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NORTHERN TERRITORY GEOLOGICAL SURVEY
LT. BUNDEY EXPLORATION PROGRAMME

EXPLORATION LICENCE 2097

ANALYSIS OF 1980 PROGRAMME

ANNUAL REPORT

OPEN FILE

CR 80/244

A.C.A. Howe Australia Pty. Ltd. for:

Aquitaine Australia Minerals Pty. Ltd.
Jimberlana Minerals N.L.
Pan D'Or Mining N.L.

P.A. Treasure
Senior Geologist
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*See ca 80/245*
ABSTRACT

The area encompassed by Northern Territory Exploration Licence 2097 was considered to exhibit a slight potential for the discovery of economic concentrations of uranium mineralisation. This was based primarily on vagaries of stratigraphic interpretation, whereby the possible presence of rock units, elsewhere mineralised within the Pine Creek Geosyncline, was indicated.

To test this potential, detailed geologic and radiometric surveys were conducted over a period of two to three months, during the 1980 field season. Exploratory work was carried out, under the auspice of a joint venture agreement between Pan D’Or Mining N.L., Jimberlana Minerals N.L. and Aquitaine Australia Minerals Pty. Ltd., by personnel of A.C.A. Howe Australia Pty. Ltd., Geological & Mining Consultants.

Apart from occasional slight radiometric anomalies over superficial sediments and one quartz vein displaying minor base metal values, no discoveries of note were made. In addition, geological mapping indicated the absence of potentially mineralised lithological units. It is considered that no continued potential is displayed by the Licence.

It has been recommended that E.L. 2097 be allowed to lapse at the end of its first year of tenure (20th November 1980).
1.0 INTRODUCTION

The following constitutes an analysis of mineral exploration carried out over the area encompassed by Northern Territory Exploration Licence 2097, during the 1980 field season. The Licence was granted to Pan D'Or Mining N.L. on the 20th November 1979, for a first period of tenure of 12 months. It lies approximately 100 kilometres east-south-east of Darwin and covers an area of some 224km$^2$. Exploration is being conducted under the auspice of a joint venture agreement between Pan D'Or Mining N.L., Jimberlana Minerals N.L. and Aquitaine Australia Minerals Pty. Ltd.

Detailed geological surveys have been carried out by A.C.A. Howe Australia Pty. Ltd., Mining & Geological Consultants, over a period of two to three months. Work consisted primarily of 1:10 000 scale geological mapping, photogeologic interpretation and ground uranium reconnaissance. Fieldwork was carried out primarily by S. Harnish, under the direction of P.A. Treasure, senior geologist. This report comprises a summary of details given in an informal report prepared by the former, in addition to recommendations and observations made by the latter.

The extent and location of the Licence, in relation to other areas falling under investigation by the joint venture, are illustrated by Text Figure 1. The region is easy of access, although limited to the Northern Territory dry season (May to December). Vegetation is sparse and topographic variations are limited by the general absence of more competent geologic horizons.

Geological surveys have been aimed primarily at an assessment of the uranium potential of the area in question. It was considered that the Licence exhibited such a potential for the following...
NORTHERN TERRITORY
MOUNT BUNDEY
JOINT VENTURE

Aquitaine Australia Minerals Pty. Ltd
Jimberlana Minerals N.L.
Pan D'Or Mining N.L.

KEY

- Koolpin Formation
- Mount Bundey Granite
- Mineralized Zone
- Property Boundary

TEXT FIG 1

JOINT VENTURE AREAS

TEXT FIG 2
LOCATION OF MINERALIZED ZONES
reasons:

a) Due to the fact that it is predominantly underlain by Lower Proterozoic rocks - a succession that displays mineralisation in certain constituent formations, elsewhere in the Pine Creek Geosyncline.

and  b) Particularly, to the possible presence of the Masson and Coomalie Dolomite Formations, which contain mineralisation in economically viable proportions in the Rum Jungle Area.

It was considered that this potential could be adequately tested by controlled geological mapping and radiometric surveying along approximately 500 metre spaced traverses across the Licence. The accompanying plans (under separate cover) were compiled from the data collected.

As no data of direct economic significance were collected and no further potential is recognised, the following information is only briefly discussed.

2.0 PREVIOUS WORK

Limited surveys have been carried out over portions of E.L. 2097 in the past, primarily by C.R.A. Exploration and Geopeko. Their investigations were aimed primarily at the definition and testing of base metal anomalies. However no concentrations of recognised economic potential were discovered. Open-file reports on the work carried out are available from the Mines Department in Darwin. As results were not promising, no further discussion is warranted. Comment is limited to the observation that the true uranium potential of the area was not investigated.
3.0 SUMMARY OF 1980 PROGRAMME

As mentioned above, the exploration programme over this Licence was limited primarily to ground geological surveying, this being considered sufficient for a rapid assessment of its potential.

Geological mapping was carried out, with the aid of 1:10 000 aerial photograph enlargements, along 500-700 metre spaced traverses. Whenever possible, controlled traverses were conducted perpendicular to the regional strike, to allow a clearer definition of geology. Radiometric surveying was effected concurrently with the mapping, utilising a Mt. Sopris gamma-ray scintillometer, set on a continuous running mode. Where any significance to these readings was recognised they were recorded. The data collected were compiled at a scale of 1:10 000 (Plates - 2097/6, 2097/1).

A photogeologic investigation of the area in question was carried out prior to the initiation of ground surveys. This was intended to provide an initial definition of target areas, of possible structural complexity, for detailed exploration and as an aid to the geological mapping. Due mainly to the lack of topographic variation displayed by the Licence, little useful information was gathered. Photogeologic data were compiled at a scale of 1:20 000 and appear here as Plates PG1 & PG2.

As no radiometric anomalies of immediate economic significance were discovered during ground surveys, little rock sampling was carried out. Samples submitted for investigation were primarily aimed at lithological identification, intended to aid a stratigraphic analysis of the area as a whole. Ten samples in all were sent to S.G.S. Australia Pty. Ltd., in Sydney, of which seven were for thin section and identification. The

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others were submitted for uranium and base metal assay. Sample assays and rock descriptions are detailed in Appendices 1 and 2, attached.

4.0 GEOLOGY

Plates - 2097/1  1 : 10 000 geological compilations.  
           2097/6  
           1     1 : 50 000 regional geological compilation.

Regionally, E.L. 2097 is underlain by moderately folded and lightly metamorphosed sediments of the Lower Proterozoic succession. Locally, these are comprised of rocks belonging to only two formations - the Wildman Siltstone and Mt. Hooper Sandstone Formations. Carpentarian age intrusives are represented by outcrop of the Mt. Goyder syenite on the southwestern margin of the Licence. Certain thin volcanic or tuffaceous horizons are recognised within the lower portions of the Wildman Siltstone and the upper portions of the Mt. Hooper Sandstone. Flat-lying Cretaceous sediments are occasionally represented throughout the study area. No rocks belonging to the Masson or Coomalie Dolomite Formations were recognised.

Further pertinent details of regional geology and structural history have been voluminously discussed in previous reports on this general area (Treasure, Jan. 1980 and June 1979 - Summary Reports). They will not, therefore, be discussed further. The following summary of the local geology should allow the minor discoveries made to be placed in their full context.

4.1 Local Stratigraphy

a) Cretaceous Sediments (K)  
Minor outcrops of Cretaceous sediments, overlying Lower Proterozoic rocks, consist predominantly of loosely consolidated sandstone, quartz arenite, grit and conglomerate.
Interstitial cement is commonly ferruginous. Bedding is generally horizontal, but occasionally very slight dips to the north are recognised. Grains and clasts are generally derived from underlying Lower Proterozoic metasediments.

b) **Wildman Siltstone Formation** (Ws)
The Wildman Siltstone is the uppermost formation of the Lower Proterozoic represented on E.L. 2097. It characteristically consists of alternating white and maroon thinly bedded siltstone, which rarely crops out. Its upper boundary with the Koolpin Formation (not represented on this Licence) is marked by one to two laterally persistent orthoquartzite/ grit horizons. In addition, within its central to lower portions, thin bands of orthoquartzite, tuffaceous volcanics and, occasional calcareous tuffaceous siltstone are recognised.

Iron-indurated siltstone, similar in aspect to that mapped further south in the Koolpin Formation, are occasionally observed. It is considered that they reflect a similar genesis, in that they are formed by the reconcentration of iron towards a favourable structural (?) focus.

Harnish postulates various environments of deposition for these sediments. The writer concurs with the suggestions that:

a) the siltstones were deposited within quiet water, anaerobic conditions

and b) that the nature of the orthoquartzites necessitates their formation within active water, aerobic conditions.
It is considered probable therefore that the Wildman Siltstone Formation, as it is represented within the study area, was deposited in a near-shore environment. Rapidly oscillating conditions represented by the differing sediment types may have prevailed within an active, large, deltaic-type system.

c) **Mt. Hooper Sandstone Formation (NH)**

The Mt. Hooper Sandstone directly underlies the Wildman Siltstone in the study area, being represented as a domal outlier within its southern and south-central portions. It consists of alternating quartzo-feldspathic arenites (with occasional quartzite, orthoquartzite and pebble conglomerate) and finely bedded ferruginous siltstone. The siltstone occasionally appears phyllitic in texture.

It was previously postulated that the Mt. Hooper Sandstone had been incorrectly identified as such by the B.M.R. Where it outcrops to the south and southeast of the Mt. Bundey project area, it appears to thin and lens out northwards. It was considered possible, therefore, that rocks outcropping on E.L. 2097 may in fact belong to the Crater Formation, of similar aspect to the Mt. Hooper Sandstone. This would radically change the stratigraphic interpretation made - in that, whereas the Mt. Hooper Sandstone is considered to be younger that the Masson Formation, the Crater Formation is known to be older. The implied unconformity, of greater than 2 000 metres, if the latter is present below the Wildman Siltstone, appears stratigraphically unlikely. It was suggested, therefore, that
the Masson Formation is in fact present on E.L. 2097 although previously unidentified. The presence of Coomalie Dolomite outcrops to the northeast of the Licence lent credence to this possibility. The relevance of these suggestions in reference to uranium potential is obvious, in that the lower portion of the Masson and upper portion of the Coomalie Dolomite Formations are mineralised in the Rum Jungle Uranium Province. However, no lithologies recognisable as belonging to either of these Formations were located. The similarities of environment of deposition suggest stratigraphic conformity between the Mt. Hooper and Wildman Siltstone Formations. Therefore, although not clearly identified, the Mt. Hooper Sandstone unit remains as mapped by the B.M.R.

It is recognised that rocks hereby identified as Mt. Hooper Sandstone may in fact reflect a drastic lateral facies change in Masson Formation rocks. However, insufficient stratigraphic evidence indicating such a situation is available.

d) Intrusives
Intrusive rocks in the study area are dominated by the presence of an early Carpentarian (?) syenite body. The Mt. Coyder syenite outcrops in the southwestern corner of the Licence. Compositionally it may be classified as a biotite-syenite, with minor porphyritic and biotite granite phases. It is transected by a number of small (1-10 metres in thickness) later acid to intermediate dykes, which are now extensively kaolinised. The main intrusive may have subsurface connections with the Mt. Bundey batholith to the southwest.
Extrusive igneous rocks are occasionally represented within the lower portion of the Wildman Siltstone Formation and the upper portion of the Mt. Hooper Sandstone. These constitute tentatively identified fine-grained volcanic and tuffaceous sediments deposited conformably within the Lower Proterozoic succession.

4.2 Structural Geology

Regional, relatively open folding, has formed under the influence of at least two orogenic events. North-south fold axes reflect the major east-west compressional stress and 'doming', reflected by outcrop mode of the Mt. Hooper Sandstone, the less prominent north-south compressional event. Relatively intense local folding and fracturing is evident throughout the Licence. Quartz infill of minor fractures along fold axes is common.

5.0 DISCUSSION OF RESULTS OBTAINED

No occurrences of either uranium or base metal mineralisation, considered to exhibit a further potential, were located. Certain slight radiometric anomalies, indicated on the 1:10,000 geologic plans, were located over recent sedimentary cover at scattered localities. At one locality, samples of quartz vein material returned very slightly anomalous base metal values. These localities, numbered 51-54 on Plate 1 (composite geological plan) are briefly described below:

5.1 Anomaly 51

Location: Plate 2097/1

AMG Coordinates: 798900E/8581400N
Scattered outcrops of quartz-vein material were observed to display disseminated pyrite and arsenopyrite mineralisation at this locality. An aggregated chip sample (ACA 4216), taken over an area of some 2.5m x 7.5m, returned the following assay (ppm):

- Cu : 275
- Pb : 1120
- Zn : 1710
- Ag : 1.8
- Au : less than 0.02

Although slightly anomalous values are indicated, especially of lead and silver, the nature and extent of the mineralisation is considered insufficient to warrant further investigation.

5.2 Anomaly 52

Location : Plate 2097/4, Map 10/9577
AMG Coordinates : 78700E/8579700N

Anomalous radioactivity discovered at this locality represents a northerly extension of mineralisation (?) located on the northwestern corner of E.L. 1655 during the 1979 field season. Readings, over surficial sediments, lie in the region of 2 to 2½ times background values (Mt. Sopris scintillometer, background 80cps, total count) with localised 'spot highs' to 5 times background (400cps). The source of radioactivity cannot be readily defined at surface, the only outcrops present being of ferricrete.
5.3 Anomaly 53

Location: Plate 2097/4, Map 10/9577
AMG Coordinates: 797700E/8577900N

This constitutes a similar occurrence to Anomaly 52 with radiometric readings lying in the same range. Again, the anomalous radioactivity is recorded over recent sediments through which ferricrete occasionally outcrops.

5.4 Anomaly 54

Location: Plate 2097/1, Map 10/8683
AMG Coordinates: 792000E/8585000 - 100N
792680E/8585360 - 550N

Again, anomalous radioactivity was recorded at this locality over recent sedimentary cover. The area is described as containing rubbly ferricrete outcrop, surrounded by alluvium. Readings of up to 540cps, over a background of 80cps have been recorded over a linear zone of some 600m x 200m. They generally lie in the range of 3-5 times background, high spots normally being over ferricrete outcrop.

A 25 metre backhoe trench was excavated perpendicular to the long axis of this anomaly. Radioactivity increased to 820cps at the deepest point (over a surface reading of 520cps) - at a depth of 40-50cm, where a consolidated ferricrete layer became impenetrable. As this rise cannot be wholly attributed to mass effects, it is suggested that

...11
the source of the anomaly lies in the ferricrete.

Scattered further occurrences of slightly above background radioactivity were located over surface sediments throughout the Licence. The extent and significance of anomalous radioactivity did not warrant their representation as numbered 'anomalies'.

Radioactivity over all three of the above 'alluvial' anomalies is suggested to have its source within the recent sedimentary profile. The thickness of cover in all of the areas cited would possibly exceed 10 metres, whereby any anomalous radioactivity originating from mineralisation in underlying hard rock should be masked. This should especially be the case where impervious layers, such as consolidated ferricrete, form a barrier to the upward migration of gaseous daughter-products of the radioactive decay of uranium. It is more probable that layers rich in ferric hydroxides have had a 'scavenging' effect on minor amounts of uranium carried by circulating groundwater. As such, it is not considered that these occurrences display any further economic potential.

6.0 CONCLUSION

As mentioned, none of the above described anomalies are considered to display further economic potential. Although the 'alluvial' radiometric anomalies have their source in secondary concentration of uranium within the recent sedimentary profile, it is recognised that that uranium must have an original source, possibly in concentrations of economic viability. However, the location of such a 'hidden' body would involve very extensive drilling
(and a great deal of luck). The chances of discovering such a deposit are not considered high enough to warrant the very considerable costs that would be incurred.

Geological mapping and stratigraphic interpretation do not indicate the presence, within this Licence, of rock units mineralised elsewhere in the Pine Creek Geosyncline.

For the above reasons it was recommended that E.L. 2097 be allowed to lapse at the end of its first year of tenure (20th November, 1980).

P.A. Treasure
Senior Geologist
APPENDIX 1

E.L. 2097 : Sample Assays
<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Location</th>
<th>Anomaly No.</th>
<th>Description</th>
<th>cps</th>
<th>U</th>
<th>Cu</th>
<th>Pb</th>
<th>Zn</th>
<th>Ag</th>
<th>Au</th>
<th>Mo</th>
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<tr>
<td>4201</td>
<td>792560E; 858536N</td>
<td>54</td>
<td>Ferricrete to determine if source of Uranium</td>
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<td>4202</td>
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<td>I.D. Ox.w lim/qts/clay rock ?volc or tuff parent</td>
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<td>4203</td>
<td>808860E; 8537320N</td>
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<td>I.D. alt. ox.w.carb f.g.sed. (silt sized detritus)</td>
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<td>I.D. V w alt.ox volc sed or lithic tuff</td>
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<td>4212</td>
<td>804210E; 8584350N</td>
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<td>I.D. alt. ox ex plag. rich lithic volc arenite/tuff or flow rock</td>
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<td>4216</td>
<td>798900E; 8581400N</td>
<td>51</td>
<td>chip 2.5x7.5m -recrystallised f.g. orthoquartzite</td>
<td>275</td>
<td>1120</td>
<td>1710</td>
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<td>4221</td>
<td>797750E; 8577900N</td>
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<td>Fe-rich brecc goethite Fe-stone 130-140 Fe-ind. siltstone</td>
<td>21</td>
<td>100</td>
<td>1270</td>
<td>-1.0</td>
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APPENDIX 2

E.L. 2097 : Petrological Investigation of Rock Samples
Sample No. ACA 4202

Rock Type Strongly oxidised and weathered limonite-quartz-clay rock which may have had a volcanic or tuffaceous parent.

Hand Specimen The rock is red-brown and extremely weathered. It is a medium to fine grained rock and has distinct joints coated with dark red-brown oxides which have stained the host rock in a band about 1 cm wide.

Thin Section The rock retains traces of a relict texture which suggests that it may have had a vesicular igneous or tuffaceous parent. However, it is substantially altered, mainly by weathering effects. It contains subrounded to well rounded patches of radiating cryptocrystalline quartz which may represent former vesicle sites. Also elongate lath-shaped, clay filled patches are probably former lath-shaped feldspar sites. There are also some irregular patches of clay-rich material which may have replaced former lithic inclusions, however, no primary material remains in this rock. The remainder of the rock, probably the former matrix, consists of dense red-brown hematite with scattered small patches of quartz with undulose extinction and ragged to subradiating grain shapes. The proportions of quartz, clay and hematite are approximately similar.

A major vein system cuts the rock and this is characterised by lensing and bifurcating veins with a maximum width of about 0.4 mm across. The veins contain red-brown goethite and limonitic products, a little clay and a little quartz. A stained envelope about 1 cm wide is developed around the veins. Also developed are rare euhedra that are filled with limonite and may have been former sulphide crystals. The limonitic products that are present within the narrow veins also may replace former sulphides.

The rock is very strongly oxidised and weathered and now consists entirely of limonite, quartz and clay. It was probably a former igneous volcanic or tuffaceous lithology that contained a small amount of sulphides in the veins and as scattered single grains.

Sample No. ACA 4203

Rock Type Altered, oxidised and weathered, carbonated fine grained sediment containing silt-sized detritus.
Hand Specimen: This is a brown coloured, very oxidised fine grained rock. It has a very weak layering or foliation but is otherwise massive. It contains a somewhat rectangular system of very narrow joints filled with limonitic products. Also irregular minor narrow veins are developed.

Thin Section: The rock probably represents a thoroughly oxidised fine grained sediment, containing silt-sized detritus. It retains a clastic texture of very small irregular-shaped to ? subrounded quartz grains and rare sericite flakes with very abundant oxidised limonitic rhombic grains scattered throughout a weakly foliated limonite and clay-rich matrix. The original sediment probably contained less than 5% quartz with about 3% of sericite, and about 40% of rhombic iron-rich carbonate in ferruginous and clayey matrix comprising the remainder. It is not possible to determine whether the carbonate rhombs are primary or are a later alteration product, but the latter is possibly the case, since veins are developed which contain similar oxidised alteration products, probably from former iron-rich carbonate.

The veins are anastomosing, irregular and discontinuous. They reach a maximum of about 0.3 mm across and contain heavily stained, reddish-brown subradiating, birefringent altered ? carbonate. Rare patches and narrow stringers of dark red-brown oxidation products probably represent minor altered sulphides.

The rock is an altered oxidised and weathered, carbonated fine grained sediment which once contained minor patches of sulphides.

Sample No.: ACA 4205

Rock Type: Thoroughly altered oxidised and weathered volcanic sediment or lithic tuff.

Hand Specimen: The rock is a yellow-brown colour and is medium to fine grained. It is quite massive except for a widely separated system of red-brown coated joints which are roughly parallel. The rock is thoroughly oxidised and weathered.

Thin Section: The rock is probably a fine grained volcanic or tuffaceous sediment containing arenite-sized clasts. It has been thoroughly oxidised and...
weathered but retains a relict texture that suggests it has been weakly foliated. It now consists entirely of secondary alteration products, however, the average grain size of the original detritus was probably about 0.3 mm across with some grains reaching about 0.8 mm across. The rock is poorly sorted and contains about 40% of altered angular debris in a fine ferruginous and clayey matrix. All the detritus has been replaced by secondary products but some flattened clasts retain a texture that suggests they were formerly vesicular and may have been weakly porphyritic. The former vesicles are marked by circular narrow rims of secondary quartz with the former ? crystal material replaced by darker limonitic products than the surrounding matrix material.

The rock now contains about 15% secondary quartz and the remainder is limonitic alteration products. Irregular elongate patches of scattered fine grained opaque oxides comprise only about 3% of the rock. A narrow straight joint which is represented in the thin section contains granular red-brown limonitic oxidation products and a little clay.

The rock is a thoroughly oxidised and weathered sediment or tuff containing clasts with poorly preserved relict volcanic textures. The rock does not appear to be mineralised.

**Sample No.** ACA 4206  
**Rock Type** Quartz-rich arenite with ferruginous matrix.  
**Hand Specimen** The rock contains abundant medium to coarse white to grey poorly sorted detritus in a finer grained red-brown matrix. It is a rather poorly sorted thoroughly oxidised and weathered sediment.

**Thin Section** The rock is an arenaceous medium to coarse grained, sediment. It has a poorly sorted, clastic texture of subrounded to angular crystal and some lithic grains set in a matrix of similar finer grained material. Abundant red-brown limonitic staining marks grain boundaries and occupies sites of fine grained matrix material. The grain size of the detritus is somewhat variable with about 20% of the rock consisting of detritus with an average grain size of about 2 mm across scattered throughout a finer grained matrix of detrital grains with an average grain size of about 0.5 mm across, which are in turn set in a meagre matrix of fine grained limonitic oxidation products. About 90% of the
detritus is quartz with a few altered clastic mica grains and about 10% of lithic grains including quartzite, fine grained chert and rare siltstone. All the quartz detritus shows some deformation effects from strain shadows to complete recrystallisation, however, the whole rock is only weakly deformed. Minor narrow joint surfaces are also coated with limonitic oxidation products.

The rock is a poorly sorted, quartz-rich sandstone whose matrix has been considerably oxidised to limonitic products.

Sample No. ACA 4210

Rock Type
Completely altered oxidised and weathered quartz-limonite-clay rock with poorly preserved relict textures of a former crystal tuff or volcanic sediment.

Hand Specimen
This is a red-brown, strongly oxidised fine grained rock. It has a weakly developed layering or foliation only marked by slight differential weathering.

Thin Section
The rock is an extremely altered, oxidised lithology in which no original mineralogy remains. There is a rather poorly preserved relict texture which suggests the presence of sparse, former resorbed volcanic grains and abundant very small angular, broken and lath shaped crystal debris which is poorly oriented. A somewhat discontinuous lensed layering is marked by abundant concentrations of limonitic oxidation products.

The rock consists entirely of secondary alteration products. Secondary irregular scattered patches of granular quartz account for about 20%, with the remainder consisting of very abundant fine grained red-brown limonitic alteration products, together with a little clay. Minor patches of stained yellowish chlorite are also developed and these may replace certain former mafic crystals, none of which remain. Narrow discontinuous trails of opaque grains are formed parallel to the poorly developed layering.

The rock is thoroughly oxidised, weakly foliated and partly recrystallised. It retains a poor relict texture which suggests that the parent lithology may have been a fine grained crystal tuff or sediment. The rock contains little evidence of any former sulphide mineralisation.
Sample No. ACA 4211

Rock Type Altered oxidised and weathered fine grained volcanic rock. (Quartz-hematite-clay rock).

Hand Specimen The rock is a red-brown colour, strongly oxidised and is rather fine grained. It is a massive rock with no visible veining.

Thin Section The rock is thoroughly altered and oxidised and no primary phases remain. A distinct relict texture is preserved where small abundant former lath-shaped plagioclase crystals are completely altered to very fine grained clay and former outlines are marked by abundant red-brown limonitic alteration products. Scattered sub-rounded to angular patches of partly recrystallised quartz possibly represent some former vesicle sites and some altered crystal material. The rock probably represents a pyroclastic volcanic lithology rather than a flow rock or shallow intrusive since the poorly preserved outlines of small fragments may be present.

The rock consists entirely of secondary alteration products, the approximate proportions of which include the following: quartz 25%; clay 40%; red-brown hematite-limonite 35%, with a few grains of epidote. There are no veins developed and there is no indication of any former sulphide mineralisation.

The rock is a completely altered oxidised and weathered volcanic lithology which was formerly rich in small plagioclase laths. It was possibly partly fragmental or may have been a massive flow, since it is not clear whether fragmental material was formerly present. The present assemblage is probably a result of some kind of low grade alteration followed by very substantial weathering.

Sample No. ACA 4212

Rock Type Altered and completely oxidised former plagioclase-rich lithic volcanic arenite/tuff, or flow rock. (Quartz-clay-limonite rock).

Hand Specimen The rock is a red-brown to yellow-brown colour and is medium
APPENDIX 3

E.L. 2097 : Expenditure (approx) to end November 1980
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1. Typical view of the eastern $\frac{3}{4}$ of E.L. 2097
2. Typical view of the western $\frac{1}{4}$ of E.L. 2097