# The Geological Reconnaissance of an Area in the North West of the Hundred of Encounter Bay in the County of Hindmarsh, South Australia

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## Introduction

An attempt to do a reconnaissance of some of the geology in the Northwest of the Hundred of Encounter Bay

## Sections and Topographical Features

All sections and topographical features mentioned in this thesis occur in the Hundred of Encounter Bay unless otherwise indicated.

## Significance of the letters KA

These 2 letters prefix the numbered specimens collected in order to identify them from other peoples specimens. They also prefix numbers which indicate a position on the map. All specimens were collected from positions of the same number

# Limits of the Area

## Northern Western limit.

This is part of the boundary between the Hundreds of Encounter Bay and Myponga. This part commences at the north western boundary of section 580 of the Hundred of Encounter Bay and passes ~~along~~ northwards along the western or north western boundaries of sections 140, 139, 114, 112, 113, and 91 to ~~83~~ the boundary of sections 91 & 83

## Northern limit

This extends from the junction of the Hundred of Myponga, & sections 91 & 83, along the boundary of sections 91 & 83 to Gum Tree Gulley Creek, then along the creek to the north and east into section 78 to a position ~~half way along~~ in the creek ~~in section 78~~ half way between the western and eastern boundaries of section 78

## Eastern limit

This limit extends from a point half-way ~~between~~ on the ~~Southern~~ boundary of sections 55 & 78 to the road at the intersections of sections 91, 78, 92 & 93. Down the creek which forms the boundary between sections 92 & 93 to the Grey Spur. From there along the fence between Sections 361 & 85, 361 & 404, 142 & 146 to the ridge at the junction between ~~the~~ Sections 142, 146 & 145. In a straight line then to the junction of the River Boundry & the fence between Sections 278 & 361. Along the River Boundy to the road separating sections 280 & 277.

## Southern limit

Along the road separating sections 280 & 277 from the River Boundary to the intersection of sections 324, 89, 423 & 330 and then in a straight line to the far north-west point of the fence separating sections 580 & 141

## Physiography

The north west limit of the area forms the dividing line between the two main directions of flow of rivers in this part of the Mt Lofty Ranges. Rivers to the west of this limit flow into St Vincent's Gulf and the rivers to the east flow into Encounter Bay.

The Road separating sections 113 & 91, & 91 & 92, and passing close to Scrub Hill & Clarke Hill separate the Gum Tree Gully system to the north from those creeks to the south which flow into the River Boundy.

Tops of hills in the vicinity ie. the 2 ~~limit~~ just watershed dividing lines just mentioned form part of the old Tertiary peneplain.

The valley of the River Boundy may be an old Permian glacial valley. It is filled with Permian sands and the highlands to the north west of this river rise abruptly from its valley. The other patch of Hills at the join of sections 142, 146, & 145 also rise abruptly from the valley.

Other indications of an abrupt drop from the north west hills into the River Boundy are shown by Waterfalls. These occur in every creek of any size from the Grey Spur to Charlie's Gulley which empties into the River Boundy at the join of sections 279, 140, 360, 278 & 276. The one in Charlies Gulley is ~~on~~ really high and in the creek which forms the boundary of sections 92 & 93 are 5 good ones together just before entering the River Boundy.

These Waterfalls indicate a more than average drop for the creeks.

## Ages of the Rocks in the Area

These can be divided into Archean, Proterozoic, Permian, Tertiary & Recent.

## Archean

This term is used to cover the rocks in the area which are distinctly metamorphosed and altered by invading pegmatite veins. These rocks were called Archean by Professor Howchin in his paper "The Geology of the Victor Harbour, Inman Valley and Yankallilla Districts, with Special Reference to the Great Inman Valley Glacier of Permo-Carboniferous Age", Trans. Roy. Soc. Sth. Aus. vol 1, 1926.

## limits of Archean

These rocks cover the whole area except for the ~~for~~ southern and part of the eastern end. They occur right up to the north-western limit, all along the northern limit and all down the eastern limit to the Grey Spur except for the spur itself and some rocks to the north east. The southern limit of the Archean now follows a course parallel to the River Boundy about 400 yds to the north and west of it to ~~approx-~~ imately the intersection of this line with Charlies Gulley. It now more or less follows the creek which is a tributary of Charlie's Gulley and which flows down the western & southern portion of section 140 up its major western branch to the ~~fence~~ north west point of the fence between sections 140 & 580

## General Geology of the Archean

The geology is very difficult because it is on a relatively fine scale. Also a complete correlation of the fading of one rock type into another is almost completely not seen because of the very frequent occurence of patches of alluvium and undergrowth. Other complecations are apparently faults which seem to change the geology suddenly to something entirely different and unexpected. One can travel long distances looking at patches of rock separated by alluvium etc only 20 yards apart and in each case find rocks which seem to have no connection with one another. Therefore no attempt will be made to correlate rock for rock & creek by creek.

However the rocks fall into a pattern which was obtained from the geology of the creek which runs in the western & southern parts of section 140. The method used is to take the rocks as they come and fit them into the pattern found in the creek and without endeavouring to fit them together neighbour for neighbour

## Geology of the Creek which runs in the western and southern portions of section 140

500 yds up the creek from the intersection of the creek and the fence between sections 140 & 281 occurs KA 86 which is a mica - chlorite - plagioclase - quartz gneiss, schist showing evidence of ~~shear~~ stress. It is a schist which possibly has been feldspathized and subsequently stressed again.

Coming down the creek to KA 90 which is about 350 yds up from the fence - creek join one passes through KA 87 which is a coarser & more biotitic variety of KA 86 with parallel stringers of ~~feldspar~~ some ½ thick. Then KA 88 which is a contorted variety of KA 87. Then KA 89 which is ~~even~~ more biotite and contains sillimanite ~~visible~~ in the hand specimen. Then KA 90 which is even ~~&~~ more biotitic

KA ~~90~~ 91 just down from KA 90 is more schisty and this characteristic carries on down to KA 92, 93, & 94 which occur together about 250 yards up from the fence creek - join.

KA 92, 93, & 94 are part of a quartzite bed which plays no part in the sequence which is being set out

More schistose rocks occur now down to KA 95, 96, 97 & 98 which are at the fence - creek join

KA 95 is a sheared plagioclase - biotite - chlorite - quartz rock. KA 96 is a biotite schist which contained a crystal of pyrite KA 97 shows one of the big pegmatite stringers which are coming in here and KA 98 is one of the more plagioclasic varieties

The Rocks now revert to schists down to KA 99 which occurs 350 yards down from the fence -

creek join. With it occurs a graphic pegmatite and then the more or less sedimentary like schistosity and gneissosity ceases suddenly and pegmatitic material occurs every else down the creek from KA 99

In this creek the schistosity ≠ gneissosity are parallel to the bedding of the quartzite. The general strike is 250° there being however fluctuations KA 86 being 330° and KA 95 – 98 being 280° and KA 99 being 250°. Thus giving horizontal folds. A vertical monoclinal fold occurs in the creek also KA 88 dipping 53°S, KA 91 64°S and KA 99 41°S.

The pegmatites occur in parallel swarms the inner ones large and outer ones small. The swarms occur in groups. The biggest group in this creek occurs in at KA 97

Therefore the pattern obtained in this creek into which most of the rocks in the area fall is that in the centre of the pegmatite swarm occur the big pegmatites. Along these edges intermingling of country rock has occurred giving a granitic gneissic granulite. Outside this rock the country rock is a Plagioclase – Biotite – gneissic granulite. As one moves away from the big pegmatites to the little ones the plagioclase rich rocks become more gneissic, blacker and are called plagioclase biotite gneisses. Then moving further away from the swarms chlorite is more more commonly seen and one gets plagioclase – biotite – muscovite – chlorite – quartz – feldspathised – gneissic schists.

All over the area shear seems to have subsequently affected the gneisses & schists but not the granulites so much.

Correlation of other rocks in the area into the pattern of the creek in the western and southern portion of Section 140

A Pegmatites

① non-graphic

KAo:— 4A, 35, 48, 60, 80, 120, 137, 143, 156.

② graphic

KAo:— 4, 100, 124.

B Granitic Gneissic Granulites

Hybrids of pegmatite v country rock

KAo:— 7, 7A, 12, 13, 14, 15, 16, 17, 19, 20, 22, 25, 26, 28, 29, 30, 34, 37, 44, 49, 50, 51, 52, 72, 74, 79, 84A, 138, 152, 160, 162

C Plagioclase-biotite-gneissic-granulites

These rocks have more plagioclase than class B, less biotite, less gneissosity and a lighter colour.

KAo:— 1, 2, 21, 22, 36, 38, 39, 41, 46, 53, 61, 62, 63, 64, 67, 67A, 68, 73A, 75, 76, 77, 81, 97, 105, 115, 125, 126, 142, 155, 158, 165, 167, 168, 169, 170, 171, 172, 176, 176B, 177, 178

D. Plagioclase-biotite-gneiss

KAo:— 45, 47, 54, 131, 149, 150, 151, 166A, 166B, 7B, 43, 44B, 72A, 72B, 77B, 83B, 84, 85, 87, 88, 98, 99, 140, 154, 163, 164, 166, 166C, 5, 6, 18, 87, 9, 89, 157

E, Plagioclase-biotite-muscovite-chlorite-quartz-feldspathised gneiss-schist

KAo:— 69, 86, 90, 107, 3, 31, 40, 42, 65, 69A, 70, 73, 79A, 83, 91, 95, 96, 122, 141B, 147, 159, 161, 180

## Rocks which appear to show subsequent stress

### Class D.

KA's :— 7B, 43, 44B, 72A, 72B, 77B, 83B, 84, 85, 87 88, 98, 99, 140, 154, 163, 164, 166, 166C, 9, 89, 157

### Class E

KA's :— 3, 31, 40, 42, 65, 69A, 70, 73, 79A, 83, 91, 95 96, 122, 141B, 147, 159, 161, 180.

In the above classification many rocks are transitional and may be found to be wrongly classified when examined in thin section or by an expert.

## Rocks that do not fit into the Pattern

Pegmatites containing much mica

KA's :— 23, 33. These occurred near tops of hills in Section 139

Tourmaline - Quartz - Rock

KA3 :— 24, 124A. These occurred near tops of hills and are confined to sections 140 except for K24 in section 139

Dykes

Basic - ordinary

KA3:-106, 114, 123, 130, 132, 135, are fairly general and seem to mark faults.

Epidote - Hornblende

KA3 :— 71 & 78. Confined to section 84

Composite Gneiss (as defined in Tyree)

KA133. Occurs in Charlie's Gully from 200yds down from the join between the Gully and the fence between section 114 & 139 to a position in the gully ½ way between the north and south fences of section 139

Migmatites which seem to be a mix granitic mixture of country rock & pegmatite. KA's :— 10, 11, 136. Occurs as the main rock in Charlie's Gully from the southern end of the composite gneiss to the big waterfall, ⅓ of the way

from the section 139-140 fence in the Gulley to its join with the Boundy.

Quartz-Reefs

KA 113 - Occurs on tops of hills

Iron-Ore

KA 126A occurs as a scree on the eastern side of the valley which forms the to source & watershed of the most northern main branch of the creek which runs through the west & south parts of section 140 and the tributary of Charlie's Gully which rises to the west of the Gully and is parallel to, just north of and nearest to the section 139-140 fence

KA 173 occurs as a pocket in the west cliff of the 4th big waterfall up ~~the creek~~ from the Grey Spur ~~which~~ in the creek which marks the boundary between section 92 & 93

KA 154A may be a conglomerate, it also may not be in situ

Composite Rock

KA 179 occurring on Gum Tree Gulley seems to contain all rocks of the type pattern i.e. class A - E in it

## Generalisations on the Archean Petrology.

### Observations (not already made)

① Rocks containing sillimanite visible to the naked eye i.e. KA's :— 5, 6, 18, 87, 9, 39, 157, all except 157 occurs in the eastern side of section 140. Therefore hottest area

② The predominate rock in the area is plagioclase rich

③ The absence of real igneous rocks except the pegmatites.

④ KA 52 obtained from the western side of the Boundary R. in the middle of that portion of section 361 contained a speck of azurite.

③ ~~②~~ Unmentioned areas are predominately plagioclase granulite (class C)

④ ~~③~~ Most of epidote occurs in south of section 84 & north of 361 Also SW corner of section 139

### Areal Generalizations

① The Western sides of section 140 & 139 are mainly schists (Class E)

② Sections 360 & 361 are mainly the granitic gneisses (class B)

⑤ In the creek which flows into Charlie's Gully from the E. and is // section 112–114 fence and ~ just S of it, occurred the largest pegmatites some 100 of yards across also much granitic gneiss (class B) and plag. granulite (class C)

## Microscopic Descriptions

Now follows ~~many~~ full descriptions of important types rocks and thumbnail sketches of some others

KA1

Macroscopic

This rock has a light grey colour. In the field it appears to be predominately pegmatitic in origin with which is mixed small quantities of colour altered sedimentary rock. In the hand specimen occurs pearl grey translucent quartz with white to pink feldspar and biotite with a vague gneissosity

Microscopic

In the slide the grain size ranges up to 5mms. The structure is xenoblastic and the gneissosity is not clear.

Quartz

Occurs as clear, colourless, transparent, xenoblastic crystals with many inclusions. Some are in rows, others are unorientated. They are either blebby like or hair like. The RI is > balsam, DR 1st order grays & yellows uniaxial positive.

Feldspar

Has nearly all been altered to an unorientated mass of finely divided Muscovite[2] some individuals of which are big enough to show the mica-like structure, colourlessness, straight-extinction and DR of 2nd order. What feldspar remains is too cloudy and altered to identify

Biotite

Occurs as xenoblastic individuals showing pleochroism in greens & browns & yellows, mica-like form, straight extinction and 2nd order DR masked by the colour

Accessories

Magnetite

Occurs as black opaque xenoblastic crystals

Zircon

Occurs as brown, transparent, rounded crystals (some show tetragonal system) with a very high DR & RI.

The Rock is a quartz-feldspar-mica gneiss

KA6

Macroscopic.

This rock has a gray colour. It has a gneissic structure; the granoblose bands being about 1 mm. wide, separated by thinner, vaguer, more biotitic bands. It contains ~~quartz~~ pearly light grey quartz, white to dark gray feldspar, biotite & sillimanite.

Microscopic.

In thin section distinct bands occur of sillimanite & garnet together and vaguer bands of feldspar. Quartz sometimes occurs in the feldspar bands, and biotite is variable occurring sometimes in either bands.

Some vague bands occur of altered feldspar.

Perthite

Occurs as clear, colourless, transparent, slightly cracked shapeless, untwinned crystals except for some bands of heavily altered ones. The distinctive parallel blebs of albite are clear under high power. The D.R. is 1st order grays to yellows. In a section $\perp X$, $Z \wedge 001 = 3°$, in a section $\perp Y$, $X \wedge 010 = 0°$. A negative biaxial figure with a 2E of 70°-80° was obtained.

Quartz

Occurs as clear, colorless, transparent shapeless crystalls with a D.R. of 1st order yellows & an RI > balsam. A uniaxial positive figure was obtained.

Sillimanite

Occurs as clear, colourless, transparent, idioblastic crystals with a very high RI & a DR. of up to low 2nd order. Typical long, thin, oblong prisms occur & square cross-sections showing diagonal cleavage. The crystals are length slow

Garnet

Occurs as clear, pink, transparent, rounded, much cracked & isotropic grains with a high RI

Biotite

Occurs as fairly clear, brown, transparent crystals.

# KA 10

## Macroscopic

This rock has a dark colour and a patchy granulitic structure. Its approximate average grain size is 2 mms ranging up to 7 mms. It has patches of biotite which may represent xenoliths of country rock. The main mass contains pearl grey translucent quartz, pink feldspar and sub-macroscopic black patches

## Microscopic

The structure is xenoblastic granulitic, the grain size ranging up to 5 mm.

### Quartz

Occurs as colourless, transparent, clear, xenoblastic crystals. R.I. > balsam, D.R. 1st order yellow. The crystals are cracked and the D.R. has strain shadows. Inclusions are bleb-like & hair-like and are arranged in lines & without order. A biaxial figure with a v. high 2V was obtained

### Perthitic - Microcline

Occurs as colourless, transparent, xenoblastic crystals altering to Sericite. The perthitic & microcline structure is not very clear. The DR is 1st order grays. A biaxial negative figure was obtained and in a section ⊥X, Z∧001 = 1½°

### Sub-Macroscopic Black Patches

This apparently was once a perthitic microcline crystal with a grain of magnetite in it. After sericitization of the feldspar, iron from the magnetite reacted with the sericite to get a ring-like structure.

### Biotite

Occurs as xenoblastic crystals with mica-like structure, straight extinction, IR 2nd order, pleochroism X = light yellow Y = Z = dark brown & also in greens.

### Chlorite

Occurs as xenoblastic crystals with mica-like structure

pleochroic in greens, DR 1st order

Magnetite

Occurs as xenoblastic, black opaque crystals

Zircon

Occurs as bronzed rounded crystals with very high DR & RI

Sillimanite

One crystals occurs showing 1 cleavage, straight extinction high RI, DR 2nd order, length slow, colourless, biaxial positive and although the evidence is not conclusive it is called sillimanite because it is the mineral with properties nearest approaching the evidence. Sillimanite appears in the hand-specimen

The rock is called a migmatite because it appears to consist of material ½ pegmatite in origin and ½ xenolithic.

KA 28

Macroscopic

This rock has a favour colour and a granulitic structure slightly gneissic. The average grain size is about 2 mms. It contains pinkish white feldspar, biotite and iron ore

Microscopic

The structure is granulitic with an average grain size of about 2 mm.

Albite

Occurs as cloudy, colourless, transparent, xenoblastic crystals some of which show albite twinning. The DR is 1st order grey. In a section ⊥ 010 the maximum extinction angle was 15°. In a section ⊥ X Z ∧ 010 = 77° & Z ∧ 001 = 10°. A biaxial positive figure was obtained giving a composition of about $Ab_{93}An_7$

Magnetite

Occurs as xenoblastic black opaque grains

Biotite

Occurs as subidioblastic crystals with a mica-like structure, pleochroism X = light yellow, Y = Z = dark brown, straight extinction and a nearly uniaxial negative figure obtained. DR second order masked by the colour.

Quartz

Occurs as xenoblastic transparent, colourless, clear crystals with a ~~RI~~ RI > balsam and a DR of 1st order yellow. It occurs in cracks & interstitially. No figure obtained because of the small grain size.

Muscovite

Occurs as a few subidioblastic, clear, colourless, transparent crystals with mica-like structure, straight extinction, D.R. of 2nd order

The Rock is an albite-magnetite-mica-granulite.

KA41

Macroscopic

This rock has a dark colour, and a gneissic structure. It contains epidote arranged in bands throughout a granulitic mass of pink feldspar and biotite.

Microscopic

The average grain size is 1.5 mms. ranging up to 7 mms. The epidote occurs as small xenoblastic unoriented crystals in bands. In between the bands occurs very saussuritized feldspar, recrystallized quartz in some cases formed into lenticules and other squeezed out forms and biotite. The structure is gneissose.

Epidote

Occurs as rounded, xenoblastic grains with pleochroism in greens and yellows. The DR is 2nd order, straight extinction in longitudinal sections but inclined in cross-sections

Plagioclase

Occurs associated with the epidote and is xenoblastic The crystal outlines are very ragged as though it is fusing into epidote. DR 1st order grey, no twinning, heavily saussuritized and studded with epidote grains. Extinction angle in a zone ⊥ 010 was 15°. A biaxial positive figure obtained. The evidence is not conclusive but the presence of the epidote possibly indicates a plagioclase possibly an andesine.

Quartz

Occurs as clear, colourless, transparent xenoblastic crystals in a recrystallized squeezed out form. RI > balsam, DR 1st order yellows. A uniaxial positive figure was obtained

Biotite

Occurs as subidioblastic mica-like forms. Pleochroism X = light yellow, Y = Z = dark brown straight extinction

Magnetite

Occurs as xenoblastic black opaque crystals

Haematite

Occurs as cherry-red plates with a very high DR.

Zircon

Occurs as rounded brownish grains with high RI & DR

Apatite

Occurs as transparent, clear, colourless idioblastic crystals with DR of very low 1st order grey & high RI. Straight extinction

The Rock is an Epidote - Plagioclase - Quartz - Mica - Gneiss

KA46

## Macroscopic

This rock has a brown colour. It has a granulitic texture with a grain size ranging up to 1 mm and porphyroblast of amphibole ranging up to 7 mm. It contains principally white to pink feldspars with bands of epidote with amphibole running through it.

## Microscopic

In this section the feldspar and quartz have a granulitic structure. The feldspars are studded with epidote. Bands of granular epidote occurs with some porphyroblasts of amphibole in them. The grain size of the ground mass ranges up to 1 mm. with porphyroblasts ranging up to 7 mm.

## Andesine

Occurs as colourless, transparent xenoblastic crystals studded with epidote grains the DR is 1st order grays with albite twinning. The maximum extinction angle in the zone ⊥ 010 = 17°. In a section ⊥ X a biaxial negative figure was obtained and Z ∧ 010 = 82° giving a composition of about $Ab_{70}An_{30} - Ab_{65}An_{35}$.

## Epidote

Occurs in bands and studded on the andesine crystals as green xenoblastic crystals. It is pleochroic in yellow-greens has a high RI and a DR of 2nd order

## Tremolite – Actinolite

Occurs in the ground mass and in the epidote bands and as pl porphyroblasts. It is studded throughout with epidote and magnetite grains. It is sometimes colourless and sometimes pleochroic in yellow greens and greens. The extinction angle is 11° the DR is middle 2nd order

## Magnetite

Occurs as black opaque xenoblastic grains

## Quartz

Occurs as clear, colourless, transparent xenoblastic crystals It has a DR of 1st order yellows and some strain shadows and strings of inclusions

## Sphene

Occurs as one brown xenoblastic grain with very high RI & a DR of 1st order white.

The rock is a plagioclase – epidote – actinolite – granulite

# KAS1

## Macroscopic.

This rock has a dark pink colour with a grain size ranging up to 7 mms. Its structure is gneissose and appears to be derived from pegmatitic material into which some country rock has been incorporated. It shows pink feldspar, biotite & quartz

## Microscopic

The structure is gneissic, very thin bands of mica occurring sometimes

## Microcline

Occurs as colourless, transparent, xenoblastic, somewhat cracked and cleaved crystals. They have many inclusions, a DR of 1st order grey & very typical microcline cross hatching. Some crystals are now coloured completely of submicroscopic sassaurite and may have been Plagioclase especially as a crystal at two of epidote occurs.

## Quartz

Occurs as colourless, clear, transparent, xenoblastic, individuals mostly as a recrystallized mosaic and mostly occurring as bands showing the possibility of subsequent dynamic metamorphism. The RI is > balsam, DR is 1st order yellows. The figure is again biaxial positive with a not inconsiderable 2V.

## Biotite

Occurs as subidioblastic crystals, pleochroism X = light brown Y = Z = dark brown. Straight extinction. Mica-like form. Varieties pleochroic in greens & in green & light yellow occur. In the green varieties since the DR varies down to 1st order some grains may be Chlorite & chloritoid. DR usually 2nd order. Occurrence is in patches and bands.

## Muscovite

Occurs as subidioblastic crystals, colourless, clear & transparent. Mica-like form. DR 2nd order, Straight Extinction.

It often occurs as thin bands.

Apatite

Occurs as clear, colourless, transparent, idioblastic grains with straight extinction, high RI, DR 1st order dark grey

Epidote

Occurs as xenoblastic grains pleochroism in greens, straight extinction, fairly high RI, DR 2nd order.

Magnetite

Occurs as xenoblastic, black opaque grains

Haematite

Occurs as cherry red subidioblastic plates with a very high DR.

Zircon

Occurs as rounded bipyramidal grains with a very high RI & a high DR

The rock is a granitic gneiss

KA63A

Macroscopic

This rock has a light fawn colour. The structure is generally granulitic with a vague gneissosity. It contains fawn feldspar, some quartz, magnetite & magnetite. Average grain size is 2 mms. ranging up to 5 mms

Microscopic

Here the gneissic structure is more evident, the biotite being sparsely separated but all orientated parallel

Feldspar

Occurs as clear, transparent, colourless, xenoblastic crystals. Slightly altered. Twinned & untwinned, DR 1st order grey.

Twinned both albite & pericline occurs. Maximum extinction angle in a section ⊥ 010 was 16½°. In a section ⊥ X, Z ∧ 010 = 83°, Z ∧ 001 = 7°. In this plagioclase the conclusive properties were 4 figures which were biaxial negative which gives a composition of $Ab_7 An_3$ and as they were not good doubt is cast on the composition.

Untwinned good biaxial positive figures were obtained but which suggests $Ca_1 Ab_1$ or $Ab_{60-40} An_{40-60}$ but in a section ⊥ Z, X ∧ 001 = 6° suggesting Or or $Ab_7 An_3$. It would appear most probable of all possibilities that if the good untwinned good biaxial positive figures are wrong then all the evidence points to $Ab_7 An_3$

Biotite

Occurs as xenoblastic crystals pleochroism X = light yellow, Y = Z = greenish-brown, mica like form, straight extinction.

Magnetite

Occurs as xenoblastic black opaque crystals

KA63A

Muscovite

Occurs as clear, colourless, transparent, xenoblastic crystals showing mica-like form, straight extinction and a DR of 2nd order

Apatite

Occurs as clear, colourless, transparent, xenoblastic crystals with a high RI, DR of 1st order dark grey. E

The Rock is a Plagioclase - magnetite - biotite gneiss

KA72A

Macroscopic.

This rock is a brownish-grey colour and has a gneissic structure. It is seen to contain xenoblastic pinkish white feldspars ranging from round porphyroblasts 5 mms. across through elongated and stretched individuals to almost sub-microscopic layers. Black biotite occurs as schistose bands separating the feldspar layers and also flowing round the porphyroblasts.

Microscopic.

In thin section the gneissic structure is well defined. Mica bands with xenoblastic individuals up to 0·7 mms. long, alternate with bands consisting of a mosaic of quartz, xenoblastic individuals being up to 0·2 mms. These bands flow round and invade the cracks of xenoblastic porphyroblasts of zoned plagioclase which range up to 5·5 mms. in size.

Albite-Oligoclase.

Colourless, transparent, slightly cloudy porphyroblasts of approximate composition $Ab_{80}An_{20}$ occur zoned and cracked. They show a DR of 1st order grey, some have albite twinning with a maximum extinction angle in the zone ⊥ to 010 of 12°. All including untwinned individuals give a positive biaxial figure. The are sausuritized to some extent.

Quartz.

This mineral occurs as a colourless transparent mosaic. It has a D.R. of 1st order yellows. Figures taken on individuals big enough were uniaxial positive. The mosaic forms with mica the prominent banding of the rock. It occupies cracks and crevisses in the Albite-Oligoclase porphyroblasts.

It is possible that some of the smaller particles of the mosaic may be albite.

Biotite

Occurs as brown xenoblasts. Pleochroism X = light greenish yellow Y = Z = dark brownish black. Extinction angle straight, DR 2nd order.

Muscovite

Occurs as colourless xenoblasts. Straight extinction and the cleavage traces are length slow. DR 2nd order.

Epidote

Occurs as small xenoblastic individuals some associated with biotite and some with the mosaic. It is colourless with straight extinction and a 2nd order DR.

Accessories.

Apatite

Occurs as small idioblastic individuals, colourless straight extinction and a DR of 1st order grey.

Zircon

Occurs as small individuals, some idioblastic some xenoblastic. They have a high DR and a very high RI.

Orthite

One xenoblastic individual was found which might be orthite. It was brown & isotropic and had a high RI.

Magnetite

Occurs mostly as idioblastic individuals black & opaque

The Rock is a Plagioclase - mica - epidote - quartz - augen - gneiss apparently formed by regional metamorphism and later possibly coming under the influence of subsequent dynamic metamorphism.

KA 77

Macroscopic.

This rock has a dark grey colour. It contains pink porphyroblastic feldspars up to 14 mms across, which are somewhat in line and embedded in a matrix of pink feldspar and biotite which range up to 2 mms. across. The texture is somewhat gneissic.

Microscopic.

In thin section porphyroblasts of plagioclase occur up to 9 mms. across containing patches of microcline. The matrix contains microcline, plagioclase, quartz biotite, muscovite, ranging up to 1·2 mms. The micas are usually arranged in bands.

Oligoclase

Occurs as colourless transparent, ~~somewhat~~ xenoblasts, both porphyroblastic & in the groundmass. RI is greater than balsam and the DR is 1st order grey. Albite twinning occurs and the maximum extinction in the zone ⊥ 010 is 8°. Biaxial negative figures were obtained and in a section ⊥ X, Z∧010 was 86° giving a composition approximately $Ab_{77}An_{23}$

Microcline

Occurs as cloudy, colourless, transparent, xenoblasts in the ground mass and sometimes as inclusions in the porphyroblastic oligoclases. It has a DR of 1st order grays and biaxial negative figures were obtained. Some of the grains are perthitic.

Quartz

Occurs as clear, colourless, transparent xenoblasts. It has a DR of 1st order yellow, an RI greater than the feldspars and gave uniaxial positive figures. The grains are somewhat cracked and contain some inclusions

Biotite

Occurs as brown xenoblasts. It is pleochroic

X = pale yellow, Y = Z = brownish black, straight extinction, high DR and the cleavage traces are length slow.

Muscovite

Occurs as colourless clear transparent xenoblasts. It has a high RI, a DR of upper 2nd order, straight extinction and the cleavage traces are length slow.

Accessories

Apatite

Occurs as small clear colourless idioblasts. They have a high RI, DR of 1st order dark grey and straight extinction.

Zircon

Occurs as clear tiny brownish xenoblasts with a veg high RI & a high DR

Magnetite

Occurs as small black opaque mainly idioblastic individuals associated with the biotite.

The rock is a feldspar - quartz - mica - grains

KA 133

Macroscopic

This a dark rock with a gneissic structure. It is ptygmatically folded. It contains bands of pink feldspar up to 6 mms. across with individual porphyroblasts up to 4 mms across. Between the feldspar bands occur dark bands containing mainly biotite and thin streaks of feldspar. Very fine acicular crystals of sillimanite can be seen in these bands. Rounded black grains of garnet up to 7 mms. in size can be seen scattered throughout the rock. Translucent pearly-grey rounded grains of quartz also occur in this manner.

Microscopic

In this section the gneissic structure is not so marked as in the hand specimen, however bands of feldspar and quartz occurring together have xenoblastic individuals up to 3 mms. Bands of idioblastic sillimanite and xenoblastic biotite, occurring together, contain individuals up to 1·5 mm. long which are orientated mainly parallel to the gneissosity. Diablastic pink garnet occurs up to 7 mms. across containing biotite, quartz and sillimanite.

Orthoclase

Occurs as clear, colourless, transparent xenoblastic crystals. average RI < balsam, the balsam of all KA slides being 1·524. DR first order grays. Biaxial negative figures were obtained. In a section ⊥ Z, X ∧ 001 was 2°. It is somewhat perthitic.

Albite

Occurs as clear, colourless, transparent xenoblastic crystals. The average RI > balsam

the DR first order grays. Albite twinning is present and the maximum extinction angle in the zone ⊥ 010 was 16°. Biaxial positive figures were obtained. In a zone ⊥ Y, X ∧ 010 was 2°. This gives a composition approximately $Ab_{95}An_5$. It is sometimes antiperthitic.

Quartz

Occurs as clear colourless transparent xenoblastic crystals. The DR is first order yellows and uniaxial positive figures were obtained

Garnet

Occurs as pink xenoblastic isotropic individuals with a high RI. They enclose crystals of biotite, quartz and sillimanite.

Sillimanite

Occurs as clear colourless cracked idioblastic crystals, some as large as 1·5 mm long by 0·2 mms broad. A few patches consisting of a felted mass of fibres occur. Square cross-sections were seen showing cleavage parallel to 010. RI is high, DR upper 1st order and lower 2nd order, length slow.

Biotite

Occurs as brown xenoblastic individuals, showing the basal cleavage. Pleochroism X = light greenish yellow, Y=Z = brownish black. Straight extinction, DR 2nd order masked by the colour of the mineral.

Accessories

Magnetite

Occurs as a black opaque xenoblastic individuals associated mainly with the biotite

Zircon occurs as grain, very high RI, high DR

The Rock is Feldspar-Quartz-Mica-Garnet-Sillimanite-Composite-Gneiss.

KA65

Is a quartz-muscovite schist containing in addition biotite, magnetite & zircon cut by a stringer of pegmatite containing microcline, quartz, biotite, sericite & zircon

KA67A

Is a banded gneissic granulite with a dark grey colour. The banding is due to parallel streaks of different coloured feldspars and in thin section it is not evident whether this is due to segregations of different kinds of feldspar. Micas are dispersed but parallel giving a gneissosity. Minerals are microcline, oligoclase, quartz, biotite, magnetite, chlorintoid, muscovite, apatite & zircon.

KA67A

Is a chlorite - quartz - schist, individual plates of chlorite being on a large scale. Quartz occurs as lentinles and is recrystallized. The chlorite appears to be changing to biotite and magnetite & muscovite occurs.

KA78

Occurs as a patchy dyke consisting of alternate streaks of epidote and blue-green actinolite-hornblende. Feldspars occur altering to epidote some twinned and some not. Other minerals seen are quartz, leucoxene, ilmenite, apatite and zircon. The rock may once have been a quartz dolerite.

KA 83D

Is essentially a muscovite schist with lenticles of quartz and feldspar. The whole rock which too may have once been a regional metamorphic has now been strongly under the influence of dynamic metamorphism. Other minerals seen were biotite, chlorite, magnetite & zircon. Feldspars are so altered, and the slide so thick it is difficult to determine them. One crystal showed albite twinning and is obviously plagioclase

KA 84A

Is a essentially a pegmatite with patches of biotite included possibly of country rock origin. The feldspar is an almost graphic intergrowth of perthitic microcline and plagioclase. Quartz & Muscovite also occur

KA 85

Is a plagioclase - mica - gneiss. Shows evidence of stress as the micas fold round rounded feldspar porphyroblasts. The feldspar is acid oligoclase, biaxial positive figures being obtained even from untrimmed crystals. Other minerals are magnetite & zircon.

KA 86

This rock is a mica - chlorite - plagioclase - quartz gneissic schist. It also contains magnetite, sillimanite and possibly epidote. It shows evidence of stress.

KA 105

This rock is a plagioclase - biotite - gneiss - granulite. It contains oligoclase, biotite, muscovite, quartz, sillimanite, epidote, ilmenite, zircon, leucoxene, apatite and possibly allanite.

KA107

This rock is a feldspar - biotite gneiss. It contains sillimanite, magnetite and zircon as well. The feldspar has been sausseritized completely except for a few small pieces giving some slight evidence of albite twinning to make the feldspar oligoclase

KA114

A quartz dolerite dyke containing quartz, $Ab_5An_5$ and blue green hornblende, magnetite

KA123

Similar to KA174, so is K135

KA126

An epidote - actinolite - feldspar gneissic granulite. The feldspars show almost a graphic intergrowth of microcline & oligoclase. Ilmenite and leucoxene occur. This rock can classed with the granitic gneisses and it occurred with pegmatites

KA125

An actinolite - plagioclase - gneissic - granulite. Contains also magnetite & the plagioclase is oligoclase Can be classed with the granitic - gneisses

KA131

I a plagioclase - biotite - gneiss, the plagioclase being andesine. Also contains, quartz, ilmenite, leucoxene, apatite and zircon

## Tectonics in the Archean Rocks

The regional schistosity and gneissosity runs north and south, the pegmatites coming in between the schist planes, except south W of Charles's Gully where it corresponds to the bedding and is 250°

The junction of these 2 regional schistosities is seen between the river running in the W & S portions of section 140 o Charles Gully. Here huge blocks have their schistosity pointing in all directions.

There must exist here either a break in a fold or a fault and since the Charles Gully rocks are different from all the others a NW-SE regional fault may be a possibility.

Faulting on a minor scale complete with infillings of basic dykes occurred frequently. Blocks seemed to rise out of nowhere and change the geology

# Proterozoic

## Areas

① A patch in section 145
② The Coog Spur Conglomerate
③ An area on Baon Hill

## Remarks

A These areas were named Proterozoic (Adelaide Series) by Professor Howchin in his paper mentioned above It is now thought by Sir Douglas Mawson that they are older than Adelaide Series and that the area on Baon Hill may not be equivalent of the Coog Spur Conglomerate.

## Individual Areas

① The patch in section 145 was mapped by Guppy in 1944 and the quartzitic KA's 58 & 59 come from there

② The Coog Spur Conglomerate is shown on Guppy's map of 1944 as an entirety commencing at a point on the boundary of sections 84 & 361 just west of the join between sections 84, 85 & 361 and proceeding to the NE.

Now we found a variation. In the creek which runs along the boundary between sections 92 & 93 and about 150 yards south of the join of the creek and the fence between sections 92 & 84 occurs the 2nd big waterfall d 5 coming down the creek. It is the same waterfall from which the pocket of iron ore KA 173 was obtained.

At the foot of the waterfall the schistosity and gneissosity of the ~~same~~ Archean rocks is 160 dip vertical. Overlying them and separated by what appears to be a fault occurs

a sedimentary series with no intense metamorphism with strike 045° dip 80°-90° SE. The intense metamorphism of the Archean halts abruptly at this junction. The sedimentary rock obtained KA174 is a fine grained black phyllitic schist. The sequence down the creek and up the series is slate, grey quartzite (KA175) slate & banded quartzite which takes one almost to the junction of this creek and Hell Gate creek which is half-way between the Grey Spur and the section 92-84 fence.

This sedimentary series occurs on the map as underneath the conglomerate if it were present in an unbroken line. The conglomerate was not found in the creek. It appears then that these rocks belong stratigraphically above the conglomerate and that they have been set back by faulting folding or a meandering Archean-Proterozoic contact line and the conglomerate faulted, folded or lensed out. Personally I suspect faulting

③ In the area on Barn Hill we found that the conglomerate fitted in perfectly with Professor Howchin's description but his description does not tally with his map or what we found.

The easterly point of the conglomerate occurs on the top of the south bank of the creek which runs ~~down~~ down in the west of Such portions of section 140 at a point ½ way between the join of this creek and the section 140-281 fence and where ~~it~~ joins the creek joins Charlie's Gulley. Now ~~Proff~~ Professor Howchin says in his paper that the underlying Archean ~~strike 032°~~ rocks dip S 20° E at 37° which gives a strike of 250°. Also he says the conglomerate strikes 250°. We agree with Professor Howchin except that we obtained a dip of 41° for the schists and 45° for the conglomerate. So no west unconformity exists between the 2 series and the conglomerate here shows signs to turning into a quartz - chlorite - gneissic - schist

The quartzite KA 92, 93 094 was next taken as an indicator bed. They occur 250 yards up from this creek - section 140-281 fence join. The quartzite continues to the north of the creek for 350 yds strike 250° & disappears. To the south of the creek it continues as an unbroken line curving to the SW till it disappears in section 323 with a strike of 220° dip 65°

Now this quartzite is sensibly parallel to the conglomerate except that the conglomerate here a break in it in section 281 and it shows displacement & possibly there are 2 conglomerates but we ~~did~~ were not able to settle this point. The conglomerate disappears in the

southern portion of section 281 strike 238° dip 60° SE.
A specimen was taken here KA110

Sections were run across the strike in 3 places.

Working from conglomerate down the sequence.

| Section ① | Section ② | Section ③ |
|---|---|---|
| Position :– from the northern portion of section 281 into the southern portion of section 140 | Position :– from the north-east corner of section 323 into the south of section 580 | Position :– from the north west corner of section 323 through the north east corner of section 89 into the south west of section 580 |
| ① conglomerate (KA110) | | |
| ② schists, gneisses, granulites and pegmatites KA 99, 98, 97, 96, 95 | ② a/ alternate bands of quartzite & slate<br>b/ phyllitic slate (KA108) | ② a/ alternate bands of quartzite and slates<br>b/ phyllite slate (KA124) |
| ③ indicator quartzite KA 94, 93, 92 | ③ indicator quartzite | ③ indicator quartzite. |
| ④ schists, gneisses, granulites and pegmatites, KA 91, 90, 89, 88, 87, 86 | ④ a/ flagstone (KA105)<br>b/ plag.-biot-gneiss-granulite<br>c/ basic dyke (KA106)<br>d/ fold.-biot-gneiss (KA107 | ④<br>b/ slate<br>c/ basic dyke (KA123)<br>d/ schistose gneiss (KA122)<br>e/ graphic pegmatite (KA121)<br>f/ white gneissic rock (KA120) |

So it can be seen that this sedimentary series need not be a separate series from the Archean but that the intensity of metamorphism increases to the N & E.

No faulting was seen at the basic dykes or pegmatites. Also Professor Howchin reports a slate on top of the conglomerate dip SE at 57° which we did not see.

Both the indicator quartzite and conglomerate end abruptly in the disturbed area between Charles Gully and the creek under mention as already ~~pointed out~~ said in the item on Archean Tectonics

## Permian

The boundaries of sands of this age are carefully indicated on Guppy's map.
Erratics of Victor Harbour Granite ~~were~~ were KA 57 & 101 were obtained in sections 361 & 278 respectively. KA 48 may be an erratic and also KA 84 A

## Tertiary

The tops of the peneplain mentioned in the item on physiography contain laterite which Sprigg says is tertiary in his papers on the Adelaide Hills.

## Recent

Alluvium apparently recent covered the hills and spurs in the area.

## Bibliography and Acknowledgments

I am indebted to 2 items pointed out by Sir Douglas Mawson in conversation and lectures, Professor Howchin's paper, "The Geology of the Victor Harbour, Inman Valley, and Yankalilla districts, with special reference to the Great Inman Valley Glacier of Permo-Carboniferous Age" (Trans. Roy. Soc. S.A. Aus. vol 1926) ~~&~~ various papers by R.C. Sprigg published as Trans. Roy. Soc. S.A. Aus., the text books set for 3rd & 4th year Geology and the staff and students of the Geology Department of the University of Adelaide