COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Records 1967/129

REGIONAL GEOCHEMICAL SURVEY
AYR 1:250,000 SHEET
QUEENSLAND

by

N.J. Marshall

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TABLE OF CONTENTS

	Page
SUMMARY	1
INTRODUCTION	1
Scope and Organisation of Survey	1
Geography	2
Geology (Regional)	3
PLANNING OF SURVEY	3
Layout of Sample Sites	3
Areas Sampled	4
GEOLOGY OF AREAS SAMPLED	4
Mount Roundback - Sprole Castle	4
Cape Upstart Peninsula	4
Central Granitic Area	5
Kelly's Mountain	6
Mount Dalrymple	7
Mount Elliot - Saddle Mountain - Cape Cleveland Area	8
SAMPLING LAYOUT AND TECHNIQUES	8
SAMPLES REGISTRATION	10
NUMBER OF SAMPLES COLLECTED	10
GEOCHEMICAL ENVIRONMENT AND GENERAL CONSIDERATIONS	11
SELECTION OF ELEMENTS FOR SURVEY	11
ANALYTICAL PROCEDURES	12
Orientation Analyses by B.M.R.	12
Sample Analysis by A.M.D.L.	13
Discussion	14
Analytical costs	15
DATA ANALYSIS AND PRESENTATION	15
Relation of Element Patterns to Lithological Units	15
Statistical Analysis	16
Data Presentation	19
INTERPRETATION OF GEOCHEMICAL MAPS	20
Results for copper	20
1) copper distribution in rocks (fig. 5)	20
2) " " " soils (fig. 6)	20
3) " " " stream sediments (fig. 7)	21
4) summary and conclusions	21
Results for Zinc	21
1) Zinc distribution in rocks (fig. 9)	21
2) " " " soils (fig.10)	22
3) " " " stream sediments and heavy mineral concentrates (fig. 11 + 12)	22
4) summary and conclusions.	23

TABLE OF CONTENTS (Cont'd)

	Page
INTERPRETATION OF GEOCHEMICAL MAPS (CONT'D)	
Results for Lead	24
1) Lead distribution in rocks (fig. 13)	24
2) " " " soils (fig. 14)	24
3) " " " stream sediments (fig. 15)	24
4) summary and conclusions	24
Results for Cobalt	25
1) Cobalt distribution in rocks (fig. 17)	25
2) " " " soils (fig. 18)	25
3) " " " stream sediments (fig. 19)	25
4) summary and conclusions	26
Results for Nickel	27
1) Nickel distribution in rocks (fig. 21)	27
2) " " " soils (fig. 22)	28
3) " " " stream sediments (fig. 23)	29
4) summary and conclusions	29
Results for Molybdenum	30
1) Molybdenum distribution in rocks (fig. 25)	30
2) " " " soils (fig. 26)	31
3) " " " stream sediments (fig. 27)	31
4) summary and conclusions	32
Results for Ba, Nb, Sn,Sr in rocks (Appendix 5)	32
Results for Ba, Nb, Sn, Sr in soils (Appendix 6)	34
Results for Heavy Mineral Concentrates (Appendix 7)	34
SUMMARY OF GEOCHEMICAL DATA	35
Average Concentration of trace elements	35
Copper distributions	35
Zinc distributions	35
Lead distributions	36
Cobalt distributions	36
Nickel distributions	36
Molybdenum distributions	36
Tin and niobium distribution	37
RECOMMENDATIONS FOR FUTURE WORK	37
ACKNOWLEDGEMENTS	38
REFERENCES	39

LIST OF APPENDICES

iii

APPENDIX 1:- Laboratory report No. 5. Spectrochemical analysis of geochemical samples from Ayr, Queensland, by A.D. Haldane. Lists results of spectrographic orientation studies.

APPENDIX 2:- Results of Cu, Pb, Zn, Co, Ni and Mo analyses on rock samples from Ayr 1:250,000 sheet area.

APPENDIX 3:- Results of Cu, Pb, Zn, Co, Ni and Mo analyses on soil samples from Ayr 1:250,000, sheet area.

APPENDIX 4:- Results of Cu, Pb, Zn, Co, Ni and Mo analyses on stream sediment samples from Ayr 1:250,000 sheet area.

APPENDIX 5:- Results of Sn, Nb, Ba and Sr analyses on rock samples, Ayr 1:250,000 sheet area.

APPENDIX 6:- Results of Sn, Nb, Ba and Sr analyses on soil samples, Syr 1:250,000 sheet area.

APPENDIX 7:- Results of Cu, Pb, Zn, Co, Ni, Sn, Au, Cr, V, W, Mo, Be and Pd analyses on heavy mineral concentrates from the Ayr 1:250,000 sheet area.

LIST OF FIGURES

FIGURE 1 Regional geological map, Ayr 1:250,000 sheet area
Compiled by Paine et al., 1966.

FIGURE 2 Location of rock samples on Ayr sheet

FIGURE 3 " " soil " " " "

FIGURE 4 " " stream sediment and heavy mineral samples on Ayr sheet.

FIGURE 5 Copper distribution in rock samples, Ayr 1:250,000 sheet area

FIGURE 6 " " " soil " " " " "

FIGURE 7 " " " stream sediment samples, Ayr 1:250,000 sheet area.

FIGURE 8 " " " heavy mineral samples, " " " "

FIGURE 9 Zinc distribution in rock samples, Ayr, 1:250,000 sheet area

FIGURE 10 " " " soil " " " " "

FIGURE 11 " " " stream sediment samples, Ayr, 1:250,000 sheet area.

FIGURE 12 " " " heavy mineral " " " " "

FIGURE 13 Lead distribution in rock samples, Ayr 1:250,000 sheet area

FIGURE 14 " " " soil " " " " "

FIGURE 15 " " " stream sediment" " " "

FIGURE 16 " " " heavy mineral " " " "

FIGURE 17 Cobalt distribution in rock samples, Ayr 1:250,000 sheet area

FIGURE 18 " " " soil " " " " "

FIGURE 19 " " " stream sediment" " " "

FIGURE 20 " " " heavy mineral " " " "

FIGURE 21 Nickel distribution in rock samples, Ayr 1:250,000 sheet area

FIGURE 22 " " " soil " " " " "

FIGURE 23 " " " stream sediment" " " "

FIGURE 24 " " " heavy mineral " " " "

FIGURE 25 Molybdenum distribution in rock samples, Ayr 1:250,000 sheet area

FIGURE 26 " " " soil " " " " "

FIGURE 27 " " " stream sediment" " " "

FIGURE 28 " " " heavy mineral " " " "

REGIONAL GEOCHEMICAL SURVEY AYR 1:250,000 SHEET, QUEENSLAND.

SUMMARY

A regional multi-element geochemical survey was carried out during the 1965 field season on rocks, soils, stream sediments, and heavy mineral concentrates from the Ayr 1:250,000 Sheet area, with a view to establishing background concentrations and trace element dispersion patterns and relating these to the regional geology of the area.

Geochemical maps showing the distribution of copper, lead, zinc, cobalt, nickel, and molybdenum in rocks, soils, stream sediments, and heavy mineral concentrates are presented and interpreted.

The survey was successful in establishing trace element assemblages for the various geological units in the Ayr Sheet area. A metallogenic province for molybdenum was identified, and an area of potentially economic molybdenum mineralization delineated at Kelly's Mountain.

Recommendations for future work of this nature are given at the end of this report.

INTRODUCTION

Scope and Organisation of Survey

During the 1965 field season, the Bureau of Mineral Resources carried out a regional geochemical survey of the Ayr 1:250,000 Sheet area. This project was supervised by the author, but considerable advice and assistance was provided by A.G.L. Paine, who had carried out a regional geological survey of this area during the previous field season.

This was the first regional multi-element survey of a virtually non-mineralized area to be carried out in Australia. The purpose of the survey was to provide a regional geochemical map to accompany the geological map, (Paine et al, 1966; Gregory, in prep.; Paine et al., in prep.) and to delineate any broad metallogenic provinces and metal-structural element or metal-rock type relationships which might provide targets for detailed geochemical exploration. In addition, the survey was expected to provide geochemical background values which, with caution, could be extrapolated onto adjoining sheets such as Bowen, where mineralization is known to occur in a similar geological setting.

The geochemical samplers, consisting of M.J. Kelly and A.P. Boland were attached to a geological mapping party under A.G.L. Paine and were expected to work with a minimum of supervision. The survey was completed in 13 weeks.

Geography

(Adapted and condensed from Paine et al., 1966).

The Ayr 1:250,000 Sheet area is situated between latitudes 19 and 20 degrees south and longitudes 147 degrees and 148 degrees 30 minutes east. The area is served by two towns, Ayr and Home Hill, on the northern and southern sides of the Burdekin River respectively, and the smaller centres of Giru, Brandon, Clare, and Millaroo. The North Coast Railway from Brisbane to Cairns closely follows the Bruce Highway (bitumen-sealed throughout) which connects Ayr and Home Hill with other centres along the coast. A good sealed road joins Ayr with Dalbeg (on Bowen 1:250,000 Sheet area), running along the western levee of the Burdekin River. Many miles of sealed and gravel roads service the sugar-cane growing districts (generally not sampled in this survey) around Ayr, Home Hill, and Giru. Gravelled roads and numerous unformed vehicle tracks (usually suitable for four-wheel-drive vehicles only) afford good access to most of the area sampled. The seaward part of the Cleveland and Upstart peninsulas are inaccessible by vehicle, but in good weather (i.e. throughout most of the dry season from May to November) landings can be made from a launch along most of their coasts, and also on Gloucester and Middle Islands.

The climate in the area is mild and usually dry in winter, and hot and wet in summer. The average annual rainfall at Ayr is about forty inches, three-quarters of which usually occurs between November and April. The annual rainfall decreases away from the coast. Summer rain sometimes closes all roads for short periods. Almost without exception, all stream sediments were collected dry.

The main industry around Ayr, Home Hill, and Giru is the growing of sugar cane and the production of sugar. In the areas sampled during this survey, beef cattle raising is the main industry.

The topography of the Ayr Sheet area varies from rugged mountains between 1,000 and 3,000 feet high, to featureless plains near sea-level. The mountains occur in discrete ranges of limited extent. Except for Mount Dalrymple, they are all formed of granite. Some rise abruptly from the coastal plain or from the sea: such are Mount Elliott just to the west of the Ayr Sheet area (summit 4000 feet above sea-level), Saddle Mountain (2800 feet), Cape Cleveland peninsula range (1800 feet), Cape Upstart peninsula range (2400 feet), Mount Roundback (2400 feet), and Gloucester Island (1700 feet). Mount Dalrymple (upper Carboniferous Volcanics, 1900 feet), Mount Benjonney (1200 feet), and the Gregory Ranges (1500 feet) dominate the south-western part of the Sheet area.

Most of the Sheet area consists of an extensive coastal plain formed from alluvial and deltaic deposits, deposited chiefly by the Burdekin River. The plain rises imperceptibly from sea-level to over 100 feet inland near Millaroo. In places, inselbergs, irregular hills, and small ranges emerge from the coastal plain; these may be of any height up to 1000 feet, but most range between 200 and 700 feet in height.

The catchment area of Kirknie and Plumtree Creeks is topographically distinctive. It consists of an undulating plateau sloping gently to the south. In the north it is fringed by ranges of low but steep linear hills, formed by dykes.

Geology (Regional)

(Adapted and condensed from Paine et al., 1966).

The geology of the Ayr 1:250,000 Sheet area was mapped at that scale in 1964 by a combined party of the Bureau of Mineral Resources (A.G.L. Paine and C.M. Gregory) and the Geological Survey of Queensland (D.E. Clarke). However, extensive revisions to the rock-unit categories were made necessary by later field work in the Bowen 1:250,000 Sheet area and by isotopic age-determinations.

Most of the bed rock in the area is igneous, and, apart from Cainozoic superficial deposits, sediments are confined to a few isolated hornfelsed roof-pendants.

The oldest rocks are roof-pendants of possibly early Palaeozoic low-grade metasediments (Pzu). These have been intruded and metamorphosed by locally foliated granodiorite which is correlated with the Silurian-Lower Devonian Ravenswood Granodiorite (S-Dr) of the Townsville and Charters Towers 1:250,000 Sheet area. Upper Carboniferous acid volcanics (Cuv) form Mount Dalrymple and a few smaller peaks in the south-western part of the area; and Upper Carboniferous to Permian intermediate volcanics (C-Pv) crop out around Mount Eliott and Saddle Mountain and at Cape Cleveland. These volcanics are intruded by epizonal granites (P-Mg), which are probably Upper Permian or possibly Mesozoic. Other granitic rocks in the eastern and south-central portions of the sheet area were originally mapped as separate units (Pzg, Pzug and C-Mg), but are now grouped into a single Upper Carboniferous to Lower Permian unit (C-Pg). Dyke swarms are abundant in most of these rock units.

The remainder of the Sheet area consists mostly of alluvial, deltaic, and littoral deposits of the coastal plain, of which the most important feature is the Burdekin River Delta.

PLANNING OF SURVEY

Layout of sample sites

Before going into the field, the proposed sample sites were plotted directly onto aerial photographs. Sample density and type were varied according to the geology, topography, access, and drainage of the particular area.

Much of the Sheet area includes the Pacific Ocean, and much of the remaining land surface is covered by alluvial and deltaic deposits, particularly around the Burdekin River Delta and in the complex of tidal streams in low-lying country between Cape Cleveland and Cape Bowling Green. For this reason, only 800 square miles of the Ayr sheet were sampled, of which about 600 square miles contain frequent outcrops, and 200 square miles contain mostly sub-outcrop and residual soil.

Areas Sampled

For ease of presentation, the areas sampled have been subdivided into six somewhat arbitrary units, as follows:-

1) Mount Roundback - Sprole Castle roof pendant area.
2) Cape Upstart peninsula - an epizonal granite stock.
3) Central Granitic area.
4) Kellys Mountain.
5) Mount Dalrymple.
6) The Mount Elliot - Saddle Mountain - Cape Cleveland area.

Known mineralization is sparse and nowhere economic in the Ayr Sheet area, but details of all known mineralization were assembled, and likely areas for potential mineralization selected on geological grounds.

GEOLOGY OF AREAS SAMPLED

Mount Roundback - Sprole Castle

This is a roof pendant area comprising diorites, gabbros, and dolerites (C-Pd) which have been intruded by granitic rocks (C-Pg, P-Mg). The area includes Abbot Point, Sprole Castle, and Mount Roundback.

A small, high-grade deposit of magnesite with minor asbestos and chromite occurs in an altered shear-zone in basic plutonic rocks on Mount Pring, a few miles to the south (on the Bowen 1:250,000 Sheet area). The older basic rocks which cap the intrusive acid rocks could act as a structural trap for hydrothermal/pneumatolytic exhalations. Molybdenite has been recorded from the area, but its precise location is not known.

Samples of soil, rock, and stream sediment were collected from this area. Stream sediment samples were collected at a closer spacing than on the adjoining low-lying area of diorite south of Guthalungra, in order to distinguish between streams draining solely basic rock suites and streams draining acid rock suites. For the same reason, soil and rock sampling was done on a rather more detailed basis than elsewhere, to obtain adequate coverage of both rock suites.

Cape Upstart Peninsula

Most of the peninsula consists of a rugged, pink leucogranite stock of Permian to Mesozoic age (P-Mg). Narrow slivers of probably contemporaneous dioritic rocks crop out around the margins in places. The coast-line consists of rugged cliffs on the northern and eastern sides, and sandy coves and tidal beaches on the western (leeward) side. The southern margin of this epizonal stock intrudes granite (C-Pg) and minor diorite and gabbro (C-Pd), which form a smaller, easterly trending range at the landward end of the peninsula. Roof pendants of hornfelsed sediments (including graphite-chiastolite hornfels) and some volcanics (Pzu) occur in places on and around this range.

The main peninsula range (P-Mg) is crossed by several faults, which form major erosion valleys, but the interior is rather inaccessible.

Sampling of the margins of the stock was done by launch, which could readily land on the western beaches. Access to the rugged eastern side required considerable seamanship to enable the sampling crew to leap off the boat onto the rocks. The co-operation of Mr. Ivan Ross, the launch owner, is gratefully acknowledged in this matter.

Stream sediment and heavy mineral samples were collected from streams above the influence of high tide.

It was hoped to sample the interior of Cape Upstart by helicopter, but the rugged terrain and scrub cover made this impossible; instead, the helicopter was used to visit a number of additional sample sites on the western side after completion of the launch programme.

The sample distribution is therefore circumferential rather than areal, as the only samples taken in the interior of the stock were obtained during a traverse on foot along a major fault valley cutting across the peninsula.

A loose block of heavily kaolinized granite containing pyrite and molybdenite was noted on a cliff on the northern side of Cape Upstart. This gave a high molybdenum value, but no samples of this type were found in situ.

Particular attention was paid to detailed sampling along the southern margin of the stock because of the juxtaposition of various rock types.

Central Granitic Area

The central granitic area consists of a tract of diorite and granodiorite (C-Pd), flanked in the south by a belt of granitic rocks (C-Pg), which are probably intrusive into the diorite and granodiorite.

The country is generally flat to gently rolling, except for Mount Louisa, a group of rugged hills eroded from a late Palaeozoic acid volcanic plug (C-Ph), in the western part of the area.

The most interesting feature in this area is the east-north-east trending Inkerman Shear Zone, with its associated dyke system. The shear zone has been traced on the surface for a length of 5 miles, but it is concealed at each end by superficial deposits, and its true length is probably very much greater. It is at least two miles wide and contains gneissic diorite and granite and masses of metasomatic rocks, some of which are clearly altered dykes. The metasomatic rocks include garnet, epidote, magnesite, and tremolite rocks (monomineralic in places), garnet-wollastomite-diopside gneiss, and other rock types. North-north-westerly and east-north-easterly dykes have been intruded into the Inkerman Shear Zone after the main movement on the shear. The dykes, which consist chiefly of pyritic, epidotized hornblende microdiorite, form prominent parallel ridges. The country rock between the dykes has also been strongly epidotized and is generally weathered deeply so that it now forms areas of fairly flat, soil covered terrain between the dyke ridges, and outcrop is very scarce.

Apart from sporadic gouging for vermiculite and garnet, no minerals have been worked in the Inkerman Shear Zone. However the zone has obviously been the locus of much metasomatic and/or hydrothermal activity and semi-quantitative spectrographic analysis of some samples collected by Paine et al in 1964 revealed 1,000 ppm Ni in an epidote rock and 200 ppm Cu in a magnetite rock.

The Inkerman Shear Zone and associated dyke swarms were therefore more intensively sampled than the remaining granitic area to the south, and samples were collected, as far as possible, from all the rock types occurring in the shear zone..

All major dykes were sampled, but sampling of the epidotized country rock between the dykes, as pointed out above, was difficult due to dearth of outcrop, and in most cases floaters and soil had to be sampled in lieu of outcrop.

Samples of rock and soil were taken along the strike of several major dykes to test whether constant values are maintained along the strike of any one dyke.

Kelly's Mountain

This is a group of inselbergs of granite (C-Pg).

An extensive greisen occurs on the north-eastern slopes, and a number of pits and costeans have been dug on portion of this greisen. No economic minerals were seen in this area, even after a close examination of many outcrops, but a sample of the greisen taken by the Bureau mapping party in 1964 gave 300 ppm molybdenum by spectrographic analysis, and minor showings of silver, lead, bismuth and gold were reported on by Morton (1930).

On the southern flank of Kelly's Mountain, a one inch thick vein of galena and some small veins of chalcopyrite are exposed in a road-metal quarry in epidotized granite.

The greisen consists of a fine to medium grained quartz-feldspar-sericite rock with abundant boxworks after pyrite. In places the greisen is bleached and hydrothermally altered to quartz-kaolinite-sericite, while elsewhere it is heavily iron-stained. The iron-stained greisen has a typical gossanous appearance with coarse pyritic boxworks and development of specularite. The outcrop is very rubbly and consists of weathered large boulders of both bleached and (more frequently) iron-stained phases strewn over the hillside.

11

The northern and western flanks of Kelly's Mountain slope gently into the surrounding alluvial plain and are largely buried by sandy piedmont fan deposits.

In view of the fact that only a comparatively small portion of the greisenized zone had been pitted and costeaned many years ago, and that this greisen represents an intensely altered and possibly high-level phase of an acid stock, the possibility of high temperature acid granite mineralization such as copper, tin and molybdenum appeared to warrant further testing.

Streams only drain the non-greisenized margins of Kelly's Mountain where these slope gently down to the surrounding alluvial flood plain.

It has been demonstrated on the Southern Tablelands of N.S.W. (Ivanac and Marshall, 1965) that gossans can retain heavy metals coprecipitated in limonitic minerals and not release them to streams where a fairly mature eroxion cycle (precluding mechanical dispersion) exists.

Since this greisen is rich in iron oxides and somewhat gossanous in its weathered state, it was decided to extensively sample the actual gossan rather than to rely on soil and stream sediment sampling.

In order to establish background values, the surrounding unaltered granite was also extensively sampled in the quarry and elsewhere at various distances from the greisenized zone.

Mount Dalrymple

Mount Dalrymple is a down-faulted block of Upper Carboniferous acid volcanics (Cuv), west of the Burdekin River near the southern margin of the Ayr sheet.

The area is one of volcanics in complexly faulted juxtaposition with granite and from a structural-lithological aspect could contain potential mineralization.

Just west of the Burdekin River, where granite (C-Pg) is faulted against the volcanics, pyritic "quartzites" occur. These appear to be mostly sheared and silicified acid volcanics.

Some small pits have been dug in these pyritic rocks, presumably for gold, but no mineral production is recorded in the literature.

The known occurrence of pyrite near the fault proves that ample sulphur is available to act as a scavenger for chalcophile elements; if the volcanics were a source rock for sulphide minerals one would therefore expect these to be localized by the complex faulting as vein or fissure type deposits.

For the above reasons, this area was sampled in some detail using rocks, soils and stream sediments, and increasing the sample density around the fault zones.

As before, samples for comparison purposes were collected away from the fault zones.

Mount Elliot - Saddle Mountain - Cape Cleveland Area.

This area lies in the north-western part of the Ayr sheet and consists of Permian to Mesozoic (P-Mg) epizonal granite. This occurs as three separate stocks which form rugged mountains flanked in places by foot-hills of Upper Carboniferous to Permian (C-Pv) volcanics. These volcanics are mostly andesitic.

Because of the rugged terrain and juvenile drainage, outcrops in this area are fresher than elsewhere on the Ayr sheet.

The volcanics/granite contact was considered the feature of greatest interest in this area, and samples of soils, rocks and stream sediments were collected along traverses from east to west across and at varying intervals from this contact.

SAMPLING LAYOUT AND TECHNIQUES

Prior to commencing the field season, the approximate location of samples was plotted directly onto aerial photographs, using various symbols to denote sample type. Sample density and type were varied according to the geology of particular areas, as discussed above.

Samples of soil and rock were collected throughout the area, to give as representative a coverage as possible of all lithologies and geological units.

At the scale of air-photographs and compilation (1:85,000) grid references could only be read to the nearest 50 yards, and samples within 50 yards of each other were regarded as being "from the same site". This situation frequently arose where soil samples were only available a few yards away from outcrop.

Rock samples were made up of a number of chips several inches across, taken over a radius of about 25 yards. Where possible weathered material was avoided, unless the country rock in the area was uniformly weathered, in which case it was collected "as is" and noted as being weathered. With medium-grained granites, about a dozen chips were collected, totalling about 5 lbs. in weight; larger quantities of material were collected from coarser-grained rocks or rocks of heterogeneous appearance. A small hand-specimen was also collected at each rock sample locality to build up a reference rock collection.

Soil samples were collected from both A and B horizons in many instances. A post-hole auger was used to collect these samples, the 'A' horizon being sampled over an interval of 4" from about 2" below the surface, and the 'B' horizon being sampled over an interval of 4" from a depth of about 2" below the 'A' horizon boundary. This boundary was identified by the colour change in the soil profile, and the change in soil consistency from sandy to clayey.

In some instances the soil profile was more complex and included sub-horizons such as A1, A2, B1, B2. Each of these was sampled during the orientation survey, but not during the main survey. Auger sampling of both A and B horizons was carried out in conjunction with outcrop sampling where convenient; only surface samples were collected from rocky ridges and in areas of difficult access.

Whole soil samples were placed in Kraft envelopes, after discarding obious pebbles and large fragments.

Stream sediments were sifted to minus 80 mesh on the site, using nylon bolting cloth or stainless steel sieves.

Heavy mineral samples were collected at the necks of each drainage basin by sieving a large quantity of material (sufficient to fill an 8" x 10" calico bag) to minus 16 mesh. These samples were subsequently panned in a prospector's dish to a grey fraction at the base camp. Normal minus 80 mesh stream sediments were always collected in conjunction with heavy mineral samples and given a consecutive number described by a common grid reference. Wet stream sediments and heavy mineral concentrates were placed in small plastic sample bags folded inside a Kraft envelope. In collecting stream sediment samples precautions were taken to avoid contamination from slumped bank material.

In many areas such as Kelly's Mountain and Cap Upstart, where isolated ridges stand up in relief above the surrounding landscape, stream sampling alone would not give representative coverage of the feature of interest. This is because there are few streams, and minor gullies often drain only one portion of a ridge. In such cases, emphasis was placed on outcrop samples and samples of colluvial soil at the base of hillslopes.

The Cape Upstart peninsula was the only area where it was found impossible to adhere closely to the proposed sampling programme. This is because it proved impossible to sample the interior of the stock by helicopter, as originally planned, and samples were only obtained from the shore-line and along one traverse up a major fault valley.

Extra samples (to those marked on photographs) were collected during the author's orientation visits, where sampling was often carried out in greater detail across contacts.

No hard and fast rules such as "x samples per square mile" were used to determine sample density in this survey, and until much more study has been done, it is unrealistic to attempt any regularly spaced grid. Sample spacing was adapted to the local conditions, - where the drainage is mature and simple over one rock type; samples are more widely spaced than where drainage is juvenile and complex over several rock types.

Similarly, sample density was increased in the vicinity of structural features, such as igneous contacts and shear zones. In addition, the selection of sites was biased from the viewpoint of access. For example, sample sites were selected around the base of a hill, and the summit was avoided unless there was good geological evidence to justify the extra time taken to climb the hill for a sample. Similarly, sample sites were located as near to access tracks as possible, provided a pattern of distribution over a rock unit could be maintained.

SAMPLES REGISTRATION

At the sample site, the precise locality was marked on the appropriate air-photo, and given a sample number. All samples taken during the Ayr survey were given the prefix 6515 followed by the sample number, in this case, from 0001 to 1064. The prefix 6515 stands for the year (1965) and the project number (15).

The method of recording sample data onto the bags, in preparation for subsequent punch card coding has been described in detail by Walpole et al (1964), and Mather (1965).

These bags were designed as multipurpose ones and for a regional geochemical survey such as this, all the squares could not be filled in. Some data, such as stratigraphic information, were often not known, while others, such as rainfall, can always be provided after the survey and there is little point in filling in repetitive data in the field. Hand specimen description of rocks (alteration, minerals etc.) were completed by the author at the conclusion of the survey, but soil descriptions were not attempted, as it was felt that the basis of soil classification used was not applicable without specialized techniques and a considerable knowledge of soil science.

NUMBER OF SAMPLES COLLECTED

During the survey, which lasted 13 weeks, 1064 samples were collected from approximately 750-800 sites on the Ayr Sheet. Sampling was done mainly by Landrover cross-country driving and on foot, except for 4 days'sampling of Cape Upstart and islands by launch and one and a half days' work by helicopter.

The samples collected comprised:-

503 stream sediments
56 heavy mineral concentrates
235 soil samples from surface and subsurface
270 outcrop samples

GEOCHEMICAL ENVIRONMENT AND GENERAL CONSIDERATIONS

With the exception of a few isolated metamorphic roof-pendants the area consists largely of plutonic rocks, with associated volcanic phases on the western half of the sheet.

The area has been influenced by the Hunter-Bowen orogeny and includes parts of the Gympie and Georgetown metallogenic provinces of Hills (1965).

No economic mineralization has been recognised on the Ayr sheet, although gold and minor sulphide mineralization is well known in adjoining areas e.g. on the Bowen Sheet (Normandy Goldfield) and the Charters Towers Sheet (Charters Towers and Ravenswood Goldfields). Moreover, occurrences of copper, lead, zinc, bismuth and molybdenum are known in adjoining districts.

SELECTION OF ELEMENTS FOR SURVEY

Though it would be desirable to obtain data on the distribution of a wide range of elements on the Ayr sheet, aspects of economy and time have also to be considered, and these are related to the analytical problem of how many elements can be analyzed on a routine basis by any one method.

For instance, Cu, Pb, Zn, Co, Ni, Ag, Cd, Bi, can all be analyzed by one method, either emission spectrograph or atomic absorption spectrophotometry. However, arsenic, fluorine and mercury would require entirely separate techniques for their analysis, and in the absence of specific indicators in this essentially virgin area, there is little justification for including these elements in a routine analytical program.

The list of trace elements can be further shortened when it is considered that with the important exceptions of gold, cassiterite and to a lesser extend molybdenite, few large deposits are monomineralic in ores of the rarer elements not analyzed in this survey (e.g. Bi, Ag, Te, Hg, Cd).

Taking into account the cost and time of analytical procedures and the likely range of trace elements to be expected in the Ayr Sheet area, determinations Cu, Pb, Zn, Co, Ni, Sn, Nb, Ba, Sr, Mo, were made on soil and rock samples, Cu, Pb, Zn, Co, Ni, Mo in stream sediments, and Cu, Pb, Zn, Co, Mo, Ni, Sn, Au, Cr, V, W, Be, Pd in heavy mineral concentrates.

This range of elements is comprehensive enough to provide a series of geochemical maps showing distributions of trace metals over the various rock types and geological features of the Ayr sheet. In addition, most types of element associations, including complex and simple base metal associations, if such exist, could be identified.

Barium and strontium were included in soil and rock samples because they are commonly associated with hydrothermal activity, and in the absence of significant concentrations of other elements would indicate "barren" hydrothermal activity on the geological map.

Gold was included in the heavy mineral concentrate analyses only, because analytical sensitivities are inadequate to detect slightly anomalous values in soils and rocks.

A similar reasoning, to a lesser extent, applies to tin as cassiterite, but analyses of soils and rocks (but not stream sediments) were requested for tin because it was considered that detection limits should be adequate to obtain a meaningful distribution pattern.

Palladium (Pd) was looked for in heavy mineral concentrates to cover the remote possibility of platinum group metals occurring in significant concentration in the gabbros and associated basic rocks. Palladium, being a heavy noble metal, would be more likely to be detected in heavy mineral concentrates from streams draining basic rocks than in any other type of sample material. Palladium was looked for rather than platinum, because the limit of detection by emission spectrograph is 1 ppm, as against 100 ppm for platinum.

Of the elements analyzed in all samples (Cu, Pb, Zn, Co, Ni, Mo), Co and Ni are likely to be associated in high amounts only with basic and ultrabasic rocks, due to their natural substitutions in mineral constituents of these rocks. Cobalt and nickel analyses were included in all samples, however, both for the sake of completeness of the geochemical map of element distributions, and because of the juxtaposition of basic and acid rocks in areas such as the Mount Roundback roof pendant area, and the possible occurrence in dominantly granitic terrains, of basic dykes and diorite bodies which are too small to show on the regional geological map.

ANALYTICAL PROCEDURES

Orientation analyses by BMR (Appendix 1)

Samples collected during the first month of the field season, including those taken during the three weeks orientation survey, were analyzed by A.D. Haldane on the Bureau's Hilger and Watts Large Quartz Spectrograph. The developed plates were compared visually with standard plates. 59 soil samples and 86 rock samples were analyzed by this technique for Cu, Co, Ni, Pb, Mo, V. Other elements sought but not necessarily detected, included Sn, Be, Au, Bi, Sb, Zn, As, W, Ta and Nb. These results showed Ni values varying from "absent" to 150 ppm, Co values from "absent" to 60 ppm, Cu values from 2 to 80 ppm, Pb values from 5 to 1,000 ppm (near a galena vein in granite) and Mo values ranging from 2 to 1,000 ppm. Vanadium values varied from 1 to 400 ppm, and several samples contained Sn up to 10 ppm. Beryllium (2ppm) was detected in one sample only. The other elements mentioned above were not detected; detection limits being: Au = 10 ppm, Bi = 10 ppm, Sb = 100 ppm, Zn = 60 ppm, As = 180 ppm, W = 100 ppm, Nb = 10 ppm, Ta = 180 ppm.

The spectrographic scans of orientation samples (see Appendix 1 and above discussion), collected over all representative geological units on the Ayr sheet, demonstrated that only Cu, Co, Ni, Pb and Mo were likely to show values of interest, so that the selection of elements for routine analysis was in fact a comprehensive one.

17

The absence of zinc values from the spectrographic orientation work shows that the 60 ppm detection limit of the emission spectrograph makes this method unsuitable for zinc determinations in this type of survey.

Repeat analyses for Cu, Co, Ni, Pb, Zn by atomic absorption spectrophotometry were subsequently carried out on the 59 soils and 86 rocks collected during the orientation survey. The procedure was similar to that used by A.M.D.L., but on aqueous solutions only. Solvent extraction was not used, because of the time factor, and readings below the detection limits in aqueous solutions are simply reported as "less than" x ppm.

These analyses were repeated by atomic absorption because it was felt that spectrographic (i.e. total metal) analyses for one batch of samples could not be incorporated in the maps and compared with atomic absorption (i.e. perchloric acid soluble metal) values obtained on the majority of the samples.

Sample Analysis by A.M.D.L.

The prepared samples were analyzed by A.M.D.L. using the following techniques.

a) Heavy Mineral Samples
"Scheme A1" spectrographic analysis for Cu, Co, Ni, Pb, Zn, Au, Cr, V, W, Mo, Be, Pd.

b) Stream Sediment Samples.
Atomic absorption analysis by "scheme C2" for Cu, Pb, Zn, Co, Ni. This method involved digestion of prepared samples in hot perchloric acid, followed by subsequent dilution to a standard volume. Solutions were aspirated into Techtron AA-3 atomic absorption spectrophotometer and all readings in the range 20 - 80% absorption were recorded and calculated to parts per million by comparison with reference standards. Samples which gave more than 80% absorption were further diluted and the determination repeated, thus ensuring that the logarithmic absorption scale was read only over its most accurate range. Samples which gave less than 20% absorption were made alkaline with ammonia in the presence of citrate (to prevent hydroxide precipitation) and then solvent extracted into methyl isobutyl ketone using sodium diethyldithiocarbonate as chelating agent. By this means, concentration and isolation from matrix elements which cause non-atomic absorption is effected, so that detection limits could be improved at least ten-fold and the mid-range of the scale utilized when the diethyldithiocarbonate-ketone extract was aspirated into the atomic absorption unit. The method has been described by Bowditch and Powell (1965) in the 5th Australian Spectroscopy Conference, and also by Marshall (1965) at the same conference.

c) Soil Samples.
Atomic absorption analysis by "scheme C2" for Cu, Co, Ni, Pb, Zn, and X-ray fluorescence analysis by "scheme B" for Sn, Nb, Ba, Sr.

d) Rock Samples.
Analysis as for soil samples.

In addition, analyses for molybdenum were carried out in the Bureau's laboratories on all samples, using a hot concentrated hydrochloric acid digest, followed by a colorimetric dithiol technique described by Marshall (1964). The results were evaluated by visual comparison with prepared standards.

Discussion.

Except for the heavy mineral concentrates, emission spectrographic analyses were not favoured, because spectrographic detection limits for Zn are inadequate, and previous experience in the BMR laboratories has shown that results for all elements are less reliable than by the atomic absorption method. The trend of results is generally ramdom, with a tendency for slightly anomalous values to be overestimated.

Thus the emission spectrographic technique can only be regarded as useful where a qualitative, or very rough quantitative scan is required. For this reason, this method was avoided for all but the heavy mineral concentrates. In the case of these concentrates, obtained by panning of stream sediments to a grey fraction, the percentage of heavy mineral concentrate retained, relative to the amount of material discarded, varied considerably from sample to sample, depending on the grain size, mineralogy and human error. Therefore there was no point in striving for accurate analyses and these results are only meant to show the presence of such elements as gold or tin, and to give a rough indication of the presence of the elements in high concentration.

A.M.D.L. quotes the following detection limits for their emission spectrographic technique:- Cu, Pb, Co, Ni, Sn, V, Mo, Be, Pd, all 1 ppm; Au, Cr = 3 ppm, Zn, W = 20 ppm.

The detection limits quoted for their "scheme C2 " atomic absorption analyses are:- Cu = 1ppm, Co and Ni = 2 ppm, Zn = 0.3 ppm, Pb = 3 ppm. An accuracy of ± 5% is claimed.

Nb, Sn, Ba, Sr analyses are offered by A.M.D.L. by emission spectrography and X-ray fluorescence only. X-ray fluorescence was chosen as being more reliable for these elements. The following detection limits are listed by A.M.D.L. for their X-ray fluorescence analysis:-

Nb and Sn = 10 ppm, Ba = 20 ppm, Sr = 5 ppm; and an accuracy of ± 5% is claimed for total element values. Unfortunately time did not allow all soil and rock samples to be analyzed for Nb, Sn, Ba, and Sr.

Apart from emission spectrograph analysis, A.M.D.L. offer molybdenum analysis by colorimetry (spectrophotometry). However, a rapid (80 samples per man-day) colorimetric procedure with a 1 ppm detection limit was available at the B.M.R. laboratory and this was accordingly employed for routine analysis of the returned A.M.D.L. samples.

For tabulated results of analyses, see Appendices 2 to 7.

Analytical Costs

The following costs were involved in the analysis of samples.

a) heavy mineral samples - 13 elements at $1.10 per sample using emission spectrograph.

b) stream sediment samples - 5 elements at $1.95 per sample using atomic absorption.

c) soil and rock samples:- 5 elements (as for stream sediments) at $1.95 per sample by atomic absorption plus 4 elements at $2.80 per sample by X-ray fluorescence.

d) Sample preparation costs at $6.00 per hour.

DATA ANALYSIS AND PRESENTATION

Relation of Element Patterns to Lithological Units

After the geochemical survey was carried out and this report was drafted, Paine regrouped most of the granitic rock units in accordance with the results of geological mapping of the Bowen and Proserpine Sheet areas, and of isotopic age-determinations. To avoid redrafting of this report and laborious corrections to the accompanying geochemical maps (figs. 5-28), the original rock units are adhered to on the geochemical maps. The geological map, however, shows the revised rock units, as follows:

(1) The name "Urannah Complex" has been abandoned.

(2) The Ravenswood Granodiorite (Silurian to Lower Devonian) has been confined to west of the Burdekin River.

(3) Rocks formerly mapped as "Ravenswood Granodiorite" (S-Dr) east of the river are now regarded as the same age as rocks formerly mapped with the dioritic phase of the Urannah Complex (C-Md). Both are now combined to form a single Upper Carboniferous to Lower Permian unit (C-Pd).

(4) The acid plutonic units which had formerly been mapped separately under the headings of (Pzg, Pzug, and C-Mg) have now been combined, for the purposes of regional mapping, into a single Upper Carboniferous to Lower Permian unit (C-Pg).

It was anticipated that trace element values would fall into a number of groups or "populations" according to the lithology and geology of various portions of the Ayr Sheet. In addition, it was desired to see if any statistically significant differences could be recognised between the trace element values from granites of different ages - e.g. whether the granite stock at Cape Upstart, and the group of intrusions at Cape Cleveland, Saddle Mtn., and Mt. Elliot were substantially different from the other granitic units on the Ayr 1:250,000 Sheet area.

However adequate sample coverage was not always available for these relatively small units. Moreover, the Pzg and S-Dr granites are very variable in petrology, ranging from aplitic phases, through adamellites to quartz diorites, and they contain numerous major and minor dykes and sheared, epidotized phases. If samples of the hornblende microdiorite dykes are ignored, the number of rock analyses is very low in proportion to the area occupied by these rocks, and the petrological variation within the remaining samples makes it extremely difficult to justify a statistical analysis.

As far as stream sediments are concerned, statistical evaluation was only attempted for streams wholly draining a particular rock unit. Even so, this approach is only valid for streams draining large areas of apparently "simple" lithology such as the interior of Cape Upstart, since streams draining granitic areas of complex lithology would contain detritus derived from the various phases as well as the numerous dykes.

Statistical Analysis

There are several methods of statistical analysis (Moruney, 1965; Dean and Dixon, 1951) which can give different information, depending on whether emphasis is placed on the arithmetic means, medians, geometric means, logarithmic means, percentile groupings, etc.

Hawkes and Webb (1963) define a probable anomaly as having a value equal to the mean plus twice the standard deviation, and a definite anomaly (with a higher confidence level), as mean plus three times standard deviation. This is a good approach for geochemical exploration where an orebody may be expected to give good contrast with background values in an area of fairly constant background. However in a regional survey this approach breaks down. For example, a statistical rise in background from 10 to 50 ppm copper in a granite may be significant as an indication of a source rock for mineralization, but if an area of granite and diorite (having a background of say 100 ppm Cu) is considered as a whole, the basic rock values will mask subtle variations in the acid rock values. This is the reason for subdividing the area into lithological units and only considering variations <u>within</u> those units, although the number of samples for each unit then tends to become undesirably low for statistical analysis.

Hawkes and Webb (1963) also fail to emphasize the need for a truly Gaussian distribution, which is a pre-requisite for calculating an arithmetic mean which they call the background.

Most trace element geochemical values follow a log-normal distribution law. This is because all values are confined within the theoritical limits of 0 - 100%, and of course there are many more low trace element values in nature than high ones.

When statistical methods of calculating means and standard deviations were applied to data from the current survey, it was soon realized that grossly different results could be obtained depending on which method was chosen.

As an example, it may be desired to compare the zinc content of sediments from streams draining P-Mg granite at Sprole Castle and Horseshoe Bay with the zinc content of sediments from streams draining other outcrops of the same granite. Streams wholly within the drainage watershed of this granite carry the following zinc values: (see fig. 11) 10, 6, 37, 12, 35 ppm.

If we apply classical statistical methods to these five values, we obtain a mean background of 20 ± 14.8 ppm. Thus the normal range is 5 to 35 ppm and values exceeding mean plus twice standard deviation, that is 50 ppm, would be considered anomalous using the definition of Hawkes and Webb (1963).

However the distribution is obviously not a Gaussian one.

If we apply logarithmic transformations, assuming that the distribution follows a log-normal rather than normal law, and calculate mean and standard deviation using the logarithms of the numbers, we obtain a mean background at 16 ± 2.2 ppm. Thus the range is 14 - 18 ppm, which is very restricted and totally unrealistic, for all values would lie outside this. The threshold value would then be 20 ppm, which makes two of the values anomalous.

Dean and Dixon (1951) suggest that it is better to use medians rather than averages where small numbers of observations are concerned, the median being uninfluenced by any extreme high or low values.

Thus their method would give background = median = 12 ppm, which appears to be more realistic. According to their formula, which relates the standard deviation to the range of values and an efficiency factor inversely dependant on the number of observations, the standard deviation for this example is ± 13. 4 ppm.

Thus the range of values is - 1 ppm (which is ridiculous)to 25 ppm, and the threshold would be 39 ppm.

Using these three methods, three different answers are thus obtained, with three different threshold values, and three different lots of "significant anomalies", (unless such anomalies are outstandingly obvious, in which case no statistics are required to identify them). The reason for this difficulty is that the frequency distribution plot of the values considered in this example is bimodal as well as being positively skewed, and follows neither a normal nor log-normal distribution, whereas the three statistical methods used in the example are only applicable to values showing a normal or log-normal distribution. (Log-normal distributions can be dealt with by taking the logarithms of the trace element values and performing the calculations on these rather than on the values themselves).

On plotting histograms of the trace element distribution at both arithmetic and logarithmic class intervals, the distribution of some elements in a number of rock types was found to be Gaussian or normal on the arithmetic scale, and some were log-normal (i.e. Gaussian on the logarithmic class interval scale), but most followed neither law.

Obviously if we are to compare rock units and areas by statistical methods, we must treat each batch of data by the same statistical method. However, elementary statistical analysis deals only with Gaussian distribution of random numbers clustered about a central mean, whereas geochemical distributions are governed by many natural parameters, such as the influence of varying rock types, weathering processes, etc.

It is therefore not surprising that the distribution plots are variable. Such variations doubtless reflect various overlapping populations in the rock units, due to petrological variations, etc. If we had enough samples, we could subdivide the plots showing multi-modal tendencies into population subgroups, each with a simple Guassian distribution, and analyze each population subgroup. However, this would require an immense number of samples, and if the data presented in this report is subdivided into population subgroups, the number of samples in each group is too small to allow statistical conclusions to be drawn.

For these reasons, and the disappointing results from the examples shown, statistical analysis was abandoned, and it was decided to use a rather intuitive and subjective approach, by sub-dividing the geochemical values into a number of groups with limits rising in geometric progression, e.g. 0-5, 6-10, 11-20, 21-40, 41-80 and +80ppm. The selection of class intervals was chosen arbitrarily by inspection of the element distribution, and the chosen intervals were adhered to in dealing with results for any one element in rock, soil and stream sediment samples. Thus comparison of the results from rock, soil and stream sediment samples in that sequence would show any enrichment or depletion of any particular element in the weathering cycle.

There are two good reasons for choosing a geometric progression rather than an arithmetic one. Firstly, the percentage of analytical error must be smaller than the class interval considered. For instance, a ten percent error at the 3 ppm level would still give a value falling within the 0-5 ppm grouping, whereas if this arithmetic interval is maintained, a ten percent error at the 80 ppm level could cause the value to be in any of the groupings 70-75, 75-80, 80-85, or 85-90 ppm. Secondly, a given variation, say 10 ppm, is equivalent to a much smaller percentage variation in a group of high values such as 80-90 ppm than a corresponding variation in a group of low values, such as 10-20 ppm.

Data Presentation

All sample sites were transposed from aerial photographs onto photoscale base maps at the completion of the survey. Each sample site was also described by a grid reference, taken off the base map, and the sample number, grid reference and geochemical values were recorded onto punch cards by the Bureau's transit room for record purposes.

Rock descriptions were also coded onto punch cards by the author, using the coding described by Walpole et al (1964). Figs. 2, 3, and 4 show the location of rock, soil, stream sediment and heavy mineral samples collected in this survey. For convenience in handling, the photo-scale base maps were reduced photographically, and geochemical values for rocks, soils, stream sediments and heavy mineral concentrates were plotted onto four maps for every element, giving 24 maps in all for the elements Cu, Pb, Zn, Co, Ni, Mo. Appendices 2, 3 and 4 list the results for Cu, Pb, Zn, Co, Ni and Mo, together with sample number and grid reference, and are essentially a reproduction of data stored in the punch card records.

Some X-ray fluorescence analyses for Sn, Nb, Ba, and Sr, were also done by A.M.D.L., but time did not permit this phase of the project to be completed. Results for these elements are given in Appendices 5 and 6 and the location of each sample can readily be obtained by referring to figs. 2, 3 and 4.

Some difficulty was experienced in reconciling aerial photographs with the base maps for transposing sample points. Much distortion was evident, and the photo-scale maps did not join up well when assembled and photographically reduced.

Moreover, the geology plotted onto the base maps made it difficult to clearly spot on geochemical values; for future work of this nature it is suggested that accurate topographic maps, rather than geological maps, should be used as base maps.

Where minor creeks not shown on the base map have been sampled, the dispersion train has been diagrammatically sketched in to join the nearest major creek.

In some cases, multiple samples were collected from the one sample point - e.g. country rock and adjoining dyke samples. Values for these are shown on the maps as numbers separated by an oblique stroke (e.g. 20/115). Where single values appear on the rock map, one can assume that the rock sample is fairly typical of the geological unit in which it appears.

Soil values from A and B horizons are depicted on the maps as the A horizon value over the B horizon value, thus $\frac{26}{30}$. Where only one value appears on the soils map, only an A horizon sample was collected.

INTERPRETATION OF GEOCHEMICAL MAPS

Results for Copper

1) Copper distribution in rocks (fig. 5).

The granites of Cape Upstart, Saddle Mountain, Mount Elliot and Cape Cleveland show generally low values, commonly less than 20 ppm, and mostly in the range 0-5 ppm.
These values are somewhat enhanced near the P-Mg/C-Pv granite/volcanics contact at Mt. Elliot; the values here are slightly higher than can be accounted for solely by assimilation of C-Pv volcanics, as these volcanics do not exhibit high copper values away from the contact.
The south-eastern and north-western portions of the central granitic area contain values markedly higher than the surrounding areas. While many of these values were obtained directly over microdiorite dykes, the associated country rock (granodiorite and diorite) is also enriched in copper. This enrichment is believed to be related to the shearing and epidotization of the country rock observed in this area. Slightly higher than usual copper values (of the order of 20 ppm) occur in a north-trending line of samples over the greisen on Kelly's Mountain. Somewhat anomalous values also occur in a road metal quarry at the south end of Kelly's Mountain, where a 2" vein of chalcopyrite was noted. It is possible that this minor mineralization was introduced from a north-north-west trending shear system marked by the dyke swarm in the granite south of the Burdekin River, and similar minor mineralization could occur in faults cutting this dyke swarm. An anomalous value of 8,000 ppm Cu obtained from dump material at a copper prospect from the Inkerman shear zone was extremely localized and did not persist even 60' along strike. Values of up to 100 ppm copper also occur in the gabbro near Abbot Point where disseminated chalcopyrite grains up to 0.01 mm diameter were recognised by I. Pontifex (B.M.R. Record 1966/68 - Paine et al., 1966, Appendix 3, pp. 2-3). These values are greater than those for other basic rocks of the C-Md Urannah Complex, but still well within the normal range for copper in basic rocks. Values of the order of 50 ppm on Sprole Castle and Mount Roundbank, where the high level, epizonal granite is intruded into diorites, are probably due to contact effects. Samples taken along the strike of dykes in this area show that the dykes generally have a fairly consistent copper content.

2) Copper distribution in Soils (fig. 6)

Generally, the copper distribution in soils reflects the distribution in rocks, with a slight enrichment in areas west of the Burdekin River. The anomalous values in the north-west of the central granitic area, associated with the dyke swarm, are considerably reduced, probably because copper values within the bed-rock are highly localized and soil values tend to be more representative of the underlying rock as a whole.
The anomalous values in the south-eastern portion of the central granitic area, associated with the dyke swarm, are maintained fairly uniformly in the soil samples when compared to the values in the rock samples, implying that the copper is not so highly localized in the rocks of this area.

25

This area must therefore be regarded as having the greatest potential for copper mineralization on the Ayr Sheet, although such mineralization would probably be in the form of small veins parallelling the shear system. With few exceptions, there is remarkable conformity in copper content between soil samples from the A and B horizon. For practical purposes, surface samples of soil could therefore be expected to give comparable results to the more difficult to collect B horizon samples.

3) Copper distribution in Stream Sediments (fig. 7)

The area of greatest copper content in stream sediments is at Mount Luce, near Abbot Point; this confirms the results obtained by rock and soil sampling, and as suggested above, could be due to a more basic intrusion at this locality. Small anomalies at Sprole Castle and Mount Roundback are probably due to contact effects near the roof zone of the granite, as suggested above. The anomalous values recorded in rock and soil samples from the south-eastern part of the central granitic area also show up in the stream sediment samples and give long dispersion trains, consistent with the hypothesis that the underlying rocks are enriched in copper. In addition, some short anomalous trains are developed in the basic volcanics east of Mount Elliot, but rock and soil sampling here is not adequate to interpret these in detail. Apart from the anomalous trains, the background values for copper in stream sediments on the Ayr 1:250,000 Sheet area are of the same order of magnitude as the rock and soil backgrounds previously discussed.

4) Summary and Conclusions

The highest copper values occur in basic rocks and in the roof zones of epizonal granites in the eastern portion of the sheet. The eastern portion of the central granitic area, which contains prominent micro-diorite dyke swarms, also has a copper content somewhat above the average for the sheet area. These anomalies are relative, however, and they are not considered exotic for the petrology of the area, or high enough to justify an intensive explorations programme. Contrary to expectations, the Inkerman shear zone, the Kelly's Mountain greisen and the Cape Upstart granite gave relatively low copper background values.

Results for Zinc

1) Zinc distribution in Rocks (fig. 9).

Zinc content throughout the Ayr Sheet area is very variable. The granites of Saddle Mountain, Mount Elliot and Cape Cleveland tend to contain higher values than the granite of Cape Upstart and the sheared leucogranite on Wards Hill. Except for Mount Dalrymple, the volcanics (Cuv and C-Pv) have zinc contents in the range 41-80 ppm, as have the small exposures of metamorphics (Pzu). These volcanics and also the rhyolite plug of Mount Louisa are therefore geochemically distinct from the volcanics of Mount Dalrymple, where zinc values in the 0-20 ppm range predominate. An anomalous area in the granite on the east side of Mount Dalrymple is believed to be due to the influence of faulting, as the adjoining volcanics and granite (C-Pg)are low in zinc content elsewhere.

Some of the zinc content in rocks near the Dalrymple fault could also be due to the influence of the granite east of the Burdekin River which is anomalous. Kelly's Mountain contains mostly low zinc values, in the range 0-20 ppm, except for a value of 79 ppm Zn in a microdolerite dyke and a localized anomaly of 420 ppm Zn in the vicinity of a small chalcopyrite and galena-bearing vein in the quarry. However, the high values do not extend to the country rock granite in the quarry. In contrast to copper, both acid and basic rocks in the eastern part of the Sheet area (Abbot Point, Sprole Castle, Mount Roundback) are low in zinc content and do not show any distinct pattern. A isolated value of 73 ppm on Gloucester Island is probably related to an acid/basic intrusion breccia. The central granitic area contains a wide range of zinc values, which appear to be randomly distributed in granodiorite, diorite, granite, and microdiorite dyke swarms, with the highest values (89, 320, 112 and 109 ppm) on and around dykes in the Inkerman shear zone. Lesser zinc values (mostly in the range 41-80 ppm) predominate in the dyke swarms in the north-western and south-eastern portions of the area, but several of the highest values occur away from dykes. It is therefore probable that the first order anomalies, of more than 80 ppm Zn, are due to the introduction of secondary zinc during shearing and epidotization, which are prominent features within this area.

2) Zinc distribution in soils (fig. 10)

As in the case of copper, the zinc distribution in soil samples shows similarities to the distribution in rocks, discussed in the preceding section. Thus, apart from the central granitic area and a few values near the Dalrymple fault system, no significant anomalies exist. An isolated sample gave 83 and 86 ppm Zn in Cuv volcanics in the south-western portion ofthe sheet, but this is higher than the value in a rock sample (49 ppm) from the same site and must be regarded as being due to enrichment in the soil. Values in the soil over the greisenized portion of Kelly's Mountain fall in the lowest class interval, probably due to retention of zinc in the iron oxides of the gossan. Comparison of the values in rock and soil samples shows that not only the patterns, but the values themselves are remarkably similar. There is slight tendency for low values in rocks (such as at Wards Hill, on the eastern extension of the Inkerman Shear Zone) to be enhanced in soils, but the higher anomalous values are remarkably consistent. Similarly, the values for zinc in A and B horizons are very close for values above 40 ppm, but in the lower ranges, there is more variation (up to twofold) between horizons. The interpretations made for zinc dispersion in rocks are confirmed by the dispersion map for soil samples.

3) Zinc distribution in Stream Sediments and Heavy Mineral Concentrates (fig. 11 and 12)

Several first order anomalies (+80 ppm Zn) occur in stream sediment samples. These include a value of 200 ppm Zn in the granite of the extreme south-western corner of the map. Soil and rock sample coverage is poor in this region, and no explanation can be offered for this isolated high value.

An anomalous area has also been delineated in volcanics (Cuv) on the western side of Mount Dalrymple, although soil and rock sampling in this area, albeit of low density, does not indicate an anomaly. However, the whole of the Mount Dalrymple volcanic complex and its associated fault system are anomalous relative to other volcanic rocks on the Ayr 1:250,000 Sheet area, and this area must therefore be regarded as one of potential zinc mineralization. Another area of first (+80 ppm) and second order (41-80 ppm) zinc anomalies occurs in the central granitic area north-east of Mount Louisa. Relatively high values were also found in rock and soil samples from this area, indicating that the higher zinc background is not localized but of general extent in the bedrock. Minor dyke swarms occur in the vicinity, and it is likely that this portion of the central granitic area is enriched in zinc, possibly due to contact effects, and therefore is a potential source for zinc mineralization. The Seven Sisters granite inselberg also stands out as an anomalous area containing first and second order zinc values in stream sediment samples. Two samples of rock and soil from this area do not confirm the anomaly, having zinc contents of less than 40 ppm, but the stream sediment values are considered to be more representative of the area than the two rock and soil samples. The area must therefore be regarded as one of higher background, and therefore anomalous in relation to the other granites on the Ayr Sheet. The possibility of false anomalies in stream sediments due to enrichment or contamination must be considered, but the topography and soil type are not considered conducive to enrichment effects, and contamination is unlikely over such a wide area, as no mining activity etc. has taken place. An area of second order zinc values occurs on Mount Roundback, associated with the roof pendant complex. However the absence of first order values, having regard to the close sampling interval, make this area of less interest than the one discussed above. The anomalies found in rock and soil sampling in the Inkerman shear zone do not persist in the stream sediments. This is interpreted as being due to dilution effects from barren material brought in by the streams, implying that the rock and soil anomalies are highly localized (perhaps in minor mineralized shears) and do not indicate the average metal content of the bedrock. By contrast, the rock and soil anomalies east of Mount Louisa are not diluted in the stream sediment samples, suggesting that the bedrock here is generally higher in zinc content. Heavy mineral concentrates show zinc values up to 250 ppm, which are probably due to zinc trapped in the lattice of ferromagnesian minerals and spinels (magnetite).

4) Summary and conclusions

Areas of higher than average zinc background occur around Mount Dalrymple, The Seven Sisters and north-east of Mount Louisa. Because of the correlation of high zinc values in widely spaced rock, soil and stream sediment samples, the granite east of Mount Louisa is considered to have the best potential as a source rock for zinc mineralization.

Results for Lead

1) Lead distribution in rocks (fig. 13).

With three isolated exceptions, values for lead on the Ayr Sheet are abnormally low in relation to the rock types considered; the leucocratic granites (containing high potassium feldspar, which is a lattice host for lead) average well below 48 ppm Pb which is suggested as an average for felsic rocks by Hawkes and Webb (1963). Two samples from the Kelly's Mountain quarry contain 500 and 520 ppm lead in granite wallrock adjoining a 2" vein of galena, but this is localized and the lead value in the country rock granite is abnormally low. Two isolated samples in the central granitic area give values of 92 and 60 ppm lead, and the south-eastern dyke swarm in the central granitic area, the volcanics near Mount Elliot and the area east of Mount Louisa all give weak anomalies relative to the surrounding rocks, but the absolute values are too low to place much significance on any of them.

2) Lead distribution in Soils (fig. 14).

The geochemical map of lead distribution in soils is similar to that showing the distribution in rocks, in that values are uniformly and abnormally low throughout the area where leucocratic granites occur. The Mount Dalrymple volcanics, the western central granitic area and a granite north-east of Mount Woodhouse show areas of relatively higher lead content, as in the case of rock sampling, but these are by no means anomalous. The lead content in A and B horizon samples is generally comparable, except for two cases of B horizon enrichment, north-east of Mount Woodhouse and on Mount Louisa. In general the lead content in the soils is of the same order as the lead content in rocks.

3) Lead distribution in Stream Sediments (fig. 15).

Low values again predominate throughout the Ayr Sheet except for three isolated first order anomalies (+80 ppm Pb). In agreement with the results of soil and rock sampling, the Mount Dalrymple area and granitic rocks east of Mount Louisa have lead values in a higher class interval than their surroundings. These anomalies are too low to be of economic interest, but it is worth noting that they generally correlate with zinc anomalies.

4) Summary and Conclusions

Lead background throughout the Ayr sheet is abnormally low for the prevailing rock types. Slightly higher lead content was observed in some samples from areas of above-average zinc content, but the Ayr 1:250,000 Sheet area is considered to have little potential for economic lead mineralization.

Results for Cobalt

1) Cobalt distribution in rocks (fig. 17).

With the exception of the central granitic complex, all granites on the Ayr sheet contain less than 5 parts per million cobalt, which is the average cobalt content of felsic rocks (Hawkes & Webb, 1963). Basic rocks (Pzt) contain cobalt values ranging from 2 ppm to the highest value on the Ayr sheet, 44 ppm, on Camp Island. This is well within the average cobalt value for mafic rocks of 45 ppm (Hawkes and Webb, 1963), - in fact the cobalt value at Mount Luce, near Abbot Pt is abnormally low, but this could be a local effect. In the central granitic complex, the high cobalt values (in the class intervals 10-20 and 21-40 ppm) tend to occur in hornblende microdiorite dykes, although some dykes contain as little as 2 ppm cobalt. The cobalt values are fairly consistent along the strike of individual dykes. It would appear that no cobalt has been introduced with shearing, as the large Inkerman shear zone has a very low background (-2 ppm). Cobalt values in the range 21-40 ppm which are not shown as occurring on dykes are interpreted as being due to more basic phases or to contamination from minor basic dykes too small to show up on the aerial photographs. Thus no cobalt anomalies in the true sense occur in rock samples collected from the Ayr 1:250,000 Sheet area, as values can be related to petrological variations and no relative peaks occur within any one rock unit.

2) Cobalt distribution in Soils (fig. 18).

The map of cobalt distribution in soils shows an enrichment in the lower background values over acid granites and the volcanics at Mount Dalrymple. Thus the large areas of cobalt values in the -2 ppm class interval for the rock samples now display values in the class intervals 2-10 ppm Co. The cobalt enrichment in soils is fairlv uniform in both the A and B horizons, which generally give values falling within the same class interval. Apart from the upgrading of the low cobalt values (-2ppm), the geochemical map for soils is very similar to the rock map, with most of the values again reflecting petrological variations between basic and acid rocks. The higher cobalt values occurring in andesitic volcanics east of the Mount Elliot granite are probably due to enrichment effects in the soil derived from weathered mafic rock.

3) Cobalt distribution in Stream Sediments (fig. 19).

The acid granite on Cape Upstart and Cape Cleveland generally gives cobalt values in stream sediment of less than 2 ppm, similar to the values in rock samples from these areas. Enrichment in stream sediments does not occur, because there is little development of residual soil by chemical weathering processes, and the stream sediments consist largely of mechanically eroded rock debris. For this reason, soil samples were not collected on Cape Cleveland and Cape Upstart. The remaining areas give cobalt dispersion trains of the same order of magnitude as the soil values - that is, the stream sediments are derived from erosion and dispersal of the chemically enriched residual soils.

The central granitic area contains values predominantly in the 11-20 ppm class interval, with a few higher values up to 42 ppm Co. This class interval also predominates in the soil samples from the same area, where an enrichment over bedrock values was postulated. The dispersion trains in the 11-20 ppm class interval therefore probably represent the background (somewhat enriched relative to bedrock) of the diorites and granodiorites. Material derived from the basic dyke swarms must also contribute to the background in this region, and the higher values in the class intervals 21-40 ppm and +40 ppm probably represent drainage from dykes near the sample point. The random distribution and isolated nature of these highs lends support to this hypothesis. Other cobalt highs occur in streams draining basic rocks south of the Seven Sisters, and on Sprole Castle and Mount Luce. These highs are not anomalous in the absolute sense, and merely reflect the difference in petrology between basic and acid rocks. Two interesting dispersion trains carrying relatively high cobalt values occur in areas of residual soil cover (Czs) north of Mount Louisa and off the north-eastern limit of outcrop of the central granitic area. These areas contain little outcrop, and are not represented by soil and rock sampling. It is suggested that they indicate the presence of buried basic rocks. The stream dispersion pattern between coordinates 590,000 and 605,000 yards east could reflect an underlying granite basement, with a slight enrichment in cobalt values during the soil forming process. The western portion of the central granitic area, represented by C-Pg granite, gives lower cobalt values in stream sediments, rocks and soils than the rest of this granite complex, and it is suggested that this could indicate a more acid granite phase. Occasional high values in heavy mineral concentrates from streams draining the central granitic area are probably due to lattice entrapment of cobalt in ferromagnesian minerals.

4) Summary and Conclusions

Cobalt distributions in soils, rocks and stream sediments on the Ayr Sheet area is characterized by a contrast between basic (cobalt values up to 50 ppm) and acid (values generally below 10 ppm) rock types. The central granitic area gives intermediate cobalt values, reflecting the more basic nature of this complex relative to acid leucogranites elsewhere on the sheet. These values increase in areas containing swarms of basic dykes. Soils developed over granitic rocks are enriched in their cobalt content relative to bedrock, whereas no marked enrichment occurs in soils developed over basic rocks. Stream sediment values closely follow the soil values, except in rocky areas undergoing rapid erosion, such as Cape Cleveland and Cape Upstart, where no true soil development occurs and stream sediments consist largely of mechanically eroded bedrock debris. Areas of above average cobalt content can be correlated directly with particular rock types, and no relative anomalies exist within any one rock unit. The area is therefore considered to be of low potential for cobalt mineralization. A stream sediment anomaly in residual soil cover north of Mount Louisa may be due to underlying basic bedrock, and a similar "high" further east, with an adjacent "low", may indicate basic and acid rocks below the soil cover.

Results for Nickel

1) Nickel distribution in Rocks (fig. 21).

Taking the average nickel content of felsic rocks as 8 ppm (Hawkes and Webb, 1963), there is a marked difference between the granites (P-Mg) in the north-western part of the Ayr Sheet and the granite stock (P-Mg) on Cape Upstart. The former, with values predominately in the class intervals 0-10 ppm Ni, are lower than average in nickel content, while the Cape Upstart granite is above average, with most values occurring in the class intervals 21-40 ppm Ni. Nickel values rise on crossing the contact from granite (P-Mg) into volcanics (C-Pv) in the north-western part of the Ayr Sheet, but the higher values associated with predominately intermediate volcanics are well within the normal range for these rocks. Granites and volcanics in the south-western portion of the Ayr Sheet (Mount Dalrymple and Mount Woodhouse areas) have an uniformly and abnormally low nickel content, in the range 0-5 ppm Ni. Zones of anomalous values occur in the greisen on Kelly's Mountain, and in country rock and wallrock adjoining very minor copper and lead mineralization in the Kelly's Mountain quarry. The Mount Louisa rhyolite (C-Ph) gives values in the range 20-30 ppm, which contrast markedly with the low values (-5 ppm) for volcanics and granites to the west and east. Within the central granitic complex, the granite phase (C-Pg) contains uniformly lower values (-5 ppm Ni) than the granodiorite phase; this is in agreement with the results for cobalt values. Samples from the Inkerman shear zone are also generally low in nickel except for a value of 1,000 ppm Ni obtained by A.D. Haldane on a specimen of epidote rock from the Inkerman shear zone by semi-quantitive spectro-chemical analysis - Paine, et al., 1966, Appendix 1. As in the case of cobalt, this suggests that little nickel was introduced the hydrothermal activity observed in this shear zone.

In the north-western portion of the central granitic complex there is a definite association of higher nickel values (+40 ppm Ni) with pyritic hornblende microdiorite dykes. As with the other elements considered, there is a remarkable consistency of trace element content along the strike of any one dyke.

In the eastern portion of the central granitic area, high values also occur, but more sporadically and not necessarily over major dykes. These values could be due to minor basic dykes or more basic (i.e. dioritic) phases within the granitic complex, as suggested in the case of cobalt dispersion.

The granite (C-Pg)at the base of Cape Upstart and the granites of Middle Island (P-Mg), Sprole Castle and Mount Roundback (P-Mg and C-Pg) have nickel values mostly in the 21-40 ppm class interval, as does the granite stock (P-Mg) on Cape Upstart.

Basic rocks in the eastern part of the sheet area have nickel values ranging from 10 up to 470 ppm (at Camp Island). These variations in nickel values probably correlate with petrological variation within the basic rocks, which include large masses of diorite and gabbro.

2) Nickel distribution in Soils (fig. 22).

As with cobalt, there is some enrichment of nickel in soils developed over granitic areas, except in the case of Kelly's Mountain.

Thus the granites in the north-western and south-western portions of the Ayr Sheet, having nickel values predominantly in the 0-5 ppm class interval, give soil values predominately in the 5-10 ppm range.

The volcanics of Mount Dalrymple, which also have nickel values in the 0-5 ppm class interval, give rise to slight enrichment in the overlying soils, but not sufficient to include these values in a higher class interval.

No extensive residual soil development occurs over the Cape Upstart granite stock, so that no conclusions can be drawn about this area.

Soils over the greisen at Kelly's Mountain do not reflect the anomalous nickel values obtained by rock sampling, probably due to retention of nickel by the iron oxides in the greisen, so that nickel is not released during weathering and soil formation processes.

In contrast to soils developed over granites, the soils developed over basic rocks, notably the gabbros and diorites in the eastern part of the Sheet area, have lower nickel contents than the underlying bedrock.

Thus the overall contrast between high and low nickel values due to petrological variations in the bedrock is reduced in the case of soil samples, in which low values are upgraded and high values diminished.

Soil values in the B horizon are generally equal to or slightly greater (up to 50 percent) than A horizon values.

Relatively high nickel values occur in soil samples from the central granitic area associated with the dyke swarm. However, the highs, which reflect the petrology of the basic dykes, generally fall in a lower class interval than the corresponding values for rock samples. As in the case for soils developed over basic rocks in the eastern part of the Sheet area, this depletion in nickel values is believed to be a function of soil chemistry. The alternative explanation, of dilution from country rock (granodiorite) is unlikely, because most of the dykes form prominent ridges, and no topographically subdued country rock could possibly affect the soil samples taken from them.

The distribution pattern for nickel in soils is thus very similar to that for nickel in rocks, except for a lowering in contrast due to soil formation processes.

3) Nickel distribution in Stream Sediments (fig. 23).

As expected, the nickel concentrations in stream sediment samples are of the same order of magnitude those in soil samples.

Samples from streams draining Cape Upstart, however, are with one exception very low in nickel. Soil development in this area is non-existent, apart from a few skeletal soils, which are due to physical erosion of rock rather than chemical weathering, so that a good correlation between rock and stream sediment values was expected. This lack of correlation is difficult to explain, as the stream sediments are virtually granite gravels and sands, - perhaps sieving to minus 80 mesh has selectively removed the ferromagnesian minerals, mainly biotite, and the nickel content of the granite may be largely due to lattice nickel in these ferromagnesians. (This explanation is not contradicted by the cobalt data, where rock values are already low to begin with).

In general the nickel distribution is very similar to the cobalt distribution in stream sediments, as expected from the petrology of the area and the geochemical behaviour of cobalt and nickel. Thus the cobalt highs in soil cover (Czs) off the north-western and eastern outcrop boundaries of the central granitic area have corresponding nickel highs which tend to confirm the earlier suggestion that basic rocks underlie the soil cover in these areas.

A few isolated anomalies occur within the central granitic area; these are probably due to the local influence of basic dykes or more basic phases (e.g. diorite) near the sample point.

4) Summary and Conclusions

The granites (P-Mg) of Mount Elliot, Saddle Mountain and Cape Cleveland are lower than average in nickel content, as are the granite and volcanics in the south-western portion of the Ayr Sheet.

By contrast, the granite stock on Cape Upstart and the granites on Sprole Castle, Mount Roundback and Middle Island have higher than average nickel values.

The more acid phases (C-Pg) of the central granitic area are lower in nickel than the granodiorites and diorites (C-Pd).

Nickel has not been introduced by hydrothermal activity in the Inkerman Shear Zone, except possibly very locally.

Apart from the granite at Kelly's Mountain, the nickel values on the Ayr Sheet generally follow petrological variations from acid to basic rocks.

The only zones of truly anomalous nickel values occur in the Kelly's Mountain greisen and in country rock adjoining very minor chalcopyrite and galena mineralization at Kelly's Mountain.

There is a general enrichment of nickel in residual soils over granites, and a depletion of nickel in residual soils over basic intrusives. This is believed to be a function of soil formation processes. Hence the soil and stream sediment patterns show a lower contrast over petrological units than the rock dispersion pattern.

As expected from the geological environment, the Ayr 1:250,000 Sheet area is considered potentially barren for nickel mineralization.

Results for Molybdenum

1) Molybdenum distribution in Rocks (fig. 25).

Apart from Kelly's Mountain and a portion of Cape Upstart, molybdenum concentrations on the Ayr Sheet are very low, averaging around 1 ppm or less. This is in accord with the accepted global averages for molybdenum, which are 1.4 ppm for mafic rocks and 1.9 ppm for felsic rocks (Hawkes and Webb, 1963).

Analytical detection limits, at 1 ppm, are therefore not adequate to differentiate between molybdenum values over basic and acid rock units.

Slightly higher molybdenum values, averaging 2 ppm, are associated with granites on the eastern portion of the Sheet. One value of 200 ppm with a nearby value of 2 ppm occurs in granite on the north-eastern coast of Cape Upstart. This contrasts with lower values in the interior of Cape Upstart and it is therefore likely, as with many known molybdenum occurrences in acid granites of the Tasman Geosyncline, that concentration has taken place near the margins of the stock. A floater of heavily kaolinized granite containing several percent pyrite and minor molybdenite was picked up on a cliff on the north central coast of Cape Upstart. This floater probably represents a small pod of disseminated molybdenite/pyrite mineralization, but no such mineralization could be seen in situ in the typical Cape Upstart granite in the vicinity of the floater.

The 8 ppm molybdenum value obtained in an acid/basic intrusion breccia on Gloucester Island is not considered to be of much significance, since the intrusion breccia is a geologically obvious locus for hydrothermal activity. However, it is emphasized that sampling is by no means representative.

The granite in the immediate vicinity of the Kelly's Mountain greisen, and to a greater extent, the greisen itself, are highly anomalous in molybdenum. This is by far the most significant anomaly on the Ayr Sheet, and has real potential as an exploration target.

The nature of the greisen has been described in an earlier section of this report. The Kelly's Mountain granite away from the zone of greisenization is low in molybdenum content. The greisen itself is deficient in quartz, and tends to be fine-grained. It is suggested that the Kelly's Mountain granite is a high level, epizonal stock in which differentiation occurred near the roof zone to give aplitic phases, low in quartz, and somewhat fine grained. These aplitic phases, were later greisenized. Pyrite, as evidenced by abundant cubic boxworks, together with molybdenite, either occurred as disseminations in the aplite or was introduced during greisenization.

The greisen is now highly weathered and the outcrop consists of a vuggy, porous mass of locally bleached and heavily iron stained sericitized rock, in which no fresh molybdenite or pyrite could be seen.

Extensive gossans have been developed on parts of the greisen, and flakes of micaceous hematite (specularite) are a feature of some of these.

It is interesting to note that the Kelly's Mountain greisen is slightly enriched in nickel, and slightly molybdenum-and nickel-enriched granites also occur on the eastern portion of the Ayr Sheet. This association is a rather unusual one, and suggests that these eastern granites contain introduced nickel (due to assimilation of more basic rock) rather than compositional (i.e. petrological) nickel related to rock type.

2) Molybdenum distribution in Soils (fig. 26).

With the exception of a few samples over the Kelly's Mountain greisen, all molybdenum soil values on the Ayr sheet are 1 ppm or less. These values therefore reflect the molybdenum contents of the underlying rock, showing that no enrichment has occurred during soil formation.

No true residual soil profiles are developed over the bare rocky granites of the eastern portion of the Ayr Sheet, so that rock/soil comparison cannot be made in this area.

The soils over greisen at Kelly's Mountain are bleached organic rich skeletal soils with a well-developed A horizon, but generally lacking a B horizon. Molybdenum is believed to occur as ferrimolybdite in the limonitic phases of the greisen, and in this form it is chemically fixed and not released to the soil during chemical weathering processes. For this reason, molybdenum content at the soil is very much lower than that of the underlying gossan.

3) Molybdenum distribution in Stream Sediments (fig. 27).

No anomalous molybdenum trains are revealed, the stream sediments being well within the background of the rocks which they drain.

The failure of the Kelly's Mountain anomaly to show up in the surrounding stream sediments is thought to be due to the fact that molybdenum cannot travel in solution to enter the streams directly or via soil dispersion due to its fixation as ferrimolybdite as discussed above. However, any molybdenum which does disperse from the anomalous zone would be diluted by barren rock detritus especially as the nearest sample points are well away from any direct drainage from the gossanous area. The molybdenum rich area occurs on an elevated plateau surrounded by gentle slopes of barren granite and most of the local streams begin in the barren granite and do not reach the gossan zone.

This example illustrates that stream sediment sampling for geochemical exploration can fail to reveal anomalies associated with gossans. A similar case occurred on the southern tablelands of New South Wales, at Michelago (Ivanac and Marshall, 1965) where a stream sediment sample collected 150 feet downstream from a copper- and zinc- rich gossan failed to indicate an anomaly. Gossans, by virtue of their secondary iron oxide content, will carry any metals present as coprecipitates in the limonite, in which form they are chemically fixed and unlikely to be released by normal weathering. Mechanical erosion of the gossan is the only means by which the metals could enter the stream sediment, and, in the example cited, erosion is not active due to the mature topography. In any case, large detrital particles of gossan, before they have been reduced by attrition in the streams, would not enter the minus 80 mesh fraction invariably collected in stream sediment surveys.

4) Summary and Conclusion

Rock sampling revealed that granites rich in molybdenum and to a lesser extent nickel, occur at Kelly's Mountain and in the eastern portion of the Ayr Sheet.

The Kelly's Mountain granite contains a highly anomalous zone developed over a pyritic greisen with extensive gossan cappings. This greisen is believed to be an alteration of an aplitic segregation within the granite. The anomalous zone has an extent of at least several hundred feet, and should be followed up by detailed mapping and grid sampling of the rocks to delineate the full extent of the anomaly.

Molybdenite/pyrite mineralization must be responsible for the anomaly, but the observed molybdenum values in the gossan are of course no indication of the molybdenum content of the underlying rock.

To assess the economic potential of this occurrence, costeaning and large hole drilling should be carried out through the greisen, and if possible into the underlying granite or aplite.

The large area of the greisen and its accessible situation make this an attractive target for consideration as an open cut proposition, providing a grade in excess of 0.2% Mo can be proved.

Until fresh rock is exposed, however, the possibility of superficial enrichment of molybdenum in the gossan cannot be discounted.

Results for Ba, Nb, Sn, and Sr in rocks (Appendix 5)

Several rock samples from the Ayr 1:250,000 sheet area were analyzed for Ba, Nb, Sn, and Sr by A.M.D.L. using X-ray fluorescence. These analyses are additional to those for Cu, Pb, Zn, Co, Ni and Mo plotted on the geochemical maps.

Appendix 5 shows the tabulated results against sample number. These values can be located by referring to the map (fig. 2) of sample location. (These show sample numbers minus the common 6515 prefix).

Comparison of the tabulated values with the published averages of these elements showsthat all Ba and Sr and most Nb and Sn values fall within the normal range for the rock types occurring on the Ayr Sheet, and distribution patternscan generally be related to petrological variations in the bedrock.

The following samples have values of possible interest.

Sample No.	ppm Sn	ppm Nb	Location
0004	15	25	granite near Horseshoe Bay
0012	40	"	granite, Sprole Castle
0065	15	"	" " "
0106	100	"	Kelly's Mountain granite
0116	15	"	" " greisen
0123	40	"	" " "
0129	30	25	rhyolite on Mount Louisa
0132	90	"	granite on Burdekin River
0146	80	"	Cape Upstart granite
0147	80	"	" " "
0150	25	"	" " "
0193	15	"	Gloucester Island granite
0390	15	130	granite, NW central granitic area
0401	15	35	granite, NW central granitic area
0417	15	80	granite north of Mount Louisa
0445	15	45	North-eastern dyke swarm in central granitic area
0451	15	40	" " " " " " " "
0540	15	30	Mount Dalrymple volcanics
0572	15	25	Mount Dalrymple volcanics

This table shows that the granites of Sprole Castle and Cape Upstart are anomalous in tin; this is not unexpected in view of the acid nature of these granites, and their locally high molybdenum content.

The greisen over Kelly's Mountain also contains anomalous amounts of tin, accompanying anomalous nickel values and molybdenum mineralization.

Granites of the central granitic area carry anomalous niobium values and one analyzed sample of granite on the Burdekin River was high in tin (90 ppm).

Results for Ba, Nb, Sn and Sr in soils (Appendix 6)

Appendix 6 lists the results of analyses for Ba, Nb, Sn and Sr on a number of soils from the Ayr 1:250,000 Sheet area.

The samples of possible interest are listed below.

Sample No.	ppm Sn	ppm Nb	Location
0278	10	20	Inkerman shear zone
0289	10	10	Inkerman shear zone
0317	15	10	Southern Cape Upstart granite
0320	40	10	Southern Cape Upstart granite
0419	15	50	Granite north of Mount Louisa

Soil sample 0419 confirms the anomalous result for niobium obtained from a rock sample at a different locality within the granite body north of Mount Louisa.

Results for Heavy Mineral Concentrates (Appendix 7)

Appendix 7 lists A.M.D.L. spectrographic results for Cu, Pb, Zn, Co, Ni, Sn, Au, Cr, V, W, Mo, Be, Pd, in heavy mineral concentrates obtained by panning of stream sediments.

The spectrographic data are of a semiquantitative nature only, and it should be realized that due to the method of panning, consistent heavy mineral concentration factor cannot be expected. Therefore the results should only be taken as a qualitative guide, and cannot be related to each other.

Gold and palladium were not detected.

In emission spectrograph analyses, spurious molybdenum values up to about 10 ppm can result from interference from a very weak iron line superimposed on the molybdenum spectrum. For this reason iron-rich samples frequently show some apparent Mo in spectrographic analysis.

As mentioned elsewhere in this report, high zinc values in heavy mineral concentrates are probably due to lattice entrapped zinc in ferromagnesian minerals and spinels (magnetite).

SUMMARY OF GEOCHEMICAL DATA

Average Concentration of Trace Elements

Hawkes and Webb (1963) list the following typical concentration ranges for various elements in the relevant sample types. All values are in parts per million.

Pb	igneous rocks 16; mafic rocks 12, felsic rocks 48, soils 10, range 2-200.
Cu	igneous rocks 70; mafic rocks 140, felsic rocks 60, soils 20, range 2-100.
Zn	igneous rocks 80; mafic rocks 130, felsic rocks 60, soils 50, range 10-300.
Ni	igneous rocks 100; mafic rocks 160, felsic rocks 8, soils 40, range 5-500.
Co	igneous rocks 18; mafic rocks 45, felsic rocks 5, soils 8, range 1-40.
Nb	igneous rocks 20; mafic rocks 20, felsic rocks 20.
Ba	igneous rocks 640; mafic rocks 270, felsic rocks 830, soils 500, range 100-3,000.
Sn	igneous rocks 32; mafic rocks 6, felsic rocks 45, soils 10.
Mo	igneous rocks 1.7; mafic rocks 1.4, felsic rocks 1.9, soils 2, range 0.2-5.

However, S. R. Taylor (pers.comm.) lists the average value for tin in basalts as 1 ppm and in granites as 3 ppm, and the results of this survey tend to support these lesser tin values rather than those given by Hawkes and Webb.

Copper Distribution

The highest copper values occur in basic rocks and the roof zones of epizonal granites on the eastern portion of the sheet.

The eastern portion of the central granitic area is also high in copper relative to the rest of the central granitic area. Copper values are generally normal for the rock types in which they occur.

Zinc Distribution

Relatively high zinc values occur in the Mount Dalrymple volcanics and at the Seven Sisters, as well as in the granitic complex east of Mount Louisa. The latter is considered the most likely area of potential zinc mineralization on the Ayr Sheet.

Lead Distribution

Lead background throughout the area is abnormally low for the prevailing rock types, although areas of slightly higher lead content correlate with some areas of higher zinc content.

The Ayr 1:250,000 sheet area is considered to have no potential for economic lead mineralization.

Cobalt Distribution

The cobalt distribution merely reflects petrological variations in bedrock and the area is considered to have no potential for cobalt mineralization.

Soils developed over granites are enriched in cobalt relative to bedrock, but the soils over basic rocks have the same order of cobalt content as the parent rocks. Stream sediments reflect this pattern, except in areas where they are derived from mechanical erosion of bedrock.

Nickel Distribution

The granites of the north-western portion of the Ayr sheet are lower than average in nickel, as are the granites and volcanics in the south-west.

By contrast, the granite stock on Cape Upstart and the granites on Sprole Castle, Mount Roundback, and Bowen Island have higher than average nickel values.

The granite phases of the central granitic area are lower in nickel than the dioritic phases.

The Kelly's Mountain greisen and granite are anomalous in nickel, but apart from this the nickel distribution generally follows that for cobalt and can be related to petrological variations in the bedrock.

Soil and stream sediment dispersions are modified by soil formation processes, and therefore show a reduced contrast relative to rock dispersion values.

The Ayr 1:250,000 sheet area is considered to have no potential for nickel mineralization.

Molybdenum Distribution

The granites of Kelly's Mountain and the eastern portion of the Ayr Sheet locally contain above average molybdenum values.

Disseminated molybdenum may occur on Cape Upstart, but exploration would require intensive rock sampling at close intervals, which would be difficult to carry out due to the rugged terrain and lack of road access.

Molybdenum mineralization occurs in an extensive gossan-capped pyritic greisen on Kelly's Mountain, and detailed mapping and rock sampling are recommended, followed by costeaning and drilling.

Apart from Kelly's Mountain, and to a lesser extent Cape Upstart, the molybdenum values on the Ayr sheet follow the norm for these rocks.

Gossans such as the one on Kelly's Mountain do not chemically release heavy metals to soils and streams.

Tin and Niobium Distribution

The granites of Sprole Castle and Cape Upstart, and the granite on Kelly's Mountain, are potentially stanniferous.

The north-western portion of the central granitic area is enriched in niobium.

RECOMMENDATIONS FOR FUTURE WORK

1. This project proved that it is possible, from about 1,000 samples, to produce geochemical maps showing dispersion patterns of economic trace elements. At Kelly's Mountain, where 300 ppm Mo had previously been detected by A.D. Haldane in a sample collected during regional mapping in 1964 (Paine, et al., 1966, Appendix 1), the occurrence of molybdenum mineralization was confirmed in the course of the survey.

It is therefore recommended that similar geochemical surveys be undertaken elsewhere in Australia, initially on the adjoining Bowen sheet, where the field experience on Ayr could be applied.

Where common rock units occur on both the Bowen and Ayr Sheets, the existing work on Ayr could supply valuable data on background concentrations and on the behaviour of elements in the soil and stream sediment cycles.

2. It is recommended that, in future surveys, geochemical data be recorded in a field geochemical notebook instead of on the sample packets. This has the advantage that the sample bags, carrying the sample number only, can be sent direct to the laboratories, while a carbon copy of the field data is sent to the Bureau's transit room for entering onto punch cards, so that there are no delays in punching or analysis through handling the coded packets.

3. In the present survey, many man-hours were spent in panning stream sediments for heavy mineral concentrates, but the results of the heavy mineral sampling have no quantitative significance because the concentration ratio between original sample and heavy mineral fraction was not constant.

The use of a laboratory scale Wilfley table, run from a 240 volt motor powered by an electric generator in the base camp, would enable rapid and efficient panning to be done.

The original sample could be weighed on a rough spring balance prior to panning, and the heavy mineral fractions sent to Canberra for drying and weighing, prior to spectrographic analysis and examination by binocular microscope. Then the concentration factor can be calculated as the ratio of sample weights before and after concentration. All spectrographic analyses can then be "normalized" by applying the appropriate concentration factor, and the resultant quantitative data plotted on maps.

4. Statistical analysis is very difficult, if not impossible, in areas with a wide petrological variation (e.g. the central granitic area on the Ayr sheet). Therefore, future work should give consideration to determining the trace element contents of the constituent mineral components of rocks, rather than the contents of whole rocks. This would involve mineral separation on bulk samples, e.g. flotation, followed by analyses on ubiquitous fractions such as biotites or hornblendes, but it would facilitate the use of statistical methods by reducing all petrological variations to a common denominator.

A number of bulk samples were collected during the Ayr survey with this object in mind, and the crushed material, together with representative hand specimens, is held in the BMR museum. It is suggested that the validity of this idea be tested by carrying out mineral separation work and analyses on biotites and hornblendes from the rock samples collected in this survey.

5. Consideration should also be given in future programmes to the use of an automatic plotter coupled to a computer to plot analytical results directly onto maps, utilizing grid coordinates and analytical data supplied by punch cards. The computer can also be used to plot frequency distribution diagrams, perform statistical analysis (where applicable) and plot trend surfaces.

ACKNOWLEDGEMENTS

The encouragement of Mr. J.F. Ivanac, who supervised this project, is gratefully acknowledged.

A.G.L. Paine provided much valuable geological information and gave general supervision to the field assistants. A.D. Haldane also gave much valuable advice on aspects of this work, in particular the application of statistical methods.

J. Kelly and A.P. Boland carried out the sampling with a minimum of supervision. The maps were compiled by A. McDonnell.

Following the resignation of the author from the Bureau of Mineral Resources, the text of this report was substantially revised and in part re-written by P.W. Crohn and A.G.L. Paine.

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45

Appendix 1.

SPECTROCHEMICAL ANALYSIS OF GEOCHEMICAL SAMPLES FROM AYR, QUEENSLAND.

by

A.D. Haldane

Following are the results of semi-quantitative spectrochemical analysis of 59 soil and 86 rock samples collected from the Ayr 1:250,000 Sheet area as part of the Bowen Basin Geochemical Survey.

The samples were submitted by N.J. Marshall. Gold, bismuth, antimony, zinc, arsenic, tungsten, niobium and tantalum were south but not detected in any sample. All results are expressed in parts per million.

Soil Samples

Sample No.	Ni	Co	Cu	Pb	Mo	V	Other elements
6515037	50	40	25	5		50	
040	30	40	50	5		120	Be(2)
061	a	a	2	10		20	
062	a	a	2	5		6	
063	a	a	2	5		30	
091	a	6	4	10		120	
092	a	3	4	10		60	Sn(5)
101	5	a	4	5		50	
102	a	a	4	5		30	
104	a	a	2	20		2	
105	a	a	2	15		6	
107	a	a	2	15		2	
108	1	3	4	20		12	
110	a	a	2	15		1	
111	a	a	2	15		1	
112	a	a	4	15	2	2	
113	a	a	4	10	10	12	
127	a	3	15	15		60	
128	a	7	10	20		80	
130	a	5	25	60		120	
131	a	7	20	100		120	
133	a	a	2	5		30	
134	a	a	2	5		60	
136	a	3	2	5		60	
137	5	2	4	30		120	
139	5	2	6	40		80	
141	80	60	30	10		250	
159	a	a	2	10		4	
162	a	a	6	20		6	
188	a	a	2	10		10	
190	a	a	4	20	10	40	
195	a	6	4	10		120	
196	a	2	2	10		100	
202	35	20	25	10		150	
199	10	10	25	10		150	

Sample No.	Ni	Co	Cu	Pb	Mo	V	Other Elements
65150204	5	10	10	10		120	
206	15	15	15	10		150	
208	10	15	15	10		150	
210	20	12	15	10		200	
215	a	4	15	10		60	
217	5	10	20	10		150	
219	a	6	20	10		200	
221	5	10	15	10		120	
222	5	10	15	10		120	
224	5	10	10	10		120	
225	5	10	15	10		150	
228	5	12	20	10		120	
230	5	10	10	10		120	
233	20	15	20	10		150	
234	30	15	25	10		200	
236	20	15	30	10		150	
238	40	20	25	10		250	
240	20	10	20	10		120	
242	6	2	10	10		50	
244	2	2	10	20		50	
246	2	a	4	20		40	
248	4	a	5	20		50	
250	10	6	15	20		80	
252	6	6	5	20		80	

Rock Samples

65150003	10	1	2-	10		30	
4	20	a	2	15		5	
12	15	1	2-	10		20	
15	8	1	2	10-		20	
23	10	a	2-	15		a	
24	25	15	30	10-		200	
29	30	20	15	10-		250	
65150036	40	30	10	10-		100	
41	40	20	20	10-		200	
49	30	15	20	10-		200	
56	10	a	2-	15		10	
65	8	10	20	10-		100	
66	10	a	2-	20		1	
75	20	2-	2	130	3	1	
89	25	2-	3	30	3	2	
90	20	2-	2-	30	2	7	
103	60	2-	20	100	3	3	
106	40	2-	15	100	4	3	
109	60	2-	20	100	10	7	
114	30	2-	15	60	700	80	Sn(10)
115	60	2-	15	130	7	2	
116	40	2-	20	100	700	60	Sn(10)
117	40	2-	20	130	20	1	
118	100	25	40	10	5	300	
119	80	2	35	1000	5	20	Ag(2)
120	3	2-	2-	600	2	25	
121	80	2-	30	30	3	20	

Sample No.	Ni	Co	Cu	Pb	Mo	V	Other Elements
65150123	40	2-	15	30	2	15	
126	20	2-	3	30	2-	20	
129	20	2-	3	30	2-	25	
132	20	2-	2	20	2-	1	
135	20	2-	2-	20	2-	1	
138	12	3	6	20	2-	80	
140	150	25	15	10-	2-	100	
142	20	2-	2-	20	2-	3	
146	15	2-	2-	20	4	20	
147	20	2-	2	10	2-	15	
150	15	2-	3	20	3	20	
154	15	25	10	15	1000+	10	
156	20	2-	2-	20	6	15	
158	20	2-	10	30	2-	15	
160	15	2-	3	20	2	3	
65150161	20	2-	10	20	2-	2-	Sn(10)
163	25	2-	2-	20	2	10	Sn(7)
165	20	2-	2-	15	2	10	
166	15	2-	2-	10	2-	10	
168	15	2-	2-	20	3	15	
173	15	2-	2-	10	2	15	
177	20	2-	2-	10-	2	10	
182	20	2-	2-	10-	4	10	
184	15	2-	2-	10	3	10	
189	20	2-	2-	15	6	2	
191	20	2-	2-	10	15	3	
192	20	2-	2-	10	4	4	
193	25	2-	4	10	2-	6	
194	25	2	6	10-	30	40	
197	30	12	20	10-	2-	250	
198	30	10	40	10-	2-	250	
201	30	10	40	10-	2-	200	
203	10	2-	3	10-	2-	30	
205	25	10	20	10-	2-	200	
207	130	30	30	10-	2-	500	
209	80	20	60	15	2-	300	
211	60	10	80	10	3	200	
212	80	15	30	10	2-	300	
213	30	10	20	20	2	200	
216	40	10	60	20	4	300	
218	80	8	60	20	4	250	
220	60	10	40	20	3	300	
223	80	15	60	20	3	300	
227	80	15	40	10	3	300	
229	80	4	35	10	3	100	
231	60	10	40	10	3	200	
232	60	15	15	30	2-	400	
235	30	10	30	20	2	200	
237	20	10	40	10-	2-	300	
214	25	2-	40	30	2-	35	
65150239	20	2-	3	15	2-	30	
241	25	4	6	10	2-	100	
243	25	3	3	20	2-	60	
245	10	2-	2	20	3	25	

Sample No.	Ni	Co	Cu	Pb	Mo	V	Other Elements
65150247	10	2-	2	20	2-	25	
249	30	12	40	20	2	200	
251	10	2-	2-	20	2-	6	
253	15	2-	2-	20	2-	15	

- = less than,
+ = greater than
a = sought but not detected

Serial Nos : 2136,2111.
Plate Nos : 951-952,954,957-959

Appendix 2.

Results of Cu, Pb, Zn, Co, Ni and Mo analyses on Rock Samples from Ayr, 1:250,000 Sheet area.

Sample No.	Grid Ref. East	North	Cu	Pb	Zn	Co	Ni	Mo
3	658700	2496150	4	-3	31	2	17	-1
4	655900	2494500	5	6	15	-2	25	-1
12	636100	2497500	4	4	40	2	27	-1
15	633950	2497400	5	3	38	3	19	-1
23	632000	2497200	3	6	12	12	24	-1
24	630200	2496200	61	4	29	-2	20	-1
29	632200	2495500	24	5	22	-2	22	-1
36	637550	2508500	22	2	28	38	98	-1
41	633500	2506850	108	4	21	2	42	-1
49	632150	2506750	106	-3	14	-2	42	-1
56	622900	2504050	4	6	17	2	24	-1
65	634000	2501050	36	4	63	2	17	-1
66	627750	2498400	3	9	3	-2	25	-1
75	607700	2511300	5	12	9	-2	21	2
89	615550	2502000	5	7	40	-2	23	2
90	617400	2501700	4	4	16	-2	18	1
103	550050	2538400	22	6	13	-2	70	1
106	550300	2537900	22	9	14	-2	59	2
109	550250	2537400	21	12	9	-2	66	4
114	550550	2536750	19	13	3	-2	35	450
115	550450	2537000	22	12	15	-2	54	2
116	550200	2536700	22	16	4	-2	41	500
117	550700	2536650	23	10	31	-2	57	6
118	545850	2533050	52	6	79	27	93	1
119	545850	2533050	41	500	420	22	76	1
120	545850	2533050	8	520	22	2	10	-1
121	545850	2533050	40	9	17	-2	100	-1
123	547600	2532150	22	14	7	-2	45	-1
126	541350	2509900	7	7	25	-2	21	1
129	542450	2507500	7	10	51	-2	22	1
132	542850	2503250	7	7	95	-2	26	1
135	546150	2503150	7	10	27	-2	24	1
138	542500	2510550	10	10	65	5	15	-1
140	617950	2513300	24	-3	40	44	470	-1
142	612000	2523050	5	5	10	-2	34	1
146	611400	2527900	6	9	24	-2	24	2
147	610050	2528550	7	5	13	-2	32	1
150	611700	2525050	8	10	8	-2	17	1
154	610350	2528300	17	6	3	22	13	-
156	605550	2530000	5	5	12	-2	24	1
158	603600	2530200	17	12	23	-2	29	1
160	603000	2517450	8	5	19	-2	19	1
161	602900	2517100	15	5	5	-2	26	-1
163	602700	2517350	7	6	15	-2	28	1
165	600600	2522700	5	5	11	-2	32	1
166	601350	2526250	5	5	12	-2	27	1
168	605450	2526300	4	9	22	-2	22	1
173	605400	2526500	4	5	13	-2	25	1
177	604450	2526400	4	5	15	-2	26	1
182	602950	2527500	5	4	13	-2	32	2
184	602000	2527800	4	6	13	-2	24	1
189	669950	2496550	5	7	16	-2	27	2
191	670400	2496650	6	7	15	-2	24	4
192	682450	2495050	6	6	13	-2	27	1
193	683350	2494250	13	5	18	-2	35	1

50

Sample No.	Grid Ref. East	North	Cu	Pb	Zn	Co	Ni	Mo
194	680450	2497500	17	-3	73	2	35	8
197	551600	2528400	44	4	32	15	61	-1
198	551700	2527850	61	4	51	12	60	1
201	551950	2527300	61	3	31	7	74	-1
203	551750	2527450	11	3	20	-2	26	-1
205	551600	2527200	34	4	34	7	32	-1
207	551450	2527850	24	-3	82	17	80	-1
209	550750	2528250	43	3	84	21	76	-1
211	549750	2527650	46	3	53	18	70	-1
212	550000	2527650	38	4	50	20	80	-1
213	551000	2525900	24	4	51	14	44	-1
214	552450	2524400	16	7	14	-2	39	-1
216	552950	2524450	56	8	47	16	68	-1
218	553700	2524700	63	6	80	15	95	-1
220	554100	2523800	61	7	55	5	85	-1
223	554350	2523950	61	5	56	17	76	-1
227	554050	2523850	46	-3	51	15	83	-1
229	554050	2523850	28	3	43	6	70	-1
231	554550	2522200	44	9	45	8	72	-1
232	554600	2522800	10	8	12	4	30	-1
235	555000	2521900	38	7	49	10	35	-1
237	555300	2521650	52	-3	41	8	22	-1
239	554450	2521700	8	5	14	-2	28	-1
241	519400	2550950	13	3	33	4	34	-1
243	518250	2551000	8	4	21	3	28	-1
245	517700	2551150	6	11	27	-2	18	-1
247	517950	2551050	9	9	27	-2	21	-1
249	517950	2551050	48	3	44	7	30	-1
251	519950	2563500	4	5	12	-2	17	-1
253	518800	2566450	4	9	19	-2	20	-1
254	570750	2511150	30	4	53	20	75	-1
256	570550	2511300	24	13	64	10	140	-1
258	569400	2512050	41	15	69	16	46	-1
260	564250	2518150	10	7	26	7	61	-1
262	564200	2519600	10	5	35	3	10	-1
264	564350	2520000	2	11	19	-2	3	-1
266	567700	2523150	7	4	9	-2	3	-1
269	564000	2518600	8000	4	27	10	26	
270	564000	2518600	40	5	21	-2	2	-1
273	565150	2520850	10	3	11	-2	-2	-1
277	562650	2519950	12	9	75	5	9	-1
281	606000	2519100	43	28	53	3	8	-1
282	606000	2519100	9	34	41	8	23	-1
284	633800	2508000	4	11	5	-2	2	-1
286	556800	2521100	22	7	89	17	8	-1
288	556800	2520250	86	5	320	5	7	-1
290	556650	2519800	4	5	6	-2	-2	14
291	561200	2519300	12	20	112	2	8	1
292	561100	2518500	32	14	74	18	56	-1
293	561250	251890	17	28	109	5	12	-1
294	571900	2526700	4	3	19	-2	-2	
295	571250	2526450	46	-3	37	16	54	-1
296	571250	2526450	5	3	7	-2	2	-1
308	604200	2519300	4	4	11	3	3	-1
312	604900	2518750	5	8	12	-2	-2	-1
322	607900	2517600	3	9	57	8	23	-1
323	608500	2518000	6	5	46	5	5	-1
327	606850	2519700	3	3	13	-2	-2	2
344	552000	2502650	8	11	48	-2	-2	-1

Sample No.	Grid.Ref. East	North	Cu	Pb	Zn	Co	Ni	Mo
349	555450	2499600	4	-3	46	-2	-2	-1
355	557000	2500600	5	3	50	-2	-2	-1
361	555100	2503600	5	4	47	-2	-2	-1
367	552600	2504100	8	5	25	-2	-2	-1
370	550150	2507400	14	-3	30	2	3	-1
374	547900	2506750	3	6	52	6	2	-1
378	545000	2507400	3	9	25	-2	-2	-1
383	545300	2510150	16	18	64	4	8	-1
388	641700	2496400	53	9	12	8	36	-1
390	642400	2496600	3	7	5	-2	-2	
393	521200	2502900	5	16	6	-2	-2	-1
397	548150	2510650	11	25	99	-2	-2	-1
401	550150	2510850	20	16	81	7	10	-1
407	550450	2512750	26	9	19	5	5	-1
417	546400	2510050	34	6	21	4	11	-1
445	566600	2516400	48	5	50	12	7	-1
451	526800	2506100	5	9	34	-2	2	-1
458	525300	2498800	3	6	32	-2	2	-1
460	523900	2506000	4	13	11	-2	-2	-1
462	522700	2501000	6	14	10	-2	2	
465	523200	2502000	8	13	17	-2	-2	-1
477	525500	2509300	2	7	60	-2	-2	
478	525600	2509000	5	13	17	-2	7	-1
500	555100	2520400	40	14	37	11	33	-1
501	538900	2511000	7	11	17	-2	3	-1
519	533600	2505200	4	11	25	-2	3	-1
522	532700	2505400	7	4	11	-2	-2	-1
527	530000	2505000	6	20	30	-2	-2	-1
532	530700	2503300	2	5	3	-2	-2	-1
540	534200	2501000	2	9	10	-2	-2	-1
548	535600	2499100	5	12	35	-2	-2	-1
552	536300	2499400	4	5	52	-2	2	-1
559	538400	2501500	3	4	64	-2	-2	-1
563	539300	2503000	5	6	127	-2	2	-1
570	537100	2503200	13	3	42	-2	-2	-1
572	536300	2503600	4	5	4	-2	-2	-1
574	535800	2502800	4	5	9	-2	-2	-1
576	535900	2503100	7	4	11	-2	-2	-1
578	537500	2502600	6	8	55	-2	-2	-1
582	539000	2504000	5	12	43	-2	2	-1
585	537500	2505000	8	14	6	-2	2	-1
591	536300	2504800	4	3	21	-2	-2	-1
598	529200	2507300	-1	8	64	-2	-2	-1
602	528100	2517400	6	3	12	-2	-2	-1
605	527800	2517500	6	6	11	-2	2	-1
612	529300	2515700	8	48	49	-2	2	-1
615	528400	2515300	4	7	15	-2	-2	-1
618	528900	2514400	6	11	30	-2	2	-1
620	529500	2515100	4	5	43	-2	2	-1
634	555900	2514400	7	5	13	-2	3	-1
635	555100	2514300	13	5	11	-2	2	-1
636	554800	2514400	2	10	14	-2	2	-1
643	559000	2506500	48	11	62	16	30	-1
653	579800	2509900	81	12	66	-2	78	-1
656	578500	2510500	46	10	80	3	58	
659	578100	2510900	14	7	45	2	3	-1
661	577500	2511000	6	16	45	2	-2	-1
665	576400	2510700	30	12	31	9	15	-1
673	574100	2511000	28	10	52	-2	56	-1
676	573800	2510650	20	-8	41	18	2	-1

Sample No.	Grid Ref. East	North	Cu	Pb	Zn	Co	Ni	Mo
680	574250	2509900	36	-8	40	19	2	-1
681	573100	2510150	66	60	59	32	17	-1
686	573300	2509800	66	-8	48	22	2	-1
702	568150	2507100	68	-8	120	23	18	-1
705	566050	2504300	8	-8	33	6	5	1
708	567900	2500850	9	-8	19	4	4	1
709	566700	2500950	27	-8	55	12	5	-1
713	564800	2501550	52	-8	58	6	5	-1
721	560550	2499100	40	92	75	25	29	-1
726	563100	2500350	6	-8	12	4	2	-1
727	563700	2500150	4	-8	12	4	2	-1
732	568050	2500300	7	-8	9	4	3	-1
741	573750	2503750	44	-8	78	23	22	
744	573750	2505400	3	-8	56	8	6	-1
748	573900	2506350	15	-8	13	8	12	-1
750	572400	2497600	7	-8	25	4	4	-1
753	574400	2507650	36	-8	81	26	35	-1
769	642700	2499100	28	-8	8	12	10	-1
772	640700	2499400	13	-8	9	18	71	-1
823	586200	2497900	4	-8	7	1	2	-1
825	585300	2497800	5	-8	19	2	4	-1
828	584450	2497850	4	-8	6	1	2	-1
832	583900	2497800	46	40	58	16	8	-1
839	582300	2496800	6	-8	31	5	4	1
840	582400	2495900	7	-8	3	3	2	1
854	580050	2500200	3	-8	8	3	2	-1
862	580600	2507950	42	-8	38	22	44	-1
864	580900	2507250	16	-8	24	2	6	-1
865	581050	2507450	74	20	56	20	60	
866	581250	2507450	4	20	7	1	2	-1
867	581800	2506600	7	20	32	2	4	1
868	581250	2506550	4	-8	19	3	4	-1
871	576900	2500450	4	-8	38	6	5	-1
872	576650	2500500	4	-8	7	6	5	2
875	576750	2501300	5	40	70	3	6	-1
876	577000	2501300	5	30	41	4	4	-1
877	577050	2502300	57	30	43	19	22	-1
878	576800	2502300	5	10	38	2	4	2
881	578000	2503150	14	10	38	8	6	1
882	578250	2503350	36	10	41	18	18	-1
889	576500	2508700	41	10	28	18	16	-1
893	519200	2561000	8	-8	32	10	10	-1
899	515900	2568900	4	-8	19	2	2	-1
908	516500	2557550	6	-8	24	3	5	-1
910	515700	2556650	4	-8	22	3	6	-1
913	515250	2556350	41	-8	22	4	3	-1
917	518350	2553100	14	-8	32	3	4	-1
928	515850	2540850	8	-8	89	3	7	-1
930	516450	2542700	28	30	58	22	48	-1
933	515800	2545350	24	-8	40	12	32	-1
938	516300	2545950	4	-8	6	3	6	-1
941	516900	2546950	10	-8	16	2	2	-1
943	516600	2547150	8	-8	12	2	4	-1
946	517800	2547450	5	-8	26	4	6	-1
949	517750	2548200	3	-8	17	3	5	-1
952	517300	2548450	3	-8	18	3	4	-1
953	519400	2548900	6	-8	33	18	53	
957	517900	2551000	4	-8	24	3	4	-1
960	518300	2540900	4	-8	31	3	6	-1
964	525650	2539350	3	-8	40	2	3	-1

Sample No.	Grid Ref East	North	Cu	Pb	Zn	Co	Ni	Mo
967	523450	2545550	6	-8	14	1	5	-1
969	522300	2546800	9	40	38	16	16	-1
972	570650	2526350	4	-8	4	1	4	-1
974	571200	2526800	3	-8	6	1	4	-1
977	573650	2528350	3	-8	6	2	4	-1
979	572850	2526800	4	-8	5	2	5	-1
981	572000	2526500	4	-8	2	1	5	-1
983	571450	2525850	6	-8	8	1	5	-1
998	547100	2532350	10	40	4	1	4	-1
999	546100	2533850	4	-8	15	3	4	-1
1002	546400	2534100	3	-8	10	2	6	-1
1008	549100	2536500	4	-8	15	3	8	-1
1015	551600	2536750	6	-8	15	2	2	-1
1018	550900	2536250	13	-8	25	1	4	-1
1019	550200	2535750	10	-8	6	3	6	22
1033	519500	2512300	8	-8	7	5	6	-1
1036	515500	2582200	4	-8	15	3	6	-1
1039	514300	2585250	4	-8	23	4	6	-1
1046	523450	2569100	5	-8	7	3	6	-1
1047	523800	2567300	3	-8	24	1	2	-1
1048	600300	2524850	2	-8	10	1	6	-1
1051	601050	2530650	3	-8	10	1	8	-1
1052	601400	2529550	3	-8	15	2	8	2
1053	600100	2523850	3	-8	7	2	4	-1
1056	601500	2521950	3	-8	22	1	4	1
1059	603900	2518250	4	-8	36	3	7	-1
1060	604000	2518000	12	-8	40	3	8	-1
1061	608200	2514150	108	-8	8	28	62	1
1062	591150	2514700	46	-8	16	8	14	-1
1063	590700	2516000	4	-8	-4	2	5	-1

54

APPENDIX 3.

Results of Cu, Pb, Zn, Co, Ni and Mo analyses of Soil samples from Ayr 1:250,000 sheet area.

Sample No	Grid Ref East	Grid Ref North	Cu	Pb	Zn	Co	Ni	Mo
37	637850	2508850	16	<8	20	40	33	<1
40	632400	2506400	48	<8	38	52	28	<1
61	634050	2503200	2	<8	6	4	-	<1
62	634200	2502150	2	<8	3	4	1	<1
63	635250	2501000	2	<8	5	4	2	<1
91	616800	2501200	6	<8	34	11	4	<1
92	615900	2501500	5	<8	19	7	2	<1
101	614200	2504100	5	<8	14	6	2	<1
102	614800	2504400	2	<8	16	5	2	<1
104	550050	2538400	2	<8	6	4	2	<1
105	550050	2538400	2	<8	7	2	2	<1
107	549600	2537650	2	<8	4	4	2	<1
108	549600	2537650	2	<8	4	6	2	<1
110	550250	2537400	2	<8	7	3	2	<1
111	550250	2537400	2	<8	7	4	2	<1
112	550550	2536750	4	<8	4	4	2	5
113	550550	2536750	4	<8	7	5	2	20
127	541350	2509900	12	<8	51	8	2	<1
128	541350	2509900	9	<8	29	12	2	<1
130	542450	2507500	17	<8	104	11	5	<1
131	542450	2507500	14	126	114	12	8	<1
133	542850	2503250	2	<8	22	2	5	<1
134	542850	2503250	2	<8	24	3	5	<1
136	546150	2503150	2	<8	14	6	3	<1
137	546150	2503150	5	<8	15	4	10	<1
139	542500	2510550	6	<8	25	8	5	<1
141	617950	2513300	29	<8	22	45	84	<1
159	603000	2517450	3	<8	10	5	2	<1
162	602900	2517100	7	<8	10	6	6	<1
188	682100	2494800	4	<8	8	4	6	<1
190	669950	2496550	4	<8	20	12	5	<6
195	679300	2496450	7	<8	22	8	4	<1
196	679700	2493350	2	<8	7	4	2	<1
199	551700	2527850	18	<8	36	15	6	<1
202	551950	2527300	25	<8	41	22	34	<1
204	551750	2527450	15	<8	21	15	10	<1
206	551600	2527200	15	<8	30	18	28	<1
208	551450	2527850	13	<8	29	17	18	<1
210	550750	2528250	20	<8	40	18	30	<1
215	552450	2524400	12	<8	23	9	6	<1
217	552950	2524450	33	<8	25	10	11	<1
219	553700	2524700	24	<8	45	12	4	<1
221	554100	2523800	12	<8	18	10	6	<1
222	554100	2523800	14	<8	35	12	6	<1
224	554350	2523950	8	<8	35	10	8	<1
225	554350	2523950	12	<8	20	15	14	<1
228	554050	2523850	30	<8	36	15	14	<1
230	554050	2523850	12	<8	26	12	12	<1

Sample No	Grid Ref East	Grid Ref North	Cu	Pb	Zn	Co	Ni	Mo
233	554600	2522800	11	<8	64	14	12	<1
234	554600	2522800	14	<8	64	16	14	<1
236	555000	2521900	28	<8	64	16	14	<1
238	555300	2521650	23	<8	20	23	26	
240	554450	2521700	21	8	28	20	24	
242	519400	2550950	16	8	65	10	18	
244	518250	2551000	6	<8	18	6	5	
246	517700	2551150	5	<8	24	4	5	
248	517950	2551050	9	<8	22	5	5	
250	517950	2551050	11	<8	34	8	10	
252	519950	2563500	5	<8	13	8	6	
257	577550	2511300	100	20	60	5	16	<1
259	569400	2512050	17	3	75	21	76	<1
261	564250	2518150	36	<3	44	20	69	<1
263	564200	2519600	155	3	68	17	20	<1
265	564350	2520000	5	<3	20	8	9	<1
267	567700	2523150	6	3	14	7	13	<1
268	567700	2523150	6	4	15	7	15	<1
271	564000	2518600	565	5	62	12	35	<1
272	564000	2518600	12	3	42	7	23	<1
274	565150	2520850	13	3	30	6	13	<1
275	565200	2520700	8	<3	23	2	13	<1
276	565200	2520700	15	<3	22	4	13	<1
278	562650	2520250	12	3	36	19	30	<1
279	562650	2520250	40	3	44	17	55	<1
280	562650	2519950	40	<3	98	6	42	<1
285	558800	2520850	23	3	56	6	32	<1
287	556800	2521100	15	<3	69	10	10	<1
289	556800	2520250	60	3	102	12	35	<1
317	606500	2518500	14	10	28	7	13	<1
318	606500	2518500	17	10	28	4	12	
320	608100	2518100	3	3	6	4	4	<1
321	608100	2518100	3	3	6	3	3	<1
337	550250	2498400	2	5	7	< 2	11	<1
338	550250	2498400	7	6	10	< 2	29	1
384	545300	2510150	12	13	44	2	12	
385	545300	2510150	11	13	39	2	10	1
398	548150	2510650	13	20	85	5	15	
402	550150	2510850	16	13	75	6	18	1
408	550450	2512750	9	13	46	4	8	
416	548800	2521600	19	11	26	17	65	1
418	546400	2510050	21	16	68	3	33	1
419	546550	2519500	22	10	20	10	17	1
429	563900	2516450	40	<3	43	13	47	1
430	564150	2518400	37	5	39	12	24	1
446	566600	2516400	42	5	45	6	11	1
456	525400	2500300	5	<3	4	< 2	2	1
457	525400	2500300	6	<3	4	< 2	4	1
463	522700	2501000	18	10	25	3	5	1
466	523200	2502000	8	5	11	< 2	3	1
467	523200	2502000	9	5	12	2	3	1
471	516900	2503300	5	5	7	10	2	1
472	516900	2503300	5	5	7	11	2	1
480	560400	2522600	26	5	48	9	24	1

Sample No	Grid Ref East	Grid Ref North	Cu	Pb	Zn	Co	Ni	Mo
481	560400	2522600	26	5	44	9	23	
485	561000	2521200	24	5	13	10	18	<1
486	561000	2521200	21	5	35	4	17	<1
495	555700	2520800	20	5	49	<2	21	<1
496	555700	2520800	28	5	68	18	31	
498	554700	2521200	36	5	45	24	43	<1
499	554700	2521200	38	5	47	20	56	<1
502	538900	2511000	8	10	21	5	5	<1
503	538900	2511000	9	12	20	3	4	<1
504	538000	2510900	13	17	36	18	12	<1
505	538000	2510900	7	12	23	2	5	<1
506	536650	2510800	12	5	15	5	6	<1
507	536650	2510800	6	5	17	7	9	<1
510	535600	2507500	16	12	36	7	10	<1
511	535600	2507500	28	17	56	10	18	<1
512	534850	2505500	6	10	36	5	4	<1
513	534850	2505500	5	10	36	7	4	<1
516	533650	2505500	5	5	15	4	3	<1
517	533650	2505500	5	5	13	4	3	<1
520	532700	2505400	8	10	15	3	3	2
523	531200	2506400	5	5	7	<2	2	<1
524	531200	2506400	5	5	8	2	4	<1
525	530800	2505200	5	5	9	3	4	<1
526	530800	2505200	5	7	13	4	6	<1
528	530000	2504300	9	15	25	12	9	<1
529	530000	2504300	12	12	28	13	8	<1
530	530000	2503800	16	25	53	14	9	2
533	529300	2502900	10	15	15	8	6	<1
534	529300	2502900	12	17	13	8	6	<1
535	530500	2502700	12	20	45	12	6	<1
537	531800	2502200	15	20	26	7	6	1
541	532600	2499700	4	7	6	2	3	1
542	532600	2499700	3	10	4	2	2	1
549	535600	2499100	5	9	31	2	4	1
550	535600	2499100	5	8	24	2	5	<1
553	536300	2499400	4	5	14	2	3	
554	536300	2499400	3	5	12	2	3	<1
560	538400	2501500	4	4	23	3	4	<1
561	538400	2501500	7	8	36	3	4	<1
564	539300	2503000	3	4	22	2	3	<1
565	539300	2503000	3	4	22	<2	3	<1
567	538100	2503700	4	4	9	2	3	<1
568	538100	2503700	3	<3	6	<2	2	<1
583	539000	2504000	11	12	48	9	4	<1
584	539000	2504000	8	11	42	8	4	<1
586	537500	2505000	6	8	13	5	2	<1
587	537500	2505000	7	12	22	5	3	<1
600	529200	2517000	8	8	9	8	4	<1
601	529200	2517000	10	8	11	7	6	<1
603	528100	2517400	6	7	8	6	3	<1
604	528100	2517400	3	7	5	5	2	
606	527800	2517500	5	9	8	5	3	<1
607	527800	2517500	9	35	23	42	8	<1
613	529300	2515700	12	38	83	7	10	<1
614	529300	2515700	11	42	86	10	10	<1
621	529500	2515100	4	12	20	3	3	1

Sample No	Grid Ref East	Grid Ref North	Cu	Pb	Zn	Co	Ni	Mo
628	555100	2520400	19	7	47	9	15	<1
651	579800	2509900	35	7	75	38	41	<1
652	579800	2509900	35	8	74	28	40	<1
654	578500	2510500	33	5	74	32	23	<1
655	578500	2510500	31	5	70	23	23	<1
657	578100	2510900	29	6	58	21	41	<1
658	578100	2510900	42	6	56	25	40	<1
663	576400	2510700	39	4	47	2	17	<1
664	576400	2510700	40	5	50	14	20	<1
667	574900	2510600	32	5	35	15	15	<1
668	574900	2510600	42	5	36	8	17	<1
669	574500	2510600	41	5	56	13	37	<1
670	574500	2510600	44	4	47	5	35	<1
671	574100	2511000	29	4	40	4	20	<1
672	574100	2511000	42	3	44	9	20	<1
677	573800	2510650	35	3	42	4	33	1
678	573800	2510650	61	3	39	3	38	<1
682	573100	2510150	68	4	36	22	44	<1
683	573100	2510150	85	4	43	22	50	1
710	566700	2500950	19	4	19	13	21	<1
711	566700	2500950	12	4	14	14	19	<1
722	561300	2499800	7	<3	12	7	9	<1
723	561300	2499800	4	4	11	6	10	<1
724	562600	2499750	8	5	6	4	4	<1
725	562600	2499750	8	4	15	4	5	<1
728	564900	2500050	8	11	15	2	3	1
729	564900	2500050	7	9	16	<2	2	<1
730	566700	2500250	5	4	5	2	3	<1
731	566700	2500250	6	4	4	2	4	<1
733	568050	2500300	16	5	28	17	30	<1
734	568050	2500300	21	8	28	20	33	<1
742	573750	2503750	11	4	16	11	18	<1
743	573750	2503750	10	<3	19	17	18	<1
745	573750	2505400	17	4	16	8	13	<1
746	573750	2505400	17	4	15	11	11	<1
751	574050	2506300	25	4	6	2	25	<1
752	574050	2506300	27	4	14	14	28	<1
754	574400	2507650	29	4	22	7	43	<1
755	574400	2507650	30	4	11	25	42	
759	582300	2509750	19	<3	16	15	18	<1
761	581900	2510250	18	4	5	19	18	
824	585800	2498000	2	4	3	<2	2	<1
826	585300	2497800	9	11	11	9	9	<1
827	585300	2497800	12	13	7	7	9	<1
829	584450	2497850	14	4	9	13	13	<1
830	584450	2497850	14	4	7	8	13	<1
833	583900	2497800	32	4	23	20	29	<1
834	583900	2497800	37	<3	20	17	52	<1
841	582400	2495900	11	5	12	8	8	<1
842	582400	2495900	92	11	26	5	16	
846	582500	2495500	6	4	5	4	6	<1
847	582500	2495500	7	4	2	4	8	<1
855	580050	2500200	7	<3	2	5	3	<1
856	580050	2500200	7	4	2	5	3	

Sample No	Grid Ref East	North	Cu	Pb	Zn	Co	Ni	Mo
905	517400	2558800	14	8	12	22	11	<1
915	518100	2554200	38	4	23	60	62	<1
920	518400	2552950	9	4	10	11	8	<1
929	515850	2540850	3	4	4	6	3	<1
931	516450	2542700	16	4	15	22	25	<1
934	515800	2545350	29	5	28	5	31	<1
947	517800	2547450	10	4	15	7	6	
950	517750	2548200	10	5	22	11	9	<1
965	525650	2539350	10	8	16	5	5	<1
966	526150	2541550	15	4	25	17	21	<1
971	522000	2547550	18	3	37	9	22	<1
973	570650	2526350	2	3	5	2	4	<1
975	571200	2526800	3	3	11	5	5	<1
976	572000	2527450	11	4	16	9	10	
978	573650	2528350	12	4	22	8	13	<1
980	572850	2526800	11	4	19	12	15	<1
982	572000	2526500	2	4	29	8	19	<1
984	571450	2525850	10	4	19	5	15	<1
1006	548700	2535600	5	<3	2	4	4	
1007	548700	2535600	3	<3	3	2	3	
1011	549100	2539750	7	<3	4	2	4	
1012	549100	2539750	2	8	9	<2	5	
1013	550550	2539450	6	<3	6	<2	5	
1014	550550	2539450	2	4	7	<2	4	
1016	551600	2536750	5	11	55	2	3	
1017	551600	2536750	6	13	32	4	4	
1020	552100	2536450	11	4	27	<2	4	
1021	552100	2536450	16	<3	29	<2	4	
1023	522850	2498900	6	<3	12	<2	2	
1024	522850	2498900	5	<3	10	<2	<2	
1037	514700	2583700	5	<3	26	2	7	
1038	514700	2583700	<1	<3	14	2	5	

APPENDIX 4

Results of Cu, Pb, Zn, Co, Ni and Mo analyses of Stream Sediment samples from Ayr 1:250,000 sheet area.

Sample No	Grid Ref East	Grid Ref North	Cu	Pb	Zn	Co	Ni	Mo
1	658500	2496700	3	8	10	-2	-2	-1
2	658650	2496350	2	2	6	-2	-2	-1
5	635550	2498200	11	3	36	10	25	-1
6	635050	2497500	6	3	51	2	8	-1
7	634750	2497200	4	3	31	4	7	-1
8	634500	2497000	3	-3	15	-2	5	-1
9	634450	2497250	66	-3	52	17	40	-1
11	636100	2498200	1	-3	7	-2	2	-1
13	634400	2496800	51	-3	42	13	35	-1
14	634300	2496750	7	3	56	3	9	-1
16	634000	2497500	42	-3	45	8	26	1
17	633100	2497450	9	-3	50	7	10	1
18	633550	2497500	13	-3	38	7	11	-1
19	633350	2497000	28	-3	39	12	16	-1
20	633200	2497200	26	-3	42	-2	13	3
21	632600	2497350	1	-3	24	2	7	-1
22	632250	2497200	3	3	24	3	3	-1
26	631000	2496150	31	-3	62	-2	33	-1
27	631600	2496400	56	-3	57	15	18	-1
28	631500	2495950	36	-3	49	10	45	-1
30	631900	2495400	51	8	68	43	420	-1
31	631350	2495400	46	8	57	40	320	-1
32	631400	2495200	42	4	34	10	18	-1
33	630200	2497050	12	3	27	12	29	-1
34	635000	2498600	12	3	27	10	17	-1
35	634200	2498700	9	3	30	10	13	-1
38	633550	2506700	64	3	53	24	65	-1
39	633500	2506550	51	3	54	12	18	-1
42	633700	2506250	89	3	62	2	25	-1
43	633950	2505900	64	3	59	21	20	-1
44	633900	2505500	43	-3	59	12	20	-1
45	633250	2505550	56	-3	38	13	26	-1
46	632950	2505450	31	3	38	13	23	-1
47	632400	2507650	46	3	17	-2	7	-1
48	632600	2506300	69	3	40	21	64	-1
50	632300	2506550	66	-3	31	12	49	-1
51	632700	2505950	51	-3	48	15	23	-1
52	633450	2500400	12	6	31	7	14	-1
53	632250	2500400	6	4	24	5	9	-1
54	631300	2500150	3	3	13	3	3	-1
55	622500	2504150	14	5	31	10	15	-1
57	623500	2504250	13	3	28	8	22	-1
58	623400	2504450	15	3	40	6	17	-1
59	623650	2504400	13	3	34	11	21	-1
60	634200	2501050	2	4	3	-2	-2	-1
64	631900	2498950	5	-3	21	7	13	-1

Sample No	Grid Ref East	North	Cu	Pb	Zn	Co	Ni	Mo
*68	620350	2501850	12	-8	24	4	6	-1
69	615100	2506600	38	-3	34	18	40	-1
70	614850	2506150	19	-3	36	17	18	-1
71	613850	2502950	2	3	2	19	-2	-1
72	613000	2502850	4	4	5	8	3	-1
73	606850	2511150	1	5	6	-2	-2	-1
76	607800	2511200	3	8	19	-2	3	-1
77	603450	2505850	3	4	5	4	2	-1
78	603100	2503750	3	3	3	7	2	-1
79	603050	2501250	8	5	21	9	7	-1
80	602800	2500950	12	6	19	15	7	-1
81	603150	2499000	10	6	18	11	8	-1
83	604900	2508250	4	8	9	9	3	-1
84	605900	2503850	3	12	9	5	3	-1
85	604900	2503050	5	8	11	5	5	-1
86	604550	2505600	6	10	16	20	7	-1
87	605000	2505650	2	6	5	3	-2	-1
88	604400	2504950	13	10	20	18	9	-1
93	615650	2501750	10	4	119	11	8	-1
94	615150	2501800	3	3	51	4	3	-1
95	615000	2502000	9	3	64	10	5	-1
96	617050	2501900	5	5	69	3	6	-1
97	616750	2501950	14	4	86	10	14	-1
98	616500	2501950	5	3	50	5	4	-1
99	615900	2502100	3	3	52	3	2	-1
100	615450	2502250	3	3	58	3	-2	-1
125	547600	2532150	2	8	16	3	3	-1
143	612000	2523050	2	8	22	-2	-2	-1
145	612000	2523250	3	12	24	2	-2	-1
*149	610050	2528550	11	-8	40	4	4	2
152	611700	2525050	2	10	19	-1	-2	1
153	610700	2525200	2	10	20	-2	-2	1
157	605550	2530000	2	8	20	2	-2	-1
167	601350	2526250	2	5	18	2	-2	-1
169	605450	2526300	1	17	19	-2	-2	-1
*170	605300	2526150	16	-8	29	1	6	-1
171	605500	2526100	3	10	21	-2	-2	2
*172	605700	2526450	5	-8	11	1	5	-1
174	605000	2526850	2	9	14	-2	-2	-1
175	604900	2526650	3	9	25	-2	-2	-1
176	604350	2526700	3	14	19	-2	-2	4
178	603550	2526950	2	12	20	-2	-2	1
179	603700	2527100	3	14	27	-2	-2	2

* Analysis by B.M.R. A.C.T.

Sample No	Grid Ref East	North	Cu	Pb	Zn	Co	Ni	Mo
180	603100	2527150	2	14	22	-2	-2	1
181	602950	2527500	2	11	18	-2	-2	1
183	603200	2527600	2	11	21	-2	-2	-1
185	602200	2527900	2	13	23	-2	-2	-1
187	602100	2528000	3	12	30	-2	-2	1
200	551800	2527700	33	11	48	-2	59	-1
226	554350	2523950	49	11	62	12	31	-1
255	570750	2511150	17	10	35	13	4	-1
297	605700	2520500	1	6	16	-2	-2	4
298	605700	2520300	7	10	31	2	7	-1
299	605400	2520200	9	5	28	3	6	-1
300	605150	2520650	2	10	17	-2	2	-1
301	605100	2520750	4	10	36	3	3	-1
302	604000	2520500	4	5	24	4	6	-1
303	604150	2521400	2	11	16	-2	-2	-1
305	604650	2521550	2	11	23	-2	-2	2
306	604700	2521350	2	13	22	-2	2	-1
307	605150	2521600	2	15	19	-2	-2	-1
309	604900	2519150	2	3	7	-2	-2	-1
310	604900	2518750	4	6	26	-2	3	-1
311	605000	2518400	3	-3	12	-2	3	-1
313	607050	2518000	3	6	11	3	3	-1
314	606700	2517150	8	3	17	3	5	-1
316	606500	2518700	3	5	9	2	3	-1
319	607100	2517300	4	3	5	2	3	-1
324	609100	2518350	18	6	26	16	12	-1
325	608500	2518700	7	8	18	3	4	-1
326	607600	2519700	10	13	33	7	2	-1
328	607150	2519600	6	10	22	3	5	-1
329	607050	2519500	4	8	18	2	3	-1
330	607650	2519000	4	5	14	2	3	-1
331	607800	2519500	3	5	14	3	3	-1
332	608000	2519100	9	6	29	3	6	-1
333	542000	2508600	4	10	46	4	37	-1
335	552900	2497100	4	6	21	3	9	-1
339	549800	2500700	6	6	18	4	24	-1
341	542500	2509000	11	22	68	3	80	-1
342	550050	2502700	7	15	75	6	21	-1
343	550900	2502350	4	6	35	2	18	-1
345	553200	2501450	6	5	37	-2	13	-1
346	554100	2500600	7	5	33	3	12	-1
347	554400	2499900	16	6	56	6	23	-1
348	555450	2499600	3	3	27	4	7	-1
350	554500	2497800	4	5	21	9	8	-1

Sample No	Grid Ref East	Grid Ref North	Cu	Pb	Zn	Co	Ni	Mo
352	558500	2499000	10	3	15	6	10	-1
354	557000	2500600	12	5	35	7	10	-1
356	556900	2501300	6	5	38	9	7	-1
357	556600	2501700	5	5	41	6	5	-1
358	556600	2502450	7	7	35	8	10	-1
359	556400	2502700	6	5	27	2	6	-1
360	555100	2503600	9	3	30	4	5	-1
362	553650	2504900	8	6	47	4	62	-1
363	555300	2505300	22	8	19	8	14	-1
364	555100	2505300	8	5	16	6	7	-1
365	555000	2505050	7	5	17	3	6	-1
366	553500	2504700	9	5	15	5	5	-1
368	550300	2506000	15	6	31	4	8	-1
369	550500	2506500	11	8	22	4	7	-1
371	549900	2506450	15	20	42	7	13	-1
372	549400	2505700	7	11	18	3	8	-1
373	548800	2505800	16	20	49	4	14	-1
375	546200	2506300	10	10	22	4	8	-1
376	545500	2506250	15	34	49	6	10	-1
377	545200	2506100	12	16	35	6	10	-1
379	544100	2507000	15	85	101	6	6	-1
380	542800	2505250	5	13	24	4	7	-1
382	544600	2511000	5	24	43	6	4	-1
386	546000	2510150	13	51	90	3	2	-1
387	642200	2495600	105	3	37	6	15	-1
389	642800	2496000	45	5	35	14	16	-1
391	642600	2496900	26	8	31	14	19	-1
392	642300	2496800	30	11	27	14	21	-1
394	543150	2521450	27	18	73	20	24	-1
396	547200	2510650	14	32	59	3	7	-1
399	548750	2510700	21	28	88	13	20	-1
400	549650	2510750	21	26	52	10	19	-1
403	550500	2511150	34	55	120	12	29	-1
404	550450	2512150	10	42	61	8	15	-1
405	546200	2513450	16	34	45	7	20	-1
409	550400	2515300	9	15	20	3	11	-1
411	551950	2514700	6	20	20	-2	6	-1
412	554200	2515000	13	11	26	6	20	-1
413	553400	2519800	8	11	24	4	20	-1
414	551800	2521150	7	8	16	4	13	-1
420	545300	2520800	30	20	53	54	36	-1
421	571850	2512350	27	4	38	12	19	-1
423	570200	2511200	23	-3	35	12	17	-1

Sample No	Grid Ref East	North	Cu	Pb	Zn	Co	Ni	Mo
424	569200	2512650	37	-3	39	13	18	-1
425	569050	2511500	30	-3	45	13	19	-1
426	569050	2511200	14	-3	17	-2	9	-1
427	563450	2514350	24	5	35	13	19	-1
428	562550	2513850	30	5	56	12	22	-1
431	563750	2519400	19	5	29	7	16	-1
432	563400	2519550	20	-3	26	10	16	-1
433	564650	2519550	28	5	33	3	25	-1
434	563750	2519450	25	-3	37	10	24	-1
435	566500	2518000	27	5	33	12	20	-1
437	568250	2521150	19	5	24	15	18	-1
438	570500	2517700	24	-3	27	19	19	-1
439	570650	2516400	25	5	25	11	12	-1
440	571100	2518000	10	-3	9	7	7	-1
442	567400	2515750	25	-3	19	8	10	-1
443	567200	2516150	26	-3	27	4	12	-1
444	566550	2516450	38	5	39	8	19	-1
447	527600	2508300	3	5	2	-2	2	-1
448	527000	2507700	10	5	7	2	3	-1
450	528100	2506400	5	5	4	-2	2	-1
453	527200	2503600	6	-3	7	3	4	-1
454	524600	2501700	15	7	23	-2	5	-1
455	524800	2501600	11	5	23	3	5	-1
459	525300	2498800	6	7	25	-2	2	-1
461	519800	2504000	4	7	8	-2	-2	-1
464	523200	2502500	20	12	34	7	9	-1
468	515800	2501000	8	10	26	2	2	-1
469	515800	2500600		sample missing				-1
470	519900	2506700	5	5	7	3	-2	-1
473	520300	2508700	4	5	7	8	-2	-1
474	520500	2508900	3	-3	6	2	-2	-1
476	518800	2508000	6	5	19	11	2	-1
479	560400	2522600	15	5	18	10	14	-1
483	562300	2521600	17	7	25	10	13	-1
484	561000	2521200	22	7	31	10	19	-1
487	561000	2519200	19	5	33	13	13	-1
488	559900	2519700	22	5	35	12	18	-1
489	559100	2518900	19	5	30	13	16	-1
490	559400	2518700	17	5	32	18	15	-1
491	557800	2519000	17	5	34	16	17	-1
492	557500	2518700	20	5	35	-2	21	-1
493	557700	2519700	12	-3	23	-2	12	-1
494	556200	2520000	15	5	32	-2	14	-1

64

Sample No	Grid Ref East	Grid Ref North	Cu	Pb	Zn	Co	Ni	Mo
497	556800	2521700	18	-3	45	11	19	-1
508	536600	2508200	6	7	23	8	5	-1
514	535300	2505250	13	15	68	10	9	-1
515	534800	2505000	15	17	72	7	9	-1
518	533600	2505200	11	15	76	9	10	-1
521	533000	2505400	12	17	75	7	9	-1
531	530700	2503300	40	25	107	11	11	-1
536	531300	2502600	40	25	116	13	11	-1
538	532200	2502000	13	15	50	-2	10	-1
539	534200	2501000	8	15	32	3	6	-1
543	533500	2498900	4	7	16	2	2	-1
545	535400	2498500	3	5	9	2	3	-1
547	535600	2499100	8	12	51	4	5	-1
551	536300	2499400	4	8	30	2	2	-1
555	539600	2499300	6	8	26	3	3	-1
557	538300	2500400	5	16	63	3	3	-1
558	538000	2500000	4	15	52	[illegible]	2	-1
562	538900	2502200	5	12	36	3	3	-1
566	538500	2503100	12	38	67	4	10	-1
569	537600	2503400	12	24	59	7	7	-1
571	537100	2503200	13	48	78	3	8	-1
573	536300	2503600	17	76	93	6	9	-1
575	535800	2502800	8	18	52	9	13	-1
577	535900	2503100	7	15	64	6	3	-1
579	537500	2502600	5	20	45	4	3	-1
580	542800	2500150	8	8	40	8	6	-1
589	537000	2505500	8	16	58	6	3	-1
590	536700	2504700	10	22	72	3	3	-1
592	536300	2504800	8	13	39	5	8	-1
594	530250	2516000	2	5	5	3	-2	-1
596	530000	2518000	6	8	11	5	3	-1
597	529700	2517600	7	15	16	8	4	-1
599	529200	2517000	12	13	24	20	7	-1
608	527700	2516600	3	5	5	3	2	-1
609	526700	2516500	2	-3	3	2	2	-1
610	526900	2516700	2	4	3	3	2	-1
611	525800	2517000	3	6	7	3	2	-1
617	528000	2514000	2	-3	4	2	8	-1
619	529500	2514500	3	8	14	5	3	-1
622	530050	2514500	3	-3	7	3	2	-1
623	530300	2514500	3	7	7	8	2	-1
624	530000	2513100	3	5	6	3	2	-1
625	529900	2512300	10	-3	5	5	2	-1
626	529700	2511300	8	7	11	6	3	-1
627	528600	2509300	3	4	9	3	2	-1
629	555000	2519900	8	5	24	7	11	-1

65

Sample No	Grid Ref East	Grid Ref North	Cu	Pb	Zn	Co	Ni	Mo
630	553400	2519800	8	7	16	9	10	-1
632	555600	2514700	8	7	19	8	8	-1
633	555700	2515700	8	5	24	9	8	-1
637	558500	2513000	3	5	8	7	4	-1
638	559100	2512900	10	5	22	12	8	-1
639	558400	2512500	23	9	47	21	13	-1
640	559300	2510200	1	9	12	16	6	2
641	558800	2508300	7	8	38	17	7	-1
642	558900	2506100	8	5	54	10	6	-1
644	562500	2506000	8	5	32	16	9	-1
645	564300	2507500	9	4	25	11	8	-1
646	575000	2520800	7	5	14	12	5	-1
648	577300	2515800	11	4	20	17	8	-1
650	577400	2515800	41	4	60	23	25	-1
660	577800	2510700	40	4	40	20	15	-1
662	577300	2510800	49	5	53	5	24	-1
666	575500	2511300	19	4	30	12	12	-1
674	583000	2511800	14	9	28	3	8	-1
675	583800	2510500	8	11	15	7	8	-1
679	573450	2510100	28	-3	40	10	19	-1
684	572300	2510850	28	-3	26	14	17	-1
685	572650	2510800	31	3	31	13	22	-1
687	574150	2507650	19	-3	19	10	15	-1
688	571300	2500750	10	-3	17	3	10	-1
689	571300	2501050	17	11	29	11	12	-1
690	570800	2499650	9	21	34	3	5	-1
693	570300	2499600	10	11	29	6	10	-1
694	570250	2500950	11	3	17	2	14	-1
695	570100	2502250	11	3	19	6	13	-1
696	570200	2503950	16	-3	23	10	18	-1
697	570150	2505150	26	5	37	16	25	-1
698	570000	2504950	14	5	19	14	17	-1
699	570150	2507250	40	5	42	27	35	-1
700	569500	2507400	24	3	19	2	23	-1
701	568150	2507100	26	9	14	21	33	-1
703	564150	2505050	17	5	10	42	24	-1
704	564900	2505000	16	5	12	24	23	-1
706	566100	2503900	19	5	14	13	24	-1
707	567800	2501400	12	3	12	10	16	-1
712	564800	2501550	18	16	29	11	16	-1
714	562550	2502050	17	9	14	13	17	-1
715	559150	2502500	11	-3	8	11	7	-1
717	559000	2502750	12	5	8	19	7	-1
719	559250	2500650	11	11	12	11	10	-1
735	567050	2498700	11	9	12	11	10	-1
737	569400	2497400	18	16	26	14	13	-1
738	568950	2496050	30	64	62	17	13	2
739	572150	2498000	17	23	40	13	11	-1
740	571900	2497850	24	23	54	16	14	-1
747	573100	2505650	14	-3	12	6	12	-1

Sample No	Grid Ref East	North	Cu	Pb	Zn	Co	Ni	Mo
749	572300	2497550	17	31	57	10	6	-1
756	584800	2507800	19	14	26	16	13	-1
757	583450	2505500	12	16	21	13	8	-1
760	582100	2510100	9	5	10	17	10	-1
763	643500	2496500	15	13	12	15	10	1
764	642500	2497100	6	19	10	8	4	1
765	642600	2497400	4	37	5	8	2	-1
766	643000	2498000	9	5	8	8	5	-1
767	643100	2498200	21	11	10	21	14	-1
768	643100	2498900	48	-3	12	44	61	-1
770	641800	2499400	62	5	12	36	43	-1
771	641000	2499200	31	5	14	21	20	-1
773	641200	2498200	45	23	10	3	24	-1
774	641500	2497800	29	5	14	10	14	-1
775	641400	2498000	35	-3	14	25	20	-1
776	641800	2497500	19	5	12	17	16	-1
777	641800	2497100	19	5	10	15	14	-1
778	641500	2496900	36	-3	10	28	23	-1
779	640950	2496500	29	-3	12	32	17	-1
781	615200	2500500	11	3	3	16	8	-1
782	616300	2500500	12	-3	5	19	9	-1
783	617800	2500300	7	-3	8	13	5	-1
784	620200	2490300	7	-3	5	13	5	-1
786	616700	2498600	21	3	14	23	14	1
787	618200	2498700	28	5	14	23	17	-1
788	615850	2498700	26	5	12	29	15	-1
789	615500	2498000	17	-3	10	25	14	-1
790	613300	2495550	4	-3	3	11	5	-1
791	615000	2495600	37	-3	26	21	19	-1
792	612500	2497500	18	3	5	21	11	-1
793	610600	2501200	11	5	8	11	6	-1
795	611300	2500200	43	7	26	30	20	-1
796	610800	2499900	25	16	24	54	19	1
797	607700	2497100	14	16	8	11	8	-1
798	607100	2497100	8	3	5	10	6	-1
799	607250	2498600	5	-3	1	8	4	-1
800	606900	2499400	6	3	3	13	6	-1
801	606700	2500200	7	5	1	11	6	-1
802	600400	2505700	5	14	5	9	4	-1
803	600200	2503900	4	3	5	6	4	-1
805	600000	2503200	3	-3	3	4	4	-1
806	599600	2503400	3	-3	1	3	3	-1
807	598700	2504750	5	-3	3	5	5	-1
808	596350	2503700	4	-3	5	4	5	-1
809	594100	2502000	5	-3	8	3	6	-1
810	594500	2500650	6	-3	8	5	4	-1
812	588250	2506250	9	-3	10	5	6	-1
813	587800	2504450	8	-3	10	4	6	-1
814	585700	2503250	14	3	14	8	10	-1

Sample No	Grid Ref East	North	Cu	Pb	Zn	Co	Ni	Mo
815	584650	2502650	20	9	23	11	9	-1
816	584200	2502200	16	5	21	9	6	-1
819	588350	2498100	17	7	29	10	11	-1
820	587950	2498100	17	-3	17	3	11	-1
821	588100	2498000	20	-3	26	15	12	-1
822	586300	2496900	15	-3	21	11	9	-1
831	583950	2496700	17	-3	19	13	9	-1
835	583500	2497700	14	-3	17	8	7	-1
836	583300	2497700	14	-3	17	9	7	-1
837	583100	2497650	10	-3	8	8	6	-1
838	583100	2497800	14	3	12	10	8	-1
843	582500	2495300	22	-3	19	16	14	-1
844	582000	2495400	19	-3	26	14	13	-1
845	581400	2495200	24	-3	26	15	15	-1
848	584000	2500700	12	3	8	4	5	-1
850	582100	2503150	17	-3	10	3	6	-1
852	579250	2502250	25	-3	10	10	5	-1
853	581000	2500850	41	3	19	13	7	-1
857	580050	2500550	17	5	5	6	4	-1
858	579750	2500300	48	11	48	10	9	-1
859	580350	2507500	36	-3	17	21	17	-1
860	580150	2507700	23	-3	10	19	9	-1
861	580600	2507950	24	-3	19	11	8	-1
863	580750	2507450	31	5	21	21	11	-1
869	581050	2506300	32	5	17	19	11	-1
870	577850	2500200	37	-3	31	19	10	-1
873	575750	2499700	27	9	29	21	9	-1
874	575350	2499600	36	5	21	17	10	-1
879	578100	2501900	31	3	29	-2	11	-1
880	578250	2502950	20	5	19	13	8	-1
883	578600	2503650	28	9	26	5	11	-1
885	575400	2505000	18	-3	10	-2	8	-1
886	575750	2505000	12	-3	5	10	6	-1
887	575850	2506450	16	-3	14	11	8	-1
888	576450	2507500	24	-3	17	16	10	-1
890	524900	2543850	8	14	12	-2	5	-1
891	525100	2543250	7	13	3	14	6	-1
892	525450	2542750	7	5	5	9	5	-1
895	519950	2563000	10	43	26	-2	7	-1
896	519000	2566200	5	27	14	-2	6	-1
897	518200	2567550	10	29	29	-2	8	-1
898	515900	2568900	10	184	14	3	5	-1
900	637200	2496400	12	8	10	10	4	-1
901	519450	2559100	11	23	17	5	2	-1
903	518600	2559150	14	21	12	8	3	-1
904	516750	2558100	12	19	19	10	10	-1
906	516650	2557750	8	13	12	3	5	-1
909	515700	2556650	14	13	17	5	6	-1
911	515300	2556600	9	18	19	3	4	-1
912	515250	2556350	9	10	17	3	3	-1

Sample No	Grid Ref East	North	Cu	Pb	Zn	Co	Ni	Mo
914	517800	2556550	16	8	12	3	11	-1
916	518350	2553300	3	8	3	-2	2	-1
918	519050	2553100	8	8	10	8	7	-1
921	518700	2552150	22	8	17	11	19	-1
922	519400	2552050	13	13	14	10	12	-1
924	518800	2546300	9	21	17	3	6	-1
926	518300	2543850	6	9	14	-2	6	-1
932	515400	2545000	20	19	26	24	19	-1
935	515800	2545350	31	3	19	-2	44	-1
936	515250	2545950	7	13	17	3	8	-1
937	516300	2545950	20	-3	17	11	42	-1
939	515550	2546500	11	5	10	11	21	-1
940	516900	2546950	49	23	34	21	66	-1
942	516600	2547150	31	23	26	10	18	-1
944	517900	2547700	10	18	19	3	5	-1
948	517750	2548200	7	19	17	3	6	-1
951	517300	2548450	8	16	17	3	4	-1
954	519350	2547400	48	7	17	3	11	-1
955	519250	2546950	56	-3	26	32	89	-1
956	517900	2551000	12	10	14	5	8	-1
958	518450	2550150	10	10	14	5	8	-1
959	518300	2540900	22	8	12	11	16	-1
961	520900	2548300	28	-3	10	25	49	-1
962	524550	2538700	11	-3	8	11	11	-1
968	522850	2546800	19	25	12	21	18	-1
970	522050	2546900	45	16	19	28	52	-1
986	636900	2496250	13	14	5	11	16	-1
987	636150	2496200	20	16	10	11	18	-1
988	636000	2495950	20	8	8	13	16	-1
989	636050	2495750	13	8	8	9	10	-1
990	638900	2497500	12	5	3	14	12	-1
992	590750	2510750	7	8	8	5	3	-1
994	584100	2514300	23	34	1	32	21	-1
995	582950	2515100	10	15	3	23	11	-1
996	579700	2514600	30	5	3	56	35	-1
1000	547500	2534900	6	3	1	3	7	-1
1001	546700	2534850	6	6	10	3	9	-1
1003	546750	2536300	4	5	5	3	5	-1
1005	548700	2535600	3	-3	3	3	4	-1
1009	548550	2538650	7	6	5	3	7	-1
1022	522200	2498500	6	3	5	4	7	-1
1025	522800	2499300	6	5	5	-2	4	-1
1026	523300	2498750	5	5	5	-2	3	-1
1027	523500	2498500	8	5	5	3	7	-1
1029	518550	2509500	5	3	5	-2	5	-1
1031	519350	2510600	2	-3	1	-2	3	-1
1032	519500	2512300	3	-3	5	-2	4	-1
1034	524150	2511450	2	-3	1	-2	3	-1
1040	515800	2587700	4	10	8	2	4	2
1042	516600	2589400	6	6	17	-2	5	1
1044	519700	2588050	7	8	8	-2	4	2
1054	600100	2523850	3	8	5	3	3	2
1057	601500	2521950	1	20	8	3	2	-

69

APPENDIX 5.

RESULTS OF Ba, Nb, Sn, and Sr ANALYSES ON ROCK SAMPLES FROM AYR 1:250,000 SHEET AREA.

Sample No.	Ba	Nb	Sn	Sr
6150003	500	15	-10	350
0004	750	-10	15	80
0012	650	-10	40	200
0015	550	10	10	300
0023	50	20	10	20
0024	100	-10	-10	400
0029	100	"	"	450
0036	- 10	"	"	200
0041	50	"	"	250
0049	100	"	"	300
0056	700	"	"	120
0065	350	15	15	350
0066	-10	15	-10	20
0075	100	-10	"	20
0089	550	"	"	120
0090	800	"	"	120
0103	150	"	"	50
0106	200	15	100	60
0109	100	15	-10	50
0114	15	-10	"	25
0115	70	10	"	50
0116	80	20	15	25
0117	90	20	-10	40
0118	300	-10	-10	350
0119	250	"	"	100
0120	1000	"	"	100
0121	600	"	"	150
0123	600	"	40	125
0126	800	15	10	250
0129	950	-10	30	200
0132	600	15	90	80
0135	650	20	-10	50
0138	800	-10	"	150
0140	20	-10	"	150
0142	300	20	"	40
0146	600	-10	80	130
0147	500	20	80	80
0150	450	10	25	60
0154	650	-10	-10	170
0156	500	"	"	70
0158	650	"	"	90
0160	800	"	"	100
0161	700	"	"	80
0163	500	"	"	40
0165	400	10	10	80
0166	450	20	-10	80
0168	450	-10	-10	110
0173	600	-10	"	80
0177	450	10	"	70
0182	500	-10	"	100

Sample No	Ba	Nb	Sn	Sr
0184	500	10	-10	80
0189	400	-10	10	100
0191	350	"	-10	70
0192	500	"	-10	60
0193	450	15	15	80
0194	700	-10	-10	300
0197	300	"	"	420
0198	500	"	"	350
0201	500	"	"	350
0203	750	"	"	330
0205	450	"	"	400
0207	600	"	"	310
0209	700	"	"	600
0211	500	"	"	400
0212	450	"	"	380
0254	–	-10		380
0256		"		400
0258		"		320
0260		"		320
0262		"		200
0264		"		230
0266		"		100
0269		"		250
0270		20		100
0273		25		250
0277		-10		550
0281		20		130
0282		20		130
0284		-10		120
0286		"		300
0288		"		80
0290		"		130
0291		20		250
0292		-10		400
0293		-10		700
0294		15		100
0295		-10		150
0296		-10		150
0308		20		100
0312		"		90
0322		"		150
0323		-10		200
0327		20		90
0344		15		60
0349		-10		30
0355		-10		30
0361		20		90
0367		20		100
0370		-10		30
0374		"		400
0378		"		250
0383		"		700
0388		"		230
0390		130		30
0393		25		120

71

Sample No	Ba	Nb	Sn	Sr
0397		-10		180
0401		35		250
0407		20		350
0417		80		450
0445		45		550
0451		40		250
0458		25		130
0460		20		100
0462		20		30
0465		20		120
0477		20		80
0478		10		5
0500		-10		380
0501		-10		250
0519		15		70
0522		20		50
0527		10		100
0532		20		10
0540		30		50
0548		20		70
0552		20		50
0559		25		50
0563		20		60
0570		20		40
0572		25		70
0574		10		50
0576		15		70
0578		15		50
0582	200	-10	-10	160
0585	250	"	"	80
0591	250	"	"	20
0598	300	"	"	40
0602	320	"	"	120
0605	250	"	"	130
0612	200	"	15	90
0615	130	"	-10	120
0618	220	"	-10	50
0620	180	"	10	100
0634	250	"	-10	170
0635	250	"	"	150
0636	250	"	"	150
0643	150	"	"	300
0653	140	"	"	290
0656	110	"	"	400
0659	200	"	"	30
0661	220	"	"	350
0665	200	"	"	450
0673	160	"	"	450

APPENDIX 6

Results of Sn, Nb, Ba, and Sr analyses on soil samples from Ayr 1:250,000 sheet area.

ANALYSIS
parts per million

Sample Mark	Ba	Nb	Sn	Sr
65150257	150	-10	-10	450
0259	150	-10	-10	220
0261	150	-10	-10	240
0263	120	-10	-10	200
0265	300	-10	-10	230
0267	380	-10	-10	100
0268	200	-10	-10	80
0271	130	-10	-10	270
0272	130	-10	-10	190
0274	200	-10	-10	100
0275	200	-10	-10	100
0276	200	-10	-10	130
0278	130	20	-10	180
0279	120	-10	-10	100
0280	90	-10	-10	300
0285	130	-10	-10	130
0287	100	-10	-10	200
0289	120	-10	10	130
0317	150	-10	15	50
0318	160	-10	-10	15
0320	260	-10	40	50
0321	250	-10	-10	50
0337	350	-10	-10	70
0338	350	-10	-10	50
0384	280	-10	-10	160
0385	260	-10	-10	180
0402	270	-10	10	300
0408	290	-10	-10	130
0416	190	-10	-10	180
0418	250	-10	-10	100
0419	170	50	15	120
0429	130	-10	-10	240

APPENDIX 7

Results of Cu, Pb, Zn, Co, Ni, Sn, Au, Cr, V, W, Mo,Be and Pd analyses on heavy mineral concentrates from Ayr 1:250,000 sheet area.

Sample No	Grid Ref East	Grid Ref North	Cu	Pb	Zn	Co	Ni	Sn	Au	Cr	V	W	Mo	Be	Pd
10	634450	2497250	25	6	25	10	15	1	-3	400	70	-20	-1	1	-1
25	631000	2496150	15	5	70	12	10	2	-3	200	120	-20	-1	-1	-1
67	620350	2501850	12	7	-20	7	5	1	-3	800	40	20	3	-1	-1
74	606850	2511150	8	8	-20	2	2	1	-3	700	15	-20	3	-1	-1
82	604900	2508250	15	4	20	6	4	1	-3	600	30	20	1	-1	-1
124	547600	2532150	15	60	20	7	7	12	-3	-	120	20	-1	-1	-1
144	612000	2523050	20	15	40	5	5	10	-3	-	30	30	-1	-1	-1
148	610050	2528550	15	12	30	8	4	20	-3	-	250	-20	-1	-1	-1
151	611700	2525050	15	12	50	5	4	8	-3	-	80	30	-1	-1	-1
164	602700	2517350	12	20	-20	4	3	7	-3	-	25	20	-1	-1	-1
186	602100	2528000	12	10	20	3	3	70	-3	-	25	-20	-1	-1	-1
304	604150	2521400	12	15	25	2	2	3	-3	500	20	20	2	-1	-1
315	606700	2517150	20	8	30	20	8	2	-3	600	200	25	3	1	-1
334	542000	2508600	15	20	25	10	7	4	-3	700	150	20	1	-1	-1
336	552900	2497100	12	5	20	5	6	2	-3	800	50	20	3	-1	-1
340	549800	2500700	10	4	-20	4	3	1	-3	600	25	20	3	-1	-1
351	554500	2497800	10	12	20	4	2	1	-3	500	60	-20	1	-1	-1
353	558500	2499000	30	10	30	8	7	2	-3	700	150	20	-1	1	-1
381	542800	2505250	25	10	25	10	6	2	-3	700	100	20	-1	-1	-1
395	543150	2521450	50	15	50	30	30	4	-3	800	200	50	7	-1	-1
406	546200	2513450	30	50	25	10	25	3	-3	-	250	-20	-1	-1	-1
410	550400	2515300	30	10	30	10	12	3	-3	600	120	20	2	-1	-1
415	551800	2521150	40	15	30	40	50	2	-3	-	500	-20	-1	-1	-1
422	571850	2512350	25	8	80	25	12	3	-3	40	250	-20	2	-1	-1
436	568250	2521150	40	6	40	30	10	3	-3	250	200	-20	1	1	-1
441	571100	2518000	30	7	50	50	12	3	-3	200	200	-20	-1	-1	-1
449	528100	2506400	15	6	-20	5	4	1	-3	-	40	-20	-1	-1	-1
452	527200	2503600	20	5	20	7	3	1	-3	-	120	-20	-1	-1	-1
469	515800	2500600	20	4	200	3	2	2	-3	400	40	-20	-	2	-1
475	518800	2508000	15	6	-20	3	2	2	-3	-	15	-20	-1	-1	-1
482	562300	2521600	25	12	60	25	50	5	-3	-	600	-20	-1	-1	-1
544	533500	2498900	10	6	20	2	2	3	-3	-	20	-20	-1	-1	-1

Sample No	Grid Ref East	Grid Ref North	Cu	Pb	Zn	Co	Ni	Sn	Au	Cr	V	W	Mo	Be	Pd
546	535400	2498500	10	6	20	2	1	2	-3	-	25	-20	-1	-1	-1
556	539600	2499300	12	15	25	5	2	25	-3	-	20	-20	-1	-1	-1
588	537000	2505500	25	40	50	8	5	7	-3	-	250	-20	-1	-1	-1
593	530250	2516000	80	40	50	40	6	3	-3	200	150	20	-1	1	-1
595	530000	2518000	10	4	-20	2	1	-1	-3	-	15	-20	-1	-1	-1
616	528000	2514000	8	1	-20	-1	1	-1	-3	-	5	-20	-1	-1	-1
631	555600	2514700	60	20	150	40	80	8	-3	-	700	25	-1	-1	-1
647	575000	2520800	50	8	250	70	30	6	-3	-	600	-20	-1	-1	-1
649	577300	2515800	70	7	200	60	50	6	-3	-	500	-20	-1	-1	-1

75

APPENDIX 8

LIST OF ROCK TYPES SAMPLED

Number	Rock Type	Texture	Alteration	Occurrence	Accessories
65150003	Biotite Granite	-	-	-	-
4	" "	-	-	-	-
12	" "	-	-	-	-
15	" "	-	-	-	-
23	" "	-	Weathered	-	-
24	Diorite	-	-	-	-
29	"	-	-	-	-
36	Gabbro	-	-	-	-
41	Diorite	-	-	-	Pyrite
49	Biotite Granite	-	-	-	-
56	Diorite	-	Weathered	-	-
65	Granite Aplite	-	-	-	-
66	Biotite Granite Aplite	-	-	-	-
75	Biotite Granite	-	-	-	-
89	" "	-	-	-	-
90	" "	-	-	-	-
103	" "	-	Weathered	-	-
106	" "	-	Weathered	-	-
109	" "	-	-	-	-
114	Granite	-	Strong	-	-
115	Granite Aplite	-	Strong	-	-
116	Granite	-	Strong	-	-
117	Granite Aplite	-	Moderate	-	-
118	Micro-Diorite	-	Moderate	Dyke	-
119	Granite Aplite	-	Strong	-	-
120	Granite	-	Strong	-	Pyrite, galena
121	Granite Aplite	-	-	-	-
123	" "	-	Moderate	-	-
126	Rhyolite	Porphyritic	-	-	-
129	"	Porphyritic	-	-	-
132	"	-	-	-	-
135	"	Porphyritic	-	-	-
138	"	-	-	-	-
140	Gabbro	-	-	-	-
142	Granite Aplite	-	Moderate	-	-
146	Biotite Granite	-	-	-	-
147	" "	-	-	-	-
150	" "	-	-	-	-
154	Granite Aplite	-	Strong	-	Pyrite, Molybdenite
156	Biotite Granite	-	-	-	-
158	" "	-	Slight	-	-
160	" "	-	Weathered	-	-
161	Biotite Granite Aplite	-	Weathered	-	-
163	Granite	-	Slight	-	-
165	Biotite Granite	-	Slight	-	-
166	" "	-	Slight	-	-
168	" "	-	-	-	-
173	" "	-	-	-	-
177	" "	-	Slight	-	-
182	" "	-	Slight	-	-
184	" "	-	-	-	-
189	" "	-	-	-	-

Number	Rock Type	Texture	Alteration	Occurrence	Accessories.
65150191	Biotite Granite	-	-	-	-
192	" "	-	-	-	-
193	" "	-	Slight	-	-
194	Hornblende Diorite	-	-	Dyke	-
197	" "	-	-	Dyke	Pyrite
198	" "	-	-	Dyke	-
201	" "	-	-	Dyke	Pyrite
203	Hornblende Grandiorite	-	Weathered	-	-
205	Diorite	-	-	Dyke	-
207	Hornblende Diorite	-	-	-	-
209	Diorite	-	Moderate	-	-
211	"	Porphyritic	-	Dyke	Pyrite
212	Hornblende Diorite	-	Slight	Dyke	-
213	" "	Porphyritic	-	Dyke	-
214	Hornblende Granite	Porphyritic	Moderate	-	-
216	Hornblende Diorite	-	-	Dyke	Pyrite
218	Diorite	-	-	Dyke	Pyrite
220	Hornblende Diorite	-	-	Dyke	-
223	" "	-	-	Dyke	-
227	" "	-	-	Dyke	Pyrite
229	Hornblende Granodiorite	-	-	-	-
231	Hornblende Diorite	Porphyritic	-	Dyke	Pyrite
232	Granite	-	Strong	-	-
235	Diorite	Porphyritic	-	Dyke	Pyrite
237	Rhyolite	-	Strong	-	-
239	Hornblende Granite	Porphyritic	Moderate	-	-
241	Micro-Diorite	Porphyritic	Slight	-	-
243	" "	Porphyritic	Slight	-	-
245	Biotite Granite	-	Moderate	-	-
249	Andesite	-	-	-	-
251	Rhyolite	-	Weathered	-	-
253	Granite	-	Slight	-	-
254) to 673)	No information available on these samples.				
676	Hornblende Diorite	Sheared	-	Dyke	-
680	" "	Sheared	-	Dyke	-
681	" "	-	-	Dyke	-
686	Hornblende Granodiorite	Sheared	-	Dyke	-
702	Diorite	Porphyritic	-	Dyke	-
705	Hornblende Granite	Porphyritic	-	-	-
708	Granite Aplite	-	-	-	-
709	Hornblende Granite	Porphyritic	Moderate	-	-
713	" "	Porphyritic	-	-	-
721	Hornblende Diorite	-	Moderate	-	-
726	Granite Aplite	-	Moderate	-	-
727	" "	-	Moderate	-	-
732	" "	-	-	-	-
741	Hornblende Diorite	-	Strong	-	-
744	Hornblende Grandiorite	-	-	-	-
748	Granite Aplite	Aphanitic	Strong	-	-
750	" "	Aphanatic	Moderate	-	-
753	Diorite	Porphyritic	-	-	-
769	Gabbro	-	-	-	Pyrite
772	"	-	-	-	-

77

Number	Rock Type	Texture	Alteration	Occurrence	Accessories
61510823	Granite Aplite	Porphyritic	-	-	-
825	" "	Porphyritic	-	-	-
828	" "	-	-	-	-
832	Diorite	Porphyritic	-	Dyke	-
839	Granite	Porphyritic	-	Dyke	-
840	Granite Aplite	-	-	-	-
854	" "	-	Slight	-	-
862	Diorite	-	Slight	Dyke	Pyrite
864	Hornblende Granite	Porphyritic	-	-	-
865	Hornblende Diorite	-	-	-	-
866	Granite Aplite	-	-	Dyke	-
867	" "	-	-	Dyke	-
868	" "	-	-	-	-
871	Hornblende Granite	Porphyritic	-	-	-
872	" "	Porphyritic	Moderate	-	-
875	Granite	Porphyritic	-	-	-
876	Hornblende Granite	Porphyritic	-	-	-
877	Hornblende Diorite	Porphyritic	-	Dyke	-
878	Hornblende Granite	Porphyritic	-	-	-
881	Hornblende Granite	Porphyritic	-	-	-
882	Hornblende Diorite	-	-	Dyke	Pyrite
889	" "	-	-	Dyke	-
893	Andesite	Porphyritic	-	-	-
899	Hornblende Granite	-	Slight	-	-
908	" "	-	-	-	-
910	" "	-	-	-	-
913	" "	-	-	-	-
917	" "	-	-	-	-
928	Granite	-	Slight	-	-
930	Andesite	-	Slight	-	-
933	"	Aphanitic	-	-	-
938	Hornblende Granite	-	-	-	-
941	Granite Aplite	-	-	-	-
943	Granite	-	-	-	-
946	Hornblende Granite	-	Slight	-	-
949	" "	-	Slight	-	-
952	" "	-	Slight	-	-
953	Andesite	Aphanatic	Strong	-	-
957	Hornblende Granite	-	-	-	-
960	" "	-	-	-	-
964	Granite Aplite	-	-	-	-
967	Hornblende Granite	-	Slight	-	-
969	Hornblende Diorite	-	Slight	-	-
972	Granite Aplite	Porphyritic	-	-	-
974	Granite	Porphyritic	-	-	-
977	Granite Aplite	Porphyritic	-	-	-
979	" "	Porphyritic	-	-	-
983	" "	Porphyritic	-	-	-
998	Hornblende Granite	-	-	-	-
999	" "	-	-	-	-
1002	Granite	-	-	-	-
1008	Hornblende Granite	-	Weathered	-	-
1015	Granite	-	Weathered	-	-
1018	Granite Aplite	-	Moderate	-	-
1019	" "	-	Strong	-	-
1033	" "	-	-	-	-

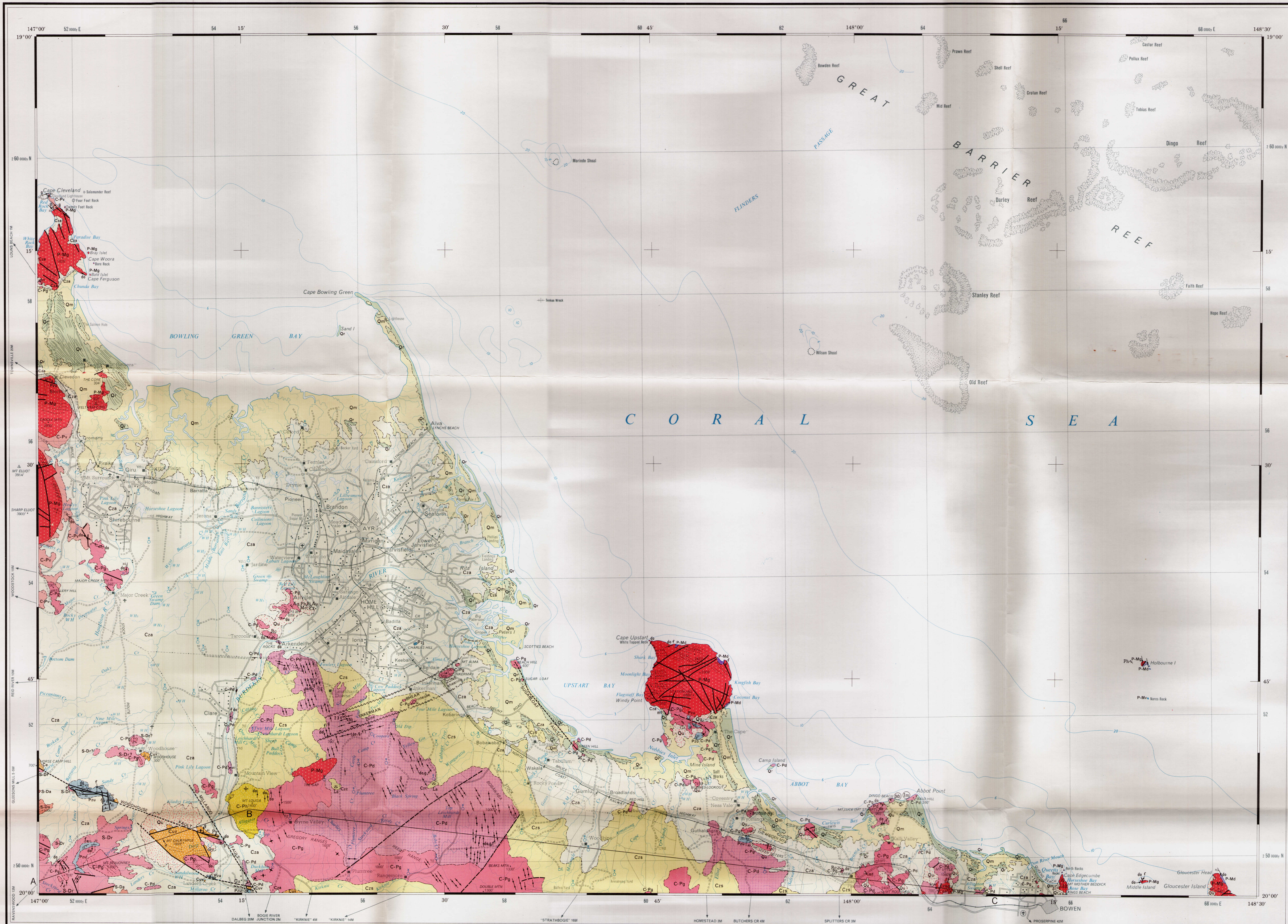
Number	Rock Type	Texture	Alteration	Occurrence	Accessories
65151036	Granite	-	-	-	-
1039	"	-	-	-	-
1046	Hornblende Granite	-	-	-	-
1047	Granite	-	Weathered	-	-
1048	"	-	Weathered	-	-
1051	"	-	-	-	-
1052	"	-	-	-	-
1053	"	-	Weathered	-	-
1056	"	-	Slight	-	-
1059	Diorite	Porphyritic	Weathered	-	-
1060	Granite Aplite	Porphyritic	-	-	-
1061	Gabbro	-	Slight	-	-
1062	Hornblende Granodiorite	-	-	-	-
1063	Dolerite Pegmatite	-	-	-	-

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

AYR
QUEENSLAND

SHEET SE 55-15

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS
FIRST EDITION 1968



Reference

Geological boundary

Fault, showing relative horizontal movement

Boundary of major shear zone

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes

Joint pattern } air-photo interpretation
Trend of coastal sand dunes } air-photo interpretation

Strike and dip of strata

Strike and dip of cleavage

Strike and dip of foliation

Vertical foliation

Foliation, dip indeterminable

Strike and dip of platy flow

Vertical platy flow

Strike and dip of primary banding in gabbro

Primary banding in gabbro, dip indeterminable

Sample locality for age determination

Dyke

do = dolerite, andesite, microdiorite

f = felsite (including rhyolite and acid porphyry)

g = granophyre, granite

mt = microtonalite

Mineral prospect, little or no production

Quarry

Unexploited mineral deposit

Minor mineral occurrence

Ag	Silver
Au	Gold
Bi	Bismuth
Cu	Copper
Gt	Graphite
Im	Ilmenite
Ls	Limestone ('earth lime')
Mo	Molybdenum
Mt	Magnetite
Ni	Nickel
Pb	Lead
Ph	Phosphate Rock
Py	Pyrite
Rc	Crushed rock aggregate

Bore

Windpump

Spring

Dam

Waterhole on stream

Bank of major watercourse

Swamp

Depth in fathoms

Road

Vehicle track

Railway with siding

Tramway (sugar cane)

Fence

Power transmission line

Telephone line

Town

"Lisgar" Homestead

House or building

Pump Pumping station

Yd Yard

Airfield

Landing ground

Trigonometrical station

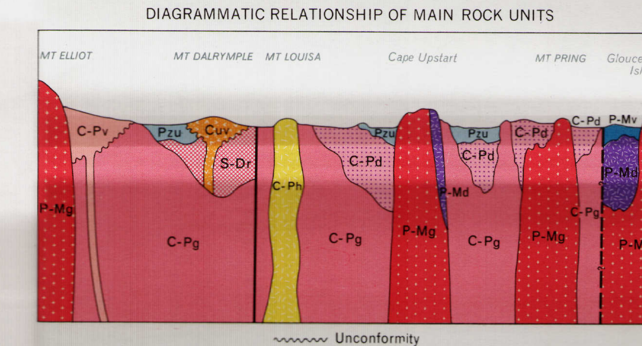
1900′ Elevation in feet, derived from military maps

MW Microwave repeater station

Reference

CAINOZOIC	QUATERNARY		Qm	Coastal mud flats
			Qr	Coastal sand dunes
			Qu	Outwash and talus
			Cza	Alluvial and deltaic deposits
			Czs	Residual soil, sand and rubble; some semi-consolidated material
			Czc	'Earth lime'
	PERMIAN TO MESOZOIC		P-Mg	Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro
			P-Md	Dolerite, microdiorite, gabbro
			P-Mv	Hornfelsed tuff
PALAEOZOIC	UPPER CARBONIFEROUS TO LOWER PERMIAN		C-Pv	Intermediate lavas and pyroclastics, minor acid volcanics
			C-Ph	Rhyolite, trachyte, trachyandesite; mainly intrusive
			C-Pg	Adamellite, granite, some granodiorite; minor fine-grained variants
			C-Pd	Diorite, quartz diorite, tonalite, gabbro, norite; minor granodiorite, adamellite and granite
	UPPER CARBONIFEROUS		Cuv	Flow-banded rhyolite and massive welded tuff; andesite and andesitic tuff
		Ellenvale Beds	Ce	Flow-banded rhyolite, rhyolite-breccia, andesite
	UPPER DEVONIAN ?		Pzj	Hornfelsed calcareous conglomerate, with calcareous quartzite interbeds
	SILURIAN TO LOWER DEVONIAN	Ravenswood Granodiorite	S-Da	Biotite granite, leucocratic adamellite
		Ravenswood Granodiorite	S-Dr	Deeply weathered hornblende-biotite granodiorite; minor adamellite, quartz diorite, diorite, alkali granite
	EARLY PALAEOZOIC		Pzu	Schist, phyllite, quartzite, hornfels

DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS



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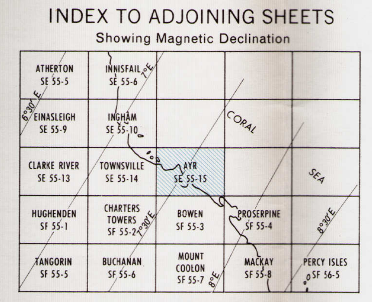
Vertical aerial photography at 1:85,000 scale by Adastra Airways Pty. Ltd., 1961.
Transverse Mercator Projection.

Geology, 1964, by: A. G. L. Paine, C. M. Gregory (B.M.R.), D. E. Clarke (G.S.Q.)
Compiled by: A. G. L. Paine, C. M. Gregory, N. L. Kruger, A. Tatarow (B.M.R.), D. E. Clarke (G.S.Q.)
Drawn by: Austral Cartographic Service, Canberra, A.C.T.

INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



ANNUAL CHANGE 1°30′E

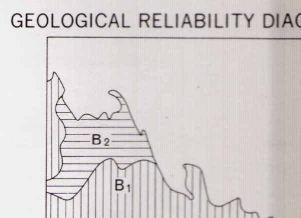
Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE 7 (AUSTRALIA SERIES)

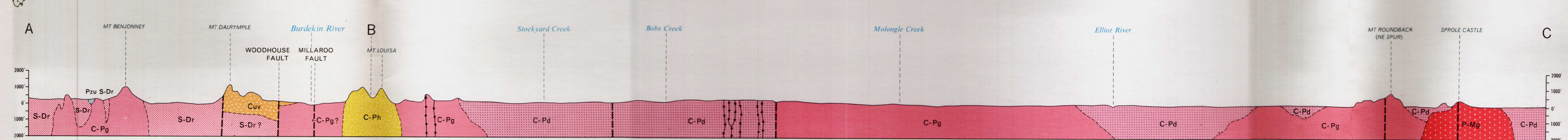
GEOLOGICAL RELIABILITY DIAGRAM



B_1 Detailed reconnaissance with air-photo interpretation

B_2 Mainly air-photo interpretation

Section
Scale $\frac{V}{H} = 4$
Cainozoic sediments omitted from section; attitude of faults not known



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SHEET SE 55-15

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Fig. 2.

MAP SHOWING ROCK SAMPLE POINTS
AYR 1:250,000 QLD

To accompany Record 1967/129

Fig. 3.

MAP SHOWING SOIL SAMPLE POINTS

AYR 1:250,000 QLD

To accompany Record 1967/129

Fig. 4

To accompany Record 1967/129

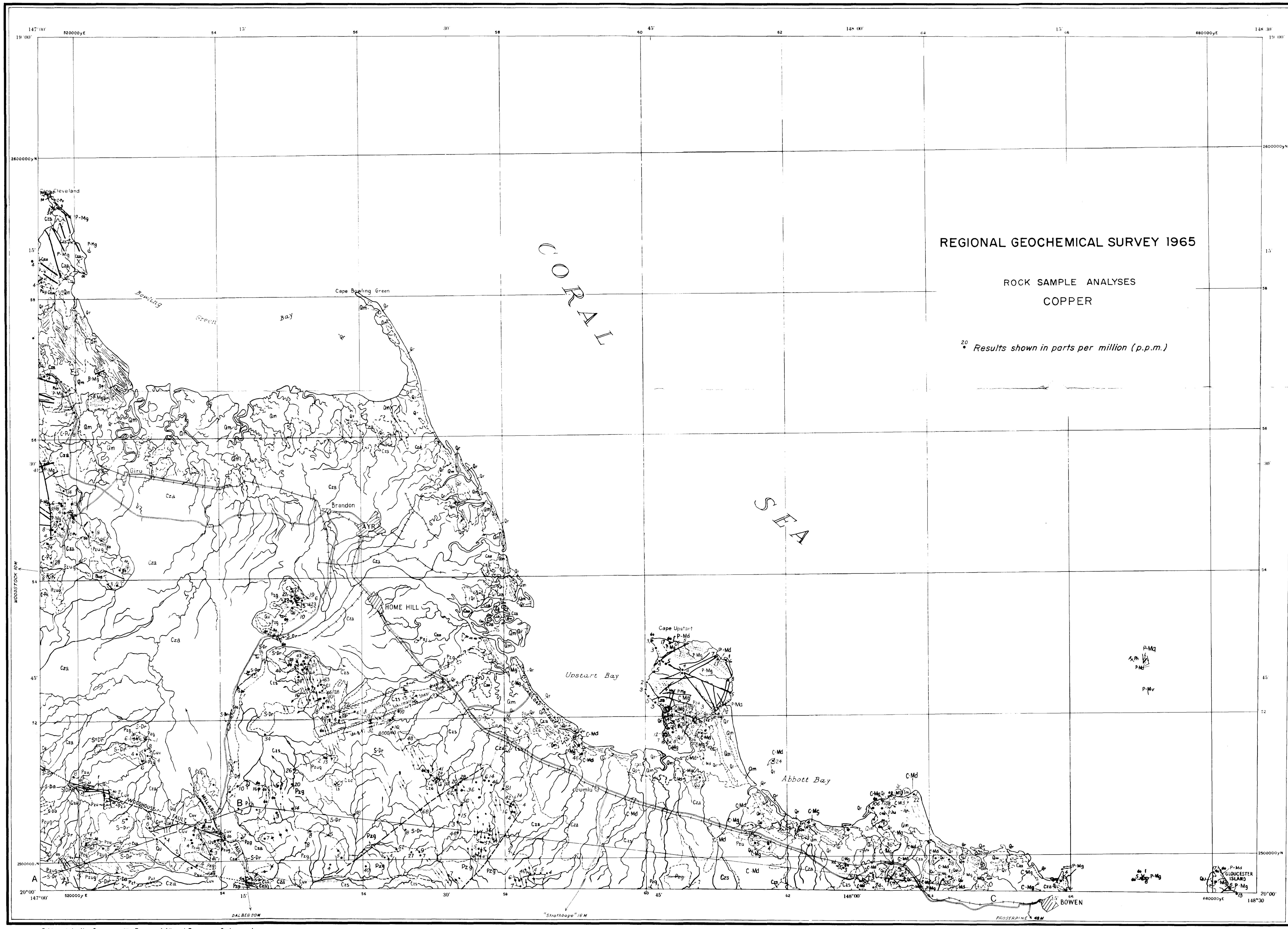
AUSTRALIA 1:250.000

AYR
QUEENSLAND

1:250.000 GEOLOGICAL SERIES SHEET SE 55-15

Fig. 5

FIRST EDITION 1967



Reference

CAINOZOIC	QUATERNARY		Qm	Coastal mud flats
			Qr	Coastal sand dunes
			Qu	Outwash and talus
			Cza	Alluvial and deltaic deposits
			Czs	Residual soil, sand, and rubble; some semi-consolidated material
			Czc	'Earth Lime'
PALAEOZOIC–MESOZOIC	PERMIAN TO MESOZOIC		P-Mg	Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro
			P-Md	Diorite, microdiorite, gabbro
			P-Mv	Hornfelsed tuff (Nares Rock)
	CARBONIFEROUS TO MESOZOIC	Urannah Complex	C-Mg	Leucocratic adamellite and granite, tonalite; locally sheared
			C-Md	Diorite, gabbro, norite, tonalite, dolerite, microdiorite; minor diallagite
PALAEOZOIC	LATE PALAEOZOIC		Pzug	Granite, microgranite, adamellite
			Pzh	Rhyolite, trachyte, trachyandesite; mainly intrusive
	CARBONIFEROUS TO PERMIAN		C-Pv	Intermediate lavas and pyroclastics, minor acid volcanics
	UPPER CARBONIFEROUS		Cuv	Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff
		Ellenvale Beds	Ce	Flow-banded rhyolite, rhyolite-breccia, andesite
	UNDIFFERENTIATED		Pzt	Olivine microgabbro
			Pzg	Leucocratic granite and adamellite, foliated in places; dykes of rhyodacite and acid porphyry; minor granodiorite and microgranite
	UPPER DEVONIAN ?		Pzj	Hornfelsed calcareous conglomerate, with calcareous quartzite interbeds (Charles Hill, near Home Hill)
	SILURIAN – LOWER DEVONIAN	Ravenswood Granodiorite	S-Da	Biotite granite, leucocratic adamellite; foliated in places
			S-Dr	Hornblende granodiorite and diorite, minor granite, adamellite and gabbro; foliated in places
	EARLY PALAEOZOIC		Pzu	Schist, phyllite, quartzite. hornfels

- Geological boundary
- Fault
- Boundary of major shear zone

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes

- Joint pattern } air-photo interpretation
- Trend of coastal sand } air-photo interpretation
- Strike and dip of strata
- Strike and dip of cleavage
- Strike and dip of metamorphic foliation
- Vertical metamorphic foliation
- Metamorphic foliation, dip indeterminable
- Strike and dip of platy flow
- Vertical platy flow
- Strike and dip of primary
- Primary banding in gabbro, dip indeterminable
- Dyke
  - do = dolerite, andesite, microdiorite
  - f = felsite (including rhyolite and acid porphyry)
  - g = granophyre, granite
  - mt = microtonalite
- Mineral prospect, little or no production
- Quarry
- (Mt) Unexploited mineral deposit
- • Minor mineral occurrence

Cu	Copper
Gt	Graphite
Im	Ilmenite
Ls	Limestone ('earth lime')
Mt	Magnetite
Ph	Phosphate rock
Py	Pyrite
Rc	Crushed rock aggregate

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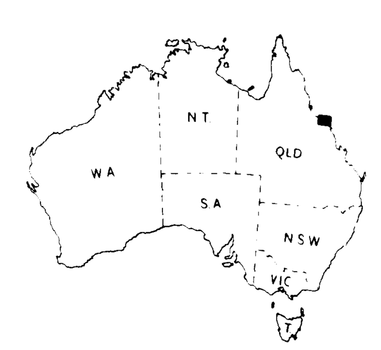

INDEX TO ADJOINING SHEETS
Showing Magnetic Declination

ATHERTON SE 55-5	INNISFAIL SE 55-6			
EINASLEIGH SE 55-9	INGHAM SE 55-10		CORAL SEA	
CLARKE RIVER SE 55-13	TOWNSVILLE SE 55-14	AYR SE 55-15		
HUGHENDEN SF 55-1	CHARTERS TOWERS SF 55-2	BOWEN SF 55-3	PROSERPINE SF 55-4	
TANGORIN SF 55-5	BUCHANAN SF 55-6	MOUNT COOLON SF 55-7	MACKAY SF 55-8	PERCY ISLES SF 56-5

ANNUAL CHANGE 1'30'E

Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

GREY NUMBERED LINES INDICATE THE 10,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

Section

Cainozoic sediments omitted from section   Attitude of faults not known

Scale $\frac{V}{H} = 4$

Geology by : A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.).
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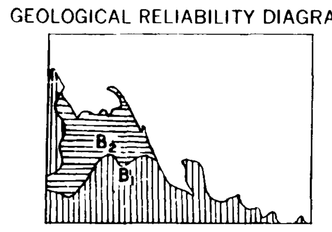
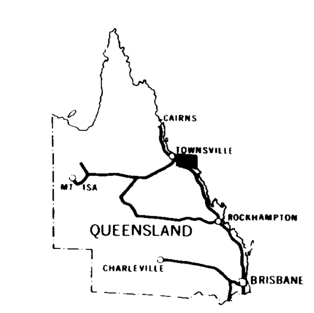
GEOLOGICAL RELIABILITY DIAGRAM

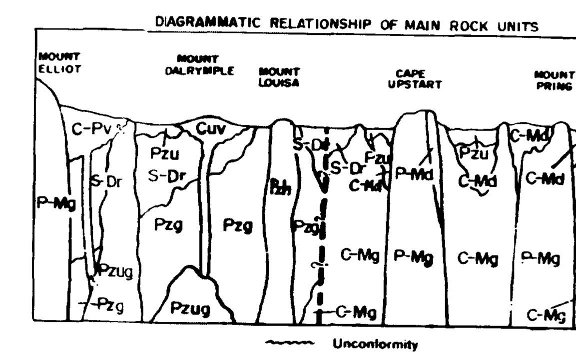


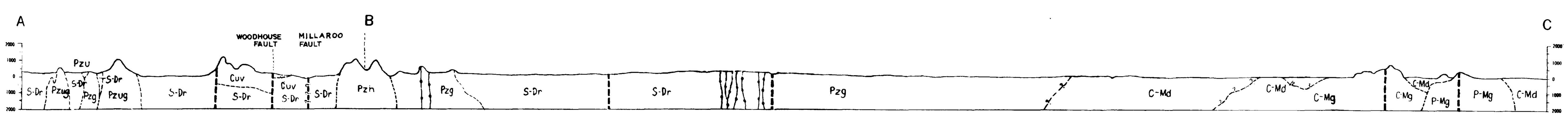
B_1 Detailed reconnaissance with air-photo interpretation

B_2 Mostly air-photo interpretation



DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





AYR
SHEET SE 55-15

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To accompany Record 1967/129

AUSTRALIA 1:250,000

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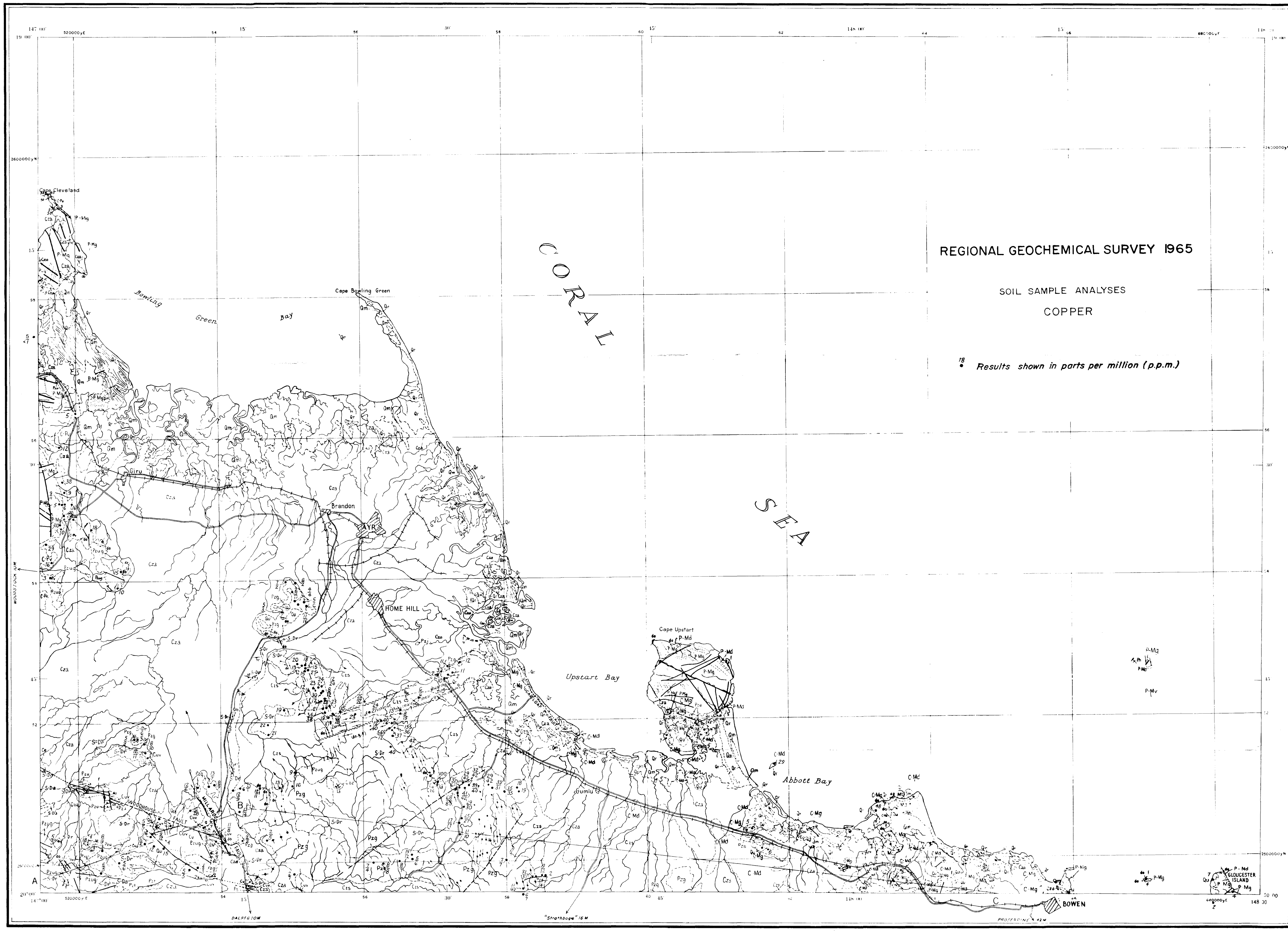
1:250,000 GEOLOGICAL SERIES SHEET SE 55-15

FIRST EDITION 1967



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Geological boundary

Fault

Boundary of major shear zone

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Trend of coastal sand }

Strike and dip of strata

Strike and dip of cleavage

Strike and dip of metamorphic foliation

Vertical metamorphic foliation

Metamorphic foliation, dip indeterminable

Strike and dip of platy flow

Vertical platy flow

Strike and dip of primary

Primary banding in gabbro, dip indeterminable

Dyke
- do = dolerite, andesite, microdiorite
- f = felsite (including rhyolite and acid porphyry)
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Unexploited mineral deposit

Minor mineral occurrence

- Cu Copper
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- Ls Limestone ('earth lime')
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- Py Pyrite
- Rc Crushed rock aggregate

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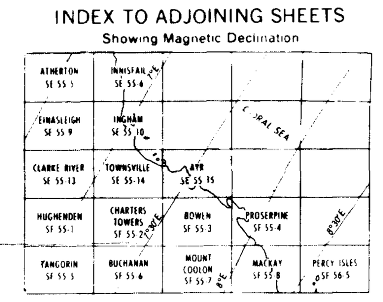
INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



Scale 1:250,000

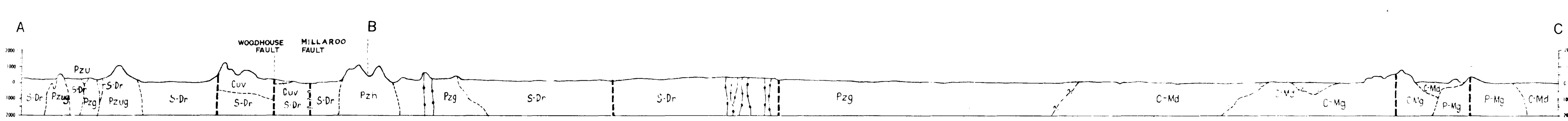
MILES / KILOMETRES

GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

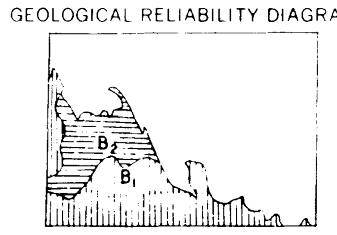
Section

Cainozoic sediments omitted from section. Attitude of faults not known

Scale V/H 4



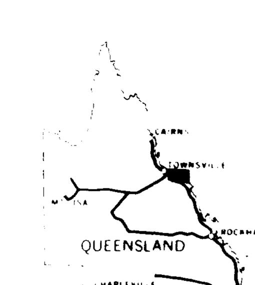
GEOLOGICAL RELIABILITY DIAGRAM



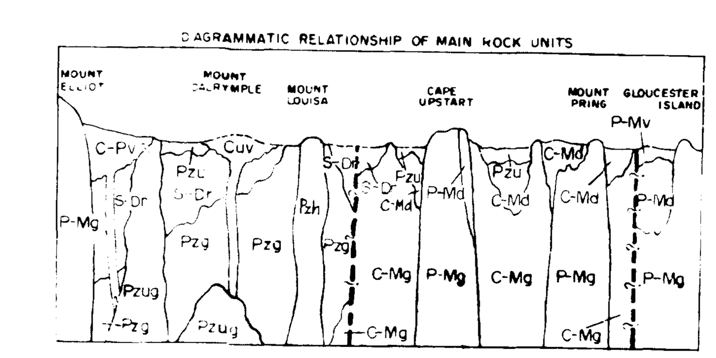
B_1 Detailed reconnaissance with air-photo interpretation

B_2 Mostly air-photo interpretation

Geology by A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.)
Compiled by A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)



DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS



AYR
SHEET SE 55-15

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To accompany Record 1967/129

Fig. 7

AUSTRALIA 1:250,000

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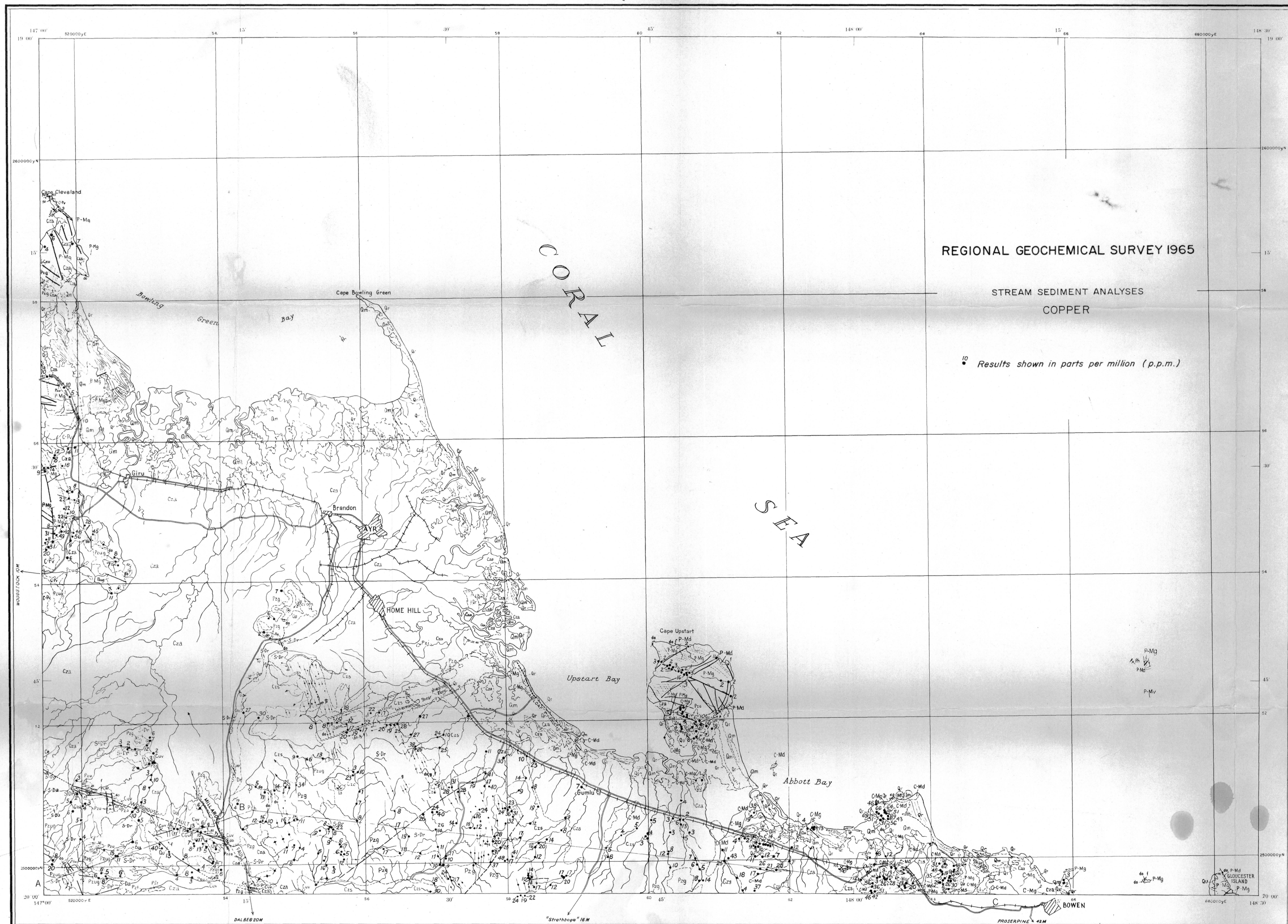
1:250,000 GEOLOGICAL SERIES SHEET SE 55-15

FIRST EDITION 1967



Reference

CAINOZOIC	QUATERNARY		Qm	Coastal mud flats
			Qr	Coastal sand dunes
			Qu	Outwash and talus
			Cza	Alluvial and deltaic deposits
			Czs	Residual soil, sand, and rubble; some semi-consolidated material
			Czc	'Earth Lime'
PALAEOZOIC–MESOZOIC	PERMIAN TO MESOZOIC		P-Mg	Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro
			P-Md	Diorite, microdiorite, gabbro
			P-Mv	Hornfelsed tuff (Nares Rock)
	CARBONIFEROUS TO MESOZOIC	Urannah Complex	C-Mg	Leucocratic adamellite and granite, tonalite; locally sheared
			C-Md	Diorite, gabbro, norite, tonalite, dolerite, microdiorite; minor diallagite
PALAEOZOIC	LATE PALAEOZOIC		Pzug	Granite, microgranite, adamellite
			Pzh	Rhyolite, trachyte, trachyandesite; mainly intrusive
	CARBONIFEROUS TO PERMIAN		C-Pv	Intermediate lavas and pyroclastics, minor acid volcanics
	UPPER CARBONIFEROUS		Cuv	Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff
		Ellenvale Beds	Ce	Flow-banded rhyolite, rhyolite-breccia, andesite
	UNDIFFERENTIATED		Pzt	Olivine microgabbro
			Pzg	Leucocratic granite and adamellite, foliated in places; dykes of rhyodacite and acid porphyry; minor granodiorite and microgranite
	UPPER DEVONIAN ?		Pzj	Hornfelsed calcareous conglomerate, with calcareous quartzite interbeds (Charlies Hill, near Home Hill)
	SILURIAN – LOWER DEVONIAN	Ravenswood Granodiorite	S-Da	Biotite granite, leucocratic adamellite; foliated in places
			S-Dr	Hornblende granodiorite and diorite, minor granite, adamellite and gabbro; foliated in places
	EARLY PALAEOZOIC		Pzu	Schist, phyllite, quartzite, hornfels

Geological boundary

Fault

Boundary of major shear zone

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes

Joint pattern } air-photo interpretation

Trend of coastal sand } air-photo interpretation

Strike and dip of strata

Strike and dip of cleavage

Strike and dip of metamorphic foliation

Vertical metamorphic foliation

Metamorphic foliation, dip indererminable

Strike and dip of platy flow

Vertical platy flow

Strike and dip of primary

Primary banding in gabbro, dip indeterminable

Dyke
do = dolerite, andesite, microdiorite
f = felsite (including rhyolite and acid porphyry)
g = granophyre, granite
mt = microtonalite

Mineral prospect, little or no production

Quarry

Unexploited mineral deposit

Minor mineral occurrence

Cu	Copper
Gt	Graphite
Im	Ilmenite
Ls	Limestone ('earth lime')
Mt	Magnetite
Ph	Phosphate rock
Py	Pyrite
Rc	Crushed rock aggregate

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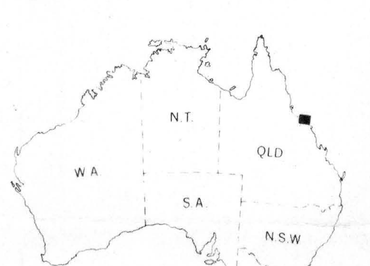
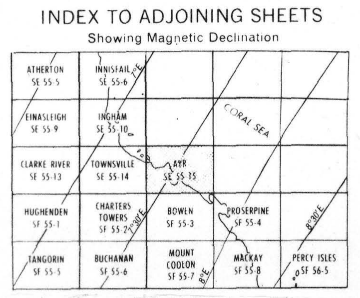


INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

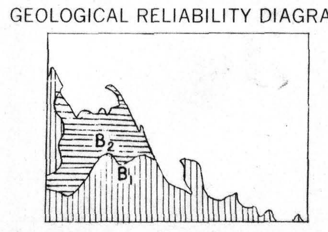
GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

Section

Cainozoic sediments omitted from section. Attitude of faults not known

Scale $\frac{V}{H} = 4$

GEOLOGICAL RELIABILITY DIAGRAM

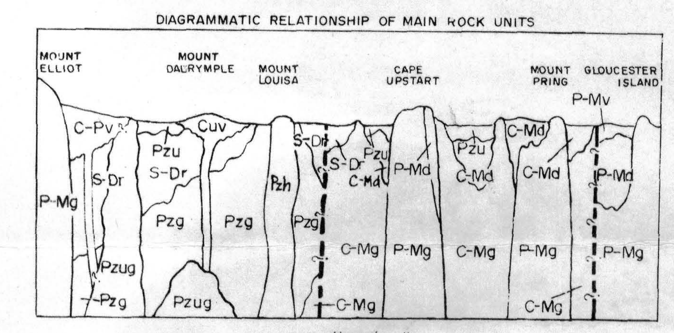


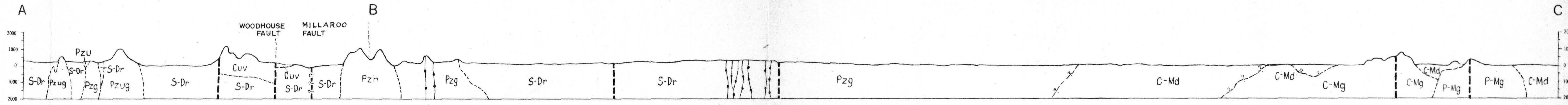
B_1 Detailed reconnaissance with air-photo interpretation

B_2 Mostly air-photo interpretation

Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.)
Compiled by: A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)

DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





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SHEET SE 55-15

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To accompany Record 1967/129

AUSTRALIA 1:250.000

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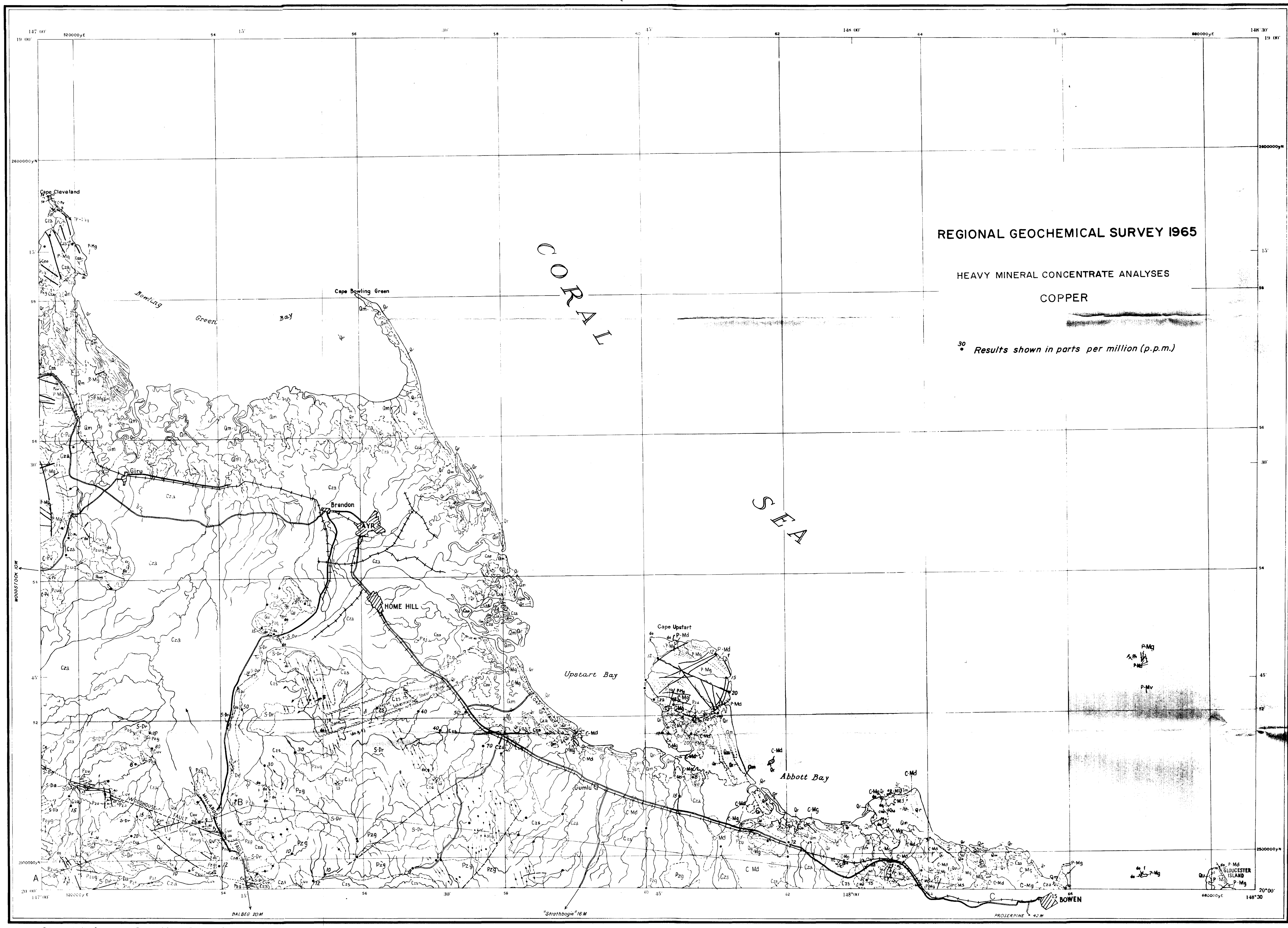
1:250.000 GEOLOGICAL SERIES SHEET SE 55-15

Fig.8

FIRST EDITION 1967



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			Qa	Outwash and talus
			Cza	Alluvial and deltaic deposits
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			P-Md	Diorite, microdiorite, gabbro
			P-Mv	Hornfelsed tuff (Nares Rock)
	CARBONIFEROUS TO MESOZOIC	Urannah Complex	C-Mg	Leucocratic adamellite and granite, tonalite; locally sheared
			C-Md	Diorite, gabbro, norite, tonalite, dolerite, microdiorite; minor diallagite
PALAEOZOIC	LATE PALAEOZOIC		Pzug	Granite, microgranite, adamellite
			Pzh	Rhyolite, trachyte, trachyandesite; mainly intrusive
	CARBONIFEROUS TO PERMIAN		C-Pv	Intermediate lavas and pyroclastics, minor acid volcanics
	UPPER CARBONIFEROUS		Cuv	Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff
		Ellenvale Beds	Ce	Flow-banded rhyolite, rhyolite-breccia, andesite
	UNDIFFERENTIATED		Pzt	Olivine microgabbro
			Pzg	Leucocratic granite and adamellite, foliated in places; dykes of rhyodacite and acid porphyry; minor granodiorite and microgranite
	UPPER DEVONIAN ?		Pzi	Hornfelsed calcareous conglomerate, with calcareous quartzite interbeds (Charlies Hill, near Home Hill)
	SILURIAN – LOWER DEVONIAN	Ravenswood Granodiorite	S-Da	Biotite granite, leucocratic adamellite; foliated in places
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	EARLY PALAEOZOIC		Pzu	Schist, phyllite, quartzite, hornfels

Geological boundary
Fault
Boundary of major shear zone
Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes
Joint pattern } air-photo interpretation
Trend of coastal sand }
Strike and dip of strata
Strike and dip of cleavage
Strike and dip of metamorphic foliation
Vertical metamorphic foliation
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Vertical platy flow
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do - dolerite, andesite, microdiorite
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Mineral prospect, little or no production
Quarry
Unexploited mineral deposit
Minor mineral occurrence
Cu Copper
Gt Graphite
Im Ilmenite
Ls Limestone ('earth lime')
Mt Magnetite
Ph Phosphate rock
Py Pyrite
Rc Crushed rock aggregate

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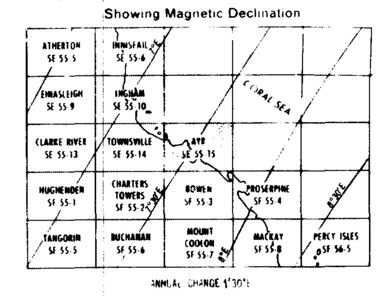
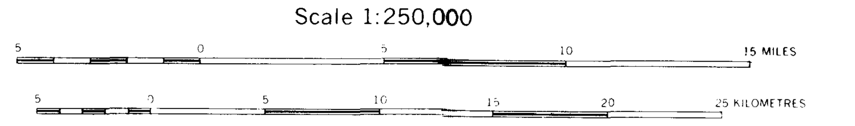
INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



Scale 1:250,000



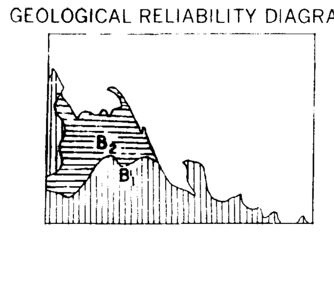
GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

Section

Cainozoic sediments omitted from section   Attitude of faults not known

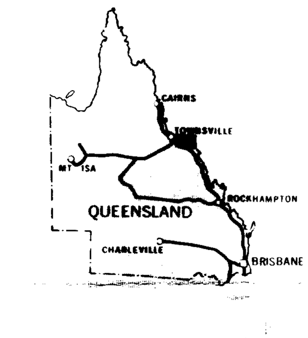
Scale V/H = 4

GEOLOGICAL RELIABILITY DIAGRAM

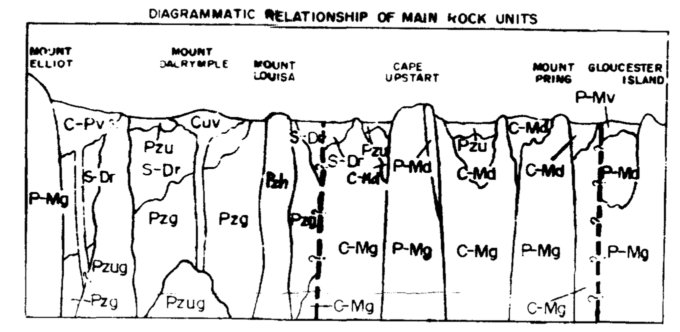


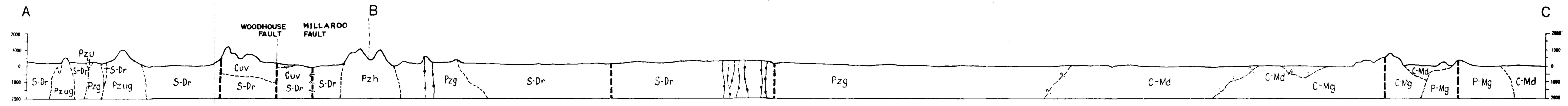
B_1 Detailed reconnaissance with air-photo interpretation
B_2 Mostly air-photo interpretation

Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.)
Compiled by: A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)



DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





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SHEET SE 55-15

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To accompany Record 1967/129

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Fig.9

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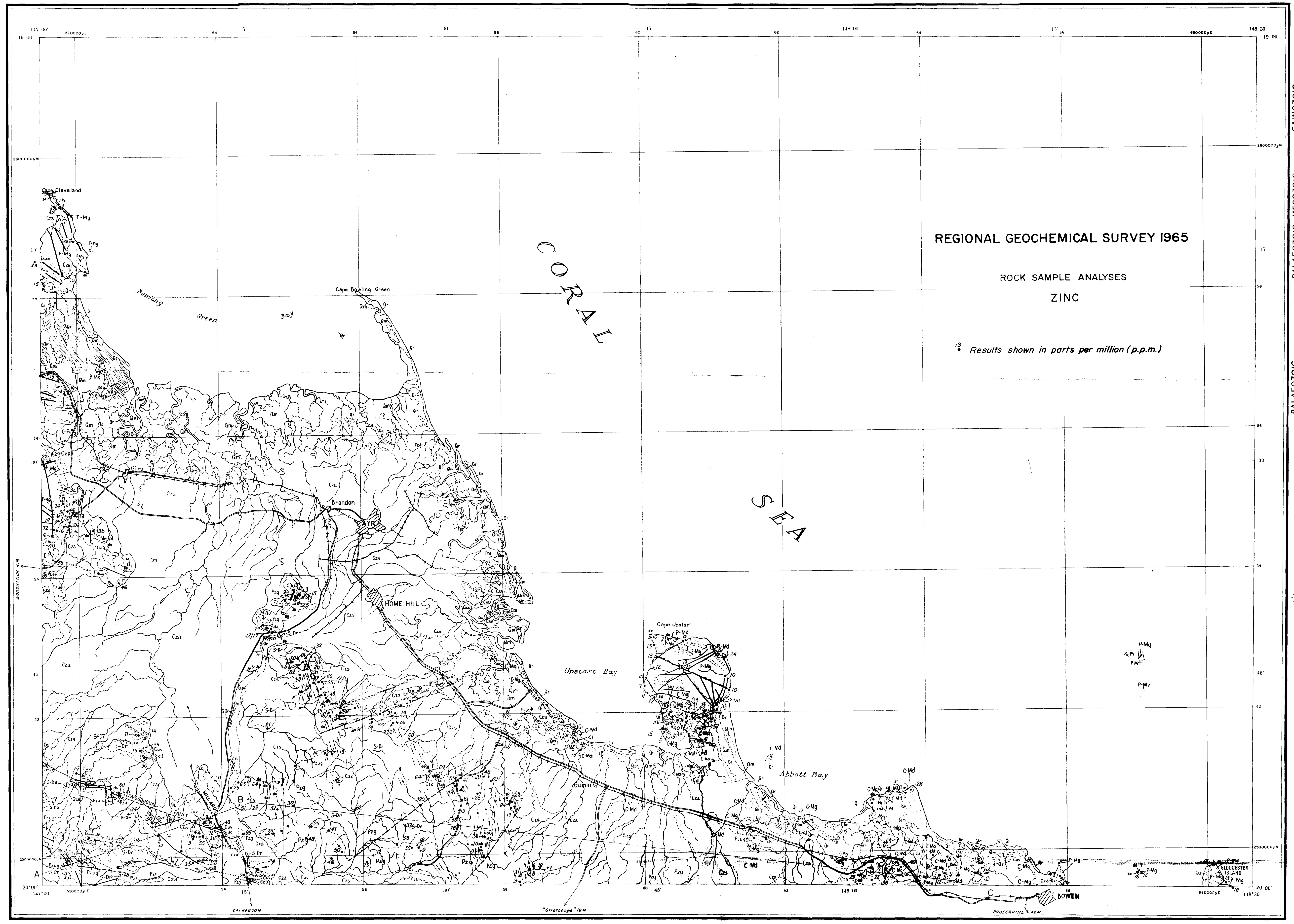

Reference

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			Cza	Alluvial and deltaic deposits
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			P-Md	Diorite, microdiorite, gabbro
			P-Mv	Hornfelsed tuff (Nares Rock)
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		Ellenvale Beds	Ce	Flow-banded rhyolite, rhyolite-breccia, andesite
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	EARLY PALAEOZOIC		Pzu	Schist, phyllite, quartzite, hornfels

Geological boundary

Fault

Boundary of major shear zone

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes

Joint pattern } air-photo interpretation

Trend of coastal sand

30 Strike and dip of strata

80 Strike and dip of cleavage

60 Strike and dip of metamorphic foliation

Vertical metamorphic foliation

Metamorphic foliation, dip indeterminable

70 Strike and dip of platy flow

Vertical platy flow

60 Strike and dip of primary

Primary banding in gabbro, dip indeterminable

Dyke
do = dolerite, andesite, microdiorite
f = felsite (including rhyolite and acid porphyry)
g = granophyre, granite
mt = microtonalite

Mineral prospect, little or no production

Quarry

(Mt) Unexploited mineral deposit

• Minor mineral occurrence

Cu Copper

Gt Graphite

Im Ilmenite

Ls Limestone ('earth lime')

Mt Magnetite

Ph Phosphate rock

Py Pyrite

Rc Crushed rock aggregate

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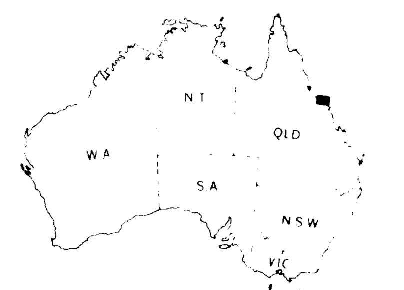
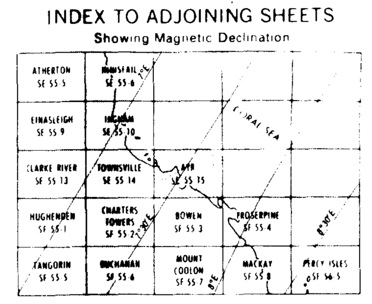


INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



Scale 1:250,000

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GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

Section

Cainozoic sediments omitted from section. Attitude of faults not known.

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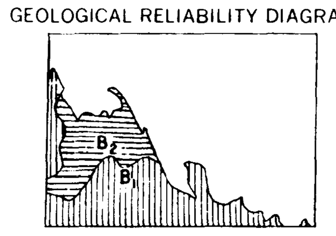
GEOLOGICAL RELIABILITY DIAGRAM



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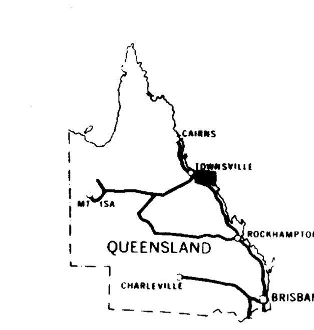
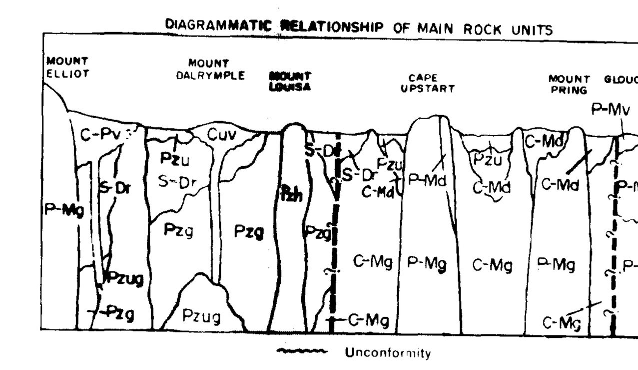
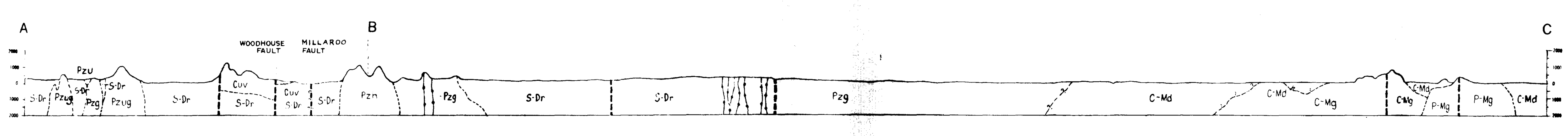
B_2 Mostly air-photo interpretation



DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





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SHEET SE 55-15

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To accompany Record 1967/129

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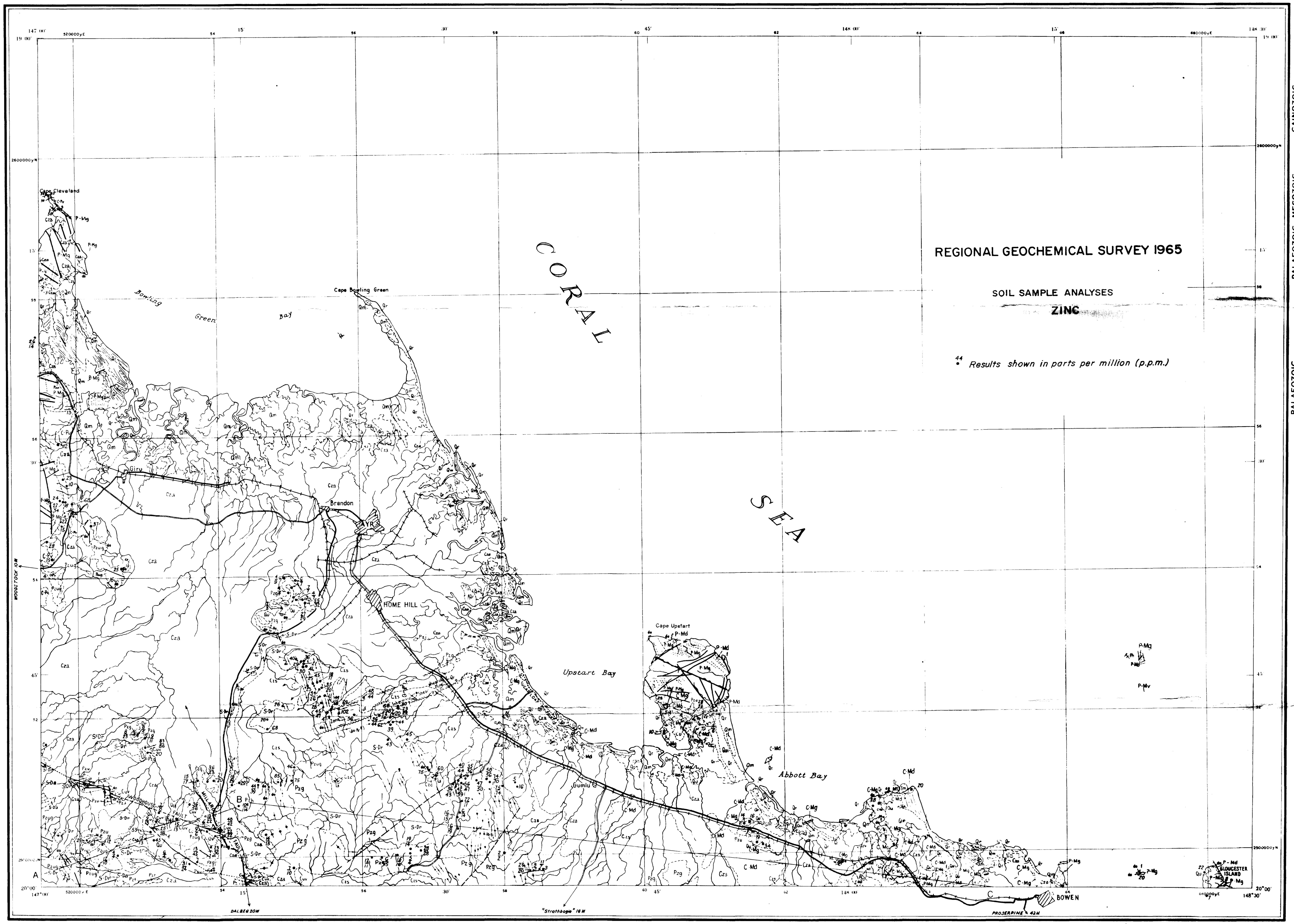
QUEENSLAND

Fig. 10

FIRST EDITION 1967



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Strike and dip of metamorphic foliation

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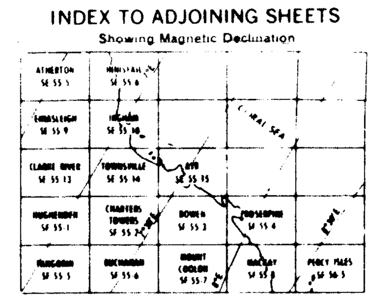
INDEX TO ADJOINING SHEETS

Showing Magnetic Declination



Scale 1:250,000

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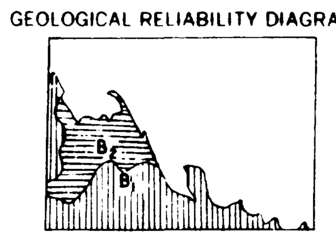
GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

Section

Cainozoic sediments omitted from section — Attitude of faults not known

Scale $\frac{V}{H}$ 4

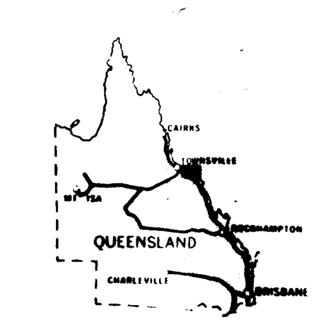
GEOLOGICAL RELIABILITY DIAGRAM



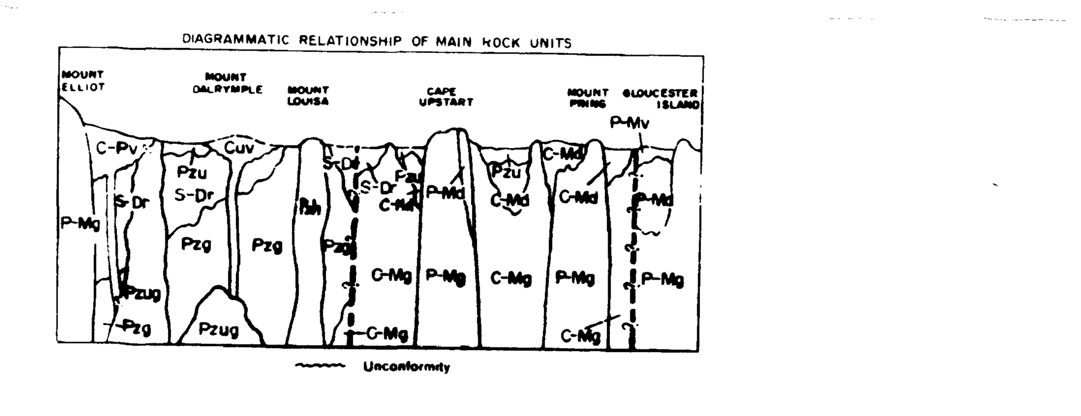
B_1 Detailed reconnaissance with air-photo interpretation

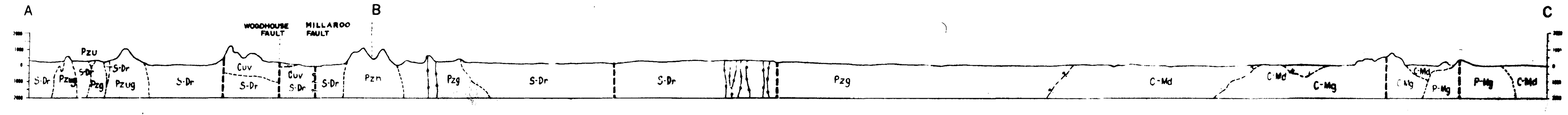
B_2 Mostly air-photo interpretation

Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.).
Compiled by: A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)



DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





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SHEET SE 55-15

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To accompany Record 1967/120

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Fig.11

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Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.)

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SHEET SE 55-15

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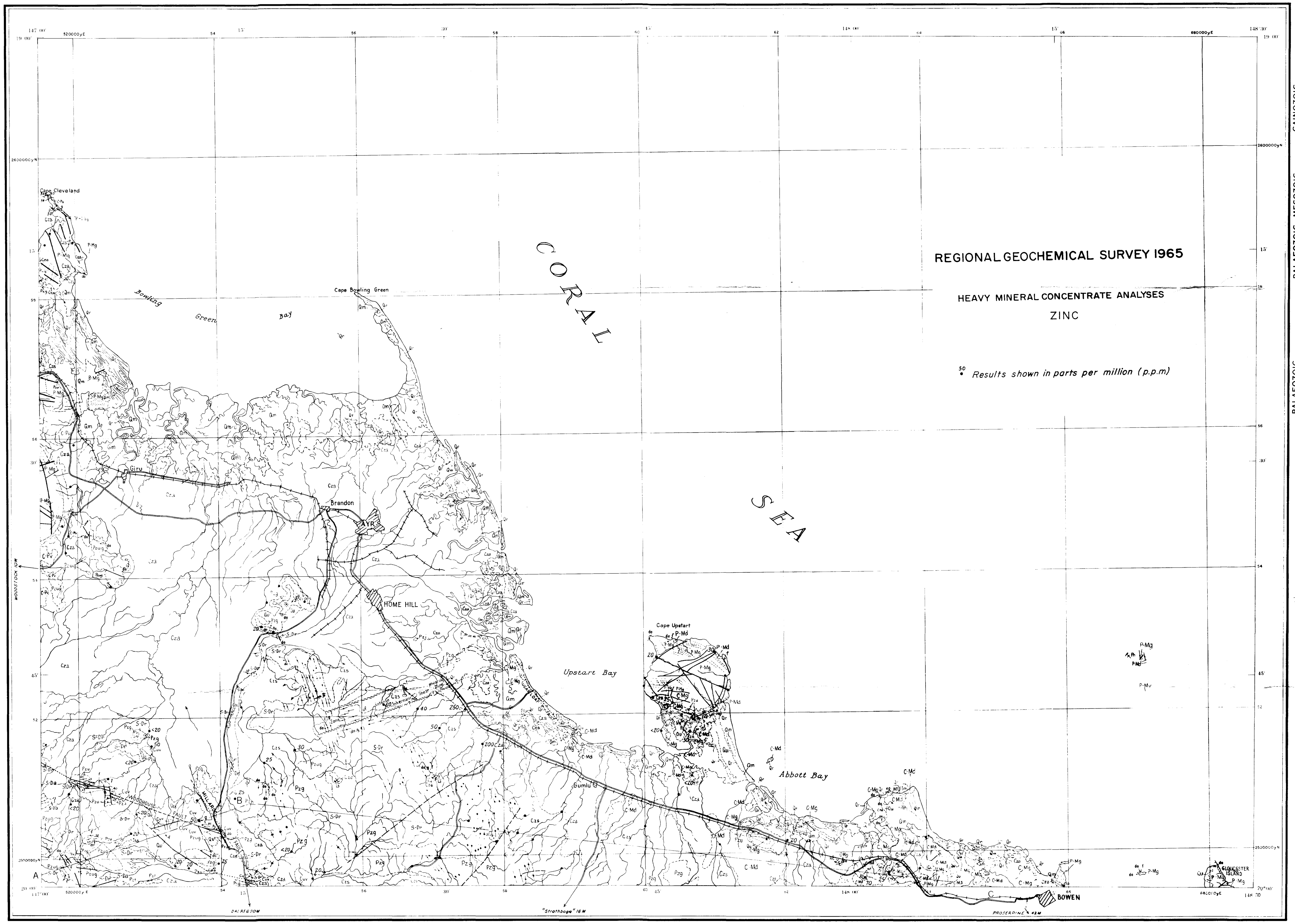
Fig. 12

FIRST EDITION 1967



Reference

CAINOZOIC	QUATERNARY		Qm	Coastal mud flats
			Qr	Coastal sand dunes
			Qu	Outwash and talus
			Cza	Alluvial and deltaic deposits
			Czs	Residual soil, sand, and rubble; some semi-consolidated material
			Czc	'Earth Lime'
PALAEOZOIC–MESOZOIC	PERMIAN TO MESOZOIC		P-Mg	Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro
			P-Md	Diorite, microdiorite, gabbro
			P-Mv	Hornfelsed tuff (Nares Rock)
	CARBONIFEROUS TO MESOZOIC	Urannah Complex	C-Mg	Leucocratic adamellite and granite, tonalite; locally sheared
			C-Md	Diorite, gabbro, norite, tonalite, dolerite, microdiorite; minor diallagite
PALAEOZOIC	LATE PALAEOZOIC		Pzug	Granite, microgranite, adamellite
			Pzh	Rhyolite, trachyte, trachyandesite; mainly intrusive
	CARBONIFEROUS TO PERMIAN		C-Pv	Intermediate lavas and pyroclastics, minor acid volcanics
	UPPER CARBONIFEROUS		Cuv	Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff
		Ellenvale Beds	Ce	Flow-banded rhyolite, rhyolite-breccia, andesite
	UNDIFFERENTIATED		Pzt	Olivine microgabbro
			Pzg	Leucocratic granite and adamellite, foliated in places; dykes of rhyodacite and acid porphyry; minor granodiorite and microgranite
	UPPER DEVONIAN ?		Pzj	Hornfelsed calcareous conglomerate, with calcareous quartzite interbeds (Charlies Hill, near Home Hill)
	SILURIAN – LOWER DEVONIAN	Ravenswood Granodiorite	S-Da	Biotite granite, leucocratic adamellite; foliated in places
			S-Dr	Hornblende granodiorite and diorite, minor granite, adamellite and gabbro; foliated in places
	EARLY PALAEOZOIC		Pzu	Schist, phyllite, quartzite, hornfels

Geological boundary

Fault

Boundary of major shear zone

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes

Joint pattern } air-photo interpretation

Trend of coastal sand } air-photo interpretation

Strike and dip of strata

Strike and dip of cleavage

Strike and dip of metamorphic foliation

Vertical metamorphic foliation

Metamorphic foliation, dip indeterminable

Strike and dip of platy flow

Vertical platy flow

Strike and dip of primary

Primary banding in gabbro, dip indeterminable

Dyke
do = dolerite, andesite, microdiorite
f = felsite (including rhyolite and acid porphyry)
g = granophyre, granite
mt = microtonalite

Mineral prospect, little or no production

Quarry

Unexploited mineral deposit

Minor mineral occurrence

Cu Copper
Gt Graphite
Im Ilmenite
Ls Limestone ('earth lime')
Mt Magnetite
Ph Phosphate rock
Py Pyrite
Rc Crushed rock aggregate

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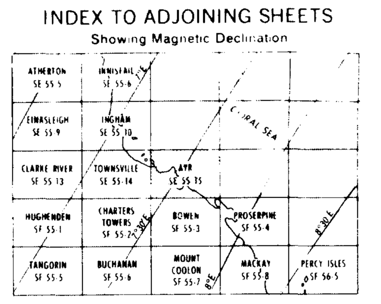
INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



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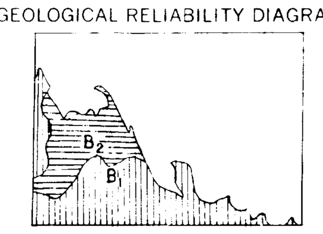
GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

Section

Cainozoic sediments omitted from section. Attitude of faults not known

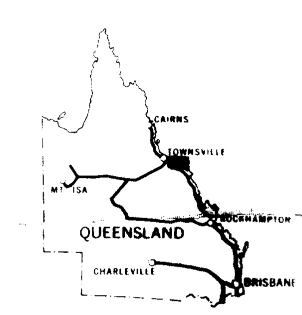
GEOLOGICAL RELIABILITY DIAGRAM



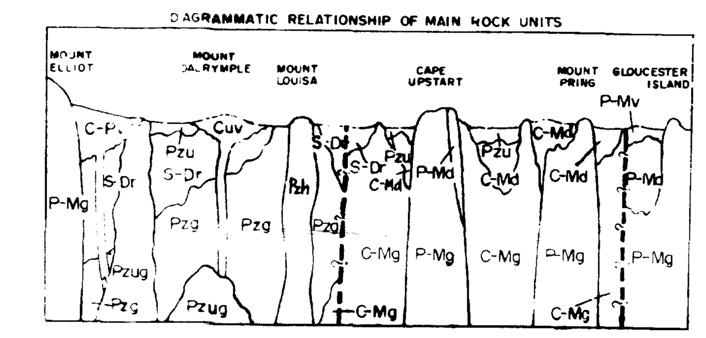
B1 Detailed reconnaissance with air-photo interpretation

B2 Mostly air-photo interpretation

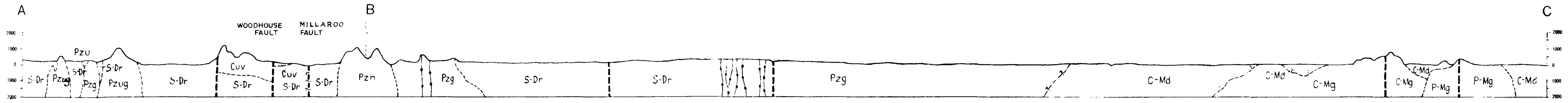
Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.).
Compiled by: A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)



DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS



Unconformity



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SHEET SE 55-15

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Fig. 13.

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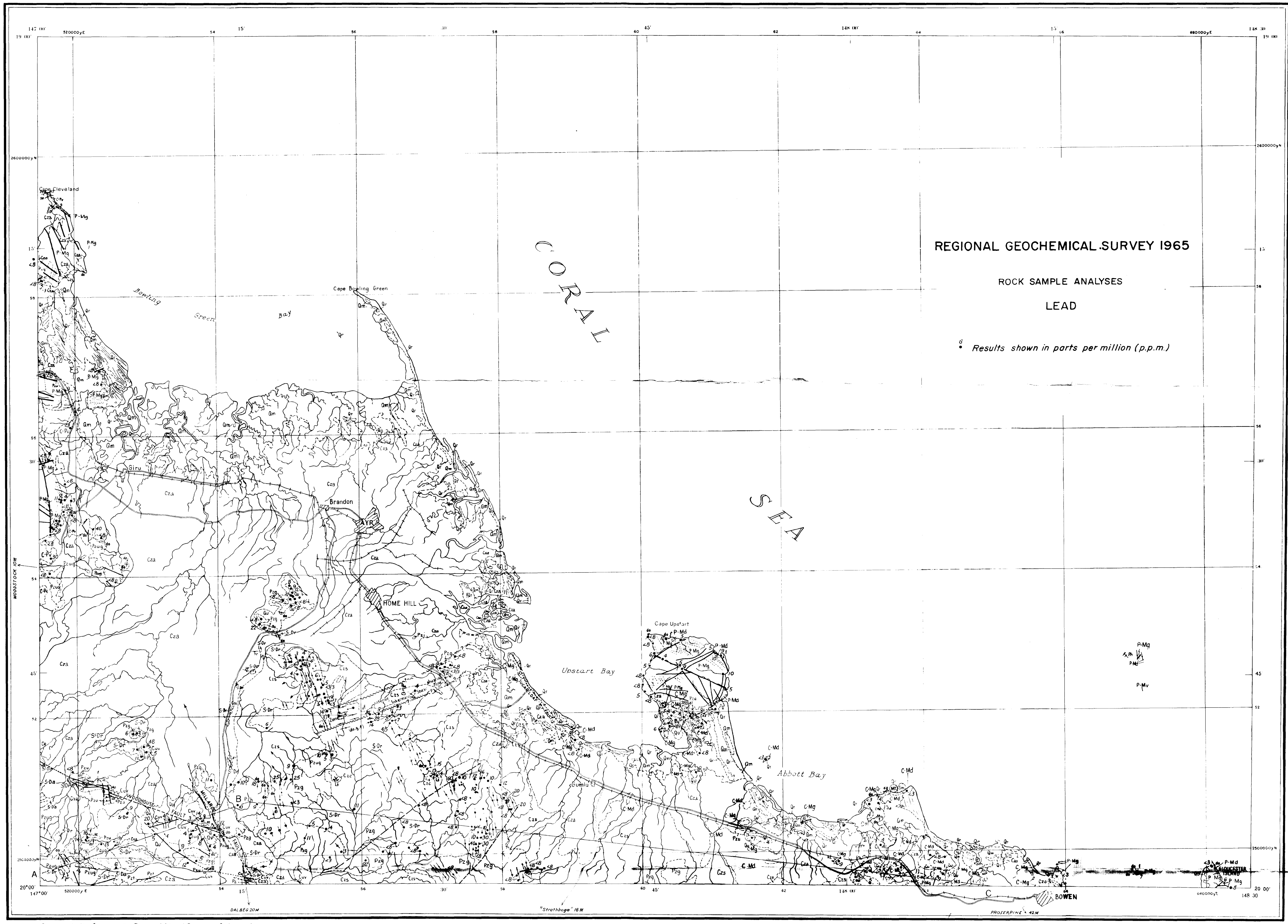

Reference

CAINOZOIC	QUATERNARY	Qm	Coastal mud flats
		Qr	Coastal sand dunes
		Qo	Outwash and talus
		Cza	Alluvial and deltaic deposits
		Czs	Residual soil, sand, and rubble; some semi-consolidated material
		Czc	'Earth Lime'
PALAEOZOIC–MESOZOIC	PERMIAN TO MESOZOIC	P-Mg	Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro
		P-Md	Diorite, microdiorite, gabbro
		P-Mv	Hornfelsed tuff (Nares Rock)
	CARBONIFEROUS TO MESOZOIC (Urannah Complex)	C-Mg	Leucocratic adamellite and granite, tonalite; locally sheared
		C-Md	Diorite, gabbro, norite, tonalite, dolerite, microdiorite; minor diallagite
PALAEOZOIC	LATE PALAEOZOIC	Pzug	Granite, microgranite, adamellite
		Pzh	Rhyolite, trachyte, trachyandesite; mainly intrusive
	CARBONIFEROUS TO PERMIAN	C-Pv	Intermediate lavas and pyroclastics, minor acid volcanics
	UPPER CARBONIFEROUS	Cuv	Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff
	(Ellenvale Beds)	Ce	Flow-banded rhyolite, rhyolite-breccia, andesite
	UNDIFFERENTIATED	Pzt	Olivine microgabbro
		Pzg	Leucocratic granite and adamellite, foliated in places; dykes of rhyodacite and acid porphyry; minor granodiorite and microgranite
	UPPER DEVONIAN ?	Pzj	Hornfelsed calcareous conglomerate, with calcareous quartzite interbeds (Charlies Hill, near Home Hill)
	SILURIAN – LOWER DEVONIAN (Ravenswood Granodiorite)	S-Da	Biotite granite, leucocratic adamellite; foliated in places
		S-Dr	Hornblende granodiorite and diorite, minor granite, adamellite and gabbro; foliated in places
	EARLY PALAEOZOIC	Pzu	Schist, phyllite, quartzite, hornfels

Geological boundary

Fault

Boundary of major shear zone

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes

Joint pattern } air-photo interpretation

Trend of coastal sand } air-photo interpretation

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Strike and dip of cleavage

Strike and dip of metamorphic foliation

Vertical metamorphic foliation

Metamorphic foliation, dip indeterminable

Strike and dip of platy flow

Vertical platy flow

Strike and dip of primary

Primary banding in gabbro, dip indeterminable

Dyke

da: dolerite, andesite, microdiorite; f: felsite (including rhyolite and acid porphyry); g: granophyre, granite; mt: microtonalite

Mineral prospect, little or no production

Quarry

Unexploited mineral deposit

Minor mineral occurrence

Cu Copper

Gt Graphite

Im Ilmenite

Ls Limestone ('earth lime')

Mt Magnetite

Ph Phosphate rock

Py Pyrite

Rc Crushed rock aggregate

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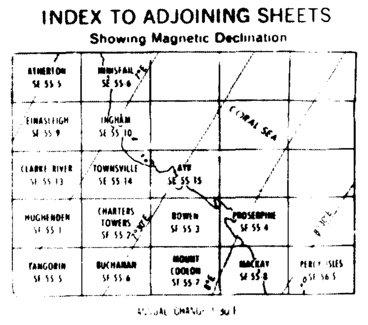
INDEX TO ADJOINING SHEETS

Showing Magnetic Declination



Scale 1:250,000

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GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

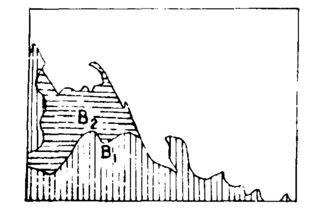
Section

Cainozoic sediments omitted from section. Attitude of faults not known.

Geology by A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.)

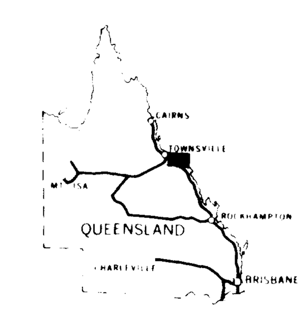
Compiled by A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)

GEOLOGICAL RELIABILITY DIAGRAM

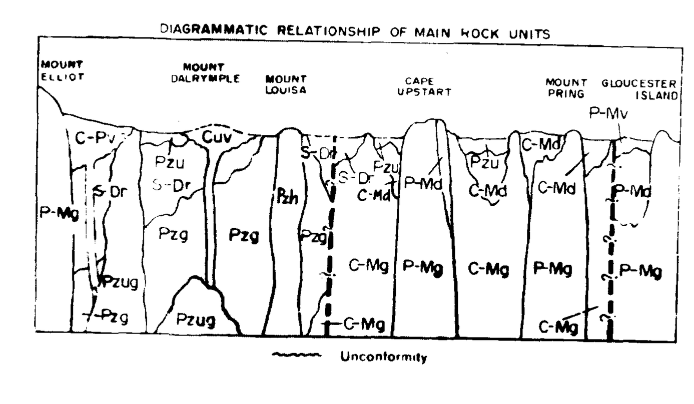


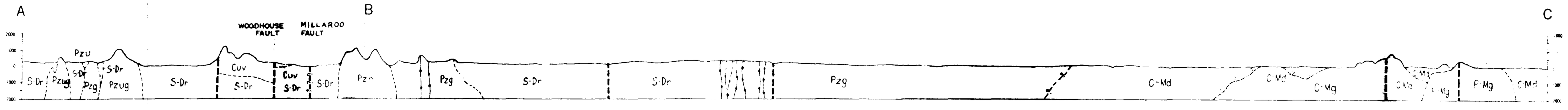
B_1 Detailed reconnaissance with air-photo interpretation

B_2 Mostly air-photo interpretation



DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





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SHEET SE 55-15

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Fig. 14

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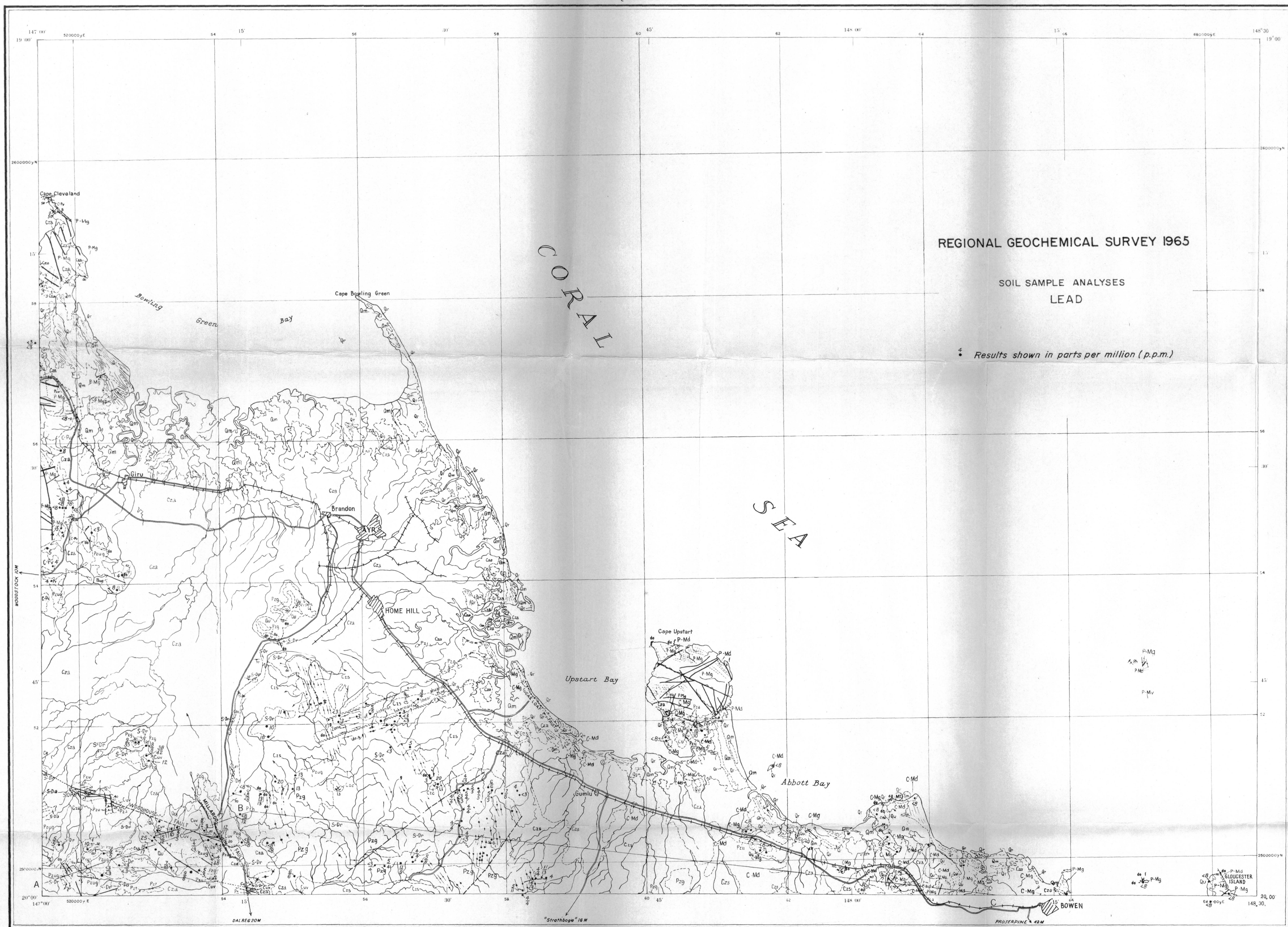

Reference

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			Qr	Coastal sand dunes
			Qu	Outwash and talus
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			P-Md	Diorite, microdiorite, gabbro
			P-Mv	Hornfelsed tuff (Nares Rock)
	CARBONIFEROUS TO MESOZOIC	Urannah Complex	C-Mg	Leucocratic adamellite and granite, tonalite; locally sheared
			C-Md	Diorite, gabbro, norite, tonalite, dolerite, microdiorite: minor diallagite
PALAEOZOIC	LATE PALAEOZOIC		Pzug	Granite, micrograntite, adamellite
			Pzh	Rhyolite, trachyte, trachyandesite; mainly intrusive
	CARBONIFEROUS TO PERMIAN		C-Pv	Intermediate lavas and pyroclastics, minor acid volcanics
	UPPER CARBONIFEROUS		Cuv	Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff
		Ellenvale Beds	Ce	Flow-banded rhyolite, rhyolite-breccia, andesite
	UNDIFFERENTIATED		Pzt	Olivine microgabbro
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	SILURIAN – LOWER DEVONIAN	Ravenswood Granodiorite	S-Da	Biotite granite, leucocratic adamellite; foliated in places
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	EARLY PALAEOZOIC		Pzu	Schist, phyllite, quartzite. hornfels

Geological boundary

Fault

Boundary of major shear zone

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Joint pattern } *air-photo interpretation*

Trend of coastal sand } *air-photo interpretation*

Strike and dip of strata

Strike and dip of cleavage

Strike and dip of metamorphic foliation

Vertical metamorphic foliation

Metamorphic foliation, dip indererminable

Strike and dip of platy flow

Vertical platy flow

Strike and dip of primary

Primary banding in gabbro, dip indeterminable

Dyke

- do = *dolerite, andesite, microdiorite*
- f = *felsite (including rhyolite and acid porphyry)*
- g = *granophyre, granite*
- mt = *microtonalite*

Mineral prospect, little or no production

Quarry

(Mt) *Unexploited mineral deposit*

• *Minor mineral occurrence*

Cu	*Copper*
Gt	*Graphite*
Im	*Ilmenite*
Ls	*Limestone ('earth lime')*
Mt	*Magnetite*
Ph	*Phosphate rock*
Py	*Pyrite*
Rc	*Crushed rock aggregate*

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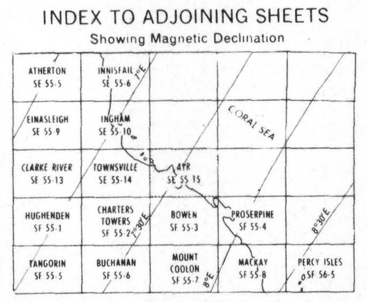
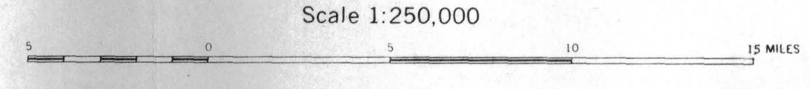


Scale 1:250,000



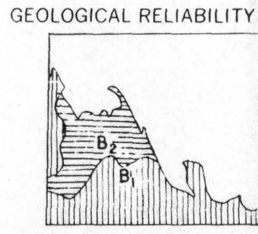
GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

Section

Cainozoic sediments omitted from section   Attitude of faults not known

Scale $\frac{V}{H} = 4$

GEOLOGICAL RELIABILITY DIAGRAM



B_1 *Detailed reconnaissance with air-photo interpretation*

B_2 *Mostly air-photo interpretation*

Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.).

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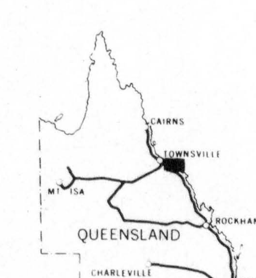
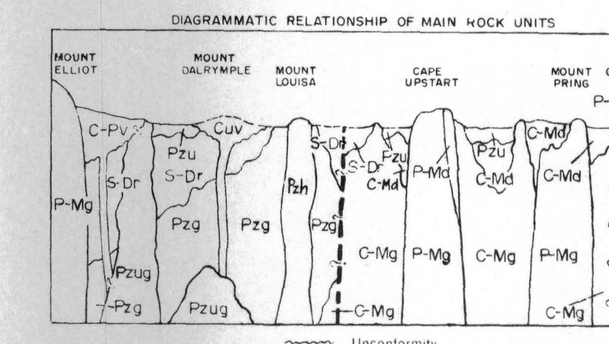
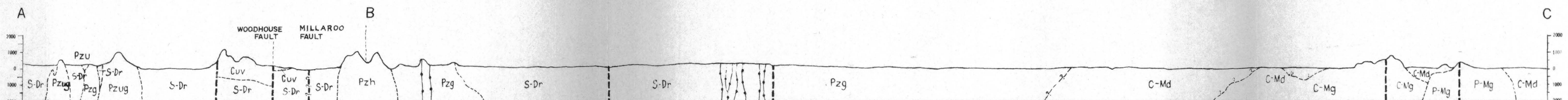


DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





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SHEET SE 55-15

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Fig. 15

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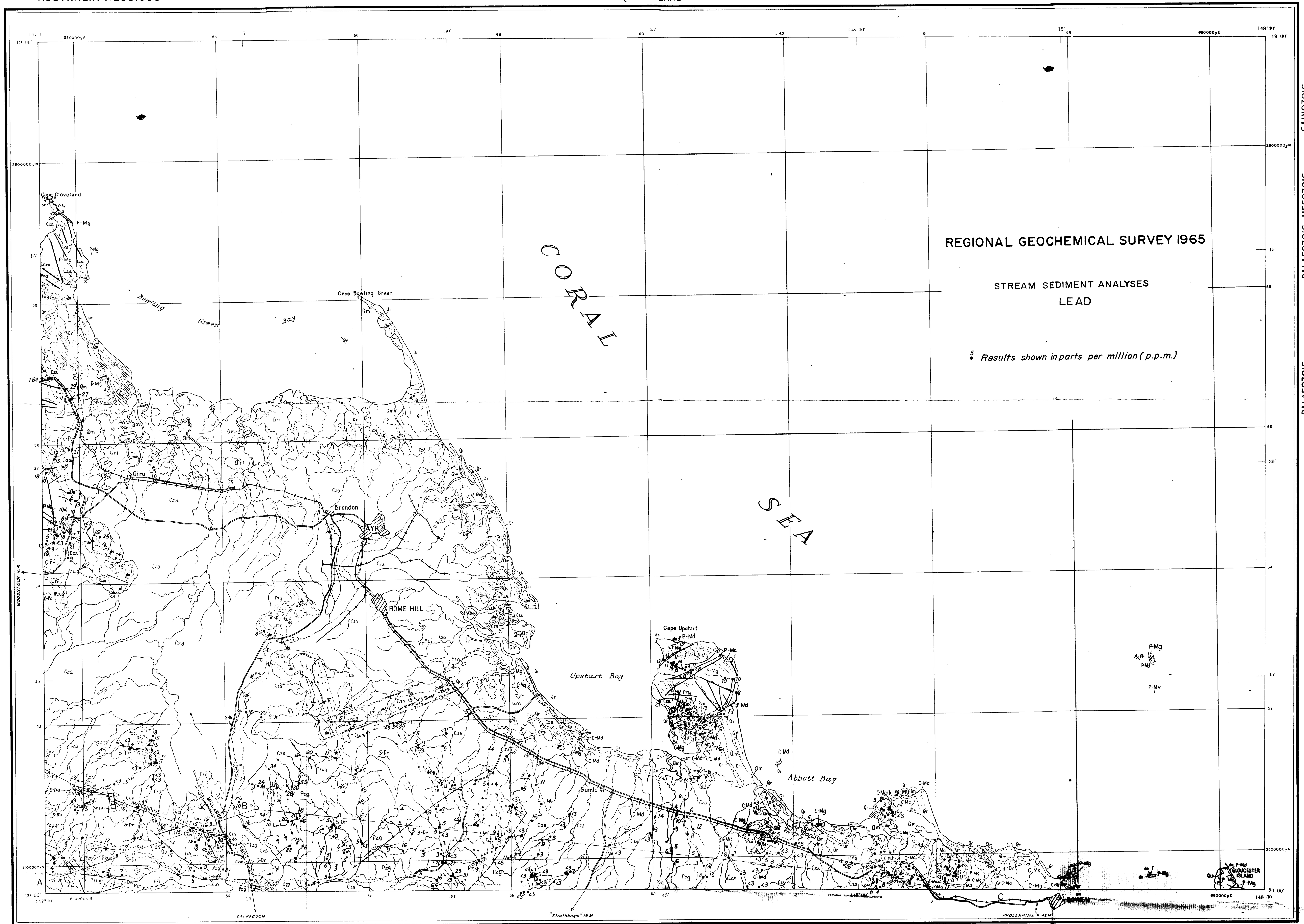
FIRST EDITION 1967



Reference

CAINOZOIC	QUATERNARY		Qm	*Coastal mud flats*
			Qr	*Coastal sand dunes*
			Qu	*Outwash and talus*
			Cza	*Alluvial and deltaic deposits*
			Czs	*Residual soil, sand, and rubble; some semi-consolidated material*
			Czc	*'Earth Lime'*
PALAEOZOIC–MESOZOIC	PERMIAN TO MESOZOIC		P-Mg	*Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro*
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	CARBONIFEROUS TO MESOZOIC	Urannah Complex	C-Mg	*Leucocratic adamellite and granite, tonalite; locally sheared*
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			Pzh	*Rhyolite, trachyte, trachyandesite; mainly intrusive*
	CARBONIFEROUS TO PERMIAN		C-Pv	*Intermediate lavas and pyroclastics, minor acid volcanics*
	UPPER CARBONIFEROUS		Cuv	*Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff*
		Ellenvale Beds	Ce	*Flow-banded rhyolite, rhyolite-breccia, andesite*
	UNDIFFERENTIATED		Pzt	*Olivine microgabbro*
			Pzg	*Leucocratic granite and adamellite, foliated in places; dykes of rhyodacite and acid porphyry; minor granodiorite and microgranite*
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	SILURIAN – LOWER DEVONIAN	Ravenswood Granodiorite	S-Da	*Biotite granite, leucocratic adamellite; foliated in places*
			S-Dr	*Hornblende granodiorite and diorite, minor granite, adamellite and gabbro; foliated in places*
	EARLY PALAEOZOIC		Pzu	*Schist, phyllite, quartzite, hornfels*

Geological boundary

Fault

Boundary of major shear zone

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes

Joint pattern / *Trend of coastal sand* — *air-photo interpretation*

Strike and dip of strata

Strike and dip of cleavage

Strike and dip of metamorphic foliation

Vertical metamorphic foliation

Metamorphic foliation, dip indeterminable

Strike and dip of platy flow

Vertical platy flow

Strike and dip of primary

Primary banding in gabbro, dip indeterminable

Dyke
- do = *dolerite, andesite, microdiorite*
- f = *felsite (including rhyolite and acid porphyry)*
- g = *granophyre, granite*
- mt = *microtonalite*

Mineral prospect, little or no production

Quarry

(Mt) *Unexploited mineral deposit*

Minor mineral occurrence

- Cu *Copper*
- Gt *Graphite*
- Im *Ilmenite*
- Ls *Limestone ('earth lime')*
- Mt *Magnetite*
- Ph *Phosphate rock*
- Py *Pyrite*
- Rc *Crushed rock aggregate*

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INDEX TO ADJOINING SHEETS
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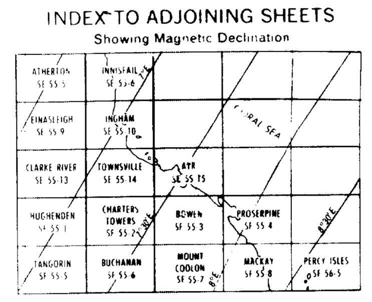

Scale 1:250,000

0 5 10 15 MILES

0 5 10 15 20 25 KILOMETRES

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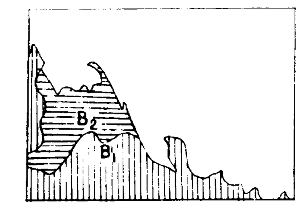
GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

Section

Cainozoic sediments omitted from section — Attitude of faults not known

Scale $\frac{V}{H} = 4$

GEOLOGICAL RELIABILITY DIAGRAM

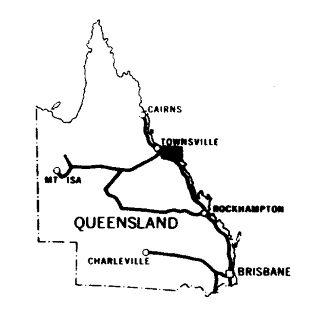


B_1 *Detailed reconnaissance with air-photo interpretation*

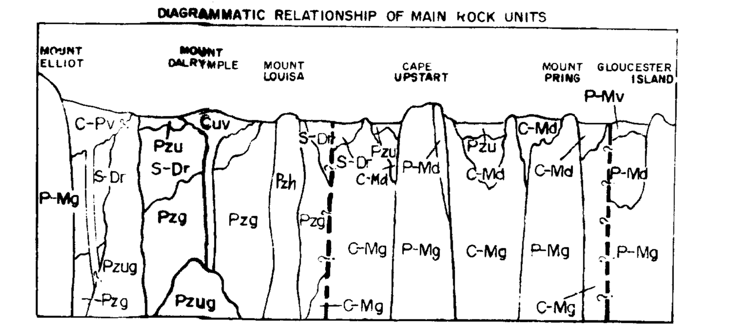
B_2 *Mostly air-photo interpretation*

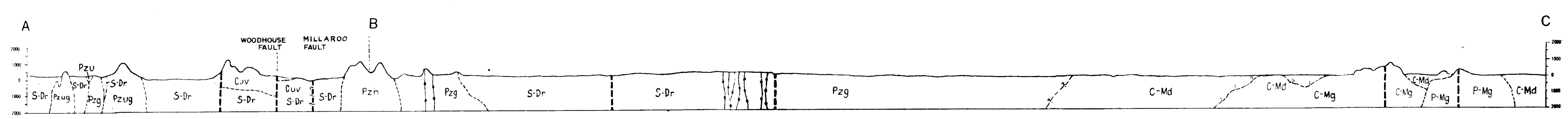
Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.)

Compiled by: A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)



DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





AYR
SHEET SE 55-15

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To accompany Record 1967/129

Fig. 16
AUSTRALIA 1:250.000
AYR
QUEENSLAND
1:250.000 GEOLOGICAL SERIES SHEET SE 55-15
FIRST EDITION 1967
REGIONAL GEOCHEMICAL SURVEY 1965
HEAVY MINERAL CONCENTRATE ANALYSES
LEAD
Results shown in parts per million (p.p.m.)
CORAL
SEA
Cape Cleveland
Cape Bowling Green
Bowling Green Bay
Giru
Brandon
AYR
HOME HILL
Upstart Bay
Cape Upstart
Abbott Bay
GLOUCESTER ISLAND
BOWEN
Reference
QUATERNARY
Qm Coastal mud flats
Qr Coastal sand dunes
Qo Outwash and talus
CAINOZOIC
Cza Alluvial and deltaic deposits
Czs Residual soil, sand, and rubble; some semi-consolidated material
Czl 'Earth Lime'
PERMIAN TO MESOZOIC
P-Mg Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro
P-Md Diorite, microdiorite, gabbro
P-Mv Hornfelsed tuff (Nares Rock)
PALAEOZOIC-MESOZOIC
CARBONIFEROUS TO MESOZOIC
Urannah Complex
C-Mg Leucocratic adamellite and granite, tonalite; locally sheared
C-Md Diorite, gabbro, norite, tonalite, dolerite, microdiorite; minor diallagite
LATE PALAEOZOIC
Pzug Granite, microgranite, adamellite
Pzh Rhyolite, trachyte, trachyandesite; mainly intrusive
CARBONIFEROUS TO PERMIAN
C-Pv Intermediate lavas and pyroclastics, minor acid volcanics
PALAEOZOIC
UPPER CARBONIFEROUS
Cuv Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff
Ellenvale Beds
Ce Flow-banded rhyolite, rhyolite-breccia, andesite
UNDIFFERENTIATED
Pzt Olivine microgabbro
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S-Dr Hornblende granodiorite and diorite, minor granite, adamellite and gabbro; foliated in places
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dn - dolerite, andesite, microdiorite
f - felsite (including rhyolite and acid porphyry)
g - granophyre, granite
mt - microtonalite
Mineral prospect, little or no production
Quarry
Unexploited mineral deposit
Minor mineral occurrence
Cu Copper
Gt Graphite
Im Ilmenite
Ls Limestone ('earth lime')
Mt Magnetite
Ph Phosphate rock
Py Pyrite
Rc Crushed rock aggregate
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CROWN COPYRIGHT RESERVED
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Cainozoic sediments omitted from section
Attitude of faults not known
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B1 Detailed reconnaissance with air-photo interpretation
B2 Mostly air-photo interpretation
Geology by A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.)
Compiled by A.G.L. Paine, C.M. Gregory, N.L. Kruger, A Tutarow (B.M.R.), D.E. Clarke (G.S.Q.)
QUEENSLAND
DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS
Unconformity
WOODHOUSE FAULT
MILLAROO FAULT
A
B
C
AYR
SHEET SE 55-15
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To accompany Record 1967/129

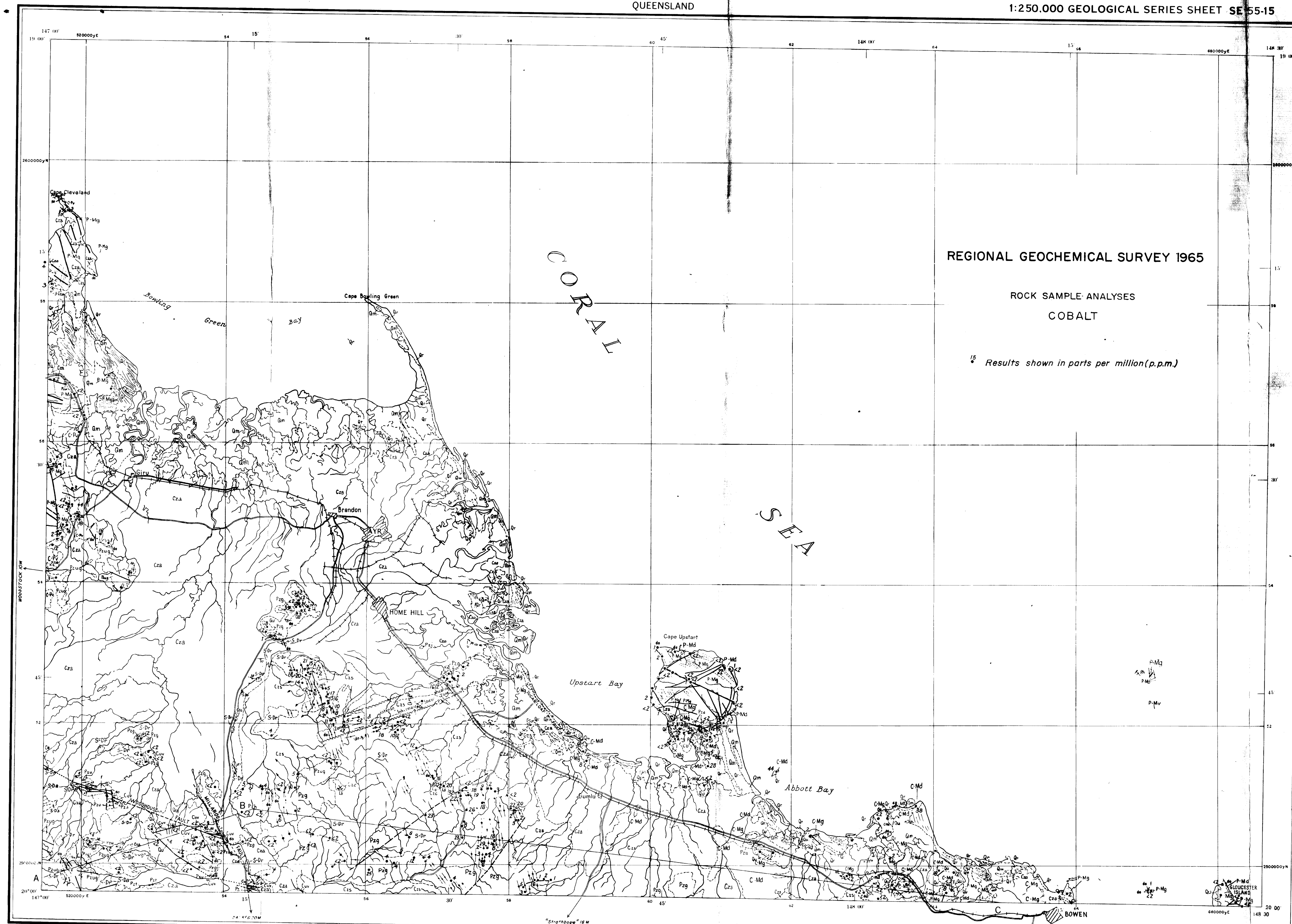
AUSTRALIA 1:250.000

AYR
QUEENSLAND

1:250,000 GEOLOGICAL SERIES SHEET SE 55-15

Fig. 17

FIRST EDITION 1967



Reference

CAINOZOIC	QUATERNARY		Qm	Coastal mud flats
			Qr	Coastal sand dunes
			Qu	Outwash and talus
			Cza	Alluvial and deltaic deposits
			Czs	Residual soil, sand, and rubble; some semi-consolidated material
			Czc	'Earth Lime'
PALAEOZOIC–MESOZOIC	PERMIAN TO MESOZOIC		P-Mg	Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro
			P-Md	Diorite, microdiorite, gabbro
			P-Mv	Hornfelsed tuff (Nares Rock)
	CARBONIFEROUS TO MESOZOIC	Urannah Complex	C-Mg	Leucocratic adamellite and granite, tonalite; locally sheared
			C-Md	Diorite, gabbro, norite, tonalite, dolerite, microdiorite; minor diallagite
PALAEOZOIC	LATE PALAEOZOIC		Pzug	Granite, microgranite, adamellite
			Pzh	Rhyolite, trachyte, trachyandesite; mainly intrusive
	CARBONIFEROUS TO PERMIAN		C-Pv	Intermediate lavas and pyroclastics, minor acid volcanics
	UPPER CARBONIFEROUS		Cuv	Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff
		Ellenvale Beds	Ce	Flow-banded rhyolite, rhyolite-breccia, andesite
	UNDIFFERENTIATED		Pzt	Olivine microgabbro
			Pzg	Leucocratic granite and adamellite, foliated in places; dykes of rhyodacite and acid porphyry; minor granodiorite and microgranite
	UPPER DEVONIAN ?		Pzi	Hornfelsed calcareous conglomerate, with calcareous quartzite interbeds (Charlies Hill, near Home Hill)
	SILURIAN – LOWER DEVONIAN	Ravenswood Granodiorite	S-Da	Biotite granite, leucocratic adamellite; foliated in places
			S-Dr	Hornblende granodiorite and diorite, minor granite, adamellite and gabbro; foliated in places
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Trend of coastal sand }

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Unexploited mineral deposit

Minor mineral occurrence

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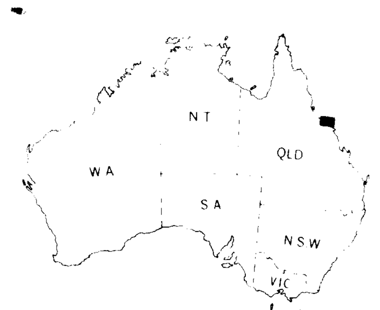
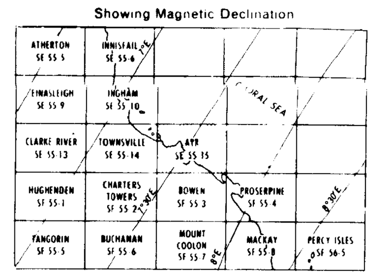


INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



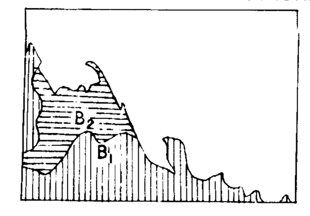
Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID ZONE (AUSTRALIA SERIES)

GEOLOGICAL RELIABILITY DIAGRAM



B_1 Detailed reconnaissance with air-photo interpretation

B_2 Mostly air-photo interpretation

Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.)

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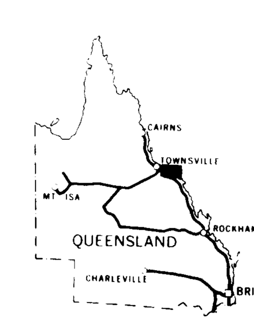
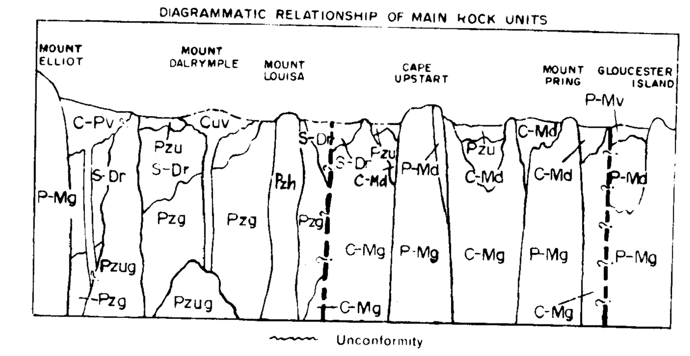


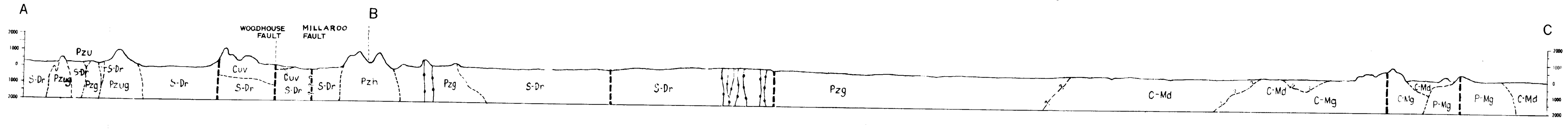
DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS



Section

Cainozoic sediments omitted from section. Attitude of faults not known

Scale V/H : 4



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SHEET SE 55-15

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To accompany Record 1967/129

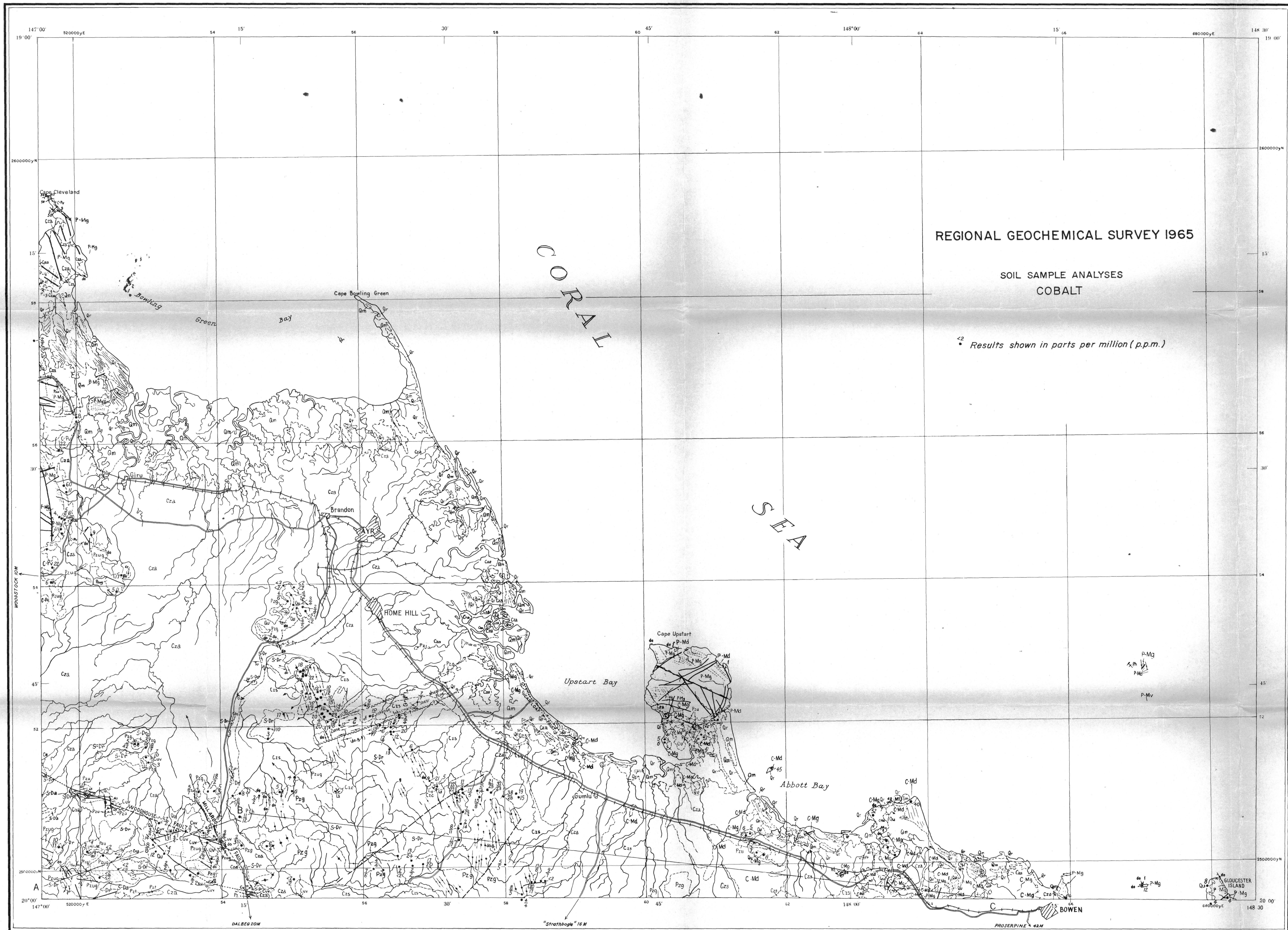
AUSTRALIA 1:250,000

AYR
QUEENSLAND

1:250,000 GEOLOGICAL SERIES SHEET SE 55-15

Fig. 18

FIRST EDITION 1967



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Joint pattern } air-photo interpretation

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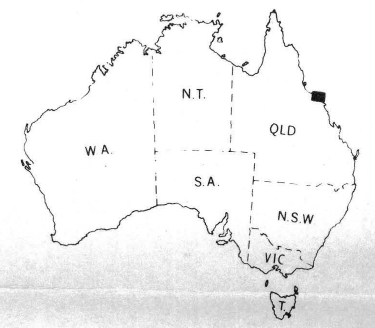

INDEX TO ADJOINING SHEETS

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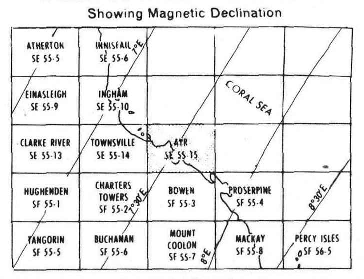

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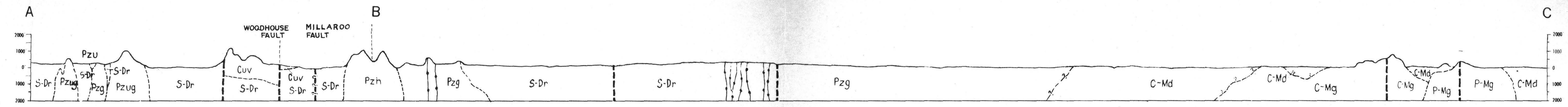

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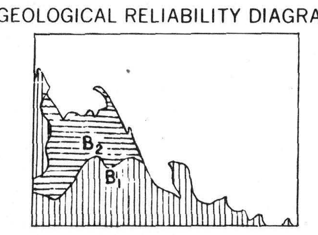

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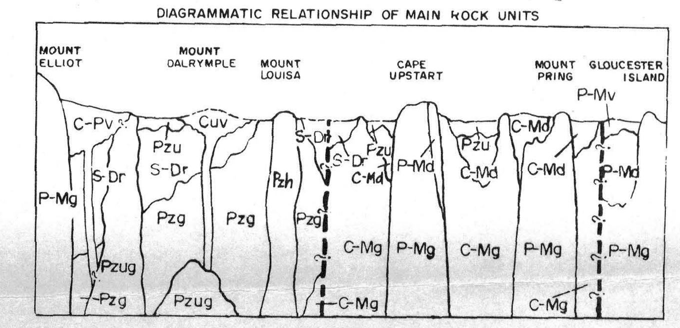

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AUSTRALIA 1:250.000

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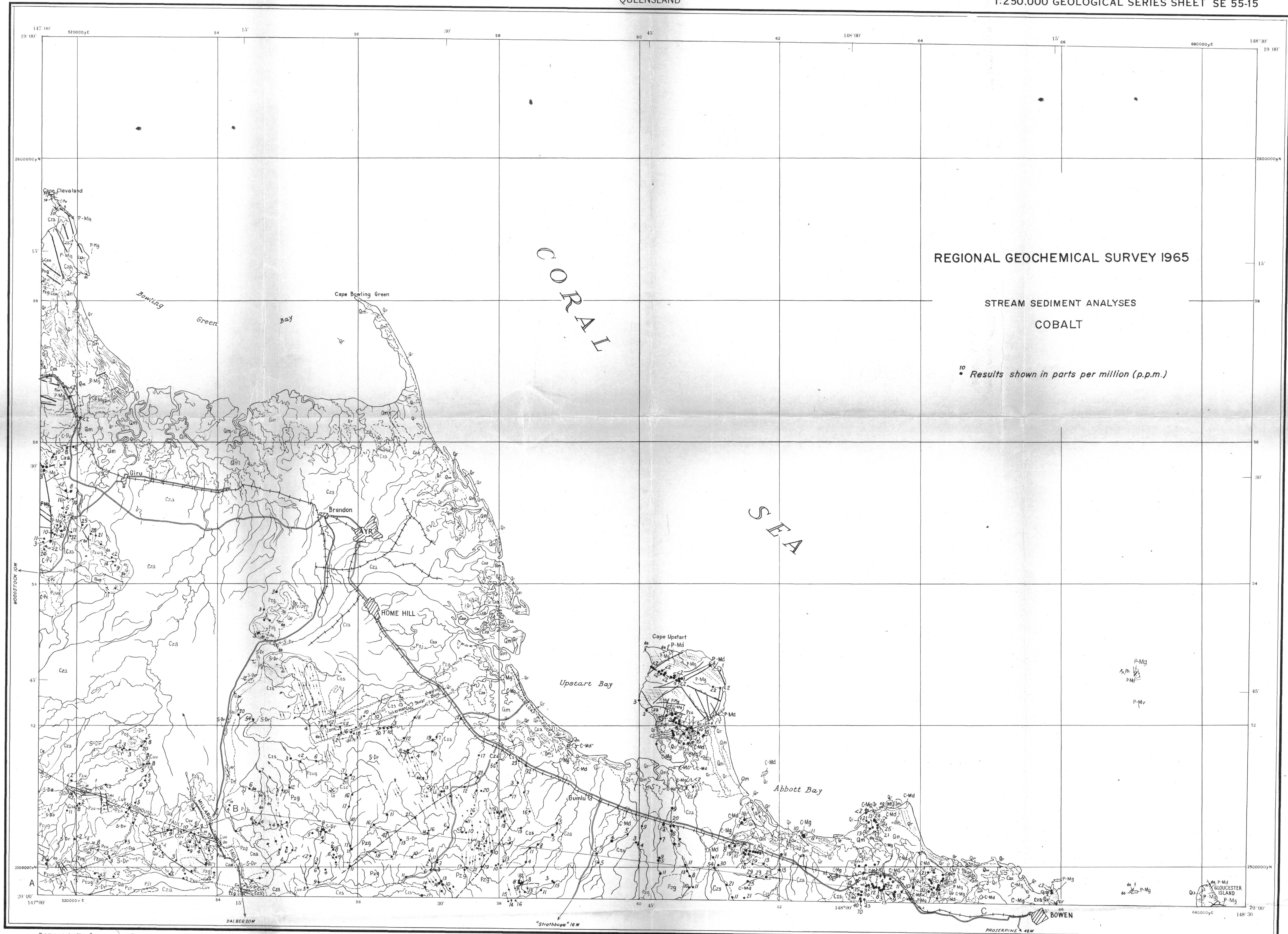
Fig 19

FIRST EDITION 1967



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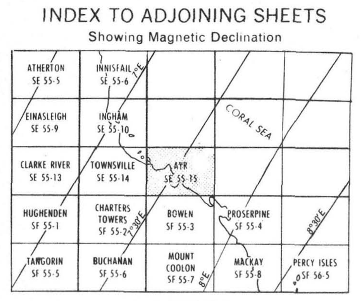
INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



Scale 1:250,000

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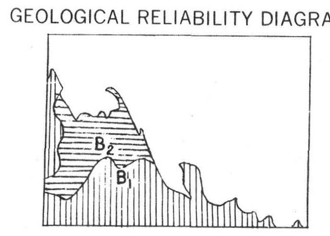
GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

Section

Cainozoic sediments omitted from section. Attitude of faults not known

Scale V/H = 4

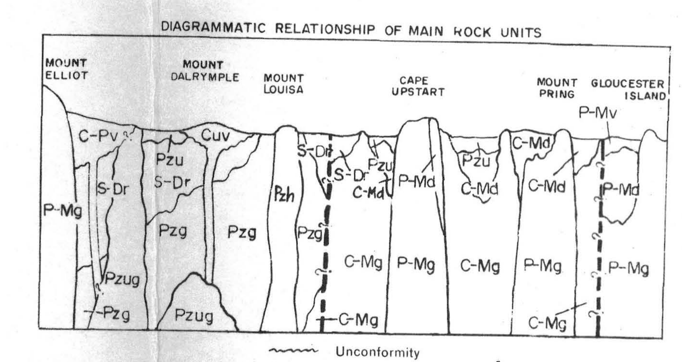
GEOLOGICAL RELIABILITY DIAGRAM

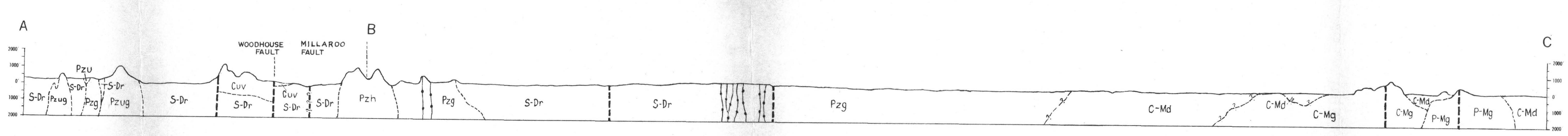


B_1 Detailed reconnaissance with air-photo interpretation
B_2 Mostly air-photo interpretation

Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.)
Compiled by: A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)

DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





AYR
SHEET SE 55-15

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To accompany Record 1967/129

Fig. 20

AUSTRALIA 1:250.000

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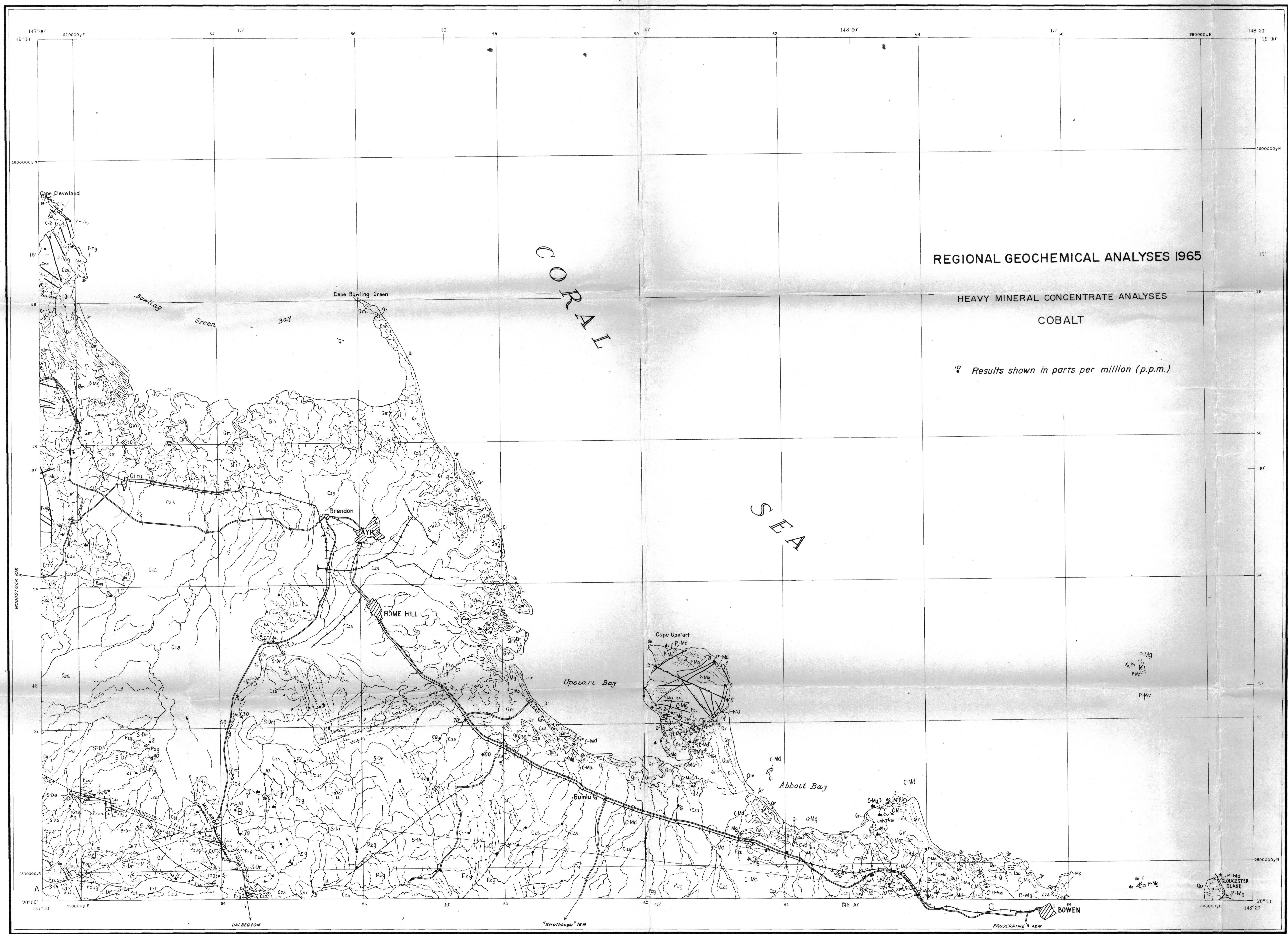
QUEENSLAND

1:250.000 GEOLOGICAL SERIES SHEET SE 55-15

FIRST EDITION 1967



Reference

CAINOZOIC	QUATERNARY		Qm	*Coastal mud flats*
			Qr	*Coastal sand dunes*
			Qu	*Outwash and talus*
			Cza	*Alluvial and deltaic deposits*
			Czs	*Residual soil, sand, and rubble; some semi-consolidated material*
			Czc	*'Earth Lime'*
PALAEOZOIC–MESOZOIC	PERMIAN TO MESOZOIC		P-Mg	*Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro*
			P-Md	*Diorite, microdiorite, gabbro*
			P-Mv	*Hornfelsed tuff (Norea Rock)*
	CARBONIFEROUS TO MESOZOIC	Urannah Complex	C-Mg	*Leucocratic adamellite and granite, tonalite; locally sheared*
			C-Md	*Diorite, gabbro, norite, tonalite, dolerite, microdiorite; minor diallagite*
PALAEOZOIC	LATE PALAEOZOIC		Pzug	*Granite, microgranite, adamelite*
			Pzh	*Rhyolite, trachyte, trachyandesite; mainly intrusive*
	CARBONIFEROUS TO PERMIAN		C-Pv	*Intermediate lavas and pyroclastics, minor acid volcanics*
	UPPER CARBONIFEROUS	Ellenvale Beds	Cuv	*Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff*
			Ce	*Flow-banded rhyolite, rhyolite-breccia, andesite*
	UNDIFFERENTIATED		Pzt	*Olivine microgabbro*
			Pzg	*Leucocratic granite and adamellite, foliated in places; dykes of rhyodacite and acid porphyry; minor granodiorite and microgranite*
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	SILURIAN — LOWER DEVONIAN	Ravenswood Granodiorite	S-Da	*Biotite granite, leucocratic adamellite; foliated in places*
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	EARLY PALAEOZOIC		Pzu	*Schist, phyllite, quartzite, hornfels*

- *Geological boundary*
- *Fault*
- *Boundary of major shear zone*

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes

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- *Trend of coastal sand* } *air-photo interpretation*
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- *Strike and dip of cleavage*
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- (Mt) *Unexploited mineral deposit*
- • *Minor mineral occurrence*

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Gt *Graphite*
Im *Ilmenite*
Ls *Limestone ('earth lime')*
Mt *Magnetite*
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Py *Pyrite*
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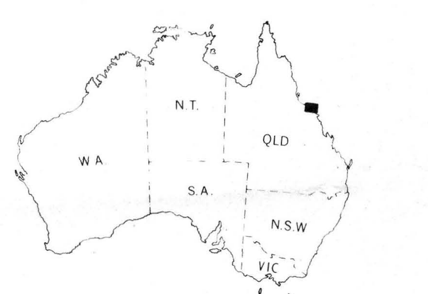
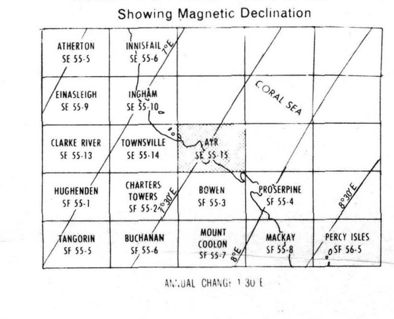


INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



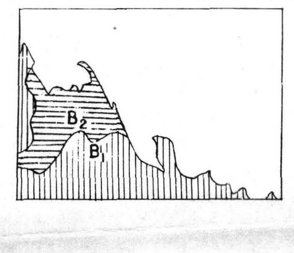
Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

GEOLOGICAL RELIABILITY DIAGRAM



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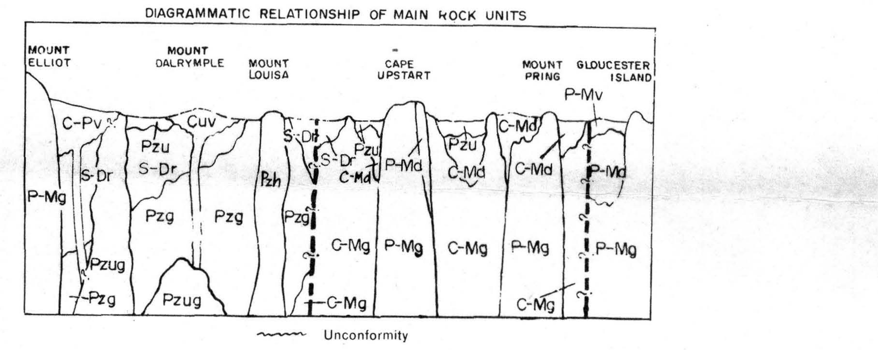
B_2 *Mostly air-photo interpretation*

Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.)
Compiled by: A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)

DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS



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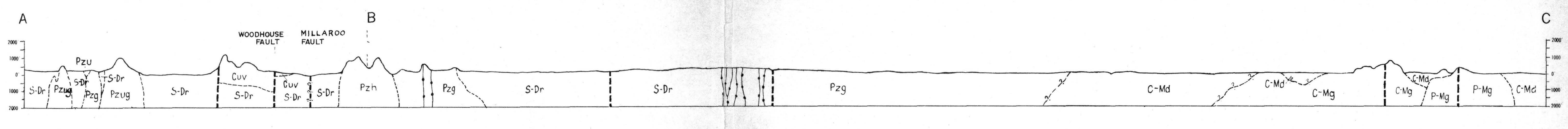
Scale $\frac{V}{H} = 4$



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SHEET SE 55-15

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To accompany Record 1967/129

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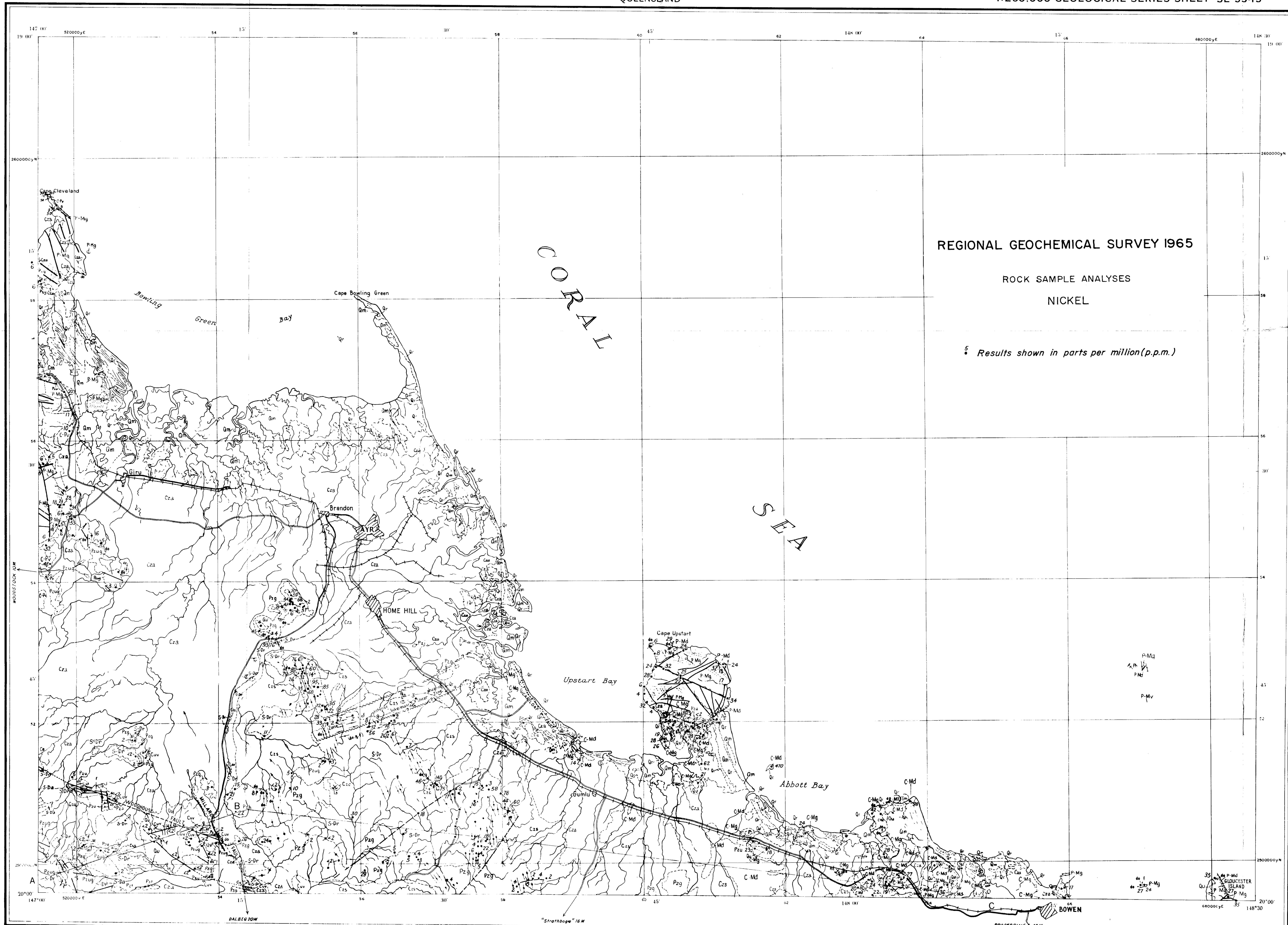
1:250,000 GEOLOGICAL SERIES SHEET SE 55-15

Fig. 21

FIRST EDITION 1967



Reference

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		Qr	Coastal sand dunes
		Qo	Outwash and talus
		Cza	Alluvial and deltaic deposits
		Czs	Residual soil, sand, and rubble; some semi-consolidated material
		Czk	'Earth Lime'
PALAEOZOIC–MESOZOIC	PERMIAN TO MESOZOIC	P-Mg	Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro
		P-Md	Diorite, microdiorite, gabbro
		P-Mv	Hornfelsed tuff (Norea Rock)
	CARBONIFEROUS TO MESOZOIC — Urannah Complex	C-Mg	Leucocratic adamellite and granite, tonalite; locally sheared
		C-Md	Diorite, gabbro, norite, tonalite, dolerite, microdiorite; minor diallagite
PALAEOZOIC	LATE PALAEOZOIC	Pzug	Granite, microgranite, adamellite
		Pzh	Rhyolite, trachyte, trachyandesite; mainly intrusive
	CARBONIFEROUS TO PERMIAN	C-Pv	Intermediate lavas and pyroclastics, minor acid volcanics
	UPPER CARBONIFEROUS — Ellenvale Beds	Cuv	Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff
		Ce	Flow-banded rhyolite, rhyolite-breccia, andesite
	UNDIFFERENTIATED	Pzt	Olivine microgabbro
		Pzg	Leucocratic granite and adamellite, foliated in places; dykes of rhyodacite and acid porphyry; minor granodiorite and microgranite
	UPPER DEVONIAN ?	Pzi	Hornfelsed calcareous conglomerate, with calcareous quartzite interbeds (Charlies Hill, near Home Hill)
	SILURIAN – LOWER DEVONIAN — Ravenswood Granodiorite	S-Do	Biotite granite, leucocratic adamellite; foliated in places
		S-Dr	Hornblende granodiorite and diorite, minor granite, adamellite and gabbro; foliated in places
	EARLY PALAEOZOIC	Pzu	Schist, phyllite, quartzite, hornfels

- Geological boundary
- Fault
- Boundary of major shear zone
  - Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes
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- Vertical platy flow
- Strike and dip of primary
- Primary banding in gabbro, dip indeterminable
- Dyke
  - do - dolerite, andesite, microdiorite
  - f - felsite (including rhyolite and acid porphyry)
  - g - granophyre, granite
  - mt - microtonalite
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- Quarry
- (Mt) Unexploited mineral deposit
- • Minor mineral occurrence
- Cu Copper
- Gt Graphite
- Im Ilmenite
- Ls Limestone ('earth lime')
- Mt Magnetite
- Ph Phosphate rock
- Py Pyrite
- Rc Crushed rock aggregate

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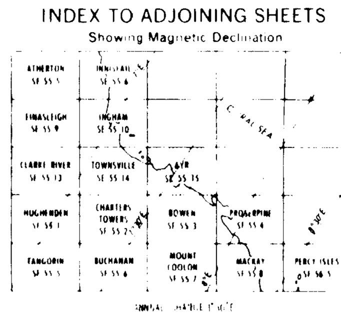
INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



Scale 1:250,000

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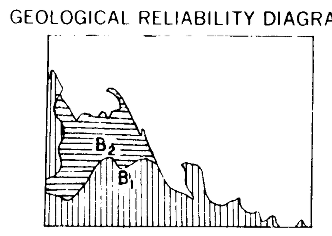
GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID ZONE (AUSTRALIA SERIES)

Section

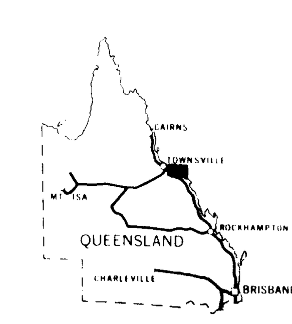
Cainozoic sediments omitted from section. Attitude of faults not known.

GEOLOGICAL RELIABILITY DIAGRAM

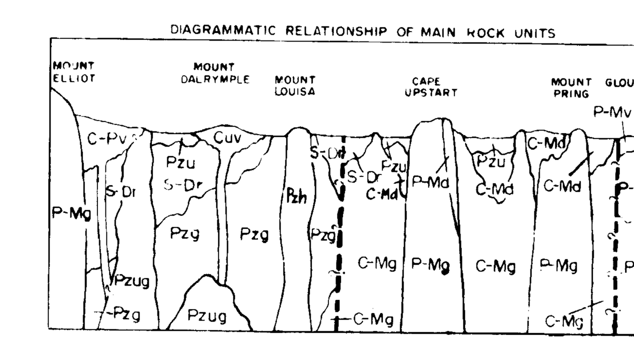


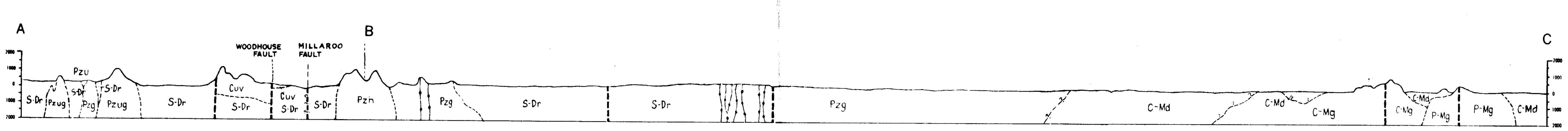
B1 Detailed reconnaissance with air-photo interpretation
B2 Mostly air-photo interpretation

Geology by A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.)
Compiled by A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)



DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





AYR
SHEET SE 55-15

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To accompany Record 1967/129

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QUEENSLAND

1:250,000 GEOLOGICAL SERIES SHEET SE 55-15

Fig. 22

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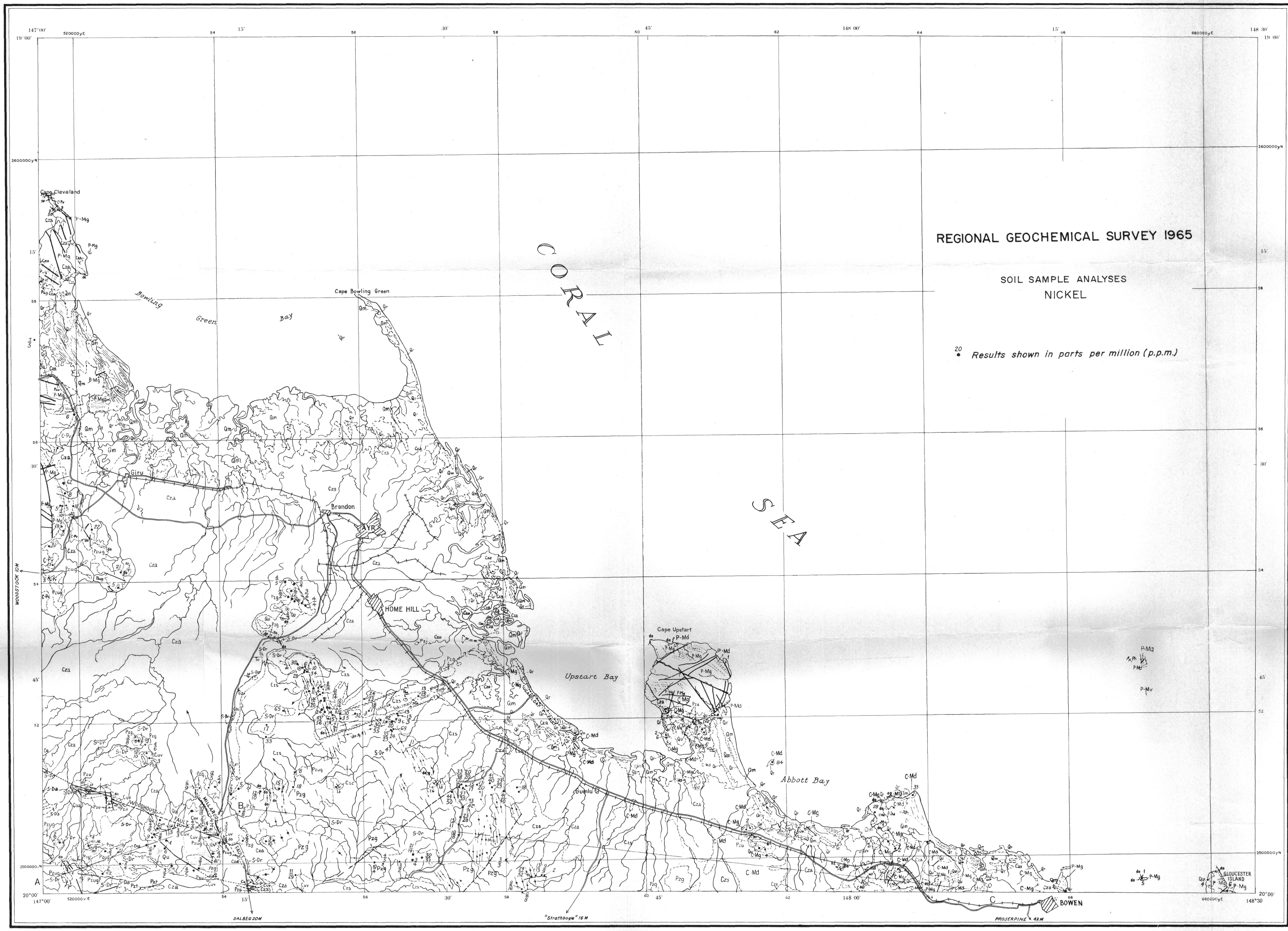

Reference

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			Qr	*Coastal sand dunes*
			Qu	*Outwash and talus*
			Cza	*Alluvial and deltaic deposits*
			Czs	*Residual soil, sand, and rubble; some semi-consolidated material*
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			P-Md	*Diorite, microdiorite, gabbro*
			P-Mv	*Hornfelsed tuff (Nares Rock)*
	CARBONIFEROUS TO MESOZOIC	Urannah Complex	C-Mg	*Leucocratic adamellite and granite, tonalite; locally sheared*
			C-Md	*Diorite, gabbro, norite, tonalite, dolerite, microdiorite; minor diallagite*
PALAEOZOIC	LATE PALAEOZOIC		Pzug	*Granite, microgranite, adamellite*
			Pzh	*Rhyolite, trachyte, trachyandesite; mainly intrusive*
	CARBONIFEROUS TO PERMIAN		C-Pv	*Intermediate lavas and pyroclastics, minor acid volcanics*
	UPPER CARBONIFEROUS		Cuv	*Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff*
		Ellenvale Beds	Ce	*Flow-banded rhyolite, rhyolite-breccia, andesite*
	UNDIFFERENTIATED		Pzt	*Olivine microgabbro*
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	EARLY PALAEOZOIC		Pzu	*Schist, phyllite, quartzite, hornfels*

Geological boundary

Fault

Boundary of major shear zone

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes

Joint pattern } *air-photo interpretation*
Trend of coastal sand }

Strike and dip of strata

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Vertical metamorphic foliation

Metamorphic foliation, dip indererminable

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Dyke
do = *dolerite, andesite, microdiorite*
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Mineral prospect, little or no production

Quarry

Unexploited mineral deposit

Minor mineral occurrence

Cu	*Copper*
Gt	*Graphite*
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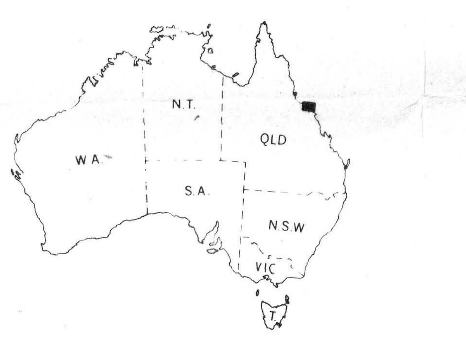
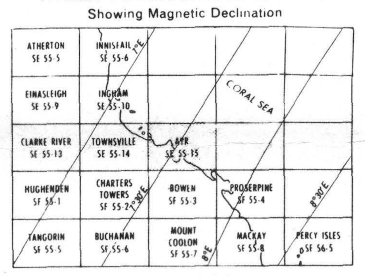


INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



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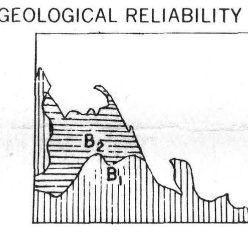

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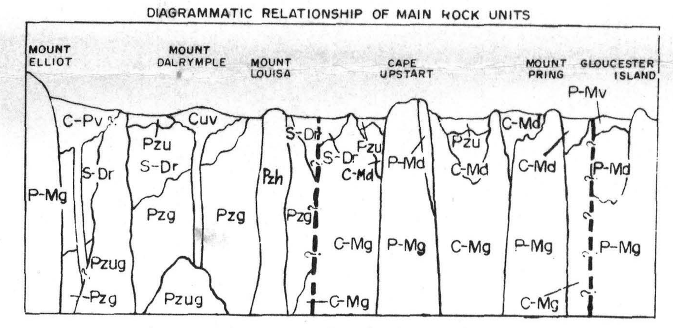

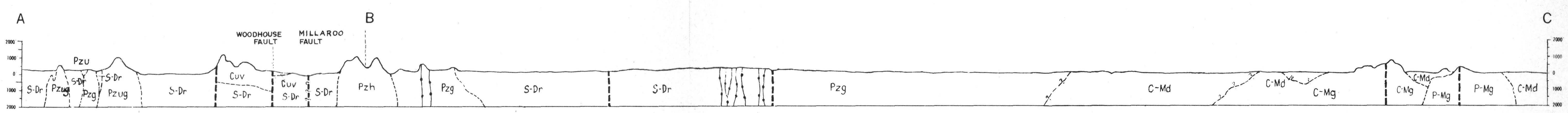

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SHEET SE 55-15

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To accompany Record 1967/129

Fig. 23

FIRST EDITION 1967

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Py Pyrite
Rc Crushed rock aggregate

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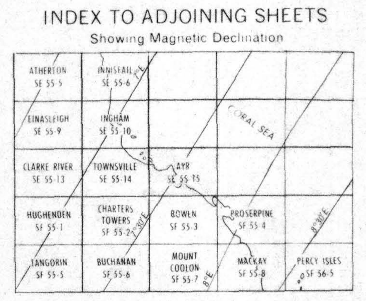
INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



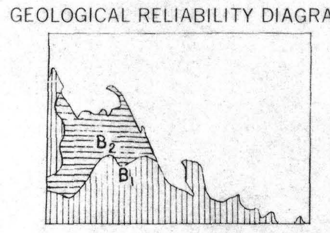
Scale 1:250,000

GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

Section

Cainozoic sediments omitted from section. Attitude of faults not known.

GEOLOGICAL RELIABILITY DIAGRAM

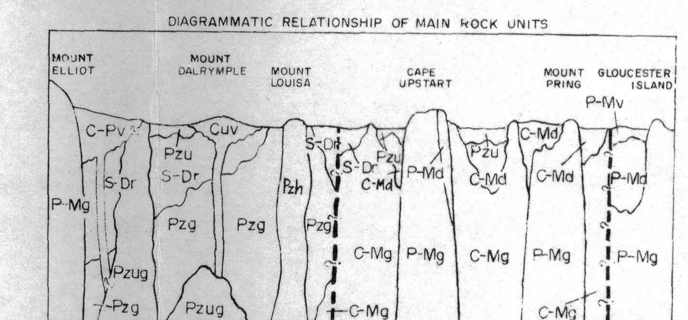


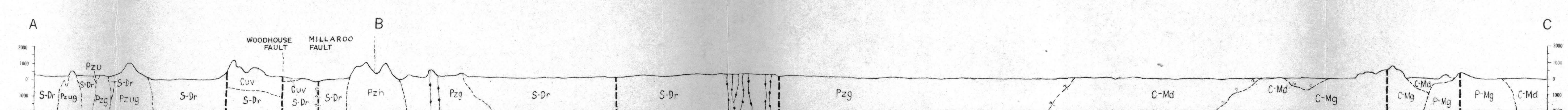
B_1 Detailed reconnaissance with air-photo interpretation

B_2 Mostly air-photo interpretation

Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.).
Compiled by: A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)

DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





AYR
SHEET SE 55-15

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To accompany Record 1967/129

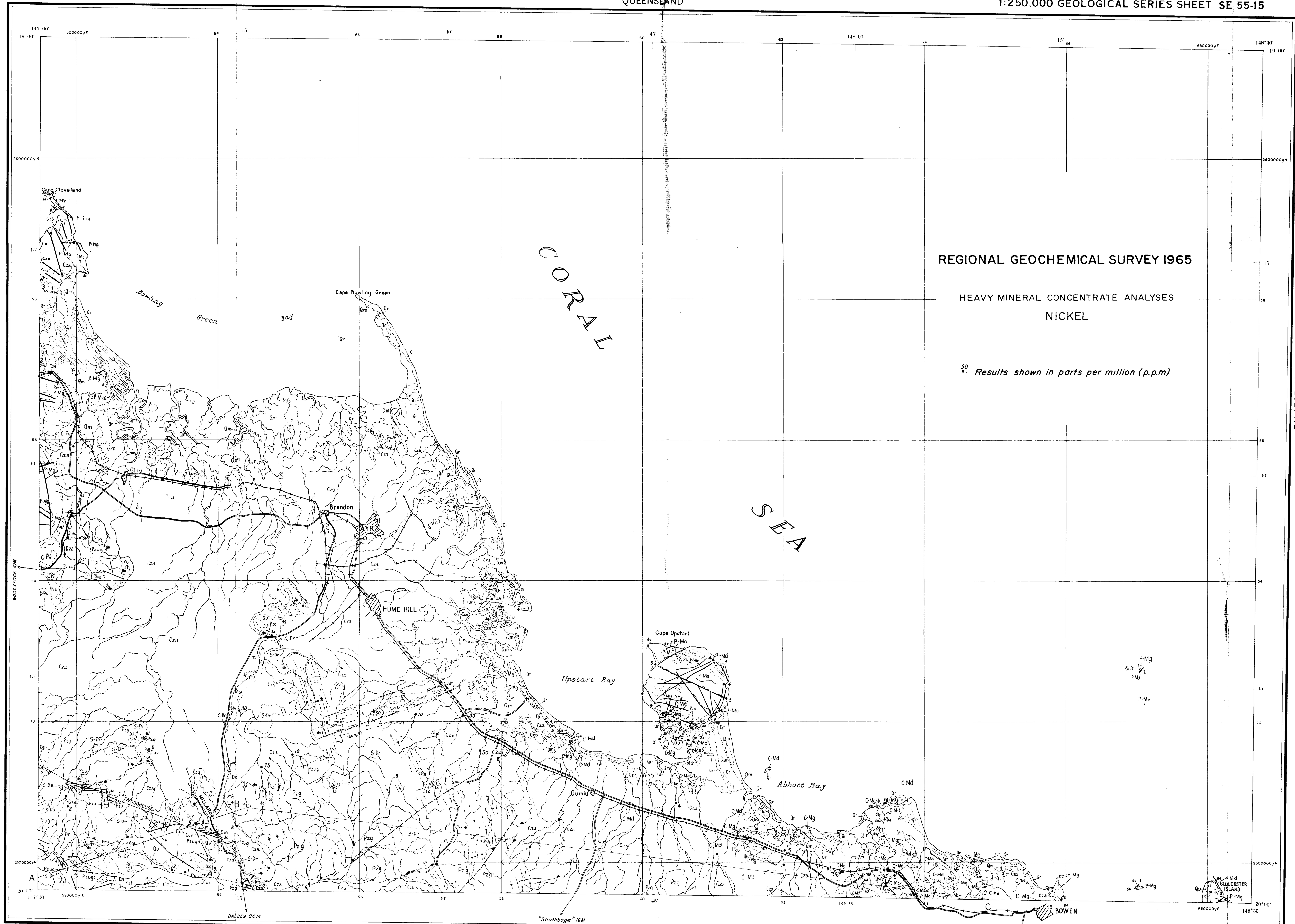
AUSTRALIA 1:250,000

AYR
QUEENSLAND

1:250,000 GEOLOGICAL SERIES SHEET SE 55-15

Fig. 24

FIRST EDITION 1967



Reference

CAINOZOIC	QUATERNARY		Qm	*Coastal mud flats*
			Qr	*Coastal sand dunes*
			Qu	*Outwash and talus*
			Cza	*Alluvial and deltaic deposits*
			Czs	*Residual soil, sand, and rubble; some semi-consolidated material*
			Czc	*'Earth Lime'*
PALAEOZOIC–MESOZOIC	PERMIAN TO MESOZOIC		P-Mg	*Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro*
			P-Md	*Diorite, microdiorite, gabbro*
			P-Mv	*Hornfelsed tuff (Nares Rock)*
	CARBONIFEROUS TO MESOZOIC	Urannah Complex	C-Mg	*Leucocratic adamellite and granite, tonalite; locally sheared*
			C-Md	*Diorite, gabbro, norite, tonalite, dolerite, microdiorite: minor diallagite*
PALAEOZOIC	LATE PALAEOZOIC		Pzug	*Granite, micrograniite, adamellite*
			Pzh	*Rhyolite, trachyte, trachyandesite; mainly intrusive*
	CARBONIFEROUS TO PERMIAN		C-Pv	*Intermediate lavas and pyroclastics, minor acid volcanics*
	UPPER CARBONIFEROUS		Cuv	*Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff*
		Ellenvale Beds	Ce	*Flow-banded rhyolite, rhyolite-breccia, andesite*
	UNDIFFERENTIATED		Pzt	*Olivine microgabbro*
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	UPPER DEVONIAN ?		Pzj	*Hornfelsed calcareous conglomerate, with calcareous quartzite interbeds (Charlies Hill, near Home Hill)*
	SILURIAN — LOWER DEVONIAN	Ravenswood Granodiorite	S-Da	*Biotite granite, leucocratic adamellite; foliated in places*
			S-Dr	*Hornblende granodiorite and diorite, minor granite, adamellite and gabbro; foliated in places*
	EARLY PALAEOZOIC		Pzu	*Schist, phyllite, quartzite, hornfels*

Geological boundary

Fault

Boundary of major shear zone

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes

Joint pattern } *air-photo interpretation*
Trend of coastal sand }

Strike and dip of strata

Strike and dip of cleavage

Strike and dip of metamorphic foliation

Vertical metamorphic foliation

Metamorphic foliation, dip indeterminable

Strike and dip of platy flow

Vertical platy flow

Strike and dip of primary

Primary banding in gabbro, dip indeterminable

Dyke
- do = *dolerite, andesite, microdiorite*
- f = *felsite (including rhyolite and acid porphyry)*
- g = *granophyre, granite*
- mt = *microtonalite*

Mineral prospect, little or no production

Quarry

(Mt) *Unexploited mineral deposit*

• *Minor mineral occurrence*

Cu	*Copper*
Gt	*Graphite*
Im	*Ilmenite*
Ls	*Limestone ('earth lime')*
Mt	*Magnetite*
Ph	*Phosphate rock*
Py	*Pyrite*
Rc	*Crushed rock aggregate*

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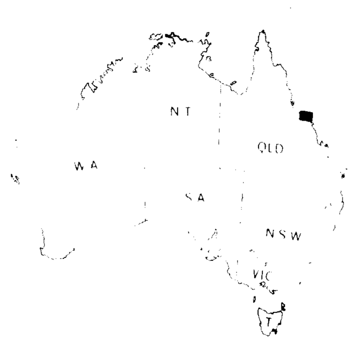
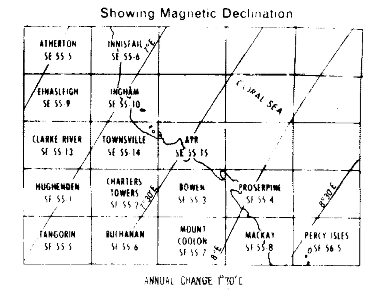


INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



Scale 1:250,000

MILES

KILOMETRES

GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

Section

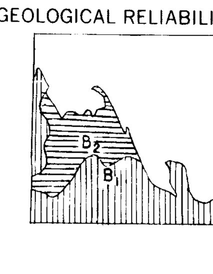
Cainozoic sediments omitted from section   Attitude of faults not known

Scale $\frac{V}{H}$ = 4

Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.).

Compiled by: A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)

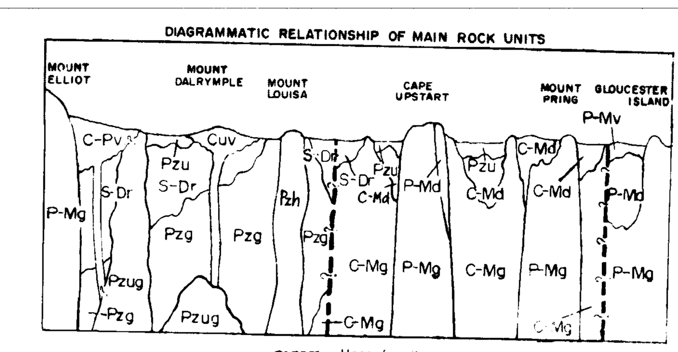
GEOLOGICAL RELIABILITY DIAGRAM

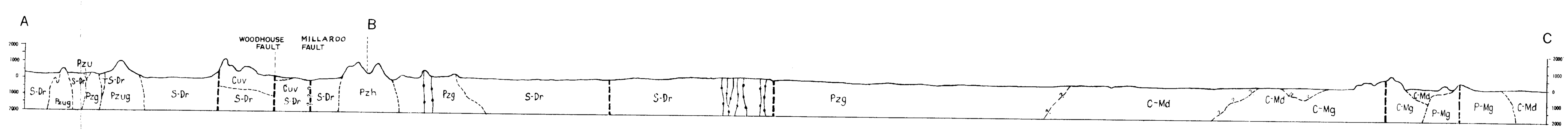


B_1 *Detailed reconnaissance with air-photo interpretation*

B_2 *Mostly air-photo interpretation*

DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





AYR
SHEET SE 55-15

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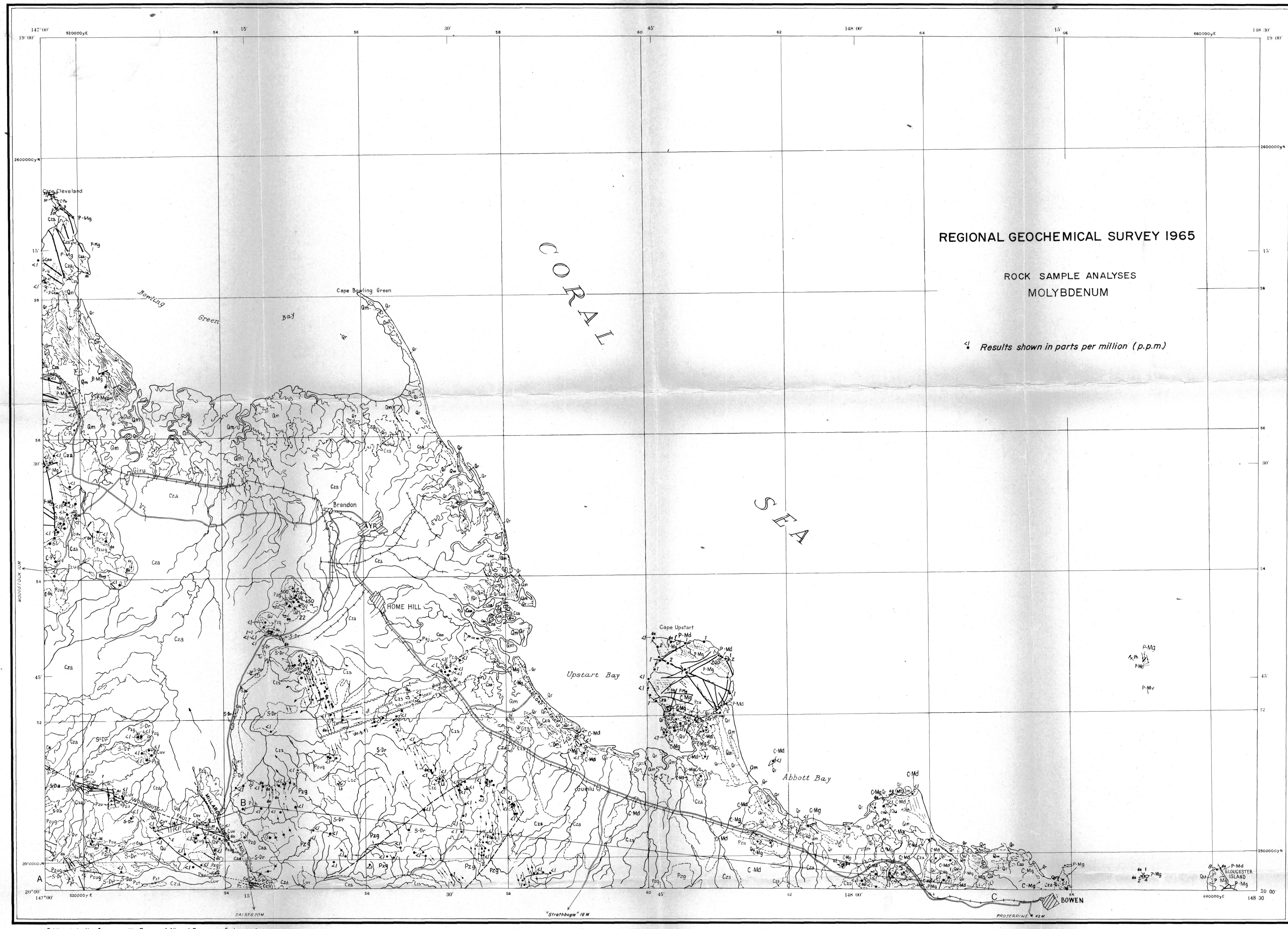
To accompany Record 1967/129

Fig. 25

FIRST EDITION 1967



Reference

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		Qr	Coastal sand dunes
		Qu	Outwash and talus
		Cza	Alluvial and deltaic deposits
		Czs	Residual soil, sand, and rubble; some semi-consolidated material
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		P-Md	Diorite, microdiorite, gabbro
		P-Mv	Hornfelsed tuff (Nares Rock)
	CARBONIFEROUS TO MESOZOIC — Urannah Complex	C-Mg	Leucocratic adamellite and granite, tonalite; locally sheared
		C-Md	Diorite, gabbro, norite, tonalite, dolerite, microdiorite: minor diallagite
PALAEOZOIC	LATE PALAEOZOIC	Pzug	Granite, microgranite, adamellite
		Pzh	Rhyolite, trachyte, trachyandesite; mainly intrusive
	CARBONIFEROUS TO PERMIAN	C-Pv	Intermediate lavas and pyroclastics, minor acid volcanics
	UPPER CARBONIFEROUS	Cuv	Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff
	Ellenvale Beds	Ce	Flow-banded rhyolite, rhyolite-breccia, andesite
	UNDIFFERENTIATED	Pzt	Olivine microgabbro
		Pzg	Leucocratic granite and adamellite, foliated in places; dykes of rhyodacite and acid porphyry; minor granodiorite and microgranite
	UPPER DEVONIAN ?	Pzj	Hornfelsed calcareous conglomerate, with calcareous quartzite interbeds (Charlies Hill, near Home Hill)
	SILURIAN — LOWER DEVONIAN — Ravenswood Granodiorite	S-Da	Biotite granite, leucocratic adamellite; foliated in places
		S-Dr	Hornblende granodiorite and diorite, minor granite, adamellite and gabbro; foliated in places
	EARLY PALAEOZOIC	Pzu	Schist, phyllite, quartzite, hornfels

Geological boundary

Fault

Boundary of major shear zone

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes

Joint pattern } *air-photo interpretation*

Trend of coastal sand } *air-photo interpretation*

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Strike and dip of cleavage

Strike and dip of metamorphic foliation

Vertical metamorphic foliation

Metamorphic foliation, dip indererminable

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Vertical platy flow

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- mt = microtonalite

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(Mt) *Unexploited mineral deposit*

• *Minor mineral occurrence*

- Cu — *Copper*
- Gt — *Graphite*
- Im — *Ilmenite*
- Ls — *Limestone ('earth lime')*
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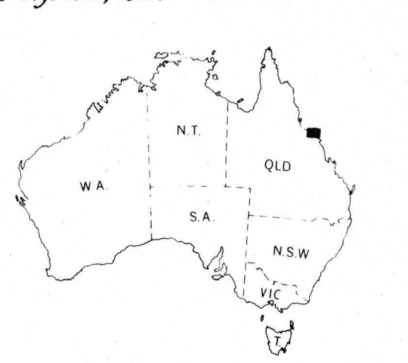
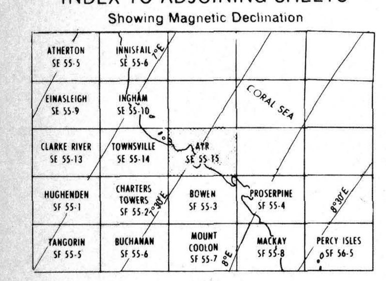


INDEX TO ADJOINING SHEETS
Showing Magnetic Declination



Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

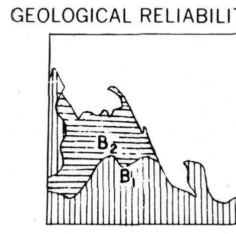
GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

Section

Cainozoic sediments omitted from section   Attitude of faults not known

Scale $\frac{V}{H} = 4$

GEOLOGICAL RELIABILITY DIAGRAM



B_1 *Detailed reconnaissance with air-photo interpretation*

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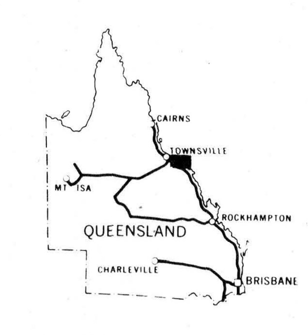
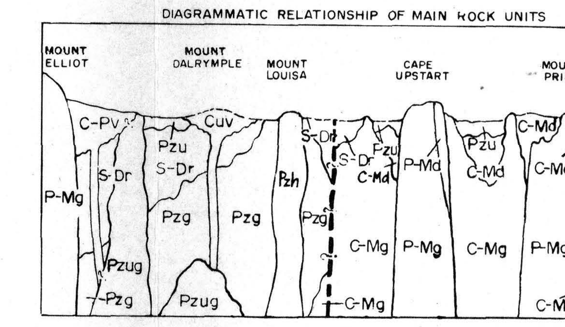
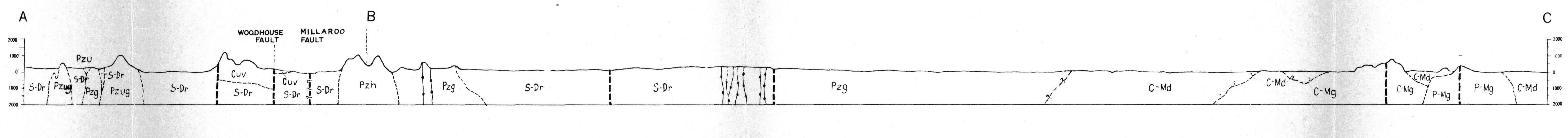
Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.).

Compiled by: A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)



DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS





AYR
SHEET SE 55-15

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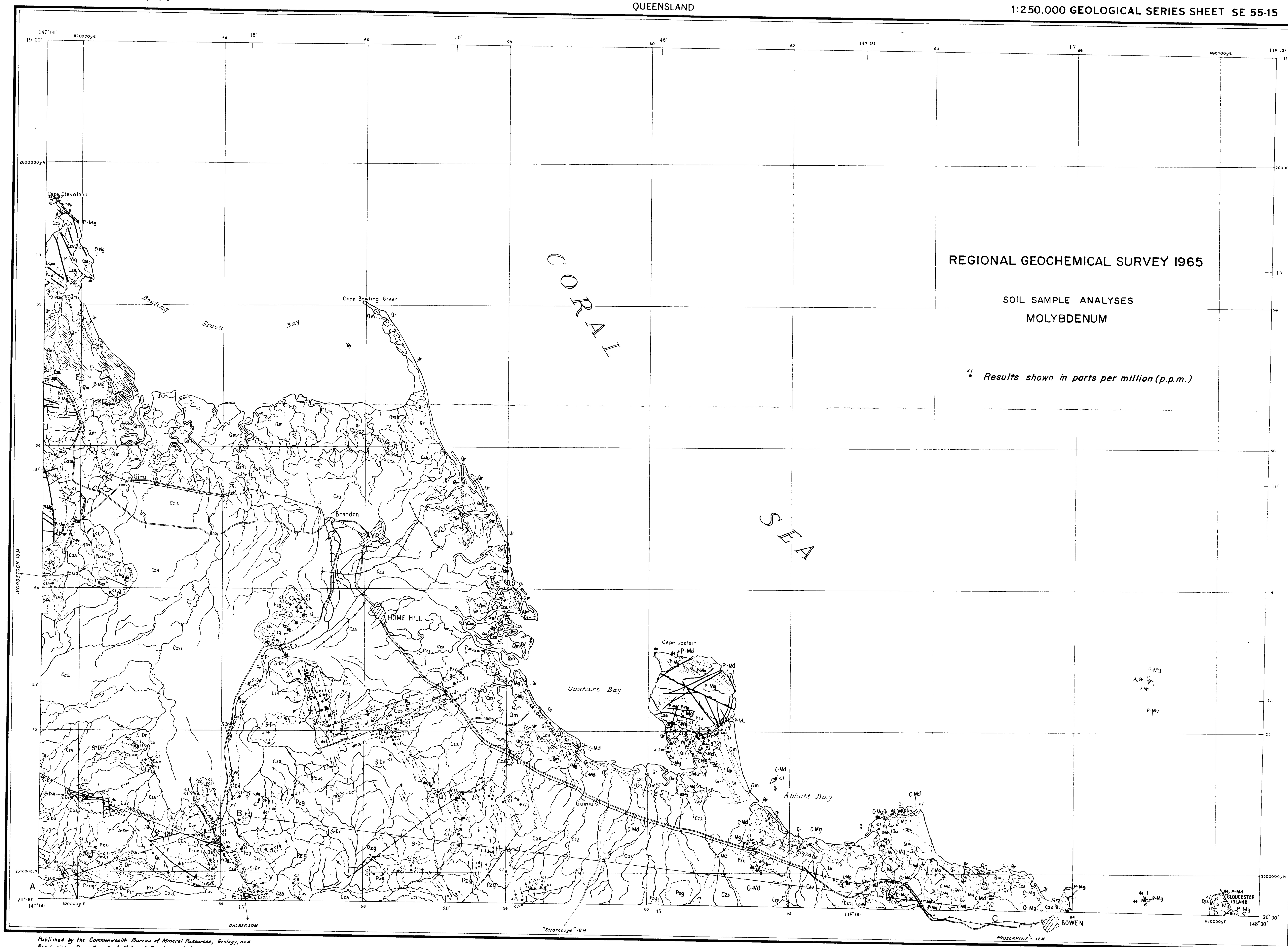
To accompany Record 1967/129

AUSTRALIA 1:250.000

AYR
QUEENSLAND

1:250.000 GEOLOGICAL SERIES SHEET SE 55-15

Fig.26



FIRST EDITION 1967

Reference

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			Qr	Coastal sand dunes
			Qu	Outwash and talus
			Cza	Alluvial and deltaic deposits
			Czs	Residual soil, sand, and rubble; some semi-consolidated material
			Czc	'Earth Lime'
PALAEOZOIC – MESOZOIC	PERMIAN TO MESOZOIC		P-Mg	Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro
			P-Md	Diorite, microdiorite, gabbro
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	CARBONIFEROUS TO MESOZOIC	Urannah Complex	C-Mg	Leucocratic adamellite and granite, tonalite; locally sheared
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PALAEOZOIC	LATE PALAEOZOIC		Pzug	Granite, microgranite, adamellite
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	UPPER CARBONIFEROUS		Cuv	Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff
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	UPPER DEVONIAN ?		Pzj	Hornfelsed calcareous conglomerate, with calcareous quartzite interbeds (Charlies Hill, near Home Hill)
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			S-Dr	Hornblende granodiorite and diorite, minor granite, adamellite and gabbro; foliated in places
	EARLY PALAEOZOIC		Pzu	Schist, phyllite, quartzite, hornfels

Geological boundary

Fault

Boundary of major shear zone

Where location of boundaries and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries are dotted, and faults are shown by short dashes

Joint pattern } air-photo interpretation

Trend of coastal sand } air-photo interpretation

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Dyke
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- mt = microtonalite

Mineral prospect, little or no production

Quarry

(Mt) Unexploited mineral deposit

• Minor mineral occurrence

Cu Copper

Gt Graphite

Im Ilmenite

Ls Limestone ('earth lime')

Mt Magnetite

Ph Phosphate rock

Py Pyrite

Rc Crushed rock aggregate

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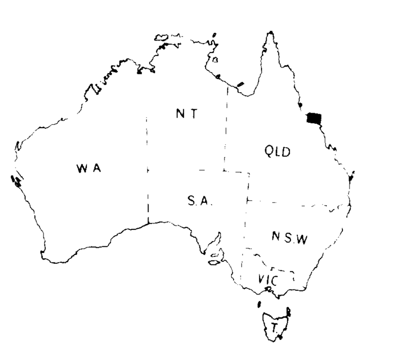
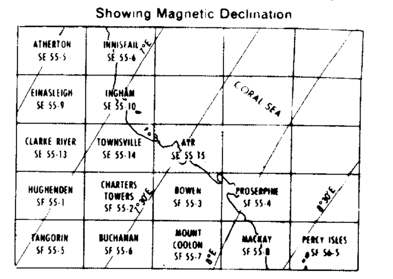


INDEX TO ADJOINING SHEETS

Showing Magnetic Declination



Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

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GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

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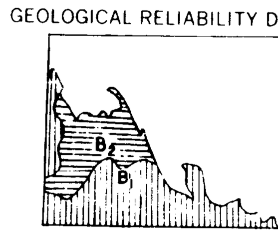
GEOLOGICAL RELIABILITY DIAGRAM



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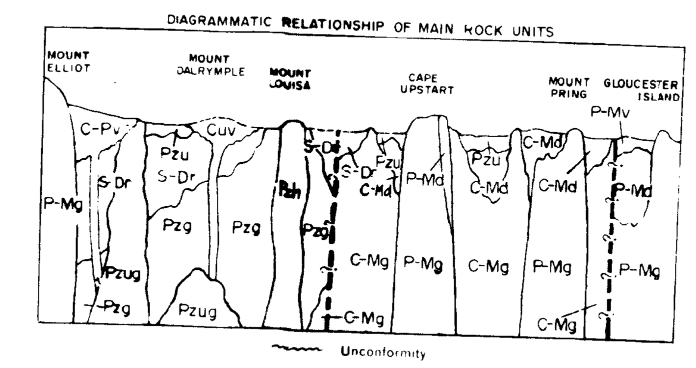
DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS



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To accompany Record 1967/129

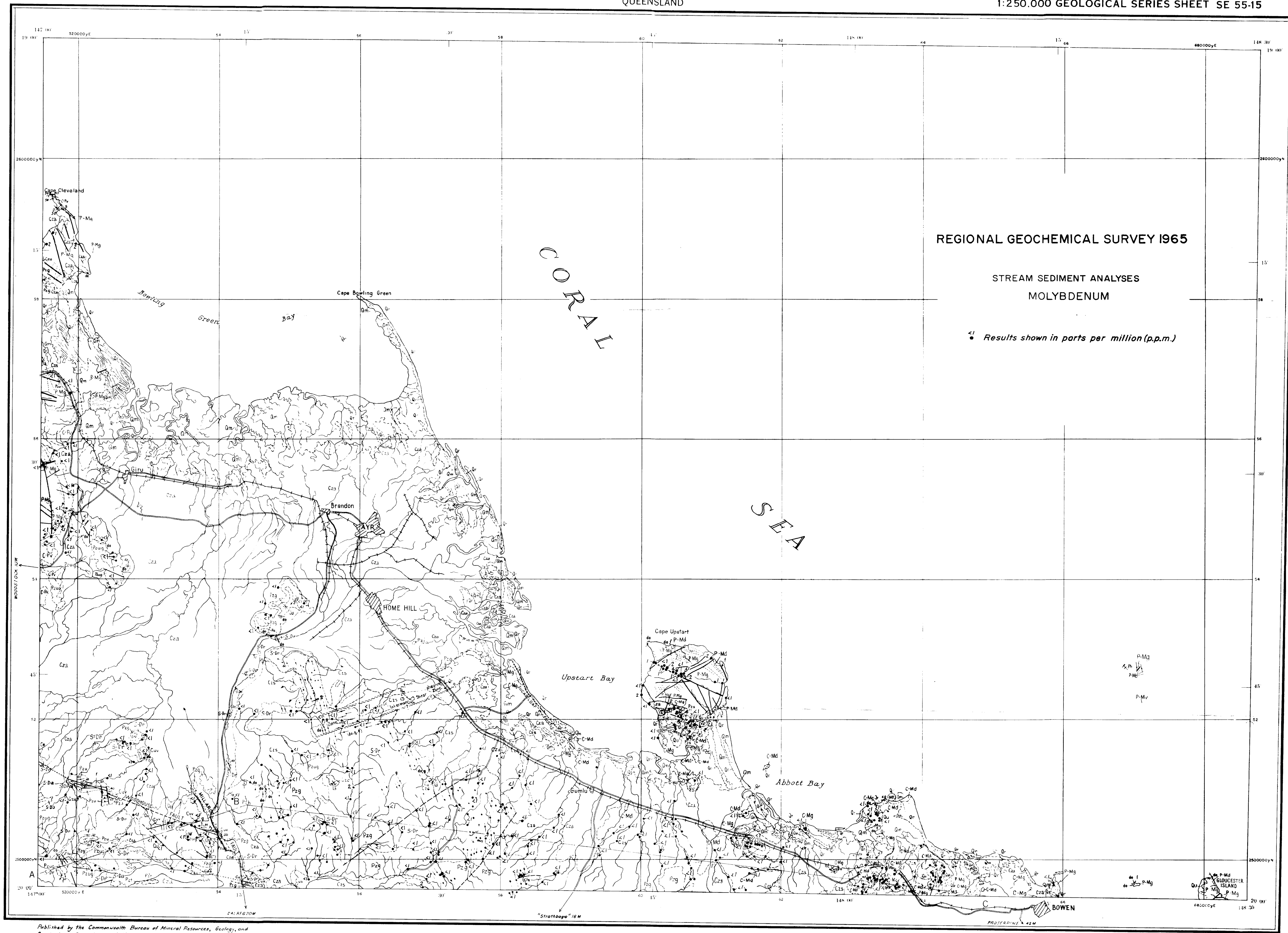
AUSTRALIA 1:250,000

AYR
QUEENSLAND

1:250,000 GEOLOGICAL SERIES SHEET SE 55-15

Fig. 27

FIRST EDITION 1967



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• *Minor mineral occurrence*

Cu	*Copper*
Gt	*Graphite*
Im	*Ilmenite*
Ls	*Limestone ('earth lime')*
Mt	*Magnetite*
Ph	*Phosphate rock*
Py	*Pyrite*
Rc	*Crushed rock aggregate*

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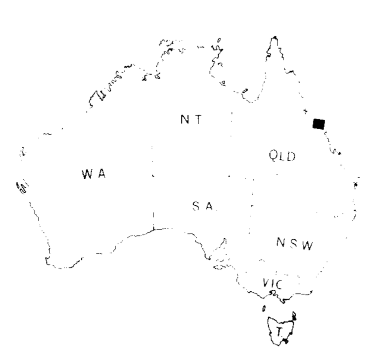
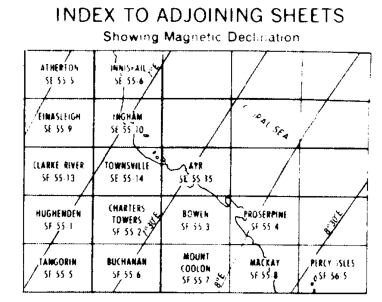


INDEX TO ADJOINING SHEETS

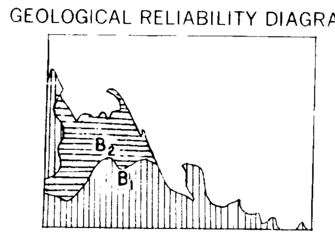
Showing Magnetic Declination



Scale 1:250,000

GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONE (AUSTRALIA SERIES)

GEOLOGICAL RELIABILITY DIAGRAM

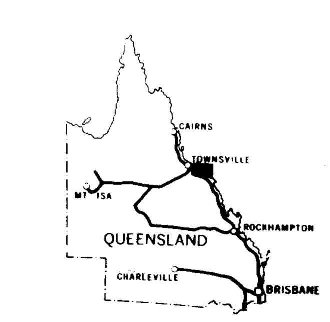


B_1 *Detailed reconnaissance with air-photo interpretation*

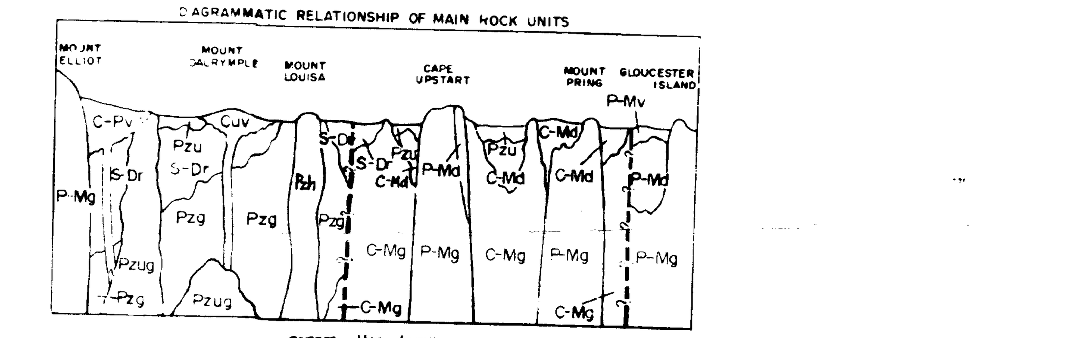
B_2 *Mostly air-photo interpretation*

Geology by: A.G.L. Paine, C.M. Gregory (B.M.R.), D.E. Clarke (G.S.Q.)

Compiled by: A.G.L. Paine, C.M. Gregory, N.L. Kruger, A. Tatarow (B.M.R.), D.E. Clarke (G.S.Q.)



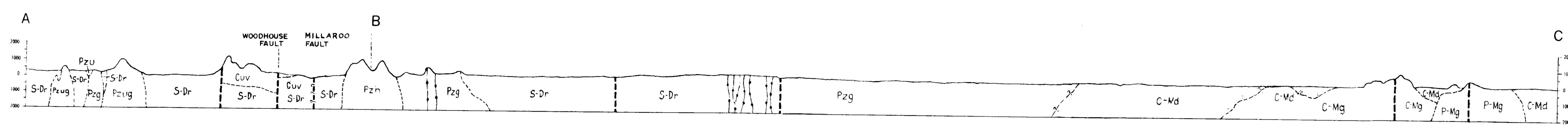
DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS



Section

Cainozoic sediments omitted from section. Attitude of faults not known

Scale V/H = 4



AYR
SHEET SE 55-15

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To accompany Record 1967/129

Fig. 28


AUSTRALIA 1:250.000
AYR
QUEENSLAND
1:250.000 GEOLOGICAL SERIES SHEET SE 55-15
FIRST EDITION 1967
REGIONAL GEOCHEMICAL SURVEY 1965
HEAVY MINERAL CONCENTRATE ANALYSES
MOLYBDENUM
Results shown in parts per million (p.p.m)
CORAL SEA
Reference
QUATERNARY
Qm Coastal mud flats
Qr Coastal sand dunes
Outwash and talus
Cza Alluvial and deltaic deposits
Czs Residual soil, sand, and rubble; some semi-consolidated material
Czc 'Earth Lime'
CAINOZOIC
PERMIAN TO MESOZOIC
P-Mg Epizonal leucocratic adamellite and granite, minor granophyre, syenite, rhyolite-porphyry, rare diorite and gabbro
P-Md Diorite, microdiorite, gabbro
P-Mv Hornfelsed tuff (Nares Rock)
CARBONIFEROUS TO MESOZOIC
Urannah Complex
C-Mg Leucocratic adamellite and granite, tonalite; locally sheared
C-Md Diorite, gabbro, norite, tonalite, dolerite, microdiorite; minor diallagite
PALAEOZOIC-MESOZOIC
LATE PALAEOZOIC
Pzug Granite, microgranite, adamellite
Pzh Rhyolite, trachyte, trachyandesite; mainly intrusive
CARBONIFEROUS TO PERMIAN
C-Pv Intermediate lavas and pyroclastics, minor acid volcanics
UPPER CARBONIFEROUS
Ellenvale Beds
Cuv Flow banded rhyolite and massive welded tuff; andesite and andesitic tuff
Ce Flow-banded rhyolite, rhyolite-breccia, andesite
UNDIFFERENTIATED
Olivine microgabbro
Pzg Leucocratic granite and adamellite, foliated in places; dykes of rhyodacite and acid porphyry; minor granodiorite and microgranite
UPPER DEVONIAN ?
Pzj Hornfelsed calcareous conglomerate, with calcareous quartzite interbeds (Charlies Hill, near Home Hill)
SILURIAN – LOWER DEVONIAN
Ravenswood Granodiorite
S-Du Biotite granite, leucocratic adamellite; foliated in places
S-Dr Hornblende granodiorite and diorite, minor granite, adamellite and gabbro; foliated in places
EARLY PALAEOZOIC
Pzu Schist, phyllite, quartzite, hornfels
PALAEOZOIC
Geological boundary
Fault
Boundary of major shear zone
Joint pattern
Trend of coastal sand
air-photo interpretation
Strike and dip of strata
Strike and dip of cleavage
Strike and dip of metamorphic foliation
Vertical metamorphic foliation
Metamorphic foliation, dip indeterminable
Strike and dip of platy flow
Vertical platy flow
Strike and dip of primary
Primary banding in gabbro, dip indeterminable
Dyke
Mineral prospect, little or no production
Quarry
Unexploited mineral deposit
Minor mineral occurrence
Cu Copper
Gt Graphite
Im Ilmenite
Ls Limestone ('earth lime')
Mt Magnetite
Ph Phosphate rock
Py Pyrite
Rc Crushed rock aggregate
Cape Cleveland
Cape Bowling Green
Bowling Green Bay
Giru
Brandon
AYR
HOME HILL
Upstart Bay
Cape Upstart
Abbott Bay
Gumlu
BOWEN
GLOUCESTER ISLAND
DALBEG 20M
"Strathbogie" 16M
PROSERPINE 42M
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INDEX TO ADJOINING SHEETS
Scale 1:250,000
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Section
GEOLOGICAL RELIABILITY DIAGRAM
B_1 Detailed reconnaissance with air-photo interpretation
B_2 Mostly air-photo interpretation
QUEENSLAND
Geology by A.G.L. Paine, C.M. Gregory (B.M.R.), D.L. Clarke (G.S.Q.)
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DIAGRAMMATIC RELATIONSHIP OF MAIN ROCK UNITS
Unconformity
WOODHOUSE FAULT
MILLAROO FAULT
AYR
SHEET SE 55-15
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