1960/36 B

COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

1960/36

MISCELLANEOUS PETROGRAPHIC AND MINERAGRAPHIC INVESTIGATIONS DURING THE PERIOD JANUARY - JUNE, 1959.

Compiled by

W.R. Morgan.

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Miscellaneous Petrographic and Mineragraphic Investigations During the Period January - June, 1959.

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W.R. MORGAN.

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INTRODUCTION

This record consists of a collection of reports completed by the personnel of the Bureau petrographic and mineragraphic laboratory during the period January to June, 1959. The reports are in chronological order, and each one has its date of completion, and the relevant file number above its heading.

The Geological Officers responsible for these reports are W.B. Dallwitz (Senior Geologist), W.M.B. Roberts, (Geologist Grade III), W.R. Morgan (Geologist, Grade I) and W.Oldershaw (Geologist, Grade I). Mr.Roberts is in charge of X-ray and mineragraphic work, and Messrs Dallwitz and Morgan, and Dr.Oldershaw deal with the petrographic work.

The reports need no elaboration. Some, such as No.10, were written in the form of letters, and have been slightly altered and given a title.

12DN/1 25th February, 1959.

1. THE PETROGRAPHY OF TWO SPECIMENS COLLECTED FROM NEAR BOWNING, N.S.W.

by

W.B. Dallwitz

Following are very brief descriptions of two rocks submitted by Miss J. Gilbert and Tomlinson.

A. Goulburn 4-mile Sheet (155/12), Road section, about 1 mile south of Bowning, N.S.W. Slide 2726.

In a fine-grained groundmass consisting of plagioclase and very much subordinate uralitized pyroxene are set fresh and altered euhedral phenocrysts of plagioclass and pyroxene. Many of the plagioclase crystals are saussuritized in varying degree, but some are quite fresh. Their composition as determined on combined albite - Carlsbad twins is labradorite (An65-70), which is somewhat calcic for normal andesite.

About half of the pyroxene crystals are colourless to very pale green augite, and are, with very few exceptions, completely fresh. The remainder are pseudomorphed by what appears to be uralite; these may have been originally some other pyroxene, possibly hypersthene; however, two crystals of augite are partly replaced by uralite, and it seems possible that all of the pyroxene was augite. Nevertheless, it is difficult to understand why so many of the crystals should show no sign of alteration if only one pyroxene was present.

A few grains of black iron-ore and a few small pseudomorphs of magnetite after lamprobolite are present.

The rock is a porphyritic augite andesite which shows partial uralitization and saussuritization.

B. Goulburn 4-mile Sheet (155/12), Quarry on western side of Mt. Bowning, ½ mile south of Bowning. Slide 2727.

This specimen is different from the andesite.

It is a silicified and otherwise altered dacite or granodiorite porphyry, depending on whether it is extrusive or intrusive.

The groundmass appears to consist entirely of a mosaic of small quartz grains so crowded with minute indeterminate inclusions as to resemble, in ordinary light, a devitrified glass. However, between crossed nicols the coarser appearance of the groundmass is evident, and it seems that all feldspar has been completely replaced by quartz.

Porphyritic crystals of oligoclase which are partly sericitized and kaolinized, and contain very small veinlets and pockets of golden yellow (?) nontronite, are abundant. Some small phenocrysts of possible orthoclase were noted, but their true identity could not be established. No porphyritic quartz appears in the slide, nor was any seen in the handspecimen. Pseudomorphs of (?) nontronite after probable pyroxene phenocrysts are not very common; no unaltered ferromagnesian remains in the slide examined.

Hydrated iron oxide pseudomorphs black iron ore, and also stains the whole rock rather uniformly. Specks of leucoxene are scattered throughout the groundmass.

187G/1 6th April, 1959.

2. THE PETROGRAPHY OF A FLAGGY BUILDING STONE FROM NEAR HARDEN, N.S.W.

By

W.B. Dallwitz.

Following is a brief description of a specimen of flaggy building stone recently submitted by Mr. M.J. Moir, and which comes from 16 miles North-east of Harden, N.S.W.

The slab of stone measures about 8½" x 7" x 11/12"; it is pale greyish buff, and appears to be a fine-grained sedimentary quartzite. Brown, concentric, iron oxide stains form prominent markings on the polished surface and the naturally broken surface parallel to it; these markings are continuous between the two faces. It seems likely that the direction along which the specimen has broken is the direction of bedding, as scattered flakes of muscovite lie more or less parallel to it. On a fresh fracture the rock appears not to behave quite perfectly for a quartzite - i.e., there seems to be some breaking around the grains; however, the clear impression remains that the rock is closer to being a quartzite than a sandstone.

In thin section the rock is found to be fairly evengrained (average grainsize is about 0.1 mm.). Quartz makes up about 90-95 percent of the rock. The boundaries of most of the grains are somewhat irregular due to addition of secondary silica in optical continuity with that in the original detrital grain. In a number of places the rounded shapes of these original grains can still be clearly seen, but an outer shell of optically continuous secondary quartz is invariably present. Many of the quartz grains are quite strongly strained, and elongation of a very high proportion of them is at once apparent. The long axes of these grains show quite good parallelism in a direction making an angle of almost exactly 20° with the supposed direction of bedding (see above).

Apart from quartz, some fragments of fine-grained siliceous and sericitic rock, and possible sericitized feldspar are present; the siliceous fragments may represent sediments and/or felsitic volcanic rock. Accessories are muscovite, leucoxene, black iron-ore, and very rare zircon, tourmaline, and rutile or one of the other TiO_2 minerals.

The rock is a very fine-grained, flaggy quartzite.

198NT/1 7th April, 1959.

SPECIMENS OF CULLEN GRANITE

AND ASSOCIATED ROCKS SUBMITTED BY J. HAYS

By

W. Oldershaw

D7 (Slide No. 2743) is a fine-grained black rock having a conchoidal fracture. It is harder than steel and so probably has a siliceous matrix. It has a minutely pitted weathered crust about ¼" thick.

Under the microscope the rock is seen to consist of irregularly shaped angular phenocrysts of quartz and felspar up to 0.5 mm across set in a patchy matrix of varying grain-size.

The larger felspar phenocrysts do not show albite twinning as well as the smaller and more irregular shaped crystals. The felspar is a biaxial opticaly +ve plagioclase having a 2V of about 75-80 degrees and extinction angles normal to 010 of 8-10 degrees. It therefore appears to be an albite-oligoclase plagioclase. The margins of the crystals are minutely irregular and diffuse and the groundmass minerals appear to penetrate the phenocrysts slightly.

The quartz phenocrysts are rather more rounded though they still have the minutely irregular margins. One of them is marginally embayed in a similar manner to the quartzes found in acid porphries.

The groundmass consists of minute, irregularly shaped, intergrown crystals having an R.I. below Canada Balsam and polarising in greys. A few crystals show one or two faint twin lamellae and so the groundmass may consist of albite-oligoclase. On the other hand the texture is characteristic of chalcedony and the groundmass is harder than steel which suggests that it is siliceous. Unfortunately the matrix is so fine-grained that its identification is very difficult and both silica and albite-oligoclase may be present in unknown proportions. The groundmass is rather patchy and the grainsize varies from patch to patch. The groundmass contains a lot of minute sericite and chlorite flakes and a little epidote and iron-oxide dust.

The accessory minerals: A few patches of rather brown-stained calcite occur, probably filling geode or drusy cavities. Large, colourless, irregularly shaped sphenes range up to 0.2 mm across and some occur in the centres of clear albite phenocrysts where they were probably formed by the alteration of the felspar. Small prismatic, highly birefringent zircons and small acicular apatites are scattered through the rock as well as numerous diffuse clots of minute granular magnetites.

The rock appears to be a porphyritic, acid, igneous rock having a groundmass of albite-oligoclase and possibly some quartz, though the proportion of the latter is hard to estimate. The confused nature of the groundmass and the minutely irregular resorbed margins of the phenocrysts suggest that there has been some post-crystallisation metasomatic alteration and reorganisation.

The rock does not appear to have been basic igneous rock such as a dolerite, for the plagioclases are too sodic and there are no traces of any mafic minerals nor of chlorite pseudomorphs derived from them. The rock is probably a quartz-albite-dacite.

D8 (Slide 2741) is a faintly foliated brownish grey rock containing lighter coloured phenocrysts.

Under the microscope it is seen to be a highly altered rock composed of felted sericites and penninites ranging up to 0.1 mm across and larger fresh muscovites up to 1 mm across. Numerous euhedral rectangular phenocrysts up to 1 mm across occur of a grey cloudy mineral containing sericite flakes and other inclusions. One crystal showed albite twinning having an extinction angle of 15° normal to 010. This evidence plus the fact that the R.I. of the phenocrysts varies around the R.I. of Canada Balsam suggests that the mineral is probably albite-oligoclase. Unfortunately the rock is so altered that no good optic axis figures could be obtained, and only two or three crystals showed albite twinning.

Numerous large phenocrysts of quartz up to 2 mm across were found. They were unusual in that along their margins they were invaded by euhedral plagioclases growing out from the surrounding matrix. These ophitic quartz phenocrysts were crowed with gas bubbles, long needles of apatite and sericite dust. They also showed well marked strain shadows but were not broken or shattered.

The groundmass of the rock contains patches of minute, shadowy, intergrown quartzes. They do not appear to be granulated and are more likely to be a result of secondary silicification. There are no signs of any mafic minerals at all such as green, iron rich chlorite pseudomorphs etc. The rock contains scattered patches of granular black iron ore, some having coatings of leucoxene, and lines of hematite staining which were probably introduced along planes of shearing.

The rock appears to be a highly altered, probably metasomaticaly altered, igneous rock. The original rock was probably a coarse-grained acid rock possibly a quartz-diorite, a granodiorite or even a granite. Unfortunately we cannot be more informative or precise as the rock is so highly altered that everything is obscured by penninite and sericite. Although the rock appears to contain shear planes only the quartz phenocrysts show any signs of tectonic deformation such as strain shadows. The euhedral felspars, and the fresh muscovites, show no signs of crushing. on the other hand the muscovites could be a late stage metasomatic introduction, probably along with some of the iron on the shear planes.

W.B. Dallwitz suggests that the rock may be a somewhat sheared and altered acid differentiate from a basic magma. Granophyric differentiates from dolerite are plentiful in the South Alligator River area, and similar differentiates from gabbro or dolerite are found near Hatches Creek. The main reasons for suggesting that the rock is such a differentiate are:

(1) Chlorite is too plentiful for the rock to have been a normal acid type. The handspecimen is quite dark.

(2) Rare intergrowths of quartz and altered plagioclase are reminiscent of ophitic intergrowths in dolerite.

It would be necessary to study a less altered specimen before speaking with any assurance on the true nature of this rock.

D9 (Slide 2744). In handspecimen it consists of glistening micas and dark coloured clots set in a greyish matrix.

Under the microscope the micas are seen to be large, irregularly shaped, porphyroblastic muscovites up to 1 mm across. The rock consists of porphyroblastic muscovites, quartzes, chlorites and a few oligoclase-andesines. The quartzes vary in size but are mainly irregularly shaped porphyroblasts. The groundmass consists of irregularly shaped, felted masses of sericite, quartz, green pleochroic chlorites, and penninite. Leucoxene granules were found scattered through the rock. A few irregularly shaped albite-twinned oligoclase-andesines were found.

The dark coloured patches seem to be areas of small quartz and felspar grains crowded with inclusions of chlorite, sericite, magnetite etc. whereas the lighter coloured areas appear to be areas of larger quartz grains which are nearly clear of inclusions and it is here that the large muscovites are developed.

The rock appears to be a metamorphic rock of some sort. The absence of a prefered orientation points to the absence of directed stress during the metamorphism. It is probably a contact metamorphic rock and the dark coloured areas were caused by the segregation and aggregation of the mafic minerals during the metamorphism.

The rock is a felspathised chlorite-quartz-muscovite-hornfels.

G 11 (Slide 2745) is a fine-grained black and white rock consisting of black biotites and clear glassy quartzes set in a white matrix.

Under the microscope the rock is seen to consist of irregularly shaped crystals of microcline-microperthite, plagioclase, quartz and biotite of varying sizes ranging up to ⅛" across. On the whole, the quartz crystals tend to be smaller than the other minerals. None of the minerals are euhedral nor porphyritic to the other minerals. There is no division into phenocrysts and groundmass.

The microcline shows well marked "cross-hatching" and some crystals show a faint microperthitic structure. Often the larger microclines are bordered by a ring of partly included grains of the other minerals suggesting that the microcline did grow a little by metasomatic accretion after the crystallisation of the rock. There are, however, no signs of extensive post-magmatic deuteric metasomatism.

The plagioclases consist of oligoclases which are usually sericitised in their central parts while their margins are often water clear.

The biotites are pleochroic from colourless to dark brown and contain pleochroic haloes round minute inclusions of zircon.

The rock is a fine-grained biotite adamellite. It has not suffered any post-magmatic tectonic disturbances at all and is definitely not a mylonite. It is more like an aplite or the chilled marginal phase of an intrusion.

G 12 (slide 2742). In handspecimen it is a coarsely foliated, porous, rusty coloured rock containing a ⅛" thick vein of hydrated iron oxide (limonite) and myriads of mica flakes up to 2mm across.

Under the microscope the mica was found to be a colourless muscovite, biaxially negative having a small 2V. The muscovite is rather porphyroblastic and contains numerous minute quartzes and iron ores.

The matrix of the rock consists of a mosaic of minute, angular, granular quartzes up to 0.2 mm across. The margins of the crystals are sharp and do not show suturing or intergrowths.

The rock is crossed by a vein of limonite and is flooded with granular hydrated iron oxide often penetrating along crystal margins and along the cleavage planes in muscovite flakes. The limonite is probably after hematite or perhaps even pyrites.

The rock is a granular quartzose rock which has been invaded by iron ore and muscovite. The original rock may have been a quartzite or it may have been a "greisenized" granite in which all the other minerals were replaced by quartz and muscovite or even a micaceous hornfels which has been extensively silicified and recrystallised and invaded by iron ore.

84Q/3. 12th May, 1959.

4. THE PETROGRAPHY OF TWO SPECIMENS OF CARBONATE - BEARING ROCK FROM THE GRAY CREEK AREA, NORTH QUEENSLAND.

By

W.B. Dallwitz.

Following is a report on two specimens of siliceous carbonate-bearing rock from the Gray Creek area, North Queensland.

The first, No.142, consists of irregularly-shaped, rust-coloured clots, grey siliceous streaks and clots, and small quantities of a bright green micaceous mineral.

Microscopically the rock is found to be composed mainly of quartz, siderite or other iron-bearing carbonate stained with hydrated iron oxide, and a minor amount of chalcedony. The siderite occurs as rhombs, nearly all of which appear to have been very much flattened in the direction of their longer axes; groups of these rhombs form the rust-coloured areas noted in handspecimen. The attenuation of the carbonate rhombs suggests either that the mineral was formed under conditions of directed stress or, more probably, that the rock containing the carbonate was stressed after its formation.

Accessory constituents are green mica, possible chromite and/or iron oxide, and calcite. The mica is pleochroic from very pale yellowish green to very pale greenish blue. Its identity was confirmed by X-Ray powder photography. (This shows only that the mineral belongs to the mica group, but does not identify it beyond that.).

Both nickel and chromium were detected in the rock by W.M.B. Roberts, using the X-Ray spectrograph, but in very small amounts only. An attempt was made to determine nickel chemically, but so little was present that a virtually unweighable precipitate was obtained with dimethyl-glyoxime - a reddish colour appeared in the test solution, but no clear precipitate was seen. Thus nickel is present in trace amount only.

Two special mounts were also prepared for X-Ray spectrographic examination. Identical quantities (11.4 mg.) of almost pure green mica and of the powdered rock (including any mica contained therein) were evenly spread on a glass slide, and each was semi-quantitatively analysed with the X-Ray spectrograph. The mica was found to contain only 4/5 as much Ni as the whole rock, but its Cr content was about 6 times greater than that of the rock (including contained mica). The mica is, therefore, the variety fuchsite, in which Cr substitutes for some of the Al.

No separate nickel mineral was detected in the thin section. It seems possible that the Ni is associated with the hydrated iron oxide.

The presence of possible chromite suggests that this rock may have been derived from serpentine, though its actual mode of origin and that of the fuchsite are matters for speculation. (At the time when this specimen was submitted for examination I did not know that it was associated with serpentine.)

....

Specimen 97557 (slide No. 4538) is a massive, medium-grained, reddish brown rock containing patches of a green mineral. The rock is cut by a white vein of probable dolomite.

In thin section the rock is seen to be made up of quartz, probable fine-grained chalcedony, carbonate, hydrated iron oxide, and light green mica closely resembling that described in specimen No. 142. Most of the mica is enclosed in quartz or chalcedony, but a little is found as thin veinlets in carbonate.

Most of the carbonate has a lower relief (lowest R.I. less than that of balsam) than that in specimen No. 142, and, as it does not react with cold, dilute HCI, it is probably dolomite, though it is likely that ferrous carbonate is present in the dolomite in varying amount. Evidence for this is that many of the carbonate bodies are bordered by hydrated iron oxide. None of the carbonate has the rhombic shapes noted in specimen No. 142.

The green mica shows the high interference-colours which are characteristic of members of the mica group. An interference figure obtained on a near-basal section had a very small or zero optic axial angle, and gave a negative sign; according to Winchell (Optical Mineralogy, Part II, Fourth Edition, p.369) chromochre, which may be a chromian variety of phengite, has a very small optic axial angle, and contains more Cr_2O_3 than does fuchsite. Because of its small optic axial angle, it is possible that the mica in specimen 97557 is chromochre, rather than fuchsite. Because the mica is so intimately mingled with quartz it was not possible to separate pure sample for X-Ray powder photography.

M.B. Bayly has carried out a semiquantitative X-Ray spectrographic analysis for certain elements on a small portion of specimen 97557 with the following results: Cu, trace; Co, trace; Mn, trace; Cr, strong trace; Ni, 1-3%. All quantities were estimated by inspection of peak heights on the X-Ray spectrographic chart.

106G/17 11th May, 1959.

5. THE NON-CARBONATE CONTENT OF EIGHT SPECIMENS COLLECTED IN THE GREAT AUSTRALIAN ARTESIAN BASIN.

By

W.R. Morgan.

Seven specimens of limestone and one of sandstone were sent for examination by M.A. Reynolds, to determine the non-carbonate mineral compositions of each.

1. Hilary Tank on the Mt. Whelan 4-mile sheet, 16 miles south of Marion Downs Homestead on the Boulia-Bedourie Road.

The specimen is a fossiliferous limestone, and has the following approximate composition: carbonate: 97%, clay: 3%, and hydrated iron oxide: 0.02%. The "clay" fraction is seen to consist mostly of argillaceous material, with some very fine grains of quartz: it is rather iron stained. The hydrated iron oxide forms irregular grains, though some of it has "cubic" form, suggesting that it is an alteration product of pyrites. Fossil fragments which are present appear to be made of hydrated iron oxide. A grain of pyrites was noted.

2. Bedourie 3. Bedourie 4-mile sheet, 5 miles south-west of Canuts Waterhole, Sandringham Station.

The specimen is a fossiliferous clay limestone, and has the following approximate composition:- carbonate: 85%, "clay": 15%, with traces of hydrated iron oxide, quartz, and plagioclase. The "clay" portion is formed of argillaceous material, with subordinate, very fine grains of quartz: the whole shows strong iron staining. Hydrated iron oxide normally forms irregular fragments, although some have a cubic form. Ferruginized fossil fragments are present, and a few grains of pyrites were noted. Quartz and plagioclase form sub-angular to sub-rounded grains, the latter mineral shows albite twinning, and its refractive is less than 1.54, suggesting it to be albite.

3. G.432. Glenormiston 4-mile sheet, 12½ miles north-north-west of Leslie Peak on Alderley Station.

The specimen, in the hand, is seen to be a medium-grained limonitic and fossiliferous sandstone.

In thin section the rock is seen to be inequigranular, and to consist of sub-angular grains, whose average size is 0.13 mm., embedded in a matrix of hydrated iron oxide. The majority of the grains consist of quartz, which shows a little undulose extinction. Some plagioclase and microcline are present. Hydromuscovite forms irregular flakes with random orientation. A little tourmaline may be seen: it is pleochroic with O= brown, e= pale grennish yellow. Some rounded grains of an apparently amorphous material are present; it is possibly coprolitic. Hydrated iron oxide forms a matrix separating the grains from one another. The grain margins are fretted, as though corroded. The rock is a <u>limonitic quartz sandstone</u>.

The following approximate composition was found: quartz and felspar: 62%, hydrated iron oxide: 33%, material soluble in dilute hydrochloric acid (?hydrated iron oxide): 5%, heavy minerals: 0.02%. The heavy minerals included equal quantities each of tourmaline and zircon. Tourmaline forms round to sub-rounded grains, sometimes showing a remnant prismatic form. Most commonly it is pleochroic, with O= smoky brown black, and e= very pale cream. A few grains of bluish tourmaline were also present. Zircon forms prismatic and pyramidal crystals, some showing slight rounding. It is colourless. An angular grain of rutile was seen.

4. Jynoomah Homestead - Tambo 4-mile sheet, 6 miles west-north-west of Minnie Downs.

A specimen of argillaceous limestone was combined with one of a fossiliferous limestone. The approximate composition of the combined representative sample was found to be:-
carbonate: 70%, "clay": 30%, with traces of hydrated iron oxide and quartz. The "clay" fraction was seen to consist of argillaceous material mixed with very fine quartz grains. Hydrated iron oxide occurs as irregular grains, and also as possible microfossils. The latter are flat, disc-like objects, 0.1-0.2 mm diameter: a narrow ridge is present around the circumference on the side, set in a very short distance from the border: a small "nob" is present at the centre of most of the discs. The reverse side of the discs appears to be reasonably flat. It is suggested that this specimen be passed on to the micropalaeontological section. Quartz occurs as sub-angular to sub-rounded grains.

5. Roundstone Dam, on the border of the Tambo and Angathella 4-mile sheets, 4-5 miles south-west of Jynoomah Homestead.

The specimen is a calcareous siltstone, and has the following approximate compositions: carbonate: 44%, quartz: 37%, plagioclase: 19%, heavy mineral fraction: 0.23%. Of the quartz and felspar, approximately 75% is of silt size, and the remainder is of sand size. The heavy mineral fraction may be divided:- magnetite: 75%, leucoxene: 11%, garnet: 6%, zircon: 4%, rutile: 2%, and pyrites and biotite each 1%. Traces of epidote and tourmaline are present.

Quartz and felspar occur as sub-angular grains. The latter mineral has a low refractive index, and shows albite twinning: some of the finer grains tend to have euhedral shape, suggesting that they are authigenic. Magnetite forms sub-angular, subhedral grains. Garnet is colourless to very pale pink, and forms angular to rounded anhedral grains. Zircon forms prismatic and pyramidal crystals 0.01-0.02 mm in size; often the crystals are broken so that only one set of pyramids is seen. Zircon commonly contains irregular opaque inclusions. Some rounded zircons are present. Rutile, occurs as dull red, translucent grains which are prismatic with rounded edges. Tourmaline is prismatic, and is pleochroic with O= smoky brown black, e= very pale smoky green.

6. 10 miles north of Tambo on the road to Blackall, Tambo 4-mile sheet.

The specimen is a silty limestone, and has the following estimated composition:- carbonate: 61%, quartz and plagioclase: 38%, heavy minerals: 0.02%. The heavy fraction is composed: magnetite: 67% leucoxene: 17%, zircon: 6%, chlorite: 4%, garnet: 3%, rutile: 2%, biotite: 1%.

Quartz, occurs as sub-rounded grains. Plagioclase shows albite twinning, and forms tabular to anhedral grains. Magnetite forms imperfect octahedra. Zircon occurs in three forms: (a) as thin prismatic pyramidal crystals, measuring 0.08 mm. by 0.04 mm. average size; (b) as more stubby, somewhat rounded prismatic crystals measuring 0.06 mm. by 0.04 mm.; (c) and as anhedral, sub-angular grains roughly 0.06 mm. in diameter. Chlorite and biotite occur as anhedral flakes. Colourless to very pale pink garnet forms anhedral grains. Rutile is brownish-red, and forms rounded grains.

7. W37 - Mt. Whelan 4-mile sheet, 16 miles south of Polly's Lookout on Glenormiston Station.

The specimen is a coarse-grained fossiliferous sandy limestone. It has the following approximate compositions:-
carbonate: 53%, quartz: 42%, "clay": 5%, and heavy minerals: 0.02%. The heavy minerals are divided:- opaque ore ((?) ilmenite): 54%, garnet: 20% tourmaline: 12%, leucoxene: 11%, zircon, rutile and kyanite each 1%.

Quartz occurs as rounded grains. The "clay" fraction is formed of iron-stained argillaceous material, with fine quartz. The opaque ore forms sub-rounded grains. Garnet is very pale pink, and occurs as sub-angular anhedral grains. Tourmaline is pleochroic, with O= dark brownish-black, e= very light brownish yellow. It occurs as large sub-rounded grains 0.2 mm. to 0.25 mm. in diameter, and sometimes contains minute acicular - prismatic inclusions. Small amounts of bluish tourmaline are present, forming similar grains to the brown tourmaline. Zircon and rutile form anhedral grains. Kyanite occurs as subhedral, long prismatic crystals, and is colourless.

8. Sl. Springvale 4 -mile sheet, four miles south-south-west of Warra Homestead.

The specimen is a medium-grained fossiliferous limestone. It has the following compositions:- carbonate: 98.74%, argillaceous material: 1.24%, the remainder: 0.02%. The remainder consists of hydrated iron oxide, quartz, and plagioclase. No heavy minerals, other than the iron oxide, were found.

<u>Remarks.</u> Table I shows the percentages of the various fractions, and were calculated from their weights:-

<u>Table I</u>

Specimen No.	1	2	3	4	5	6	7	8
Carbonate	97	85	(?)5	70	44	61	53	99.74
"Clay"	3	15	-	30	-	-	5	0.24
Hydrated iron oxide	0.02	Tr	33	Tr	-	-	-	)
Quartz	-	-	) 62 (	Tr	37	) 39 (	42	)0.02
Felspar	-	-	) (	-	19	) (	-	)
Heavy Fraction	-	-	0.02	-	0.23	0.02	0.02	
Total:	100	100	100	100	100	100	100	100

Table II shows the percentages of the components of the heavy fractions (excluding hydrated iron oxide):-

Table II

Specimen No.	1	2	3	4	5	6	7	8	
Magnetite	-	-	-	-	75	67	-	-	
(?)Ilmenite	-	-	-	-	-	-	54	-	
Leucoxene	-	-	-	-	11	17	11	-	
Tourmaline	-	-	50	-	Tr	-	12	-	
Garnet	-	-	-	-	6	3	20	-	
Zircon	-	-	50	-	4	6	1	-	
Rutile	-	-	-	-	2	2	1	-	
Pyrites	-	-	-	-	1	-	-	-	
Biotite	-	-	-	-	1	1	-	-	
Epidote	-	-	-	-	Tr	-	-	-	
Chlorite	-	-	-	-	-	4	-	-	
Kyanite	-	-	-	-	-	-	1	-	
TOTAL:	-	-	100	-	100	100	100	-	

The percentages of heavy minerals were obtained by grain counting. The following points should be noted:-

i. There is little correspondence between the figures, except between those for samples 5 and 6.

ii. The results should not be regarded as really accurate because of the small size of the samples involved. Larger samples, i.e., up to 200-300 gms each, would give a more satisfactory representation of the heavy minerals occurring in the original rock.

iii Difficulties in the correlation of rocks by their heavy mineral suites arise when the samples are collected from localities too far apart: any one rock unit may have several sources for its material, each supplying its own characteristic suite of heavy minerals; hence the character of the heavy mineral suite may change considerably over a distance. On the other hand, a characteristic suite of heavies from one provenance may well be laid down in a diachronous rock unit, again giving some confusion in correlation. Milner (Sedimentary Petrography, 1952, Thomas Murby & Co.) gives good information, both on this subject, and on sampling.

120 ACT/1 11th May, 1959

6. PETROGRAPHY OF SPECIMENS OF QUARTZ GREYWACKE FROM THE MURIARRA AND PITTMAN FORMATIONS INCLUDED ON THE CANBERRA 1-MILE SHEET

by
W. R. Morgan

SPECIMEN 1. Slide No. 4516. Muriarra Formation. Canberra 1-mile sheet, grid reference: 562 232.

The hand specimen is seen to be a fresh, dark medium-grained and rather inequigranular sandstone containing quartz and felspar enclosed within a very fine-grained, apparently micaceous matrix. The weathered surfaces of the rock are very slightly stained by hydrated iron oxide.

The thin section shows the rock to be medium-grained, but very inequigranular, the grain sizes ranging from 0.5 mm. for the larger grains of quartz, to 0.007 mm. for the mica of the matrix. Grains of quartz, plagioclase (probably albite) and a little perthite are angular, and have serrated margins. Quartz shows gentle undulose extinction, and is cracked. Both felspars are lightly kaolinized, and plagioclase multiple twinning is somewhat strained, and sometimes fractured - where this has happened, the line of fracture is marked by minute flakes of sericite. The grains of quartz and felspar are embedded in a matrix of minute flakes of biotite (pleochroic in brown) and colourless sericite. The mica flakes appear to have "corroded" the margins of quartz and felspar. Occasionally, large irregular flakes of mica have grown in the matrix. Large, sometimes highly irregular grains of black iron ore are present, often associated with the micas in the matrix, but sometimes cutting across quartz or felspar grains. Sub-rounded grains of apatite, zircon and brown tourmaline are present as accessories. Also, minute acicular crystals of apatite are enclosed in some quartz grains. Quartz also has some minute, rounded and colourless inclusions.

An estimation of the percentages of minerals present is: quartz: 62, felspar: 20, mica: 15, Black iron ore: 2, and accessory minerals: 1. The rock is a slightly metamorphosed greywacke. It seems likely that incipient metamorphism has recrystallized the groundmass, producing biotite and sericite.

SPECIMEN 2. Slide No. 4517. Muriarra Formation, Canberra 1-mile sheet, grid reference: 355,230

The hand specimen is of a medium-grained buff-coloured and inequigranular sandstone, which, apart from its much weathered appearance, is largely similar to Specimen 1. The weathered surfaces are strongly stained by hydrated iron oxide.

In thin section, the rock has the same general appearance of Specimen 1, of medium-grained, sub-angular grains of quartz and felspar, embedded in a fine-grained matrix. On further examination, certain differences may be noted: these are mentioned as follows:-

(a) The rock has a more granulated appearance, i.e. quartz is cracked, and shows more pronounced strained extinction. The cataclastic action has also given a rough lineation to the grains. Minute inclusions in quartz are arranged in trains which are seen to run continuously across neighbouring quartz grains, approximately at right angles to the grain lineation: this is not seen in Specimen 1. Harker (1932, "Metamorphism", p. 241, Fig. 114B) states that this phenomenon occurs in rocks suffering slight dynamic metamorphism, and that the inclusions (fluid) are arranged in trains at right angles to the direction of tension in such rocks.

(b) Some differences in the mineralogical composition are apparent: an estimation of the percentages of minerals present is: quartz: 76, felspar: 15, micas: 3, hydrated iron oxide and (?) leucoxene: 5, and accessory minerals: less than 1. The matrix of the rock is much less micaceous than that of Specimen 1. Instead, finer grains of quartz and felspar (albite) are present there. The felspar is commonly confined to the matrix. The micaceous minerals present are muscovite, biotite and nontronite, and they occur as minute intergranular flakes, which are sometimes aggregated into clots. Some rounded grains of leucoxene are present. Hydrated iron oxide, with mica, forms very thin rims surrounding most of the coarser grains. The grain margins are not so obviously fretted as those in Specimen 1. The accessory minerals present are zircon, rutile and (?) sphene.

The rock is a slightly sheared and felspathic sandstone.

SPECIMEN 3. Slide No. 4518. Pittman Formation, Canberra 1-mile sheet, grid reference: 408 110.

The hand specimen shows the rock to be a somewhat weathered buff-coloured sandstone superficially similar to Specimen 2.

Thin section shows that the rock is fairly similar in texture to Specimen 2, in that the matrix is formed of fine quartz and felspar grains, and not more micaceous, as it is in Specimen 1. An estimation of the percentages of minerals present is:- quartz: 75, felspar: 15, mica: 8, hydrated iron oxide: 2, and accessory minerals: less than 1. Though the rock has the appearance of being sheared, the quartz shows less strained extinction than is seen in Specimen 2, though some elongation of grains is evident.

Felspar (plagioclase) occurs as large grains, as well as in the matrix. The dominant mica is biotite, or nontronite; little sericite is present. Some highly irregular grains of leucoxene are present, being very similar in aspect to the black ore of Specimen 1. The other accessory minerals noted are zircon and apatite. The latter mineral normally occurs as anhedral, sub-rounded grains, although one euhedral, prismatic crystal was noted. Some hydrated iron oxide is associated with the mica.

The rock is a felspathic sandstone.

SPECIMEN 4. Slide 4519. Pittman Formation, Canberra 1-mile sheet, grid reference: 442 098.

Like Specimens 2 and 3, the hand specimen is a buff-coloured, medium-grained sandstone, stained with hydrated iron oxide.

Thin sections shows the rock to be a medium-grained sandstone which is rather better sorted than the other three specimens. It is composed of sub-angular and rather interlocking grains, which show no linear shear-texture. The grains show little granulation: quartz normally has a slight undulose extinction, although a few of the grains are quite strained - this straining, however, may have been imparted to these grains prior to the formation of the rock. Some plagioclase is present, and its multiple twinning is commonly slightly strained.

The matrix is composed of finer grains of quartz and felspar, and of intergranular strings and clots of sub-radiating flakes of (?) nontronite. Intergranular hydrated iron oxide is also present.

The accessory minerals are mainly zircon and leucoxene. The former mineral normally occurs as sub-rounded grains in the matrix, although a euhedral zircon was seen in one place to be almost entirely enclosed by quartz. Leucoxene forms rounded to tabular grains. Apatite occurs in very minor quantities as minute, acicular crystals enclosed in quartz. Other minute inclusions in quartz are seen to be in continuous trains across series of grains in several directions. Cube-shaped grains of hydrated iron oxide are present, probably pseudomorphing pyrites.

An estimation of the percentages of minerals present is:- quartz: 80, felspar: 5, nontronite: 10, hydrated iron oxide: 5, and accessory minerals: less than 1.

The rock is a quartz sandstone. There is an enrichment in hydrated iron oxide in the matrix around a possible vein which broke out during the slide's manufacture.

SUMMARY

Only minor differences between the specimens are apparent, and the differences are greater between the individual specimens, than between the representatives of the two formations. The differences are summarized:-

1. Shearing and granulation. All the specimens show some effect of strain (e.g., strained quartz), but specimens 2 and 3 are affected more than the others in that the shearing has imparted a rough lineation of grains to the texture. This difference, however, may be regarded as insignificant, as it is not a feature resulting from the deposition of the rock, but the result of tectonic activity which may have been greater in one part of a bed than another.

2. With regard to the degree of sorting, specimen 4 is rather better sorted than the others, and is more equigranular.

3. The matrix in Specimen 1 is rather more micaceous than those of the others, and contains sericite, as well as biotite: the former mineral is absent in the other specimens. Quartz and felspar are more dominant in the other specimens.

4. Table III shows the estimated percentages of minerals present in these specimens:-

Table III

<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>Quartz</td><td>62</td><td>76</td><td>75</td><td>80</td></tr>
<tr><td>Felspar</td><td>20</td><td>15</td><td>15</td><td>5</td></tr>
<tr><td>Mica or Nontronite</td><td>15</td><td>3</td><td>8</td><td>10</td></tr>
<tr><td>Black ore or Leucoxene</td><td>2)</td><td rowspan="2">5</td><td>-</td><td>5</td></tr>
<tr><td>Hydrated iron oxide</td><td>-)</td><td>2</td><td>1</td></tr>
<tr><td>Accessory minerals</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>

It is seen that from Specimens 1 to 4 there is an increasing percentage of quartz, and decreasing amounts of felspar, although specimens 2 and 3 are rather similar. Nontronite, in these rocks, is probably an alteration product of biotite by weathering: the mica may have been formed by incipient metamorphism of a chloritic groundmass.

5. The accessory minerals noted are listed in table IV.

Table IV.

1.	2.	3.	4.
Zircon	Zircon	Zircon	Zircon
Tourmaline	Rutile	Apatite (groundmass)	Apatite (enclosed in quartz
Apatite (anhedral grains in the groundmass)	(?) Sphene	Leucoxene	Leucoxene
Apatite (euhedral inclusions in quartz)	Leucoxene		Hydrated iron oxide pseudomorphing pyrites.
Black ore			

The black ore of Specimen 1 and leucoxene of Specimen 2 both occur as highly irregular grains in the groundmass; leucoxene is an alteration product of ilmenite, and it may be that the black ore of Specimen 1 is ilmenite. A thin section shows too few accessory minerals to make an decisive statement about them: but in this case, the presence of a mineral in one specimen and its absence in other may be due to different provenances for the mineral rather than to the rocks' being of different ages.

106W/5 13th May, 1959

7. THE PETROGRAPHY OF TWO SPECIMENS OF PISOLITIC IRONSTONE, FROM 25 MILES E.S.E. OF PORT HEDLAND, W.A.

By

W. B. Dallwitz

Following are brief descriptions for Dr. J. J. Veevers of pisolitic ironstone from a deposit 25 miles E.S.E. of Port Hedland, W.A., (26 miles from Port Hedland aerodrome on Great Northern Highway).

Specimen PH 1a (slides 4539 and 4540) is a rather coarsely pisolitic ironstone containing fragments of fossil wood measuring up to 2.5 cm. x 1 cm. Pore-spaces commonly remain near contiguous pisolites, and are also found in other positions throughout the rock. The largest pisolite measures about 1cm. across. Some soft whitish patches of probable argillaceous material are scattered through the rock.

In thin section the rock is seen to consist of ironstone pisolites and fragments of wood replaced by ironstone set in a matrix of ironstone containing angular grains of quartz. Concentric banding of various degrees of perfection is developed in the pisolites.

The cores of the pisolites may be composed of any of the following materials:

1. Fragments of wood replaced by ironstone (Plates 1 and 2).
2. Unbanded or faintly banded ironstone.
3. Fragments of sandy ferruginous argillite.
4. Pieces of broken, banded pisolites.

The pisolites are held together by structureless ironstone which may be rather porous, and may contain very unevenly distributed angular quartz grains, pieces of broken, banded pisolites, and large to small fragments of sandy ferruginous argillite which are not surrounded by banded ironstone.

Kaolin or other clay mineral occurs in small pockets (these are the whitish patches noted in handspecimen). Some cavities are partly lined by a layer of opal which may be up to 0.08 mm. thick. In one place thin, alternating layers of clay mineral and opal line a cavity.

Specimen PH 1b (slide 4541) is a pisolitic ironstone in which the average size of the pisolites is notably less than that seen in specimen PH 1a. Fragments of fossilized wood are rate as compared with the quantity noted in specimen PH 1a. Plate 3 shows pieces of broken pisolites in this rock, and Plate 4 shows similar fragments with new material built up round them.

The cores of the pisolites consist of materials similar to those described for Specimen PH 1a.

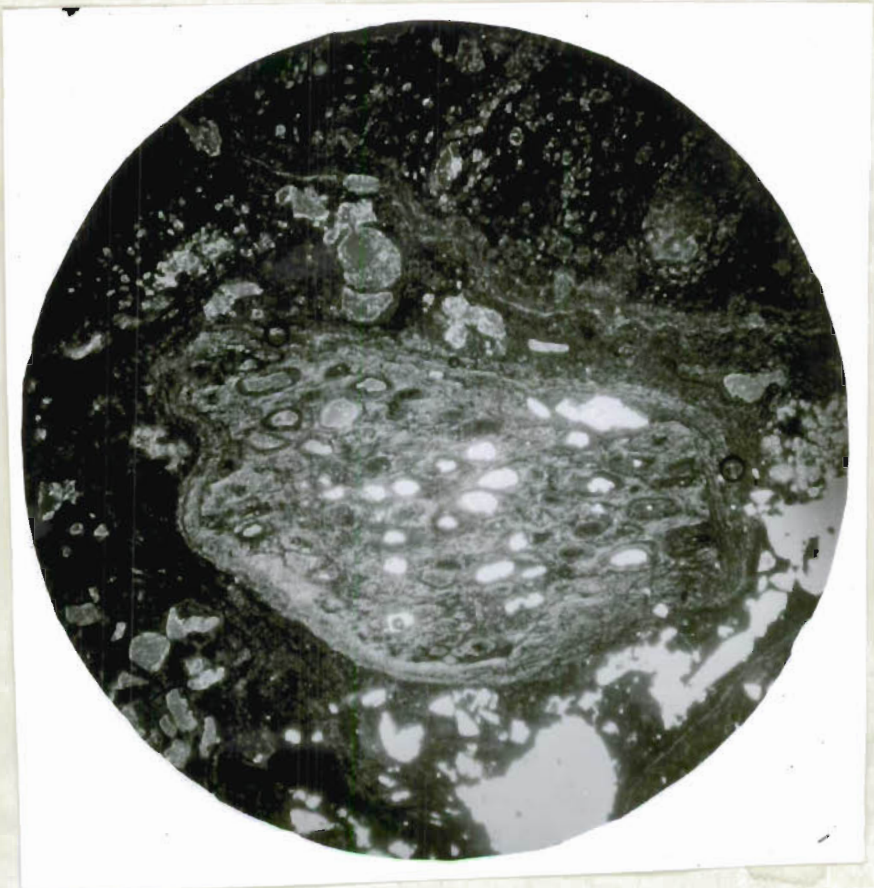

Plate 1. Slide 4539. Ferruginized wood in porous ironstone containing angular quartz grains. Ordinary light, x 34

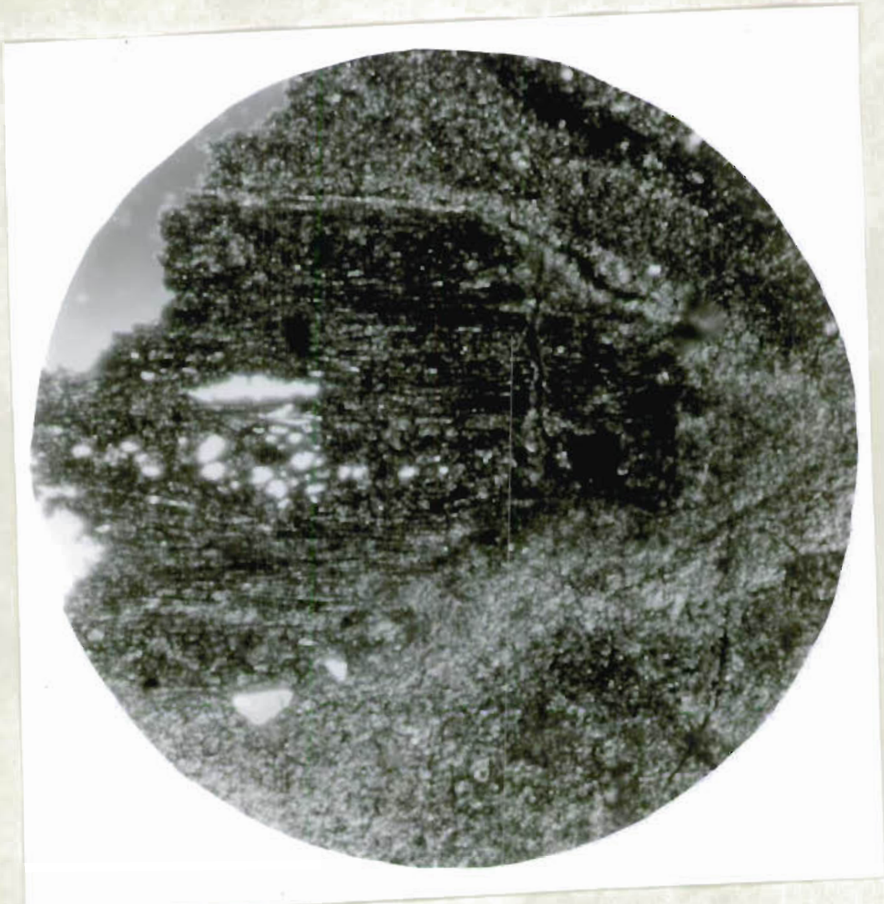

Plate 2. Slide 4539. Ferruginized wood in ironstone. Ordinary light, x 74.5.

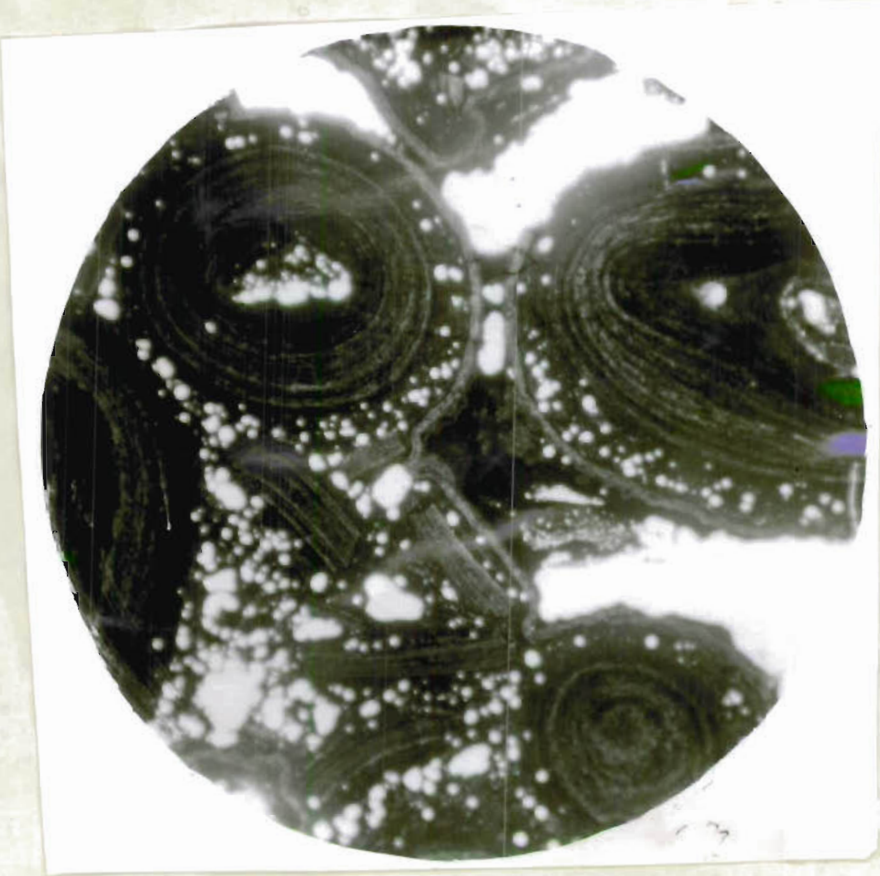

Plate 3. Slide 4541. Piso ites and fragments of pisolites in porous ironstone containing a few quartz grains. A broad porous zon is conspicuous in three of the pisolites. Ordin ry light, x 19.5.

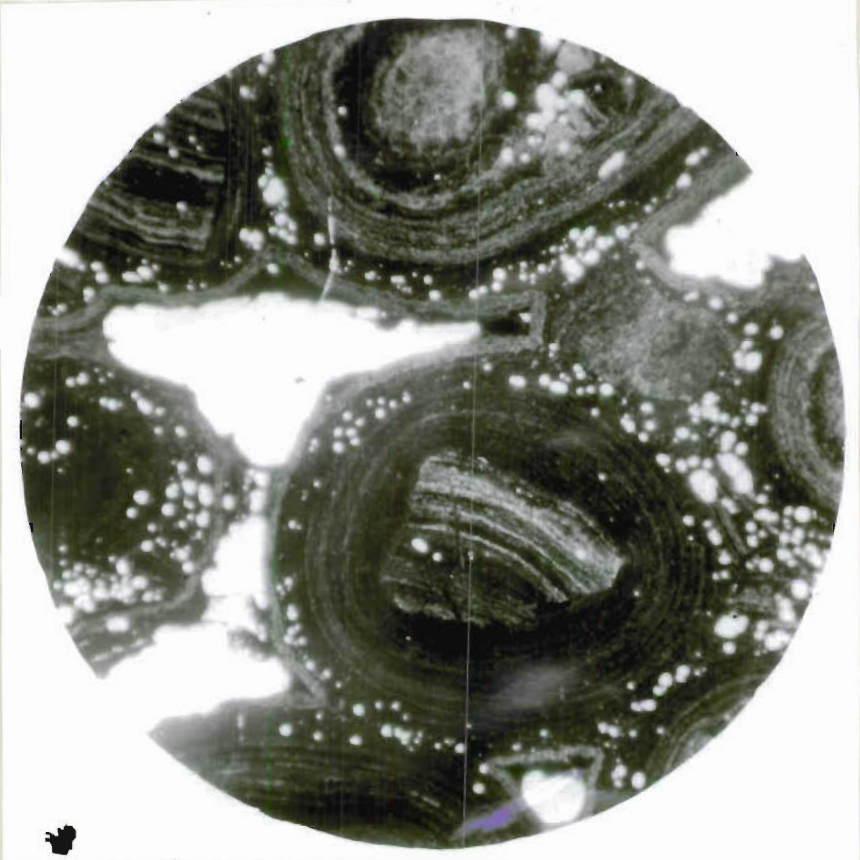

Plate 4. Slide 4541. Fragment of pisolite as a nucleus of subsequently-formed pisolite. Matrix is as described for Plate 3. Ordinary light, x 19.5.

120 ACT/1 24th June, 1959.

8. THE PETROGRAPHY OF A BRECCIA AND A XENOLITH SILTSTONE, FROM SOUTH CANBERRA, A.C.T.

By

W. R. Morgan

Herewith are petrographical descriptions of two specimens submitted by D. E. Gardner:-

A. Breccia, one mile east of cemetery; Canberra 1-mile sheet 087357.

B. (?)Xenolith, in Mugga Porphyry. Mugga Quarry, north end; Canberra 1-mile sheet 138344.

Specimen A. Slide numbers 4553 and 4554.

The hand specimen is seen to be a breccia. It contains pale cream, angular fragments of porphyry that range between 2 mm. and 6 cm. in size. They are enclosed in a dark grey, fine- to medium-grained inequigranular matrix. The larger fragments are cut by thin veins, 0.5 mm. to 2 mm. broad, composed of apparent matrix material.

In thin section the majority of the fragments are seen to consist of a dacite porphyry that has a xenomorphic granular and fine-grained groundmass, whose average grain-size is 0.04 mm. The porphyry groundmass is composed of anhedral, somewhat intergrown grains of quartz and albite. The porphyry phenocrysts range between 0.2 mm. and 1.7 mm. in size, and consist mainly of sub-tabular, somewhat corroded and sericitized albite, and of anhedral, corroded quartz. The small amounts of ferromagnesian mineral present as phenocrysts have been altered to an intergrown mixture of leucoxene, hydrated iron oxide, nontronite and pale chlorite. Accessory zircon, apatite, leucoxene, and black iron ore are present in the groundmass.

Besides the fragments of porphyry, there are rare fragments composed mainly of a mixture of black iron ore and hydrated iron oxide. The iron ore encloses sparse crystals of euhedral quartz, tabular felspar, and grains of fine quartzo-felspathic material. Very infrequently one may alsosee small composite fragments consisting of porphyry cut by veins of mixed black iron ore and hydrated iron oxide. The occurrence of these two types of fragments suggest th.t the porphyry was mineralized prior to the formation of the matrix.

The matrix itself is seen to be fine-grained and inequigranular, the grain sizes ranging between 0.02 mm. and 0.1 mm. Albite tends to be tabular, though some grains are somewhat intergrown with quartz. Albite grains and crystals are quite fresh, and are distinct from the albite of the porphyry, which is somewhat sericitized. Quartz is granular, and the grains tend to be somewhat intergrown with each other. Some quartz crystals, which are rather larger than usual, are euhedral with prismatic faces, suggesting that they are low-temperature quartz. Minute scales and grains of haematite are associated with the matrix, and are enclosed within the matrix grains, and not interstitial to them. Here and there, haematite scales enclosed in the border zones of euhedral quartz may be seen, with the longer dimensions of the scales being arranged parallel to the prism and pyramid faces of the quartz crystals. Some accessory zircon was noted in the matrix. The matrix appears to consist of some 50% felspar, 35% quartz, and 15% haematite, and appears to be a ferruginous dacite.

In considering the relationship of the matrix to its enclosed fragments, a number of points may be noted. These are described:-

a) The smaller xenocrysts from the porphyry do not have haematite inclusions. However, in places, the xenocrysts have reacted with the matrix material, and have been partly replaced by granular groundmass material, including haematite.

b) The larger porphyry fragments are seen to be cut by thin, irregular, and often discontinuous veins consisting of (?)leucoxene and hydrated iron oxide: these commonly connect the altered ferromagnesian phenocrysts. Some of these veins are cut by the matrix to the fragments, but others are continuation of veins composed of matrix material. This suggests that the iron oxide veins are associated with the formation of the matrix but that they may have been emplaced just before the intrusion of the matrix.

c) The smaller porphyry fragments are scattered generally in the matrix, and cannot be matched together. The larger fragments, however, cut by thick veins of matrix material, appear not to have been displaced too far from one another.

d) The larger fragments are commonly cut by thin veins, rarely more than 0.05 mm. thick which, in places, cut and slightly displace porphyry phenocrysts; in other places, the phenocrysts, though cut, are not displaced. The veins are composed of matrix material where they cut the porphyry groundmass and some of its phenocrysts. However, in some quartz phenocrysts, the line of the vein is marked by recrystallized quartz, in optical continuity with the phenocryst, but cleared of inclusions. Likewise, in cutting the partly sericitized albite phenocrysts, the albite has recrystallized to a fresh plagioclase, possible sodic oligoclase. In places, minute quartz grains and flakes of nontronite occur in the recrystallized felspar.

The rock, as a whole, appears to be an intrusion breccia. However, its puzzling feature is the presence of such large quantities of haematite in the intruding rock. There are, however, certain features of this specimen which are similar to some of the characteristics described by Whitten ("Tuffisites and Magnetite Tuffisites from Tory Island, Ireland, and Related Products of Gas Action": Am. Jour. Sci., vol. 257, 1959, p. 113), who considers that the magnetite formed in a vein of aplitic intrusion breccia was derived from decayed mafics in the granitic country rock, and that the tuffisites resulted from gaseous fluidization. However, the main difference between Whitten's magnetite tuffisite and the specimen under consideration is that in the former, magnetite occurs in an intergranular position: in the latter, haematite is enclosed in the grains. The writer would prefer, for the time being, to leave the paragenisis of this rock as an open question, apart from calling it an intrusion breccia.

Specimen B. Slide number 4555.

The hand specimen is seen to be a ferruginous, fine-grained and inequigranular sedimentary rock, showing some very indistinct, thin, slump-bedding.

In thin section, the specimen is seen to consist mainly of angular to sub-angular quartz grains, whose sizes range between 0.01 mm. and 0.12 mm. Some interstial flakes of muscovite and pale biotite are present, measuring 0.05 mm. long by 0.005 mm. broad. All the grains and flakes are set in a sparse matrix composed of fine, argillaceous material. Rare accessory grains of zircon, tourmaline and apatite were observed. Hydrated iron oxide is present as an intergranular, fine dust, and it is the concentration of this material into apparent laminae which show distinctly in thin section the slumped nature of the bedding. The rock is a ferruginous quartz-greywacke siltstone.

The rock is cut by very thin, sinuous veins composed of very fine white mica.

840/8 29th June, 1959.

9. X-RAY ANALYSES OF SPECIMENS SUBMITTED BY MARY KATHLEEN URANIUM LTD., MELBOURNE, VIC.

By

W. M. B. Roberts

The following are the results of X-ray analyses on three specimens, viz. DDW29, LLW30, and KKW29, which were submitted by Mr. Climas of Mary Kathleen Uranium Ltd., Melbourne, Vic.

In the interests of accuracy, two different techniques were used for the analyses and the results compared. The method used for samples listed under Table V was the standard spectrographic addition technique, and that used for the samples listed under Table VI was based on the assumption that the nature of the material to be examined was of a reasonably similar composition for each sample. The method plots directly the intensity of the uranium wavelength against concentration of U_3O_8. It is far quicker than the addition method, and because it involves less operations per analysis, would be more suitable for routine mine analytical proceedures; it requires approximately 10-20 minutes per analysis.

Table V

LLW30	DDW29	KKW29
0.161% U_3O_8	0.121% U_3O_8	0.0056% U_3O_8
± 0.008	± 0.006	± 0.0012

Table VI

LLW30	DDW29	KKW29
0.153% U_3O_8	0.134% U_3O_8	0.0051% U_3O_8
± 0.006	± 0.006	± 0.0013 *

* The standard deviation quoted for this figure includes only the error in reading the spread of results, it does not include an estimate of the standard deviation for the curve. This latter figure cannot be estimated with any validity when the analyses are derived from the extreme low concentration end of the curve. The standard deviations quoted for LLW and DDW do include an estimate of the standard deviation of the curve. The proceedure was to do five replicates, and from the resultant figures calculate the U_3O_8% by the two different methods described previously. The standard deviations are quoted to the 95% confidence limits.

The three samples analysed were almost exactly similar in their rare earth composition, and the semi-quantitative results for all three as one group are listed below:

Ce - 0.2 - 0.5% approx.
La - 0.2 - 0.5% "
Nd - 0.05 - 0.1% "
Gd - trace
Pr - trace
Dy - trace