DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

# REPT.BK.NO. 87/110
# MISCELLANEOUS THIN SECTIONS FROM THE PROTEROZOIC AND CAMBRIAN OF SOUTH AUSTRALIA

GEOLOGICAL SURVEY

by

M.G. FARRAND
REGIONAL GEOLOGY

SEPTEMBER, 1987

DME.454/82

| CONTENTS | PAGE |
|---|---|

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Rept. Bk. No. 89/110
DME No. 454/82
Disk No. 55

Pet. Rpt. 11/87
1:100 000 Sheets 5532, 6035, 6134, 6635, 6833, 6933.

# MISCELLANEOUS THIN SECTIONS FROM THE PROTEROZOIC AND CAMBRIAN OF SOUTH AUSTRALIA


## ABSTRACT

Rocks from St. Francis Island include trachyte, trachyandesite and rhyolite. Drillcore from Dampier DDH1 includes two types of dolerite. Specimens from Afmeco KGB 3 consist of fresh dolerite or basalt.

Other specimens examined include a basalt and a gneiss from the Willyama Inlier and a Cambrian rhyodacite from Parachilna.


## INTRODUCTION

A collection of thin sections from intrusive and extrusive rocks of the Gawler Craton Olary and Parachilna was received from John Parker of the Regional Geology Branch for brief petrographic examination. The specimens had mainly been collected by Richard Flint of the same Branch. No hand specimens were included.

## PETROGRAPHY

Specimen 5532 RS 90, TS C 44004, RBF 14, St. Francis Island

Rock name Trachyte

Thin section

The rock consists of a few feldspar phenocrysts in a groundmass which is dominantly feldspathic.

The phenocrysts are perthitic with untwinned feldspar exsolved in veins and patches in a host distinguished by cross-hatched twinning. The twinning is too fine and too regular to be diagnostic of microcline and the phenocrysts are probably anorthoclase hosts with exsolved orthoclase forming an antiperthite. Corrosion of phenocrysts varies from slight rounding of otherwise euhedral crystals to such intense

resorption that the crystal is skeletal. Preferential excavation of individual zones is apparent. Alteration consists of small, scattered patches of carbonate and a weak turbidity due to the exsolution of fine opaque granules.

The groundmass consists of a closely-interlocking mosaic of grains which are almost entirely feldspars and are dominantly orthoclase. Some lath-shaped plagioclase crystals are present. Quartz is present in the groundmass but only in the order of 5%. Opaque grains, chlorite and scattered carbonate alteration products are also groundmass constituents.

Comment

The absence of quartz phenocrysts and the low quartz content of the groundmass make trachyte, probably soda-rich, a more appropriate classification than rhyolite on petrographic evidence.

Specimen 5532 RS 91, TS C44005, RBF 20, St. Francis IslandRock

Rock name Rhyolite

Thin Section

The rock contains quartz both as phenocrysts and in the groundmass. Weak flow textures are apparent.

Feldspar phenocrysts are more abundant than those of quartz and consist of partially unmixed anorthoclase. The unmixing is patchy but substantial and, in contrast with RS90, plagioclase has exsolved from the anorthoclase. In some phenocrysts the host is untwinned and is probably orthoclase. The phenocrysts tend to cluster together and individual crystals are often anhedral. Resorption of feldspars has been only minor. Alteration is extremely light.

Quartz phenocrysts are rounded and embayed by resorption but to a relatively minor extent. An ovoid patch of mosaic quartz may be amygdaloidal.

The groundmass consists of irregular, patchy and imperfectly crystalline grains in a mass of finely granular to cryptocrystalline material. Quartz is identifiable in abundance and much material is recognisable as feldspathic although the

type of feldspar is not always identifiable. Rosettes of radiating fibres are common. Very fine biotite flakes are sparsely distributed and irregular patches of leucoxene may be the alteration products of ilmenite or sphene.

Comment

The rock probably belongs to the same suite as RS90 but is a more siliceous, and probably more potassic variant.
The paragenesis is very little altered.

Specimen 5532 RS 92, TS C 44006, RBF 40, St. Francis Island

Rock name Granophyric rhyolite

Thin section

The rock contains relatively fine grained quartz and feldspar phenocrysts but is dominated by a groundmass consisting largely of granophyric intergrowths of quartz and feldspar.

The quartz phenocrysts are deeply embayed in places but the resorption has not usually affected the outlines of the crystals which remain euhedral.

The feldspars vary from patchily unmixed crystals with or without twinning to a cluster of crystals in which unmixing has been sufficient to produce separate crystals of well-twinned plagioclase and an untwinned orthoclase. There is little resorption and virtually no alteration.

The groundmass contains frequent patches of completely unmixed mosaic quartz and rare plagioclase, often of quite coarse grain size, and some fine grained, randomly oriented material. The major part of the groundmass however consists of oriented intergrowths of vermicular quartz and feldspar in parallel or radiating structures. These granophyric intergrowths occur in sharply bounded blocks of similarly oriented textures. The blocks are often arranged radially around pre-existing nuclei such as phenocrysts. The limited separation of phases suggests that these structures may be produced by either devitrification in the solid or by cotectic crystallisation at a very late and highly viscous stage of magmatic history. Minor opaque minerals and chlorite are also present.

Comment

The composition of the rock is certainly rhyolitic. The texture may originally have been glassy. Alteration is again minimal.

Specimen 5532 RS 93, TS C 44007 RBF 41, St. Francis Island

Rock name Trachyandesite (?)

Thin section

The rock consists of highly altered phenocrysts of both feldspar and ferromagnesium minerals in a groundmass of felted laths of feldspar and fine mica flakes. Quartz is minor and possibly amygdaloidal.

Many of the feldspar phenocrysts are identifiable as plagioclase through traces of multiple twinning but heavy alteration of both sericite and epidote, together with turbidity due to exsolved opaque granules, make the identity of other grains doubtful. Some are almost certainly untwinned and it seems probable that both plagioclase and potash feldspar are present as phenocrysts, with plagioclase the more abundant.

The ferromagnesian phenocrysts are completely replaced by interlocking epidote crystals and a greenish brown mica. Despite the alteration, euhedral outlines remain and indicate that the ferromagnesian phenocrysts were of two types; coarse grained, broad prisms and medium grained, long, almost acicular prisms. The two types may be separate minerals or two generations of the same mineral. From the diamond shaped outlines of the cross sections of both types, the original minerals were probably amphiboles and the long, thin type at least was probably actinolite. However, the possibility that pyroxene may have been present originally cannot be ruled out. The long, thin prisms exhibit a preferred orientation.

The groundmass is largely made up of fine laths of feldspar in a felted mass which displays a strong preferred orientation due to flow. Flow lines sweep around phenocrysts. Multiple twinning is visible in a few laths but most show no twinning. It is possible that much of the felted groundass is composed of

potash feldspar. A second major constituent of the groundmass is the same pale greenish brown mica as was present in the altered ferromagnesium phenocrysts. In the groundmass it occurs as scattered, independent, fine flakes with a tendency towards preferred orientation.

Quartz occurs mainly as patches of mosaic grains. The patches are often ovoid with a rim of mica and are believed to be amygdales. Occasional smaller grains and patches of quartz in the groundmass may have been introduced at the same time as the amygdales were filled or may possibly be original constituents of the magma.

Comment

The rock is designated a trachyandesite largely because of the trachytic texture of the groundmass and the probability that plagioclase dominates the feldspar phenocrysts. However, the exact proportions of potash feldspar in both the phenocrysts and the groundmass should be tested by chemical means. The highly calcic nature of the (altered) plagioclase and ferromagnesian minerals indicates an affinity with andesitic rather than dacitic compositions. The quartz essentially apperas to have been introduced.

Specimen 6035 RS 29, TS C 44008, Dampier CD, DDH 1 100.5-100.6 m

Rock name Porphyritic amygdaloidal dolerite.

Thin section

The rock consists of a few phenocrysts of altered pyroxene and plagioclase in a medium grained groundmass of plagioclase and pyroxene. The groundmass is also strongly altered to dolomite and chlorite.

As far as may be determined, the pyroxene of both phenocrysts and groundmass is augite. However little remains unaltered. The plagioclase appears to be a calcic labradorite.

The groundmass contains many euhedral to subhedral opaque minerals, probably magnetite from the cubic form.

Quartz is present but not abundant. It occurs as an interstitial mineral in the groundmass but also occupies spheroidal to ovoid patches which are probably amygdales.

Comment

The rock is a slighly silica-oversaturated dolerite but much of the quartz is probably introduced.

Specimen 6035 RS 30, TS C 44009, Dampier CD, DDH 1 106.0-106.1 m

Rock name Porphyritic, amygdaloidal dolerite

Thin Section

The rock is simply a coarser-grained version of RS 29 with a slightly different alteration.

The minerals present as the major part of both phenocrysts and groundmass are plagioclase and augite. Opaque minerals tend to be skeletal rather than euhedral. Quartz is mainly interstitial but also occurs in patches which may be amygdales. In the latter situation it often displays textures inherited from a chalcedonic form.

The alteration products include chlorite and dolomite similar to those in RS 29. An additional material consists of a carbonate impregnated with red, powdery, amorphous iron oxide. It is possible that oxidation of the dolomite may lead to the exsolution of iron. On the other hand, a second ankeritic or even sideritic carbonate may have been introduced, the iron content of which was later oxidised.

Comment

The rock is essentially the same as RS 29. Variation in composition is relatively insignificant and involves only grain size and alteration.

Specimen 6035 RS 31, TS C 44010, Dampier CD, DDH 1 137.95-138.05 m

Rock name Veined and chloritised dolerite

Thin section

The rock is a dolerite but differs in several respects from that intersected 32 m and 38 m higher in the drill hole. The main differences are that the rock is highly feldspathic and that the original ferromagnesian mineral has been entirely replaced by chlorite.

The plagioclase includes clusters of broad, bladed crystals which are probably phenocrysts and thin laths which may be part of the groundmass. However, chloritic alteration is so intense that the nature and relationships of the plagioclase grains are not entirely clear.

Most of the chlorite is formless but a rare type is possibly pseudomorphous after primary ferromagnesian minerals. The latter type is a yellowish brown with a strong pleochroism. The major type of chlorite is green without much pleochroic range.

A third type of alteration appears to be a combination of chlorite, leucoxene and amorphous iron oxide. A few ragged grains of carbonate are present. Most opaque grains are leucoxenised.

A few thin veins of quartz and non-pleochroic chlorite cut the specimen. Irregular patches of possible pyrite may be associated with the veins.

Comment

The rock is too strongly altered for definitive petrographic conclusions. It appears to be of a different lineage from the dolerite higher up the section. Quartz has clearly been introduced, possibly with sulphide.

Specimen 6035 RS 32, TS C 44011, Dampier CD, DDH 1 147.0-147.1 m

Rock name Dolerite

Thin Section

The rock is similar to that of RS 31 in that the plagioclase occurs as relatively coarse grained phenocrysts and also as fine, almost acicular laths in the groundmass. However, there are considerable differences between the two dolerites. There are frequent coarse grains of pyroxene in RS 32 and although the pyroxenes are subject to partial alteration to chlorite, the main alteration of the rest of the rock is similar to that of the dolerites intersected at 106 m. This appears to be a combination of carbonate, chlorite, opaque grains and a turbid mass of semi-opaque, red, amorphous iron oxide. This material tends to replace the groundmass but in patches extends to alter the whole rock. Plagioclase phenocrysts are altered to sericite in relatively coarse flakes.

Comment

The rock is clearly a member of the same dolerite suite as specimens RS 29 to 31. Minor variations relate to the groundmass and alteration products.

Specimen 6134 RS 35, TS C 44012, Afmeco KGB 3, 29.8-29.95 m

Rock name Fine grained, fresh dolerite

Thin Section

In contrast to the dolerites in the Dampier drillhole, this specimen is fine grained and almost unaltered apart from the introduction of oxidised iron. Although pyroxene is abundant and coarser grained than the plagioclase, it is not a porphyritic phase formed as phenocrysts early in the history of the magma. The pyroxene grains are ophitic, enclosing plagioclase laths.

Plagioclase occurs as subhedral blade-shaped laths with no obvious preferred orientation. There is no sharp distinction in size between phenocrysts and groundmass. From symmetrical extinction angles the composition falls on the boundary between labradorite and bytownite. The plagioclase is unaltered.

The pyroxenes are large tabloid crystals but are interstitial and ophitic in habit. They are augites with moderate optic axial angles and very pale brown colour.

Small, interstitial grains of quartz appear to be part of the primary crystallisation of the magma rather than a post-magmatic introduction.

Opaque grains are probably also part of the original magmatic crystallisation. Most of the iron oxide occurs as opaque to semi-opaque reddish patches randomly superimposed on earlier minerals and was probably introduced hydrothermally.

Other alteration products affect some pyroxene and fill interstitial spaces which may have been occupied originally by pyroxene. Replacement minerals are chlorite and a poorly crystalline carbonate, probably dolomite.

Comments

This dolerite is distinct in origin from those intersected in the Dampier drillhole and much less altered. Field relationships determine whether the rock should be considered a dolerite or a basalt.

Specimen 6134 RS 36, TS C 44013, Afmeco KGB 3, 31.5-31.7 m

Rock name Fine grained, fresh dolerite.

Thin section

A few plagioclase grains are distinctly coarser in grain size than the plagioclase of the groundmass but the rock is otherwise identical to specimen RS 35.

Most of the plagioclase occurs as an interlocking mass of fine, well shaped laths without severe alteration or any detectable preferred orientation. Plagioclase of phenocrystal origin is present as single grains and clusters and exhibits a sericitic alteration. Phenocrysts are not abundant.

Pyroxenes are coarse grained but interstitial and ophitic in habit, not phenocrystal. Some grains are altered to chlorite, of both yellow and green types.

The poorly crystalline carbonate detected as an alteration product in RS 35 occurs as the filling of fine, meandering veinlets in RS 36.

Irregular patches of red iron oxide are common in both specimens.

Comment

Both specimens (RS 35 and 36) from the Afmeco KGB 3 drillhole are very similar in mineralogy, grain size and degree of alteration. They are quite distinct from the dolerites in the Dampier drillhole.

Specimen 6833 RS 257, TS C 44014, Flinders University 233.457, Willyama Inlier

Rock name Porphyritic basalt

Thin section

The rock consists of large clusters of porphyritic plagioclase in a fine grained groundmass of plagioclase, opaque minerals and alteration products of ferromagnesian minerals.

The plagioclase phenocrysts are tabular and, because they occur in clusters, subhedral to anhedral in shape. They are subject to weak to strong alteration and replacement by epidote. Twinning is not always present or sharply delineated and estimated compositions, which appear to be highly sodic, are possibly not reliable.

The plagioclase crystals of the groundmass are approximately lath shaped but in detail are poorly shaped. The grains tend to merge along poorly-defined margins and may have formed by devitrification of a glassy groundmass. Multiple twinning is rarely detectable although the grains are little altered.

The ferromagnesian component of the rock has been principally altered to an actinolitic amphibole but less abundant alteration products are sphene and epidote. Actinolite also fills a thin vein and forms sheaf-like aggregates in feldspar phenocrysts. The amphibole of the groundmass displays a preferred orientation.

Quartz and plagioclase fill a thin vein.

Opaque grains are extremely numerous and many are euhedral. A cubic habit indicates that the mineral is probably magnetite.

Comment

Petrographic evidence suggests that the rock is probably basaltic but that the phenocrysts may be more sodium-rich than is typical for basalt. The abundance of epidote as an alteration product indicates the loss of calcium from originally more-calcic phenocrysts. The abundance of a calci amphibole as the main ferromagnesian mineral suggest an andesitic basalt composition.

Specimen 6635 RS 292, TS C 44016, Adelaide Geosyncline

Rock name

Dolomitised rhyodacite tuff.

Thin section

The rock contains abundant, though relatively fine grained, phenocrysts of quartz and feldspar in a very fine grained matrix. It is probably a tuff since many of the phenocrysts appear to be fragmented. It is reddish brown due to iron staining.

Extensive dolomitisation and heavy impregnation with semi-opaque limonitic oxide obscure many details of composition but the feldspar phenocrysts appear to be mainly plagioclase with a few which are probably potash feldspar. Some reaction with the matrix at the margins of the phenocrysts is apparent but extensive resorption has not taken place.

The matrix consists of a fine grained, randomly oriented mosaic of minerals with low briefringence.

Comment

Some uncertainty exists over the composition of the rock as the limonite and dolomite conceal much petrographic evidence. However, the identification is given with reasonable confidence. Analytical data would be useful.

Specimen 6933 RS 935, TS C 44015, Flinders University 233.452, Willyama Inlier

Rock name Actinolite gneiss

Thin section

The rock consists of a matrix of fine grained, green minerals with zoned, ovoid patches about 1 cm long of light coloured minerals. The ovoids display a distinct preferred orientation.

The major part of the section is made up of a close-textured mass of fine grained actinolite. The amphibole forms clusters of prismatic, bladed and feathery crystals which often display radiating textures of sheaves and full rosettes. Most of the clusters are packed closely enough to leave no interstitial space but rare spaces are present and are filed by anhedral plagioclase or quartz particularly in the vicinity of the ovoids.

The light coloured ovoids are composed of fine grained mosaic quartz and a pale green to colourless tremolite. The amphibole is less close-packed than the actinolite of the matrix but in places occurs in the same radial aggregates. The distribution of the tremolite gives a concentrically zoned structure to the ovoids. In some ovoids sub-domains occur which are themselves ovoid and consist of curved bundles of amphibole prisms which appear to have been rotated.

Comment

The original parent for this sample is not known but may hve been either a pyroclastic or impure sedimentary carbonate. The ovoids may represent recrystallised, rotated porphyroblasts, augen in a high grade gneiss or original clastic pebbles.

The specimen is clearly not a Cambrian tuff. The hand specimen 6635 Rs 292 is a pink tuff and it appears likely that the labels have been transposed for specimens 6933 RS 935 and 6635 RS 299.

M.G. FARRAND