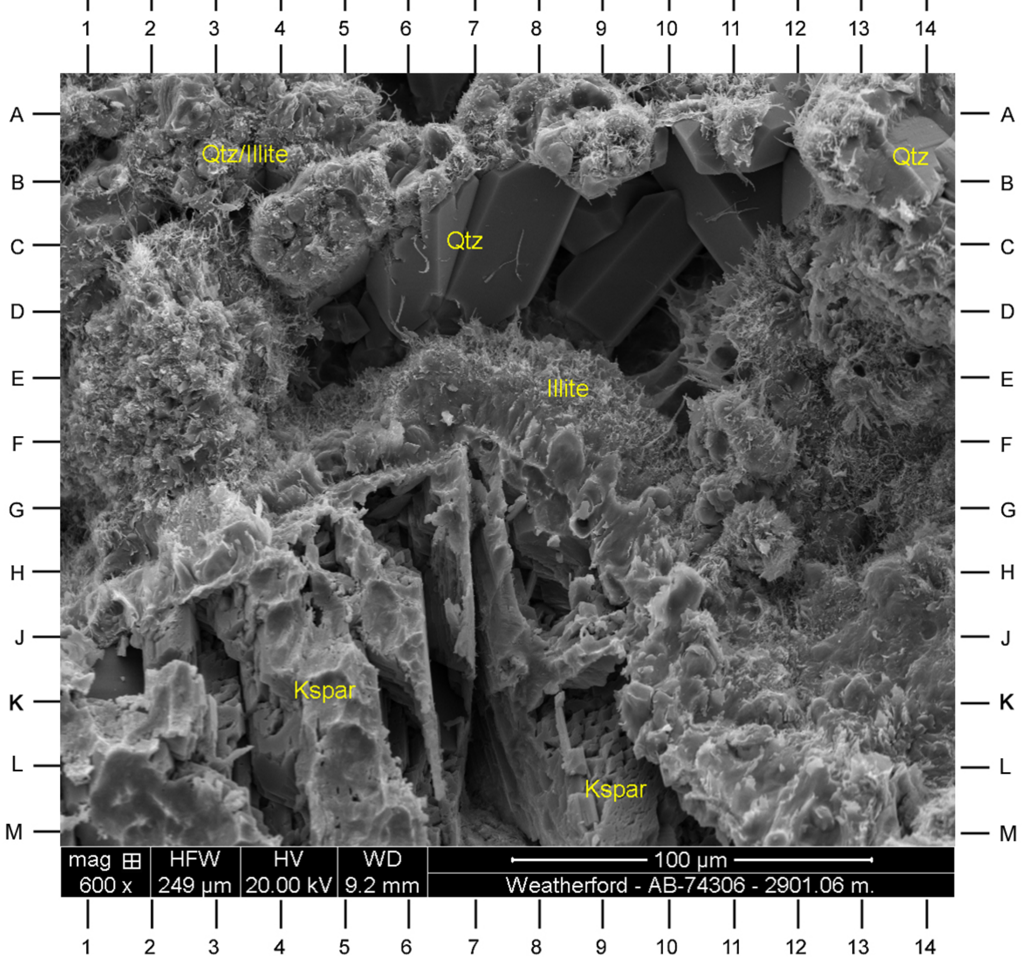
A



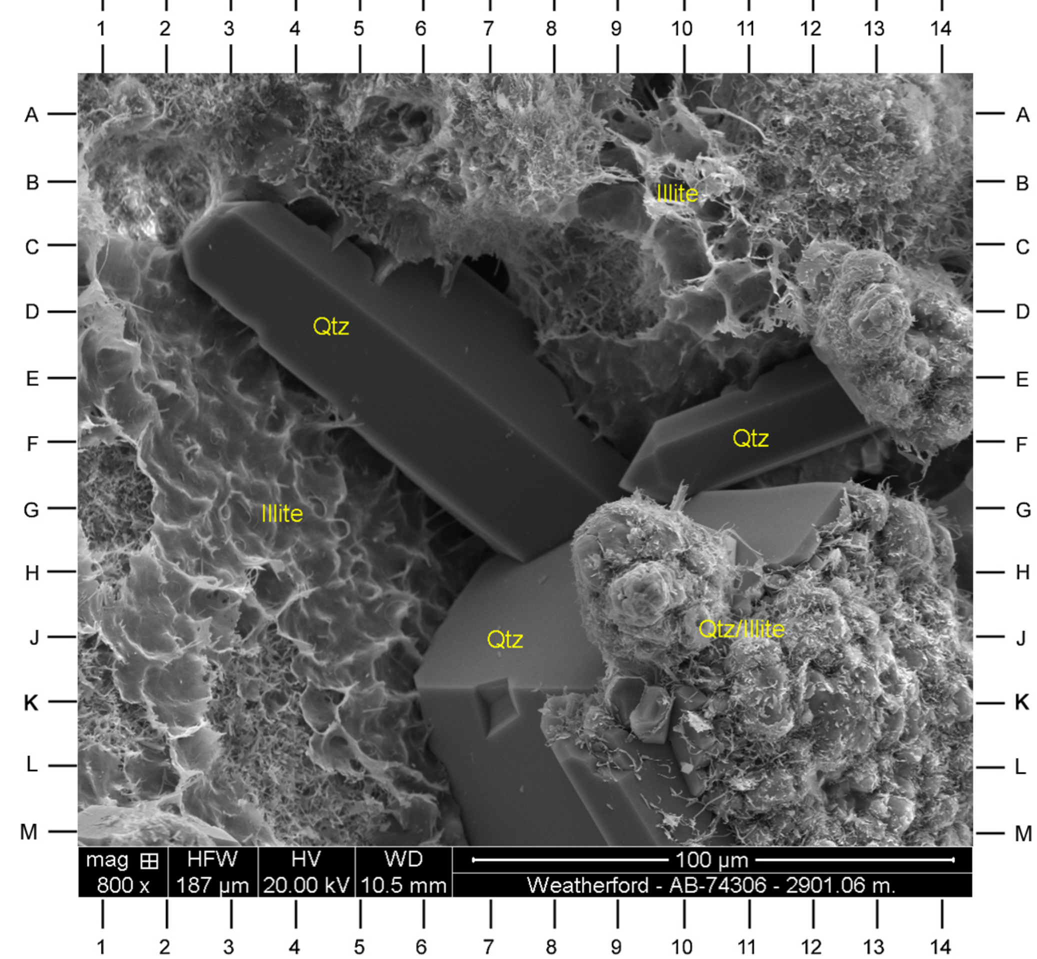

B




C




D



**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 2905.56 METERS**
**SAMPLE NUMBER: 28-RCA**

**PLATE 5**

This massive, lithic arkose (based on thin section) is composed of abundant plagioclase (Photo B: BC12, JK6, K2/ Photo C; KL2) and potassium feldspar grains (Photo B; CD4, G12/ Photo C; K13/ Photo D; G2.5). Illite commonly coats grains (Photo C; C3-EF10, FG4/ Photo D; A14-D10, A2-M10, KL12) and bridges pores (Photo C; B4, E6/ Photo D; D1.5, DE2.5). Authigenic quartz cement (Photo B; A9.5-E8/ Photo C; E2/ Photo D; EF7, H9, HJ13) further reduces intergranular pores. Secondary dissolution pores are associated with partially dissolved feldspar grains (Photo B; CD4, HJ13.5, GH8). Photo B is a high magnification view of the area centered near FG7 in Photo A.

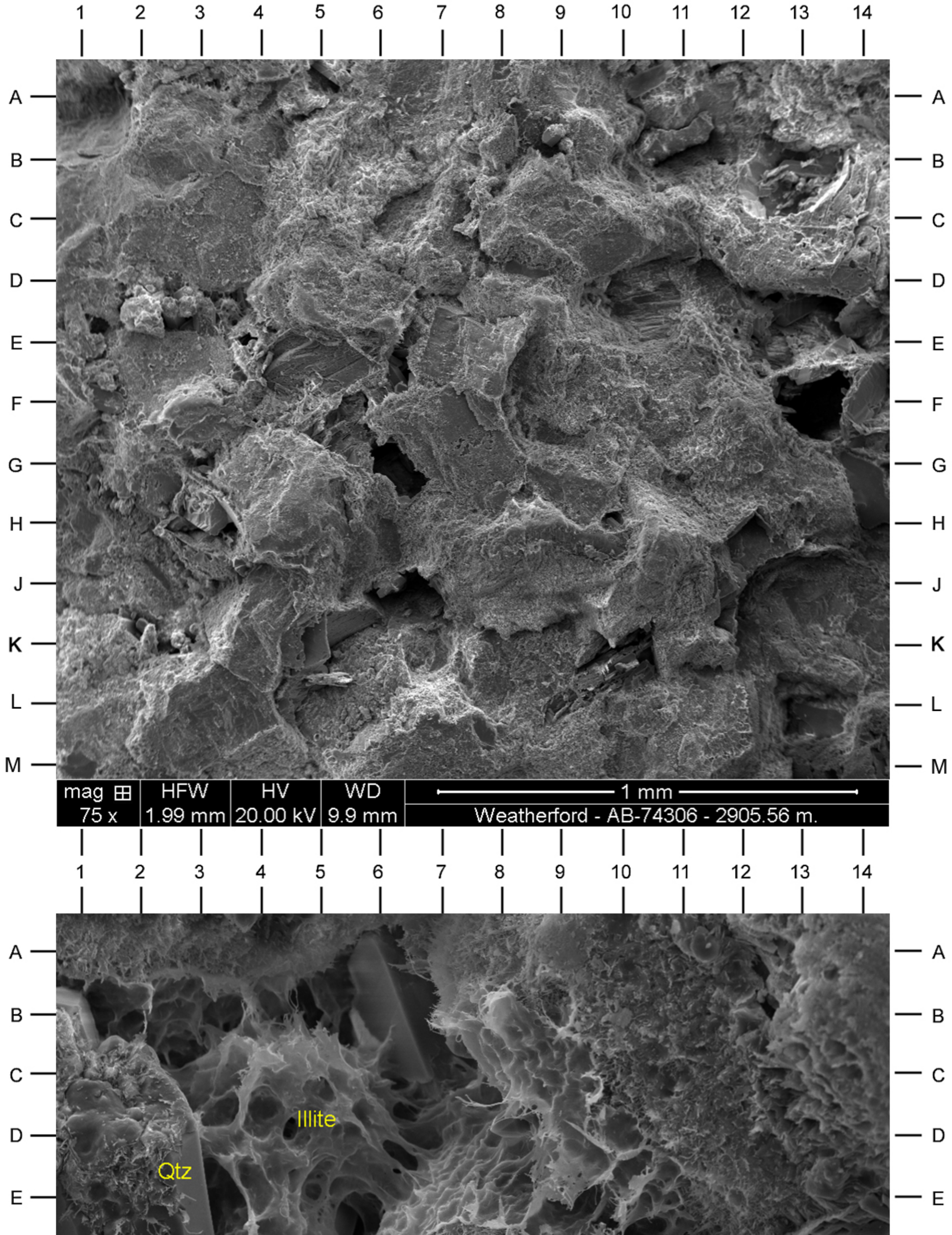
**Magnification:** A: 75X B: 300X C: 600X D: 1200X

QGC - A BG Group business
Dunk-1
Surat Basin
Queensland, Australia

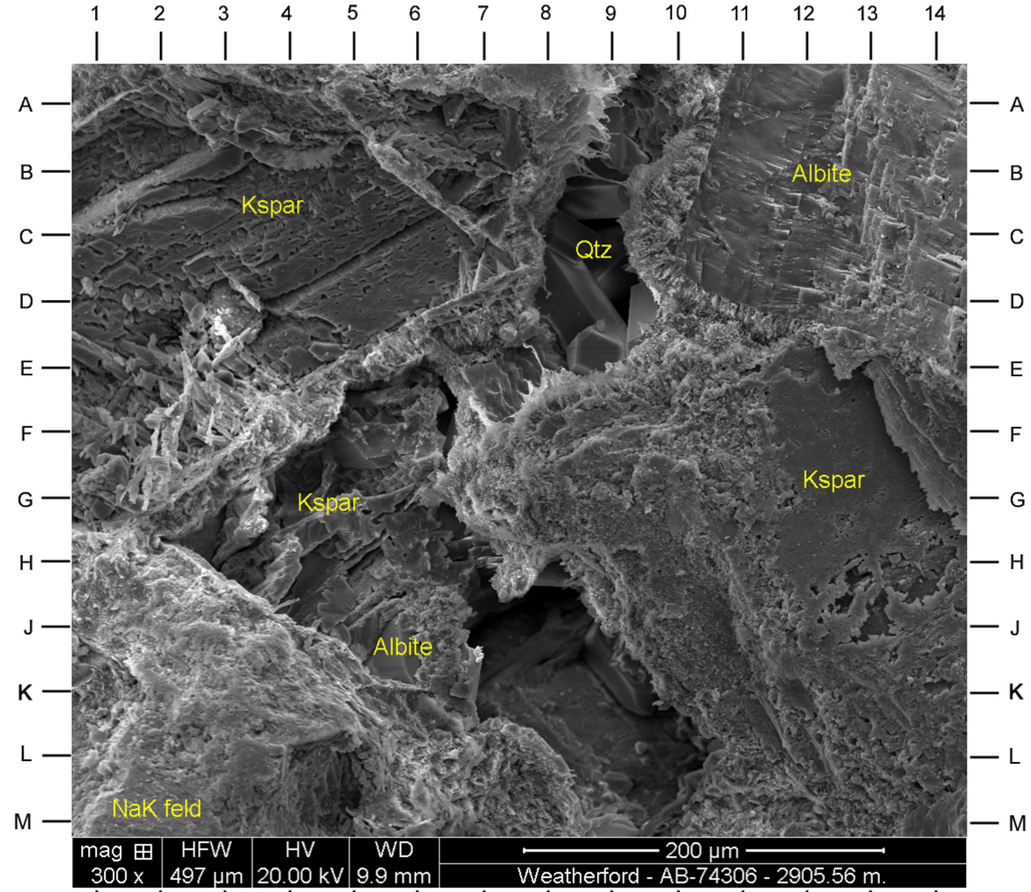
2905.56m
Plate 5

Weatherford LABORATORIES

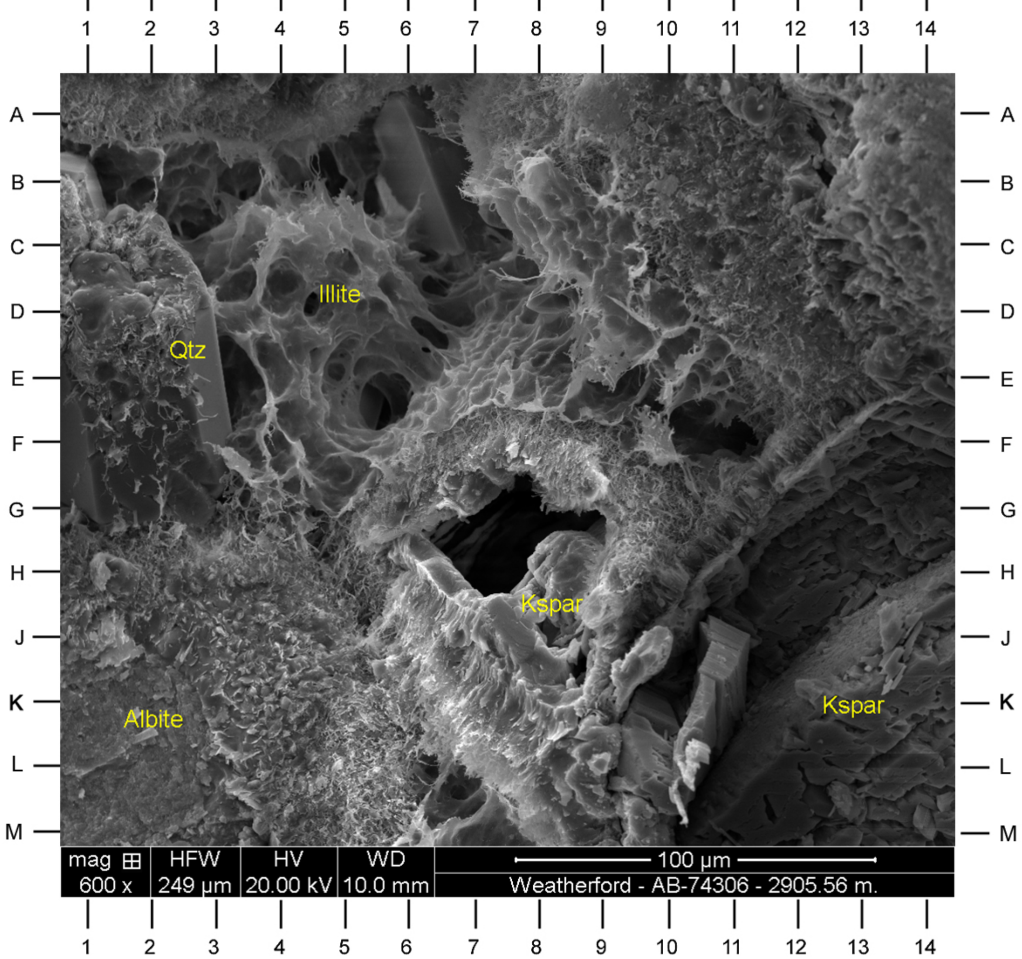
A



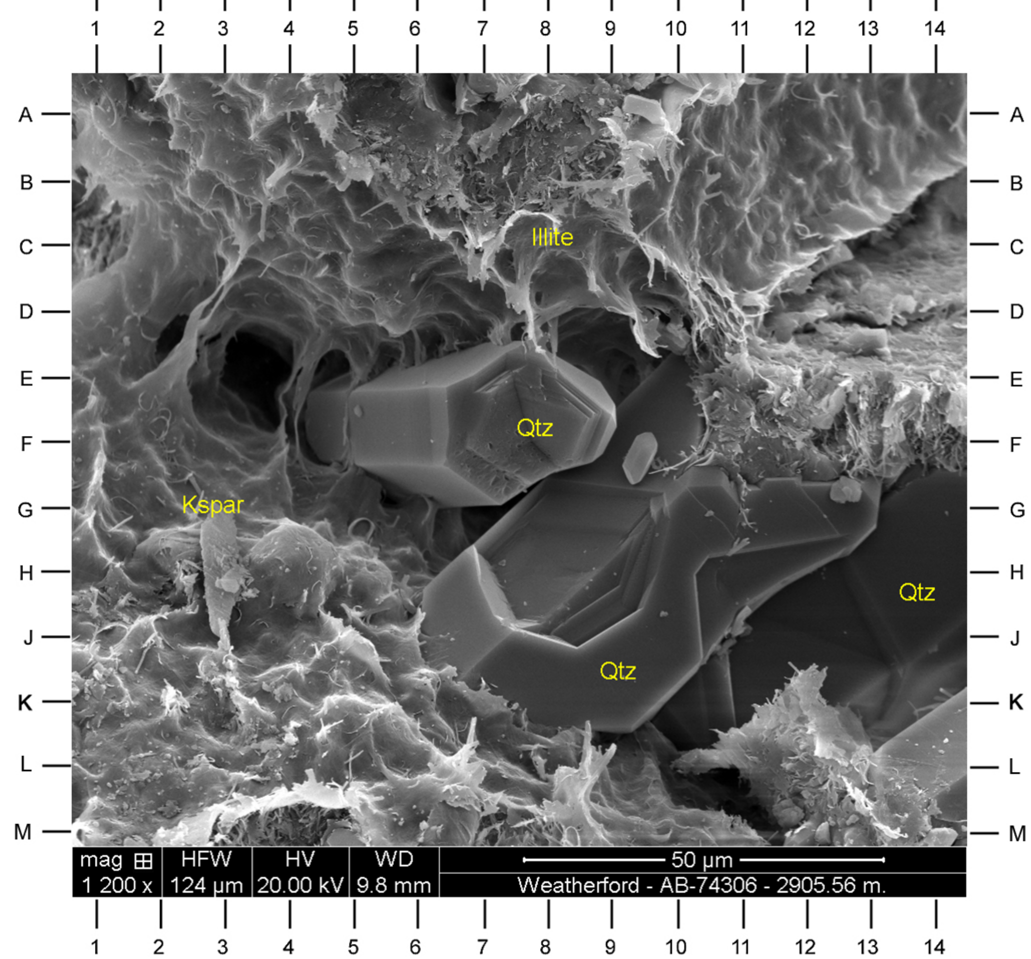

B




C




D



**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 2908.50 METERS**
**SAMPLE NUMBER: 31-RCA**

**PLATE 6**

Photo A provides a general overview of this massive lithic arkose to feldspathic litharenite (based on thin section). Large pores in Photo A are likely artificial and a result of grain plucking from sample preparation (JK5, LM3). Some detrital grains are coated with detrital clays and are only distinguishable using energy dispersive spectrometry (EDS). Authigenic quartz (Photo B; C8.8, E9, L13) and plagioclase feldspar (Photo B; C10, F8/ Photo C; F8/ Photo D; H8) cement occludes primary pores. Secondary intragranular pores associated with leached feldspar grains (Photo B; D5-K1) are the dominant pore type present. Micropores are associated with detrital clays.

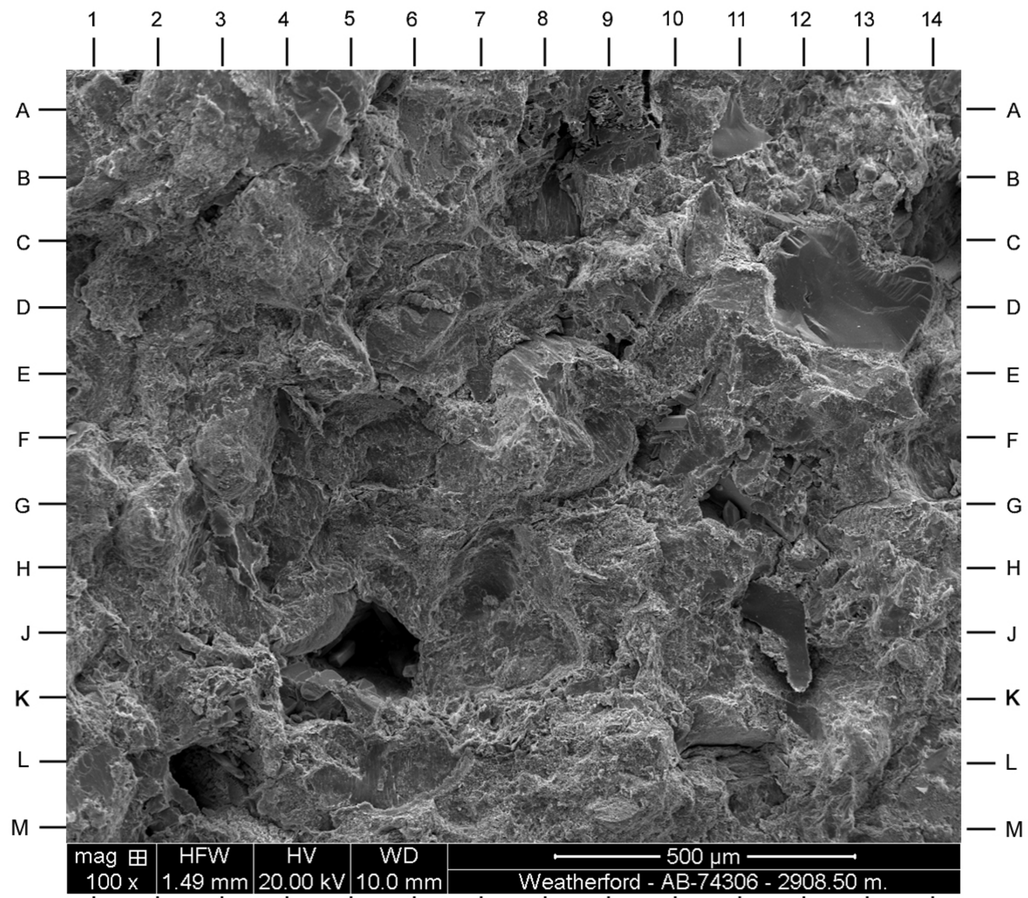
**Magnification:** A: 100X B: 500X C: 1200X D: 2000X

**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

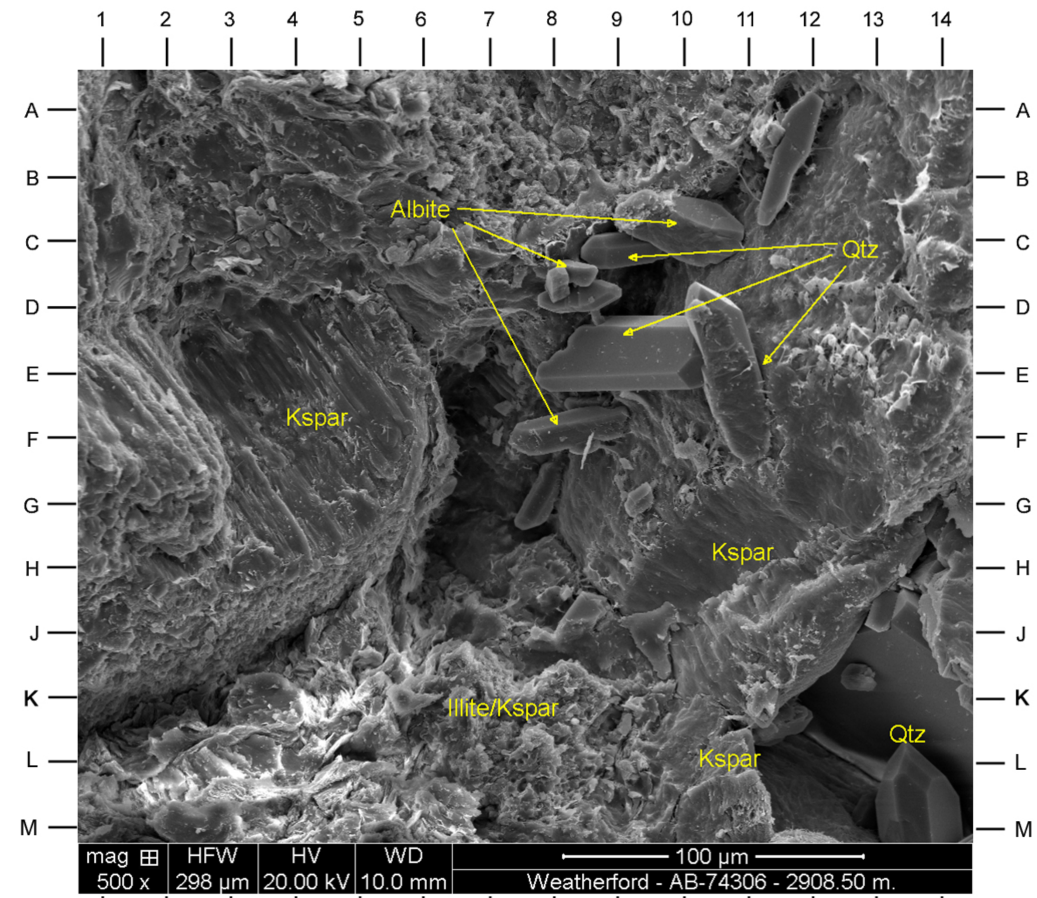
**2908.50m**
**Plate 6**

Weatherford LABORATORIES

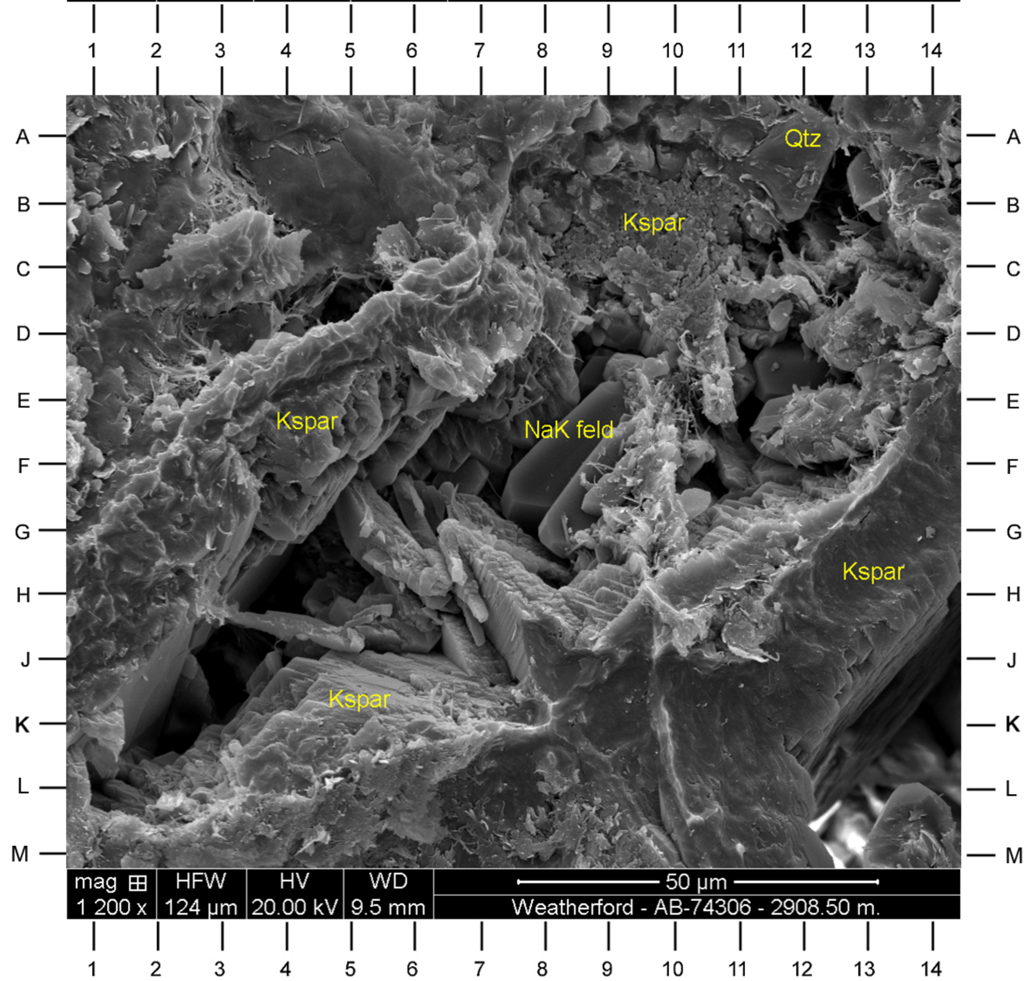
A



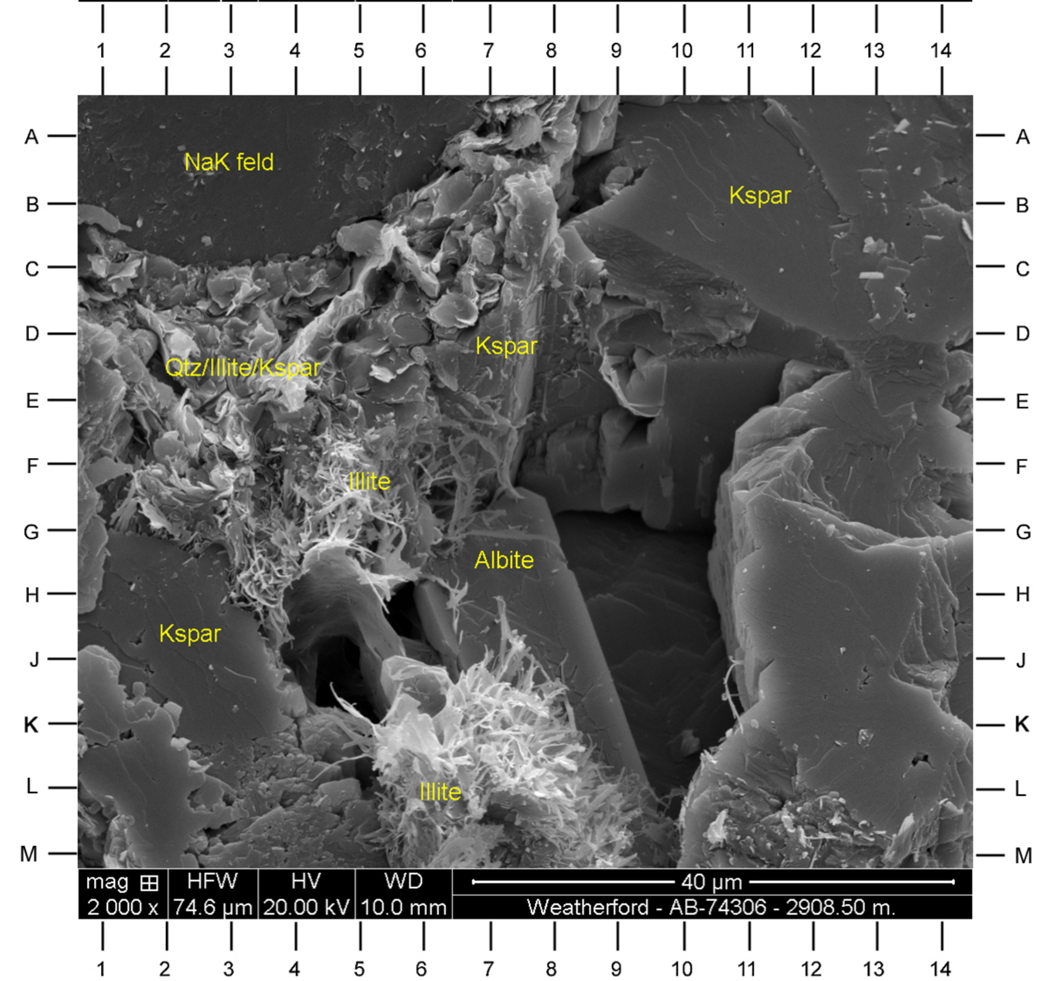

B




C




D



**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 2912.50 METERS**
**SAMPLE NUMBER: 35-RCA**

**PLATE 7**

These images represent a well consolidated, massive lithic arkose (based on thin section). Photo B is a high magnification view of the area centered near FG7 in Photo A. Detrital grains are composed primarily of plagioclase feldspar (Photo B; E-M12, LM7/ Photo D; DE10) and potassium feldspar (Photo B; C5, L2/ Photo C; H7, L3, D11/ Photo D; E3, J4), with minor amounts of quartz (Photo C; AB13). Authigenic albite (Photo C; J10/ Photo D; CD6.8, G7.5) overgrowths commonly precipitate on host detrital grains. Minor amounts of grain-coating illite is observed (Photo B; A14-C9/ Photo C; A1-F4, EF10, GH10/ Photo D; A8-M10, G6-M1). Secondary intragranular pores associated with leached grains (Photo B; C1-H4), micropores associated with clays, and primary intergranular pores (Photo C; G3/ Photo D; C-F5, G10-M8) are present.

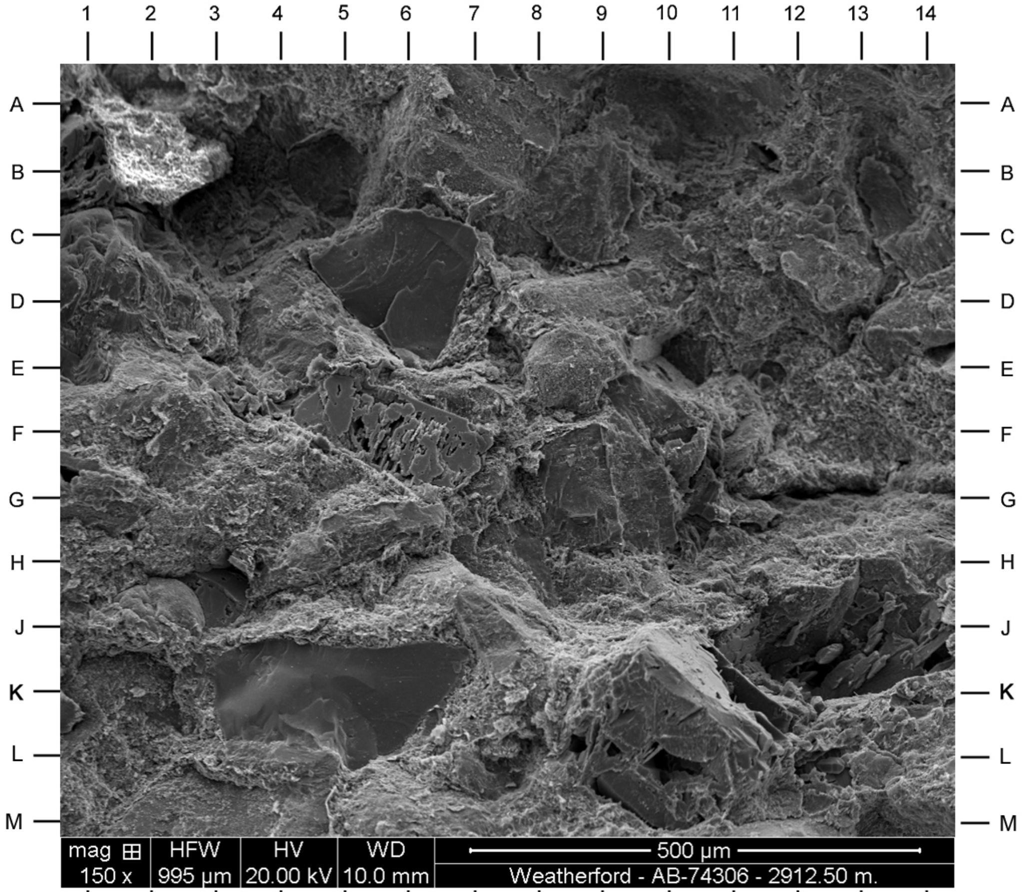
**Magnification:** A: 150X B: 600X C: 1200X D: 1200X

**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

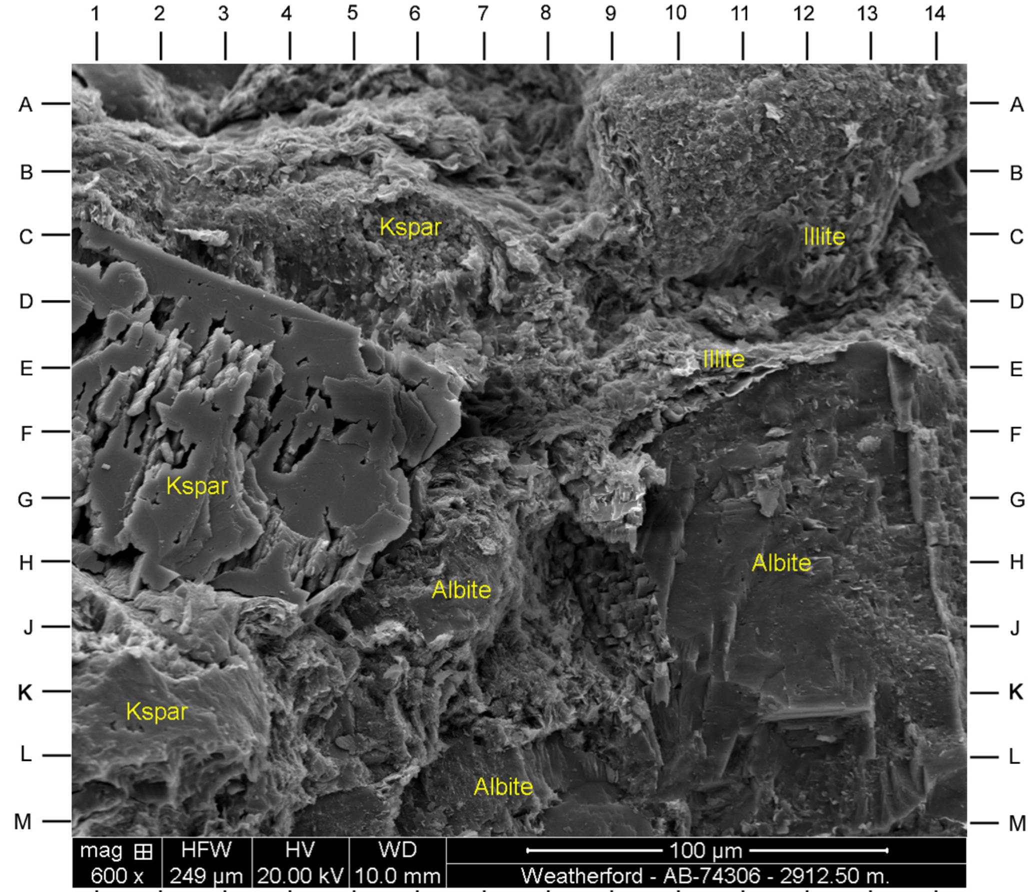
**2912.50m**
**Plate 7**

Weatherford LABORATORIES

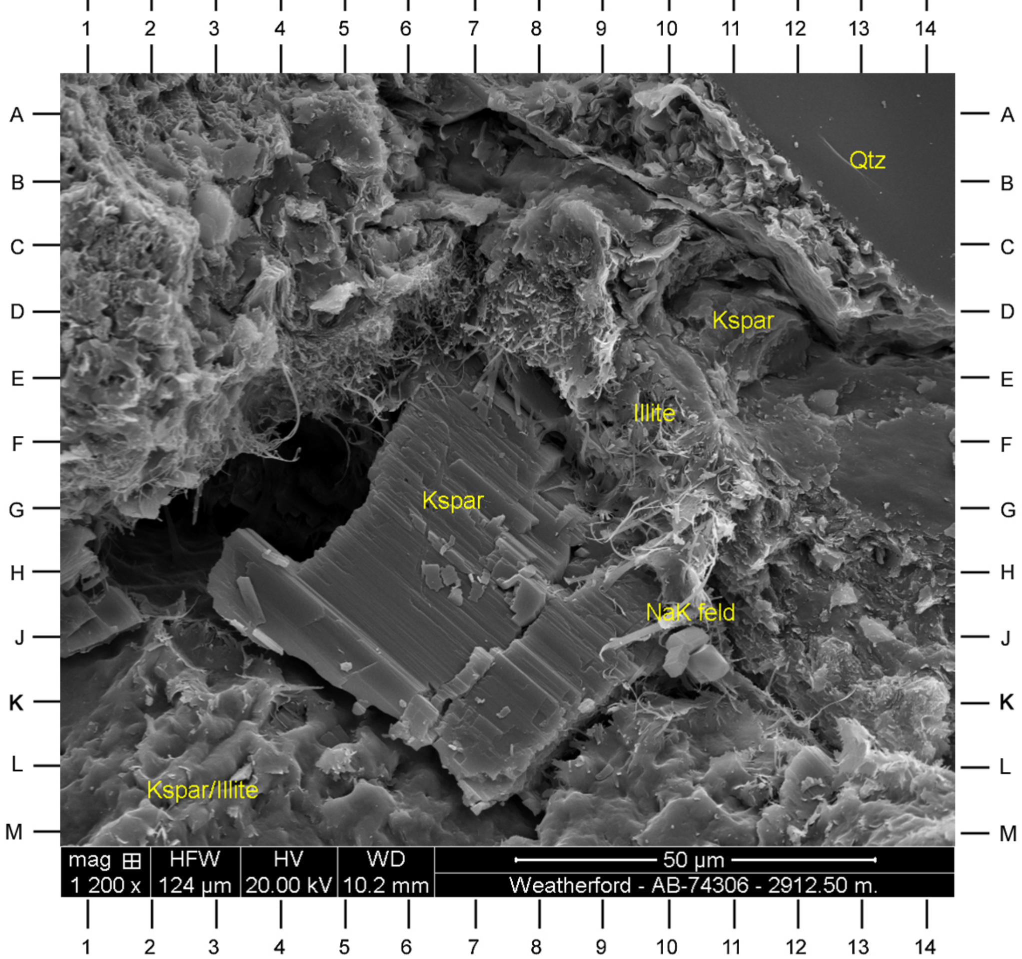
A



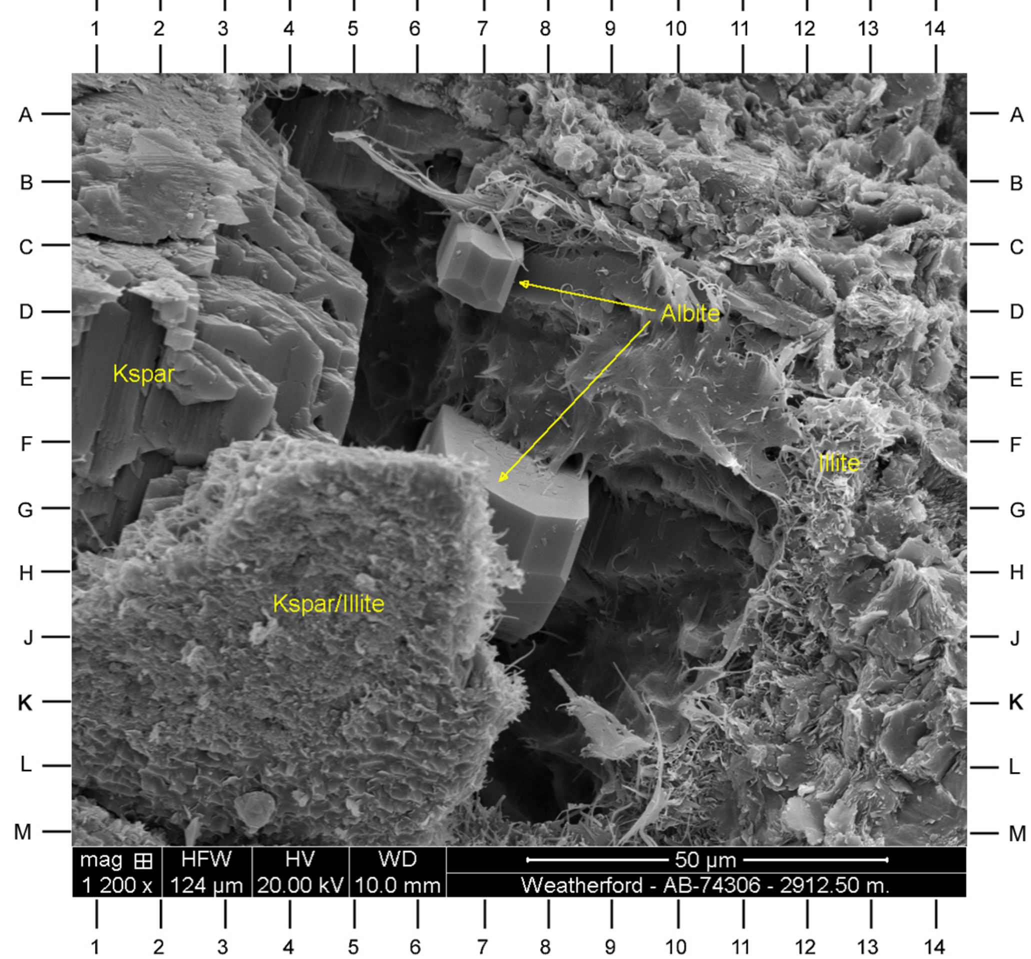

B




C




D



**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 2914.04 METERS**
**SAMPLE NUMBER: 2_20P-DS**

**PLATE 8**

Photomicrograph A provides a general overview of this massive lithic arkose (based on thin section). Photo B is a high magnification view of the area centered near CD6.5 in Photo A. Photo B documents the contact between a detrital quartz grain (D1-7.5), a partially leached feldspar grain (BM7-14), and a probable tuffaceous lithic fragment (HM1-7). Photo D illustrates a chert grain (AL10-14) occurring adjacent to potassium feldspar grains (AE1-7.5, GM1.5-7). Minor amounts of illitic clay coats detrital grains (Photo B; A2-D8, D8-M1/ Photo C; C10-M14, EM1-H3/ Photo D; A9-M14) and bridges pore throats (Photo C; GH7, HJ7, JK10). Authigenic feldspar overgrowths (Photo B; D13.5, HJ9, G14-M13/ Photo D; A1-F6) precipitate on host detrital grains. Quartz cement is also observed (Photo C; E8). Rare primary pores (Photo C; F6-L11) and secondary dissolution pores (Photo B; F12.3, L11, LM14) are present. Micropores are likely associated with authigenic clays are considered ineffective.

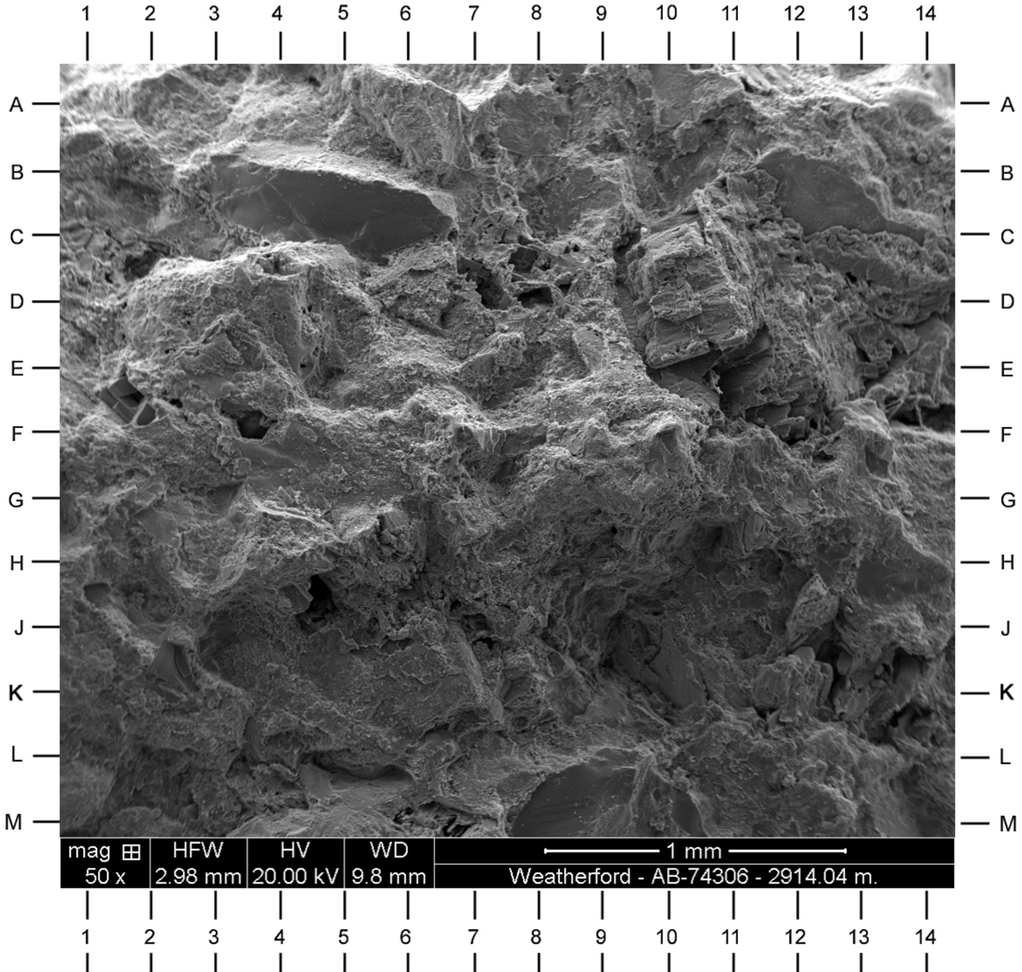
**Magnification:** A: 50X B: 300X C: 800X D: 2000X

**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

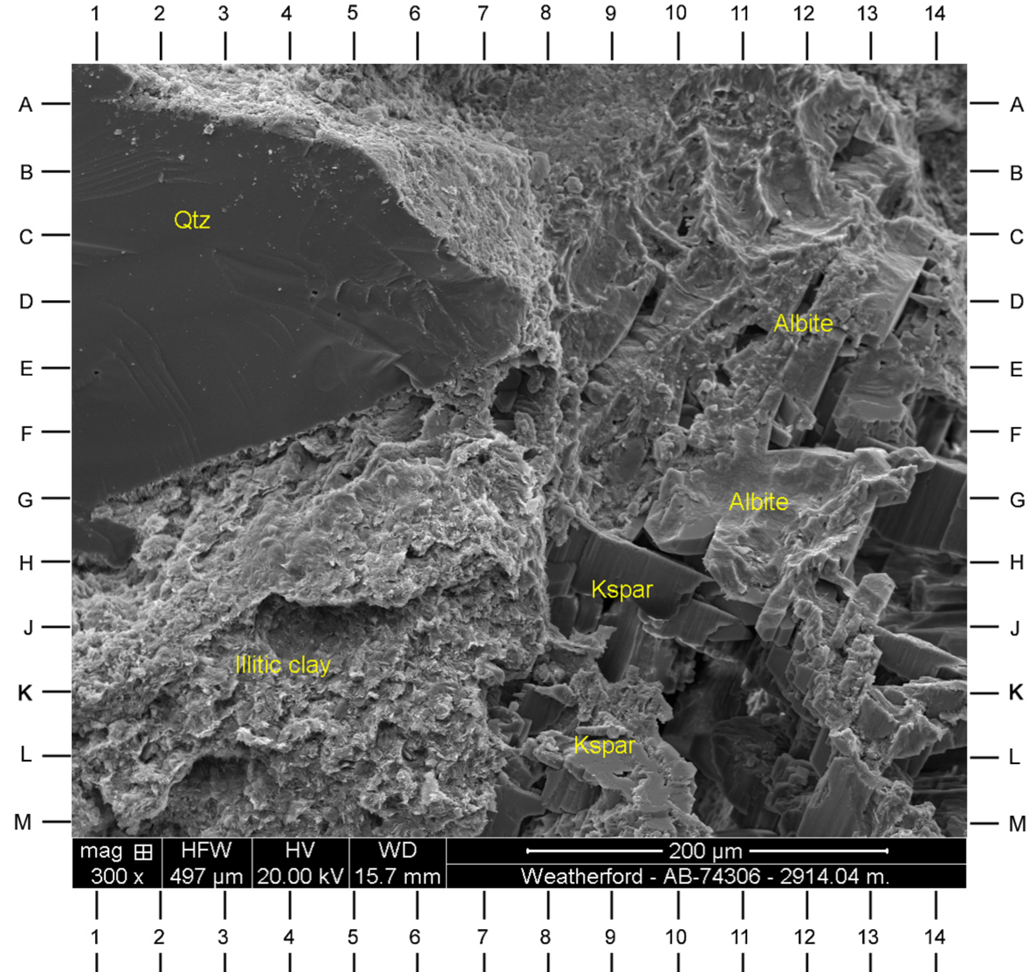
**2914.04m**
**Plate 8**

Weatherford
LABORATORIES

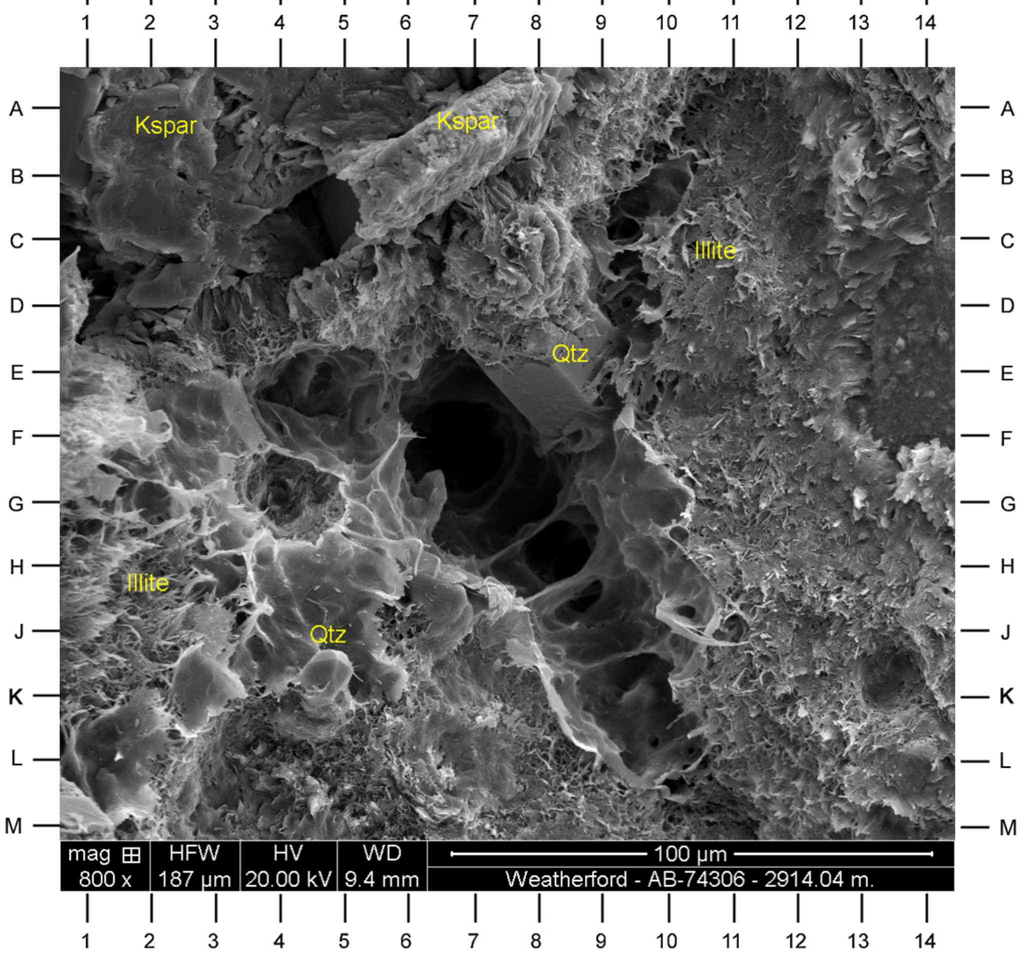
A



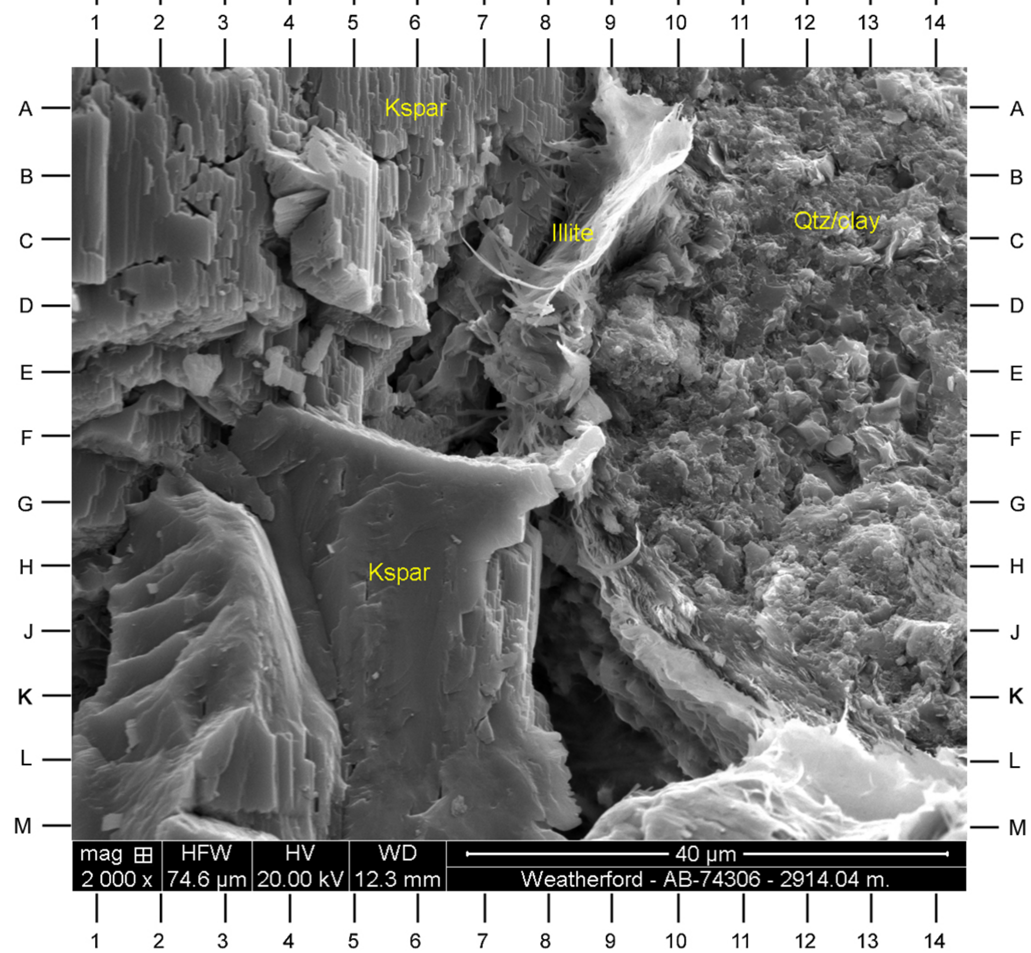

B




C




D



**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 2919.05 METERS**
**SAMPLE NUMBER: 2_26P-DS**

## PLATE 9

These photomicrographs illustrate a massive lithic arkose (based on thin section). Photo B is a high magnification view of the area centered near FG5 in Photo A, highlighting a primary intergranular pore (J8). Detrital grains consist predominantly of plagioclase (Photo B; C5/ Photo C, DE2, G4/ Photo D; F5) and potassium feldspar (Photo B; LM7, H13, DE14/ Photo C; B7, H13/ Photo D; L11) with minor amounts of quartz grains (Photo D; A3-AD14). Authigenic quartz (Photo B; H5.1, J6, JK5) and potassium feldspar (Photo B; G10) overgrowths slightly reduce the intergranular areas. Secondary dissolution pores (Photo C; DE2/ Photo D; EF11.5) are the dominant pore type, with lesser amounts of micropores associated with pore-filling/grain-coating illitic clays (Photo C; BC11-14, GH8-10, DE8.5/ Photo D; LM1-J8.5), and primary intergranular pores (Photo C; HJ8/ Photo C; E10.5/ Photo D; CD1). Secondary porosity occurs within partially altered feldspar grains (Photo C; DE2.5/ Photo D; EF10-14).

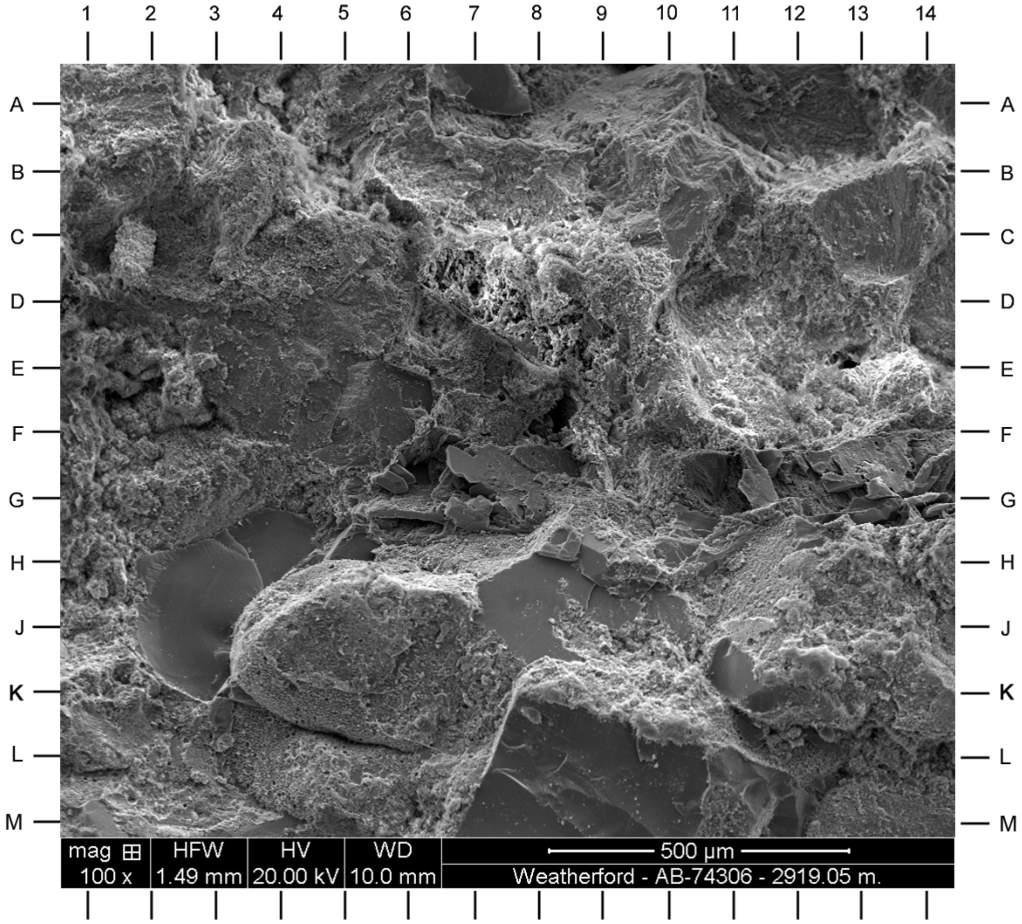
**Magnification:** A: 100X B: 500X C: 650X D: 1200X

**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

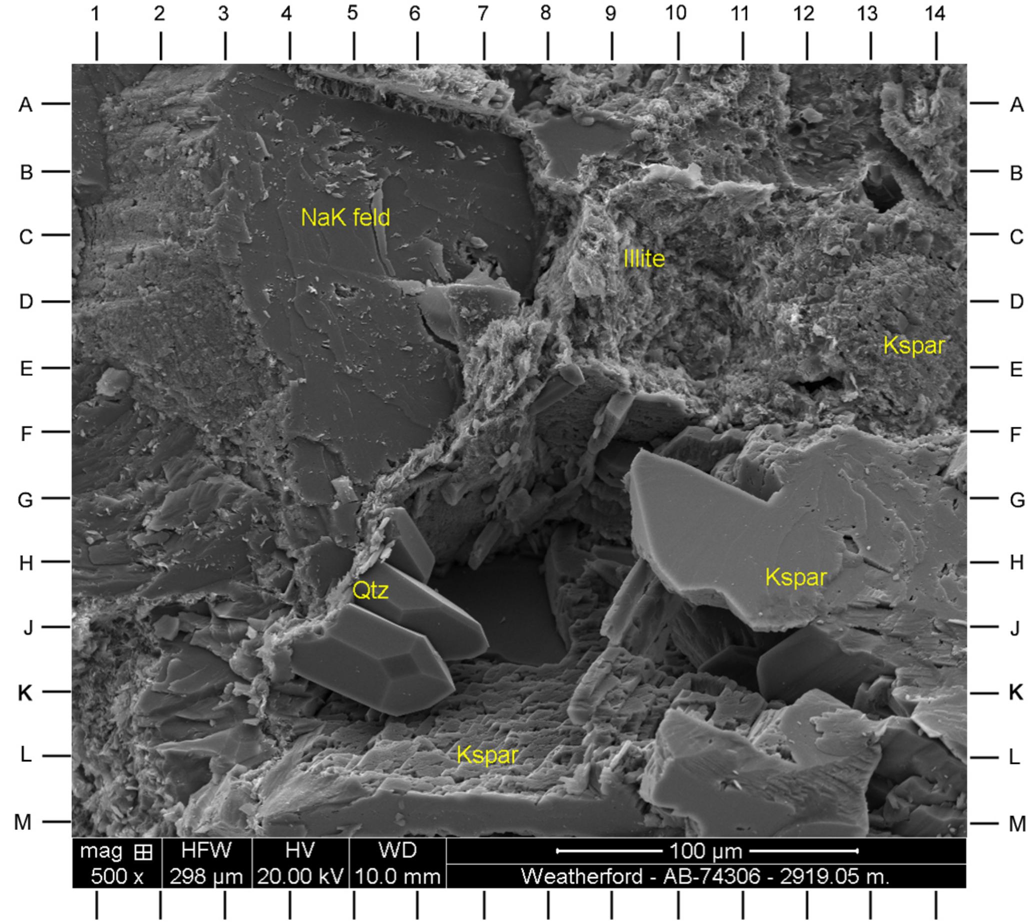
**2919.05m**
**Plate 9**

Weatherford LABORATORIES

A




B

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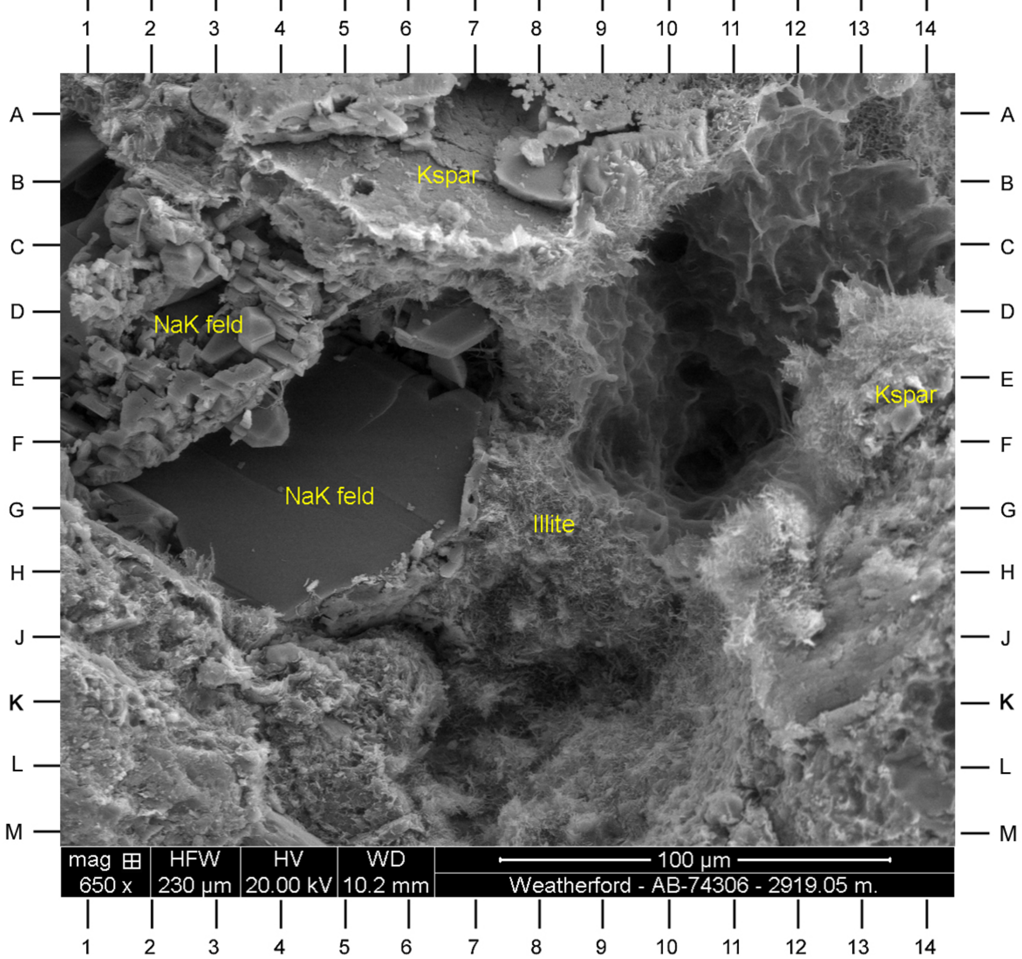
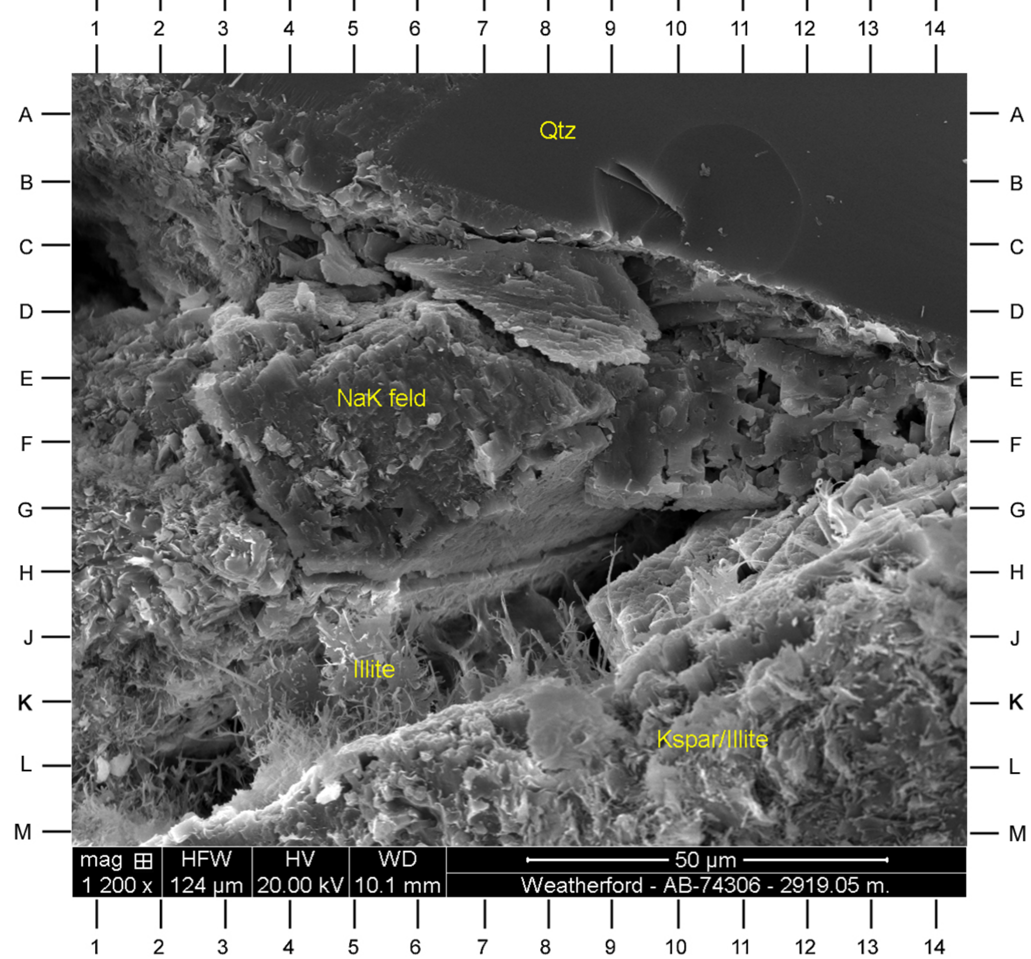



D



**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Conventional Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 2924.21 METERS**
**SAMPLE NUMBER: 2_32P-DS**

**PLATE 10**

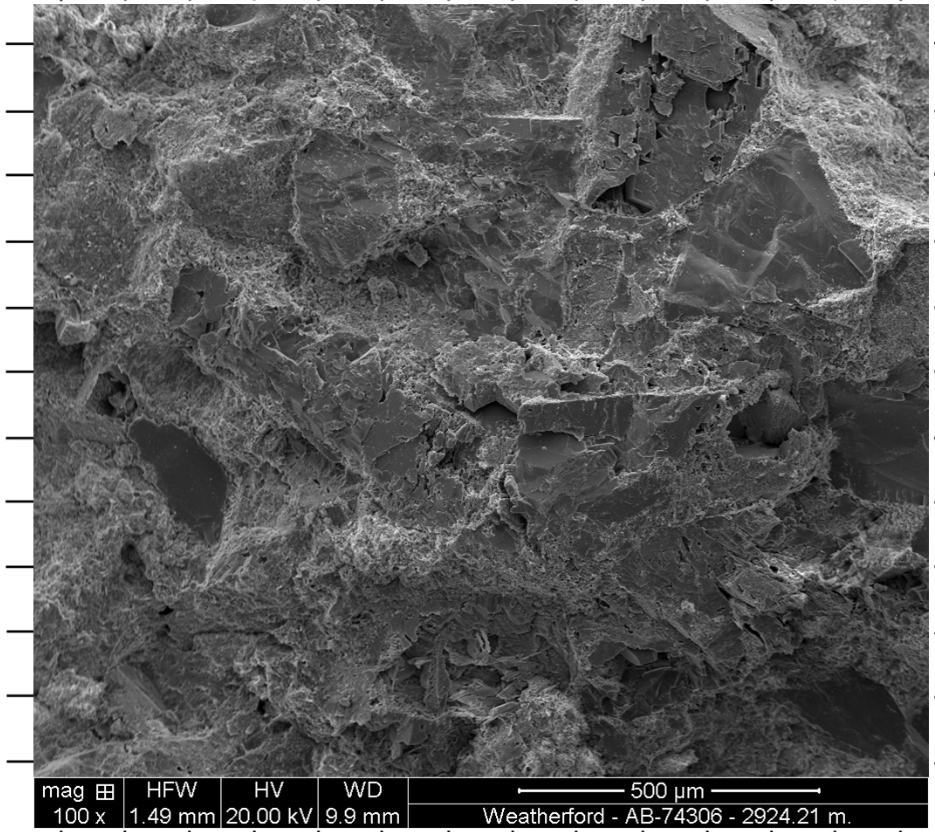
This massive, lithic arkose (based on thin section) is composed of abundant plagioclase (Photo B; DE11/ Photo D; K12) and potassium feldspar grains (Photo B; G2/ Photo C; DE4, K5.5/ Photo D; B4, D12.5). Photo B is a high magnification view of the area centered near FG7 in Photo A. Illite occurs as grain-coating material (Photo B; A11-14/ Photo C; D1.5, KM1-M7/ Photo D; E1-J7). Authigenic quartz crystals (Photo C; G2.5, G5, FG10, H11, K10, L12.5) and feldspar (Photo C; J4-M10/ Photo D; E8) overgrowth cement reduce intergranular pores. Calcite (Photo C; C5-10, F10-M14) occurs as probable replacement of less stable material. Secondary dissolution pores are associated with partially dissolved feldspar grains (Photo B; E4-K2/ Photo D; D1.5). Micropores are associated with the clays; however are considered ineffective to the overall porosity due to probable bound water. Primary intergranular pores are present in thin section but not visible in these images.

**Magnification:** A: 100X B: 400X C: 800X D: 1200X

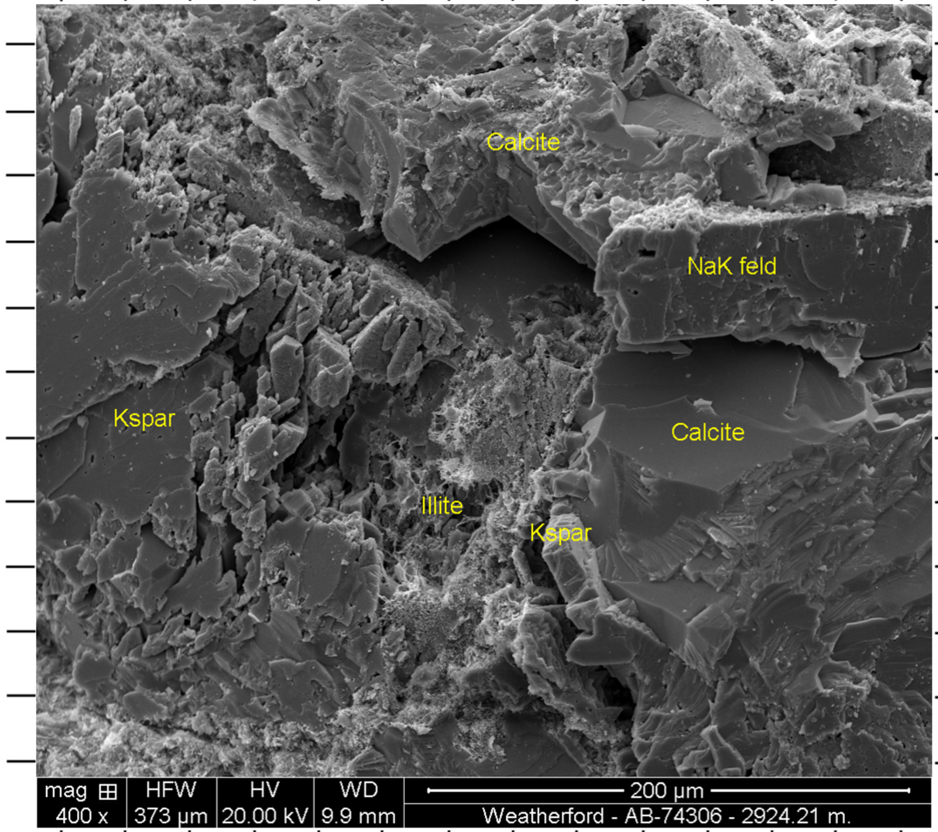
**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

**2924.21m**
**Plate 10**

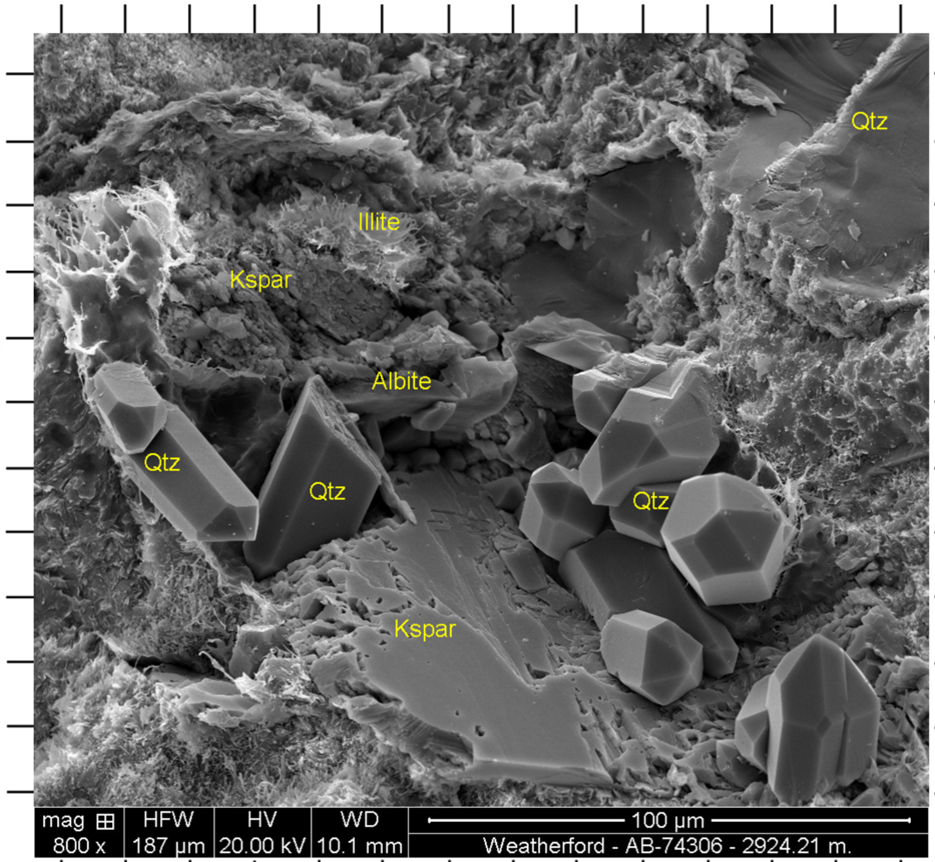
**A**



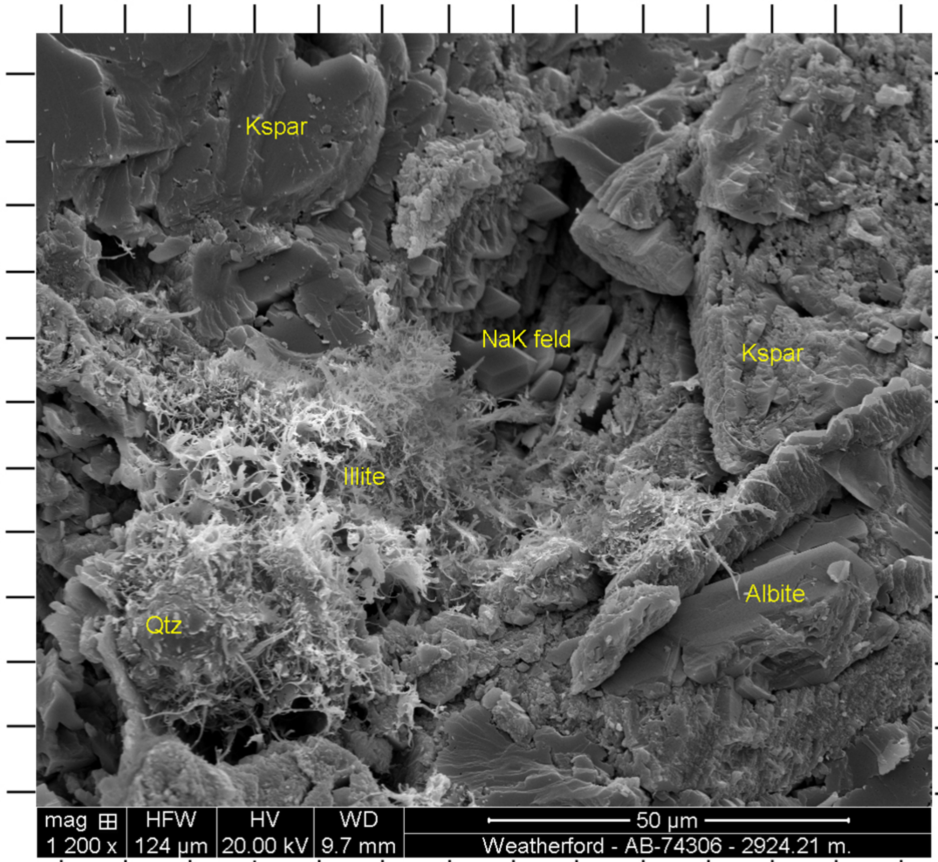

**B**




**C**




**D**



**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 3007.90 METERS**
**SAMPLE NUMBER: 23-SWC**

## PLATE 11

Photo A provides a general overview of this massive feldspathic litharenite (based on thin section). Detrital grains include albite (Photo B; B7, H7) and quartz (Photo B; L5/ Photo C; E10/ Photo D; A5-G14). Well-developed quartz overgrowths (Photo B; BC12, KL6/ Photo C; E1-12, J10, LM9.5/ Photo D; L1-J7) are common. Illite (Photo C; A6-14/ Photo D; A1-M14) and kaolinite booklets (Photo C; CD1, A2-14, E13-M14) occur as grain-coating material. Some kaolinite booklets are partially engulfed by a relatively large quartz overgrowth (Photo C; DE1.2, EF2.2, DE5.5, F7). Secondary intragranular pores associated with partially dissolved feldspar grains (Photo B; F3-H11) are the dominant pore type present. Micropores are associated with detrital clays are considered ineffective to the overall porosity.

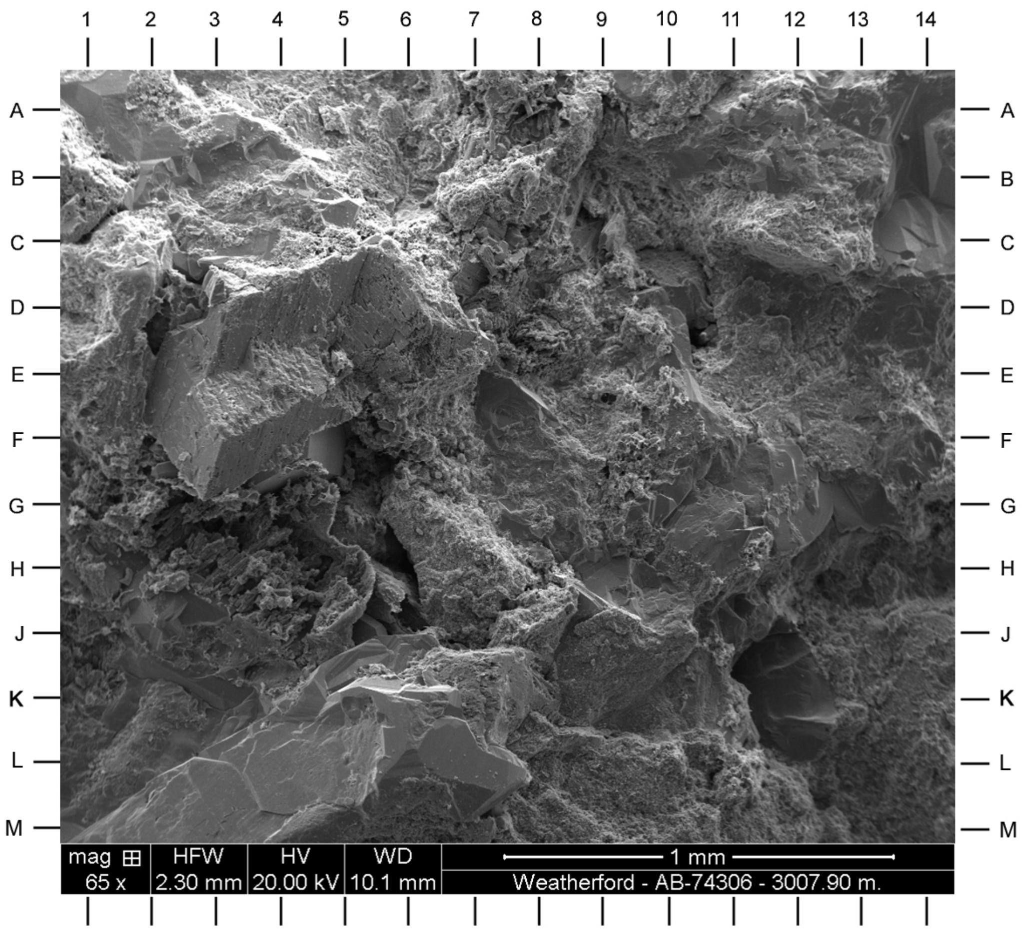
**Magnification:** A: 65X B: 200X C: 600X D: 1000X

**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

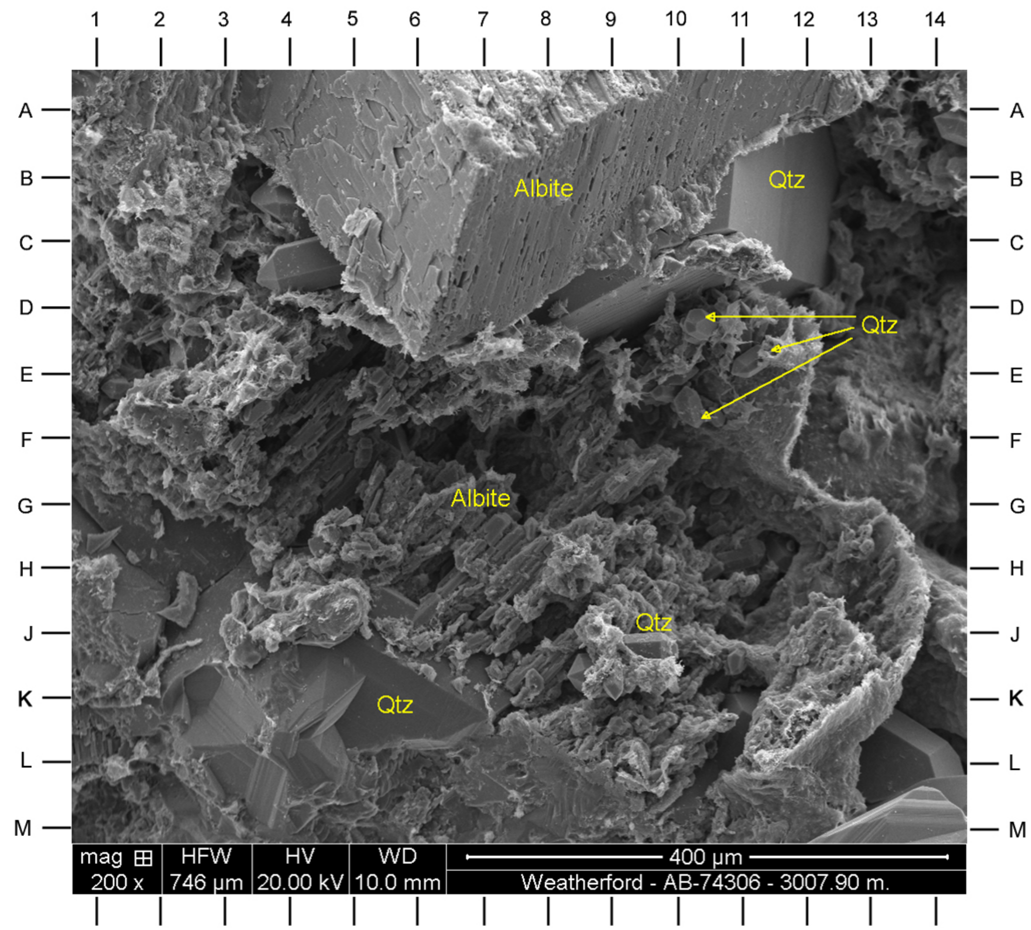
**3007.90m**
**Plate 11**

Weatherford LABORATORIES

A




B

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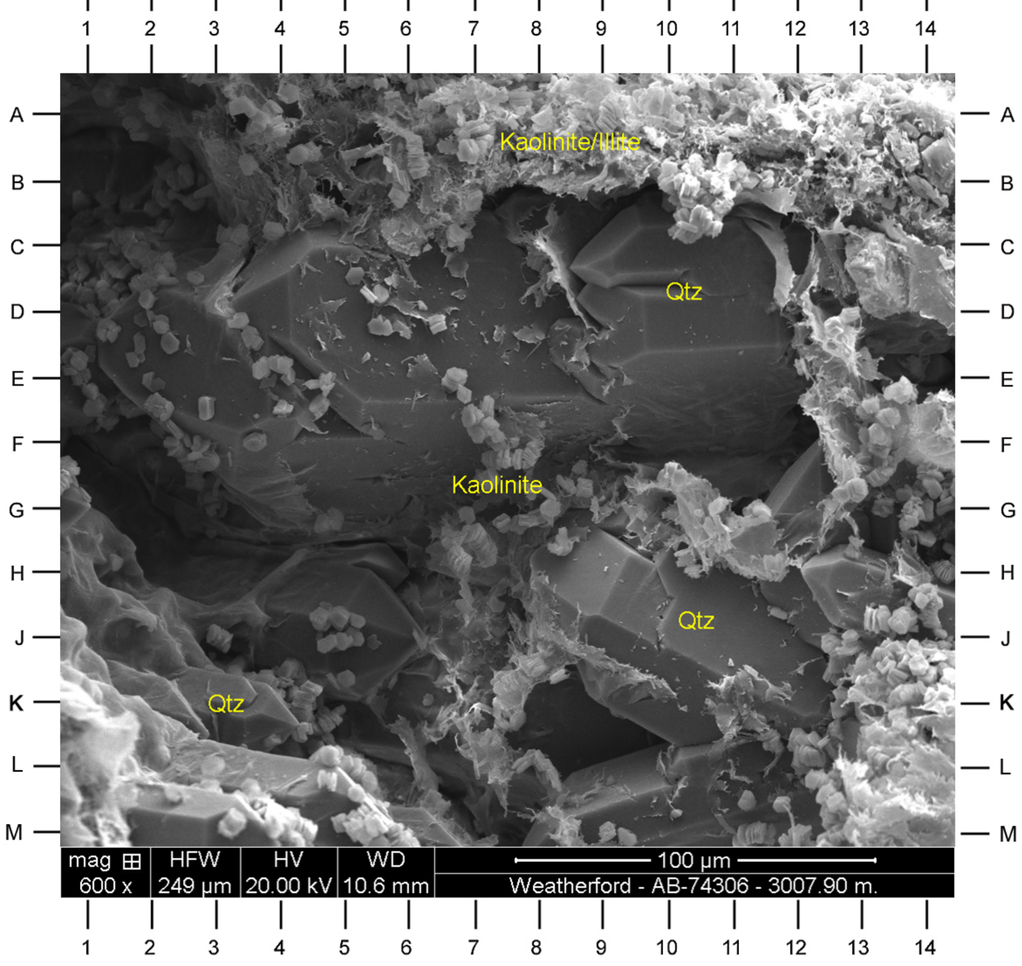
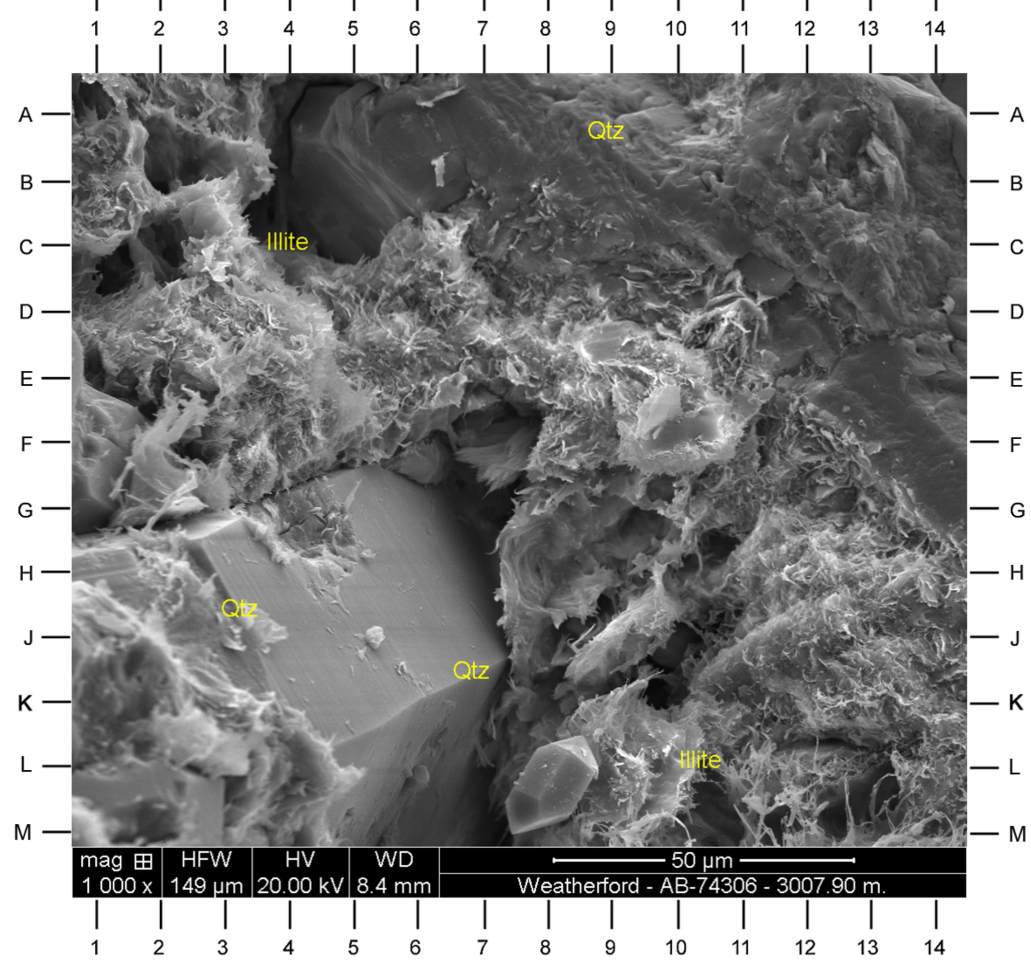



D



**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 3075.00 METERS**
**SAMPLE NUMBER: 11-SWC**

## PLATE 12

Photo A provides a general overview of this well consolidated litharenite (based on thin section). Photo B is a high magnification view of the area centered near FG7 in Photo A. Common detrital illitic clay occludes intergranular areas (Photo B; E1.5-F7.5, G9-13.5, AB4-14) and lightly coats detrital grains in localized areas (Photo D; CD11, HJ4-M12). Kaolinite booklets fill probable secondary pores (Photo C; A1-H10). Clusters of bladed chlorite also occur in Photo C (AB8-9, K6.5). Organic material was detected in Photo B using energy dispersive spectrometry (EDS) but is not distinguishable in the Photo. Illite intermixed with chlorite fill a possible intergranular pore (Photo D; H6-13). Interparticle micropores occur between clay particles; however, are considered to be ineffective to the overall porosity due to probable bound water.

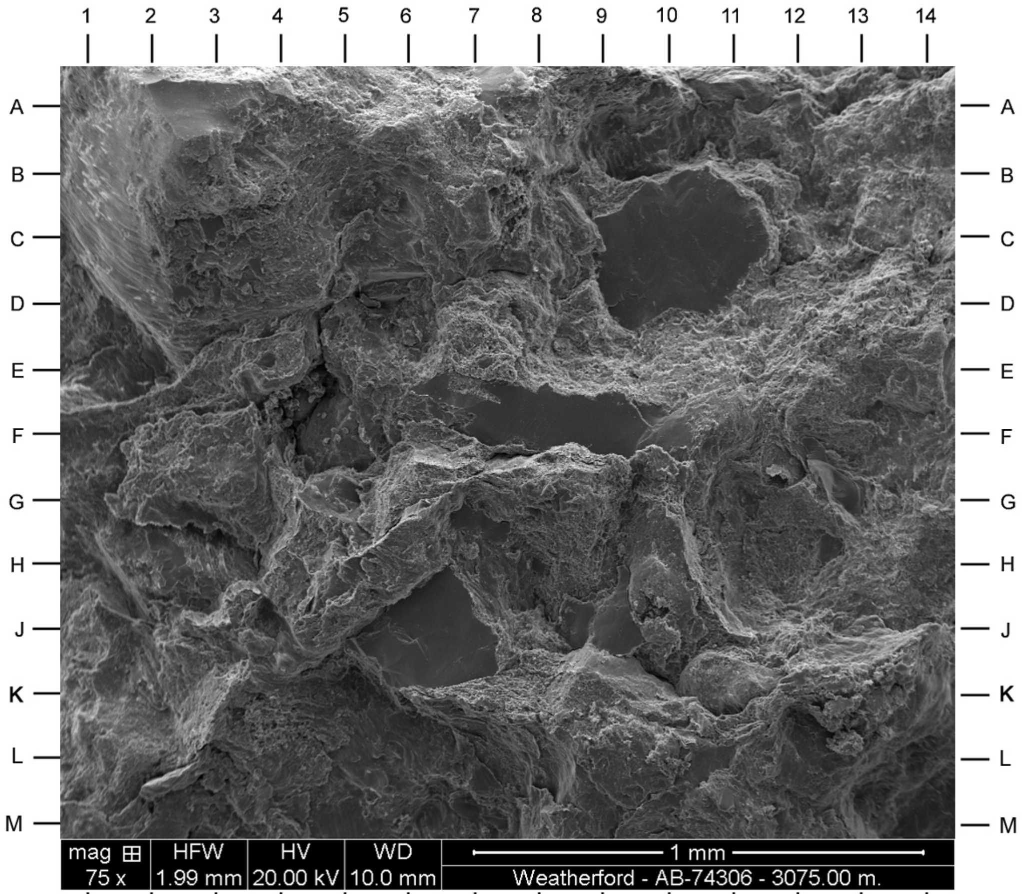
**Magnification:** A: 75X B: 300X C: 800X D: 1250X

**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

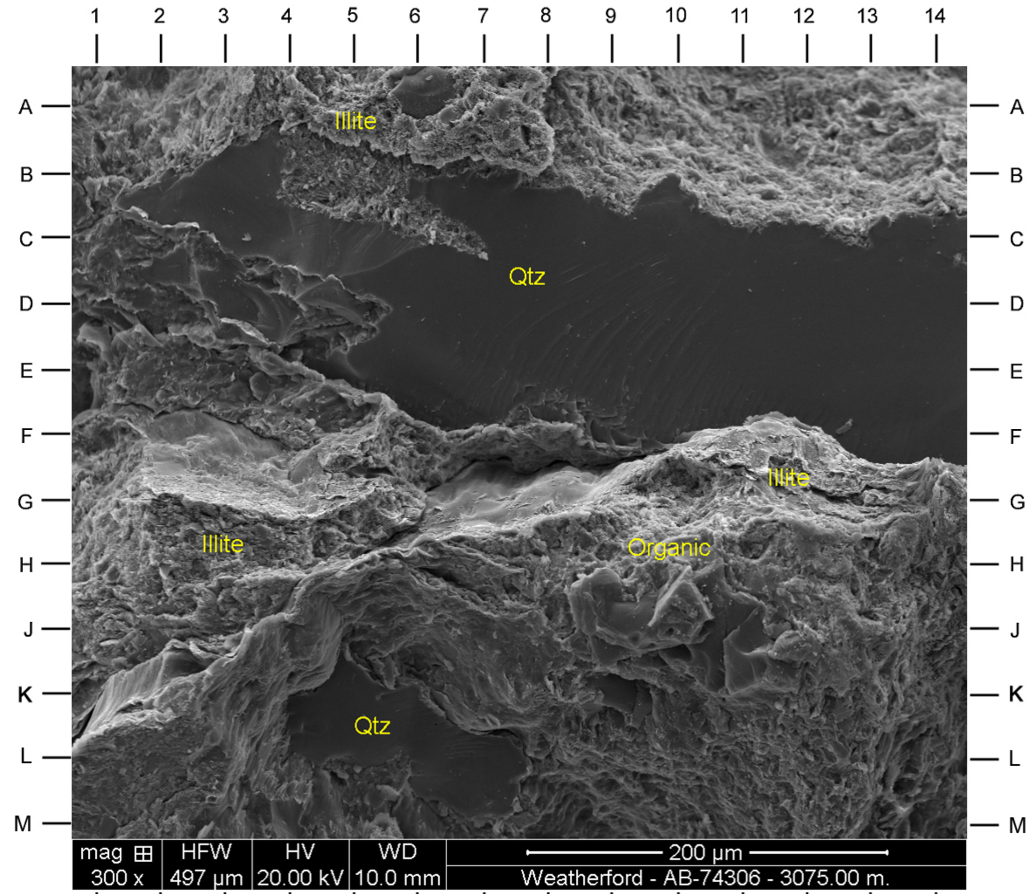
**3075.00m**
**Plate 12**

Weatherford LABORATORIES

A




B

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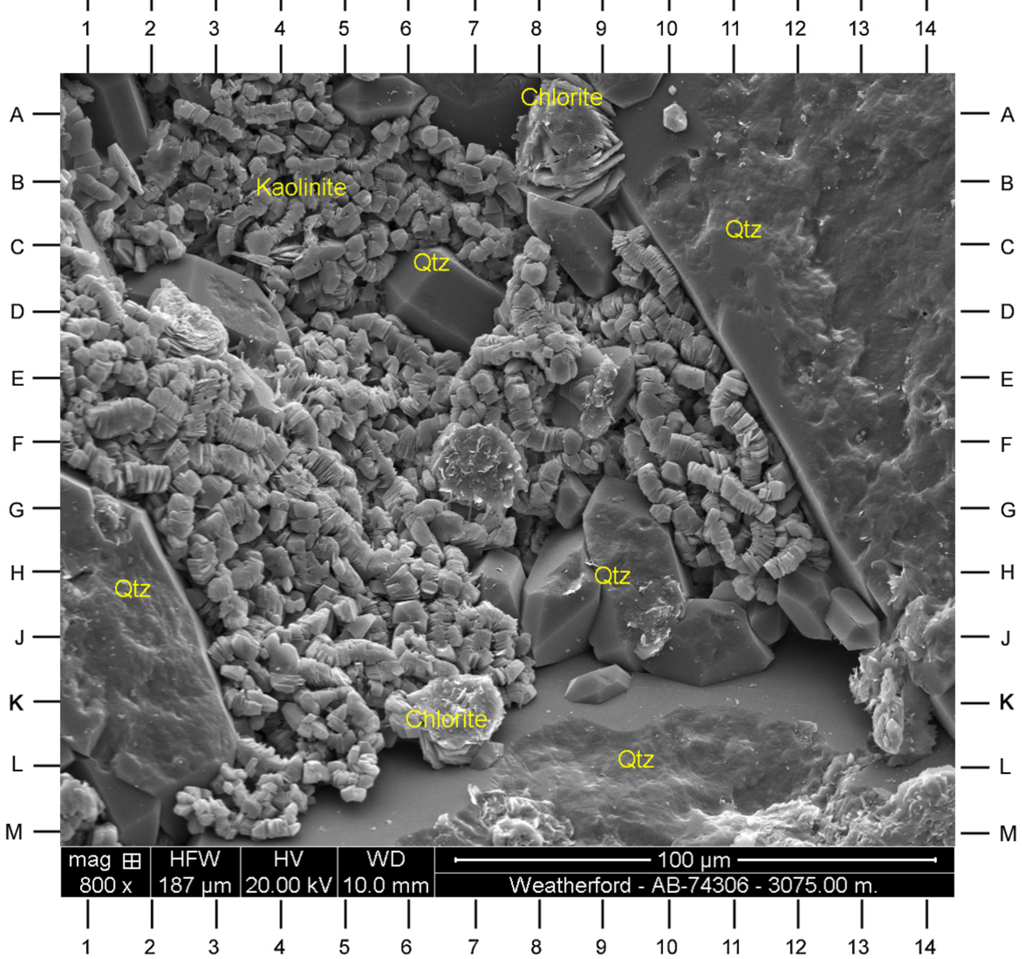


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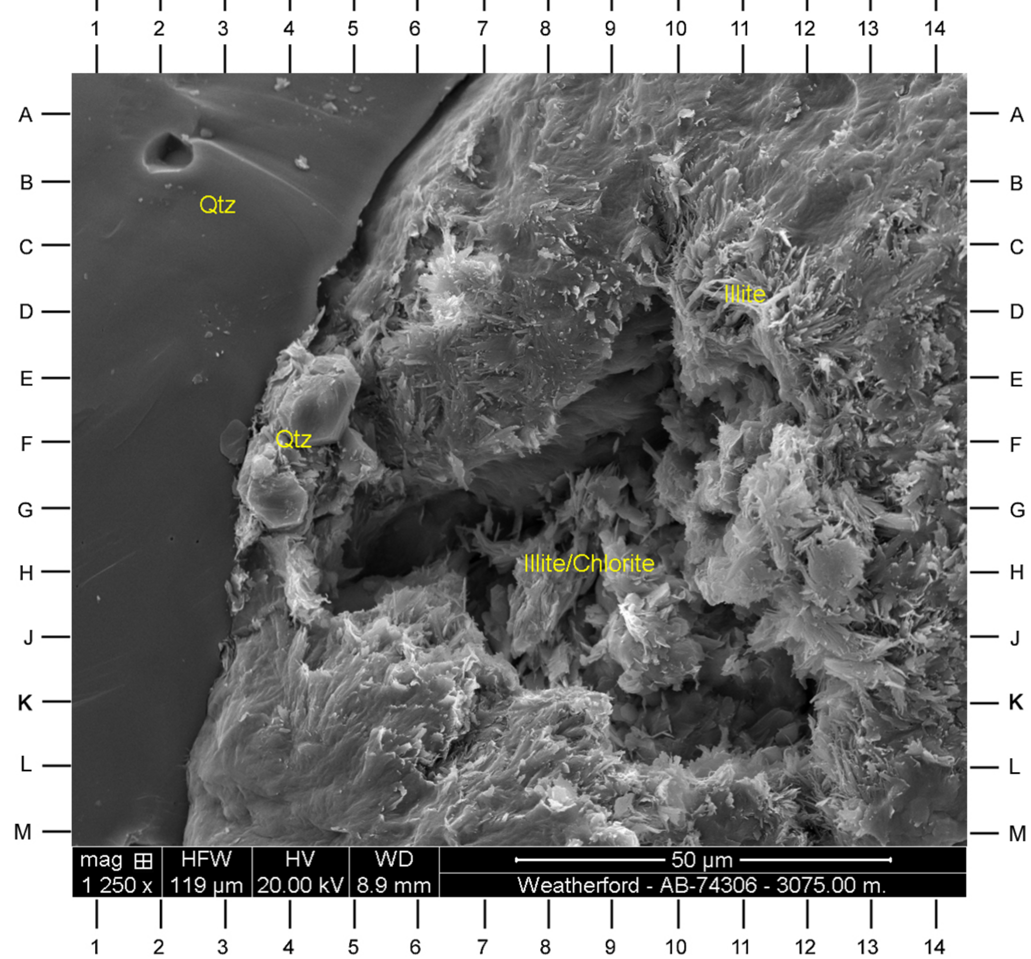


**QGC- A BG Group Business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**
**Rotary Sidewall Core**

**Weatherford Labs File No.: AB-74306**

**SAMPLE DEPTH: 3083.00 METERS**
**SAMPLE NUMBER: 8-SWC**

**PLATE 13**

Photo A provides a general overview of this highly compacted sublitharenite (based on thin section). Photo B is a high magnification view of the area centered near FG7.5 in Photo A. Authigenic quartz cement (Photo B; BC12, CD4, H4, K1-H13/ Photo C; LM10, FG11-14/ Photo D; DE11, KL4, J9-M14) fills intergranular areas. Siderite (Photo C; B1-M8) and calcite (Photo C; H11, K12) occur as possible replacement if susceptible material. Grain-coating and pore-filling illite is observed (Photo B; A6-J10/ Photo C; A1-9/ Photo D; A1-F5, C14, F8, GH4). Bladed chlorite is present (Photo D; E6.5). The remnants of a possible chlorite clay rim of a dissolved grain is observed (Photo C; B9-K14). Interparticle micropores associated with clay particles are the dominant pore type in these photomicrographs.

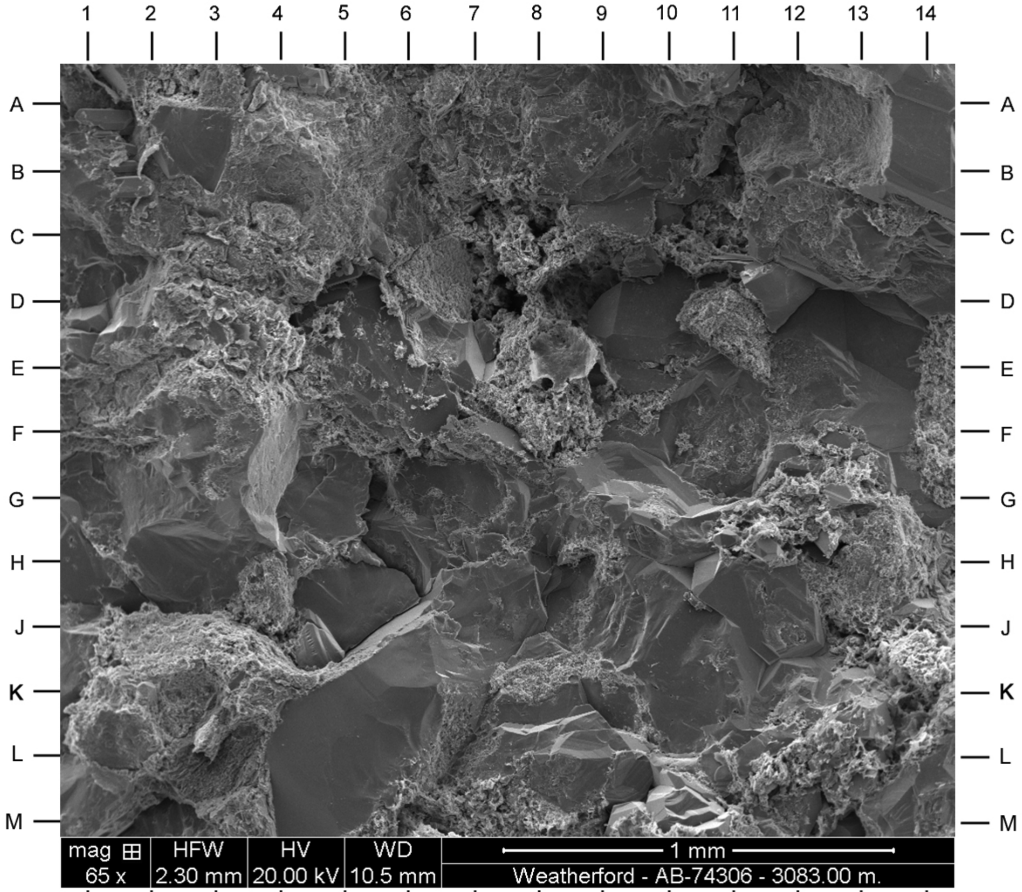
**Magnification:** A: 65X B: 250X C: 350X D: 1000X

**QGC - A BG Group business**
**Dunk-1**
**Surat Basin**
**Queensland, Australia**

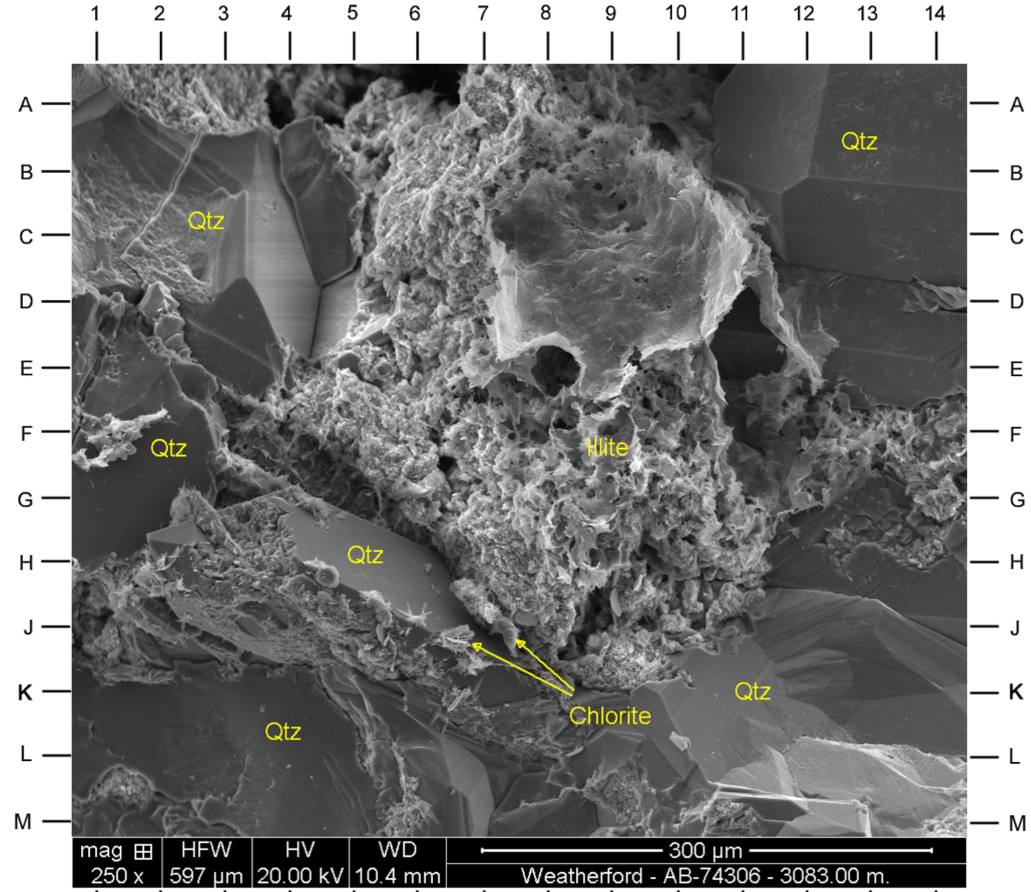
**3083.00m**
**Plate 13**

Weatherford LABORATORIES

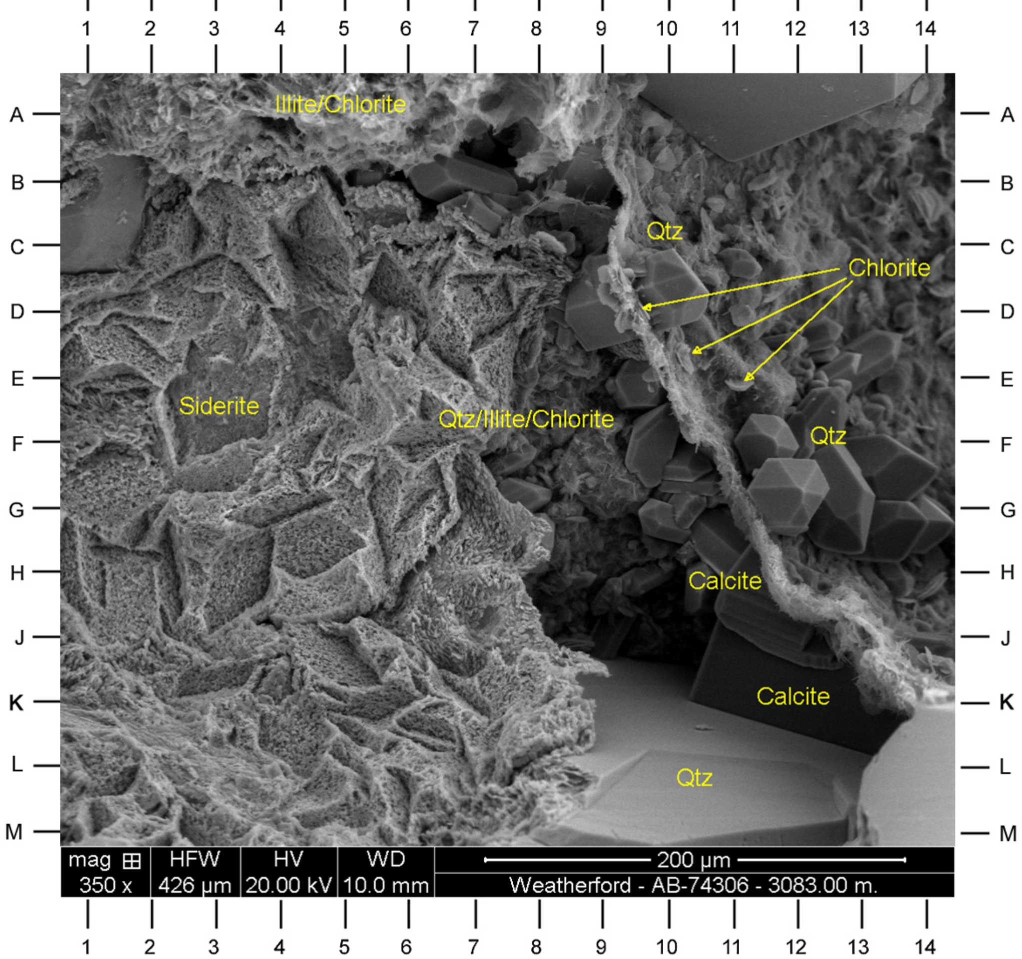
A



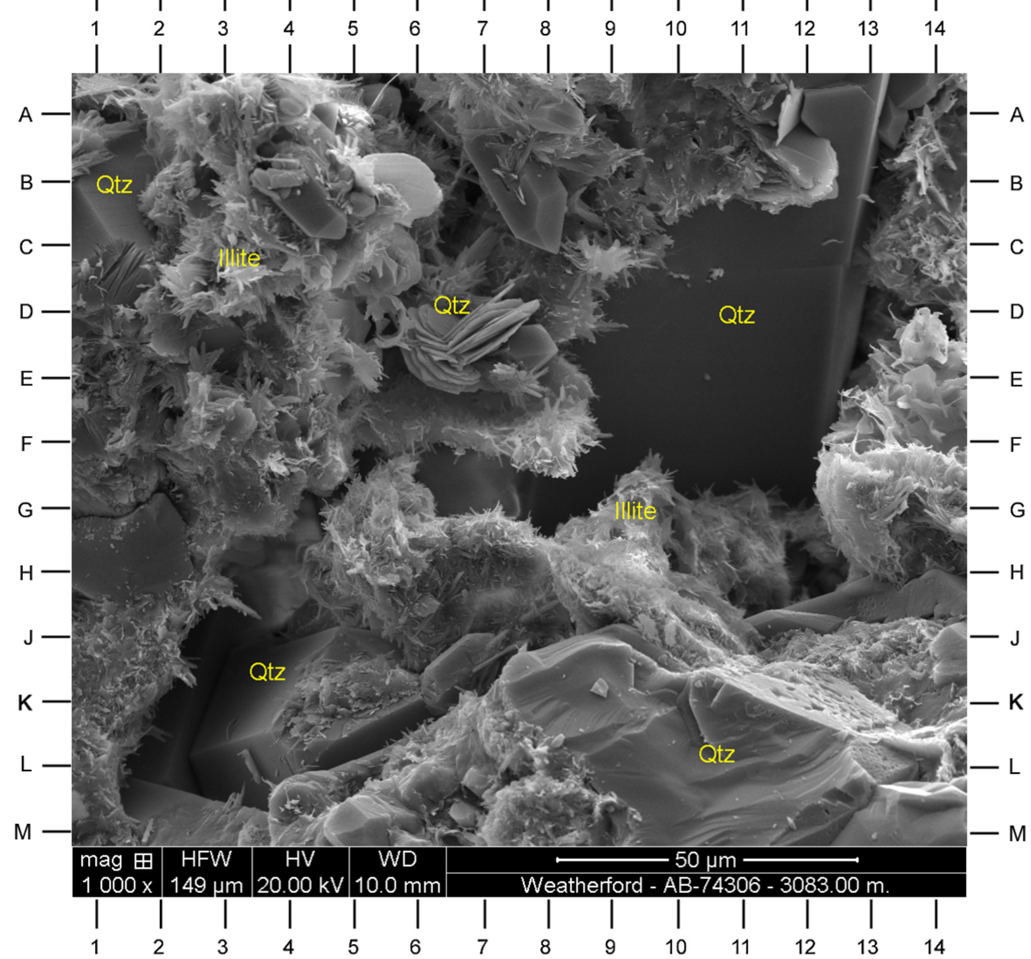

B




C




D



# APPENDIX E

# ROUTINE CORE ANALYSIS RESULTS

***OVERBURDEN CORE ANALYSIS PRELIMINARY REPORT***

**Client** : QGC - A BG Group Business
**Well** : Dunk-1

**Date** : 2/20/2015
**File** : AB-74306
**Cleaning Method** : Chloro-Meth
**Drying Method** : Oven Dry

| **Sample Number** | **Depth** *(metres)* | **Dir** | **Ambient Porosity** *(Percent)* | **OB 4000 Porosity** *(percent)* | **Grain Density** *($g/cm^3$)* | **Ambient Permeability** *(mD)* | **OB 4000 Permeability** *(mD)* | **Remarks** |
|---|---|---|---|---|---|---|---|---|
| 1_1P | 2870.05 | H | | | | | | failed |
| 1_2P | 2871.03 | H | | | | | | |
| 1_3P | 2872.08 | H | | | | | | |
| 1_4P | 2873.06 | H | | | | | | |
| 1_5P | 2874.04 | H | | | | | | |
| 1_6P | 2875.10 | H | | | | | | |
| 1_7P | 2876.05 | H | | | | | | |
| 1_8P | 2877.04 | H | 5.9 | | 2.70 | 0.0098 | | |
| 1_9P | 2877.85 | H | | | | | | N.P - not full metre section |
| 1_10P | 2878.05 | H | 3.3 | | 2.75 | 0.0040 | | |
| 1_11P | 2879.05 | H | | | | | | |
| 1_12P | 2880.06 | H | | | | | | |
| 1_13P | 2881.04 | H | | | | | | |
| 1_14P | 2882.05 | H | | | | | | |
| 1_15P | 2883.06 | H | | | | | | |
| 1_16P | 2884.06 | H | | | | | | |
| 1_17P | 2885.06 | H | | | | | | |
| 1_18P | 2886.11 | H | | | | | | |
| 1_19P | 2887.10 | H | 1.8 | | 2.71 | 0.017 | | irreg |
| 1_20P | 2888.12 | H | 5.0 | | 2.70 | 0.0063 | | |
| 1_21P | 2889.11 | H | | | | | | |
| 1_22P | 2890.10 | H | | | | | | |
| 1_23P | 2891.05 | H | | | | | | N.P - carb slt |
| 1_24P | 2892.05 | H | | | | | | N.P - carb slt |
| 1_25P | 2893.17 | H | | | | | | failed |
| 1_26P | 2894.04 | H | | | | | | |
| 1_27P | 2895.09 | H | 5.9 | | 2.67 | 0.020 | | lam |
| 1_28P | 2896.07 | H | 10.6 | | 2.65 | 0.023 | | |
| 1_29P | 2896.60 | H | | | | | | N.P - not full metre section |
| 2_1P | 2896.71 | H | | | | | | N.P - not full metre section |
| 2_2P | 2897.06 | H | 11.9 | 11.1 | 2.65 | 0.062 | 0.019 | |
| 2_3P | 2898.08 | H | 11.8 | | 2.65 | 0.061 | | |
| 2_4P | 2899.06 | H | 9.1 | | 2.65 | 0.070 | | |
| 2_5P | 2900.05 | H | 10.8 | | 2.65 | 0.033 | | |
| 2_6P | 2901.06 | H | 8.3 | 6.8 | 2.65 | 0.17 | 0.021 | carb strk |
| 2_7P | 2902.06 | H | 10.4 | | 2.65 | 0.088 | | |
| 2_8P | 2903.04 | H | 10.9 | | 2.65 | 0.031 | | |
| 2_9P | 2904.06 | H | 11.5 | | 2.65 | 0.027 | | |
| 2_10P | 2905.06 | H | 10.3 | | 2.66 | 0.047 | | |
| 2_11P | 2905.40 | H | | | | | | N.P - not full metre section |
| 2_12P | 2906.05 | H | 4.5 | 3.6 | 2.66 | 0.0047 | 0.0009 | |
| 2_13P | 2907.04 | H | 12.4 | 11.6 | 2.65 | 0.055 | 0.016 | |
| 2_14P | 2908.05 | H | 10.1 | | 2.65 | 0.051 | | |
| 2_15P | 2909.05 | H | 9.5 | | 2.66 | 0.10 | | lam |
| 2_16P | 2910.05 | H | 11.3 | 10.7 | 2.65 | 0.073 | 0.016 | lam |
| 2_17P | 2911.05 | H | 12.8 | | 2.65 | 0.090 | | |
| 2_18P | 2912.04 | H | 10.1 | | 2.65 | 0.085 | | |
| 2_19P | 2913.05 | H | 11.2 | | 2.65 | 0.11 | | |
| 2_20P | 2914.04 | H | 13.1 | 12.5 | 2.65 | 0.11 | 0.024 | |
| 2_21P | 2914.55 | H | | | | | | N.P - not full metre section |
| 2_22P | 2915.04 | H | 12.9 | | 2.64 | 0.15 | | |
| 2_23P | 2916.04 | H | 10.8 | 9.9 | 2.65 | 0.044 | 0.011 | |
| 2_24P | 2917.04 | H | 8.9 | | 2.65 | 0.019 | | |
| 2_25P | 2918.04 | H | 11.2 | | 2.65 | 0.044 | | |
| 2_26P | 2919.05 | H | 11.8 | 10.8 | 2.65 | 0.040 | 0.015 | |
| 2_27P | 2920.05 | H | 10.7 | | 2.65 | 0.092 | | |
| 2_28P | 2921.05 | H | 9.6 | | 2.65 | 0.041 | | |
| 2_29P | 2922.04 | H | 11.4 | 10.8 | 2.65 | 0.13 | 0.017 | |
| 2_30P | 2923.06 | H | 9.8 | | 2.65 | 0.030 | | |
| 2_31P | 2923.30 | H | | | | | | N.P - not full metre section |
| 2_32P | 2924.21 | H | 10.9 | 10.3 | 2.64 | 0.051 | 0.014 | |

| | |
|---|---|
| N.P | no plug |
| irreg | irreg |
| carb | carbonaceous |
| strk | streak |
| slt | silt |
| lam | lamination |

***OVERBURDEN CORE ANALYSIS PRELIMINARY REPORT***

**Client** : QGC - A BG Group Business
**Well** : Dunk-1 (SWC)

**Date** : 2/20/2015
**File** : AB-74306
**Cleaning Method** : Chloro-Meth
**Drying Method** : Humidity Dry

| Sample Number | Depth *(metres)* | Dir | Ambient Porosity *(Percent)* | OB 3500 Porosity *(percent)* | OB 4600 Porosity *(percent)* | Grain Density *($g/cm^3$)* | Ambient Permeability *(mD)* | OB 3500 Permeability *(mD)* | OB 4600 Permeability *(mD)* | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3133.75 | SWC | 4.9 | | | 2.73 | 0.0059 | | | |
| 2 | 3126.00 | SWC | 2.3 | | | 2.80 | | | | irreg, S.P |
| 3 | 3120.00 | SWC | 4.8 | | | 2.58 | 0.098 | | | |
| 4 | 3116.00 | SWC | 3.6 | | | 2.67 | 0.0058 | | | |
| 5 | 3112.78 | SWC | 1.3 | | | 2.76 | 0.0011 | | | |
| 6 | 3093.00 | SWC | 1.4 | | | 2.71 | 0.028 | | | irreg |
| 7 | 3085.33 | SWC | 4.4 | | | 2.66 | 0.24 | | | irreg, congl |
| 8 | 3083.00 | SWC | 11.4 | 10.4 | 10.3 | 2.67 | 0.28 | 0.095 | 0.069 | |
| 9 | 3081.43 | SWC | 18.4 | | | 2.70 | | | | irreg, S.P |
| 10 | 3076.47 | SWC | 8.2 | | | 2.66 | 0.15 | | | S.P |
| 11 | 3075.00 | SWC | 5.0 | 4.4 | 4.3 | 2.68 | 0.045 | 0.0052 | 0.0022 | |
| 12 | 3061.00 | SWC | 4.0 | 3.5 | 3.4 | 2.68 | 0.020 | 0.0021 | 0.0013 | |
| 13 | 3046.48 | SWC | 0.6 | | | 2.67 | 0.0012 | | | |
| 14 | 3043.10 | SWC | 0.9 | | | 2.64 | 0.016 | | | irreg |
| 15 | 3037.50 | SWC | | | | | | | | no sample recovered |
| 16 | 3025.00 | SWC | 2.2 | | | 2.65 | 0.0018 | | | irreg |
| 17 | 3021.58 | SWC | 2.0 | | | 2.60 | 0.0017 | | | |
| 18 | 3008.72 | SWC | | | | | | | | no sample recovered |
| 19 | 3007.76 | SWC | | | | | | | | no sample recovered |
| 20 | 3006.58 | SWC | | | | | | | | no sample recovered |
| 21 | 3005.00 | SWC | 15.0 | | | 2.66 | | | | irreg, S.P |
| 22 | 3008.80 | SWC | 10.5 | 9.2 | 9.1 | 2.65 | 0.33 | 0.052 | 0.039 | |
| 23 | 3007.90 | SWC | 11.9 | 10.4 | 10.2 | 2.66 | 0.29 | 0.057 | 0.048 | irreg |
| 24 | 3006.80 | SWC | 12.6 | 10.9 | 10.7 | 2.67 | 0.49 | 0.068 | 0.054 | irreg |
| 25 | 3005.20 | SWC | | | | | | | | rubble, insufficient sample |
| 26 | 3002.30 | SWC | | | | | | | | no sample recovered |
| 27 | 2992.40 | SWC | 3.4 | | | 2.68 | 0.0036 | | | |
| 28 | 2975.90 | SWC | 2.2 | | | 2.67 | 0.011 | | | |
| 29 | 2970.90 | SWC | 4.8 | | | 2.67 | 0.0096 | | | |
| 30 | 2967.80 | SWC | 6.5 | | | 2.67 | 0.058 | | | |
| 31 | 2934.95 | SWC | 8.7 | 8.4 | 8.4 | 2.63 | 0.018 | 0.0044 | 0.0035 | |
| 32 | 2931.50 | SWC | 11.0 | 10.2 | 10.2 | 2.63 | 0.069 | 0.016 | 0.014 | |
| 33 | 2920.70 | SWC | 11.7 | 11.1 | 11.1 | 2.63 | 0.038 | 0.015 | 0.0100 | |
| 34 | 2912.30 | SWC | 9.0 | 8.3 | 8.3 | 2.64 | 0.023 | 0.0052 | 0.0048 | |
| 35 | 2882.50 | SWC | 2.7 | | | 2.73 | 0.0040 | | | |
| 36 | 2882.00 | SWC | 5.1 | | | 2.73 | 0.0036 | | | |
| 37 | 2868.00 | SWC | | | | | | | | no sample recovered |
| 38 | 2864.30 | SWC | 1.6 | 1.5 | 1.5 | 2.71 | 0.0005 | 0.0002 | 0.0002 | |
| 39 | 2858.00 | SWC | | | | | | | | no sample recovered |
| 40 | 2848.00 | SWC | 3.3 | | | 2.63 | 0.055 | | | frac?, dual lith, lam |
| 41 | 2818.49 | SWC | 4.8 | 4.6 | 4.6 | 2.52 | 0.0010 | 0.0005 | 0.0004 | |
| 42 | 2816.57 | SWC | | | | | | | | no sample recovered |
| 43 | 2813.00 | SWC | 8.7 | 8.5 | 8.5 | 2.61 | 0.0047 | 0.0036 | 0.0035 | irreg |
| 44 | 2810.00 | SWC | | | | | | | | no sample recovered |
| 45 | 2796.11 | SWC | | | | | | | | no sample recovered |
| 46 | 2779.00 | SWC | | | | | | | | no sample recovered |
| 47 | 2790.07 | SWC | | | | | | | | no sample recovered |
| 48 | 2731.91 | SWC | | | | | | | | no sample recovered |
| 49 | 2719.45 | SWC | | | | | | | | no sample recovered |
| 50 | 2691.00 | SWC | | | | | | | | no sample recovered |
| 51 | 2669.12 | SWC | 5.6 | | | 2.68 | 0.0045 | | | |
| 52 | 2650.50 | SWC | | | | | | | | no sample recovered |
| 53 | 2582.99 | SWC | | | | | | | | no sample recovered |
| 54 | 2520.97 | SWC | | | | | | | | no sample recovered |
| 55 | 2384.85 | SWC | 12.2 | | | 2.66 | 169 | | | irreg |

| | |
|---|---|
| irreg | irregular |
| S.P | short plug (length < diameter) |
| congl | conglomerate |
| frac | fracture |
| dual lith | dual lithology |
| lam | lamination |

## *CORE ANALYSIS PRELIMINARY REPORT*

**Client** : QGC - A BG Group Business
**Well** : Dunk-1

**Date** : 2/20/2015
**File** : AB-74306
**Cleaning Method** : Chloro-meth
**Drying Method** : Humidity Dry

| Sample Number | Depth (m) | Dir | Porosity Helium (percent) | Grain Density ($g/cm^3$) | Permeability to Air (mD) | Remarks |
|---|---|---|---|---|---|---|
| 1 | 2870.55 | H | 3.4 | 2.70 | 0.174 | calc shl rem |
| 2 | 2871.51 | H | 2.0 | 2.70 | | irreg, calc shl rem |
| 3 | 2872.50 | H | 3.5 | 2.65 | | calc shl rem, frac |
| 4 | 2873.50 | H | 1.5 | 2.68 | 0.0019 | irreg, calc shl rem |
| 5 | 2874.50 | H | 3.0 | 2.66 | 0.086 | calc shl rem |
| 6 | 2876.51 | H | 3.4 | 2.68 | 0.0060 | |
| 7 | 2877.50 | H | 3.9 | 2.66 | 0.0044 | |
| 8 | 2878.50 | H | 2.2 | 2.69 | 0.0032 | |
| 9 | 2880.71 | H | 5.1 | 2.68 | 0.050 | lam |
| 10 | 2881.51 | H | 5.6 | 2.65 | 0.010 | |
| 11 | 2884.68 | H | 5.0 | 2.69 | 0.0063 | lam |
| 12 | 2885.60 | H | 4.4 | 2.69 | 0.0048 | |
| 13 | 2886.91 | H | 1.2 | 2.70 | 0.026 | irreg, calc shl rem |
| 14 | 2888.54 | H | 4.8 | 2.66 | 0.0030 | |
| 15 | 2889.39 | H | 4.0 | 2.71 | 0.0043 | |
| 16 | 2890.54 | H | 5.0 | 2.75 | 0.0082 | |
| 17 | 2894.49 | H | 2.7 | 2.58 | | frac, irreg |
| 18 | 2895.50 | H | 6.8 | 2.65 | 0.014 | |
| 19 | 2896.30 | H | 8.9 | 2.66 | 0.046 | lam |
| 20 | 2897.40 | H | 9.9 | 2.64 | 0.064 | |
| 21 | 2898.51 | H | 10.4 | 2.63 | 0.032 | |
| 22 | 2899.50 | H | 8.6 | 2.63 | 0.018 | |
| 23 | 2900.49 | H | 9.0 | 2.63 | 0.073 | |
| 24 | 2901.50 | H | 10.8 | 2.63 | 0.034 | |
| 25 | 2902.49 | H | 10.7 | 2.64 | 0.028 | |
| 26 | 2903.47 | H | 9.4 | 2.64 | 0.064 | |
| 27 | 2904.50 | H | 9.2 | 2.63 | 0.028 | |
| 28 | 2905.56 | H | 11.6 | 2.63 | 0.031 | |
| 29 | 2906.50 | H | 9.6 | 2.64 | 0.022 | |
| 30 | 2907.50 | H | 11.9 | 2.63 | 0.043 | |
| 31 | 2908.50 | H | 7.3 | 2.64 | 0.047 | |
| 32 | 2909.49 | H | 7.9 | 2.64 | 0.066 | |
| 33 | 2910.44 | H | 9.1 | 2.64 | 0.045 | |
| 34 | 2911.45 | H | 9.9 | 2.64 | 0.113 | |
| 35 | 2912.50 | H | 5.7 | 2.64 | 0.024 | |
| 36 | 2913.20 | H | 10.4 | 2.64 | 0.051 | |
| 37 | 2914.30 | H | 10.9 | 2.63 | 0.051 | |
| 38 | 2915.50 | H | 12.9 | 2.63 | 0.062 | |
| 39 | 2916.51 | H | 11.8 | 2.63 | 0.056 | |
| 40 | 2917.50 | H | 10.2 | 2.63 | 0.050 | |
| 41 | 2918.51 | H | 13.2 | 2.63 | 0.040 | |
| 42 | 2919.51 | H | 9.7 | 2.64 | 0.070 | |
| 43 | 2920.20 | H | 10.3 | 2.63 | 0.033 | |

| Sample Number | Depth (m) | Dir | Porosity Helium (percent) | Grain Density ($g/cm^3$) | Permeability to Air (mD) | Remarks |
|---|---|---|---|---|---|---|
| 44 | 2921.51 | H | 6.2 | 2.63 | 0.064 | lam |
| 45 | 2922.50 | H | 11.8 | 2.63 | 0.037 | |
| 46 | 2923.51 | H | 10.7 | 2.64 | 0.052 | |
| V1 | 2881.95 | V | | | | Analysis ongoing |
| V2 | 2890.74 | V | | | | Analysis ongoing |
| V3 | 2900.55 | V | | | | Analysis ongoing |
| V4 | 2910.50 | V | | | | Analysis ongoing |
| V5 | 2921.12 | V | | | | Analysis ongoing |

| | |
|---|---|
| cal shl rem | |
| N.P | no plug |
| irreg | irreg |
| carb | carbonaceous |
| strk | streak |
| slt | silt |
| lam | lamination |