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GEOPEKO LIMITED

KING ISLAND

MICROFILMED

THE REGIONAL GEOLOGY OF KING ISLAND

by:

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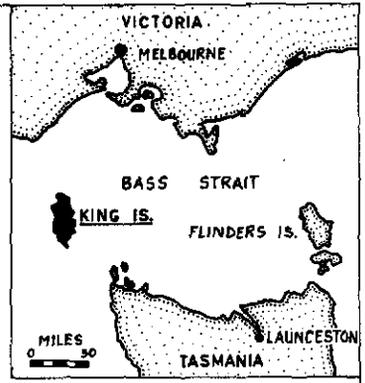
ATTACHED PLANS:

I Regional Geological Interpretation Map of King Island

II Regional Interpretation Cross Sections

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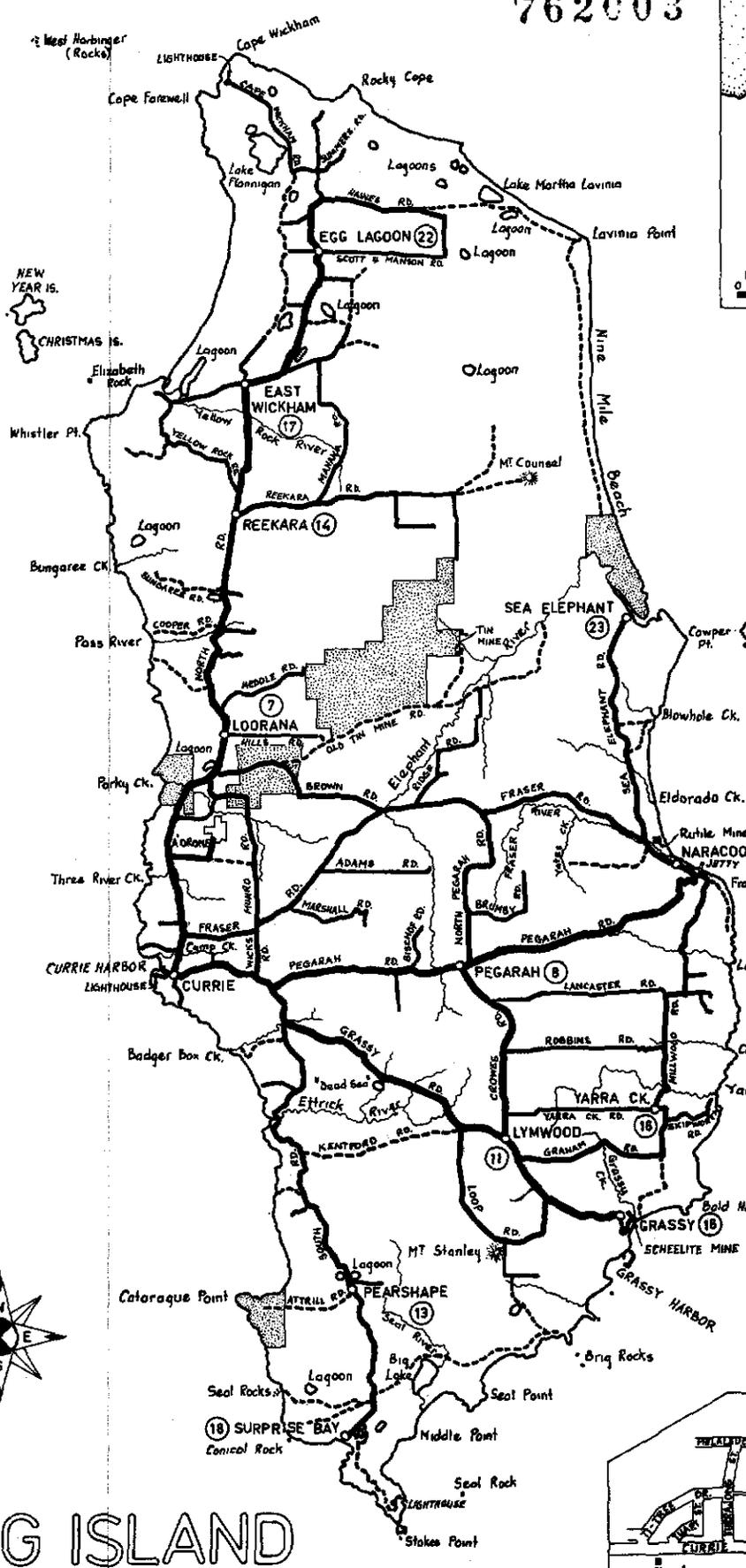
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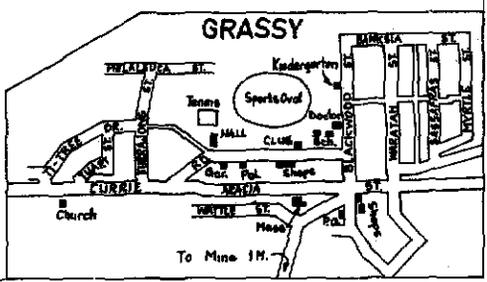
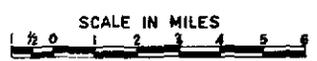
BASS STRAIT

KING ISLAND



LEGEND

- Roads... ——— ——— ———
- Miles from Currie..... ⑫
- Animal & Bird Sanctuary... [stippled box]



5 cm

INTRODUCTION

King Island is situated at the Western entrance to Bass Strait approximately 183 miles south south west of Melbourne and 213 miles north west of Launceston. The island is 40 miles long and 16 miles across at its widest point and is delimited by latitudes $39^{\circ} 35'$ and $40^{\circ} 10'$ and longitudes $143^{\circ} 50'$ and $144^{\circ} 10'$.

The island is of very low relief with the highest point being a little over 500 feet above sea level and a large proportion of the island is covered by Quaternary alluvium and aeolian sand deposits. Apart from the almost continuous outcrops around the coast and in the sharply incised creek beds of the south east, rock outcrop on the island is sparse. In the compilation of the geological map of the island this lack of outcrop has been overcome to some degree by careful mapping of all float occurrences and the results of the extensive Gemco drilling carried out in the north and west of the island.

King Island has always been of considerable geological interest because of the presence of the large scheelite ore-bodies currently being mined by King Island Scheelite Ltd and to a lesser extent the existence of Cambrian (?) volcanics and the tillite sequence on the south east coast.

However the geology of the island as a whole has been considered only in passing in papers more directed towards specific topics. After nearly three years of exploration work by Geopeko Limited, the purpose of this report is to review our knowledge of the geology of the island as a complete unit. Although the regional geological map of the island is the result of the mapping of many geologists the ideas of structural and stratigraphic relationships are largely those of the author.

PREVIOUS LITERATURE:

The first account of the geology of the island was by Debenham F. (1910) which also included the first geological map of the island. He referred to the remarkably uniform strike trend of the Paleozoic rocks (average of 12° east of north) and, noting the rocks on the west coast dipped to the west and those on the east coast dipped to the east, suggested the island may consist of a ge-anticline.

L.L. Waterhouse (1915) prepared some brief notes on King Island and a year later presented a Mines Department report on the tungsten and molybdenum deposits.

Since that date the tungsten deposits currently being mined by King Island Scheelite Ltd. have been reported on in the literature at various times. Papers by Nye (1934) Nye and Knight (1943, 1953, 1965) and Edwards Baker and Callow (1956) have discussed the stratigraphy, metamorphism and metasomatism of No. 1 Orebody and a recent paper by Large (1971) discussed metasomatism and scheelite mineralisation at Bold Head, King Island (No. 3 Orebody). Various unpublished company reports and thesis have also been presented on the geology of the three orebodies.

The rocks of the south-east coast have also been the subject of a number of papers with Carey (1945) postulating a glacial origin for the fragmental rock located on the coast and papers by Scott (1951) and Solomon (1969) discussed the spilites and picritic basalts.

A paper by Jennings (1959) discusses the physiography of the island in detail. In addition to all the literature published on King Island there is a variety of unpublished company reports, Mines Department reports and mineragraphic examinations that cover various aspects of the geology and different rock types of the island.

PHYSIOGRAPHY

King Island consists of an inclined plateau of very subdued relief that is in the greater part rimmed with recent coastal sand dunes. The highest point on the island, located in the Mt. Stanley area, is approximately 550 feet above sea level.

The land surface of the southern portion of the island is gently rolling and conforms well with the concept of a peneplain of normal erosion. This rolling country runs north to the Pagarah Road between Naracoopa and Currie and to the east the plateau remains high right to the coast. Because of this the creeks in this area (i.e. Grassy River, Yarra Creek, Conglomerate and Barrier Creek etc) are sharply incised. In these creeks excellent outcrops are exposed and it is noted that in many instances minor folds in the basement, which consist of siltstones and shales have caused deflections in the creek course.

Another effect that the bedrock geology has on the physiography in this area is that the Bold Head Granite, being less resistant to erosion, forms a natural basin that is rimmed by low relief hills that are the contact metamorphosed quartzites. The very steep western margin to the plateau that extends northward from the Red Hut headland may again be caused, to some extent, by the contact metamorphosed rocks associated with the Grassy Granite being more resistant to erosion.

The southwestern portion of the island between Fitzmaurice Bay and Surprise Bay is considered by Jennings to be a separate plateau that slopes eastward and forms a depression in the area of Big Swamp and Big Lake and the southern portion of the Seal River.

In the north east (virtually along Frasers Road between Naracoopa and North Pagarah Road) the high plateau ends abruptly in a relatively steep scarp and is incised by roughly north south flowing creeks such as Fraser and Sea Elephant Rivers and Yates Creek.

Good rock exposures occur in these creeks and their courses are again seen to follow the regional trend in the strike of the basement rocks.

North of this scarp to Mt. Counsel there is virtually no rock outcrop the entire area being covered by superficial alluvial and aeolian sand deposits.

To the west and north-west the plateau declines gently in height and apart from a fairly well defined northern margin extending approximately 9 miles in a WNW - ESE line from a point about a mile south of the Yellow Rock River to the Reekara area, the plateau margin loses its definition both in the continuation eastwards of this northern boundary to Mt. Counsel and of its eastern boundary south to the Fraser River. The lack of definition in the boundary in this area may be attributed to the soft nature of the basement rocks which are predominantly siltstones and muscovite-sericite schists. The contact metamorphic effects of the Mt. Counsel Granite (silicification) give rise to the low relief hills at Mt. Counsel and Sea Elephant River.

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North of the line joining Whistler Point and Mt. Counsel there is virtually no rock outcrop and the area is almost entirely covered with superficial deposits. There are isolated highs in the basement at Cape Wickham, Rocky Point, and Boulder Point and a low ridge running from Disappointment Bay to Lake Martha Lavinia behind the sand dunes is a high in the granite basement.

The lowest country in this northern part of the island is in the centre where there are extensive flat plains (Egg Lagoon, Reedy Lake, South East Lagoon) of young esturine sediments, part of which are covered by the peaty soils of former shallow lakes and swamps.

This depressed interior is surrounded by a rim of coastal dunes. To the south east of the depressed area the land is extremely flat and Gemco drilling has shown bedrock in this area to be covered by an average of 10 metres of aeolian sand.

Much of the island is rimmed with sand dunes and these clearly fall into two major systems designated the Old Dunes and the New Dunes. The New Dunes consist of parabolic dunes in all stages of development and they form a continuous belt up to three miles wide along the west coast of the island with a much narrower belt of dunes extending down the east coast to the Blow Hole. Isolated occurrences of the New Dunes occur on the south-east coast and significant amounts at the south end of the island.

This coastal rim of dunes has affected the drainage of the island in different ways. Some rivers have maintained their course through the dunes (i.e. Ettrick and Pass Rivers). Other rivers have had their mouth deflected to varying degrees, most noticeably in the case of the Sea Elephant River where it amounts to a deflection of two miles. Damming of the drainage by the sand dunes has led to the development of extensive lakes and swamps. (Big Swamp, Lake Flannigan).

The Old Dunes occur much more sporadically but are found all around the island and reach further inland than the New Dunes. These dunes generally have subdued relief ranging from low gentle swells to whale back mounds and smoothed ridges.

Associated with the New and Old Dunes on the east and south-east coasts of the island are two distinct sets of old shore or strand lines and these have been designated the Old and New Shorelines. The best development of these strand lines is north of Naracoopa and north of the Sea Elephant River where both sets are developed. The Old Shorelines trend roughly north-south and are approximately 6000 metres apart. These sets are very similar except that they exhibit opposite facings indicating land growth outwards in two directions from a central point.

STRATIGRAPHYSummary of Geological History:

Holocene	New Dunes, New Shorelines	
Pleistocene	Old Dunes, Old Shorelines and Lacustrine and Estuarine sediments of Egg Lagoon and Reedy Lake.	
Miocene	Fossiliferous Limestone Unconformity	Thickness Unknown
Devonian-Carboniferous	Tabberabberan Orogeny with associated intense folding and intrusion of granite bodies (Mt. Counsel, Grassy, Bold Head) during later phases with associated tin and tungsten mineralisation.	
Middle Cambrian	Spilites and picrite basalts in the form of pahoehoe, aa and pillow lavas with tuffs, breccias and agglomerates. Locally unconformable	> 8000'
Early Cambrian	Tillite, Dolomitic siltstones, shales and slates. During the same period deposition of intercalated pelitic and carbonate sediments - Mines Series - later metamorphosed and metasomatised by the Grassy and Bold Head Granites. Locally unconformable	600' 700'
Late Proterozoic-Early Cambrian	Deposition of thick sequence of siltstones, mudstones, shales and minor sandstones in possible miogeosynclinal environment. Becoming metamorphosed at depth to give muscovite-sericite schists. Unconformity	> 20,000'
Proterozoic	Penguin orogeny (715 my) accompanied by intense deformation and dynamic metamorphism of sediments and generation and local intrusion of granite. Deposition of thick sequence of siltstones, sandstone and quartzite in Proterozoic eugeosyncline (West Coast Schists)	> 18,000'

PROTEROZOICWest Coast Meta-Sediments

These rocks form a broad belt extending from Stokes Point in the south until they pinch out to the north at Woods Road. A small occurrence of these meta-sediments are located on the north-west coast between the northern end of Phoques Bay and Cape Wickham and a narrow belt of them extend from the north coast to south of Yellow Rock road. The thickness of the sequence appears to be at least 18,000 feet.

The rocks of this sequence tend to strike north-south or slightly east of north and dip to the west at varying angles but generally fairly steeply (60-70°). Folding in the sequence is limited but there is a major anticlinal structure at the south end of the island and a number of folds with amplitudes of 20 - 50 metres have been mapped. In the outcrops at the north of the island there are many small scale fold structures and these rocks have obviously been subjected to more intense stresses than those in the south.

The wide variety and nature of schists and mineralogical assemblages within this sequence necessarily implies a wide variety of original sedimentary facies. This is particularly evident in the south of the island and some of major varieties of schists are discussed below. (See Stokes Point Map Sheet 10).

Crenulated Muscovite Schists

These display very fine original bedding and are muscovite rich and strongly crenulated. They often contain garnets (almandine) and in one locality stauralites were developed. This rock type has a very limited occurrence at the very south end of the island and near the mouth of the Seal River.

Quartz-Muscovite Schists - Slightly Crenulated

These are rather similar to the preceding unit but are more quartz rich and less strongly crenulated although strong kink folding is still evident. Garnets are commonly developed in this rock type as well.

Interbedded Quartzites - Quartz Muscovite Schists

This sequence is perhaps indicative of some cyclic type of deposition within the original sedimentary basin. The sequence is highly variable with either the quartzite or the quartz-muscovite rock type being dominant. Garnets and stauralites are commonly developed and often the stauralites; large siliceous ill formed crystals are rimmed with coarse grained muscovite.

Bedding is generally evident in most of the sequence and in places graded bedding is noted. Within one quartzite outcrop approximately one mile north of Stokes Point there are pods, 30 - 50 cm in diameter, of coarsely crystalline marble. This is the only occurrence of carbonate material within the west coast sequence that is known to the author.

Andalusite-Muscovite-Garnet Schists

These rocks are well exposed in the vicinity of Surprise Bay. This sequence has clearly defined bedding and large andalusites (1 cm) are developed in nodes of small flexures within this bedding. The sequence is generally muscovite rich and garnets are commonly developed throughout.

Quartzites and Massive Quartzose Material

In the area of Surprise Point there are massive outcrops of very quartz rich material often strongly sheared and foliated and displaying no original sedimentary structures. These rocks in places have a characteristic quartz porphyroidal nature and texturally approximate the West Coast Granite. Both contacts with the granite in this area are very gradational.

Further north the dominant rock types are coarse grained quartz-muscovite schists although garnets and stauralites are still commonly developed (i.e. Ettrick River). Outcrops of chiastolite and sillimanite bearing rocks have also been reported in this area.

In the north end of the island the rocks are predominantly coarse grained quartz-muscovite schists with minor quartzites. Developed throughout these rocks are particularly those near the granite contacts are aggregations of quartz-muscovite and tourmaline and these are seen to occur in the nodes of small regular kinks in the rock. No high grade metamorphic minerals such as kyanite and sillimanite have not been recorded in these rocks but only limited petrographic work has been carried out to date.

It is considered that these rocks are correlative with the Older Pre-cambrian rocks of Tasmania.

West Coast Granite

The West Coast Granite forms an apparent composite body and occupies approximately one quarter of the island. The granite outcrops along the west coast from half way between Surprise and Cataraque Points to south of Fitzmaurice Bay and then from half a mile south of Badger Box Creek northwards to the south side of Currie Harbour, within the Currie Harbour, and then continuously from a point approximately one mile south of Porky Creek to the southern end of Phoques Bay. Apart from a narrow lense of West Coast Schists the West Coast Granite occurs continuously from Cape Wickham eastward to half way between Boulder and Lavinia Points. The contact between the granite and the east coast ("Reekara Type") schists after initially trending north-south swings to the east at the Yambacoona road junction to trend north-east - south-west. Thus the greater portion of the north end of the island north of Haines Road consists of West Coast Granite.

The granite ranges in composition from adamellite to granodiorite and is predominantly fine to medium grained with minor phases of porphyritic granite. The granite consists essentially of quartz, plagioclase, microcline perthite, orthoclase perthite with minor biotite, muscovite and chlorite and accessory zircon, apatite, sericite, zoisite and opaques. Xenoliths of basic material up to 30 cm in diameter are common throughout the granite mass.

From the silicate analyses of two samples (Table I) of typical West Coast Granite it appears to be a low silica, high potash granite and chemically corresponds more closely to a granodiorite.

TABLE I

	SAMPLE L10	SAMPLE L11
SiO ₂	63.4	61.3
Al ₂ O ₃	16.4	14.9
Fe ₂ O ₃	4.45	2.70
CaO	2.65	2.45
MgO	1.91	1.39
Na ₂ O	2.65	2.60
K ₂ O	4.7	4.75
MnO	<0.02	<0.02
P ₂ O ₅	0.31	0.19
TiO ₂	0.82	0.56
Cr ₂ O ₃	<0.1	<0.1
U ₂ O ₅	<0.05	<0.05
L.O.I.	2.5	0.81

L10 Yellow Rock (Sheet 3, 1:12,000)

L11 Porky Creek Area (Sheet 5, 1:12,000)

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At the north end of the island near Cape Wickham two distinct types of granite have been noted and are seen to be mutually intrusive. There is a strongly porphyritic phase with large (up to 5 cm) phenocrysts of orthoclase and often these are aligned and generally follow the regional north-south trend. The other phase is the typical medium to fine grained phase.

Along the west coast the fine to medium grained varieties are predominant and often they have a strongly foliated character. In thin section these types are seen to have a cataclastic texture with undulose extinction of the feldspars and quartz and also exhibit pronounced bending of the micas around other mineral grains.

The southern outcrops of the granite in the Cataraque Point area are predominantly strongly sheared and foliated and very quartzose in character.

The contacts of the granite with the west coast meta-sediments are highly variable and intermixed. The contact near Cape Wickham displays development of migmatitic type rocks and a variety of quartzose-feldspathic rocks. However the contacts display a general conformability between the west-coast meta-sediments and the West Coast Granite and it is considered the granite is only locally intrusive and largely generated in situ.

A contact between the East Coast Meta-Sediments and the granite is revealed (only at low tide and it is also often covered with sand) half way between Boulder and Lavinia Points. The contact appears to be fairly abrupt with some degree of silicification of the meta-sediments.

Potassium-Argon dating of the micas within the West Coast Granites by Mc Dougall and Leggo gave an age of 715 million years to this granite. It is felt that this age records the final major orogenic event that these rocks were subjected to and this age relates these rocks to the Penguin Orogeny of Tasmania.

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Aplites, Pegmatites and Basic Dykes of the West Coast

In all granite contact areas pegmatites and aplites are common and these become more prevalent throughout the schists at the northern end of the island.

The pegmatites occur mainly as veinlike bodies of a few centimetres to metres in width. The majority of these are concordant within the schists occasionally becoming discordant. These are best displayed in outcrop near the Cape Wickham Lighthouse.

The pegmatites consist of quartz-feldspar and muscovite with large (5 cm) crystals and aggregates of tourmaline. Occasionally the larger bodies display a distinct zonation with a core of coarse books of muscovite and large poorly defined quartz crystals. As well as these well defined veins within the schists there are the previously mentioned "sweats" of similar material that are considered to have been derived from the country rock.

The Aplites generally tend to be bulkier dykes with the appearance of the fine grained variety of the West Coast Granite.

A wide variety, in both texture and size, of basic dykes occur in both the West Coast Meta-Sediments and in the granite. In the schists these can be both conformable or unconformable and generally form massive well jointed bodies.

A common type of dyke recorded throughout the schist sequence is a very dark fine grained dense rock with large (1 cm) porphyroblasts of plagioclase feldspar. The porphyroblasts are often aligned and some varieties are seen to contain garnets.

Inland and north of Currie there is a very large semi-continuous basic dyke that trends roughly north-south. This is a massive fine grained rock with a high magnetite content. The dyke has an associated strong magnetic anomaly .

The age of the dykes is unknown but some, i.e. the plagioclase rich ones, must have been intruded before the last period of metamorphism. However some of the larger ones could be considerably younger.

Structure of the West Coast Rocks

As a complete structural unit the west coast rocks plunge to the south east. This can also be said for the entire island. The evidence pointing towards this is as follows,

- (i) The broadening of the granite belt to the north.
- (ii) The general increase in metamorphic grade to the north. No typical high grade metamorphic minerals such as kyanite sillimanite have been recorded in the schists at the north end of the island but this is probably a factor of original lithology. That is, the rocks at the north end of the island were originally low in clay minerals and high in quartz. The presence of quartz-muscovite-feldspar-tourmaline sweats is an indicator of a higher grade of metamorphism.
- (iii) An increasing degree of pegmatite and aplite veining within the schists to the north.

The largest structure within the schists appears to be an anticline at the south end of the island. This is one of the few recorded structures on the island that plunges to the north and is probably the result of an earlier phase of deformation.

Smaller scale folds with amplitudes of 20-30 metres have been recorded throughout the schists and excellent examples of these occur near Surprise Point where the entire fold structure can be observed plunging to the south.

A remarkable feature of the west coast meta-sediments, considering their degree of metamorphism, is the uniformity of strike and dip direction. For nearly two miles along the coast south of Surprise Bay there is virtually no change in the strike. This feature is also observed in the Ettrick River. However within these rocks there is abundant evidence of early small scale gravatational folding and mico-brecciation.

In the sequences at the south end of the island intense intraformational isoclinal folding is noted. This consists of horizons approximately 1-2 metres thick within the normally bedded and undisturbed sequence that exhibit an array of isoclinal fold structures with extremely small dihedral angles. Disruption of the bedding, brecciation and micro thrust faulting have also been noted. These features are considered to be largely early gravatational structures.

In the northern exposures of the schists there is abundant evidence of intense deformation. In these exposures can be seen strong warping of the strata and evidence of plastic deformation such as well developed boundinage structures. On a smaller scale tight isoclinal folds with amplitudes of less than 50 cm and dihedral angles less than 20° are noted. It is considered this type of folding is the result intense deformation of semi-plastic material. All the structures within the West Coast Meta-Sediments represent many different phases of deformation over a great period of time.

The west coast rocks are much older than any other rocks on the island and form a basement and all other rocks of the island have an unconformable relationship to this basement.

LOWER PROTEROZOIC - EARLY CAMBRIAN (East Coast Meta-Sediment and Siltstone-Shale Unit)

These rocks constitute the bulk of the island probably covering two thirds of the total area. A great thickness (greater than 20,000 feet) of predominantly fine grained sediment were deposited in a major miogeosyncline.

Burial metamorphism of these rocks took place and nowadays, because of the south easterly plunge of the island these rocks are progressively more exposed in the north end of the island. The sequence has been divided into the two units on the map but the contact between the two types is gradational and ill defined and the boundary as shown on the map can only be taken as approximate.

The best evidence for this transitional metamorphic boundary is found in the Sea Elephant River where continuous outcrop allows for good comparison between these rocks and those found outcropping in the creeks to the east (Fraser River and Yates Creek). The rocks in the Sea Elephant River are similar to those of the other creeks except in that they have a clearly developed schistosity inclined to the bedding.

East Coast Meta-Sediments

These are predominantly muscovite-sericite schists, quartz-muscovite schists and minor quartzites. Staurilites are developed in these schists to the north and garnets are developed locally in the Reekara area. In the transitional zone the rocks are schistose siltstones and shales often developing a phaecoidal habit and being rich in sericite.

Because of their inherently soft nature outcrop of this rock type is very sparse the only good occurrences known to the author being at Reekara and in the Tin Mine. However they have been easily distinguishable when using the Gemco because of the characteristic silver grey extremely micaceous soil they develop.

The mineralogy of these rocks consist essentially of muscovite, sericite and quartz with the rocks to the east being more quartzitic (i.e. Tin Mine area and to the North east) and those of the Reekara area the more typical fine grained muscovite-sericite schists.

Garnets are found in a rather localised area around the Reekara Tin workings where quartz veins carrying varying amounts of cassiterite and scheelite invade the schists.

Staurilites are located near the Reekara School area and have also been recovered from Gemco drilling on the tracks in the north-east of the island. This possibly represents a staurilite zone within the schists with a trend similar to the trend of the East Coast Meta-Sediment and West Coast Granite contact (north east). It is possible that near this contact the thickness of schists overlying the West Coast Granite is not great and the aplite-granite-basic dyke occurrence south of Reekara School is regarded as a high in the west coast basement (See Section H-G).

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Because of the extreme lack of outcrop the structure of these rocks are hard to define but it is possible that some of the major structures delineated in the siltstone-shales to the south continue to the north and across section H-G it is postulated that a major anticline exists and also a synclinal structure with a related high in the Mt. Counsel Granite occurs in the area of the Old Reekara Tin workings. No structure is apparent in the north of this area but two outcrops near the contact on the coast line have very low dips.

East Coast Siltstone-Shale-Sandstone Unit

These rocks constitute the greater portion of the south east of the island and embrace a wide variety of siltstones, mudstones, shales, fine grained quartzitic sandstones and minor sandstone. These different rock types have generally been mapped as separate units in the field but it is certain that they all belong to the one broad lithological unit and are here grouped together.

In the north of the area (Yates Creek, Frasers River) the rocks consist of massive siltstones, interbedded grey siltstones with black siltstone-shale horizons, and finely bedded siltstones.

Pyrite is common in all types and sedimentary structures such as cross-stratification and micro brecciation were noted.

The good outcrops in the creeks in this area have allowed for the delineation of a major syncline and anticline and those in the east coast creeks for the delineation of a major anticline (Section ABCD). This axis of these major folds all dip to the west at approximately the same angles and the folds plunge to the south.

Along Crowes Road and in the central portion of the area between Crowes and Millwood Roads the dominant rock types are quartzitic siltstones and fine grained quartzitic sandstone with minor softer siltstone. Along Crowes Road the strike trend of those rocks is very uniform and they all dip to the east at relatively flat angles.

East of Millwood Road the rock type is again dominantly softer bedded siltstones with minor shales. The rocks here again strike north-south and dip to the east, at moderately high angles, although minor folds and flexures are common.

The Nature and Structure of the Siltstones in the Grassy-Bold Head Area.

In this area detailed mapping has been carried out and the majority of creek beds traversed. Three major types of siltstone have been recorded in the area.

(i) Massive Siltstone - No Bedding Features

This is generally blue-grey or yellow-brown in colour, fine grained with no bedding features evident. This rock type often has a well developed cleavage and is strongly sheared in places.

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(ii) Bedded Siltstones

This is by far the most common type of siltstone in the area and consists of interbeds, 30 - 50 cm. of blue-grey, grey, or yellow-brown siltstones with narrow 2.5 - 4 cm horizons of black shaly material. This material often displays a strong alignment of mineral constituents, is pyritic, and is strongly fissile in nature.

(iii) Finely Laminated Siltstone

This is the least common of the three varieties and consists of finely laminated grey, yellow-brown, black horizons and is commonly very pyritic and has a fissile nature.

The structure of the siltstones in the Grassy-Bold Head area is very complex and is complicated by the intrusion of the two granite masses. It is felt that there are three major fold structures in the area with at least two orders of smaller scale folds.

An anticline with a very flat angle of plunge occurs in the Bold Head area and the Bold Head Granite has been intruded more or less along the fold axis. There is very flat lying synclinal structure in the Grassy River where all the strata is generally very flat lying and strikes east-west. This extreme flattening of the strata has created tension in the sequence and it is this folding that has given rise to the Grassy River Fault. From extrapolation of the coastal volcanic sequence it is postulated that the throw on this fault is at least 8,000 feet and the displacement is predominantly vertical with little transcurrent movement. The third major fold structure within the siltstones is another plunging anticline which is also represented in the Mine Series with No. 1 and No. 2.

Another major synclinal structure must exist near the Loop Road - Red Hut Road junction but this is not revealed in the siltstones because of lack of outcrop.

Apart from what can be called these three first order structures the siltstones show a high degree of structural complexity with at least two other orders of folding being recognised.

In the two Creeks south of Skipworths Road folds with amplitudes of 100 to 200 metres have been mapped and these show a degree of continuity along strike.

Also a series of very small folds and flexures with amplitudes of 10 to 20 metres and with very large dihedral angles were noted. This order of fold was also observed in the Grassy River but here the strata is so flat lying that the structures appear chaotic.

In Yarra Creek further to the north the complexity of the folding dies out and the sequence tends to have a more uniform dip and strike.

It is very difficult to locate any correlative rocks to those in Tasmania unless they relate to the Younger Pre-Cambrian referred to in Solomons paper on the Geology and Mineralisation of Tasmania.

EARLY CAMBRIANTillite-Dolomite-Siltstones-Shales etc

During early Cambrian times the miogeosyncline became emergent with concomittant slight folding of the strata. As the water shallowed deposition of a complex sequence of pelitic and limey rocks took place including a coarsely fragmental rock which is considered to be tilloidal in origin.

These rocks can be divided into two groups - the tillite-dolomite-siltstones shales of the east coast and the Mine Series rocks. The Mine Series rocks are discussed seperately in conjunction with the granites.

The Tillite-Dolomite-Siltstone-Shale of the south-east strikes north-south and dips off to the east at angles between 40 and 50°. The sequence is highly variable with individual horizons thickning or thinning to extinction over short distances along strike. The sequence has been later intruded by a sill-like body of doleritic composition. A brief description of the main units of this sequence is given.

(i) The Dolerite

This generally occurs at the base of the sequence and consists essentially of large crystals of altered feldspar, pyroxene and chlorite. This type of material has also been recorded intruding the siltstones-shales near the old lead-zinc workings at Barrier Creek and associated with the volcanics at Frasers Bluff.

(ii) Tillite

This unit may be up to 80 metres in thickness and is typified by its coarse fragmental nature. Although many different arguments have been postulated for the orign of this rock glacial or tilloidal origin is the only explanation that fits all the observed features of the rock.

- (a) Lack of sorting of boulders
- (b) Immense variety of source material including quartzite, shale, limestone, siliceous dolomite, jasper and gabbro.
- (c) Interbedded varve like strata.
- (d) Variety of matrix material - this may be carbonate rich, ferruginous, or chlorite,

Interbedded with the tillite in places is massive tuffaceous material and in the Cottons Flat area the sequence is seen to be intruded by a feldspar porphyry dyke and also a carbonate dyke.

(iii) Dolomitic Siltstones - Siliceous Dolomite

This unit directly overlies the tillite in places and consists of a finely laminated buff coloured siliceous dolomitic material.

(iv) Laminated Siltstones - Dolomitic in Part

These rocks form a sequence of variable thickness with grey-black bedded siltstone, green-grey siltstone and red siltstones. The sequence contains interbedded tuffs and basalts and is intruded by basic dykes.

The entire sequence is unfossiliferous and the search for micro-fossils both in the dolomites and in the limestone fragments in the tillite proved unsuccessful. Correlations of these rocks have been made with rocks of the Dundas Group near Smithton and Zeehan where a bed of tilloidal character underlying basic lavas occurs. Although correlations over such distances must be considered rather tenuous it appears reasonable to infer that the Grassy tilloid is an equivalent (in time) formation to the Smithton Dolomite.

MIDDLE CAMBRIANBasic Volcanics

After the deposition of the Tillite-Dolomite-Siltstone-Shale sequence there was another period of slight folding of the strata and then the deposition of a thick sequence of basic volcanics. These rocks will be described only briefly in this report as they have been described in some detail; or at least particular portions of them, in papers by Scott and Solomon.

The sequence would appear to be at least 8000' in thickness and is seen to be locally unconformable with the Tillite-Dolomite-Siltstone-Shale sequence and has a definite unconformable relationship with the siltstone-shale unit which can clearly be seen in the creek bed that more or less flows along the contact between these rock types at the southern end of Cottons Flat.

Spilitic and picrite basalts in the form of massive, pahoehoe and pillow lavas comprise the greater portion of the suite to the north of Cottons Flat and this is the base of the sequence.

South of this and in the Bold Head-Bold Point area taffaceous and agglomeratic material are predominant with minor massive basalt and vesicular basalt. This sequence is generally well bedded and strikes at approximately 035° and dips to the east at anything between 25° and 60° .

Inland from these coastal exposures massive and vesicular basalts predominate again but soon become altered due to the effects of the Bold Head Granite. Samples of volcanics both from the Mill Site diamond drill holes and from J. Hall's property, both of which are approximately one and one half miles from the Bold Head Granite, show slight to considerable alteration with development of actinolite and tremolite.

These volcanic rocks have been correlated with similar basic volcanics at Zeehan and Smithton and are considered to be middle to upper Cambrian in age.

DEVONIAN - CARBONIFEROUS

Tabberabberan Orogeny

This major orogenic event which caused the deformation of many of the rocks of N.W. Tasmania is considered to have been a major factor in the fold structures developed in the eastern portion of the island.

Major folds like those located in the central portion of the island would have originated during this period. Practically every structure located in the rocks of the east coast has a north-north-east, south-south-west trend apart from those in the Grassy-Bold Head area where the situation has been complicated by the later intrusion of the granite masses and the fold axis have been rotated to more of a north-west, south-east trend. The situation is seen to become normal again to the north away from the Bold Head Granite with the structures becoming NNE-SSW aligned again.

Towards the end of the orogeny three granite stocks were intruded into the east coast rocks and these are briefly discussed.

The Mount Counsel Granite

This occurs in the central eastern portion of the island and covers an area of approximately nine square miles. Outcrop of the granite is very limited but a series of small low relief hills mark the western and southern contacts of the granite and some outcrops occur in these areas. The granite has been radiometrically dated as 340 million years.

The granite is a medium grained rock with quartz, feldspar and biotite as the main mineral constituents. From limited petrographic work the average composition is:

Quartz	30%
Microcline Perthite	30%
Orthoclase	15%
Biotite	10%
Tourmaline (Schorlite)	7%
Horneblende	3%

Accessories include magnetite, analcine, zircon, rutile, sphene, apatite, chlorite, clinozoisite, epidote, muscovite and sulphides. Overall the composition is fairly typical of a normal granite-granodiorite apart from the high tourmaline content.

During the course of investigations into this granite as a potential producer of tin mineralisation several silicate analyses were carried out on samples of the Mt. Counsel granite. The average of these is given in Table II and from chemical criteria the rock more closely resembles a granodiorite.

TABLE II
AVERAGE COMPOSITION OF SEVEN SAMPLES
OF MT. COUNSEL GRANITE

OXIDE	%
SiO ₂	70.4
Al ₂ O ₃	15.4
Fe ₂ O ₃	1.8
CaO	2.96
MgO	1.33
Na ₂ O	3.47
K ₂ O	3.40
P ₂ O ₅	0.18
TiO ₂	0.40
MnO	<0.02
Cr ₂ O ₃	<0.01
V ₂ O ₅	<0.05
L.O.I.	0.35

The samples were obtained from outcrops near Mt. Counsel and on the Sea Elephant River. Localities are marked on the respective 1:12,000 sheets.

The granite mass has associated with it a zone of strongly contact altered rocks. These are characterised by elongate aggregates of felsic and mafic minerals (biotite-andalusite-cordierite-sillimanite assemblages). The extent of the contact altered zone is unknown because of the lack of outcrop but it is considered to be of relatively limited extent. The original sediments are thought to have been siltstones and shales perhaps regionally metamorphosed in the north.

Although the very homogeneous nature of the granite and its chemistry (low potassium and high magnesium and iron) does not point toward the Mt. Counsel Granite as a producer of tin mineralisation it is postulated that a phase or associated phase of this granite must be the source of the tin mineralisation recorded at Reekara.

Grassy and Bold Head Granites:

These are two small granite stocks occurring in the south-east corner of the island. The Bold Head Granite has an area of approximately one square mile and the Grassy Granite approximately six square miles.

Both granites have a similar textural, chemical, and mineralogical composition but significantly differ in their magnetic character. The Grassy Granite has a very strong magnetic character with a high magnetite content and the Bold Head Granite has a very low magnetite content and very low magnetic relief. This fact precludes the possibility that the two granites were originally part of the same mass and have been dislocated along the Grassy River Fault. However the fact that the Grassy and Bold Head Granites are genetically related is undoubted.

In hand specimen both granites are massive, coarsely crystalline and generally porphyritic in character with an interlocking mosaic of quartz and plagioclase feldspar (up to 5 mm) with randomly disturbed flakes of biotite and other ferromagnesium mineral. Large phenocrysts of pink potash feldspar occur throughout (up to 5 cm).

Optical estimates of mineral constituents of three samples of Grassy Granite are given in Table III and the Bold Head Granite would be of very similar petrographic nature.

Silicate analyses of samples of Bold Head and Grassy Granites have also been obtained and the average composition of these is given in Table IV.

The Grassy Granite has been radiometrically dated at 345 m.y. and both this granite and the Bold Head Granite have associated with them a sequence of contact metamorphosed and metasomatised pelitic and carbonate rocks that are locally known as the Mine Series.

TABLE III

MINERAL	SAMPLE K.I. 1	SAMPLE K.I. 2	SAMPLE K.I. 3
Quartz	40	40	40
Plagioclase	20	15	18
Orthoclase Perthite		3	
Microcline Perthite	12	7	12
Biotite	12	12	10
Hornblende	2	5	7
Chlorite	6	12	5
Epidote	2	Acc	Acc
Sphene	3	1	2
Clay Minerals	3	5	5
Orthite	Acc	Acc	1

Accessory minerals also include Apatite, zircon, zoisite, iron oxides, tremolite and opaques.

TABLE IV

	GRASSY GRANITE AVERAGE OF THREE SAMPLES	BOLD HEAD GRANITE AVERAGE OF TWO SAMPLES
SiO ₂	70.1	69.8
Al ₂ O ₃	14.93	14.50
Fe ₂ O ₃	1.90	2.0
CaO	2.80	2.53
MgO	1.42	1.69
Na ₂ O	3.25	3.25
K ₂ O	4.15	4.25
MnO	<0.02	<0.02
P ₂ O ₅	0.23	0.24
TiO ₂	0.47	0.47
Cr ₂ O ₃	<0.1	<0.1
V ₂ O ₅	<0.05	<0.05
L.O.I	0.47	1.24

The Grassy Granite samples were from outcrops located at Grassy and Red Hut and the Bold Head samples were from diamond drill holes at No. 3 Orebody.

024
The Mine Series

Associated with the Grassy and Bold Head Granites is a sequence of contact metamorphosed and metasomatised pelitic and calcareous sediments. These sediments are considered to be early Cambrian in age similar to the Tillite-Dolomite-Siltstone-Shale sequence on the south east coast but are here briefly discussed in conjunction with the Grassy and Bold Head Granites.

The sequence has been defined in detail by extensive diamond drilling at No. 1, 2 and 3 Orebodies and from mapping and limited diamond drilling, the same rocks are known to exist further to the east along the southern contact of the Bold Head Granite and to extend for approximately five miles around the contact of the Grassy Granite.

In all cases the Mine Series are overlain, obviously unconformably in places, by a massive, strongly jointed and fractured rock. This rock often has a fragmental nature, is spotted and consists essentially of tremolite, actinolite and chlorite with relict olivines. There is a tremendous variety in both texture and grain size of these rocks but they are considered to be the metamorphosed and metasomatised equivalents of the basaltic suite on the south east coast.

The sequence at No. 3 Orebody is thickest of the three orebodies attaining a thickness of over 700 feet in places. The stratigraphy can be summarised briefly as follows:

Biotite Muscovite Hornfels:

A well bedded sequence of mica rich hornfels wholly surrounding in part a complexly altered limestone lens containing mineralised skarn. (A lens) (60 metres).

B Meta Volcanics

A massive crystalline biotite pyroxene rock containing abundant phenocrysts of oligoclase with a strong remnant doleritic texture (27 metres).

Dolomitic Limestone

An impure limestone, variably altered with a zone of scheelite mineralisation on the upper margin and in part throughout (B lens) 20 metres.

Biotite Pyroxene Hornfels

A bedded unit of biotite and pyroxene hornfels (22 metres).

C Lens Complex

A complex unit of andradite skarn, pyroxene skarn, fragmental pyroxene-garnet hornfels. This zone carries appreciable scheelite on both the upper and lower contacts but also contains unaltered limestone (43 metres).

025

Banded Hornfels

An interbedded unit of biotite, pyroxene, and garnet hornfels with impure partially altered limestone horizons. Carries varying amounts of scheelite mineralisation. D lens (50 metres).

Bold Head Granite

Typical porphyritic coarsely crystalline granite.

(Le Messurier, 1970)

The sequence dips to the south east at approximately 15° and it is obvious that the strata has suffered only a minor degree of folding and mobility with the possible exception of C lens which has the associated fragmental pyroxene-garnet hornfels. This lack of folding and sedimentary mobility may be the major reason for the limited amount of mineralisation within apparent large thicknesses of potential host rock. Further Mine Series rocks occur to the east of No. 3 Orebody but these overly the quartzites and do not contain economic mineralisation.

The No. 2 Orebody sequence is not as thick as that of No. 3 Orebody but the mineralisation is richer and more extensive. The stratigraphy is also distinctly different and can be briefly summarised as follows:

Biotite Hornfels

A thick sequence (25 - 30 metres) of well jointed mica rich rock. It is occasionally overlain by a thin altered limestone horizon (A lens).

B lens

A variable zone containing numerous rock types including skarns, hornfels and marbles.

Hangingwall Biotite Hornfels

A very thinly bedded sequence of biotite hornfels containing varying amounts of actinolite.

Pyroxene Garnet Hornfels

A pyroxene-biotite hornfels with scattered ovoids of calcite and varying degrees of alteration and mineralisation.

C lens

A zone of andradite skarn averaging approximately 15 metres thick.

Banded Footwall Beds

A thinly bedded (1-2 cm) sequence of grossular garnet, pyroxene, biotite and calcite hornfels. Mineralised in part.

Biotite-Pyroxene Hornfels

A variable sequence of bedded biotite and pyroxene hornfels.

Older Volcanics

A sequence of meta-volcanics exhibiting remnant doleritic texture.

Biotite-Pyroxene Hornfels

A variable sequence of bedded biotite and pyroxene hornfels.

Granite

White, pink medium grained, porphyritic in part.

(Danielson, 1972)

No. 2 Orebody occupies the nose of a plunging anticlinal fold and is continuous with No. 1 Orebody currently being mined by open cut operations. The continuity between the two orebodies was recently proved by diamond drilling although there has been a distinct thinning in the ore horizon between the two orebodies where there is a synclinal flexure in the sequence.

The stratigraphic sequence of No. 1 Orebody is broadly similar to that of No. 2 with some minor exceptions. Apart from the eastern end, C lens mineralisation is generally weaker and is often divided into a top and bottom orebody by a sequence of marble and hornfelsic marker beds. Also in No. 1 Orebody the lower biotite-pyroxene hornfels sequence is often missing and the older volcanics are seen to directly overlie the quartzites. These quartzites are considered to be contact metamorphosed equivalent of the siltstone-shale sequence.

The Mine Series sequence is therefore seen to occupy the same stratigraphic position as the Tillite-Dolomite-Siltstone-Shale sequence that is locally unconformably overlain by the volcanics and locally unconformably overlies the siltstone-shale sequence (Contact altered quartzites in the case of the Mine Series).

However the previously reported direct correlation between the two sequences (Baker, Edwards and Callow, Large) particularly that of the pyroxene garnet hornfels and the tillite is considered untenable and is certainly not true. The fragmental pyroxene-garnet hornfels is considered to be the result of gravitational remobilisation of a transitional zone of interbedded pelitic and calcareous sediments similar to the banded footwall beds.

The Mine Series sediments would have developed in a different sedimentary environment and these rocks contain a much greater percentage of carbonate than those on the coast.

BASIC BODIES (PEGARAH AREA)

Very large bodies of basic rocks occur in the Pegarah and Forestry areas and are associated with extensive development of lateritic ironstone. The basic rock type is a massive coarsely crystalline rock consisting almost entirely of an interlocking mosaic of large hornblende crystals (up to 1 cm). The texture of the rock displays little variation in grain size or mineralogy throughout.

The rock has an apparent lopolithic character and float occurrences are observed to extend approximately five miles in a north-south direction. It is also possible that there are two or more lopolithic bodies in the area interbedded with the siltstones. Outcrops of small dykes of similar rock type have been mapped in the Sea Elephant River and in Yates Creek and they display both concordant and discordant relationships to the country rock. Also at these outcrops distinct fine grained margins were noted in the basic dykes and a strong degree of silicification of the siltstones at the contact was recorded.

MIOCENE

Restricted occurrences of Tertiary Limestone, fossil dated as Miocene in age, are found on the island. The best known outcrop is at the Blowhole on the east coast approximately four miles north of Naracoopa where bryozoal limestone, consisting almost entirely of shells and shell fragments is found. The sequence is horizontal and occurs as a shore platform. Other isolated occurrences have been recorded on the island but this rock type is not very extensive.

QUATERNARY DEPOSITS

These have been discussed in some detail in the section on Physiography and will only be outlined briefly here.

Pleistocene

The Old Dunes that occur throughout the island and the Old Strand lines were probably developed during the last interglacial period (Jennings) when sea levels were anything up to 60 feet higher than the present day.

During the Pleistocene, deposition of Lacustrine and Esturine sediments took place in the northern portion of the island (Egg Lagoon, South East Lagoon and Reedy Lake).

During this period pronounced changes in the courses of Rivers in the central portion of the island would have taken place and extensive alluvial deposits developed.

Holocene

The last 15,000 years has seen the development of the New Dunes and New Shorelines. The lack of soil profile development, their freshness and the fact that they are still actively building precludes their having survived a glacial low sea level.

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Geological Boundary

Fault

Dip and Strike of Strata

Anticlinal Axis with direction of Plunge

Synclinal Axis with direction of Plunge

Transitional Metamorphic Boundary

Unconformity

Geological Boundary

Fault

Dip and Strike of Strata

Anticlinal Axis with direction of Plunge

Synclinal Axis with direction of Plunge

Transitional Metamorphic Boundary

Unconformity

72-867

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KING ISLAND GROUP

SCALE: 1:63360

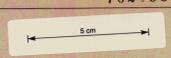
REGIONAL GEOLOGICAL INTERPRETATION MAP

KING ISLAND

762033



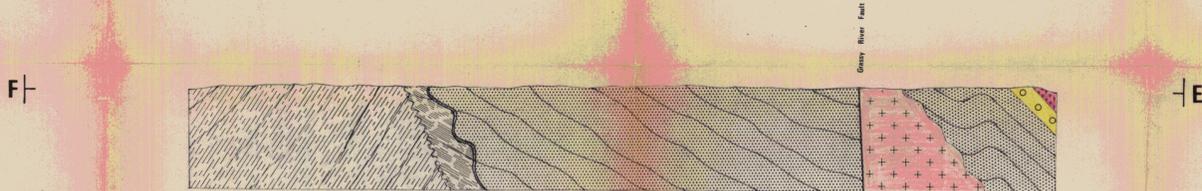
DATE: FEB 72
GEOLOGIST: J.J.G.
DRAWN: P.M.G.
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ISG REFER REPORT 70-4676

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Sections
V:H = 1:1



	Pre-Cambrian Quartzites, Muscovite schists etc.		Contact metamorphosed and metamorphosed sedimentary rocks		Pre-Cambrian 'West Coast' Granites - undifferentiated		Devonian Granites		Basic Dykes undifferentiated		Tertiary Olivine Basalt		Transitional Metamorphic Boundary		Unconformity
	Fine grained Muscovite - sericite schists		Siltsone Shale with minor Sandstone		Shale, Slate, Tiltite, Dolomite, Gabbro etc.		5 cm								

72-867

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REGIONAL INTERPRETATION CROSS SECTIONS

KING ISLAND 1138

6/35

DATE: FEB '72
GEOLOGIST: JJG
DRAWN: PMG
CHECKED: