DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

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PETROGRAPHY OF SPECIMENS FROM DDH OPB12

GEOLOGICAL SURVEY

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PETROGRAPHY OF SPECIMENS FROM DIAMOND DRILL HOLE OBD 12 AT OBSERVATORY HILL

ABSTRACT

Diamond drillhole OBD 12 was designed to define the Cambrian sequence at Observatory Hill. Lithologies observed in thin section include siltstone, sandstone, paraconglomerate and, from 473 m, basement gneiss. Matrices include clay, dolomite, limonite and authigenic silica. Grains vary in shape from well rounded to highly angular.

PETROGRAPHY

Specimen 5338 RS 55, 46.0 - 46.05 m, TS C46454

Rock name. Dolomitic siltstone.

Hand specimen

The rock consists of alternating, irregular bands of a pinkish brown, sandy lithology and wispy, branching, discontinuous bands of a finer green sediment.

Thin section

Dolomite is the most abundant mineral in both the coarser grained bands and the finer grained bands and patches. The dolomite tends to be of the same grain size as the silicate material.

In the silicate fraction the most abundant mineral constituent is microcline , with quartz and plagioclase as minor constituents. Fresh flakes of muscovite are scattered throughout the rock. Biotite is more common in the finer grained bands and has been strongly altered to chlorite, which is more abundant than the biotite itself.

Opaque material, probably limonite, occurs as individual grains and as irregular, intergranular bands.

The silicate grains are highly angular and often form thin, elongated strips. The micas and chlorite occur as long, thin flakes. Dolomite surrounds the silicate grains and consists of closely intergrown crystals of a shape determined by surrounding grains.

Specimen 5338 RS 56, 68.10 m, TS C 46455.
Rock name. Banded dolomitic siltstone.
Hand specimen

The specimen consists of regular bands of relatively coarse grained, rusty brown, sandy sediment, pink bands of intermediate grain size and fine bands of greenish grey material.

Thin section

In the bands of coarsest grain size the amount of interstitial dolomite is small. The rock is highly porous and somewhat friable due to the almost total absence of matrix. Angular fragments of microcline, quartz, plagioclase and sericitised feldspar are either in contact with each other at a few points or are unsupported in the plane of section. Muscovite and biotite flakes are common. Opaque black and brown amorphous material lines cavity walls and in places fills the interstitial cavities.

In bands of intermediate grain size, dolomite is abundant and surrounds angular grains of quartz and feldspar and flakes of biotite and occasional muscovite.

The continuous matrix of dolomite extends into the finer grained part of the specimen. It is by far the most abundant constituent of this part of the rock and surrounds a few fine quartz and feldspar fragments and a slightly larger component of altered biotite flakes. The most abundant silicate phase is oriented flakes of chlorite pseudomorphously replacing biotite.

Specimen 5338 RS 57, 133.80 - 133.85 m, TS C 46456.
Rock name. Mature quartz sandstone of medium grain size.
Hand specimen

The specimen is an even grained sandstone with so little matrix that the epoxy resin used for impregnation is almost continuous. Bedding is very weak.

Thin section

The rock consists of well rounded and well sorted grains of dominantly quartzose compositions with no matrix. Porosity is so high that many grains are unsupported in the plane of section apart from suspension in the impregnating resin. The extremely weak bedding is produced by a slight preferential alignment of those grains which are effectively elongated. Most grains are close to equidimensional.

The most abundant framework composition is monocrystalline quartz. The majority of these grains extinguish sharply between crossed polarisers and are thus relatively unstrained. Lithic fragments of quartz rocks are abundant and vary from quartzites, mainly without an oriented fabric, to fine grained cherts. Some silica in the cherts is of colloidal origin. Microcline grains are not uncommon and a few plagioclase grains are present. The feldspars are very little altered. A few lithic fragments of argillaceous lithologies are present. Opaque grains are rare. A distinctive component consists of several grains of a pinkish brown garnet.

Specimen 5338 RS 58, 190.50 - 190.55 m, TS C 46457.

Rock name. Dolomitic diamictite.

Hand specimen

The rock is a poorly sorted sediment consisting of rounded to angular fragments of quartzose and dolomitic clasts. The larger clasts consist of fine grained dolomites. The matrix of fine, sandy and silty material is stained red brown. Clasts measure 2 cm or more.

Thin section

The most abundant constituents are finely crystalline dolomite and quartz clasts. The dolomite is present both as the major constituent of the larger lithic fragments and as the matrix of the whole sediment. The large fragments vary from massive and continuous finely crystalline dolomite to weakly bedded dolomitic siltstone. Some dolomite fragments contain patches of coarse grained recrystallisation and crenulated planes marked by limonite. Most of such fragments are angular to irregular but some are partially rounded.

The quartz clasts are mainly monocrystalline with few lithic quartzite fragments. The larger clasts are generally very well rounded although a few are embayed. The finer quartz grains are frequently sharply angular. Grain size in quartz ranges from 0.01 mm to 1 mm. Microcline clasts are common in the smaller size range and a few plagioclase grains are present. Tourmaline and zircon are rare accessories.

The matrix consists of finely crystalline dolomite but is heavily to lightly stained with limonite. A patchy porosity occurs in places where interstitial matrix is absent.

Specimen 5338 RS 59, 201.80 - 201.85 m, TS C 46458.

Rock name. Fine grained sandstone.

Hand specimen

The specimen has been impregnated with epoxy resin but is coherent enough to retain integrity without impregnation. It is somewhat friable. Green partings appear to be associated with a moderately well marked bedding and on one face of the specimen outline a cross bedded fabric.

Thin section

Bedding is more prominent in thin section than in hand specimen but is related to small variations in the proportions of framework and matrix. This results in the sediment being alternately framework and matrix supported. The sediment is well sorted in terms of the framework. Most grains are angular and in the framework supported parts of the rock the fabric is of closely packed grains with minimal matrix. Occasionally adjacent grains are linked by authigenic silica. Variation is rapid and produces a fine lamination superimposed on the coarser bedding.

Quartz is the main framework constituent but microcline is abundant. Lithic fragments, plagioclase and opaque grains are moderately abundant. Muscovite is common in the finer grained, matrix rich bands but also occurs as coarser grains. Chlorite is rare as a framework grain except in a few locallised areas. Zircon and tourmaline are accessory minerals.

The matrix consists mainly of clay minerals with moderate birefringence but contains fine flakes of muscovite.

Dolomite occurs in rare patches as a relatively coarse grained mass surrounding silicate grains.

Specimen 5338 RS 60, 214.80 - 214.85 m, TS C 46459.

Rock name. Quartz sandstone

Hand specimen

The rock is a medium to coarse grained, pale brown quartz sandstone with little matrix and very weak bedding. It is too friable to make a thin section without impregnation but has not broken up completely during drilling and cutting.

Thin section

The rock is almost entirely composed of quartz and quartzite fragments. Grain size sorting is moderately good. Most grains are between about 0.5 mm and 1.0 mm but the overall range is between 0.01 mm and 1.5 mm . The grains are well rounded or contain well rounded nuclei. The spheroidal shape is modified in places by pressure solution but more commmonly by the growth of mutually interfering rims of authigenic quartz. The latter process bands groups of grains together but is only sporadic and a great deal of void space remains.

The framework grains are dominantly siliceous with monocrystalline quartz somewhat more abundant than lithic fragments of quartzite, many of which contain a preferentially oriented mosaic. A few grains consist of silica of colloidal origin or, in a very few instances, of spherulitic devitrification, possibly of glassy origin. Rare grains are composed of monocrystalline microcline, often fractured but unaltered.

Where interstitial spaces are not voids, the spaces are filled by fine grained but well crystallised clay of moderate to high birefringence, often in masses with the majority of flakes in optical continuity.

Specimen 5338 RS 61, 287.00 - 287.15 m, TS C 46460.

Rock name. Quartz sandstone

Hand specimen

The rock is a highly porous and somewhat friable, medium to coarse grained sandstone with no detectable bedding on the scale of the specimen. Impregnation by epoxy resin has been necessary for sectioning and the total penetration of the rock is an indication of very high porosity.

Thin section

The sediment is composed almost exclusively of rounded to angular quartz. The majority of grains are subangular. Most quartz is monocrystalline but a few polycrystalline quartzites are represented and rare clasts of granular chert are present. Feldspathic clasts are apparently absent and the only other mineral present as framework clasts is tourmaline. The tourmaline consists of well rounded, fine grains of pleochroic brown mineral.

Matrix is very sparse. In a few places an interstitial clay of low birefringence fills pore spaces over a distance of less than a millimetre. Similarly scattered occurrences of interstitial dolomite are of about the same dimensions. Occasionally authigenic overgrowths on quartz grains have filled the space between adjacent grains. Two occurrences of interstitial material are of greater extent but only single examples of each are represented in the section. One of these consists of a black, opaque, possibly manganiferous material which extends interstitially over about 1.5 mm. The other is a 2 mm long, weakly translucent, brown, amorphous to poorly crystalline material spotted with fine, opaque granules. This is possibly a carbonate which was originally siderite.

Specimen 5338 RS 62, 449.40 - 449.50 m, TS C 46461

Rock name. Ferruginous sandstone

Hand specimen

The rock is a fine grained, friable, dark red sandstone with scattered coarse grains and a fabric oriented at a high angle to the length of the core. This may be a weak bedding.

Thin section

The sandstone is well sorted apart from the scattered grains mentioned above. The majority of framework grains are close to an average diameter of about 0.2 mm but the occasional coarse grains are up to 4 mm across. The coarse grains are generally well rounded but the average grains are angular to irregular in shape. However, the shape is largely determined by the extent and distribution of replacement by the matrix.

The dominant mineral of the framework is monocrystalline quartz but microcline and plagioclase are common. Some dolomite crystals may be granular and part of the framework rather than part of the matrix. Fragments of fine grained chert are common. Well rounded zircon grains are trace constituents. The coarse grains consist of quartz, quartzite and micaceous lithologies.

Most of the interstitial space is occupied by a red brown, amorphous, translucent iron oxide. It is possible that argillaceous material is present but is obscured by the iron oxide but the clay may have been totally replaced, if it were in fact originally present. Patches of relatively coarse grained dolomite crystals occur at scattered localities throughout the rock. These are at least partly interstitial and to that extent formed an early matrix. Fractures in the dolomite are penetrated by the oxide which therefore postdates the carbonate.

Specimen 5338 RS 63, 473.0 - 473.10 m, TS C 46462.

Rock name. Garnet gneiss

Hand specimen

The rock is compositionally banded with a strong foliation imparted to the outer surface of the core by preferentially oriented biotite. The bands as seen on the sawn surface are pink, brown with reflections from mica cleavages and dark grey.

Thin section

Compositional bands in thin section are seen to consist of quartz, feldspar, granitoid, chlorite and garnet-biotite assemblages. The quartz is a closely interlocking mosaic of coarse grains. Intergranular boundaries are relatively simple

and a few triple junctions approximate to 120°. However, undulose extinction indicates that strain persists, or has been renewed, in the quartz. Plagioclase is more abundant than orthoclase in the feldspathic bands. Both feldspars are moderately fresh. With the addition of quartz and biotite the feldspathic bands acquire a granitoid composition. Large zircon grains are accessory components of this assemblage. Chlorite is often associated with quartz and opaque minerals but forms compositional bands which appear to be at a small angle to the regular banding. Garnet occurs as small subhedral grains and large poikilitic masses up to 3.5 mm across. The garnet is pink in colour and is closely associated with biotite and opaque material. It forms discontinuous bands and is more often present in feldspathic than in quartzose bands. In places the quartz rich bands appear to disrupt the feldspathic and garnetiferous bands.

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