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MISCELLANEOUS PETROGRAPHIC AND MINERAGRAPHIC INVESTIGATIONS CARRIED OUT IN THE GEOLOGICAL LABORATORY, CANBERRA, DURING THE QUARTER OCTOBER-DECEMBER 1960

Compiled by

Robert Bryan

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Report No. 1

120NT/1
12th October 1960.

BRIEF NOTES ON THREE SPECIMENS FROM THE NORTHERN TERRITORY, SUBMITTED BY P. G. DUNN, OF DARWIN, N.T.

by

C.M. Gregory

Listed below are brief notes on the slides cut from rocks forwarded from Darwin by P.G. Dunn.

5823: This is a coarse-grained granite with sodic plagioclase and microcline feldspars, strained quartz, anhedral and randomly oriented biotite flakes. There has been alteration in some of the plagioclase grains to saussurite, especially in the cores of the grains.

5824: This rock is probably a greywacke which has undergone low grade thermal metamorphism. Angular quartz and feldspar grains together with various types of rock fragment are combined into a rock with a quartz-biotite-muscovite-chlorite groundmass. The boundaries of the fragments have been partially resorbed into the groundmass.

5825: This is a fine-grained conglomerate containing pebbles of quartzite, basic igneous rocks and shale (with quartz and feldspar fragments) set in a groundmass of quartz, finely divided white mica, and calcite. The rock has undergone low grade thermal metamorphism that has resulted in recrystallization of the groundmass and possibly some of the rock fragments.

Report No. 2

64F/1
17th October 1960

X-RAY EXAMINATION OF TWO CLAY SAMPLES FROM BELLONA ISLAND, SOUTH WEST PACIFIC

by

W.M.B. Roberts

Two samples, No. A66/3 - 6 feet, and A66/3 - 2 feet, were submitted by O.N. Warin for identification of the constituent minerals.

Two standard patterns, one of variscite and one of crandallite, were prepared from material obtained from the museum. This was done so that comparisons could be made with the patterns from the clays if more than two mineral species were present, which would result in a complicated X-ray pattern, and hence difficult to interpret.

Neither variscite nor crandallite is present in the nodules of either A66/3 - 6 feet or A66/3 - 2 feet. The only mineral identified in both cases was fluorapatite; no other crystalline material was present in either sample.

Report No. 3

50PNG/1
13th October 1960

EXAMINATION OF A DRILL CORE SPECIMEN FROM THE LALOKI COPPER PROSPECT, NEW GUINEA

by

W.M.B. Roberts

The specimen, No.P433, is from 155 feet in the D.D.H. SC7 from the Laloki copper prospect, New Guinea. The country rock consists of sub-angular to rounded fragments of a shaly material ranging up to 4.5 mm. in length. The components of the fragments themselves are extremely fine-grained; as a result quartz and sericite are the only minerals which can be positively identified. A brown staining, probably iron oxide is apparent in all fragments.

That the rock has been subjected to severe shearing stress is evident from the strong fracture pattern, and, in places, fairly intense brecciation. The whole rock is marked by extensive introduction of calcite, effectively recementing the fragements, but without any obvious signs of having replaced them.

The sulphides identified in the rock are: pyrite, chalcopyrite, marcasite, sphalerite, and some ? cubanite, in that order of abundance.

The pyrite has been strongly fractured, in places almost pulverised, by severe shearing; it forms irregular masses and subhedral crystals which are moulded and recemented by chalcopyrite and calcite. The chalcopyrite is characterised by lamellar twinning, the individual lamellae having a lenslike form, indicative of a stress which has been imposed upon the grains after, or at a late stage in, their deposition. The chalcopyrite also has a spongy appearance in many places, due to an almost myrmekitic intergrowth of chalcopyrite and calcite. There is no doubt that this mineral is replacing pyrite; it preserves the outlines of partly replaced grains and masses, in places preserving traces of the pyrite fracture pattern. A structure clearly showing the replacement process may be seen in the accompanying photo; a mineral remaining from the original rock, having a perfect (III) cleavage, has been replaced along this cleavage by invading chalcopyrite, the remainder of the mineral clearly preserving its original outline. Marcasite forms irregular intergrowths with pyrite, mainly as chain-like masses composed of small evenly-sized grains.

Sphalerite is always associated with chalcopyrite, forming irregular areas, frequently as rims on isolated pyrite grains.

What is thought to be cubanite, is an orange-brown mineral formed along fractures in two of the chalcopyrite areas. Although similar in appearance to bornite, it is clearly distinguished from bornite by its intense anisotropism.

The only gangue mineral is calcite. A qualitative X-ray spectrographic analysis showed the metallic elements in the rock to be : Fe,Cu, Zn, Mn, As, and traces of cobalt, in that order of abundance.

CONCLUSIONS

The pyrite, which forms the bulk of the sulphide portion of the rock, shows evidence of having been very strongly sheared; in places it has been almost pulverised by the shearing action. It must therefore have been deposited before the introduction of the gangue, for, if it had followed the calcite, the relatively large quantity of this latter mineral would have, by flowage under pressure, protected the pyrite from at least the more drastic effects of the shearing. The fairly sharp break between the pyrite mass and the brecciated country rock would indicate that the pyrite was present before the shearing took place. If it were introduced subsequently it would have been injected along the multitude of fractures opened in the country rock, whereas its outlines are quite sharp, only calcite having been introduced into the fractured country rock. An area of intense shearing roughly 0.5mm. in width in the country rocks follows the boundary of the pyrite, at a distance of approximately 0.5 mm. from it, probably due to compression of the rock against the fairly unyielding pyrite.

Some movement has continued in the rock subsequent to the deposition of the copper-zinc sulphides - the lens-like lamellar twins in the chalcopyrite grains, and the extensive twinning of the calcite are evidence of a post-depositional stress.

In conclusion it can be stated with reasonable certainty that the pyrite in this rock was present prior to the shearing and consequent introduction of copper-zinc sulphides. It is not possible to say whether this pyrite is of sedimentary origin.

Report No. 4

84/G/8
7th December 1960

URANIUM ANALYSES FOR EL SHARANA MINE, NORTHERN TERRITORY

by

W.M.B. Roberts

Eleven samples of radioactive ore were submitted by the mine manager, El Sharana Mine for Uranium assay. The following are the results obtained by X-ray fluorescent spectrography:

Sample No.	$\%U_3O_8$
16964	0.152
16970	0.118
16246	0.055
16237	0.165
16247	0.112
16995	0.217
16969	0.260
8672	0.4989
8673	0.778
16984	1.188
16986	1.214

It will be noted that the radiometric figures for the samples 16970, 16246, 16237, 16247 and 16995, are higher than those obtained from the X-ray spectrograph.

The discrepancies, listed in order of magnitude are -

	$\%U_3O_8$	
	X-ray	Radiometric
16246	0.055	0.166
16247	0.112	0.243
16237	0.165	0.240
16970	0.118	0.158
16995	0.217	0.247

The probable explanation for the differences between the two methods may be seen from the accompanying chart records, which show the region of the thorium $L\alpha_1$ and Uranium $L\alpha_1$ lines. It will be noted that there is a direct relationship between the ratio of the thorium $L\alpha_1$ line to the Uranium $L\alpha_1$ line, and the magnitude of the difference between the two methods of analysis.

The X-ray method is specific for uranium - thorium in the sample does not have any effect on the uranium result. It thus appears that no allowance for thorium has been made in the radiometric analyses.

Report No. 5

84/NT/4 - A
13th December 1960

"AMPHIBOLITES" FROM THE RUM JUNGLE AREA, N.T.

by

Robert Bryan

During November 1959, I sampled drill core from Mt. Burton and Rum Jungle Creek South, that had been logged by T.E.P. geologists as amphibolite.

The Mt. Burton core was from diamond drill hole No. 351, and the samples were taken at about 20 feet intervals, between 441' and 720'. Twenty six thin sections were made from the samples (T.S. 5419 - 5444).

The Rum Jungle Creek South core was from D.D.H. No. 337, which was sampled at similar intervals between 175' and 1307'. No thin section work was done, as W. Oldershaw had previously described a sample of amphibolite from this drill core.

Petrology of the Mt. Burton "amphibolite"

The rocks consist predominantly of tremolite, with calcite, quartz, pyrrhotite, pyrite, graphite, and a little microcline and sphene. This assemblage represents calc-silicate rocks which can be shown by the mineralogy and the textures, to have formed siliceous dolomitic limestone, or siliceous dolomite. Numerous thin bands of clean quartz, and also of pure carbonate, clearly represent sandy and limy beds within a predominantly impure carbonate sequence.

The calc-silicate assemblage conforms to the "biotite-chlorite sub-facies" of the metamorphic "greenschist facies" (Turner and Verhoogen, "Igneous and Metamorphic Petrology" p.466, 1951). These authors claim that the above type of assemblage can only arise if the rocks have been subjected to "synchronous deformation or intense hydrothermal activity", in addition to the thermal effects of the metamorphism. (In other words the thermal effects of contact metamorphism, would not be sufficient, alone, to cause the changes).

In the case of the Mt. Burton calc-silicate rocks, the sub-parallel development of large tremolite porphyroblasts indicates crystallization under conditions of stress. This schistosity is commonly partly obscured by later crystallization of patches and veins of coarser calcite, often trending across the schistosity. Also there is a pronounced tendency for the pyrite and pyrrhotite to be concentrated in the areas of coarser calcite; hence it seems certain that both the coarser calcite and the iron sulphides were formed after the tremolite, probably as a result of hydrothermal activity.

Petrography of the Mt. Burton "amphibolite"

The rocks are best described under three major types, though most intermediate types are also present.

(1) Tremolite schist, and tremolite - calcite schist
(2) Recrystallized limestone and dolomite
(3) Recrystallized quartz sandstone.

1. Tremolite schist and tremolite-calcite schist:

These rocks make up the bulk of the core that has been described as amphibolite. In the hand specimen it ranges from light grey to dark steel-grey, and the surface commonly has a patchy satin lustre, due to the pronounced cheavage of the tremolite porphyroblasts.

In thin section, the rocks are seen to consist of tremolite, with very variable amounts of calcite, and some microcline, quartz, pyrite, pyrrhotite, graphite, and sphene. The rocks are usually cut be later calcite veins.

The tremolite is medium to coarse-grained, and occurs either as bundles of fibres, or else as stout separate crystals. The individual crystals may be seen in all stages from 'embryonic', very irregular sections crowded with inclusions of calcite and graphite, to large euhedral and subhedral sections, containing far fewer inclusions.

The tremolite is usually heavily masked by graphite. This graphite is, in most cases, very fine-grained and evenly disseminated through the tremolite, but may form medium-grained patches, and in a few cases, fills fractures within the tremolite. The graphite is also disseminated through the felspar, but is much less common in areas of quartz or calcite.

The percentage of calcite present is very variable but in most cases is less than that of tremolite. The fine grained calcite is the more common and occurs as streaks and patches parallel to the schistosity. Medium-grained patches and veins of calcite are less common; they trend across the schistosity and also contain considerable pyrite and pyrrhotite - far more than is found in the concordant areas of finer calcite.

Microcline was positively identified in two thin sections only; it formed small rather elongate anhedra, heavily streaked with graphite. It is possible that some plagioclase feldspar also is present, but the probable absence of twinning, combined with the masking caused by the graphite, would make recognition difficult.

Slightly pleochroic sphene is found in a few sections, together with an unknown colourless anhedral mineral, which is positive, probably uniaxial, and has moderate relief and low birefringence. This mineral is also streaked with graphite. Pyrite and pyrrhotite are both common; the pyrite forms quite large, very irregular patches, in which some of the grains show partial cubic outlines.

2. Recrystallized limestone and dolomite:

This is quite common, and forms bands from a few inches to several feet thick, parallel to the trends of the adjacent tremolite schists. These calcite bands represent recrystallized beds of dolomite or limestone, or mixtures of these two.

3. Recrystallized quartz sandstone:

This material also forms bands from a few inches to several feet thick and represents sandy beds that have been wholly recrystallized to a fine quartz mosaic. (These rocks have been logged as quartzite). The bands often contain some calcite, and in some places grade into carbonate beds. Graphite is absent from these sandy beds.

Conclusions about the Mt. Burton "amphibolite"

The present examination supports the work of John McManus of Consolidated Zinc, who examined a piece of tremolite-calcite schist from D.D.H. No. 351 occurring at 669'.

The rocks were originally limy sediments containing carbonaceous and siliceous material, together with much thinner bands of limestone, dolomite, and pure quartz. As a result of mild regional metamorphism accompanied by moderate stress conditions, the rocks were recrystallized to tremolite schists, tremolite-calcite schists, fine marble, dolomitic marble, and quartz hornfels; the carbonaceous material was made over to graphite.

At some later stage pyrite and pyrrhotite were either introduced, or - if a syngenetic origin is contemplated - redeposited by the action of some thermal agency.

Discussion of Rum Jungle Creek South "amphibolite"

In the case of the Rum Jungle Creek South "amphibolite", the story is quite different. The "amphibolite" from D.D.H. No. 337 is light grey but contains large, dull-greenish patches. It has a marked schistosity and in some places has developed boundinage structure; the 'eyes' consist of dull-green amphibole, and they are separated by 'streams' of brown biotite. No sandy or limy bands have been seen in the core.

W. Oldershaw of the B.M.R. has examined three thin sections (T.S. 5201 - 2, 5164) from D.D.H. No. 337. (File Note 84/N.T./4-A dated 12.2.60). He described the rocks as being "originally medium-to coarse-grained gabbro, ...that was metamorphosed to a xenoblastic, somewhat sodic amphibolite".

I agree with his description, but feel that the implications of his conclusions are of very local application only. It seems most unlikely that the amphibolite represents the grade of metamorphism reached within the Rum Jungle area as a whole, but rather, has been formed in response to very local high stress conditions, possibly assisted by hydrothermal activity.

I also feel that the naming of the rock as "originally a medium-to coarse-grained gabbro", may be somewhat misleading, in view of the general results of the considerable amount of detailed mapping that has been done in the Katherine - Darwin region, and especially in the Rum Jungle area. At no other place has there been any suggestion of basic plutonic rocks within the Lower Proterozoic sediments. Therefore it would be more appropriate to consider the "amphibolite" as derived from dolerite which is very common at Brocks Creek, Burrundie, and other nearby areas - at least until some undisputed gabbros are discovered in the region.

W. Oldershaw has also described a specimen from Rum Jungle Creek South D.D.H. No. 363 (File Note 84/N.T./4 - A undated). It had been altered almost beyond recognition, but Oldershaw thought that it was "a very altered basic or intermediate rock such as a dolerite trachyte or andesite". (Copies of Oldershaw's descriptions have been forwarded to R. Spratt, of T.E.P.).

Discussion of the Dolerite Ridge meladiorite:

Three surface samples from Dolerite Ridge, near Area 55 were examined in the South Australian Mines Department laboratory, during 1959. The rocks were described as "malanocratic microdiorite, sheared altered meladiorite, and sheared fine-grained amphibolite". The very brief descriptions show that the rocks are igneous in origin, and originally had either an intermediate or - more probably - a basic composition.

General Conclusions

It seems certain, that in the Rum Jungle area, two types of amphibolites occur; they are superficially quite similar, but have formed from two entirely different parents.

On the one hand, there are the tremolite-calcite schists from Mt. Burton, clearly derived from limy sediments; then there are the metamorphosed basic igneous rocks from Rum Jungle Creek South, and the sheared "diorite" from Dolerite Ridge.

Both the sediments and the basic igneous rocks were probably recrystallized at the same time, in response to low grade regional metamorphism, and in particular to moderate stress conditions. The rocks have been later modified by the formation of pyrite and pyrrhotite, and coarser patches and veins of calcite.

Whether the iron sulphides are hydrothermal, or re-deposited syngenetic pyrite is uncertain; but preliminary X-ray work by W. M. Roberts, of the B.M.R., on a sample from Mt. Burton, suggests that - providing the pyrite and pyrrhotite were formed at the same time, i.e. in equilibrium with each other - the temperature of formation of the pyrrhotite was in the range 370°C - 450°C. This is strongly suggestive of a hydrothermal origin for the iron sulphide especially in view of the overall low grade of metamorphism of the country rocks.

Report No. 6

198NT/1
13th December 1960

EXAMINATION OF A SPECIMEN OF LEAD-ZINC ORE FROM SIXTY MILES SOUTH-WEST OF ANGUS DOWNS, NORTHERN TERRITORY

by

W.M.B. Roberts

The specimen, submitted by the Alice Springs office, is an irregularly-shaped piece of banded lead-zinc ore, roughly 4 cm. long. Two polished sections and one thin section were prepared for the examination.

The opaque ore minerals were identified as pyrrhotite, galena, sphalerite, and arsenopyrite, in that order of abundance. Of these minerals only arsenopyrite has formed euhedral crystals the largest of which is 1.2 cm. in length. Viewed in hand specimen, these crystals are confined to a band about 1 c.m. wide, wherein their distribution is completely random.

Pyrrhotite, galena and sphalerite all show a gradation from banded ore to completely recrystallized material in which all traces of the original structures have been lost.*

The gangue minerals are mainly quartz and dolomite, with very minor chlorite and sericite.

The quartz has the mosaic texture typical of recrystallization; the dolomite forms fairly large rhombs, in places up to 0.8 mm in length, as well as a mosaic intergrowth.

Very little of the original rock remains; even that which is preserved in the banded sections has been largely replaced by ore. The only minerals identified were quqrtz and sericite; these have a uniform grainsize of about 0.02 mm. and also have been recrystallized, but less completely than the quartz and sericite of the gangue.

Although it is not feasible to reconstruct a complete history of the deposit from the examination of one ore specimen, some features are evident in the polished sections which allow speculation on some of the more important events associated with the mineralization.

The relatively undeformed mineralized rock, probably a shale (possibly dolomitic), contained conformable bands of galena, pyrrhotite, and sphalerite. Subsequently, a period of intense folding caused extensive recrystallization and movement of the sulphides.

As would be expected, galena has been the most easily mobilized, and has been moved into what appears to be the nose of a small fold* very similar to that of the galena at Mount Isa, Queensland. The pyrrhotite, and to a lesser extent, the sphalerite have been recrystallized in situ with only minor movement transgressing the bands, the bulk of the material remaining on the limbs of the fold.

The position of arsenopyrite is obscure; like pyrite, it exerts a strong force of crystallization, and could therefore, have grown during the reconstitution of the rock. This hypothesis is supported by the fact that the crystals, which tend to

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* Plates to accompany this report are shown only in the original report, and not in this compilation.

form a band in the lead-rich portion of the rock, are randomly distributed within the band, and do not conform to the complex folding. The crystals show no evidence of corrosion such as could normally be expected to occur if they had been surrounded by a recrystallizing matrix.

X-ray spectrographic analysis shows the major metallic elements to be Pb, Zn, Fe, with traces of Cu and Bi.

Report No. 7

16th December 1960

EXAMINATION OF AN IRON ORE SAMPLE FROM SCOTT RIVER W.A.

by

W.M.B. Roberts

The sample was submitted by the Secretary, Department of National Development, for identification of the iron minerals.

A polished section showed that two types of iron oxide are present in the sample. The principal mineral is a reddish-brown iron oxide forming roughly 70% to 80% of the total iron minerals; this was identified by X-ray diffraction as the hydrated iron oxide, goethite ($\gamma\ Fe_2\ O_3-H_2O$).

This mineral forms mainly a structureless matrix containing areas consisting essentially of an opaque, isotropic oxide having an oolitic structure.

Some of this mineral, which forms about 20% to 30% of the iron oxides, was separated from the polished section and identified by X-ray diffraction as maghemite a strongly magnetic oxide of iron having the formula γFe_2O_3. However, when both the oxides were tested for magnetism on the polished section, it was found that the goethite was apparently magnetic. A possible explanation for this magnetism could be that extremely finely divided maghemite is intimately admixed with the goethite, although there is no evidence from the polished section to support this suggestion.

Dana *states that maghemite forms presumably by slow oxidation, at low temperatures in a gossan, and may be derived from magnetite or lepidocrocite. It has been prepared synthetically by the dehydration of lepidocrocite below 750°C.

The failure to identify maghemite in the original powdered sample is due to the nature of the maghemite powder pattern, the strong lines of which coincide with slightly weaker lines of the goethite pattern. When it is not a major constituent of a goethite-maghemite mixture, the composite pattern produced is that of goethite; only a polished section shows that two forms of iron oxide are present in such a sample.

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*Dana's System of Mineralogy - Palache, Berman & Frondel Seventh Edition, Vol. 1, p.708.

Report No. 8

66PNG/1
22nd December 1960

BRIEF NOTES ON MAGNETITE SAND FROM BOUGAINVILLE ISLAND, NEW GUINEA, SUBMITTED BY J. E. THOMPSON

by

C.M. Gregory

The two specimens of sand from Bougainville Island have been examined mineralogically for J. E. Thompson, and the results appear below. The chemical assay for the amount of TiO_2 contained in the magnetite of specimen P432 has not yet been completed.

Sample P431

In this sample the ratio of discrete magnetite to discrete ilmenite is 16.8 to 1. This was obtained by point-counting on a polished section of the sand set in plastic. There are very few composite grains but the sample contains some grains (less than 1%) of magnetite with exsolution lamellae of ilmenite. Haematite is approximately 1% of the sample.

Sample P432

This sample consists of 33% plagioclase grains, 28% rock fragments, 22% pyroxene grains, 6% brown hornblende grains, 6% green hornblende grains and 5% iron oxide grains.

Rock fragments range from fresh basalt and andesite composed of the above minerals to rounded and altered pieces containing epidote, limonite, and other secondary minerals.

The iron oxide is mainly magnetite, sometimes showing fine exsolution lamellae, and very subordinate haematite and limonite.

Report No. 9

106G/17
23rd December 1960

EXAMINATION OF A MINERAL IN A SHELLY LIMESTONE FROM THE BOULIA AREA, S.W. QUEENSLAND

by

W.M.B. Roberts

The specimen, labelled GAB 72, was submitted by M. A. Reynolds for identification of a bright yellow mineral. This mineral forms rare coatings on coarsely crystalline calcite, lining small cavities in the rock.

A scraping of the mineral gave an X-ray powder diagram of calcite principally, with a group of low angle lines from the unknown, superimposed. An X-ray spectrographic analysis showed the metallic elements in the powder scrapings to be uranium, arsenic, and vanadium in that order of abundance.

Because of the extremely minute quantity of mineral present the spectrogram was fairly weak so it was considered necessary to verify the presence of uranium by the fluoride bead test; this gave a strong positive result.

The group of low angle lines conforms to the pattern of carnotite, a potassium uranium vanadate. The presence of arsenic cannot be explained; it is not part of the carnotite structure, therefore its presence may be explained either as an impurity in the limestone or as part of some other unidentified mineral.

Report No. 10

December 1960

REPORT ON GRAIN SIZE AND MINERALOGICAL ANALYSIS OF NINE SAND SAMPLES FROM THE HONEYSUCKLE DEPOSITS AND TWO SAND SAMPLES FROM DUNTROON, A.C.T.

by

C.M. Gregory

Sand samples representative of a stratigraphic column in the Honeysuckle deposit were subjected to grain size and mineralogical analyses following a standard pattern. The process was:

1. Mechanical dispersion of a weighed sample with a rubber pestle and mortar.
2. Sieving into eleven fractions using a mechanical shaker for the six finer fractions. For two samples a twelfth fraction was separated by difference in settling rate in a water column.
3. Each fraction was weighed and treated with concentrated hydrochloric acid and stannous chloride until all the free iron had gone into solution.
4. After complete washing, during which care was taken to avoid loss of insoluble material, especially in the finer fractions, the samples were dried and weighed again.
5. A small amount of each cleaned sample was then mounted on a glass slide using a mixture of black Bostik and carbon tetrachloride as a thinner.
6. Each slide was etched with hydrofluoric acid fumes then stained with sodium cobaltinitrite followed by Malachite Green.
7. After washing and air drying the slides the mineral grains were counted and the percentage weights calculated.

This staining method helps in the identification of the feldspars. Potassium feldspars stain yellow with sodium cobaltinitrite when over-stained with Malachite Green. (Care must be taken to stop this process before the yellow stain is obliterated). The other alumino-silicates are stained blue. Grains counted as plagioclase may be either fresh or weathered plagioclase, or, less probably, weathered potash feldspar. Rock fragments, plagioclase and mica may be readily distinguished from each other by cleavage or texture. Quartz is not stained by these chemicals.

A grain size cumulative frequency curve was drawn for each sample and from these frequency distribution curves were constructed. The figures 1 to 11 show cumulative and sample frequency curves for each sand sample. A - J are from Honeysuckle and K and L from Duntroon. (These figures are shown only in the original report).

The finer sieves are known to be oversize to some extent so an allowance has been made by drawing the cumulative frequency curve below the plotted points.

In the grain size analysis the most significant variation is in the weathering and chemical breakdown of feldspar in situ. Clay material may also have been introduced by washing down from the younger sands above.

The modes occur in the small range between 0.9 and 0.4 m.m. with one sample having a bimodal distribution. The general shape of the frequency distribution curve is a fairly sharp rise to the mode from the coarse material, then an equally sharp decline with a shelf at about 4 to 8 percent lower than the mode, then with a more gentle falling-off and finally a very gentle slope in the finest material range.

Mineralogically the quartz percentage by weight is the most constant (about 54%). Rock fragments range from 10% to 3% and muscovite from 2% to 0.02%. Material soluble in concentrated hydrochloric acid (largely iron oxide), ranges from 10% to 2%. The greatest range is shown by feldspar with figures falling between 23% and 36%. The ratio of potassium feldspar to plagioclase ranges from 0.53:1 to 2.18:1. Generally in the older sands the ratio of potassium feldspar to plagioclase is less than 1 : 1.

The increase in potassium feldspar in the younger sands is difficult to explain without introducing the idea of a change in the provenance. In both the older and younger sands from the Honeysuckle deposit the potassium feldspar grains are coarser than the plagioclase so that the idea of winnowing out the finer potash feldspar is not tenable. Increased weathering in the provenance with a subsequent relative increase in the potash feldspar available for transport as sand is suggested to be the cause of this increase. In other words the older sands were derived from fresher material than were the younger sands.

Two sands collected from Duntroon and thought to be of similar age to the younger of the Honeysuckle sands, show a marked difference in their frequency distribution diagrams from those of the Honeysuckle sands. From the coarse fraction the slope to the mode is gentle; there is then a sharp break in slope and a sharp rise to the mode with a similar falling off to the fine fraction. The mode fraction is between 30 and 35% of the sample weight. Mineralogically the percentage of mica, quartz and soluble material is very similar to the younger of the Honeysuckle sands. The potassium feldspar to plagioclase ratio is slightly greater than 1, (1.13 - 1.06), and total feldspar is approximately 21%.

The sand deposits at Honeysuckle are on gentle slopes compared with those at Duntroon. The method of transport of sand into these two areas probably differed because of this. In the Honeysuckle area particles were transported both by rolling or saltation along the surface and by suspension in clouds a few inches above ground level. The coarse fraction gives the broad modal peak and the fine fraction the shelf on the frequency distribution curve. The Honeysuckle sands are coarser than the Duntroon sands so transport by rolling was an important factor while at Duntroon the mode is a sharp peak on the frequency distribution curve suggesting transport very largely by suspension in low clouds of dust and sand.

If the grain size difference can be accounted for by the method of transport then the younger sands from the Honeysuckle deposit can be correlated with the two samples from Duntroon.

From their distribution in the pit at Honeysuckle the sands increase in age from laboratory sample letter A to J.

TABLE 1

These values are percentages of each mineral present in each sieved fraction. The order of accuracy does not warrant the three decimal places but these were left in for use in any further calculation from these results. From these figures a qualitative estimate can be made of the relative degrees of coarseness of the minerals.

Fraction	A			C			G			J		
	quartz.	K-felds.	plag.	quartz	K-felds.	plag.	quartz	K-felds.	plag.	quartz	K-felds.	plag.
1	0.726	1.379	.538	.035	-	-	.014	-	-	.011	-	-
2	43.755	34.519	21.164	12.728	9.373	3.219	8.307	2.585	3.390	13.034	14.193	15.945
3	25.167	10.039	24.436	26.638	14.731	18.147	15.778	14.400	15.550	20.305	32.469	22.706
4	13.355	32.620	16.096	34.389	49.147	28.894	40.372	58.256	36.612	45.430	31.128	32.654
5	1.746	1.246	7.828	5.786	7.765	4.917	11.840	13.516	8.866	7.498	8.933	10.837
6	5.363	1.149	5.899	11.742	13.251	16.625	16.452	9.616	21.621	11.131	10.037	12.148
7	0.451	0.714	0.906	0.771	0.730	1.880	0.638	0.218	1.221	0.439	0.735	0.521
8	2.348	4.862	2.638	4.674	4.381	10.619	3.135	0.487	5.559	12.677	1.669	1.544
9	3.022	6.374	5.774	1.834	0.266	10.423	1.444	0.510	1.739	0.334	0.509	1.571
10	2.147	1.935	4.929	0.701	0.266	1.894	0.966	0.582	2.674	0.119	0.226	0.997
11	1.332	1.838	2.415	0.639	0.089	3.382	0.576	0.130	1.357	0.167	0.041	0.413
12	0.587	3.338	7.185	-	-	-	0.537	-	1.412	0.265	0.062	0.664

TABLE 2

		HONEYSUCKLE SANDS									DUNTROON SANDS	
Field No.		CG2	CG3	CG1	CG4	CG5	CG6	CG9	CG7	CG8	CG10	CG11
Laboratory Letter	Sieve size	A	B	C	D	E	F	G	H	J	K	L
% of samples passing through sieves	5	100	100	100	100	100	100	100	100	100	100	100
	10	99.2	99.7	99.9	99.7	99.9	99.95	99.9	99.95	99.9	100	99.8
	18	65.5	81.8	91.0	75.5	91.5	96.8	93.8	83.4	85.8	99.8	97.2
	25	43.3	61.2	69.4	53.2	81.2	83.0	78.6	55.7	62.8	98.1	85.1
	44	28.6	39.2	39.3	24.6	47.2	42.8	34.6	18.2	22.3	68.4	44.5
	52	25.8	34.4	34.1	16.1	32.6	27.3	23.3	10.6	14.1	49.9	32.2
	85	20.4	24.5	22.4	6.4	10.8	8.3	7.6	1.7	3.2	10.7	10.2
	100	19.8	23.4	21.5	5.6	9.8	6.8	6.9	1.5	2.7	7.4	8.1
	150	16.4	14.8	16.8	3.9	4.9	2.5	3.9	0.3	1.3	2.3	3.3
	200	12.8	9.4	13.9	2.6	2.8	1.2	2.5	0.2	0.8	0.9	1.5
	240	10.3	5.0	13.0	2.4	2.4	0.5	1.2	0.1	0.5	0.6	1.1
	300	8.7	3.6	12.0	1.7	1.1	0.3	0.6	0.1	0.3	0.2	0.5
	1/256mm.	5.6	2.8	NOT	DETERMINED							
Sorting		1.82	2.01	1.79	2.39	2.19	1.86	2.04	1.90	1.95	1.58	2.46
Geometrical Skewness		0.60	0.63	0.07	0.03	0.32	0.40	0.38	0.38	0.41	0.47	0.56
% Weight of Quartz		54	53	54	53	60	52	57	52	54	58	56
K-feldspar		8	12	10	18	19	13	20	24	20	18	18
Plagioclase		15	12	15	12	9	23	15	11	12	16	17
Rock fragments		10	10	7	9	4	5	3	9	9	4	5
Mica		2	0.5	0.5	0.5	2	1	0.25	1	0.02	1	0.7
Soluble Material in HCl		5	10	2	5.5	5	4	5	3	5	3	3
Claysize fraction		6	2.5	8	2	1	1	0.4	0.05	0.2	0.1	0.3
K Na/Na Ca feldspar		.53	1	.67	1.50	2.11	0.57	1.33	2.18	1.66	1.13	1.06