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REPORT ON PLANET MINING CO.

TASMANIAN

PHOSPHATE LEASES

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of

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ABSTRACT:

The report outlines aerial reconnaissance, literature surveys, consulting, field investigations and geochemical work carried out in Tasmania. This work was undertaken as a reconnaissance survey of the Phosphate potential of that State with especial reference to Planet Mining Company's Phosphate leases.

The following general conclusions are made.

(i) The marine Tertiary rocks of all leases are dominantly limestones with no significant above background P_2O_5 analyses.

(ii) The Cambrian rocks investigated, similarly, showed no above background assays with the exception of two analyses of 4.0% and 5.4% P_2O_5 in the Smithton District.

Summarily no Tertiary Phosphate accumulations may be expected. The Cambrian sections showed a limited phosphate potential. A brief field investigation of the Cambrian of the Smithton district would be sufficient to fully evaluate the Cambrian.

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1. INTRODUCTION:

A general review of the Phosphate potential of Planet Mining Company's Exploration Leases Nos. 20/65 (King Island), 21/65 (Flinders Island) and 26/65 (North West Tasmania) was undertaken.

Initially an aerial reconnaissance flight was made (McKellar, Brunnschweiler and Watts) to delineate the occurrence of marine Tertiary strata in the lease areas. A full report of this flight is included in Appendix 1 of this Report. Subsequently, during the period of January 31st to February 5th, a review of the literature at the State Mines Department and University, along with discussions with the personnel of the Geological Survey of Tasmania and the University of Tasmania was carried out. Further to this, a field examination was carried out with special emphasis on the marine Tertiary and Cambrian rocks of North West Tasmania. This field work was carried out to elucidate information gained from the reconnaissance flight and literature review with a special emphasis on :

(i) An examination and sampling of Tertiary outcrops in the north west for the purpose of clarifying lithology, environment and age relationships.

(ii) An examination and sampling of the Cambrian section in the Smithton Area.

(iii) A general reconnaissance of North West Tasmania.

In addition to this and outside the lease area, two additional programmes were undertaken to evaluate possible Phosphate accumulation suggested by the literature survey :

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(iv) An examination and detailed sampling programme of the Cambrian sections on the coast between Ulverstone and Penguin was carried out in order to test the Phosphate potential of the Kateena and Radford Creeks formation in the vicinity of previously reported high P_2O_5 values.

(v) An examination and sampling of the Que River - Macintosh River area to delineate potential phosphate accumulation basinward in the Cambrian trough.

A total of 115 samples were collected for analysis.

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2. PREVIOUS WORK:

The current search for Phosphates in Tasmania was prompted by a report entitled "The future of phosphate exploration in Australia" compiled by Dr. R.O. Brunnschweiler for Planet Mining Co. Summarily this report reviewed economic, geologic and exploration factors relating to phosphate deposits in Australia. From theoretical considerations, Dr. Brunnschweiler made recommendations as to sedimentary basins where phosphate concentrations might be expected. Amongst these were included the Gippsland/Otway, etc. Tertiary basins.

Subsequent to this report, Planet Mining Co. obtained phosphate leases in north west Tasmania and the offshore islands where areas of marine Tertiary strata were considered to have commercial phosphate potential. The first investigations were undertaken by McKellar, Brunnschweiler and Watts (Appendix 1) by means of a reconnaissance flight to delineate marine Tertiary strata and accessibility of the lease areas. This reconnaissance flight led to the following general conclusions :

(i) Geomorphology of the offshore islands seemed to preclude any great thickness of Tertiary.

(ii) Significant marine Tertiary sediments are possibly present in the vicinity of Green Point on the west coast of Tasmania.

The report (Appendix 1) recommended the relinquishment of exploration leases over King and Flinders Islands, but the retention of the mainland license until the Green Point area had been further evaluated.

With this background, the current work was undertaken with, at the start, an emphasis on the Mainland marine Tertiary.

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3. LITERATURE REVIEW:

Very little specific work has been carried out on Phosphates in Tasmania. W.H. Twelvetrees (1917) provides the only report published solely on Phosphates and he was primarily concerned with Guano deposits. Only recently has an awareness of Phosphate economics appeared, so that much previous work was conducted without any special emphasis on Phosphate accumulations.

The occurrence of Phosphate bearing rocks in Tasmania, noted by previous authors, may be listed :-

i) Guano deposits :

(a) King Island West Coast North of Currie: layers of redeposited lime? assaying up to 10% P_2O_5 .

(b) Pyramid Rocks between King and Hunter Islands reported very small Guano deposits.

(c) Sea Elephant Rocks (east of King Island) small Guano deposits assaying 11% P_2O_5 .

(d) Flinders Island south of Whitmark 2 - 5% P_2O_5 in Guano impregnated limestone.

(e) White Island Rocks - small Guano deposits reported as 13.8% P_2O_5 .

(f) Slopem Island 13.56% P_2O_5 reported from Guano impregnated Permo-Carboniferous limestone.

Occurrences 1 (a) to (d) inclusive are located within the lease areas. In all cases the Guano deposits are very restricted and of little or no commercial value. Several samples from these deposits were examined at the Royal Victoria Museum in Launceston, being typically white-light brown, nodular, uneven textured rocks with a high carbonate content.

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2) Phosphatic Limestones:

(a) Temma (west coast of Tasmania) slightly Phosphatic Tertiary limestones.

(b) Flinders Island (Dutchman Quarries) slightly Phosphatic Tertiary Limestones, with assays generally in the 0.05 - 0.1% P_2O_5 range.

(c) St. Marys (East coast of Tasmania) Ordovician Limestones 4 miles south east of St. Marys, assaying approximately 5% P_2O_5 .

(d) Railton Quarries (south east of Ulverstone) Ordovician Limestones assaying 1.02% P_2O_5 .

Locations 2 (a) and (b) occur within the lease area. The occurrence of all these values within limestone would seem to preclude any commercial deposits. The Phosphatic nodules noted in 1 (b) above were examined at Launceston Museum and in conversation with J. Sutherland, the Geologist at the Museum, who has examined the section in the field, their very restricted nature was confirmed.

3) Metamorphic Minerals :

(a) Lefroy - occurrence of Wavelite and Turquoise in slate cleavages at Den Spur near Lefroy has been noted by several workers (Twelvetrees 1917, Sutherland 1966). Again this mineral was examined at the Museum in Launceston. This is also of very restricted extent with slate country rock showing only small traces of P_2O_5 . J. Sutherland, in a personal communication assumes a metasomatic origin for this mineral.

4) Bedded Phosphate:

(a) In the Westbank chaos (near Ulverstone) an assemblage of sheared Cambrian rocks occurs some 200 yards east of Goat Island. Here Autochthonous mudstones assaying 3.16% P_2O_5 have been reported (Burns 1964).

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In summary, none of the abovementioned occurrences give any indication of being of commercial value.

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(i) General Review

Very briefly, the geological history of Tasmania with emphasis on the North West and possible favourable Phosphate accumulating environments may be summarised :-

Pre-Cambrian rocks outcrop over one fifth of Tasmania. In the North West a sedimentary formation (quartzites, etc.) and a metamorphic formation comprising the Table Cape Group may be recognised. The age relationships within this group are obscure. Sedimentation in late Pre-Cambrian times was affected by the existence of a large geanticlinal ridge extending south west across Tasmania from the vicinity of Ulverstone to the south coast. On the eastern and western flanks of this, miogeosynclinal sediments were deposited.

In Cambrian times this geanticlinal ridge persisted and was rejuvenated (Tyennan Geanticline) but became more restricted especially at its north western extremity. Primarily sedimentation in Cambrian times occurred in the Zeehan - Magnet syncline (Burnie to Rosebury area) bounded in the east by the Porphyroid Geanticline and to the west by the Rocky Cape Geanticline (south west of Wynyard). Further sedimentation occurred on the west flank of the Rocky Cape Geanticline in the Smithton District (Fig. 1).

Ordovician to Devonian sediments are not represented in north western Tasmania. A period of stability with widespread limestone deposition in the Ordovician gave way in Silurian-Devonian times to clastic deposition initiated by uplift of the north western Tasmania source area. Sedimentation eventually halted in the Middle Devonian and did not resume until the Lower Permian.

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In the early Permian ice covered much of Tasmania with Tillites occurring in the basal part of the sequence. With the retreat of the ice, shelf deposits with volcanics, intrusives, sandstones and conglomerates were laid down. This mode of deposition persisted through the Triassic with lacustrine and fluviatile sandstones and coals. In the Tertiary, marine, non marine and volcanic sequences prevailed.

(ii) Geology of Lease areas

More specifically the general Geology of the individual lease areas may be summarised. The general coastal geomorphology and geology of these areas is shown in photographs included in Appendix 1.

(i) Mainland Lease (E.L. 26/65)

The extent of this lease is shown in Figure 1 along with the approximate distribution of Cambrian, Marine Tertiary and major structural units.

Metamorphosed and Unmetamorphosed Pre-Cambrian rocks predominate. Subsidiary Cambrian volcanics and sediments, Tertiary marine, non-marine and volcanics and in the east Permian rocks occur. A summary stratigraphic column is presented in Table 1 :

TABLE 1

AGE	FORMATION-GROUP-TYPE	LITHOLOGY
Quaternary		Alluvium
Tertiary	Marine, non marine and volcanics	Alluvial gravels, lignites, siltstones, limestones & basalts
Permian	Wynyard tillite, etc.	Sandstone, Tillites and mudstones
Cambrian	Dundas Group	Basic lavas, (spilites) tuffs, breccias, conglomerates & siltstones
Proterozoic (Smithton Area)	Carbine Group Undifferentiated Pre-Cambrian	Smithton Dolomite Bryant Hill Quartzite

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Cambrian and Marine Tertiary correlations in the area are difficult as due to the relatively undifferentiated and poorly exposed sequence. To the east and outside the lease area a fuller Cambrian section is exposed. In the Dial Range near Ulverstone, the following sequence is exposed with the Tea Tree Point and Radford Creeks formations correlating with the Dundas group of the Smithton area.

TOP Westbank beds
Tea Tree Point Megabreccia
Radford Creeks formation
Motten Spillite
Barrington chert
Hardstaff unconformity
Kateena formation
BASE Lobster Creek Volcanics

This sequence was deposited in the north east-south west trending trough (Zeehan-Magnet Syncline) with the primary source to the north west. In general, the sediments here show a large proportion of fine and coarse clastics. Southwestward a change in facies occurs until in the Huskinson River area near Rosebury a dominantly black shale clastic free succession occurs.

The Permian rocks occurring in the east of the lease area comprise a sequence of tillites and sandstones. Large areas of Tertiary basalts occur along with minor occurrences of marine and non-marine Tertiary sediments. The marine Tertiary reaches a maximum thickness of 150' of limestones at Marrawah. However, only remnants represented as isolated outcrops, occur.

(ii) King Island (E.L. 20/65)

Pre-Cambrian rocks outcrop over most of the island with subsidiary Cambrian and Quarternary.

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A total of approximately 4000' of Cambrian spillites, conglomerates and slates occur. Isolated marine Tertiary outcrops also occur (Fig. 1 and Section 4). The Cambrian sequence is similar to that of the Smithton district.

(iii) Flinders Island (E.L. 21/65)

Devonian granites and sediments along with an extensive Alluvial cover predominate. Subsidiary outcrops of marine Tertiary (Section 5 (i)) also occur.

From this survey of Tasmanian Geology two groups of strata were selected as possibly Phosphate bearing.

(a) Cambrian Phosphate prospects :

The Cambrian association of cherts - black shales in the Zeehan-Magnet synclinalorium and their correlatives on the west flank of the Rocky Cape Geanticline in the Smithton district are of interest. The environmental conditions prevailing during Cambrian times in North West Tasmania vaguely parallel the conditions of the Dark City - Chugwater Phosphorite bearing formations of Idaho and Wyoming - McKelvey (1966). Sheldon (1964) developed the idea of upwelling currents in relation to a black shale - Phosphorite - chert - limestone offshore to onshore lateral sequences.

The similarities between the classical Phosphate sequence and North West Tasmania prompted a further field investigation. In connection with this, two points are of interest :

(a) The change in facies south west (basinward) from the chert-sandstone sequence at Ulverstone to a dominantly black-shale clastic free succession in the Huskinson River area near Rosebury. This leads to the idea of a possible phosphate producing environment at or near the facies change.

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(b) The up and down transgression of the Barrington chert and subsequent lateral gradation into the overlying Redford Creeks and underlying Kateena formations to the east and west. In most instances, this lateral gradation is to a sandstone lithology, but in several localities (e.g., Westbank Chaos) it is to a mudstone where values of up to 3.16% P_2O_5 have been reported.

The localised nature of the cherts and the restricted nature of the basin, would mitigate against phosphate accumulations. However, there is some evidence for an enlarged basin with consequent upwelling currents etc., in Cambrian times more specifically to the west of the Smithton district. The presence of pyroclastics and volcanics in the Smithton district is, however, not very encouraging for Phosphates.

(b) Tertiary Phosphate prospects :

Phosphate accumulations in the Tertiary depends upon the delineation of marine non calcareous rocks. A reconnaissance of the marine Tertiary was made to determine whether in fact any marine Tertiary sequences occur with possible phosphate bearing characteristics.

Because of the abovementioned points and the limited geological information available, field investigations were carried out.

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5. FIELD INVESTIGATIONS:

(i) Tertiary:

In north west Tasmania, Flinders Island and King Island, marine Tertiary outcrops are very discontinuous and appear only as eroded remnants resting for the most part on Pre-Cambrian and Cambrian rocks. The thickest sequences present, are in general those preserved under the basalts. Figure 1 shows the sporadic occurrence of the marine Tertiary. Tertiary basalts and to a minor extent non marine Tertiary occur throughout the area. These have not been considered in the current report. Sample locations and descriptions and assays are shown in Fig. 1 and Appendix 2 with photographs of coastal areas included in Appendix 1.

(i) North West Tasmania

The Marine Tertiary rocks here exist as discontinuous and somewhat isolated outcrops reaching a maximum thickness of 150' in the Marrawah district. In general the Tertiary appears inadequately mapped and several outcrops were found that had not previously been described.

(a) Marrawah District

The aerial reconnaissance flight (Appendix 1) indicated the presence of marine Tertiary. Figure 2 shows the general geology and Tertiary outcrops of the area. Approximately 150' of Longfordian and Batesfordian limestones are present, overlying Pre-Cambrian quartzites outcropping on Green Point and underlying Tertiary basalts outcropping at Mount Cameron West. Inland the Pre-Cambrian to marine Tertiary to basalt sequence may be traced by means of scattered outcrops and drift (figure 2). The Tertiary limestones dip shallowly north west. The outcrops may be enumerated.

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(i) Green Point to Mt. Cameron West beach.

Scattered outcrops exposed at low tide occur between Green Point and Mount Cameron West. These comprise white soft fossiliferous limestones.

Samples Nos. 54 to 63, 67 to 69 and 70 to 76 taken as chip samples all show a P_2O_5 content of less than 0.2%.

(ii) Mount Cameron West

Here approximately 35' of Marine Tertiary is exposed at the base of the basalt cliffs which form Mount Cameron.

Here the sequence is :

Lithology	Thick- ness	Sample No.	% P_2O_5
Basalt	-	-	-
Calcareous siltstone, Shales	10'	77	0.2%
Claystone	2'	70	0.2%
Red siltstone and shale	10'	79	0.2%
Silty, Argillaceous Limestone	5'	80	0.5%
Claystone-Limestone	7'	81 & 82	0.2%

Only one sample (No. 80) shows an above background value of 0.5% P_2O_5 . This, however, is not considered very significant.

(a) Inland :

Sporadic outcrops of pink to grey fossiliferous limestones occur in small cuts and as drift in the hills behind the shore. Outcrop locations are as shown in Figure 2 with all assays reported as less than 0.2% P_2O_5 .

(b) Redpa District :

Small marine Tertiary outcrops occur to the north-west of Redpa. The principal deposit, however, occurs south east of Redpa as crags overlooking the Welcome River Flats. The thickness of the limestones here exposed is approximately 75' overlying Palaeozoic limestones and dolomites. These limestones (samples 83 to 90)

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are fossiliferous and pink in colour being harder than those exposed at Marrawah. Analysis of samples showed no assays above 0.2% P₂O₅ .

(c) Cape Grim - Hunter Island :

Twelvetrees (1908) and others report the occurrence of 40' of pink polyzoal limestones dipping under the basalts to the south of the cape. As due to its inaccessibility this outcrop was not visited.

(d) Temma :

Here small outcrops of pink and yellow limestones occur overlying the Pre-Cambrian Balfour slate and underlying the Tertiary basalt.

(e) Montague District:

In the Montague District small outcrops occur at the mouth of the Marcus River, Montague River and occasionally upstream in the Montague River. These comprise pink hard fossiliferous limestones. Analysis of Samples No. 93 and 95 showed no P₂O₅ content above 0.2%.

(f) Wynyard:

At Fossil Bluff near Wynyard fairly extensive outcrops of Tertiary "calcarenites" occur forming the cliffs and foreshore. Access to this sequence is via the Wynyard Golf Course. These cliffs may be traced north westwards until they disappear under the basalts comprising Table Cape. The sequence rests unconformably on Permian rocks. Summarily the sequence is :

- Basalt
- Fossil Bluff sandstone)
-) 80'
- Freestone Cove Sandstone)
- Permian

In more detail the following cliff section was measured and sampled by chip sampling :

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Lithology	Thick- ness	Sample No.	% P ₂ O ₅
Basalt	-	-	-
Poorly Consolidated Shelly Calcareous Sandstones	51'	115	0.2%
Soft Sandstones	6'	114	0.2%
Shelly Sands and Gravels	4'	113	0.2%
Shelly Sands and Gravels	6'	112	0.2%
Conglomerate	3'		0.2%
Shale, Siltstone (Calcareous)	10'	109	0.2%
Exposed on foreshore)		110	0.2%
		111	0.2%
Sea Level		-	-

Summarily the marine Tertiary of north west Tasmania shows a dominant limestone lithology with the few detrital rocks showing high Carbonate content. Only one analysis of greater than 0.2% P₂O₅ was reported at Mount Cameron West. In conclusion because of dominant limestone lithology and low P₂O₅ values no Phosphate prospects may be expected in the mainland Tertiary.

(ii) Flinders Island (E/L 21/65)

The aerial reconnaissance (Appendix 1) indicated a paucity of Tertiary strata on the Furneaux Group of Islands. On the east coast outcrops are very rare being obscured by thick deposits of recent sands and gravels. G. Everard (Personal communication) estimates a maximum thickness of 250' of Tertiary limestones and reports the lithology as friable cream coloured bryozoal limestones. Typically the limestones rest on Cambrian granites, but occasionally on sands and gravels. Recent petrographic work by Everard and other suggest an aeolian origin for these limestones.

On the west coast outcrops are frequent.

G. Everard (1957) gives the typical sequence near

White mark as :

Age	Lithology	Thickness
Tertiary	Limestone	Approx. 100'.
	Sand Gravel and Clay with interbedded lime- stone and calcareous nodules	Approx. 60'.
	Unconformity	
Cambrian	Granites	

The limestones occurring on the east coast are in general soft earthy limestones, whilst those on the west coast are compact and tough limestones. Both varieties have been extensively eroded.

Analysis of the Flinders Island Limestones are given in Limestones of Tasmania (1957). No assays above 0.1% P₂O₅ are reported. A small phosphatic nodule bed from Dutchman Quarries was reported by J. Sutherland (personal communication). Samples of this were examined at Launceston Museum and in conversation with J. Sutherland their restricted nature was confirmed. Subsequently, assays of this material, showed a P₂O₅ content of less than 0.5%.

The limestones of the Furneaux Group have been dated as Middle Miocene by Irene Crespin (1944). Fairly extensive investigations of the Tertiary rocks have been undertaken by Everard (1957) and Sutherland (1966). In discussion with these gentlemen, the dominant limestone lithology, low P₂O₅ assays etc. appear to eliminate any likelihood of commercial phosphates.

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(iii) King Island Group :

Middle Miocene limestones up to 100' in thickness are the only reported marine Tertiary rocks on King Island. These are shown in Figure 1. Hughes (1957) reports the lithology as cream coloured bryozoal and shelly limestones. These limestones are restricted in extent and only three outcrops are reported in the literature. Typically the limestones rest on Cambrian granites as at Cape Wickham on the north coast. Few P_2O_5 assays are available, those that are show uniformly low values with only the Guano impregnated limestones, of restricted occurrence, showing any P_2O_5 values (Section 3).

As with Flinders, the dominant limestone lithology and low assays preclude any possibility of commercial Phosphates in the marine Tertiary.

(ii) Cambrian :

The Cambrian association of cherts and black shales in the Zeehan-Magnet synclinalorium (Figure 1) and their correlatives on the west flank of the Rocky Cape geanticline in the Smithton district are of interest as possible Phosphate bearing formations (Section 4). These areas of possible phosphate bearing Cambrian rocks were investigated. Sample descriptions and analyses are included in Appendix 2, detailed reference here, being made only to above background P_2O_5 values.

(i) Smithton District :

The approximate extent of the Cambrian rocks in the Smithton district is shown in Figure 1. In general these rocks are poorly exposed and incompletely mapped. Nye (1937) and Guilline (1958) have mapped the northern part of the Cambrian outcrops south of Smithton (Figure 3). The Stratigraphic column is shown in Table 2.

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TABLE 2

Formation		Lithology	Thick ness
Quaternary		Alluvium	20'
		Unconformity	
Tertiary	Non marine & volcanics	Marine sands and gravels, non marine sandstones, Clays, Conglomerates Ligites and grits, basalts	40' 100'
Cambrian	Dundas Group	Basic Lavas, Tuffs, breccias, greywackes, conglomerates, silt- stones and cherts	5000'
Pre- Cambrian	Carbine Group	Smithton Dolomite Bryant Hill Quart- zite, Undifferent- iated Pre-Cambrian	3200'

Nye (1934) also reports P_2O_5 assays performed on Cambrian and Pre-Cambrian rocks. All analyses show values of less than 0.6% P_2O_5 .

A traversing and sampling programme was undertaken. A total of 25 samples were collected. Phosphate assays in general showed low values of less than 0.2% P_2O_5 for the bulk of the sequence (Appendix 3). Three exceptions occur :

(a) Sample locations T.25 to T.32 (Figure 1) in a small quarry near Nabageena, here a sequence of pyroclastics, cherts, mudstones and lavas of the Dundas group are exposed :

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Lithology	Thick- ness	Sample No.	% P ₂ O ₅
Cherts with thinly interbedded mudstones	5'	32	0.5%
Pyroclastics	3'	31	0.2%
Chert	1'	30	0.2%
Pyroclastics with Ash	3'	29	0.2%
Shale - Mudstone	3'	28	5.4%
Basalt	15'	-	-

(Base not seen)

The high assay (5.4% P₂O₅) may be noted. Outcrops to the west of this occurrence are rare so that backup assays for this were unobtainable.

(b) Sample Location T.40 Irishtown Road Quarries:

Here a fine silicified conglomerate is interbedded with dense black cherts and grey purplish slates. The rock is composed of rounded, occasionally angular, pebbles set in a siliceous matrix. Assays on the conglomerate material showed 4.0% P₂O₅. The cherts and slates showed assays of less than 0.2% P₂O₅.

(c) Sample Location T.47 near Mengai.

In this locality brown mudstones of the Dundas Group outcrop. These assay 0.7% P₂O₅.

The two other patches of Cambrian rocks occurring west of Smithton (Figure 1) are very poorly exposed and in a brief reconnaissance only one outcrop was located which gave an assay of less than 0.2% P₂O₅. The low lying nature of these outcrops suggest a softer lithology (e.g.) Brittons Swamp. Similarly Cambrian rocks exposed on the coast near Montague gave values of less than 0.2% P₂O₅.

ii) Que River - Mackintosh River Area :

Access to the area is bad with high relief and few roads and Geological map coverage is incomplete.

Sample descriptions and location are shown in Figure 1 and Appendix 2. No assays above 0.2% P₂O₅ are reported. A short reconnaissance of the Permian strata in this area was made with no indications of Phosphate bearing potential. The Cambrian sequence exposed here comprises a series greywackes, shales, slates and conglomerates.

iii) Ulverstone - Penguin District :

Cambrian rocks outcrop along the coast. Burns (1964) (Section 2) reported P₂O₅ assays of up to 3%. Attempts were made by sampling to duplicate his results in an attempt at a correlation of possible phosphate horizons. In particular, the Westbank chaos was sampled. Here a sequence of strongly sheared Cambrian rocks are present, interrupted by the occurrence of basement wedges. Burns (1964) assays were not duplicated and no analyses above 0.2% P₂O₅ were found.

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5. CONCLUSIONS AND RECOMMENDATIONS:

The marine Tertiary rocks of all leases show a dominant limestone lithology with no above background Phosphate values. Because of this no commercial Phosphate accumulations may be expected. The relinquishment of Phosphate Leases covering King Island (E.L. 20/65) and Flinders Island (E.L. 21/65) is therefore recommended.

The marine Tertiary of the mainland lease area (E.L. 26/65) is similarly non prospective as far as Phosphate accumulations are concerned.

The Palaeozoic rocks of the mainland lease area show an interesting Phosphate potential. Scattered high P_2O_5 values do occur and environmental conditions are, to a limited extent, favourable. Because of the ease of access, a more detailed field investigation could be carried out in the Smithton district in a relatively short time to fully evaluate the present results.

The present study has resulted in a shift in emphasis from Tertiary to Palaeozoic rocks. This being the case, the retention of those parts of E.L. 26/65 where Palaeozoic rocks occur is recommended. This area is outlined in red in Figure 1.

The Cambrian rocks outside the lease areas have been briefly reviewed. The results were negative but inconclusive as due to the few samples collected.

7. SELECTED BIBLIOGRAPHY:

- BANKS, M.R. (1956) The Middle and Upper Cambrian Series in Tasmania pp 165-212 in El Sistema Cambrico, 2 20th int. geol. Congr.
- BANKS, M.R. (1957) The Stratigraphy of Tasmanian Limestones. Miner. Resour. Tasm., 10, pp 39-85.
- BURNS, K.L. (1964) Geological Survey explanatory report K'55-6-29 Tasmania Dept. of Mines.
- CAREY AND SCOTT, B. (1952) Revised interpretation of the Geology of the Smithton district. Pap. roy. Soc. Tasm., 86, pp 63 - 70.
- CRESPIN, I. (1944) Middle Miocene Limestone from Cape Barren Island, Furneaux Group, Pap. Roy. Soc. Tasm. (1944) pp 13-14.
- EDWARDS, (1941) The North-West Coast of Tasmania, Prog. Roy. Soc. Vict., 53, P 233-267.
- EVERARD, (1957) See Hughes, T.D. (1957)
- GILL AND BANKS (1956) Cainozoic History of the Mowbray Swamp and other Areas of North-Western Tasmania. Rec. Q. Vict. Mus., 6 pp 1 - 41.
- GULLINE, A.B. (1959) The Underground Water Resources of the Smithton District. Underg. Wat. Supply Pap. Tasm., 5.
- HUGHES, T.D. (1957) Limestones in Tasmania. Miner. Resour. Tasm. 10.
- JENNINGS, I.B. (1957) The railton Area. Miner. Resour. Tasm. 10 pp 170 - 176.
- JENNINGS, I.B. (1959) Sheffield Map Sheet.
- JENNINGS, I.B. and BURNS, L.K. (1958) Middlesex Map Sheet Geol. Surv. Tasm. 1 inch series.
- JENNINGS, I.B. (1959) Sheffield Map Sheet Geol. Surv. Tasm. 1 inch series.
- NYE AND BLAKE (1938) The Geology and Mineral Deposits of Tasmania. Bull. geol. Surv. Tasm. 44.
- NYE, FINUCANE AND BLAKE (1934) The Smithton District Geological Survey Bull. No. 41 Dept. of Mines Tasmania.
- MCKELVEY (1966) Successful new Techniques in prospecting for Phosphate deposits Australian Mining 1966.
- SHELDON, R.P. (1964) Exploration for phosphorite in Turkey - a case history: Bull. of Economic Geology v. 59 p 1159 - 1175.

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23.

SHELDON, R.P. (1964) Paleolatitudinal and paleogeographic distribution of phosphorite: U.S. Geol. Survey Professional Paper 501-C p. C106 - C113.

SPRY AND BANKS (1962) The Geology of Tasmania Jour. Geol. Soc. of Australia V.9 part 2.

SUTHERLAND, F.L. The discovery of Turquoise in Australia (1964) Aus. Jour. of Science V27 No. 3 P 82.

TWELVETREES (1961) Phosphate deposits in Tasmania. Tasmania Dept. of Mines report No. 3.

APPENDIX 1

TASMANIAN PHOSPHATE LEASES, RECONNAISSANCE FLIGHT

McKellar et al. 1965

INTRODUCTION

The survey was made in a Beechcraft Bonanza twin-engined aircraft by M.G. McKellar, R.O. Brunnschweiler (consultant), T. Watts (Cundill Meyers & Associates), and S. Eddington (as a guest from Esso).

The aircraft was picked up at Melbourne. King Island was surveyed first, then Three Hammock and Hunter Islands, then the west coast between Cape Grim and Sandy Cape, then Robbins Island. After refuelling in Devonport an anti-clockwise circuit was flown around the Furneaux Group commencing at Passage Island and finishing at Chappell Island.

The survey will be described in three phases. Photographs were taken on Kodacolor negative film or Kodachrome 11.

Stage 1 King Island(a) Cape Wickham to Whistler Point

Very low outcrops of granite along waterline, overlain by dune or beach sand. Granite strongly jointed. No sedimentary rocks present.

(b) New Year Islands

Barren, entirely granite with a very thin sand cover.

(c) Whistler Point

Granite is either strongly jointed or somewhat sheared.

(d) Whistler Point to Currie

Dune sand overlying granite on the beaches. In places swamps occur behind the coastal dunes.

FIG 1



FIG 2



FIG 3



028

FIG 4



From Loorana south farmland extends almost right to coast

FIG 5



FIG 6



FIG 7

(e) Currie to cataraque Point

Currie has small well protected harbour and jetty.

FIG 8



FIG 9



5.

Outcrop still the same - very low granite patches covered by dune sand.

Between Ettrick River and Cataraque Point there could be a few feet of outcrop immediately below the dunes at beach level in two or three places. Would be very restricted laterally.

FIG 10



FIG 11



Beach in Photo 11 shows tertiary ? or Quarternary ? outcrops.

6.

(f) Cataraque Point to Surprise Point

South side of Cataraque Point has cliffs about 150-200 ft. high with exposures of granite or gneiss right to top. The flat tops to cliffs are due to peneplanation.

FIG 12



FIG 13



(g) Surprise Point to Stokes Point and Seal Point

South of Surprise Point cliffs give way to very low outcrops of granite gneiss at beach level overlain by low dunes of average elevation soft and maximum 20 ft.

FIG 14

(h) Seal Point to Centre of Island (144°00E 39°50'S)

FIG 15



Looking west across Big Lake

8.

Between Seal Point and a point west of Sea Elephant (144°00E, 39°50'S) land is fairly well developed for farming. Road network is good and access by vehicle fairly easy. No outcrops seen. Heavy rain prevented good photography.

FIG 16



FIG 17



Photo 17 shows a paddock ploughed in loose grey sand.

10.

(i) Centre of Island (144°00'E 39°50'S) to Disappointment Bay

Farmland gives way to low scrub cover on sand and swampy conditions. Landrover access difficult or impossible in the north east corner of island and no roads present.

(j) Disappointment Bay (east headland) to Naracoopa

Sporadic outcrops of granite on beach with scrub or timber covered dunes and swamps behind. South of Lavinia Point outcrops are very scarce. Photo 18 shows typical coastline (heavy rain).



FIG 18

(k) Naracoopa to Bond Head

At Naracoopa is a jetty for loading scheelite, and oil storage tanks.

11.

FIG 19



Looking north - west

Along coast is an elevated penneplain 100-150 ft.
above sea level with cliffs or steep slopes down
to coast.

Only metamorphics exposed in cliffs.

FIG 20



FIG 21



Workings of scheelite mine near city of Melbourne Bay.

(1) Bold Head to Seal Point

Granitic or metamorphic cliffs give way to lower sandy and swampy land across a south facing escarpment. (Photo 22)

FIG 22



037

13.

(m) Black Pyramid Islands (approx. 144°22'E, 40°29'S)

A volcanic crater (Tertiary) with a base of horizontal flows and a cap of steeply dipping ash (?) beds.

FIG 23



FIG 24



14.

(n) Albatross Island

Entirely jointed or gneissic granite.



FIG 25

Stage 2 Hunter, Three Hummock Islands and North Western Tasmania(a) Three Hummock Islands

Entirely granite outcrop with relatively thin sand cover. Photo 28 shows the largest hill, (South Hummock). A small farmhouse exists south of Coulomb Bay (see outpost radio symbol on map).

FIG 26



Fig 27



040

16.

FIG 28



(b) Hunter Island

Appears to be all gneissic or jointed granite or metamorphics

FIG 29



FIG 30



FIG 31



(c) Steep Island

Grass covered basaltic caldera remnant.

FIG 32

(d) Bird Island

Very low lying island of granite-gneiss.

(e) Trefoil Island

Entirely basalt.

FIG 33



19.

(f) Cape Grim to Bluff Point

On Cape Grim basalts dip steeply and randomly.
Small patch of 30 ft. (?) of Tertiary is shown
on left of Photo 34.

FIG 34



Coastline has cliffs 250-300 ft. high of basalt
eroded flat on top. There could be a very thin
vener of sediments overlying basalt, but at Bluff
Point none is present.

FIG 35



(g) Bluff Point to Green Point

Basalt cliffs give way to low sand hills overlying Precambrian metamorphics. Access by land is difficult and seas are very heavy, waves breaking 400-500 yards offshore. This is apparently average according to pilot. Mt. Cameron is basalt.

FIG 36



Fig 37



21.

FIG 38



(h) Green Point to West Point

Behind Green Point there may be up to 100 ft. of sediments which warrant checking (See Photo 39).

PHOTO 39



Elsewhere on this leg sand overlies metamorphics.

(i) West Point To Bluff Hill Point

Tertiary sandy cover or Cambrian sediments with swampy but accessible country behind.

(j) Bluff Hill Point to Sandy Cape

South of Bluff Hill point steeply dipping Cambrian with only thin vegetation cover. South of Arthur River sand dunes along coast with only sporadic outcrop.

(k) Sandy Cape to Robbins Island

Terrain fairly rugged on an incised peneplain with streams up to 100 ft. deep with heavy timber cover. Access with Landrover possible. Outcrop could be seen from the ground but not from the air.

(l) Robbins Island

Very low lying surrounded by sand and mud flats. On north side sporadic outcrops of steeply dipping white Pre-Cambrian quartzite. There may be 80-100ft. of Tertiary outcrop on Guyton Point (See Photo 40).

PHOTO 40



047

23.

(m) Stanley-Circular Head

Beach has basalt rubble. Photo 41 shows typical coast of island and 42 shows the basalt of Circular Head.

FIG 41



FIG 42



Stage 3 - Furneaux Group

Commenced survey opposite Passage Island south of Cape Barren Islands.

(a) Forsythe Islands and Passage Islands

Very thin sand cover over granite.

(b) Cone Point to Harley Point

Granite extends from Cone point back to Mt.

Kerford and in sporadic outcrops along beach

to Harley Point. A flat sandy plain runs south west from Harley Point (Photo 44 looking south west)

FIG 43

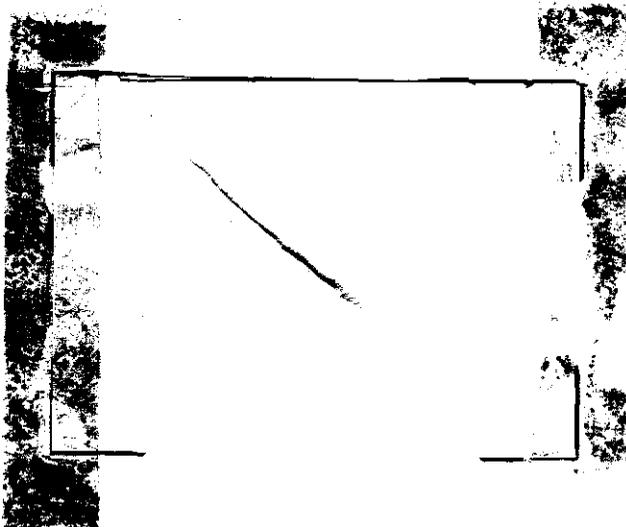
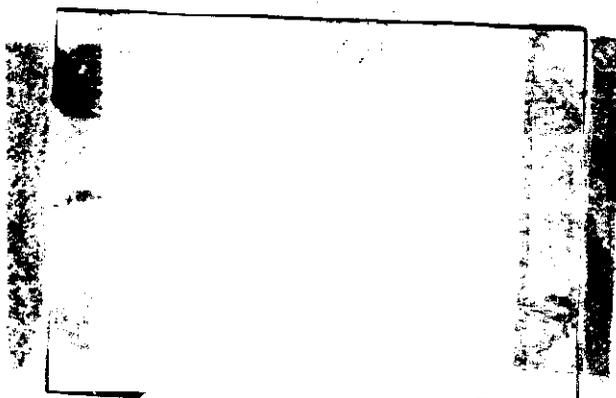


FIG 44



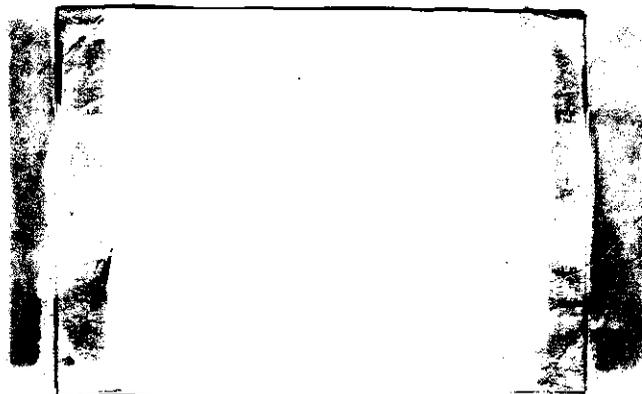




(c) Harley Point to Vansittart Island

On northern tip of Cape Barren strike lines suggest metamorphics or sediments. Photo 45 shows a wreck north of Puncheon Point. Vansittart Island is a high hill of granite (543 ft.)

FIG 45



(d) Trig No. 284 Flinders Island to Babel Island

No outcrops at all only very low sand cover with low dunes behind beach, followed by lagoons. Then a very wide flat plain. Babel Island is granite.

(e) Babel Island to North Point

Wide flat swampy plains with only rare outcrops of granite on beach. North Point is granite.



FIG 46

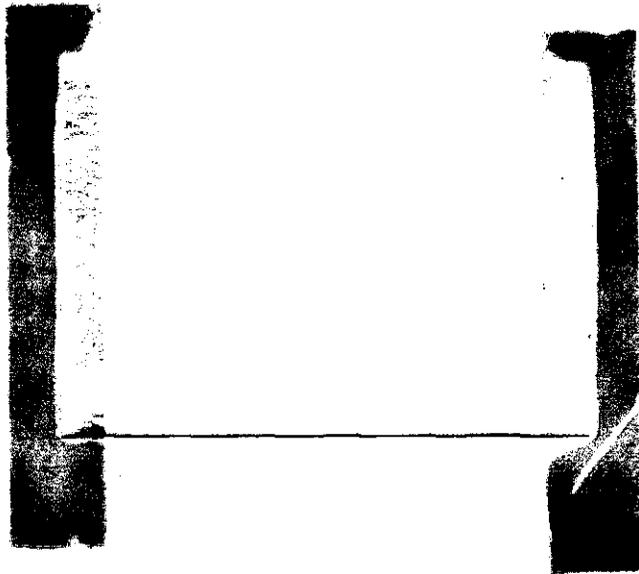


FIG 47



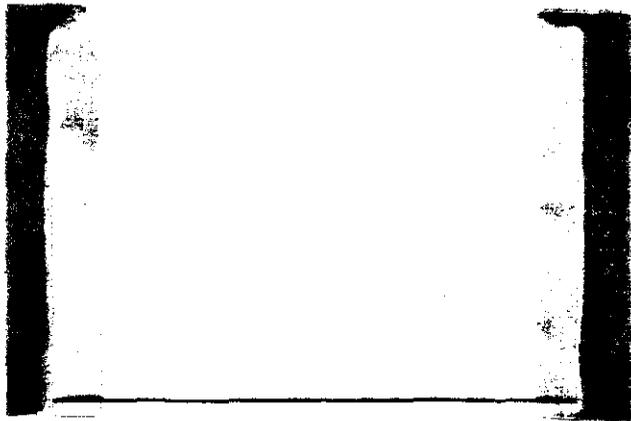




FIG 48



FIG 49







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(f) North Point to Black Point

Only low sand between two headlands. Black Point is a granite hill about 150 feet high. (Photo 49)

(g) Bligh Point to Leeka

Tertiary outcrop in Palana valley shown on geological map is not apparent. It all looks like alluvium with granite in the flanking hills. Cape Frankland and all the islands to the south are granite.

(h) Leeka to Port Davies

Around Marshall Bay sporadic small outcrops of granite occur on beach and low dunes occur behind beach. If any Tertiary were present it would be covered by this thin sand cover. Port Davies is granite. Photo 50 looks from Lillies Bay across to Marshall Bay.

FIG 50

(i) Port Davies to Mt. Chappell Island

Steeply dipping sediments or metamorphics exposed in water near airstrip (Photo 51).

Photo 52 shows Whitemark, 53 the country immediately south and 54 Strzelecki Peaks. Mt. Chappell Island is granite.



FIG 51



FIG 52





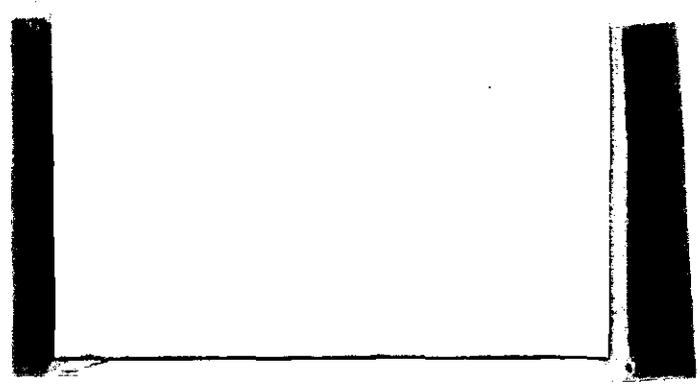


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FIG 53



FIG 54







SUMMARY AND CONCLUSIONS

The only area in which significant Tertiary marine sediments could be present on the coast is at Green Point, near Marrawah on the Tasmanian mainland.

Elsewhere on King Island, the Tasmanian west coast and the Furneaux Group, sand or alluvium covers Pre-Cambrian or Lower Palaeozoic granites, metamorphics or steeply dipping sediments.

The geomorphology in all the areas considered precludes the possibility of any significant thickness of Tertiary sediments being present. The thickest recorded section occurs at Table Cape near Wynyard, where less than 100 feet of marine Tertiary is exposed beneath basalt.

On this survey no areas apart from that at Green Point were seen that would encourage further investigation. Furthermore discussions with geologists of the Tasmanian geological survey may be sufficient to positively identify the age of the Green Point rocks.

RECOMMENDATIONS

The exploration licences over King Island and the Furneaux Group should be relinquished before any further expenditure is incurred. The mainland licence should be retained until the Green Point area has been evaluated, initially by discussions with the Geological Survey and, if still warranted, by limited field work. If ground investigations indicate sufficient reserves of economic phosphate could be present, further evaluation should be carried out. If this is not the case the entire licence should be relinquished.

APPENDIX 2 SAMPLE LOG AND ANALYSIS

SAMPLE NUMBER	LITHOLOGY	Location & Age	% P ₂ O ₅
1	Schist: green chloritic mica schist	Cambrian (Westbank Chaos)	-
2	As above		-
3	Quartzite light grey, highly silicified, with abundant quartz veining	"	-
4	Quartzite and Schists as above	"	-
5	Mudstone: light - medium grey, micaceous feldspathic, slightly schistose	"	-
6	As above	"	-
7	As above with feldspar veining		
8	Shale: dark grey, black, very blocky, hard micaceous	Cambrian (Que River)	0.2%
9	Sandstone: Pink, very fine, silty, hard, compact	"	0.3%
10	Mudstone: Light grey, kaolinitic, massive fairly hard	"	0.2%
11	Mudstone: as above, slightly glauconitic	"	0.2%
12	Mudstone: yellow-green blocky, slightly silty	"	0.2%
13	Siltstone: Light grey, massive, fairly hard very micaceous and argillaceous	"	0.2%
14	Mudstone grading to siltstone, light grey, yellow, limonite stained	"	0.2%
15	Sandstone: White-light grey, with isolated quartz grains set in an abundant kaolinitic slightly argillaceous matrix	"	0.2%
16	Siltstone: light grey to green, feldspathic, very argillaceous	"	0.2%
17	Siltstone: light brown, argillaceous, conglomeratic	Cambrian (Rosebury)	0.2%
18A	Chert: medium-dark grey, slightly silty and blocky	Cambrian Mackintosh River to	0.2%
18B	Sandstone: light grey, very fine micaceous, hard	Que River	-

2.
APPENDIX 2 (continued)

SAMPLE NUMBER	LITHOLOGY	Location & Age	% P ₂ O ₅
19	Shale: medium grey, massive	Cambrian Macintosh River to Que River	0.2%
20	Shale: as above	"	0.2%
21	Sandstone	"	-
22	Sandy limestone, very fine argillaceous	Tertiary (Wynyard)	0.2%
23	Limestone: light grey, very argillaceous fossiliferous	"	0.2%
24	Mudstone: light-grey, massive, calcareous	"	0.2%
25	Shale: dark grey, hard, massive, silty	Cambrian (Smithton)	0.2%
26	Siltstone: light brown-grey, massive, hard, silty	"	0.2%
27	Weathered Basalt	"	-
28	Shale: light grey, slightly silty, grading to mudstone	"	5.4%
29	Pyroclastics	"	0.2%
30	Chert: light grey, bedded	"	0.2%
31	Pyroclastics interbedded with mudstone, light grey-green, massive, slightly silty	"	0.2%
32	Shale: light grey, massive, silty	"	0.5%
33	Chert & Dolomite	"	-
34	Mudstone: light grey, with minor chert veining, part very calcareous	"	0.2%
35	Mudstone: light white-grey massive	"	-
36	Mudstone: as above, with thinly bedded chert	"	0.2%
37	Sandstone: white, quartzose, very fine to fine, argillaceous, kaolinitic	"	0.2%
38	Chert: white, blocky	"	0.2%
39	Chert: black with weathered mudstones		0.2%
40	Silicified conglomerate		4.0%

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3.

APPENDIX 2 (Continued)

SAMPLE NUMBER	LITHOLOGY	Location & Age	% P ₂ O ₅
41	Shale: medium grey-black, fissile silty, kaolonitic		0.2%
42	Chert: black		-
43	Dolomite		-
44	Mudstone: grey-brown, hard		0.2%
45	Sandstone: light grey, very fine, very quartzose hard and dense		0.2%
46	Mudstone: light brown, grey, massive		-
47	Mudstone: brown		0.7%
48	Siltstone: brown argillaceous		0.2%
49	Dolomite	Pre-Cambrian	0.2%
50	Argillaceous Siltstone, Cherts and Limestones	"	0.2%
51	Cherts and pink sandstones	"	0.2%
52	Sandstone: light grey-brown, quartzose hard tight	"	0.2%
52	Dolomite	Pre-Cambrian	0.2%
54)		Tertiary	0.2%
55)		"	0.2%
56)		"	0.2%
57)	Marine Tertiary Limestone,	"	0.2%
58)	grey, soft fossiliferous	"	-
59)	on beach Green Point to	"	0.2%
60)	Mount Cameron west	"	0.2%
61)		"	0.2%
62)		"	-
63)		"	-
64	Limestone: light brown, friable, sandy, fossiliferous	"	0.2%
65	Limestone: light brown, sandy, argillaceous, fossiliferous	"	0.2%
66	Limestone: as above	"	0.2%
67)			0.2%
68)	Marine Tertiary limestone:		0.2%
69)	grey, soft, fossiliferous	"	0.2%

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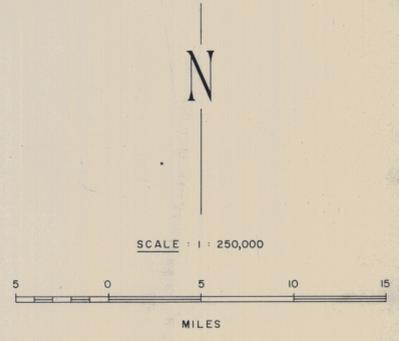
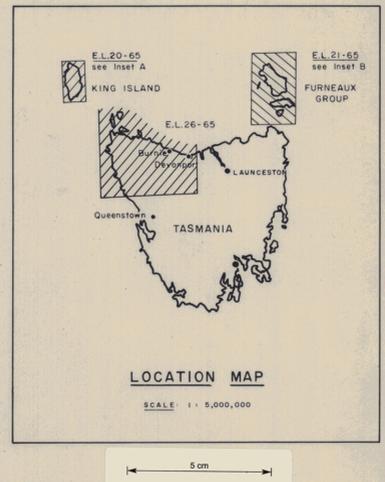
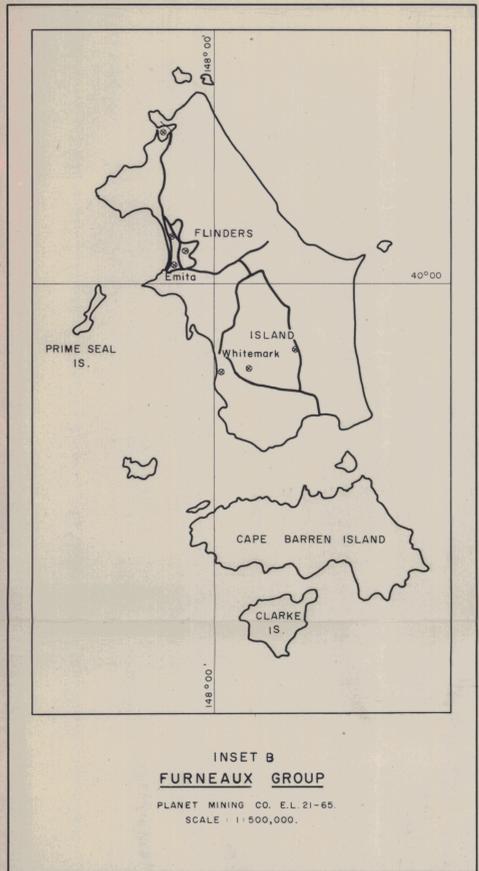
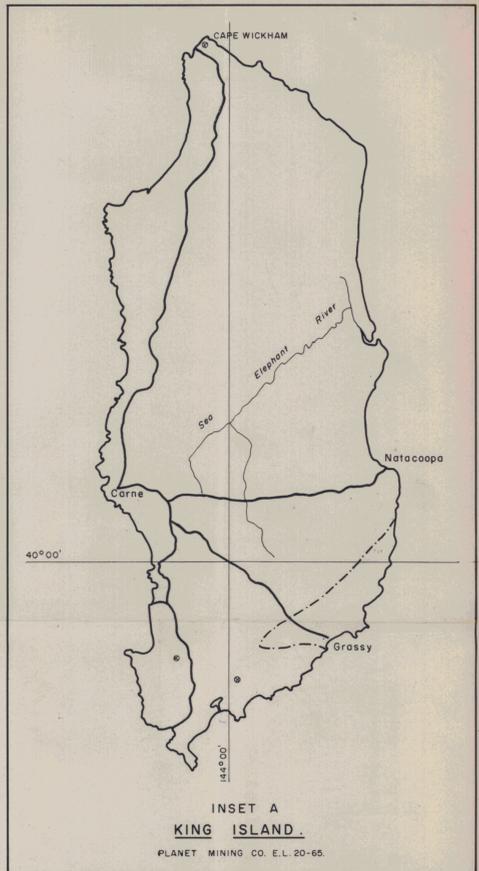
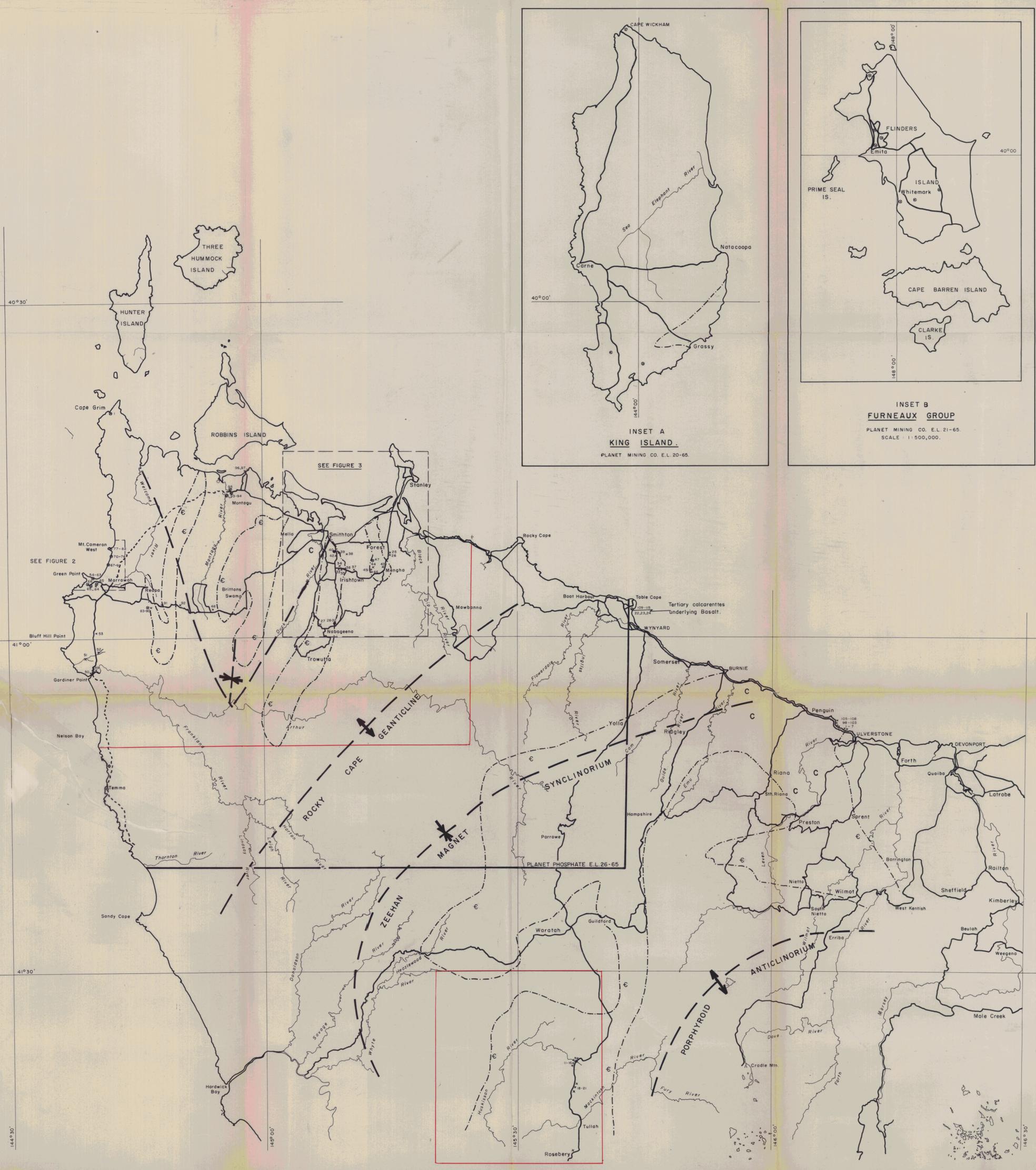
APPENDIX 2 (Continued)

SAMPLE NUMBER	LITHOLOGY	Location & Age	% P ₂ O ₅
70	Silty Limestone: light brown massive, slightly sandy, kaolonitic, grading to claystone	Tertiary	0.2%
71	Limestone: as above	"	-
72	Siltstone: light grey-brown, very calcareous grading to silty limestone	"	0.2%
73)			0.2%
74)			0.2%
75)	Marine Tertiary Limestone:		0.2%
76)	as above	"	0.2%
77	Siltstone - Shale	"	0.2%
78	Red calcareous siltstone	"	0.2%
79	Red siltstone and shale	"	0.2%
80	Silty, argillaceous limestone	"	0.5%
81	Claystone - Limestone	"	0.2%
82	Claystone - Limestone	"	0.2%
83)		"	0.2%
84)		"	0.2%
85)		"	0.2%
86)		"	0.2%
87)		"	0.2%
88)	Tertiary limestones: pink,	"	-
89)	hard, fossiliferous, at	"	0.2%
90)	Redpa	"	0.2%
91)		"	0.2%
92)		"	0.2%
93)		"	0.2%
94)		"	0.2%
95)		"	0.2%
96	Sandstone: grey, argillaceous	Cambrian (Montague)	0.2%
97	Shale-Claystone: red - green	"	0.2%
98	Black Shale	Cambrian Westbank Chaos	0.2%
99	Limestone	"	0.2%
100	Mudstone: green-grey	"	0.2%
101	Mudstone and Siltstone: red and grey	"	0.2%

5.
APPENDIX 2 (Continued)

Sample NUMBER	LITHOLOGY	Location & Age	% P ₂ O ₅
102	Mudstone: green	Cambrian Westbank Chaos	0.2%
103	Siltstone: brown, soft	"	0.2%
104	Mudstone: light grey, massive, slightly silty	"	0.2%
105	Mudstone: brown-red	"	0.2%
106	Mudstone: white and green banded	"	0.2%
107	Mudstone: brown	"	0.2%
108	Mudstone: light brown-grey, silty, micaceous	"	0.2%
109	Shale: medium grey, silty, micaceous	Tertiary (Wynyard)	0.2%
110	Siltstone: light grey-brown, hard, argillaceous	"	0.2%
111	Shale-Mudstone: grey, massive	"	0.2%
112	Conglomerate: shelly and sandy	"	0.2%
113	Shelly sand	"	0.2%
114	Sandstone: calcareous	"	0.2%
115	Shelly sandstone	"	0.2%

NOTE - Assays reported as 0.2% imply values of less than 0.2%.



REFERENCE

- × 98 Sample location and number.
- ⊙ 47 Tertiary Marine sample location and number.
- C Occurrence of Cambrian cherts.
- ⊕ Cambrian.
- - - Approximate extent of Cambrian.
- ✱ Major structure axis.

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FIGURE 1

PLANET MINING COMPANY

MAP OF PLANET MINING COMPANY'S PHOSPHATE LEASES IN TASMANIA, SHOWING SAMPLE LOCATIONS AND STRUCTURAL AXIS.

LEASE NUMBERS E.L. 20-65, E.L. 21-65 AND E.L. 26-65.

CUNDILL MEYERS AND ASSOCIATES

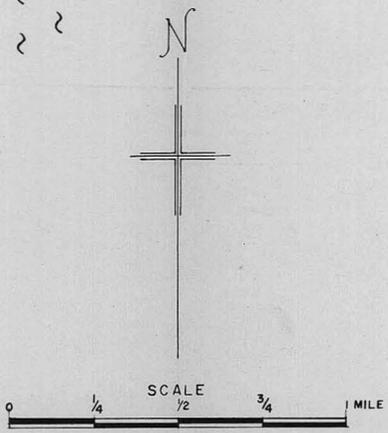
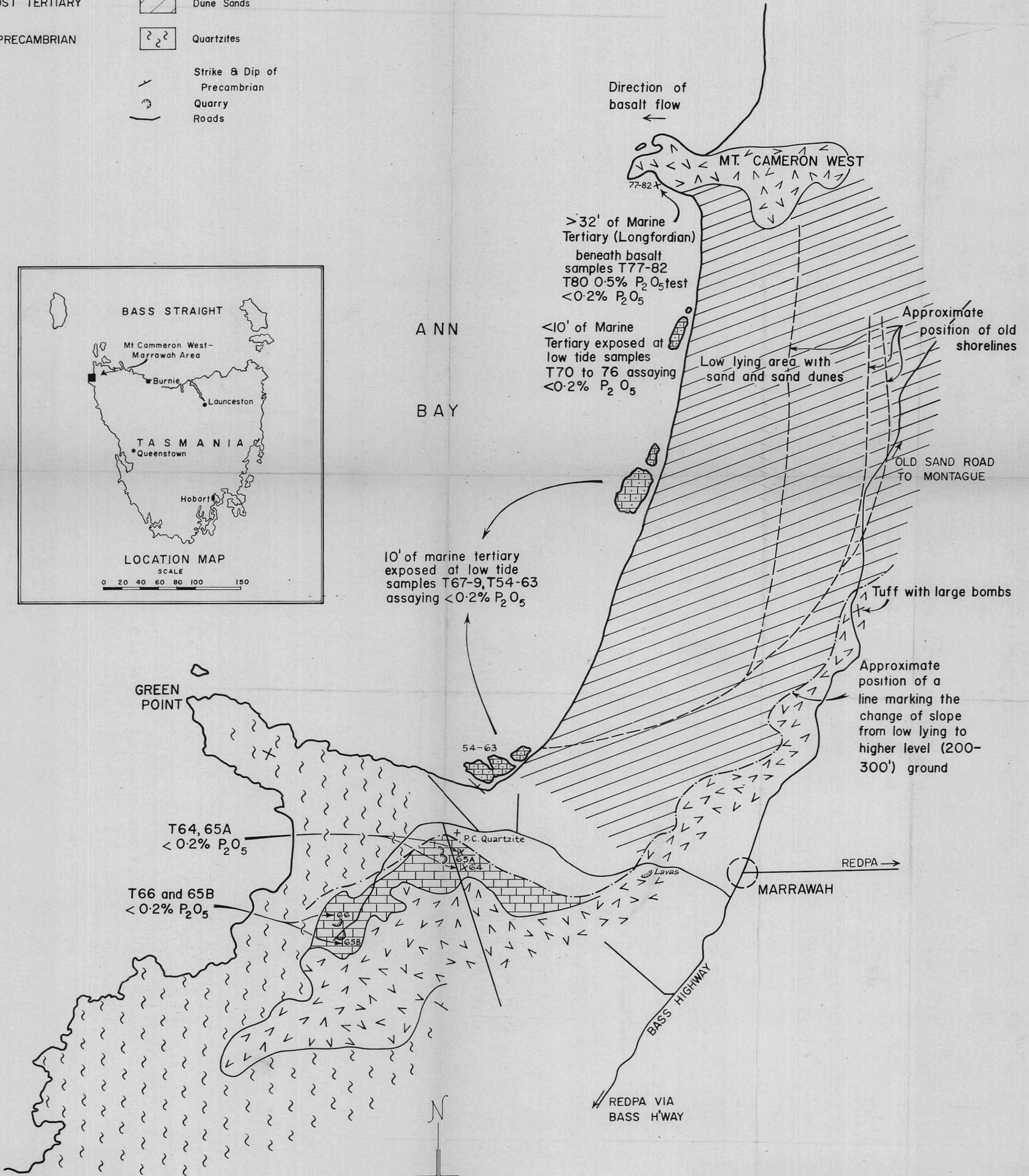
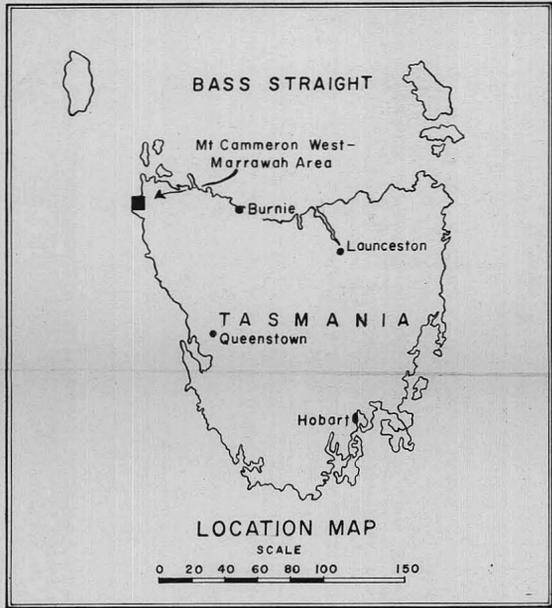
To accompany report by: T.R. Watts.	Date: April 1966
Drawn by: Geodrafting Services (N.S.W.) Pty. Ltd.	Date: April 1966.
Scales: 1:250,000 and 1:500,000	Figure: 1

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LEGEND

- TERTIARY
 - Longfordian  Marine
 - Batesfordian  Basalt
- POST TERTIARY
 -  Dune Sands
- PRECAMBRIAN
 -  Quartzites
 -  Strike & Dip of Precambrian
 -  Quarry
 -  Roads



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PLANET MINING COMPANY	
THE GEOLOGY AND GEOMORPHOLOGY OF THE AREA BETWEEN MARRAWAH AND MT CAMERON WEST Showing P ₂ O ₅ content of Marine Tertiary (After P. Quilty 1965)	
CUNDILL MEYERS AND ASSOCIATES	
To accompany report by: T. R. WATTS	Date: April 66
Drawn by Geodrafting Services (NSW) P/L	Date: April 66
Scale: 1:23,300	Fig. 2

SMITHTON AREA

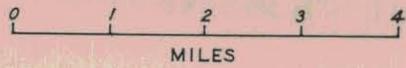
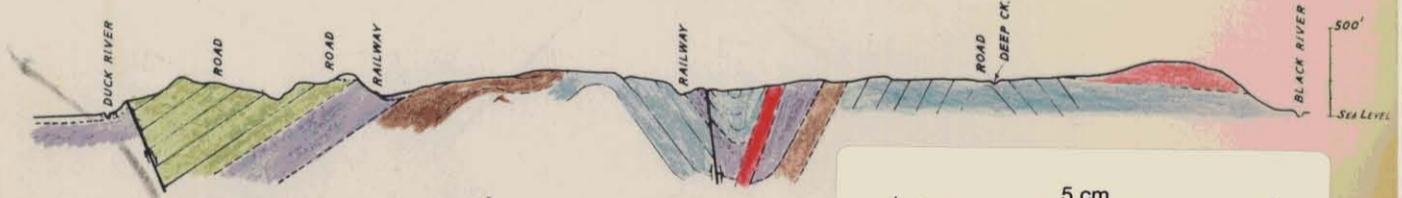
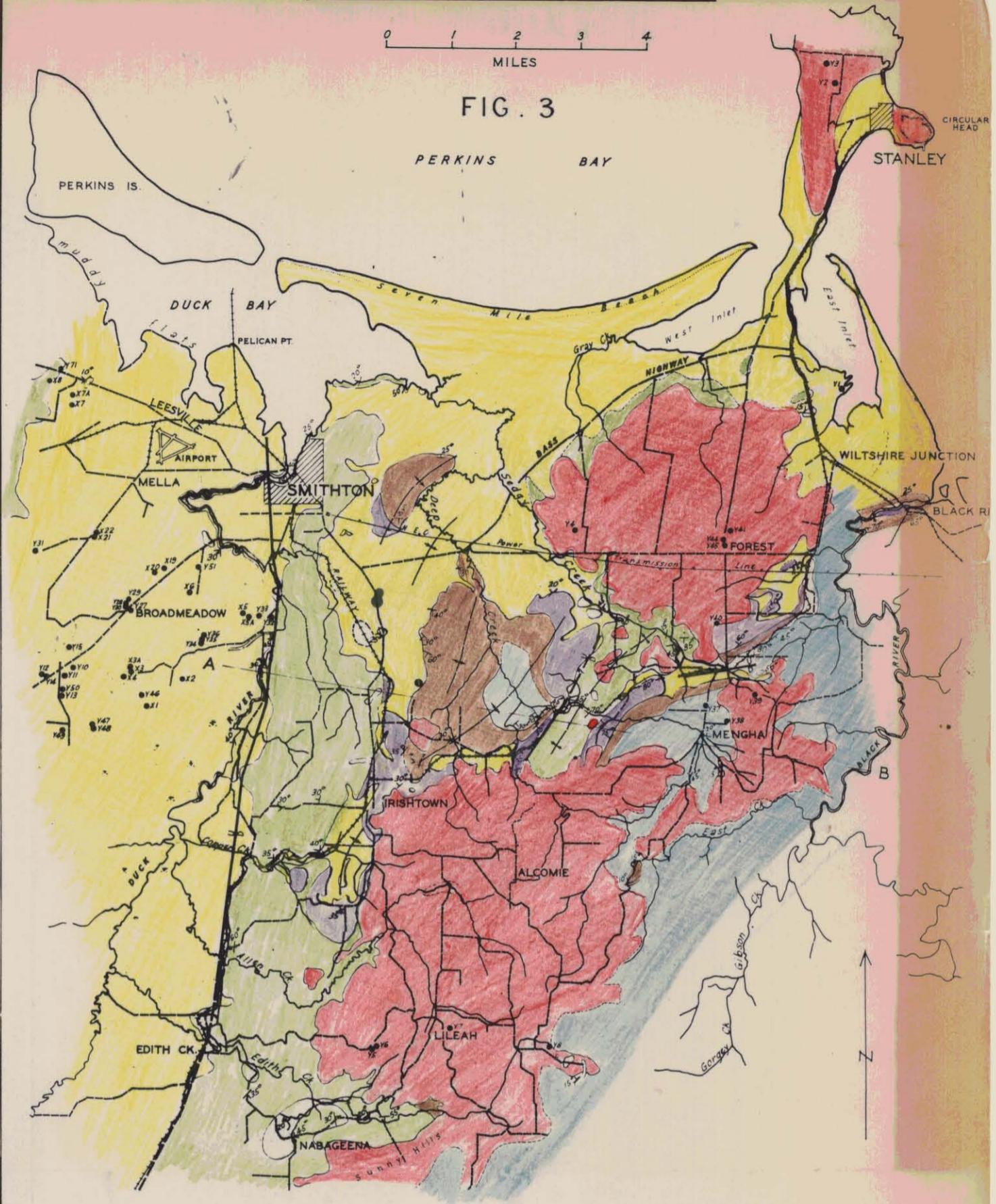
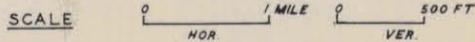


FIG. 3



SECTION AB



SEDIMENTARY		IGNEOUS		LEGEND	
QUATERNARY	SANDS, GRAVELS, CLAYS & PEAT			ESTABLISHED BOUNDARY	---
TERTIARY	LIMESTONE			INDEFINITE BOUNDARY	- - - -
CAMBRIAN (DUNDAS GROUP)	SEDIMENTS & LAVAS			ESTABLISHED FAULT	---
PRECAMBRIAN (CARBINE GROUP?)	SMITHTON DOLOMITE			SUGGESTED FAULT	- - - -
	BRYANT HILL QUARTZITE & CONGLOMERATE			ANTICLINAL AXIS	+
PRECAMBRIAN	UNDIFFERENTIATED			SYNCLINAL AXIS	+
TERTIARY	BASALT			DIP & STRIKE	/ 10°
CAMBRIAN	DOLE RITE			BOREHOLES	• Y7

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A. B. GULLINE B.Sc.
GEOLOGIST
1958

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