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DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

1960/37

PETROGRAPHIC AND MINERAGRAPHIC INVESTIGATIONS DURING THE QUARTER OCTOBER-DECEMBER, 1959.

Compiled by

F.R. Walker.

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Contents

INTRODUCTION

The record contains reports on the petrographic and mineragraphic work, by the staff of the Bureau of Mineral Resources Laboratory, which has not been prepared for publication nor appeared elsewhere in Bureau Records. The reports were written during the quarter October to December, 1959, and have been arranged in chronological order; each report is headed with its title, file number, and date of completion.

The geological officers responsible for the reports are: W.M.B. Roberts, K.R. Walker and W.R. Morgan.

As the reports for this quarter comprise rock and mineral descriptions only, they do not require further elaboration; the listed titles of the reports are a guide to their contents. Only slight modification has been necessary to the original reports, giving them a title and a suitable introductory paragraph.

206F 9th October, 1958.

1. PETROGRAPHIC DESCRIPTIONS OF VOLCANIC ROCKS FROM VELLA LAVELLA GUADALCANAL

by

K.R. Walker

The following descriptions are of two specimens from Vella Lavella, Solomon Islands, which were submitted for examination by Mr. J.C. Grover.

1. Hand Specimen: The rock is a light grey and porphyritic; it contains phenocrysts of feldspar and hornblende in an aphanitic groundmass. The feldspar phenocrysts are white and measure up to 3 mm. whereas the hornblende phenocrysts are black, columnar and are up to 2 mm. long. The rock is massive and brittle.

Thin Section: In thin section it can be seen that the rock is porphyritic. Abundant plagioclase and hornblende crystals are randomly distributed in a glassy base that is turbid brown in plane polarized light. Magnetite is the only other mineral present and it forms small grains evenly distributed throughout. The glassy base contains a few microlites. The feldspar phenocrysts mostly range from 0.2 to 2.0 mm. but include a few crystals up to 3 mm. The hornblende crystals mostly measure between 0.1 and 1.0 mm.; one columnar crystal is, however, 3 mm. long.

Plagioclase is the most abundant phenocrystic mineral. All the crystals are euhedral, though fractured crystals and undulose extinction indicate strain. Oscillatory and normal zoning is common, and the cores of crystals are generally distinctly more basic than the margins. Complex and simple twins characterize all crystals. Determination of the feldspar using albite-Carlsbad twins indicates a composition from An_{46} to An_{56} (4 determinations).

Most of the amphibole crystals are euhedral, well-cleaved and strongly pleochroic showing X = light yellow-brown, Y = red-brown, Z = dark brown, $X<Y<Z$. The amphibole is a brown hornblende that probably approaches lamprobolite is composition.

A visual estimate of mineral percentages is based on the abundance of phenocrystic minerals: 50% plagioclase, 10% hornblende, 3% opaque iron mineral and the base makes up the remainder.

The rock is a hornblende andesite.

2. Hand Specimen: The rock is light grey and contains phenocrysts of white feldspar and black hornblende. Feldspar phenocrysts measure up to 3 mm. Most of the hornblende crystals are columnar and are up to 3 mm. long. The rock is both porous and friable.

Thin Section: The thin section shows that the rock is porphyritic and contains abundant phenocrysts of plagioclase and hornblende in a cryptocrystalline base. It also contains, in lesser amounts, some small phenocrysts

of monoclinic pyroxene, apatite and magnetite. The magnetite is evenly distributed throughout. The base consists mostly of feldspar microlites but includes some glass. The plagioclase phenocrysts range in size mostly from 0.1 to 1.0 mm., but a few measure up to 3 mm. The phenocrysts of amphibole are from 0.1 to 1.0 mm. and those of pyroxene and apatite are less than 0.4 mm. across. The thin section contains many cavities.

The plagioclase crystals are euhedral. Fractured crystals and cleavage fragments are widely distributed. These features, with undulose extinction shown by most crystals, indicate strain and fracturing during crystallization. Zoning is both oscillatory and normal and the cores of the crystals are more basic than the margins. Myriads of small inclusions in the feldspar crystals also have a zonal arrangement, but such crystals with zonal inclusions are rimmed by clear plagioclase. Twinning is according to simple, parallel and complex laws and measurements on albite-Carlsbad twins indicate a composition ranging from An_{36} to An_{66} (4 determinations).

The amphibole is a brown hornblende which is probably rich in the lamprobolite molecule. Crystals are mostly euhedral. It has a pleochroic scheme X = light yellow-brown, Y = red-brown and Z = dark brown, $X<Y<Z$.

Pyroxene grains are euhedral and anhedral. They are a clear pale green and are faintly pleochroic.

A visual estimate of mineral percentages of phenocrystic minerals indicates the thin section consists of 50% plagioclase, 12% hornblende, 5% opaque iron mineral, 3% pyroxene, and the remainder is the base.

The rock is a hornblende andesite which was probably more viscous than 1. described above and consequently movement during crystallization stressed the mineral components more extensively.

163G/1 14th October, 1959.

2. TRACE SCANDIUM CONTENT IN CASSITERITE AND WOLFRAMITE FROM VARIOUS AUSTRALIAN MINES.

by

W.M.B. Roberts

A number of samples of cassiterite and wolframite was received from Professor D.P. Mellor on 4th September for analysis for their scandium; the samples have been tested on the X-Ray fluorescence spectrometer and the results are tabulated below:

LOCALITY	MINERAL	p.p.m Sc
Aberfoyle Mine, Rossarden, Tasmania	Cassiterite	400-700
Stanthorpe, Queensland	Wolframite	400-700
"6 Mile Creek", Moolyella, Pilbara Goldfield, W.A.	Cassiterite	Strong trace but difficult to estimate quantitatively because of tantalum interference.
Goodwill Extended Mine, Mt. Tolmer, N.T.	Cassiterite	Not detectable because tantalum intereference.
Mud Springs, near Moolyella, Pilbara Goldfield, W.A.	Cassiterite	Not detectable because of tantalum interference.
Berridale, N.S.W.	Wolframite	Trace
Pulletop, N.S.W.	Wolframite	None detected.
Mt. Francisco, Pilbara Goldfield, W.A.	Cassiterite	None detected.
Bownings Mine, Hatches Creek, N.T.	Wolframite	Trace
New Butlers Mine, N.S.W.	Wolframite	Not detectable.

.../2.

LOCALITY	MINERAL	P.P.M. Sc
"S.W. ARM" about 40 miles S.W. of Darwin, N.T.	Cassiterite	Not detectable, because of tantalum interference.
Pi Hong Mine, between Linton and Skipton, Vic.	Wolframite	Not detectable.
3 miles south of Wolfram leases, Wauchope, N.T.	Cassiterite	Trace.
Community washing plant, Gisbonvale, N.S.W.	Cassiterite	Trace.
Wagga, Ph. Burrandah, Co. Mitchell, N.S.W.	Cassiterite	Not detectable.

The estimates made on the first two samples are based on peak height only, and serve only to show that the minerals from these two localities are the richest of the specimens examined; they could be ± 50%. Because of its low atomic weight, scandium is just about at the limit of detectability by this method, and it is possible that those samples which showed no scandium could still contain a small quantity which is beyond the limits of detectability of the method (roughly 100 p.p.m, unless some chemical concentration is carried out).

The third specimen listed showed a strong peak for scandium superimposed on the tantalum peak, so it probably contains a fairly high quantity, but because of the interference from tantalum, this would be difficult to estimate.

120 ACT/1 2nd November, 1959

3. THE PETROGRAPHY OF FOUR SPECIMENS FROM LOCALITIES NORTH OF CANBERRA, A.C.T.

by

W.R. Morgan

The following descriptions are of rocks that occur in the Lake George 4-mile sheet area. The rocks were submitted by E.G. Wilson.

99050. Thin section number 4649. Lake George 1-mile sheet: 182523.

The hand specimen is seen to be a pale greenish grey, fine-to medium-grained, grit-like rock showing a pronounced cleavage, or shear structure. It consists of inequigranular grains of quartz and felspar enclosed in lineated chloritic material. Two or three "cubes" of hydrated iron oxide, 4 to 6 mm. in size, are probably pseudomorphs after iron pyrites. Application of dilute hydrochloric acid shows the presence of calcite.

In thin section, the specimen is seen to be and inequigranular, fine- to medium-grained rock in which the grain sizes range between 0.05 mm. and 0.7 mm. Grains of quartz and albite are partly enclosed by lineated flakes of chlorite. The rock gives the impression of having suffered shearing.

Quartz forms sub-angular grains that are, in places, elongated parallel to the lineation. Strained extinction only occurs where quartz grains abut one another, and then only in the immediately adjacent portions of the grains. Some grains have calcite-filled fractures. Somewhat sericitized felspar forms sub-angular to tabular grains that, in places, are partly replaced by calcite. Albite has multiple twinning, but little of it showed any strain. Calcite forms irregular to lenticular grains, elongated parallel to the structure, and has multiple twinning. Chlorite, which is faintly pleochroic in very pale green, occurs as anhedral, lineated flakes that tend to be wrapped around quartz and felspar. Chlorite, and sericite, apparently fret the margins of these two minerals. Small amounts of sericite, and rare nontronite are present, often intergrown with chlorite; in places their flakes follow two planes, inclined at 35° - 40° to one another. Some granules of leucoxene are present, and accessory sub-rounded, prismatic apatites may be seen. A visual estimate of the percentages of minerals present is: quartz:35, albite:25, calcite:20, chlorite:15, sericite:4, and leucoxene and accessories:1.

From the amount of felspathic and femic material present, it seems probable that the rock was originally igneous: the angularity and ill-sorted appearance of the grains suggests that it is probably a tuff, or tuffaceous sandstone. Although the quartz and felspar grains show little of the effects of straining, chlorite is well lineated and calcite commonly shows multiple twinning, suggesting that shearing has taken place: the criss-cross pattern of sericite flakes possibly marks intersecting slip-planes. It is apparent, therefore, that if the rock

has suffered shearing, chlorite and calcite acted as cushions to the harder quartz and felspar grains, the latter two only showing strain where their grains abut one another.

The rock may therefore be called a sheared tuff, or tuffaceous sandstone.

99051. Thin section number 4650. Lake George 1-mile sheet 197521.

The hand specimen is seen to be a grey porphyritic igneous rock, in which tabular to rounded phenocrysts of felspar, prismatic ferromagnesian minerals, and rare quartz, are enclosed in a very fine-grained groundmass. Small inclusions, ranging up to 5 mm. in size are present, and appear to be composed of felspar and femic material. The rock is flecked with irregular grains of pyrites. The weathered surfaces are stained by hydrated iron oxide. Application of dilute hydrochloric acid shows the presence of calcite.

In thin section the specimen is seen to be porphyritic, the anhedral to subhedral phenocrysts ranging between 0.1 mm. and 3.75 mm. in size. They are enclosed in a very fine-grained xenomorphic groundmass whose average size is 0.007 mm.

The most common phenocryst is albite, which forms anhedral to subhedral tabular crystals with somewhat corroded margins. Albite shows some alteration to kaolin; several crystals have their cores almost entirely altered to epidote and calcite. Pyrites occasionally occurs at the cores of albite crystals. Greenish penninite pseudomorphs prismatic ferromagnesian minerals. Rare phenocrysts of quartz are anhedral and have corroded margins.

The groundmass is seen to be composed of irregularly intergrown quartz, felspar and chlorite. Patches of the groundmass appear to be replaced by a mosaic of sub-amoeboid grains of quartz. Accessory granular leucoxene and prismatic apatite may be seen.

The inclusions noted in the hand specimen consist of medium-grained granular-tabular albite, with interstitial penninite. In one, cubes of pyrites were noted.

Pyrites, apart from the occurrences noted above, forms fairly large masses, ranging up to 5 mm. in size, which tend to enclose grains of calcite and albite, and intergrown quartz and epidote. Some alteration of pyrites to hydrated iron oxide has taken place.

A visual estimation of the amounts of minerals present is: albite:60, quartz:25, chlorite:13, pyrites and accessories:2. The rock is a mineralized, partly silicified, saussuritized and chloritized granodiorite porphyry, or porphyritic dacite.

99052. Thin section number 4651. Lake George 1-mile sheet, 190514.

The hand specimen is seen to be a grey, porphyritic igneous rock, in which small phenocrysts of felspar, quartz, and ferromagnesian minerals are enclosed in a fine groundmass. Application of dilute hydrochloric acid shows the presence of calcite. Cubes of pyrites,

measuring up to 3 mm. across, are scattered sparsely through the rock: each is surrounded by a "halo" of hydrated iron oxide.

In thin section the specimen is seen to have a fine-grained, xenomorphic-inequigranular groundmass that encloses subhedral to anhedral phenocrysts.

The groundmass consists of a mosaic of anhedral quartz and sub-tabular (?)albite that enclose fine flakes of sericite and green chlorite. Chlorite also occurs in interstitial aggregates, and pseudomorphing prismatic ferromagnesian minerals. Granular calcite, and black iron ore partly replaced by leucoxene, may be seen. Accessory prismatic apatite is present.

The phenocrysts consist of strongly sericitized albite (An_7), which forms tabular crystals; anhedral, corroded quartz; and anhedral to prismatic chloritized and carbonated ferromagnesian material. Small amounts of cubic pyrite may be seen.

A visual estimation of the percentages of minerals present is:- sericitized albite:55, chloritized and carbonated ferromagnesian material:15, quartz:25, black iron ore leucoxene, pyrite and apatite:5. The rock is a sericitized, chloritized and carbonated porphyritic dacite, or granodiorite porphyry.

99077. Thin section number 4748. Canberra 1-mile sheet 157239.

The hand specimen is seen to be a greenish-grey rock that is composed of coarse grains of felspar and quartz, ranging up to 4 mm. in size, and of flaky mica, all crowded into an extremely fine-grained matrix. The specimen, which is very fresh, is said by Mr. Wilson to be an extrusive volcanic.

In thin section, coarse anhedral to subhedral mineral grains, ranging between 0.1mm. to 3.9mm. in size, and fragments of acid porphyritic igneous rock, ranging up to 10 mm. long by 3.3 mm. broad, are crowded into an extremely fine-grained, apparently flow-textured, groundmass.

The rock fragments have phenocrysts of partly sericitized and carbonated tabular oligoclase; tabular, somewhat kaolinized sanidine; anhedral quartz that has pseudoinclusions and embayed margins; and flexed flakes of biotite that have been altered to black iron ore, leucoxene and chlorite. The phenocrysts are enclosed in a fine-grained xenomorphic-granular groundmass whose average grain size is 0.15 mm., and which composed of quartz and sericitized felspar, with interstitial, very fine flakes of chlorite and sericite. In some of the fragments, apparent flow-lines are marked by strings of sericite flakes. Some of the fragments appear to be deformed, as though partly rheomorphed.

The crystal fragments consist of minerals similar to those of the phenocrysts of the rock fragments, except that they tend to be more anhedral and angular, and some of the quartzes have a shard-like shape.

The rock and crystal fragments are enclosed by

an extremely fine-grained groundmass that is almost irresolvable even at a magnification of 800 times. It, however, probably consists of quartz-felspathic material, and it contains trains (possibly flow lines) of sericitic material.

The tuffaceous nature of the rock, together with the apparent flow-line texture of its groundmass, suggest that the rock is an ignimbrite (welded tuff, or ash flow), a pyroclastic rock presumably of nuee ardente type eruption.

198N/1 2nd November, 1959.

4. AN ESTIMATION OF TRACE ELEMENT CONTENT OF SPECIMENS FROM BROKEN HILL.

by

W.M.B. Roberts

Qualitative analyses for trace elements in a number of specimens from Broken Hill have been made on specimens submitted by Dr. R. Gradwell.

The enclosed table lists the elements, above atomic No. 21 contained in them. For specimen No. 1 an arbitrary figure of ten units has been taken to represent the quantity of each element present, and the figures quoted for specimens 2 and 3 represent the amounts present in these specimens relative to this reference sample.

The quantity of material submitted for specimens 2 and 3 was actually too small to permit a really sensitive trace element analysis, and therefore those elements listed as not present in these samples may actually be present but did not show up in the analysis of such a small amount of material. The elements which are question-marked are doubtful because of overlap of spectral lines.

For a more accurate estimation of elemental movement it would be better to analyse 2 grams of material from each locality; if material is scarce the powder could be returned to you. In this run all of samples 2 and 3, and roughly 0.5 grams of sample 1 were used so as to obtain maximum sensitivity, and to preserve an approximate balance between samples.

Between Fe and Ni, Ti and Cr, and Cr and Fe, some mutual spectral interference occurs, resulting in the one case of enhancement of one element and in the other, absorption of the other element. An empirical correction has been made for these effects, which would only be appreciable in the major constituents of the sample.

All of those elements above the horizontal line of the table are regarded as being major constituents, i.e. above roughly 0.05%, and those below the line are present in traces amounts only. The estimation of the relative amounts of these elements is very inexact except where there is a large difference, and the only really accurate procedure would be to do an actual quantitative analysis.

TABLE 1.

QUALITATIVE TRACE ELEMENT DETERMINATIONS ON SPECIMENS FROM BROKEN HILL

ELEMENT	SPECIMEN NUMBER 1	2	3
Fe	10	7	25
Cr	10	10	20
Ni	10	10	20
Mn	10	4	45
Ti	10	3	50
Ce	10	10	10
Zr	10	20	35
Cu	10	5	7
Zn	10	NIL	15
Sr	10	15	3
Rb	10	10	20
Sn	10	5	NIL
Y	10	10	15
Ho	10	10	15
Re	10	10	30
Sm	10	10	7
Ga	10	NIL	22
Au	10	10	15
Ir ?	10	10	10
Ag	10	10	15
Pd	10	10	30
Rh	10	NIL	15
Ru	10	10	15
Mo	10	10	30
U	10	10	15
Pb	10	5	15
Tl ?	10	10	15
As	10	10	7
Se	10	NIL	15
Hg	10	10	NIL
Er ?	10	?	?
Yb ?	10	?	?
Hf	10	10	35
Co	10	10	7
Dy ?	10	10	15
Nd ?	10	?	?
Ba	10	10	NIL
Pr	10	10	?
V	10	10	30
Cs	10	?	15

120 ACT/1 8th November, 1959.

5. THE PETROGRAPHY OF TWO SPECIMENS OF GRANODIORITE FROM THE WODEN DISTRICT, A.C.T.

by

W.R. Morgan

The following specimen descriptions are of granodiorite submitted by D.E. Gardner from the Woden District, Australian Capital Territory.

654. Slide number 4836. Federal Golf Links, 1,000 feet S.W. of Clubhouse, A.C.T.

The hand specimen is seen to be a coarse-grained, very sparsely porphyritic, hypidiomorphic-granularigneous rock that contains white felspar, amphibole, chlorite and quartz. The rare phenocrysts are composed of tabular felspar. The weathered surfaces are stained by hydrated iron oxide.

In thin section, the rock is seen to be coarse-grained, with an average grain-size of 1.35 mm., and sparsely porphyritic, the phenocrysts attaining a size of 2.75 mm. The rock is hypidiomorphic granular.

Plagioclase, which also forms the rare phenocrysts, occurs as tabular, somewhat sericitized crystals that are strongly zoned and shew multiple and Carlsbad twinning. The composition of one crystal in a section normal to the X-bisectrix was found to be An_{65} at the core, and An_{23} at the edge: on another crystal, combined Carlsbad and albite twinning shewed An_{72} and An_{35} at core and edge respectively. Hornblende, pleochroic from very pale green to olive green, forms clustered sub-prismatic crystals that are poikilitic about plagioclase and euhedral to quartz. The latter mineral is anhedral and poikilitic in habit: it gives the impression of having corroded the plagioclase margins. Penninite, granular epidote and black iron ore have, in places replaced hornblende. However, some apparently primary crystallized euhedral chlorite, poikilitically enclosed by quartz, and epidote, enclosing euhedral quartz, may be seen. Black iron ore forms rare cubic crystals, and granular sphene is associated with chlorite. Possible potash felspar may be seen in antiperthitic relationship to many of the plagioclase crystals.

A visual estimate of the amounts of minerals present is: plagioclase: 49, hornblende, chlorite and epidote: 25, quartz: 25, and black iron ore: 1. The rock is a porphyritic, partly chloritized hornblende granodiorite.

653. Slide number 4839. Federal Golf Links, 500 feet west of Clubhouse, A.C.T.

The hand specimen is seen to be a coarse-grained, hydiomorphic inequigranular acid igneous rock containing white felspar, dark ferromagnesian minerals, quartz, and small amounts of very pale pink felspar.

In thin section, the rock is seen to be hypidiomorphic and coarse-grained, but exceedingly inequigranular, the grain sizes ranging between 0.05 mm. and 3.0 mm.

Zoned plagioclase forms subhedral - tabular crystals, ranging in composition from An_{40} at their cores to an An_{15} at their edges. The plagioclase is altered, sometimes strongly so, and the products are sericite, kaolin and epidote. Veins of albite cut the rock, and some plagioclase crystals have had their cores partly replaced by this mineral. Chlorite forms anhedral, sometimes flexed, flakes, and is commonly associated with epidote and black iron ore: in one or two places, where all three minerals occur together, amphibole-like outline shapes may be seen. Rarely, apparently primary crystallized chlorite and epidote may be seen, having interstitial or poikilitic habits. Quartz commonly occurs as granular masses, and more rarely as poikilitic grains: little strained extinction is present. Small amounts of anhedral grains of kaolinized potash felspar may be seen; they have $2V_x = 30^o - 40^o$. Accessory sphene is associated with chlorite and (?) allanite is seen to cause pleochroic haloes in that mineral. Thin veins cutting the rock are composed of albite and epidote.

A visual estimation of the amounts of minerals present is: plagioclase: 55, quartz: 30, chlorite, epidote, and black iron ore: 20, potash felspar: 5. The rock is a chloritized and somewhat saussuritized granodiorite.

Note. The granodiorite represented by these specimens outcrops quite close in the field to the area underlain by the Mugga Porphyry, and it was asked if there was any magmatic relationship between the porphyry and the granodiorite. The mineralogy of the two rock types is quite similar; in fact, the main difference lies in the textures of the two types: the Mugga Porphyry has a fine-grained groundmass enclosing numerous coarse anhedral to euhedral phenocrysts, whereas the granodiorite is coarse-grained, and is sparsely porphyritic, the rare phenocryst being only slightly larger than the average grain size. Bearing in mind the apparent close field association of the two types, it seems likely that the granodiorite may well be a coarse-grained variety of the Mugga Porphyry.

120 ACT/1 9th November, 1959.

6. A RE-EXAMINATION OF SPECIMENS FROM THE WODEN DISTRICT, AUSTRALIAN CAPITAL TERRITORY.

by

W.R. Morgan

Herewith are brief descriptions of specimens originally described by B.F. Breese (Geology of the Yarralumla Area) in February, 1958. The specimens were re-submitted by D.E. Gardner in order to check the validity of Breese's descriptions. The thin sections were briefly examined by W.B. Dallwitz, and he agrees with the re-naming of the specimens given below. All specimens are from the Woden District, covered by air photo Canberra-Lake George, Run 41, No. 5003.

95111. Outcrop ½ mile S.S.W. of Bowling Club, on west edge of Yarralumla Creek. Thin section number 4920. This specimen is seen to have anhedral to subhedral, commonly angular grains of quartz and plagioclase set in a very fine-grained, somewhat sericitic quartz-felspathic groundmass that contains several amygdale-like cavities partly or entirely filled with zeolite. Many of the smaller quartz fragments are triangular, in fact, shard-like, in shape: however, many of the plagioclase and larger quartz grains show corroded margins, much as though they were phenocrysts in an acid porphyry. The rock is probably a tuff, and may be an ignimbrite.

95131. Approx. 800 feet west of Kent St. near Bare Trig., on southern slope of ridge. Thin section number 4921. Described by Breese as an acid tuff, he is reasonably correct. Small angular grains of quartz and plagioclase are set in a very fine-grained sericitic groundmass. The rock is probably a devitrified vitric tuff.

95134. Approx. 2000 feet west of Bare Trig., above west bank of Yarralumla Creek. Thin section number 4922. In this specimen, small angular polygonal to triangular grains of quartz and felspar, and flakes of sericite are set in a very fine-sericitic groundmass. The grains and flakes show some preferred orientation, as though resulting from flowage. It is most likely that the rock is a tuff, or an ignimbrite.

95138. Approx. 300 feet west of Yarralumla Creek, nearly ½ mile S.W. of Bare Trig. Thin section number 4923. This specimen is fine-grained and inequigranular. Small angular grains of quartz and alkali felspar- (?) orthoclase - are set in a fine, patchy groundmass composed of quartz, (?)felspar and extremely fine sericite. Some of the fine quartz forms areas of sub-amoeboid grain mosaics, suggesting silicification. The rock is cut by quartz veins. The patchy aspect of the rock is formed by larger irregular areas containing intergranular hydrated iron oxide dust. The rock appears to be a devitrified and partly silicified vitric tuff.

95139. Approx. 300 feet west of Yarralumla Creek, nearly ½ mile S.W. of Bare Trig. immediately south of specimen 95138. In this specimen, fine to coarse-grained anhedral to subhedral, commonly angular grains of quartz, plagioclase and chloritized hornblende, and flakes of altered mica, are enclosed by and extremely fine-grained felsic and somewhat sericitic groundmass. Some lineation of the mica flakes may be seen, suggesting flowage. Some of the quartz and felspar fragments appear to be corroded. The angularity of the fragments suggests that the rock is tuffaceous: the flow-lineation suggests that the rock is a tuffaceous lava or an ignimbrite.

95144. In Yarralumla Creek, 1/3 mile N.W. of Cemetery. Thin section number 4925. This rock consists of coarse angular to subhedral grains of quartz and plagioclase, and rare flexed flakes of altered mica, set in a sparse groundmass of limonitic, felsic and chloritic material. Some of the quartzes show corroded margins. The rock is a crystal tuff.

95149. 100 feet west of Kent St. and 1000 feet S.E. of Bare Trig. Thin section number 4926. Mr. Breese is correct in stating that this rock is a porphyry. It is, in fact, a porphyritic dacite.

95153. 1500 feet west of Bowls Club. Thin section number 4927. This specimen is a crystal tuff, and consists of angular grains of quartz and plagioclase, and rare flexed flakes of chloritized biotite crowded into a matrix composed of granular quartz, (?)felspar and sericite.

95163. ½ mile N.W. of Bowls Club. Thin section number 4928. As Mr. Breese states, this rock is an acid tuff. It is probably a devitrified vitric tuff.

95165. 1000 feet N.E. of Bare Trig. in Creek. Thin section number 4929. This rock is a quartzite.

198 F/1 19th November, 1959.

7. EXAMINATION OF A SPECIMEN. NO. R7869, FROM AMUNDSEN BAY, ANTARCTICA

by

W.M.B. Roberts

The specimen, submitted by P.W. Crohn, is a thin, dull bluish-green coating on the slightly weathered rock.

An X-Ray spectrographic analysis showed the principal constituent to be copper, with some iron and nickel, and traces of manganese, chromium, cobalt, lead and arsenic.

The material is not soluble in water, but is soluble in hot conc. HNO_3. A test for chloride gave a strong positive result, and one for sulphate was negative. Some effervescence occurred when it was heated with conc. HCl.

The bluish-green colour distinguishes it from the cuprous chloride, nantokite, which is white or colourless; its insolubility in water rules out the possibility of its being a normal chloride of copper. The mineral is therefore probably a basic chloride of copper

An X-Ray powder photograph of the material bears some resemblance to two artificial basic copper chlorides, but does not match the only two A.S.T.M. patterns of naturally-occurring basic chlorides given - those of atacamite and botallackite.

There are no powder data for the only other established, naturally-occurring basic copper chloride, paratacamite.

189 NT/3 25th November, 1959.

8. X-RAY SPECTROGRAPHIC EXAMINATION OF A SPECIMEN FROM TENNANT CREEK, N.T.

by

W.M.B. Roberts

A specimen of weathered siliceous rock was submitted by W. Oldershaw for spectrographic analysis - chiefly to determine whether it contained copper. Numerous negative crystals after pyrite are distributed throughout the specimen; most of them contain a boxwork of hematite. The largest of these crystals measures 6.0 mm. across.

The X-Ray examination showed the principal metallic element in the rock to be iron, with traces of cobalt, arsenic, lead, copper and nickel, in that order of abundance.

As an indication of the amount of copper present, several basic rocks recently examined contained more copper than the above specimen, apparently exchanging for iron in the pyroxenes.

B.60Q/1 4th December, 1959.

9. EXAMINATION OF A RADIOACTIVE ROCK SAMPLE FROM WOLFRAM CAMP, QUEENSLAND

by

W.M.B. Roberts

Two pieces of coarse grained rock, consisting essentially of quartz, were submitted for examination by J. Daly of the Geophysical section. The purpose of the examination was to determine, if possible, the identity of the mineral of minerals responsible for the radio-activity. A geophysical report on the specimens is on file B.60Q/1 dated 24th November, 1959.

The sections of the rocks marked as being the most radioactive were checked on the Austronic B G R I counter and gave a count of 3 to 4 times background.

Examination under the binocular microscope failed to reveal any separate mineral which could be the cause of the radioactivity.

The relatively strongly radioactive portion of one of the specimens was crushed and an initial separation of quartz carried out, using bromoform as the heavy liquid.

The heavy mineral concentrate was analysed on the X-Ray spectrograph for uranium and thorium, which were both found to be present in the ratio Th : U : : 3 : 1 roughly, thus confirming the spectrometer tests carried out in the Geophysical Laboratory, which gave the content of the radioactive elements in the rock as

U_3O_8 - 0.02%

ThO_2 - 0.06%

The heavy fraction was then further separated in the superpanner, giving two major fractions -

a a dark metallic opaque mineral, occurring as small veins in the original rock.

b a mixture of a straw-yellow and a colourless non-opaque mineral.

These fractions were analysed on the X-ray spectrograph and their major constituents found to be -

a Tungsten, Iron and Manganese, a trace of uranium, but no thorium was detected.

b Yttrium, tungsten, iron, yterbium, erbium, dysprosium, gadolinium, holmium, cerium, samarium, thorium, terbium, and a trace of uranium.

X-ray powder diffraction photographs of the fractions showed mineral a to be ferberite ($FeO.WO_3$ + some $MnWO_4$), and fraction b to be a mixture of Xenotime (YPO_4), and scheelite. Ideally although Xenotime has the formula YPO_4, cerium and thorium commonly exchange for Yttrium in the structure; the spectrographic analysis demonstrates that this substitution, plus some uranium, has taken place in the mineral under examination.

CONCLUSION

The principal mineral contributing to the radioactivity of the specimens is Xenotime, an Yttrium phosphate in which there has been substitution of Yttrium by cerium, thorium and some uranium.

A slight contribution to the radioactivity would also be made by the uranium contained in the iron manganese tungstate, ferberite.

120ACT/1 8th December, 1959.

10. PETROGRAPHIC DESCRIPTIONS OF SPECIMENS FROM THE CANBERRA 1-MILE SHEET AREA.

by

W.R. Morgan

Herewith are descriptions of the petrography of specimens G59/1 (Canberra 1-mile sheet 327278) and T5 (Canberra 1-mile sheet 323284).

G59/1. Thin section number 5005.

The hand specimen is seen to be a medium-grained, hypidiomorphic-inequigranular basic igneous rock.

In thin section the rock is seen to be hypidiomorphic-inequigranular, the grain sizes ranging between 0.15mm. and 1.0mm; rare phenocrysts attain a size of 2.5mm. Some ophitic intergrowth and rarely, slight fracturing of the crystals may be seen.

Labradorite (An_{68}) forms slightly saussuritized subhedral tabular crystals that, in places, contain replacement veins of albite. Rarely, inclusions and veins of chlorite are present in labradorite. Augite forms colourless subhedral to anhedral grains that are sometimes ophitically intergrown with labradorite. It commonly has a rim of pale green fibrous actinolite, and in places, augite is almost entirely replaced by this mineral. Actinolite also occurs as small euhedral crystals, and is pleochroic with X = nearly colourless, Y = pale olive green, and Z = pale green; the colours tend to be rather more dark than those of the actinolite replacing augite. Pale green fibrous chlorite, and more rare epidote, zoisite and quartz, are interstitial. Anhedral grains of leucoxene and black iron ore may be seen, and accessory apatite occurs as fine acicular crystals enclosed in labradorite.

The rare phenocrysts are formed of tabular labradorite and prismatic, somewhat uralitized augite whose margins are sometimes ophitically intergrown with groundmass labradorite.

A visual estimate of the percentages of minerals present is: labradorite: 55, augite: 20, actinolite: 20, chlorite, epidote and quartz: 2, black iron ore and leucoxene: 3. The rock is a partly uralitized quartz-dolerite.

T5. Thin section number 5009.

This specimen was collected in 1955, and only the thin section was available for examination. The rock is seen to be hypidiomorphic-inequigranular, and coarse-grained, the grain sizes ranging between 0.3mm. and 3.5mm.

The mineralogy is fairly similar to that seen in G59/1: labradorite (An_{65-70}) forms slightly saussuritized anhedral to tabular crystals that show some fracturing: the fractures are filled with fine fibrous actinolite. Augite forms colourless subhedral to prismatic crystals, of which many are partly or wholly replaced by pale green fibrous actinolite. Actinolite is also found interstitial to labradorite crystals. Anhedral leucoxene and fine acicular apatite are present.

A visual estimate of the percentages of minerals present is:- labradorite: 55, actinolite and augite: 42, leucoxene: 3. The rock is a uralitized gabbro.

120 ACT/1 10th December, 1959.

11. THE PETROGRAPHY OF SPECIMENS OF PYROCLASTIC ROCKS, FROM THE WODEN DISTRICT, A.C.T.

by

W.R. Morgan

The following are petrographic descriptions of eight specimens submitted by D.E. Gardner from the Woden District, A.C.T.

656. Slide number 4962. ¼ mile S.W. of Maguire's house, 50 feet N. of large ashstone outcrop, Woden, A.C.T.

The hand specimen is a pale pinkish-cream, very inequigranular rock in which coarse angular to rounded grains of colourless quartz and pink felspar, flakes of mica, and some (?)amphibole, are enclosed in a fine-grained, cream groundmass.

In thin section, the rock is seen to have coarse grains of quartz, anorthoclase, and ferro-magnesian minerals enclosed in a very fine-grained, devitrified and veined groundmass.

With regard to the coarse grains, quartz forms sub-angular to rounded, sometimes triangular grains that range in size between 0.1 mm. and 2.75 mm. They have embayed margins, in places, pseudoinclusions. Anorthoclase occurs as tabular to sub-angular, somewhat corroded grains that range between 0.1 mm. and 2.0 mm. in size. It is weakly to strongly sericitized, and shows an indistinct cross-hatch multiple twinning, and 2Vx is small. Prismatic to anhedral amphibole and flakes of biotite have been pseudomorphed by hydrated iron oxide and pale nontronite. Some irregular clots of hydrated iron oxide are present which, in places surround, and apparently replace black iron ore.

The groundmass consists of a very fine-grained intergrowth of felsic material that probably results from the devitrification of glass. In places, the groundmass enclosed rather more coarse, irregular and weakly birefringent areas that may be chalcedonic or zeolitic. The groundmass has small cavities, and is cut by thin veins, both being filled with pale nontronite-like material. Thin quartz veins cut the rock.

The specimen appears to be a devitrified rhyodacitic crystal tuff.

657. Slide number 4963. Locality is 100 feet north of number 656: Woden, A.C.T.

The hand specimen is a grey inequigranular rock that has numerous grains of felspar, quartz and ferromagnesian minerals enclosed in a very fine-grained groundmass.

In thin section, the specimen is seen to be inequigranular, and has a mass of crystal fragments crowded together in a fine groundmass.

The coarse grains consist of quartz, plagioclase, and altered ferromagnesian minerals. Quartz grains range between 0.05 mm. and 2.5 mm. in size, and form sub-angular to sub-rounded grains, commonly with embayed margins. Oligoclase forms tabular to anhedral, commonly strongly sericitized grains that range between 0.05 mm. and 1.75 mm., rarely to 4.0 mm. Subhedral to anhedral amphibole has been pseudomorphed by chlorite and calcite, and some flakes of biotite are replaced by intergrown sericite, chlorite and leucoxene. Rare prismatic crystals of apatite, ranging up to 0.7 mm. in length, may be seen. Accessory zircon is present.

The groundmass consists of a fine felsic intergrowth which probably results from devitrification of glass, and is dusted with leucoxene. It contains small cavities and veins filled with green chlorite, fibrous zeolite and carbonate. Quartz is sometimes associated with chlorite.

The rock is a devitrified dacitic crystal tuff.

660. Slide number 4964. ¼ mile south-east of Tanner's House, 150 feet from contact with sediment, Woden, A.C.T.

The hand specimen is a pale creamish grey, very inequigranular rock, in which coarse grains of felspar, quartz and ferro-magnesian minerals are enclosed in a fine-grained groundmass.

In thin section, the specimen is seen to be rather similar to 657, in that grains of quartz, sericitized plagioclase, and altered amphibole and biotite, are enclosed in a fine-grained felsitic groundmass that probably represents devitrified glass. The rock is a dacitic devitrified crystal tuff. In places, the rock is cut by veins of fine granular quartz.

661. Slide number 4961. 1 mile S.W. of Mugga Quarry, Woden, A.C.T.

The hand specimen is a dark reddish-grey, very inequigranular rock containing coarse grains of felspar, quartz and amphibole which are enclosed in a very fine-grained, dark groundmass.

In thin section, the texture of the rock is seen to be rather similar to that of the previously described specimens. The coarse grains of anhedral, embayed quartz; tabular to anhedral somewhat sericitized, and, in places, partly albitized labradorite (An_{52}), and euhedral amphibole now pseudomorphed by hydrated iron oxide, epidote and (?)chalcedony. Some octahedral grains of black iron ore, commonly partly replaced by hydrated iron oxide, are present. The grains are enclosed in a groundmass that appears to be a fine-grained spherulitic intergrowth composed of chalcedony and chlorite, dusted with fine haematite. In places, relatively large part spherulites of (?)chlorite may be seen. The rock is a spherulitic dacitic crystal tuff.

670. Slide number 4983. 1 mile south of Mugga Quarry, near eastern foot of ridge, Woden, A.C.T.

The hand specimen, on a fresh surface, is seen to be a dark grey, fine-grained and inequigranular rock that weathers to a creamish-yellow. It contains fairly rare, angular grains of quartz and felspar that range up to 0.75 mm. in size, and which are enclosed in a very fine-grained rather hard groundmass.

In thin section, the specimen is seen to have angular, often shard-shaped fragments, whose size ranges between 0.02 mm. and 0.4 mm., enclosed in a very fine-grained groundmass. The fragments are composed of quartz and partly sericitized plagioclase:flakes of pale brown biotite may be seen, and rare prismatic apatite were observed. The groundmass consists of very fine-grained felsic material that is dusted with granular leucoxene. The groundmass is possibly devitrified glass. The rock is a devitrified acid ashstone.

655. Slide number 4837. Half mile east of Cemetery, Woden, A.C.T.

The hand specimen is a fine-grained, greyish-white rock that is somewhat stained by hydrated iron oxide. The rock contains grains of quartz and lineated flakes of micaceous material, all enclosed in a very fine groundmass that may be easily scratched with a knife.

In thin section, the rock is seen to be fine-grained and inequigranular, the grain sizes ranging up to 0.11 mm. Quartz forms angular, often shard-shaped grains that are commonly surrounded by a rim of hydrated iron oxide. Biotite and muscovite form roughly tabular flakes that have some preferred orientation. Both minerals show staining by hydrated iron oxide, and biotite is pleochroic from almost colourless to straw-brown. Leucoxene forms granular to prismatic grains. Rare granular epidote, and prismatic apatite and zircon are to be seen.

All these grains are enclosed in a very fine-grained, almost irresolvable groundmass, apparently composed of sericite.

The rock is best called a micaceous acid ashstone.

659. Thin section number 4838. Locality as 655.

The hand specimen is seen to be a very fine-grained laminated rock that is mostly dark purple-red; however, some laminae are cream-yellow. The laminae range between 0.5 mm. and 2 mm. thickness, and their distribution gives them impression of being sedimentary slumped cut-and-fill structures.

In thin section, the mineralogy and texture, except for the lamination, are very similar to those seen in specimen 655. Small angular, often triangular-shaped, grains of quartz, and tabular, sometimes flexed, flakes of sericite and biotite, embedded in an extremely fine-grained groundmass composed of sericite. In addition, granular to tabular grains of leucoxene and

hydrated iron oxide are present, and opaque dust is commonly seen to be associated with the micas. The lamination is caused by concentrations of fine hydrated iron oxide dust occurring in thin, sub-parallel layers. The more tabular quartz grains, and the mica flakes, tend to be oriented parallel to this layering.

The layers have minor, ripple-like undulations. Although the area covered by the slide is rather restricted, it can be seen that "disconformable" sets of layers are present.

The rock is a laminated acid ashstone.

658. Slide number 4835. Locality as 655.

The hand specimen, on its weathered surfaces, is seen to be a coarse and very inequigranular breccia, in which pale greenish-cream fragments that range between 0.5 mm. and 12 cm. in size are enclosed in a fine-grained purple matrix. The specimen is illustrated in fig. 1. The fragments contain coarse grains of felspar and quartz enclosed in a fine-grained groundmass: in many (e.g. A, B, and C in fig. 1) a faint lineation may be seen; in fragments A and B, the lineation is parallel, but in C, as in many of the smaller fragments, its direction is random. The fragments commonly have angular margins, and many appear to have been formed by the purple matrix material veining larger fragments, as may be indistinctly seen at area 1, where fragment B is minutely veined. A more advanced stage of this form of fragmentation may be seen in area 2.

The matrix to the fragments is formed of two materials: the dominant is purple, and is veined by the other, which is dark purple and apparently siliceous. The later siliceous matrix material is concentrated in those areas where the "cloud-like" masses of smaller fragments are absent. The matrix material at one place (3) appears to have partly mobilized fragment A. A vein of epidote (Ep) cuts the fragments and the matrix, and numerous minor veins of epidote may be seen in the hand specimen.

In thin section, the fragments are seen to consist of a porphyritic albite dacite, and have anhedral phenocrysts of embayed quartz, and tabular, corroded and partly saussuritized albite enclosed in a fine-grained groundmass composed of an intergrowth of felsic material. Also present are large "grains" composed of quartz mosaics, which usually have a thin rim of haematite: these grains may be xenoliths, although some appear to pseudomorph pre-existing ferro-magnesian minerals.

The dominant matrix mentioned in the hand specimen description is seen to be composed of material very similar to that described in specimens 655 and 659, i.e. it appears to be micaceous ashstone.

The ashstone is cut by thick, commonly roughly lenticular veins composed of fine-to medium-grained amoeboid quartz, and of haematite dust, the latter material tending to be concentrated on the vein margins. The quartz-haematite veins cut both the ashstone and the porphyry fragments, and have numerous sinuous offshoots filled with haematite. Thin, anastomosing veins composed of epidote seem to be associated with the quartz-haematite veins.

As the fragments are enclosed in ashstone, the rock is best called a veined dacitic agglomerate. However, from the description it is apparent that both forms of the matrix vein and intrude the fragments, i.e., the fragments and matrix seem as though they are not deposited haphazardly as in an extrusive agglomerate. Hence, it is possible that this rock is an intrusive pyroclastic. Reynolds (1954, pp. 582-598) has summarized occurrences of intrusive pyroclastic rocks, and accounts for their formation by a process of gas streaming, or fluidization. This may happen, presumably, in a volcano which extrudes ignimbritic material.

Specimens 655 and 659 were noted to have a similar texture to the dominant matrix of specimen 650, hence, it is very tentatively suggested that they may be genetically associated with the agglomerate, and be intrusive ashstones.

REFERENCE

REYNOLDS, D.L. (1954) - Fluidization as geological process, and its bearing on the problem of intrusive granites. Am. Jour. Sci., Vol. 252, pp. 577-614.

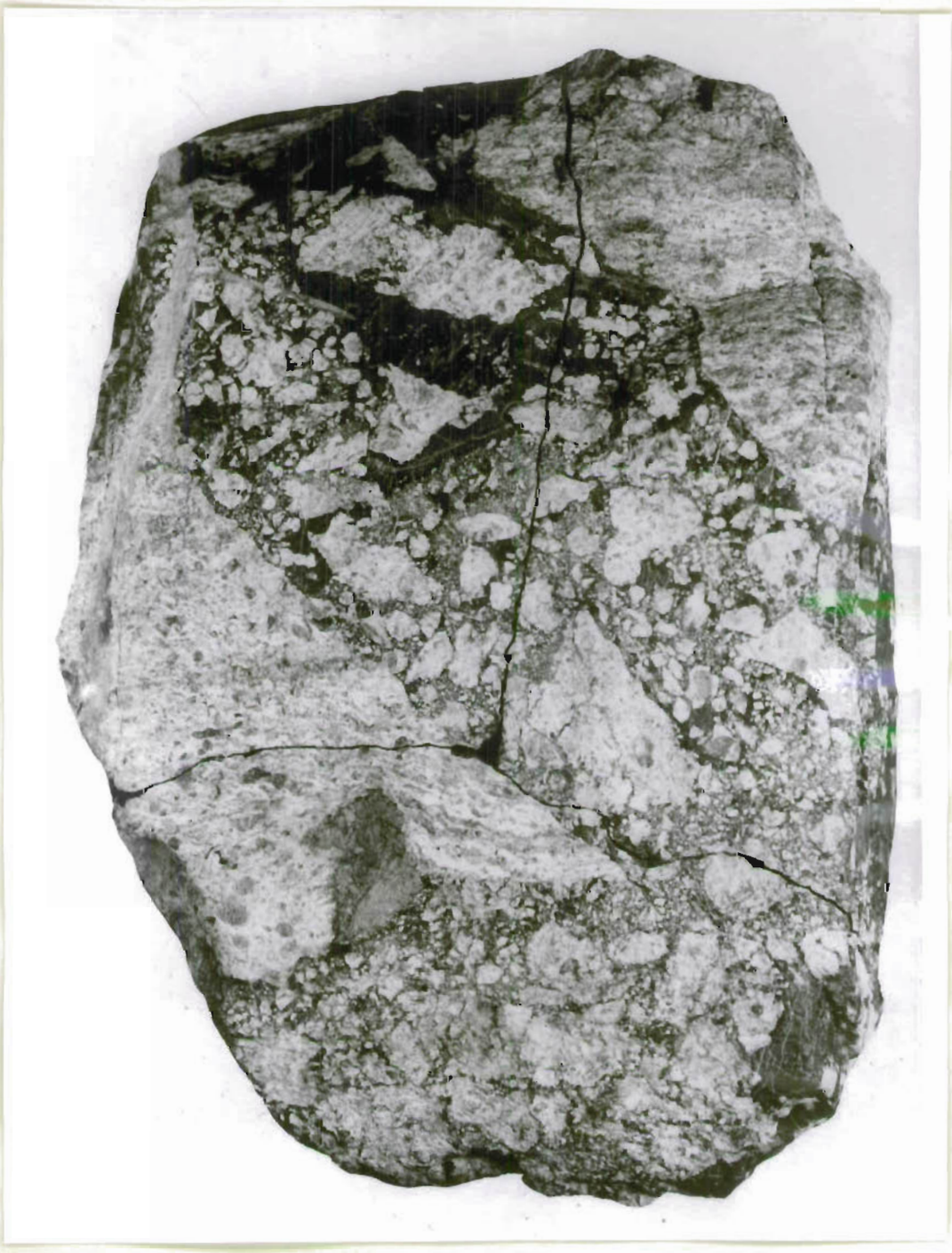

Fig. 1. The veined dacitic agglomerate; specemen 658, Woden District, A.C.T. Natural size.