Thesis

for the M.Sc. Degree

by

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PART I : THE HORNFELS SERIES

Submitted for the degree M.Sc., University of Adelaide
1946

Presented 1946

THE HORNFELS SERIES OF THE EASTERN MOUNT LOFTY CHAIN.

These metamorphosed sediments occur over a very large area extending from Cape Jervis northward past Kammantoo and eastward until covered by the Miocene beds bordering the River Murray. They have given rise to the smooth and rounded topography that is in such contrast to the rugged scenery produced by the grits and quartzites of the central portion of the ranges. In the field, they are seen as dense, fine grained, dark grey rocks with little or no character, except in some areas, where a weak schistocity is produced by the development of Biotite.

This schistocity however, is rarely developed in the southern area. Marked similarity in appearance over such a large area has led field geologists to broadly classify them as the Hornfels Series. Associated with these hornfels are interbedded quartzites and slates which are only present in a minor role.

Microscopic examinations of some thirty-six rocks of this type selected over a large area, show that they may be classified into four different and interesting varieties:

1. Hornfels
2. Granulites
3. Greywackes
4. Schistose Greywackes

In general they may be described as fine grained sedimentary types which have undergone Regional Metamorphism in a mild form, Biotite being the index mineral. Stress has only played a small part in the metamorphic forces.

Much of the original structure of the sediments is still clearly visible although recrystallization has taken place to varying degrees. It is on this original structure of the rocks, which is visible only in microscopic examination, that the basis of the proposed classification hinges.

The classification of this metamorphized sedimentary series is based on mode of deposition and composition coupled with metamorphic variations.

When the insoluble material of land erosion is deposited in a geosynclinal basin near the limit of sorting action of wave and current, variations in sedimentary types are possible. Should the material be deposited within the zone of sorting, then we may expect an evengrained sediment, as the finer, usually argillaceus material, will be taken up into suspension and carried away finally coming to rest on the sea ~~floor~~ FLOOR beyond this zone of sorting.

However if similar material to the above be deposited or dumped, without any previous sorting, beyond the limits of sorting by wave and current action then we may reasonably expect an unevenly grained sediment to result as both coarse and fine material are deposited together and remain undisturbed. Thus, it can be seen, how similar material carried in suspension may produce two dissimilar sediments almost side by side, depending upon their place of deposition, in regard to the limits of the sorting action of wave and current.

In accordance with the above reasoning we may divide the sediments under discussion into two main groups.

1. Those deposited within the limits of sorting.
2. Those deposited beyond these limits.

In Group 1 it will be seen that further classification is necessary according to the composition of the sediment. In this case it depends upon the relative amounts of Quartz and Feldspar present. Hence we have -

A. The more Arenaceous types which have an appreciable proportion of feldspar but because of sorting have very little Argillaceous material and under the effects of metamorphism they have produced the HORNFELS.

B. The feldspathic varieties which have a fairly high quartz content but little fine argillaceous material. These have given rise to the GRANULITES.

In Group 2 we have the inequigranular members (which have been deposited beyond the sorting limits). These are composed of comparatively large, irregularly shaped grains of quartz and feldspar set in a fine, dark, argillaceous base which has a composition similar to that of slate. Metamorphism has produced schistosity in some and not in others. Hence we have:-

(A) The Greywackes.

Here biotite has been produced from the argillaceous base but shows little or no evidences of schistosity or preferred orientation.

(B) The Schistose Greywackes.

Here the Biotite in particular has developed a distinctly preferred ~~concentration~~ ORIENTATION to produce the schistose structure.

It is realised that variations within the above groups will occur as well as gradations from one type to another. Although an almost continuous gradation does exist in this suite of rocks it is felt that the separation into these four types will facilitate both description and discussion.

1A

THE HORNFELS FAMILY.

These rocks have been deposited within the limit of sorting by wave and current hence they contain very little of the finer argillaceous products of weathering. They consist essentially of quartz grains with felspathic material in a minor role. In general they are equiganular sediments. Under the effects of regional metamorphism these rocks show evidences of recrystallization especially in the quartz, giving rise to a granoblastic intergrowth of quartz, largely re-crystallized, and feldspar. The quartz feldspar ratio varies but the feldspar is always less plentiful than the quartz. The argillaceous material present has produced both biotite and chlorite, depending upon the intensity of metamorphism, as well as aggregation of tiny quartz grains. Generally directional properties, especially in the micas, are absent but in some cases a weakly preferred orientation is observed.

In the hand specimen they have a marked similarity amongst themselves as well as to the whole series of rocks under discussion. They are dense and fine grained sediments with a dark grey colour and possessing very few definite characteristics. They are composed essentially of quartz felspar and biotite.

1A. THE HORNFELS FAMILY.

This family show marked similarity to the Greywackes in the field in both colour and structure there being some difference such as slight variations in hardness etc. but these are usually in a minor degree.

Microscopically they are seen to differ very considerably and although both of sedimentary nature their mode of deposition is different. They are more equigranular than the Greywackes and appear to have been deposited just within the area of wave and current sorting.

Originally they were impure feldspathic arenaceous sediments. The argillaceous impurity is usually present in small quantities but does vary considerably. The feldspar also shows variation in abundance but is usually present and in several instances is almost as plentiful as the quartz.

These rocks have undergone varying degrees of metamorphism some being in the chlorite zone whilst others have produced biotite. The quartz has been recrystallized as has the feldspars in some instances. The base has produced the micas and fine quartz aggregations. Essentially their types consist of granoblastic grains of quartz and feldspar with micas present as flakes and lathes. Generally directional properties are absent but in some cases weakly preferred orientation in the micas is exhibited.

This family consist of quartz-feldspar-biotite hornfels.

SPECIMEN SLIDE A. LOCALITY WYNYARD - MT. BARKER

See PLATE I FIGURE 1.

In thin section this specimen is seen to be fine and very evenly grained consisting essentially of small granoblastic quartz and feldspar individuals, the quartz definitely predominating with flakes of chlorite altering to biotite evenly dispersed throughout.

The quartz grains have been recrystalized into their granoblastic nature and are generally clear and uncracked with indulase extinction. Their similarity in grain size is very noticeable and they form a mosaic throughout which the feldspar and micas are dispersed.

The feldspars are predominantly orthoclase as cloudy anhedral individuals with a similar grain size to the quartz toward which it is granoblastic. There appear to be some grains of pellucid feldspar, probably albitic in character. The alternation products of the onthoclase are sericite and calcite. In some instances tiny plumose aggregations of sericite are formed.

The micas consist of squat lathes and flakes evenly distributed throughout the rock and are composed of chloite altering to biotite. It is pleachroic in green and light brown to dark green to black.

Iron ores both Magnetite as rough cubes and Ilmenite as aggregations are common as are very tiny Zircons which are not affected by the metamorphism.

The rock is a quartz feldspar biotite hornfels.

SPECIMEN. 6257. SLIDE ~~R~~ 2663 LOCALITY 387 YANKA.

The rock is seen to consist of a mosaic of quartz with a little feldspar, towards which the quartz is markedly idioblastic, as well as micas.

The grain size of the quartz is fairly even but some smaller grains are present chiefly resulting from the re-crystallization finer material presumably argillaceous in nature considering the biotite and muscovite present. The quartz grains are generally clear and black with undulose extinction forming a granoblasic mosaic with the feldspar. The feldspars are slightly cloudy and consist of onthoclose and some albite (5 per cent?) the latter forming more definitely shaped grains than the onthoclose and usually clear.

The biotite occurs as dark brown flakes with slight pleo-chroism and is scattered throughout the rock. Small flakes of muscovite are evenly distributed but not nearly as plentiful as the biotite. They have been formed as a metamorphic derivative from the argillaceous base and frequently associated with the finer quartz grains of similar origin.

Apatite, epidote and zircons are present but iron ores are scarce.

Quartz - biotite - hornfels.

SPECIMEN 3478 SLIDE 1663 LOCALITY: ROSETTA HEAD

This specimen is very fine and evenly grained consisting essentially of quartz and biotites. The quartz occurs in a granoblastic state of small clear and uncracked grains which undoubtedly have been recrystallized. They form a mosaic throughout which the other minerals are dispersed. The biotite is abundant and occurs as small flakes of a highly pleochroic nature in light brown-dark brown. Aggregations are common and here the flakes exhibit a decussate texture and generally have a weaker preferred orientation. This is more noticeable because of the high pleochroism.

Some orthoclase is present as small grains towards which the quartz is idiomorphic a few clear grains of albite (5 per cent.) are also present. Magnetite with a little apatite and tourmaline are also seen as tiny grains.

Quartz biotite hornfels - weakly schistosic.

THE GRANULITES

These rocks are metamorphic derivatives of fairly pure Feldspathic Sandstones. Originally they were even-grained sediments in which the Quartz and Feldspar were in approximately equal proportion. Their fairly high degree of purity is exhibited by the minor role usually played by the Biotite and Chlorite. It will be seen that in general the grainsize is remarkably even and every evidence points to this holding true in the original sediments. Under the effects of metamorphism these rocks have developed a typical granoblastic structure, the Quartz recrystallizing and the Feldspar showing considerable alteration. The impurity, which appears to have been chiefly argillaceous in nature, has given rise to the Micas. These Micas show no preferred orientation and Schistose structure is in no way developed in the suite.

According to Harker (p. 246) and the terminology adopted by the Geological Survey of Great Britain these rocks may be described as GRANULITES.

Some slight variations are noticed in a few instances and these are dealt with in the microscopic descriptions of the suite below. In the field they appear very similar to the other types in this series as dark grey, dense sediments which have undergone regional metamorphism without showing noticeable macroscopic characteristics of metamorphism such as schistocity etc.

SPECIMEN 513 SLIDE 2093 LOCALITY Sect. 131. Hd. WAITPINGA.

SEE. PLATE. I FIGURE. 3.

This specimen is an even and finely grained metamorphosed sediment consisting essentially of Quartz and Orthoclase in an approximate ratio of 3:2. The Quartz and Feldspar show a granoblastic texture with the Quartz idiomorphic towards the Feldspar. The Quartz grains are of a clear recrystallized type frequently forming mosaic aggregation.

The Feldspars are highly altered and cloudy but generally appear to be Orthoclase. In some cases they have been reduced to an aggregation of tiny grains of Quartz and Sericite.

Calcite in a recrystallized form is dispersed throughout the rock and may have originated from the breakdown of the Feldspars.

The Micas consist of Biotite and Muscovite in approximately equal proportions. Muscovite forms larger flakes than the Biotite, as well as aggregations. It has no doubt originated from Sericite. The Biotite is highly pleochroic from almost colourless to dark brown and shows no evidence of preferred orientation. Ilmenite and apatite are common as detrital grains.

The rock is a metamorphased variety of a fairly pure Feldspathic Sandstone where the feldspar is almost as abundant as the Quartz, and according to the nomenclature of the Geological Survey of Great Britain (Harker 246), ~~their~~ THIS type of rock would be described as A GRANULITE.

SPECIMEN 6087. SLIDE 2373 LOCALITY FINNIS RIVER HD. KONDOPARINGA.

Slide 2373 shows great similarity to Slide 2093 in most respects except grain size. It is much finer grained and shows a more even texture than Slide 2093. The Quartz: Feldspar ratio in this rock is approx. 2: 1. Biotite is more abundant as tiny light coloured flakes and aggregations. Slide 2373 may be classified as a fine grained BIOTITE GRANULITE.

SPECIMEN SLIDE X LOCALITY

Inman Valley
Ducks Nest Creek

This specimen shows very distinct similarity to Slide 2373 and Slide 2093. In composition they are almost identical except that Chlorite is more plentiful in this rock than in the other two. In grainsize it approximates to Slide 2093 but possesses the evenness of texture and grainsize of Slide 2373. Slide X may be classified as CHLORITE GRANULITE.

SPECIMEN 5133 SLIDE 2095 LOCALITY Sect. 131 H.d. WAITPINGA.

Slide 2095 is very similar in texture and composition to Slide 2093. It varies in the following way. The Quartz: Feldspar ratio has changed from 3:2 to 2:3. The Feldspars are even more highly altered than in Slide 2093. Calcite is more abundant in this specimen and the Muscovite is far less plentiful. Biotite is more common and occurs as more as aggregations of flakes. This is a granulite richer in Feldspar than Slide 2093. It may be classified as FELDSPAR RICH GRANULITE.

SPECIMEN 6252. SLIDE 2662. LOCALITY Selwyns Rock INMAN VALLEY.

This specimen consists mainly of Quartz and Feldspar in approximately equal proportions and showing a granoblastic texture. It is even grained but somewhat coarser than is Slide 2093. The Quartz occurs as clear, uncracked individuals showing undulose extinction. There are some fine grained individuals which are a metamorphic product of impurities, probably argillaceous, in the original sediment.

The Feldspars consist chiefly of Orthoclase in a highly altered state with Calcite and Sericite the main alteration products. Some Oligoclase, with an approximate composition of 20% A.N., is also present and is only slightly less decomposed than the Orthoclase. A little Microcline as well as a few myrmekitic intergrowths of Quartz and feldspar are also seen.

Chlorite, altering to Biotite, is fairly plentiful and tends to form aggregations. It is pleochroic in green to green-brown. Sericite, as aggregations of minute grains, is fairly plentiful and in places has altered to Muscovite. Some small grains of Apatite and cubes of magnetite form accessary minerals. This rock is seen to be a CHLORITE GRANULITE.

SPECIMEN 6255 SLIDE Z670 LOCALITY MacFarlanes Hill Hd. Goolwa.

This specimen differs from the suite in the Quartz: Feldspar ratio. The Quartz outweighs the feldspar considerably. This is accentuated by the high degree of decomposition shown by the Feldspar which in many cases appear only as a Quartz-Sericite aggregation showing the form of the original Feldspar as a palimpsest structure. The Quartz generally is highly idiomorphic towards feldspars and occurs as granoblastic individuals with inclusions and some cracking. The Feldspars appear to be orthoclase but alteration hides their true composition.

There is a considerable amount of fine grained material chiefly Quartz and Sericite which has originated from Feldspars and probably from an argellaceous impurity. Chlorite is abundant in light green flakes showing faint pleochroism. Some muscovite, probably from Sericite, is also present. Epidote is very plentiful both as individuals and aggregations of smaller grains. It is usually associated with iron oxides and Chlorite. This rock is IMPURE CHLORITE GRANULITE.

SPECIMEN 5092 SLIDE 2066 LOCALITY Middleton Beach Eastern End

Essentially similar to A in character consisting of granoblastic Quartz and Feldspar grains with an even grain size as well as Mica dispersed throughout. The rock has been metamorphased to a lesser degree than A as exhibited by the Mica being Chlorite and that the Quartz has not cleared itself of inclusions as much as was seen in A. Mineralogically Quartz and Feldspar are the most important minerals and are in an approximate ratio of 2: 1. The quartz contains dusty inclusions and has an unduclase extinction and invariably idioblastic towards the Feldspars.

SPECIMEN 5092. SLIDE 2066 LOCALITY Middleton Beach Eastern End

The Feldspars are very cloudy and altered and are orthoclase in all determinable instances. In spite of their abundance their character appears subdued by the idioblastic Quartz. In some places there are aggregations of Smaller Quartz grains which have been recrystallized no doubt from finer instertical material, this not prevalent.

The Chlorite is plentiful in the form of lathes and flakes which frequently form aggregations with a radiating texture. They are bright green in colour and only weakly pleochroic.

Iron Oxides are very plentiful both as aggregations of tiny grains of ilmenite and as larger individuals, cubic grains of magnetite.

This specimen is a CHLORITE GRANULITE.

SPECIMEN 6258. SLIDE 2666 LOCALITY 5136 Kanmantoo

This specimen shows some differences from the suite as a whole in that there are larger phenoblastic individuals of Quartz present and a definite schistose structure. The rock consists of Granophysic Quartz and Feldspar with Micas showing preferred orientation. There are two types of Quartz present, the Larger phenoblasts of Quartz set in the fine granophysic intergrowth of recrystallized Quartz and Feldspar. The Quartz is idioblastic towards the Feldspar which is very cloudy and altered. The Quartz Feldspar ratio is approx. 2:1 to 3:2. The Feldspar consists of Orthoclase entirely, as well as can be determined on account of alteration. The Biotite occurs as long lathes, light brown in colour and

SPECIMEN SLIDE 2666 LOCALITY 5136 Kanmantoo

very highly pleochroic in light to very dark brown. These show strongly preferred orientation and tend to dominate the texture of the rock. Muscovite is present in larger individuals which are chiefly tabular in shape and show a slight degree of orientation. Apatite, Zircons and Iron Oxides are present in small amounts.

This may be classified as SCHISTOSE BIOTITE GRANULITE.

THE GREYWACKES

The Greywackes form the largest group in the series. They were deposited just beyond the sorting action of wave and current and hence are highly inequigranular in texture, consisting essentially of irregularly shaped grains of Quartz and Feldspar dispensed throughout a very fine and highly argillaceous base which predominates over the much coarser clastic material. The quartz Feldspar ratio is about 2:1 in most instances. They show the basic characteristics of what Pettyjohn (Bull, American Geol. Survey vol. 54, 1943, pp 925-972) classifies as a Greywacke.

They have all undergone regional metamorphism up to the Biotite Zone of Harker. The larger Quartz and Feldspar individuals exhibit little in the way of alteration but the fine base has reacted to the metamorphic forces producing Biotite and general recrystalization to a slight degree. The stress factor has not been high and directional properties in the micas are generally absent.

THE GREYWACKE TYPES

These may be described microscopically as dense and fine grained, dark grey rocks with few definite characteristics and consisting essentially of quartz, feldspar and biotite.

Microscopically they show definite characteristics as will be shown by the following examples.

ROCK 5140 SLIDE 2102 1373 Hd. Waitpinga.

Microscopically this rock is seen to be highly inequigranular and is composed of large irregular shaped grains of quartz and feldspar dispersed throughout a fine and even grained base showing the effect of metomorphism.

SLIDE 2102 (Contd.)

The larger grains are chiefly quartz occurring in irregular shapes with an average grain size of .35 mms although many are much larger than this. Generally they are clear and cracked showing some effects of strain and have serrated edges due to a tendency towards resorption under agencies of metamorphism.

Orthoclase is the next in abundance of these larger clastic individuals, showing a high degree of alteration and more resorption than the quartz. Alteration products are chiefly sericite and calcite. They have a similar grain size to the quartz and are generally cloudy and tend to merge into the ground mass. Some plagioclases are present. The ~~more~~ less altered ones show a composition of about AN 32-35 giving Andesine. These plagioclases are far less prevalent than the Orthoclase.

The quartz outweighs the combined feldspars in the ratio of about 3:1.

The base of this rock is seen to be of a fine grained metamorphosed character. It appears to have been an impure argillaceous paste similar to a slate in composition throughout which were dispersed coarser grains of apatite, tourmaline and smaller zircons. Upon metamorphism the finer material has formed biotite of a highly pleochroic nature, some larger lathes of muscovite and tiny grains of sericite. Epidote has also been formed appearing as roughly rounded grains also some magnetite grains are present. The quartz has recrystallized as small clear individuals and blebs frequently forming aggregations and sometimes vermicular intergrowths. Some clear Albite individuals have been formed through metamorphism. They have an extiction angle of -13 degrees in the symetrical zone which gives them a composition of 3% AN.

SLIDE 2102 (Contd.)

There are some aggregations of recrystallized quartz and biotite which by their structure suggest the complete digestion of larger individuals which may have been slatey in character.

It can be seen by the texture of the rock that before metamorphism it was a highly inequigranular sediment. The larger quartz and feldspar individuals having been dumped indiscriminately along with the finer and more argillaceous paste which forms the base. Assuming this to be correct the rock is seen to be a Greywacke.

SPECIMEN 5134 SLIDE 2096 215 Waitpinga.

This specimen shows the basic characteristics of the suite. The quartz grains are irregular, clear and cracked showing the effects of strain. The feldspars play a slightly more prominent part and are more highly altered. They consist of orthoclase which is frequently so altered it is difficult to distinguish from base. Some secondary Albite has been developed by metamorphism.

The base is also typical but slightly more recrystallized. The quartz is noticeably recrystallized forming mosaics and frequently as vermicular intergrowths with the highly adsorbed feldspars. Some recrystallized calcite is noticeable throughout this base. Iron ores are a little more plentiful.

SPECIMEN 5135 SLIDE 2097 130 Waitpinga.

Again this shows the character of the suite but recrystallization has gone on to a greater extent. Some of the larger quartz individuals exhibit greater resorption and a small degree of recrystallization. Albite with a

SPECIMEN 5135 SLIDE 2097

comp. of 4 per cent AN is more prevalent and in larger individuals than usual. The Orthoclase is very highly altered and the greater recrystallization of the base makes this specimen to appear somewhat similar to the granulites. The quartz feldspar ratio and the important role of the base although highly recrystallized, however stamps this specimen as being of the Greywacke type.

SPECIMEN 5137 SLIDE 2099 130 Waitpinga.

Here the quartz grains show a wide variation in size, some being up to .9 mm but the average grain size of the larger detrital quartz grains is in the vicinity of .4 mm. The longer individuals show extensive cracking and marked strain shadows. In many cases the effects of strain and recrystallization have produced mosaics. The Orthoclase is again highly altered and adsorbed, frequently grading down to an intergrowth of quartz and sericite whilst vermicular intergrowths of quartz feldspar are common. Plagioclase individuals are fairly plentiful although highly altered — possibly Andesine. Some Secondary Albite (5 per cent AN) is present as moderately fresh grains.

The base again shows the scope of metamorphism consisting of recrystallized quartz, biotite, calcite, sericite and muscovite. The accessory types of minerals are more prevalent, including apatite epidote and tourmaline with numerous small zircons. Magnetite is fairly plentiful in aggregations and associated with the biotite.

Some quartz-biotite aggregations in the base suggest the total reformation of clastic material possibly of a slatey nature.

SPECIMEN 5138 SLIDE 2100 71 Waitpinga.

see PLATE I FIGURE 2.

This specimen shows most of the characteristics of the series. As recrystallization of the base has not reached quite such an advanced state as in some cases we may more clearly see what the suite looked like before metamorphism. The larger individuals of the quartz and feldspar stand out very distinctly from the finer base. They also exhibit more of their originally irregular shape. There are several knots and whorls of sericite, and chlorite, ~~biotite~~ with recrystallized quartz which suggest the presence, originally, of larger elastic pieces of fairly argillaceous material. The biotite is a little more plentiful and fairly clear. The base, although generally recrystallized, still shows much of its original texture - fine grained and non-laminated.

SPECIMEN 7068 SLIDE 2671 Aarons Hole, Waitpinga.

This rock exhibits the typical inequigranular, holocrystalline nature of the suite. The large individuals are predominately quartz and feldspar in the ratio of 2:1. The quartz grains are highly cracked, many indeed are fractured, and accompanying this cracking, is the recrystallization of some individuals. In spite of these effects of stress there is no directional structure developed and many of the large grains still retain their highly irregular shape. The orthoclase, although cloudy, is considerably less altered than usual in many cases. Some oligoclase is present but only in a small amount. The base is typical of the suite showing a fair amount of recrystalization amongst the quartz and metamorphic effects on the argillaceous matter giving the usual biotite, some muscovite, epidote etc. A large detrital tourmaline is seen in this section.

SPECIMEN 7069 SLIDE 2672 Tappernappa Ck., Waitpinga.

This is finer grained than the suite as a whole but still shows the typical structure. The quartz shows slightly less cracking but a fair degree of recrystallization. The feldspars are again weathered. The ground mass has produced smaller flakes of clearer biotite which are not so pleochroic as usual. The texture and composition of the base is very even, whilst garnets of an indeterminable composition and apatite are plentiful as small rounded grains.

SPECIMEN 6256 SLIDE 2664 Pioneer Mine, Callington

In mineral assemblage this specimen conforms to the suite but the texture of the base differs. The micaceous material except for some muscovite, is exceedingly fine grained and although some biotite has formed there appears to be large amounts of sericite and some chlorite as minute flakes. This produces a pale and very cloudy base which contains fine calcite. The feldspars show weathering to a high degree which is usual but the quartz grains vary considerably in size.

SPECIMEN 5130 SLIDE 2092 131 Waitpinga.

Shows two variations within the suite one mineralogical and the other in texture. The effects of metamorphism are more pronounced than usual, giving rise to a higher degree of recrystallization especially in the ground mass. The quartz and feldspar phenoclasts show adsorption to a marked degree, highly serrated edges being exhibited by the quartz whilst the Orthoclase is frequently totally adsorbed leaving only a palimpsest structure to distinguish it from the ground mass.

SPECIMEN SLIDE 2092 (Continued)

The mineralogical variation is seen in the quartz feldspar ratio which is approximately 1:1. Although at first glance the quartz appears to predominate due to adsorption of feldspars. In spite of this variation and the higher degree of recrystallization the rock is undoubtedly a metamorphized greywacke.

SPECIMEN 5144 SLIDE 2106 1347 Waitpinga.

Again a more highly metamorphosed variety and shows distinct similarity to 2092 varying chiefly in the quartz feldspar ratio, which is about normal for the suite in 2:1. Quartz mosaics are very plentiful but the base shows slightly less recrystallization.

SPECIMEN 5145 SLIDE 2107 1340 Waitpinga.

This specimen is a much finer grained than usual. The phenoclasts have an approximate grain size of .2 mms and yet in spite of their smaller size they form definite phenoclasts. The quartz feldspar ratio of these individuals is about 3: 1. The recrystallization of the base is fairly advanced and some such recrystallized quartz approaches the phenoclasts in size but are distinctly different in shape. An interesting skeletal crystal of epidote and quartz is seen in the sections studied. This specimen is thus seen to be a fine grained member of the greywacke suite.

SPECIMEN 6251 SLIDE 2661 115 GOOLWA

Again shows recrystallization of base to a high degree. The feldspars are greatly altered and resorbed whilst the quartz has formed fair sized individuals by recrystallization. Amongst the phenoclasts the quartz:feldspar ratio approximates 1:1. The average grain size of these phonoclasts is smaller than usual being about .35 mms. The biotite is darker coloured than usual and although finely grained forms decussate aggregations. Apatite is more plentiful than usual.

SPECIMEN 6253 SLIDE 2669. LOC. WALSH'S QUARRY

This specimen is almost identical to 2661 (115 Goolwa) in composition and structure, differing chiefly in slightly longer and more plentiful quartz phenoclasts which show a higher degree of adsorption. Albite and epidote are slightly more plentiful and the whole appearance suggests a slightly higher degree of metamorphism.

SPECIMEN 6249 SLIDE 2668 LOC. S. of NEWLANDS HILL

Shows similarity to 2096 in composition and structure but has undergone a slightly higher degree of metamorphism. This has resulted in more recrystallized quartz and micas. Muscovite is present no doubt at the expense of Sericite. The Biotite is more plentiful and darker forming dark aggregations of small grains and associated with iron oxides. This appears to indicate argillaceous rich areas in the original base of possibly phenoclasts of argillaceous material.

THE SCHISTOSE GREYWACKES

These form a variation of the general GREYWACKE family which predominates throughout the area. Originally these rocks had a similar origin to the normal greywackes being inequigranular sediments having been dumped beyond the sorting action of wave and current. Some, however, possess a banding exhibited by the fine base which is unusual to the characteristics of the suite. These bands almost free of phenoclasts and under the agencies of metamorphism produce mica rich bands. This is by no means common and cannot be considered as characteristic to the suite. The chief difference is the schistocity of the base which, under the effects of regional metamorphism, has produced mica with a definitely preferred orientation. In some cases there is a tendency for the phenoclasts to be oriented parallel to their long axis.

SPECIMEN 5141 SLIDE 2103 LOCALITY Sect 1373 Hd. WAITPINGA

This specimen shows a higher degree of metamorphism than the other members of this suite. The base has been almost entirely recrystallized and some areas ~~of~~ are, very finely grained, consiting of tiny quartz and mica grains, suggest the total recrystallization of an argillaceous phenoblast. The quartz and Feldspar phenoclasts are cracked and show evidence of recrystallization giving mosaics and intergrowths respectively. Epidote as a metamorphic mineral is very plentiful, frequently approaching the phenoblasts in grainsize. The Biotite is plentiful, pleochroic in brown to very dark brown, and forming lenticular aggregation and a general schistose structure but not as marked as usual. Calcite is abundant in large aggregations which have been recrystallized.

SPECIMEN 6250 SLIDE 2665 LOCALITY
171 Encounter Bay

Slide G shows great similarity to Slide 2105 in nearly every respect. It differs only in the degree of metamorphism as recrystallization of the base is not so marked as in Slide 2105 nor are the Biotite individuals as dark. However, they show a higher degree of preferred orientation in this specimen.

SPECIMEN 6254 SLIDE 2667 LOCALITY
Croziers Hill, Encounter Bay.

This slide shows a textural change from Slide 2101 as it more closely resembles the normal unstressed greywackes like Slide 2102 in minerological makeup. It is almost identical with Slide 2102 but the base has become Schistose due to the preferred orientation of Biotite. Recrystallization of the quartz in the base is prevelant, producing fine mosaics in some cases.

SPECIMEN 5142 SLIDE 2104 LOCALITY
143 Waitpinga.

Slide 2104 has a similar mineralogical character to Slide C but the texture differs in that the Phenoclasts tend towards elongation parallel to the schistosity of the base. The groundmass has developed fine grained Biotite which shows definite preferred orientation and is highly pleochroic from light green brown to dark brown, which tends to accentuate the schistose nature of the base. Flow structure by the biotite around many of the Phenoclasts is noticeable throughout the section studied. A thin band rich in fine micas is noticed running across the section.

SPECIMEN 5143 SLIDE 2105 LOCALITY 1353 Waitpinga.

This specimen is almost identical to Slide 2104 differing mainly in base which is more highly recrystallized. The Biotites are darker in colour and show a tendency to form lenticular aggregations with which is associated Epidote and Iron.

SPECIMEN 5132 SLIDE 2094 LOCALITY 131 Waitpinga.

Slide 2094 distinct similarity to Slide 2101 in character, the Phenoclasts are a little more evenly distributed throughout the base but are of a similar grain size. The feldspar is less plentiful and slightly more adsorbed, they are chiefly orthoclase but a little albite-rich labradorite is present in a highly altered state. The quartz phenoblasts show little cracking but invariably have strain shadows. The base is again fine and the quartz has begun to recrystalize. The Biotite is plentiful and shows strongly preferred orientation and is highly Pleochroic. Magnetite, Epidote, Apatite and Tourmaline occur as tiny grains throughout the base along with some longer flakes of muscovite which does not show the directional character of the Biotite.

SPECIMEN 5758 SLIDE 2210 LOCALITY Mt. Magnificent

Slide 2210 similar to Slide 2101 in most respects but shows a few differences. The grainsize is a little smaller than is usual in the suite but it still exhibits Phenoblasts embedded in a fine base. The structure exhibits directional properties but to a less marked degree, especially

Specimen 5139. Slide 2101 Locality, 54 Waitpinga.
SEE PLATE I FIGURE 4.

This specimen is characteristic of this group of greywackes in that it exhibits the texture of the phenoclasts of quartz and feldspar, set in the fine grained base which shows definite schistosity.

The phenoclasts are chiefly quartz and occur as irregularly shaped grains which are clear and cracked, showing adsorption in their serrated edges and some recrystallization in the mosaics which tend to form lenticular aggregation. The feldspar grains are chiefly orthoclase but a little plagioclase present and appears to be andesine. These feldspars show extensive alteration and in many cases have merged into the base.

The base shows the variation of the suite from normal greywacke family. It is fine grained in character and has become slightly recrystallized by the metamorphic forces which have also produced a preferred orientation in the biotite formed by this metamorphism. This directional structure is a typical characteristic of this suite. The biotite is generally in small lathes in distinction to the flakes formed in the non-schistose suite. This preferred orientation is very noticeable in the pleochroism which varies from light brown to very dark brown, all lathes showing the same colour at the same time. Muscovite is present and also exhibits this preferred orientation. Clear albite (5%AN) has been formed in the base and also epidote which tends to become elongated parellel to the schistosity. There is a tendency towards the phenoclasts forming bands in the base but it is not very noticeable in this section.

SPECIMEN 5758. SLIDE 2210 (Continued)

amongst the dark micas which are finer grained than usual and lighter in colour. The Feldspars show less alteration. Some Oligoclase (18% AN) has formed as a metamorphic product. The rock has not been metamorphosed to the same degree as Slide 2101 and the effects of stress are less noticeable.

CONCLUSION.

It can be seen that the majority of the rocks forming this sedimentary series are greywackes. However, there can be no real purpose served in altering the nomenclature from Hornfels Series to Greywacke Series, as it is almost impossible to differentiate between the different types in the field. As they occur over a large area and have little character, they can be of small value as marker beds or of any real importance in zoning.

Nevertheless, it is as well to point out the true character of these sediments for more than academic reasons. At the moment they are considered to be altered Adelaide Series; however, some workers are doubtful of their true position in the stratigraphical column. It is hoped that the above petrological classification will be of use in any enquiries that may be made into the true significance of the sediments.

PLATE I.

Figure 1 Hornfels.

Rock No. Slide No. Locality, Mt. Barker.

Typical hornfels consisting chiefly of quartz with some altered feldspar. The micas are mainly biotite with some flakes of muscovite, apatite, as an accessory mineral, occurs as small rounded grains.

Figure 2. Greywacke.

Rock No. 5138 Slide No.2100 Locality, Section 71, Hd. Waitpinga.

The rock is comprised of large irregularly shaped phenoclasts of clear quartz with some phenoclasts of altered feldspar. The fine grained base is partially recrystallized and consists of tiny quartz grains with biotite flakes and some albite. Accessory minerals are apatite and tourmaline.

Figure 3. Granulite.

Rock No. 5131 Slide No. 2093 Locality, Section 131, Hd. Waitpinga.

Large phenoclasts of quartz, some are recrystallized and highly altered feldspars in approximately the same proportion. The fine-grained base is purely insterticial and consists of quartz, celar feldspar and biotite with some sericite. Accessory minerals are apatite and iron oxides.

Figure 4. Schistose Greywacke.

Rock No. 5139 Slide No. 2101. Locality, Section 54, Hd. Waitpinga.

Phenoclasts of quartz and altered feldspars are set in a fine base showing a schistose texture. Biotite is abundant and muscovite fairly plentiful. These micas form long lathes with a highly preferred orientation. Accessory minerals consist of apatite, zircon, and iron oxides.

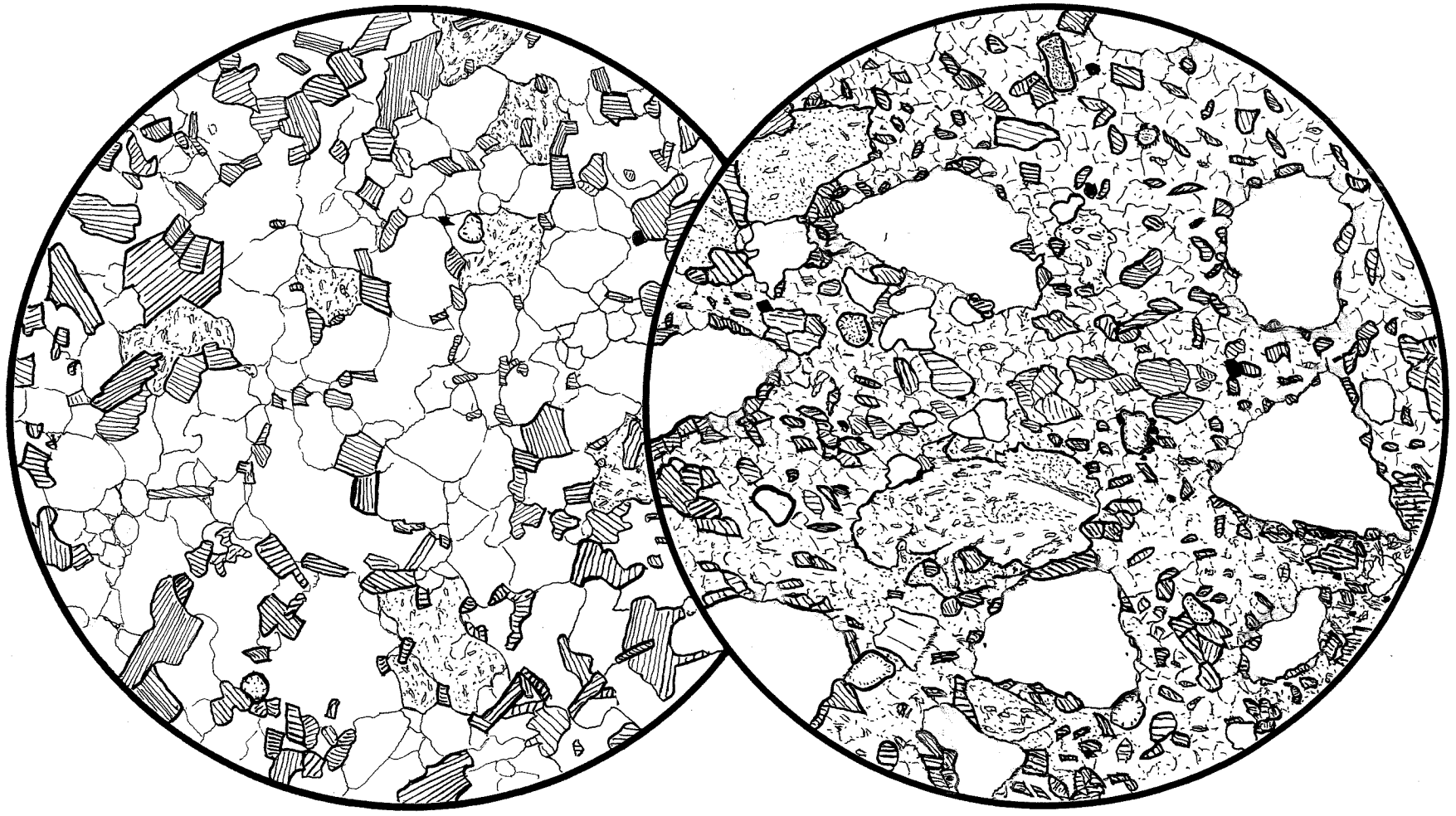

Fig. 1

Fig. 2

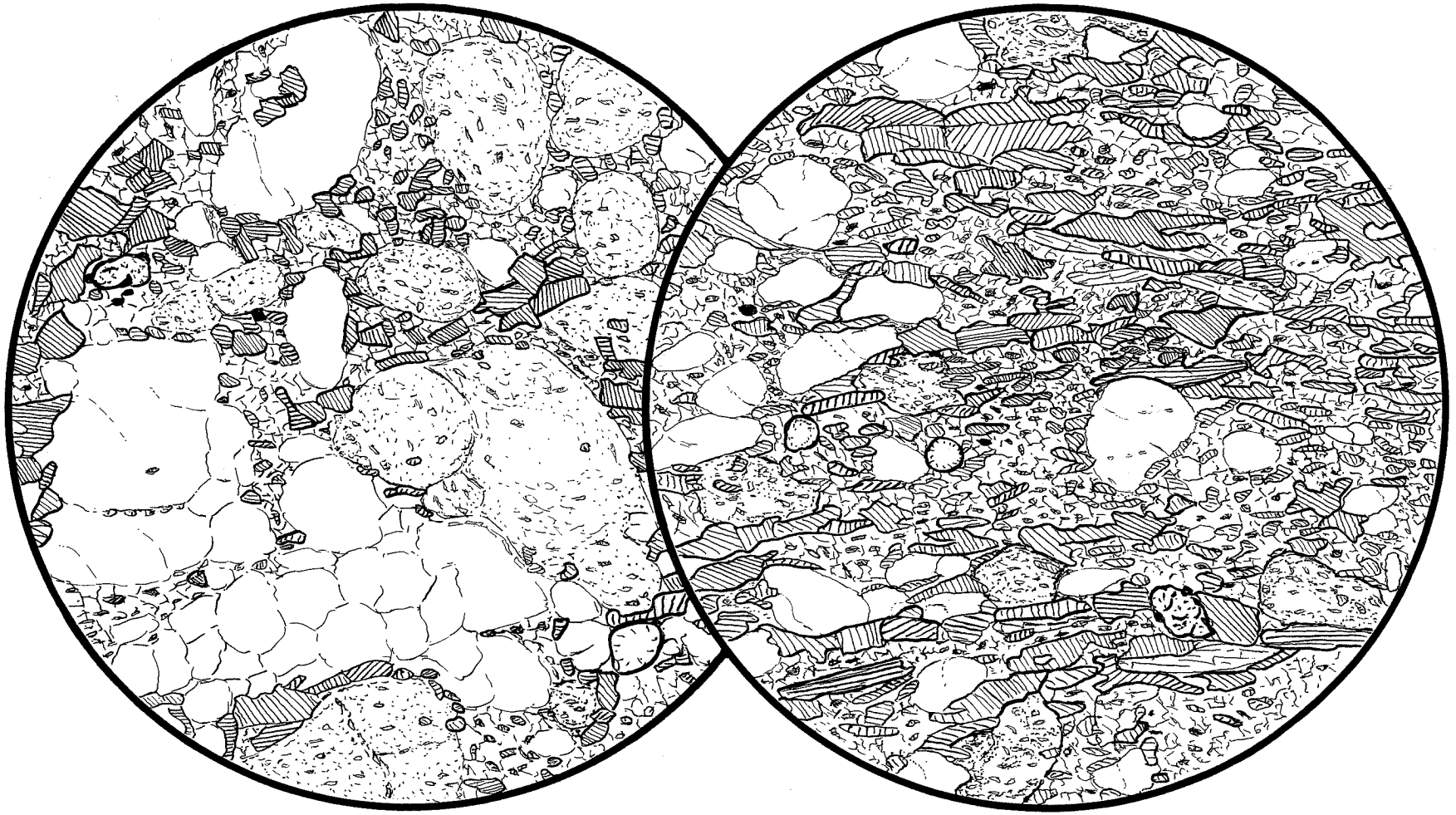

Fig. 3.

Fig. 4.

PLATE II

FIGURE: 1

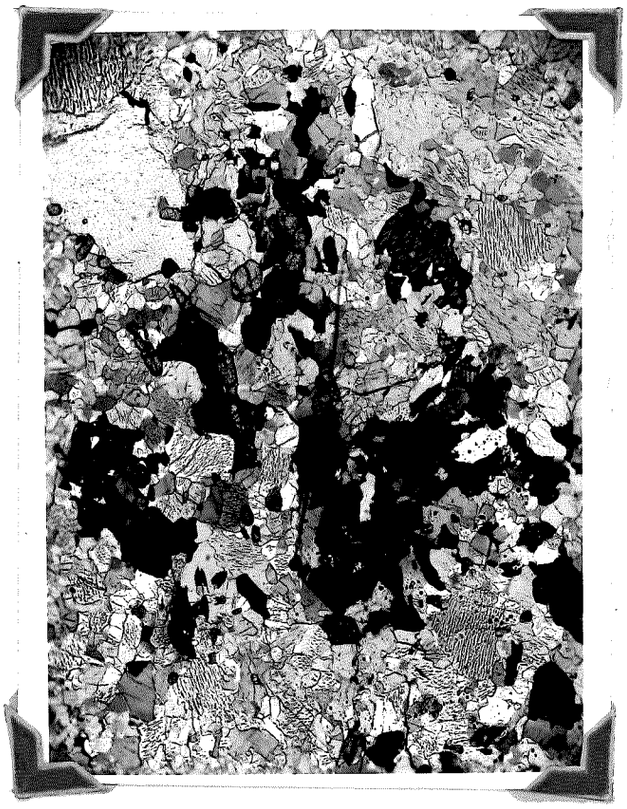

FIGURE: 2

FIGURE: 3

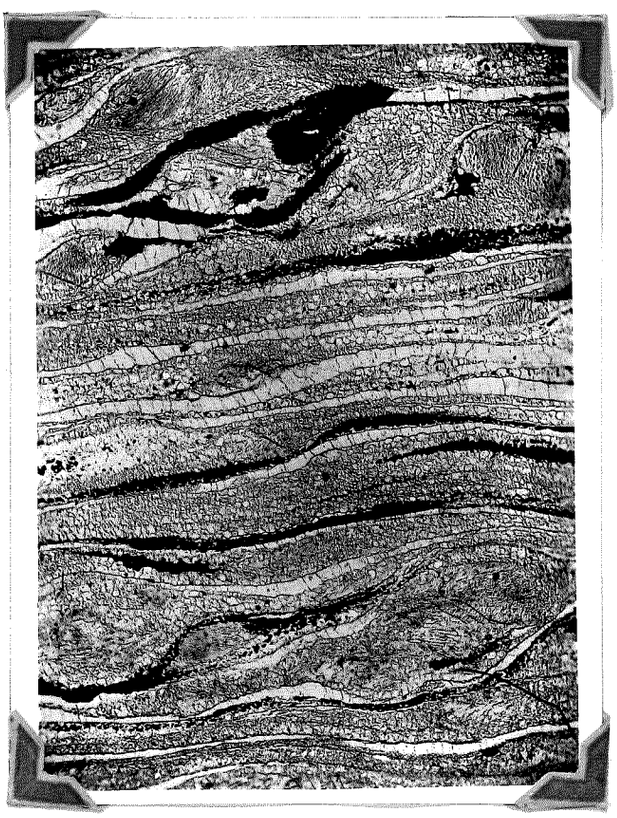

FIGURE 4.