COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

1962/176

SUMMARY OF ACTIVITIES DURING 1962

METALLIFEROUS SECTION : GEOLOGICAL BRANCH.

REPORT ON ACTIVITIES DURING 1962

METALLIFEROUS SECTION - GEOLOGICAL BRANCH

Record 1962/176

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REPORT ON ACTIVITIES DURING 1962: METALLIFEROUS SECTION : GEOLOGICAL BRANCH

SUMMARY

During the first half of the year a sustained effort was made to eliminate the backlog of records and material for publication and at the same time to complete the compilation of maps and reports on investigations carried out during 1961.

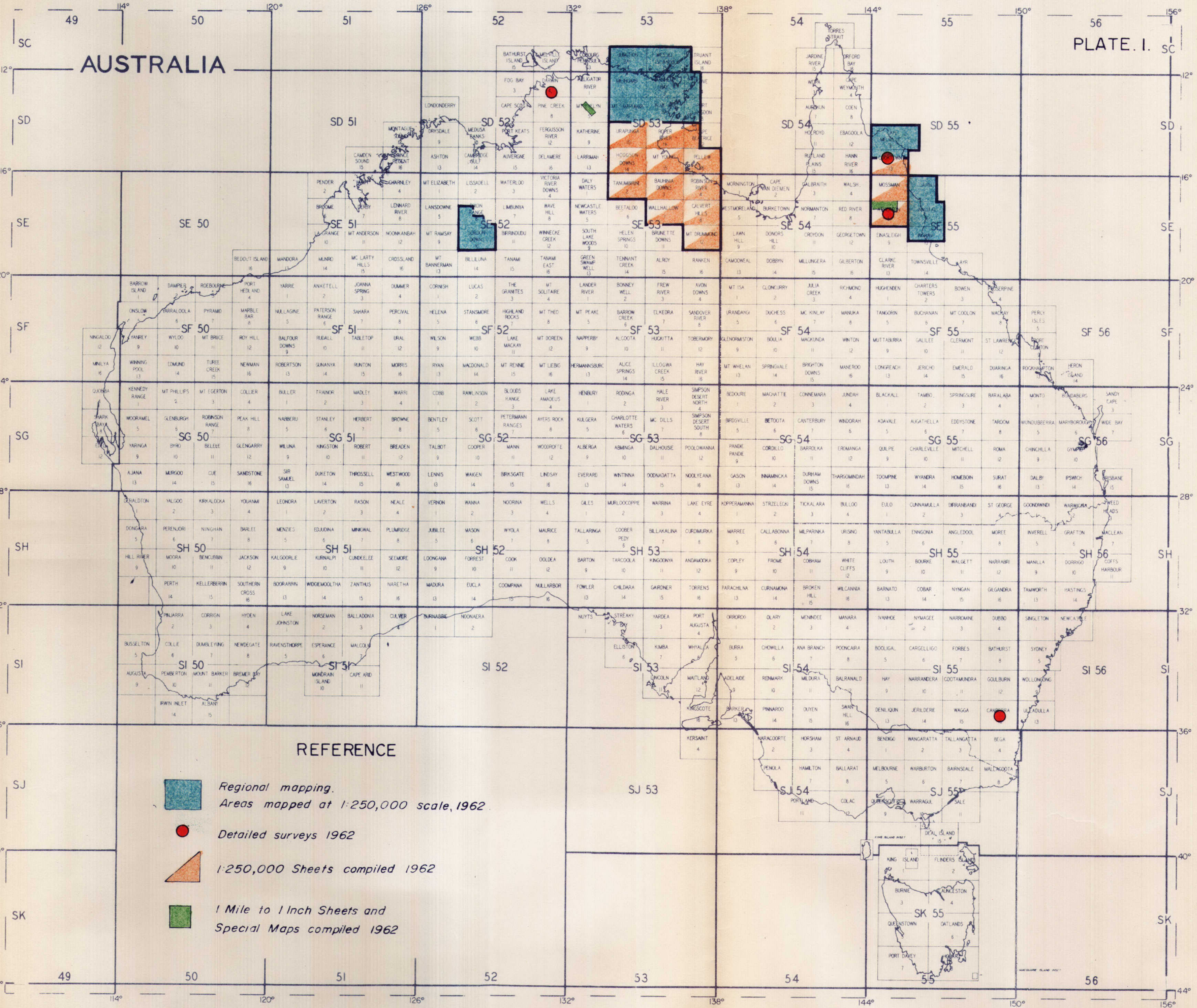
Reorganisation of the Laboratory continued, major changes made including a switch from wet chemistry to optical spectroscopy for the analysis of geochemical samples; the introduction of a new form of sample register; and the design and institution of punched card systems for the petrological index and recording of age determination data. Research into low-temperature synthesis of sulphide materials continued and some interesting results were obtained in syntheses of chalcopyrite and bornite. Bio-geochemical studies and work on absorption phenomena were also continued and the laboratory co-operated with the Australian National University in a study of Molonglo River waters.

Routine petrological work continued throughout the year and a number of projects dealing with groups of rocks from the Northern Territory and Queensland were completed. Age determination studies on the Adelaide System, Mt. Isa - Cloncurry region North Queensland granitic and volcanic rocks continued in association with A.N.U.

The Darwin Uranium Group provided services to local prospectors and mining companies and to Bureau field parties and resident offices; carried out quarterly inspections of uranium mines in the South Alligator area and provided geological and geophysical staff for work in the Rum Jungle and South Alligator fields.

Regional geological mapping was continued in the Northern Territory and North Queensland and commenced in the Kimberley region of Western Australia. The satisfactory progress in terms of area covered in 1961 was again obtained in 1962 (see plate 1) due largely to the increased use of helicopters and to some extent, although not as much as was hoped, by the advance provision of photogeological maps. A high standard of work was achieved by the field parties. Draftsmen were again allocated to field parties and although this contributed to efficiency it is clear there is still room for improvement in organisation and techniques, both in the compilation of maps in the field, and in the marrying of field data to photogeological data - the ultimate aim being to spread the compilation of maps and the attendant load of editorial work over the year instead of concentrating it into a few months as at present. This problem is being closely studied.

Detailed field investigations were carried out at Captains Flat; in North Queensland at Mt. Garnet and Kings Plains; and at Rum Jungle. The work at Captains Flat did not result in the location of a new ore body but an extensive mineralized belt was outlined. 110 geochemical anomalies were located in the area sampled but only four warrant further attention. Unfortunately the survey was commenced too late in the life of the mine for it to be of much practical value in sustaining Captains Flat as a mining centre; but



AUSTRALIA
PLATE. I.
REFERENCE
Regional mapping.
Areas mapped at 1:250,000 scale, 1962
Detailed surveys 1962
1:250,000 Sheets compiled 1962
1 Mile to 1 Inch Sheets and
Special Maps compiled 1962

the data obtained show that the chances of locating further ore in this area are not yet exhausted and that the Captains Flat mineralized zone and its probable extensions are quite attractive for ore-search.

In North Queensland the survey at Mt. Garnet has not yet been completed. The A.T.R. and Wurruma hypotheses, which were the basis of planning for 1962, were reviewed early in the field season and alternative suggestions made as to the most likely localities for further alluvial deposits. The programme was reoriented to cover both. Detailed geological mapping, gravity and seismic surveys, geomorphic studies and percussion drilling were carried out during the year, mainly in the Smiths Creek, A.T.R. and Wurruma areas, but did not result in any extension of the known alluvial tin bearing ground. Towards the end of the season percussion drilling of a seismic target in one of the alternative areas (lower Return Creek) resulted in an 80 foot intersection in payable ground. The overall results of the 1962 work are still being studied. Some geological effort was also directed towards a preliminary study of the tin-bearing lodes of the general Mt.Garnet/Herberton region. The production from four or five average size mines in this area could be equivalent to the production from one dredge and the investigation showed that it is quite probable that a number of the old mines would repay detailed investigation. The study also suggested that there is considerable scope for improvement in present treatment methods for both the alluvial and lode material. The regional geochemical stream sediment sampling programme in the area was continued.

At Kings Plains, the buried valley suggested by regional geological work in 1961 was further defined by a number of gravity traverses: but much trouble has been met with the percussion drilling of the prospect (due mainly to the inefficiency of the contractor) and the work has not yet been completed. Results obtained to date, although somewhat inconclusive, are not encouraging. Traces of tin were found in some holes.

At Rum Jungle, the deep auger drilling/sampling technique for geochemical surveys in soil-covered areas was further developed and the 1962 field work, although commenced late, was finished ahead of schedule. The change from wet chemistry to optical spectroscopy in the laboratory also allowed much greater efficiency in the analytical work and in the plotting of results. All samples were analysed and results plotted in Canberra, thus avoiding the previous practice of sending a chemist and mobile laboratory to the field. A number of interesting copper, lead and radiometric anomalies were located, the majority of which warrant further investigation. Some are programmed for diamond drilling in 1963 by Territory Enterprises Pty Ltd. The geochemical work will be continued in 1963. Use was also made of the spectrographic analyses to interpret the lithology of the soil-covered rocks and the results from this preliminary exercise indicate this type of study may be quite useful in this and other areas.

A study was made of possible beryllium-bearing areas in Australia, and a comparative survey of the efficiency of geochemical techniques and the Beryllometer was made at Torrington in the New England district of New South Wales, with the assistance of the Consolidated Zinc Corporation and the New South Wales Geological Survey. Priority given to analysis of the Rum Jungle samples has not allowed this work to be completed but it is hoped to finalise the results during December.

Tables I and II below list the material prepared for publication or in preparation.

TABLE I

Bulletins, Reports, Maps, Explanatory Notes and Records completed

Bulletins

Author	Title	Remarks
White D.A.	The Geology of the Georgetown Clarke River Area North Queensland.	Completed and with editor .
Branch C.D.	The Structural and Magnetic Relationships between Arid Lavas and Pyroclastic Flows and Granite of the Georgetown Inlier, North Q'land.	Ph.D. Thesis to be published as a Bulletin. Completed and with editor .
De Keyser F.	The Geology and Mineral Resources of the Chillagoe Area, North Queensland.	draft completed and with editor .
Dunn P.R., Smith J.W., and Roberts H.G.	The Geology of the Carpentaria Upper Proterozoic Province, N.T. Volume 1. Queensland Border to Roper River.	completed in draft form and with editor. May require minor amendments consequent on 1962 Arnhem Land Survey.
Beevers R.	Applications of Polarography and the Study of Adsorption Processes in Nature and to the Analysis of some Mineral Ores.	Ph.D. Thesis to be published as a Bulletin - in editorial stages.

Reports

Author	Title	Remarks
Dow D.B.	The Geology of the Bowutu Mountains, New Guinea	Completed and with editor.
Bryan R.	Lower Proterozoic Basic Intrusive rocks of the Katherine-Darwin region, N.T.	" "
Stewart J.R.	Upper Proterozoic volcanic rocks in the Katherine-Darwin region, N.T., Australia; with special reference to the presence of ignimbrites.	" "
H.L. Davies and D.J. Ives	The Geology of Fergussen and Goodenough Islands, T.N.G.	" "

Records

A total of 65 Records reports were compiled or processed by the Metalliferous Section to the end of October. Of these 46 were issued and 17 are in various stages of editing or awaiting maps and plans. This total includes Explanatory Notes and Reports issued as Records.

TABLE II

BULLETINS, REPORTS, MAPS, EXPLANATORY NOTES AND RECORDS ON 1962 FIELD WORK

Party/Project	Map Sheet	Scale	Field Work	Estimated date of completion Compilation	Explanatory Notes	Bulletin, Report, Records	Estimated date of completion
CARPENTARIA UPPER PROTEROZOIC PROVINCE	Mt. Marumba	1:250,000	Completed	February 28	March 28	Bulletin	31st December 1963.
	Milingimbi	1:250,000	Completed	February 28	February 28		
	Junction Bay	1:250,000	Completed	February 28	February 28		
	Blue Mud Bay (+ Port Langdon)	1:250,000	Completed	March 29	March 29		
	Arnhem Bay (+ Gove)	1:250,000	Completed	April 12	March 29		
	Wessel Islands	1:250,000	Completed	April 12	March 29		
	Carpentaria Upper Proterozoic Province - Southern Sheet (ii)	1:500,000	Completed	March 29	--		
	" Centre Sheet (i)	1:500,000	Completed	January 31	--		
	" Northern Sheet (iii)	1:500,000	Completed	June 28	--		
	SD53	1:1,000,000	Completed except Larrimah Sheet	August 31	--		
INGHAM PARTY	Cairns	1:250,000	Completed	December 12	December 12	Bulletin (Hodgkinson Basin) (in conjunction with Cooktown Party)	30th November 1963
	Innisfail	1:250,000	Completed	January 31	January 31		
	Ingham	1:250,000	Incomplete	February 28 (up to date)	--	Record (Ingham Sheet)	28th February 1963
MOUNT GARNET PARTY	Geological Map	1 inch to 1 mile	Completed	February 1	--	Geological Report (Record)	1st February 1963
	Geochemical Map	1 inch to 1 mile	Completed	March 4	--	Report	4th March 1963
COOKTOWN PARTY	Cooktown	1:250,000	Completed	March 29	March 29	Bulletin	30th November 1963
	Cape Melville	1:250,000	Completed	July 20	July 20	(see Ingham Party).	
	SD/55	1:1,000,000	Completed	August 31			
CAPTAINS FLAT	Geological Map) Geochemical Map)		Completed	December 21		Report	21 December 1962
WESTERN HIGHLANDS (NEW GUINEA)	Geochemical Map	1 inch to 2 miles	Completed	November 30	--	Report	29th March
	Geological Map	1 inch to 2 miles	Completed	January 31	--		
						Report - (Granitic Rocks)	February 1963
KATHERINE - DARWIN						Bulletin	April 1963
GORDON DOWNS PARTY	Gordon Downs	1:250,000	Completed	February 22	February 22	Record	29th March
RUM JUNGLE GEOCHEMICAL PARTY		1 inch to 800 '	Completed for 1962	February 28		Record	28th February
BERYLLIUM INVESTIGATION						Record	14th December 1962

Maps and Explanatory Notes compiled during 1962.

1:250,000 Sheets and Explanatory Notes

Sheet	E.53/12	Mt. Drummond - (revised)
	E.53/8	Calvert Hills
	E.53/4	Robinson River
	E.53/3	Bauhinia Downs - (revised)
	E.53/2	Tanumbirini
	D.53/14	Hodgson Downs
	D.53/15	Mt. Young.
	D.53/16	Pellew
	D.53/10	Urapunga - (revised)
	D.53/11	Roper River - (revised)
	D.53/12	Cape Beatrice - (combined with Roper River)
	E.55/5	Atherton
	E.55/1	Mossman
	E.53/7	Walhallow - (Notes and compilation completed and passed to Sedimentary Section to add bore data etc.)

The Explanatory Notes listed above were all issued as Records during the year and the maps as Preliminary B & W editions.

1 inch to 1 mile sheets.

E55/5/60	Almaden
E55/5/55	Chillagoe
E55/5/54	Mungana.

Special Sheets

1 inch to 1 mile.	South Alligator River. (revised).
1 inch to 2 miles.	Bowutu Mountains, New Guinea.

GEOLOGICAL LABORATORY

Chemical Section

During the year the optical spectrograph was put into full-scale operation for the analysis of geochemical samples. 4,610 samples were analysed specifically for Cu, Pb, Co, Ni, Mo, Sn, V, Be, and examined for phosphorus and any other abnormal features. Of these 1980 were stream sediments from the Chillagoe - Mt. Garnet area, Queensland, 1550 were from Queensland (various localities), 430 from D'Entrecasteaux Islands and T.P.N.G., and 2500 were auger cuttings from Rum Jungle. 130 were miscellaneous samples.

Ca, Na and Mg ratios obtained from this work were used to obtain a geochemical interpretation of lithologies in the Rum Jungle area.

193 samples from Rum Jungle, Lake Amadeus and Blood's Range areas, N.T. were analysed for phosphate. 58 surface, bore and brine samples from Alice Springs and Barkly Tableland, N.T., Canberra district, and Antarctica were examined.

Miscellaneous analyses included limestones, clays, iron ores, laterites and biotite concentrates.

A further 1580 soil samples from the Captain's Flat geochemical survey were analysed for copper and zinc, completing this survey.

One chemist was engaged on analysis of phosphate samples in the field with the Rum Jungle party.

In the Geobiology section work was carried out on the determination of sulphate and sulphide in cultures, and the isolation of sulphides from mixtures for further analysis.

Experiments were continued on the mechanism of deposition in syngenetic ore deposits and an adsorption mechanism has been shown to be capable of producing one type of banding in natural sediments. This banding is brought about by preferential adsorption of heavy metal ions from solution, by a range of adsorbents which include clay minerals, hydrated iron oxide and organic materials.

Investigations into the pollution of the Molonglo River and possible pollution in Lake Burley-Griffin have been made in conjunction with the A.N.U. The many field and laboratory experiments carried out on this topic have helped in the understanding of the fate of dissolved heavy metal ions such as copper and zinc, in the Molonglo River. The results of this work will have direct application to applied geochemical techniques at present under study. Some interesting work on the toxicity of these same metal ions to fish is being done also, and many analyses on water, fish, fish eggs, etc. have been carried out.

Petrology Section

A report on the detailed examination of the basic rocks of the Katherine - Darwin region was completed.

Forty-five igneous rocks were examined from the Bowen South 4-mile area, and a report issued.

A group of igneous rocks, pyroclasts and sediments were examined for the Towanokoko-Pondo hydro-electric scheme, New Britain, and for the Upper Cotter Dam site A.C.T.

A method was established for the rapid determination of plagioclase feldspars by fusing the material and determining the refractive index of the glass.

Petrological and chemical studies of basic igneous rocks continued throughout the year, the main interest being on petrological and trace element variations in fractionated basic intrusive bodies.

A second report on the igneous geology of the Mossman Sheet was completed. This report showed that the post batholithic intrusions of the Mareeba Granite are post-orogenic and epi-mesozonal. The mechanics of the intrusion appear to have been a concentration of intrusion along ring fractures and pushing aside of the country rocks. Chemical analyses of age determination granite samples were used in this work. The Nychum Volcanics are a calc-alkali suite and are believed to be co-magmatic with the Almaden Granite which intrudes them.

Work was commenced on the petrological examination of granite and basalt specimens from the Cooktown Sheet area.

Because of the large number of thin sections now held at the laboratory (10,000 approx.), and the probable annual increase of 2,000, it was decided to put information from petrological descriptions on to punched cards which could be used in the I.B.M. read-out system of the direct-reading emission spectrograph. The punched card system designed covers "general information", and modal analysis of igneous, metamorphic and sedimentary rocks. The general information gives locality, rock name, stratigraphic position and age, certain textural features, and alteration products. The modal analysis cards will also be of value in differentiating between similar rocks containing different common rock-forming minerals, e.g. basalts containing quartz and those containing nepheline....etc.

A report on the petrology of the granites of the Katherine - Darwin region was written in draft.

X-Ray, Mineragraphy.

Mrs. C. Rosser from the University of New England, and Mr. I. Rance from the N.S.W. Mines Branch Laboratory were taught the elements of X-Ray fluorescence spectrometry during the year. A group of 80 clay samples were analysed for potassium for the University of N.S.W., and the determination of Rb/Sr ratios on rocks for the age determination programme was continued.

The possibility of using X-Ray fluorescence analysis for three element determinations was investigated and it was found that the method was satisfactory down to 1 ppm of copper.

An X-Ray goniometer was fitted to the large X-Ray generator which enabled X-Ray diffractometer analyses of clay minerals to be carried out on a routine basis. An X-Ray method for the determination of the structural state and the potash feldspar composition of plagioclase feldspars was satisfactorily commenced.

Routine identification of minerals and clays using X-Ray diffraction and fluorescence spectrometry were carried out during the year.

The synthesis at low temperatures of copper-iron sulphides was continued, and chalcopyrite and bornite were produced at room temperature in aqueous solution. Recrystallisation experiments were carried out on the synthetic sulphides, and these were found to recrystallise completely at 2,000 atmospheres and 100° C in 20 days. A paper giving details of the work was submitted to "Economic Geology".

A paper dealing with the X-Ray and morphological examination of a zinc manganese silicate, hodgkinsonite, was submitted to the "Mineralogical Magazine".

Mineragraphic, petrographic, and heavy mineral studies were completed on samples of tin ores from mines in the Mt. Wells - Mt. Harris Area, N.T., and the Mt. Garnet area, North Queensland. Heavy minerals in beach sands and stream gravels from Papua, New Guinea, Queensland, Northern Territory, and Western Australia, were identified and standard techniques were evolved for this type of examination.

Routine examinations of specimens submitted by field parties and private individuals were carried out.

A start was made on the detailed study of the tin mineralisation of the Mt. Garnet Area, Queensland.

<u>General</u>

Investigations were carried out in connection with the purchase of a direct-reading optical spectrograph, and ancillary equipment for sample preparation.

Detailed modifications required to the instruments to make them suitable for geological application were submitted to the manufacturers concerned, and advice has been received that these modifications are acceptable to the manufacturers.

Plans for re-modelling of the present laboratory to take the instrument have been completed, and a punched card system investigated for the storage and retrieval of the information obtained from it.

Detailed plans for the laboratory in the new building have been completed.

A record of the minor investigations of the laboratory for the period January-June 1962 was issued.

AGE DETERMINATION

The combined age determination programme with the Australian National University was continued in 1962. Three geologists and three non-professional employees were engaged full-time on age determination work. One Bureau geologist is responsible for the mineral separation, indexing and the petrological work - two others work in the A.N.U. laboratory, one on Rb/Sr analyses and the other on K/A determinations.

Plate 2 illustrates the areas sampled in 1962, and the areas and oil wells in which samples were dated by K/A and Rb/Sr methods.

One hundred and seventy five samples were prepared at the B.M.R. laboratory for age determination. Most of the year was spent on the mineral separation and age measurements on granites and volcanics collected from the Cairns Hinterland and Mt. Isa/Cloncurry region, North Queensland, and from the Adelaide Geosyncline in South Australia. These three projects are virtually completed. Thirty five granites and volcanics from the Cairns Hinterland were dated by the K/A method and three by the Rb/Sr method; when the Cairns Hinterland project is completed about forty samples will have been dated. Twenty samples of granite and volcanic rock from the Mt. Isa/Cloncurry region were dated by the K/A method. About forty rocks have been dated by the Rb/Sr method from the Adelaide Geosyncline.

Apart from the major projects miscellaneous samples were determined as requested from the Bureau's field geologists, State Geological Surveys, and oil companies. These samples included five samples of the Nicholson and Norris Granites from the Northern Territory; seven granitic rocks from the Bowen Basin; six granitic basement samples from oil wells situated mainly in the Artesian Basin.

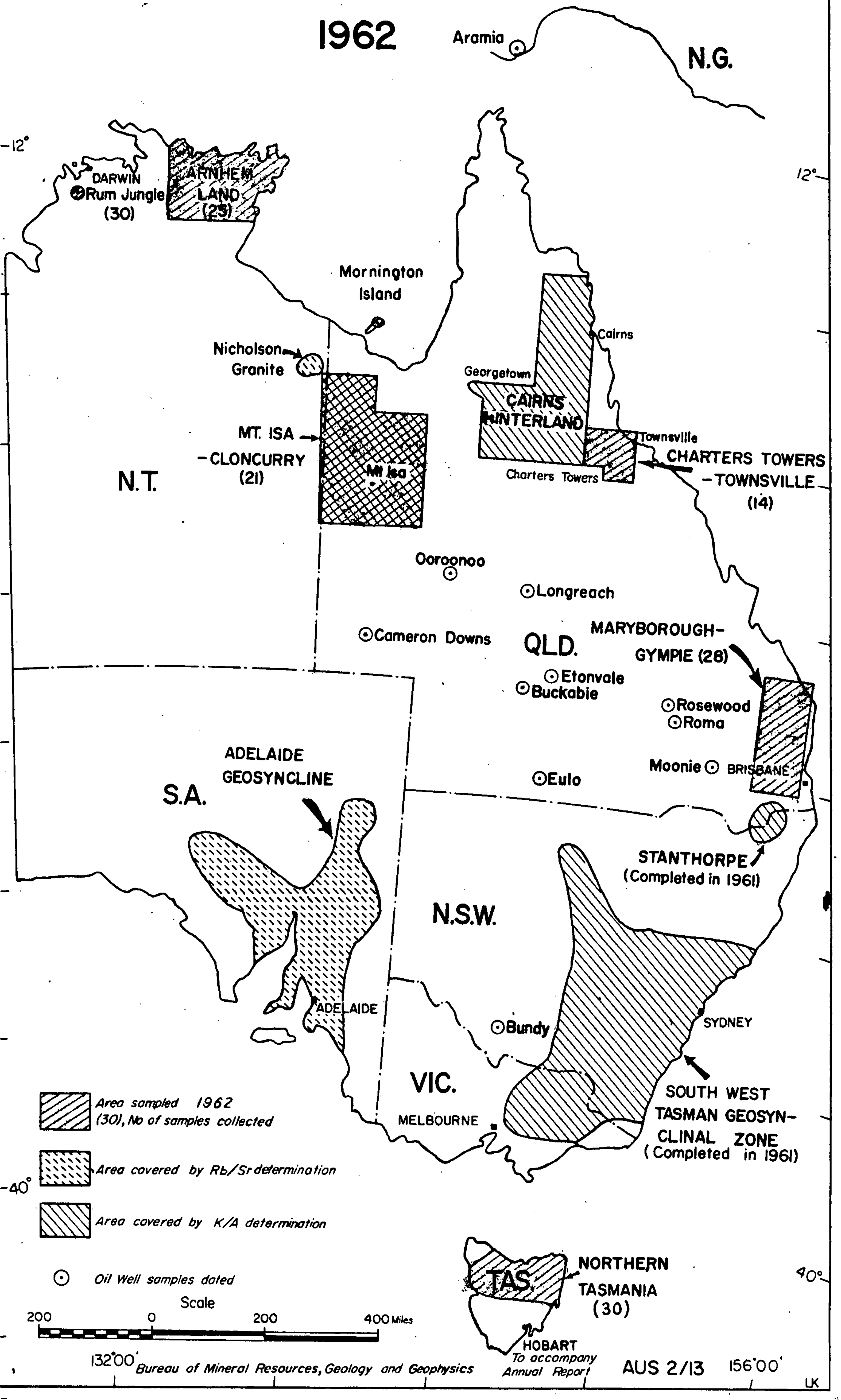
One hundred and fifty samples were collected for age determination; thirty from Tasmania; twenty one from the Mt. Isa/Cloncurry region, North Queensland; thirty from the Rum Jungle area, Northern Territory; fourteen from the Charters Towers region, North Queensland; twenty eight from the Maryborough/Gympie region, Queensland; and twenty five from Arnhem Lane, Northern Territory. All the Mt. Isa samples have been processed for dating and preparation of the Rum Jungle samples has begun.

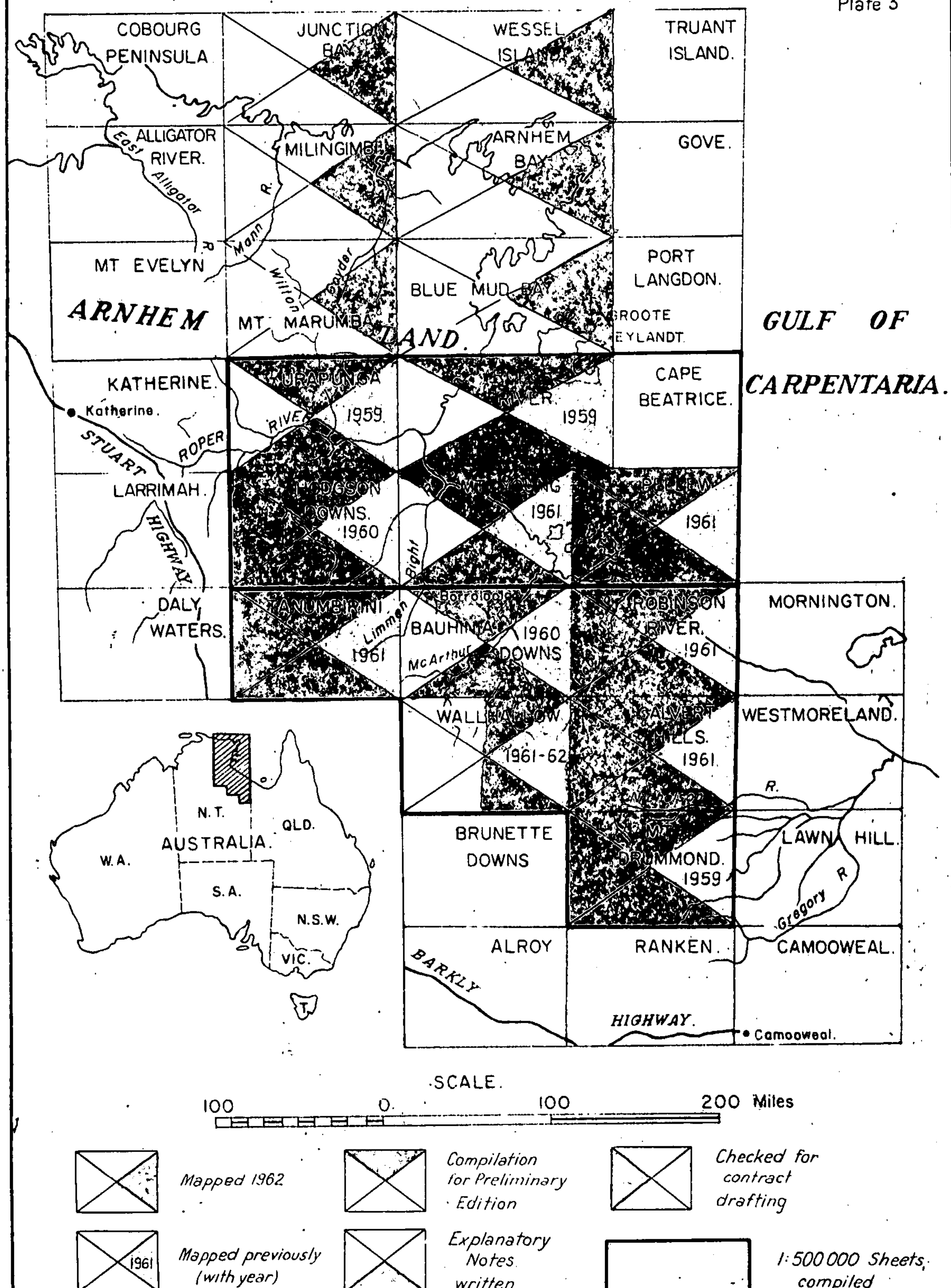
As well as the routine age determinations some research was carried out by the staff. M . Bofinger attempted to determine the half life of rubidium by determining the calcium by isotope dilution and mass spectrometric methods. J.M. Rhodes began an optical study of feldspars to determine their structural state and composition.

Most of the petrological and other data on samples, which were previously collected for dating or were dated in the Northern Territory and Queensland, were entered onto punch cards. A statement on the general requirements for samples collected for age determination was prepared and issued to field geologists. A review of the Bureau's age determination programme from 1956 to 1962 was prepared as part of the contribution to a Symposium on Age Determination organised by the British Commonwealth Geological Liaison Officer; the review was issued as a Record (1962/129).

Plate 2

AGE DETERMINATION PROGRAMME 1962





CARPENTARIA AND ARNHEM LAND PARTIES - WORK COMPLETED 1962

Bureau of Mineral Resources Geology and Geophysics November 1962 A.M.

NORTHERN TERRITORY

Regional Mapping - Carpentaria Upper Proterozoic Province.

The Borroloola Party spent until late May preparing geological maps and explanatory notes for the Mt. Young, Tanumbirini, Robinson River, Pellew, Calvert Hills and part of Walhallow 1:250,000 Sheet areas. The first draft of a bulletin on the geology of the area between Roper River and the Queensland border was completed and compilation of two 1:500,000 geological maps covering the same area commenced.

Each of the above 1;250,000 Sheets (except Walhallow which is to be completed by the Sedimentary Section) together with Urapunga, Roper River, Hodgson Downs, Bauhinia Downs and Mt. Drummond were issued as Preliminary Editions and the Explanatory Notes issued as Records. Hodgson Downs, Tanumbirini, Robinson River, Calvert Hills and Mt. Drummond were further corrected preparatory to contract drafting.

During 1962 the Arnhem Land Party continued the field work northward into Arnhem Lane - field work commenced on the 18th May and with the aid of a helicopter, mapping of the Mt. Marumba, Milingimbi, Junction Bay, Wessel Islands and Truant Island, Arnhem Bay, Gove, Blue Mud Bay and Port Langdon 1:250,000 Sheet areas was completed by late October.

The areas covered in this project are shown on Plate 3.

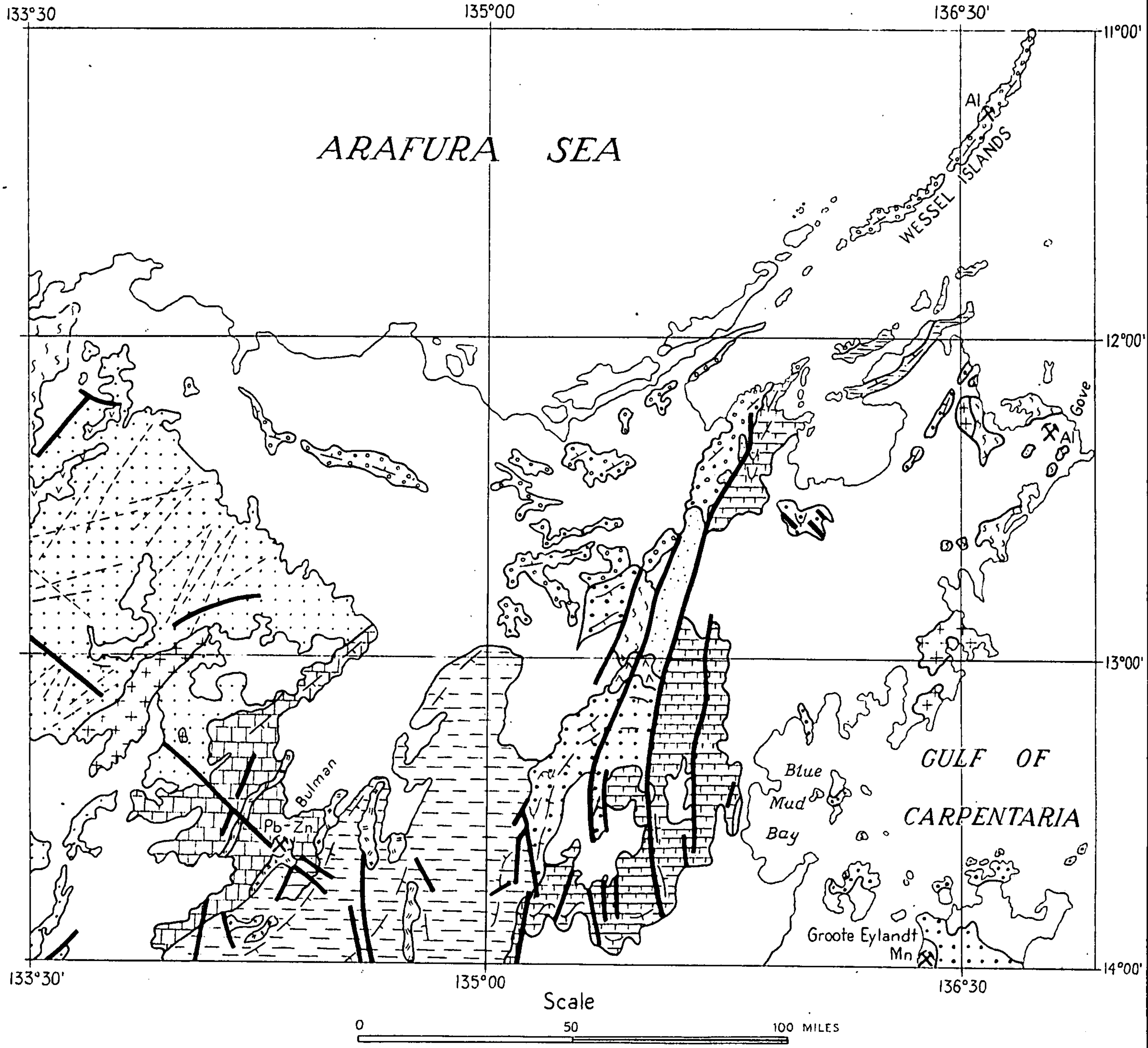
General Geology. (See plate 4)

The northern extension of the Carpentaria Upper Proterozoic Province is exposed in Arnhem Land. The general sequence comprises: Archaean and Lower Proterozoic granites and metamorphics and Middle Proterozoic (?) sandstone, porphyry and volcanics, which form the basement to the Upper Proterozoic sequence; Upper Proterozoic sandstone, siltstone, shale and carbonate rocks; Lower Palaeozoic (?) sandstone and flat-lying Cretaceous sediments which unconformably overlie the Upper Proterozoic units. Lead-zinc deposits occur in the Upper Proterozoic carbonate rocks, manganese in the Cretaceous sequence and bauxite, formed by laterization of the Cretaceous rocks, have been found in the area.

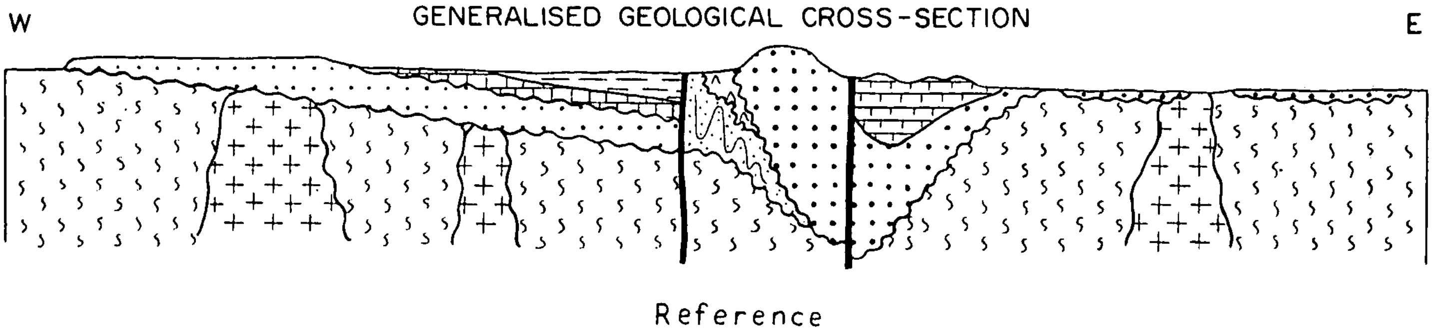
The basement granites and metamorphic rocks crop out mainly on the Gove Peninsula and along the eastern coast of Arnhem Land as far south as the islands in Blue Mud Bay. They also occur in a narrow belt along the headwaters of the McLaren River, and as inliers beneath Upper Proterozoic sandstone in Western Arnhem Land. At Gove, and along the east coast, three principal types of granite have been noted: a foliated garnetiferous two-feldspar granite which is intruded by a homogeneous leucocratic one-feldspar granite. This in turn is intruded by dykes and stocks of a red granite. The two later granites also intrude metamorphosed sediments and granite gneiss which were metamorphosed at the same time as the garnetiferous granite was intruded. Similar granites occur in the McLaren River area together with basic intrusions ("McLaren Complex"). The granites in Western Arnhem Land include foliated; homogeneous, equigranular; and porphyritic types. Foliation in both the granites and metamorphics strikes west. The foliated granites and metamorphics are regarded as Archaean in age while the younger granites are probably Lower Proterozoic.

Moderately folded quartz sandstone, feldspathic sandstone and arkose ("Mitchell Range Beds") crops out the north-trending Mitchell Range. They are down-faulted against the "McLaren Complex"

GEOLOGICAL SKETCH MAP-ARNHEM LAND N.T.



GENERALISED GEOLOGICAL CROSS-SECTION



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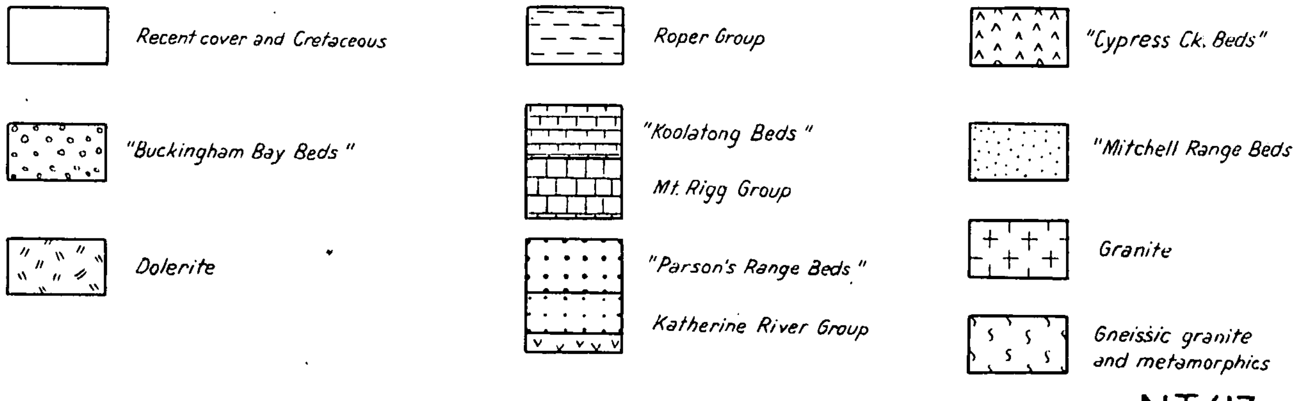


Bureau of Mineral Resources Geology and Geophysics, November 1962

NT/17

A.M.

to the west and up-faulted against Upper Proterozoic rocks to the east. The "Mitchell Range Beds" are intruded by acid porphyry and overlain with slight unconformity by acid volcanics (including ash flow tuffs), tuffaceous sandstone and micaceous siltstone ("Cypress Creek Beds"). The acid volcanics also unconformably overlie the granites and metamorphics near Gove and in the Blue Mud Bay area. The volcanics are correlated with the Edith River Volcanics in the Katherine - Darwin area and the Scrutton Volcanics in the Mt. Young area, and together with the "Mitchell Range Beds" are regarded as Middle Proterozoic or lower Upper Proterozoic in age.

The main Upper Proterozoic sequence unconformably overlies either the granite and metamorphic basement or the acid volcanics. The sequence is generally similar to that mapped to the south of Arnhem Land and comprises three principal groups summarized below:

Lithology	Western A.L.	Eastern A.L.	Roper River - Queensland Border Area.
Flaggy sandstone, micaceous siltstone, shale, minor dolomitic beds.	Roper Group	Roper Group	Roper Group - South Nicholson Group.
Dolomite, dolomitic siltstone, chert, sandstone.	Mt. Rigg Group	"Koolatong Beds"	McArthur Group.
Quartz sandstone, dolomite, volcanics.	Katherine R. Group	"Parsons Range Beds"	Tawallah Group.

The Katherine River Group and "Parsons Range Beds" both have a thick quartz sandstone unit at the base (about 2,000 ft. and 8,000 ft. respectively) which corresponds to a similar unit at the base of the Tawallah Group. Interbedded basic volcanics occur in the Katherine River Group but not in the "Parsons Range Beds". In the upper part of both units, sandstone is interbedded with finer-grained clastics and dolomite. The top of the Katherine River Group is marked by an unconformity and the top of the "Parsons Range Beds" by a change from what is essentially a sandstone sequence into a dolomitic fine-grained sequence ("Koolatong Beds").

The Mt. Rigg Group, which unconformably overlies the Katherine River Group, includes a sandstone unit, overlain by an algal dolomite-chert unit, and is about 1,500 feet thick. The "Koolatong Beds" are a northern development of the open sea facies of the McArthur Group but contain much more fine-grained terrigenous material than their southern counterparts.

The Roper Group shows little variation from the sections mapped in the areas south of Arnhem Land.

The Mt. Rigg Group and Roper Group sediments are intruded by dolerite sills, about 200 feet to 300 feet thick.

The Upper Proterozoic sediments have been deposited in three main environments. The Katherine River Group, Mt. Rigg Group and Roper Group sediments are confined to the area west of the Parsons Range and have been deposited on a shelf which dips gently to the south-east. The total thickness of each Group in the area mapped is in the order of 1,500 to 3,000 feet. A series of north-trending faults and hingelines in the area between the western edge of the Parsons Range and the western coast of Blue Mud Bay has formed a deep trough in which the "Parsons Range Beds" and the "Koolatong Beds" attain thicknesses in the order of 10,000 ft. to 15,000 ft. each. East of this trough the basement shallow abruptly and is covered by a veneer of Upper Proterozoic sandstone up to 1,000 feet thick.

Along the north coast of Arnhem Land the Upper Proterozoic sequence is unconformably overlain by a succession of quartz sandstone, flaggy fine sandstone, siltstone and shale with minor chert and carbonate rocks ("Buckingham Bay Beds"), which dip north and north-west in an arc following the Wessel Islands and the northern coast. The presence of "pipe-rock" sandstone near the base of this succession suggests it is of early Palaeozoic age but no other fossils were found to confirm this.

Cretaceous, calcareous, ferruginous and kaolinitic sandstone form plateaux and valley-fill throughout Arnhem Land.

Lead-zinc mineralization occurs in the dolomites of the Mt. Rigg Group at Bulman in southern Arnhem Land. The mineralization is in flat-lying beds above a 300 foot thick sill of dolerite and is near a major north-west trending fault.

Bauxite at Gove appears to have been derived from the lateritization of Cretaceous kaolinitic sandstone. This deposit is second only to the Weipa deposits in size in Australia. Low-grade bauxite also occurs overlying shales of the "Buckingham Bay Beds" in the Wessel Islands.

On Groote Eylandt, pisolitic manganese overlies the Upper Proterozoic sandstone on the west coast. Scattered manganese is common near the base of the Cretaceous and this deposit is probably of similar age. The economic possibilities of this deposit, which was found by the Bureau during the course of the Carpentaria regional mapping, are now being investigated by Broken Hill Proprietary Ltd.

DARWIN URANIUM GROUP

The Darwin Uranium Group continued to provide services for prospectors and mining companies, and for Bureau field parties operating in the Northern Territory; and provided the geological and geophysical staff for geochemical and geophysical surveys at Rum Jungle and geophysical surveys in the South Alligator River area.

During the first part of the year draft plans were prepared for radiometric contours and copper, lead, and zinc concentrations at the surface and at various depths down to 40 feet of the Dolerite Ridge, Dolerite Ridge East, Area 55 West, Flynn, Castlemaine, and Batchelor Laterites areas at Rum Jungle. These were geochemically surveyed in 1961. This survey was continued in April 1962. The Castlemaine North area, Castlemaine North Extended, Rum Jungle Creek South Extended, Castlemaine South, West Finnis, Area 55 West/West, Area 55A, part of Area 55B were tested by auger drilling. The results of this survey are recorded separately in this report.

The mining operations of the uranium companies in the South Alligator area were inspected each quarter. The South Alligator Uranium Company ceased mining in March, recommenced treating of stockpile ore in June, and finally closed down in September. United Uranium Company intersected ore in two adits at El Sharana West and at the No. 7 adit at Palette; the company also mined ore at Scinto 6, Koolpin Creek, and Coronation Hill.

Geophysical work by the Darwin Uranium Group included self potential surveys in the South Alligator River area and electromagnetic and radiometric surveys at Rum Jungle. These continued from surveys carried out in 1961. Drilling of Bureau S.P, anomalies at El Sharana West by United Uranium N.L. resulted in the discovery of a number of small but important new pitchblende-bearing orebodies and drilling of other anomalies is in progress.

The geophysical work at Rum Jungle was closely tied to the geochemical and phosphate surveys, the same grid being used in each case.

Miscellaneous duties during the year included sampling of the Rum Jungle Granite complex for age determination.

RUM JUNGLE GEOCHEMICAL SURVEY, 1962.

The Rum Jungle geochemical survey was continued during 1962 and was concentrated in the area between Castlemaine and Rum Jungle Creek South open cut and at Area 55. Following a request from Territory Enterprises Pty Ltd during the year, the original intention to complete the section Area 55 to Browns was deferred and drilling concentrated on the areas noted. The analysis of all samples by spectrograph in Canberra proved most satisfactory and this work more or less kept pace with the drilling. A start was made on the spectrographic analysis of 1961 samples to give uniform analytical coverage for the whole programme.

The auger drilling contract with Enterprise Exploration Pty Ltd was completed ahead of schedule during November. Analyses of the geochemical samples will not be completed until early December, but progress to date has outlined a number of anomalies suggested for diamond drilling and further auger drilling.

Castlemaine Hill Area: (Plate 6)

At Rum Jungle Creek South Extended an interesting radiometric anomaly has been located in weathered grey shale and chloritic shale. The radiometric contours are based on the average of values in weathered rock and the 0.024 mR/hr. contour surrounds auger holes 47E/10N, 48E/10W, 48E/9N and 51E/8N. The maximum individual value is 0.085 mR/hr. at a depth of 28 ft. 6 inches at 51E/8N. Diamond drilling to test this area was recommended and will be carried out by Territory Enterprises Pty Ltd in the near future.

The Castlemaine North Extended grid was completed, the only radiometric anomaly located being at the ENE corner of the grid. This is not considered important. The copper anomaly found at Castlemaine in 1961 continues to 82E/6N on the Castlemaine North grid, and diamond drilling to test it has been recommended. This is on programme for Territory Enterprises Pty Ltd.

Castlemaine South grid was completed. One small anomaly has been located but details are not yet available. Auger boring for phosphate on the adjacent grid revealed two 12 x background anomalies in weathered rock in two holes only. Full details of these are also not yet available, and they are not shown on the attached plans.

General 55 Area. (Plates 7, 8, 9.)

Radiometric anomalies which warrant further investigation were found in the weathered rock adjacent to the Finniss River between area 55W and area 55W/W. Further auger drilling is recommended to the south-west, adjacent to the river. Scout diamond drilling is suggested for near 21S/60W (55W grid) and 5N/258W (55 W/W grid).

At area 55A a small radiometric anomaly in weathered rock around 18S/26W warrants follow-up auger drilling on a 100 ft. grid.

Considerable areas at the 55 prospect are enclosed by the 0.024 mR/hr. radiometric contours based on the average of readings in weathered rock. These are the largest and most intense anomalies located since the auger drilling commenced in this area in 1961. Also they are laterally displaced from the surface radiometric anomalies which were previously costeaned and churn drilled by Territory Enterprises Pty Ltd.

Scout diamond drilling is warranted to test the sub-surface radiometric anomalies near 10S/10W and 26W/8W and the zone of the electro-magnetic anomaly between 26S and 16S along grid line 12W.

Plate 9 shows the distribution of some quite large copper anomalies located during the auger drilling programme. These also warrant further investigation of diamond drilling.

The geology of Area 55 and its surrounds is largely obscured by soil and is still not fully understood: but the information available suggests that there are a number of folds with axes striking south-west. In an attempt to clarify the picture, a study was made of the distribution of calcium, magnesium and sodium in the weathered rock samples. The results so far are shown by the interpretation on Plates 7, 8 and 9.

Rock Type A : ..... characterised by Ca and Mg - is interpreted as calc-silicates, tremolite schist, altered impure dolomitic sediments, amphibolites, etc.

Rock Type B : ..... Ca, Mg, Na - graphitic and carbonaceous sediments.

Rock Type C : ..... Mg and Ma - chloritic shales

Rock Type D : ..... Mg - dolomite

Rock Type S : ..... Na - grey shales

Types B and S can probably be grouped.

This interpretation accords reasonably well with the geology of the areas where there is some outcrop and also with the interpretation of auger cuttings, and indicates that the electro-magnetic anomaly striking north-east from the south-western corner of area 55A represents the sheared limb of a fold. The absence of geochemical or radiometric anomalies along this line indicate no further work is warranted there. The geochemical-lithological interpretation will be continued as further samples are analysed and a further check will be made on the outcrop geology in the area before the end of the field season.

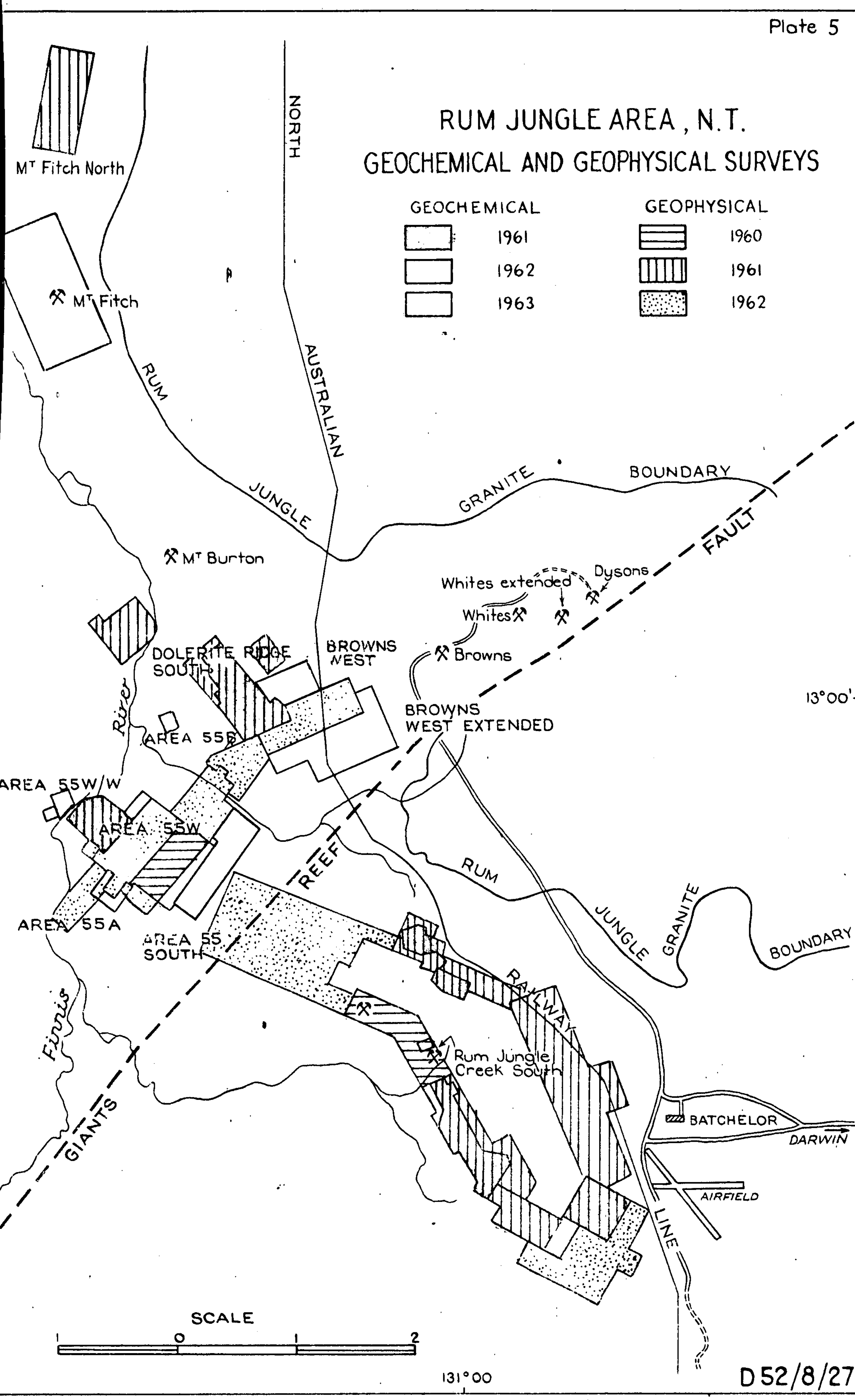
The costeaning and churn drilling carried out by T.E.P. at area 55 was concentrated at the sites of the most intense surface radiometric anomalies in the "amphibolite and chlorite schist" and limestone. The base of the shale sequence, where recent sub-surface anomalies have been found, was not tested and should be examined.

The "amphibolite and chlorite schist" between the lime-stone and shale was the locus for the weak uranium mineralization near the surface. It is suggested that this mineralized zone should be tested below the oxidised zone.

Mt. Fitch :

Previous drilling by T.E.P. appears to have touched only the northern edge of the extensive copper anomaly located at Mt. Fitch by the 1958 geochemical soil survey. It is proposed that this anomaly be examined more closely by auger sampling, initially on a 200 foot grid, during 1963. It is also suggested that this area be used for a comparative survey using EM and IP methods. Allowance has been made in the Special Mineral Exploration programme for some diamond drilling if geochemical and geophysical results are encouraging.

Plate 5



D 52/8/27


PLATE 6
GEOCHEMICAL SURVEY IN THE RUM JUNGLE AREA N.T. 1962
Rum Jungle Creek - Castlemaine Hill - Flynns Area.
GEOCHEMICAL AND GEOPHYSICAL ANOMALIES
SCALE
800 0 800 1600 2400 FEET
REFERENCE
Radiometric anomaly. Value in MR/hr.
Geochemical anomaly Copper. Value in p.p.m.
Geochemical anomaly Lead. Value in p.p.m.
Quartzite Breccia boundary
Major axes of electromagnetic anomaly
Radiometric contours in M.R/hr based on average values in weathered rock.
Geochemical contour. Value in p.p.m.
FLYNNS
Quartzite
Breccia
Rum Jungle Creek South
Open Cut
Orebody
RUM JUNGLE CK SOUTH EXTENDED
CASTLEMAINE NORTH EXTENDED
CASTLEMAINE NORTH
CASTLEMAINE
CASTLEMAINE SOUTH
BATCHELOR
LATERITES
N
25000
30,000
35,000
15000
10,000
5,000
D55/8/32

PLATE 7
RUM JUNGLE GEOCHEMICAL SURVEY 1961-62
"AREA 55" TO BROWN'S
SCALE
800 0 800 1600 2400 FEET
Geochemical Contours and geological interpretation are based on the results of spectrochemical analysis of bulked auger samples of weathered rock over an average depth of 30' - 40'
WEST FINNISS
DOLERITE RIDGE EAST
DOLERITE RIDGE
RUM FINNISS
BROWN'S WEST
WEST FINNISS RIVER
North Australian Railway
1956 Geophysical + 1958 Geochemical Baseline
Rum Jungle Creek
AREA 55 W/WEST
AREA 55 WEST
AREA 55 B
AREA 55
AREA 55A
1961 Geophysical Baseline
N
Geology and Geophysical Anomalies
REFERENCE.
A Type A Characterised by calcium and magnesium.
B Type B Characterised by calcium, magnesium and sodium.
C Type C Characterised by magnesium and sodium.
D Type D Characterised by magnesium.
S Type S Characterised by sodium.
Spectrochemical lithologies
·012 MR/hr.
·024 MR/hr.
> ·024 MR/hr.
Radiometric contours based on average values in samples from weathered rock
Recommend for scout drilling. 'A', 'B'. etc.
Fault
Axis of slingram real component.
20,000 N Mine grid coordinate
Radiometric contours in MR/hr based on average values in weathered rock
Diamond drill hole. (T. E. P.)
Phosphorous detected.
D52/8/29

PLATE 8


RUM JUNGLE GEOCHEMICAL SURVEY 1961-62
"AREA 55" TO BROWN'S
SCALE
800 0 800 1600 2400 FEET
Geochemical Contours and geological interpretation are based on the results of spectrochemical analysis of bulked auger samples of weathered rock over an average depth of 30' - 40'
WEST FINNISS
FINNISS RIVER
WEST FINNISS
DOLERITE RIDGE
DOLERITE RIDGE EAST
RUM FINNISS
North Australian Railway
BROWN'S WEST
1956 Geophysical & 1958 Geochemical Baseline
Rum Jungle Creek
AREA 55 W/WEST
AREA 55 WEST
AREA 55B
AREA 55
AREA 55A
1961 Baseline
Geophysical
N
LEAD
REFERENCE.
A Type A Characterised by calcium and magnesium.
B Type B Characterised by calcium, magnesium and sodium.
C Type C Characterised by magnesium and sodium.
D Type D Characterised by magnesium.
S Type S Characterised by sodium.
Spectrochemical lithologies
Geochemical contour, value in ppm
Geochemical center, showing average value in ppm.
Fault
Axis of slingram real component.
Mine grid coordinate
Diamond drill hole
D52/8/30

PLATE 9

RUM JUNGLE GEOCHEMICAL SURVEY 1961-62
"AREA 55" TO BROWN'S
SCALE
800 0 800 1600 2400 FEET
Geochemical Contours and geological interpretation are based on the results of spectrochemical analysis of bulked auger samples of weathered rock over an average depth of 30' - 40'
WEST FINNISS
DOLERITE RIDGE EAST
DOLERITE RIDGE
RUM FINNISS
BROWN'S WEST
WEST FINNISS RIVER
Rum Jungle Creek
North Australian Railway
1956 Geophysical & 1958 Geochemical Baseline
AREA 55 W/WEST
AREA 55 WEST
AREA 55A
AREA 55
AREA 55 B
N
COPPER
REFERENCE
A Type A Characterised by calcium and magnesium.
B Type B Characterised by calcium, magnesium and sodium.
C Type C Characterised by magnesium and sodium.
D Type D Characterised by magnesium.
S Type S Characterised by sodium.
Spectrochemical lithologies
Geochemical contour, value in ppm.
Geochemical center, showing average value in ppm.
Fault
Axis of slingram real component.
Mine grid coordinate
Diamond drill hole
D52/8/31

NORTH QUEENSLAND

Three metalliferous parties operated in North Queensland during 1962: the Cooktown Party, whose task was to map the Cape Melville, and complete the mapping of the Cooktown, 1:250,000 Sheet areas, and to assist with the supervision of drilling the alluvial tin prospect at King's Plains; the Mt. Garnet Party, which carried out detailed surface mapping of tin-bearing areas in a belt of country between Smith's Creek and the Wild and Herbert Rivers, and was also engaged in mapping and test-boring of alluvial deposits in the Mt. Garnet area; and the Ingham Party, which was engaged in regional mapping of the Cairns Innisfail and Ingham 1:250,000 Sheet areas. C.D. Branch completed a Bulletin dealing with the Upper Palaeozoic granites and associated volcanic rocks of the Georgetown Inlier.

COOKTOWN PARTY

This was a combined party with the Geological Survey of Queensland in regard to regional mapping. Bureau officers were responsible for the testing of the Kings Plains alluvial tin prospect.

The party was in the field for about 7 months - from 19th May to the middle of December.

Cooktown and Cape Melville 1:250,000 Sheet areas.

Geological mapping of the Cape Melville 1:250,000 Sheet area was completed, and additional work was done in the Cooktown 1:250,000 Sheet area.

Parts of the Cape Melville and Cooktown Sheet areas which were difficult to reach by land were visited by helicopter, and offshore islands and parts of the coast in the Cape Melville Sheet area were visited by launch. Ground traverses were made to areas of Mesozoic and Post-Mesozoic sediments within the Cooktown, Hann River, Ebagoola and Coen Sheet areas, and this work provided stratigraphic and palaeontological information which furthered the understanding of those sediments within the Cape Melville Sheet area, in particular, and within the Laura Basin as a whole.

Geology

Except for the absence of Pre-Cambrian, Silurian, and Permian rocks, which occupy quite small areas on the Cooktown Sheet , the formations represented within the Cape Melville Sheet area are virtually the same as those in the Cooktown area - viz., the Hodgkinson Formation (Devonian to Carboniferous), Dalrymple Sandstone (Jurassic), Battle Camp Formation and Wolena Claystone (Lower Cretaceous), gravels and MacLean Basalt (Tertiary), Brixton Formation, piedmont deposits, and fossil coastal dune sand (Late Cainozoic), and interfluvial sand, coastal dune sand, and alluvium (Quaternary). The granites found on the mainland and on some of the islands can mostly be related to the two main types found in the Cooktown Sheet area-the Mareeba type and the Mt. Finlayson type. Samples of a number of the granite bodies were collected for age determination.

The general geological picture of the Cape Melville Sheet is as follows:

The western area, which is of low relief, is occupied by Mesozoic sediments of the Laura Basin overlain by superficial Late Tertiary and Quaternary deposits; the coastal plain is a discontinuous feature, more prominent in the south than in the north, and is covered by late Cainozoic and Quaternary talus, alluvial, and aeolian deposits; the area between the Laura Basin and the coastal plain consists of rocks of the Hodgkinson Formation intruded by a number of granite bodies and overlain by remnants of Mesozoic sediments representing the dissected eastern part of the Laura Basin. The biggest mass of granite forms the Melville Range (immediately south of Cape Melville), which consists largely of a jumble of boulders similar to the "metal hills" of Chillagoe and the Black Trevethan Range south of Cooktown. Cainozoic basalt occurs in the Starcke River valley in the south-eastern part of the area. The Palmerville Fault, a major crustal lineament found during the mapping of areas to the south, does not crop out in the Cape Melville Sheet area, but occurs northward a few miles to the west, in the Ebagoola Sheet area; it has played a vital part in the development and post-depositional history of the Laura Basin (see below).

The Hodgkinson Formation at Noble Island is overturned in most places, and consists of closely-bedded thick to laminar turbidites of unusual coarseness and strength of bedding structures (e.g., graded bedding, truncation, and convolution). This suggests moderate tectonism and proximity of the source area. The Formation is also unusually coarse in the Cape Bowen area, immediately to the west of Noble Island. The rocks on Noble Island are intensely veined by quartz; conjugate sets of quartz-wolfram veins have been etched out by weathering, and these have been mined on a small scale since the turn of the century. The gold-quartz lode mines of the Starcke Goldfield, in the south-eastern part of the Sheet area, are now mostly collapsed. The lodes follow shears in the Hodgkinson Formation, and have several preferred orientations. Post-cleavage quartz porphyry dykes, carrying pyrite, like the lode wall rocks, are closely associated with the lodes, but their relationship to the mineralization is problematical.

In the islands of the Flinders Group, the Jurassic Dalrymple Sandstone consists of at least 800 feet of conglomerate and minor sandstone. It is overlain possibly with slight unconformity, by 500 feet of sandstone, carbonaceous shaly sandstone and siltstone, thin coal bands, and minor conglomerate. The upper unit contains plant fossils:- Otozamites sp., Brachyphyllum sp., Elatocladus sp., and Pagiophyllum sp. - which were found in shaly siltstone 200 feet above its base, on Stanley Island, and may be either Jurassic or Cretaceous. The base of the Dalrymple Sandstone could not be seen; even so, the exposure in the Flinders Group is the thickest section of the Formation measured in this area.

It was decided to lower by 200 feet the base of the Battle Camp Formation (Lower Cretaceous) in the Laura area upon the finding of more glauconitic sandstone above conglomerate of the Dalrymple Sandstone there. New collections of lamellibranchs were made from the Albian Wolena Claystone east of "Fairview" and near old "Brixton" Homestead, and *Inoceramus* sp., *Aucellina* sp., and *Pseudavicula* sp. were collected at a newly discovered outcrop of the Formation west of the boundary of the Cooktown Sheet area, 9 miles east of the Hann River crossing, on the Coen Road. A collection of starfish was made in the lowermost part of the Cretaceous, at the Little Laura River crossing, 10 miles north of Laura; the fossil locality also is rich in crinoid detritus and articulated parts, and Rhyzocorallium, *Maccoyella* sp., *Pseudomonotis* sp., *Syncyclonema* sp., and *Lilma* sp. were collected from sandstone of the Battle Camp Formation on the Coen Road, 14 miles West of Hann River Crossing.

The Cabot-Blueberry "Marina No. 1" well at Saltwater Creek, near the western part of Princess Charlotte Bay, penetrated over 3,000 feet of Mesozoic sediments, including fossiliferous parts of the Wolena Claystone. The base of the Mesozoic was at 3760 feet, where probable Chillagoe Formation was intersected. The drilling indicates that the Laura Basin deepens north of Laura and "Fairview" and probably continues under Princess Charlotte Bay.

The continuation of the Cretaceous Battle Camp Formation and the Jurassic Dalrymple Sandstone west of the Palmerville Fault means that the position of the boundary between the Laura and Carpentaria Basins is not certain. Available information suggests that post-Triassic movement on the Palmerville Fault belonged to a continuing episode of pivotal adjustment - east side down in the north and up in the south; and west side up in the north.

Fluviatile sand and gravel in the valleys of the Starcke, Upper Endeavour, and Upper Laura Rivers are post-MacLean Basalt, suggesting that the latter is of Tertiary rather than Quaternary age. The presence of basalt up to 100 feet above the floor of the Starcke River valley tends to confirm this suggestion. The alluvial deposits pre-date the capture of the Annan River.

The younger coastal and island deposits consist of fairly consolidated raised beach deposits, shelly and coralline material, and unconsolidated pumice banks.

KING'S PLAINS ALLUVIAL TIN PROSPECT.

At the end of 1961 the Queensland Department of Development and Mines took out a reservation over the King's Plains area on behalf of the Bureau. The eastern part of the reservation was surveyed by gravity methods and percussion drilled during 1962. Gravity traverses were run across the alluviated area, and drill holes were put down along two of them about 3½ miles west of the Annan (traverse 1), and the other immediately west of the Annan just upstream from the southern limit of the Gorge (traverse 14) - (see Plate 10)

By mid-November five drill holes had been completed on traverse 1, four on traverse 14, and a total of 1466 feet had been drilled. The holes on traverse 1 ranged from 131 feet to 167 feet deep, and those on traverse 14 from 137 feet to 149 feet deep.

The alluvium intersected in these holes was dominantly in the silt/sand size range. Beds of "running sand" made drilling and sampling difficult, particularly on traverse 1.

Cassiterite was detected in cuttings from all the holes, and ranged from minus 100 mesh up to sand-size. For security reasons the cuttings were panned to a rough concentrate only in the field. The field concentrates have not yet been reduced and weighed, and grades have not been determined. However, the holes on traverse 1 did not appear to contain more than a trace of cassiterite. Those on traverse 14 are nearer to provenance, and have penetrated material that appears to be richer in cassiterite than that on traverse 1, but it is unlikely that any of it will be of economic grade. However, if final results show that it approaches marginal grade, the Mungumby Creek area, east of the Annan, should be prospected. Cassiterite has recently been worked in very coarse "wash" in Mungumby Creek, about two miles upstream from the Annan.

Dr. M. Bik, geomorphologist with the C.S.I.R.O. Division of Land Research and Regional Survey, spent two weeks with the field party.

A three dimensional model of the Annan River Tinfield showing the more important faults, the geology, and known alluvial tin deposits is being prepared. It is hoped that the model will help to elucidate the more recent tectonic and geomorphological history of the area, and indicate places where alluvial tin deposits might be located. This will form part of an analysis of the whole area to be undertaken when the party returns from the field at the end of the year.

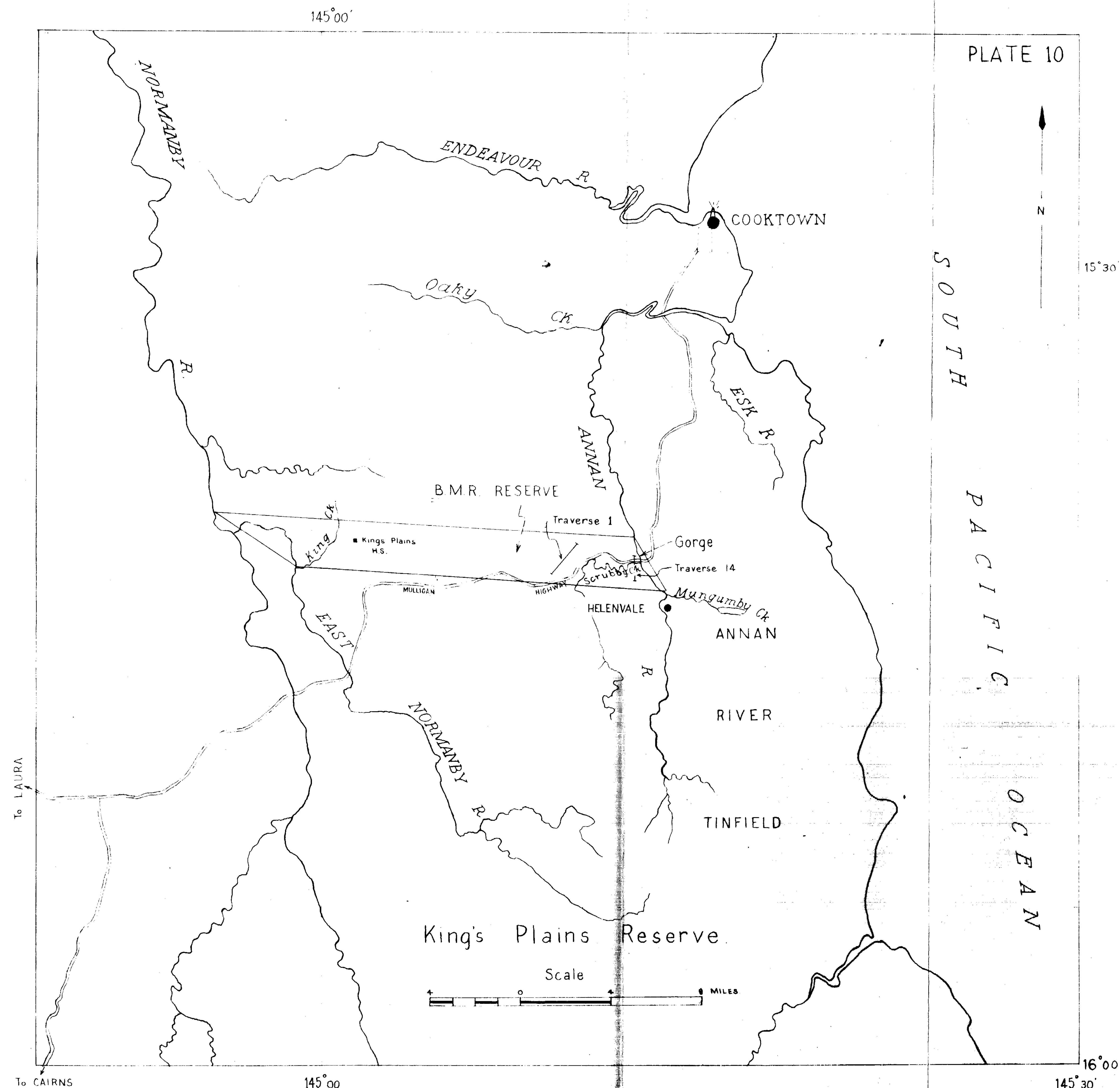


PLATE 10
145°00′
N
15°30′
NORMANBY
R
ENDEAVOUR R
COOKTOWN
Oaky Ck
ESK R
ANNAN
SOUTH PACIFIC OCEAN
B.M.R. RESERVE
Traverse 1
Gorge
King Ck
Kings Plains H.S.
Traverse 14
Scrubby Ck
MULLIGAN
HIGHWAY
HELENVALE
Mungumby Ck
ANNAN RIVER TINFIELD
EAST NORMANBY R
R
To LAURA
To CAIRNS
145°00
145°30′
16°00′
King's Plains Reserve
Scale
4 0 4 8 MILES

MOUNT GARNET PARTY.

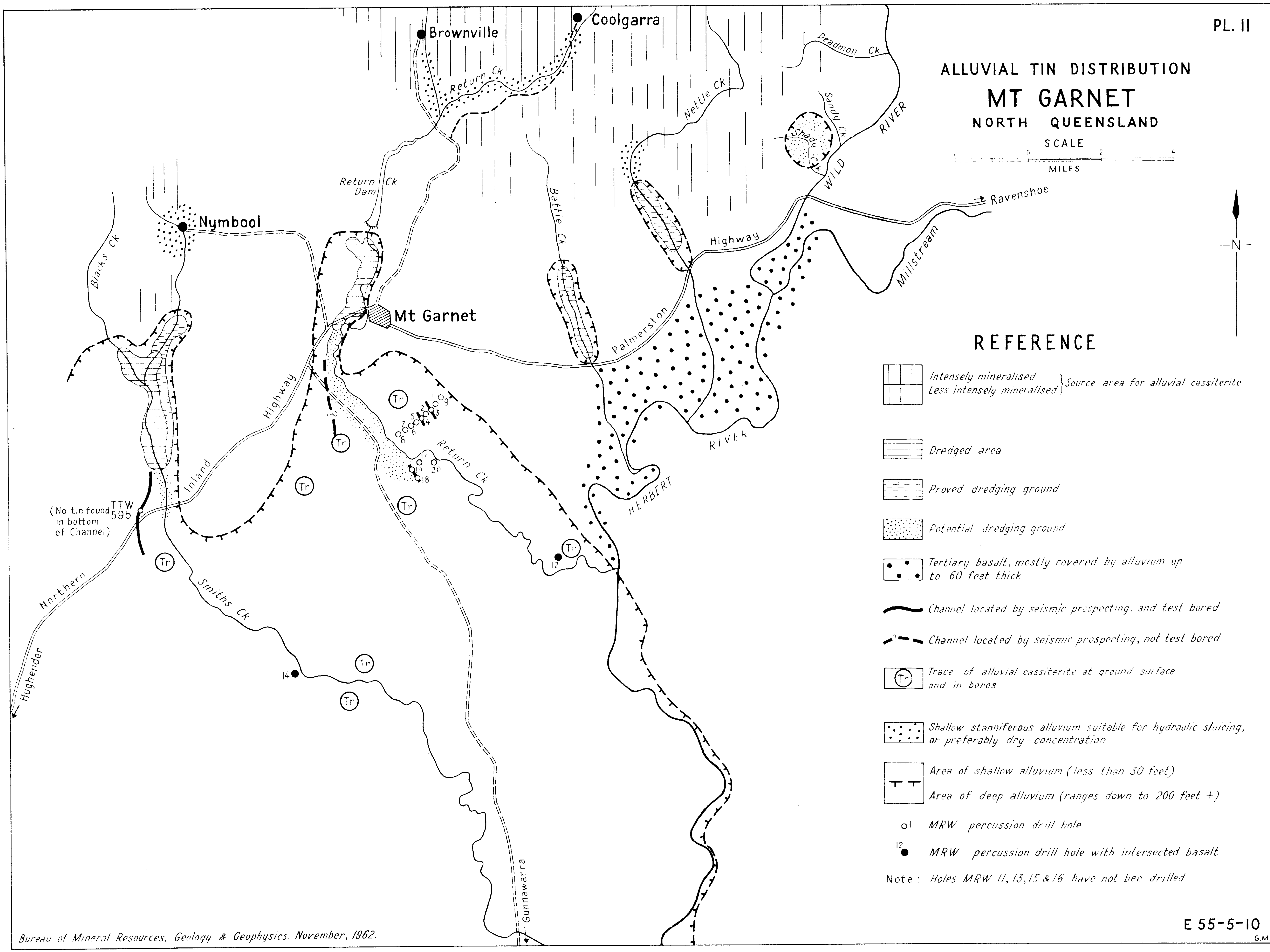
The party left Canberra on 26th April and arrived in the Mt. Garnet area on 10th May. Field work continued until 12th October.

The programme was to map in detail, and sample stream sediments, in the watershed of the Herbert River, from west of Mt. Garnet east to the Wild River (see plate 12). Mapping was at photoscale of 1:25,350, and was intended primarily to locate deposits ot tin, either lode or alluvial, and to determine the source of the tin in the alluvial deposits currently being worked in the area. Seismic and gravity work was to be carried out over the Ancestral Tate River (ATR) Prospect and the Wurruma Prospect to help in the understanding and evaluation of these prospects. A contract for 2000 feet of percussion drilling was let to Tableland Tin Dredging Ltd., to test selected prospects disclosed by geophysical work or mapping. Geochemical drainage sampling was also planned in conjunction with the mapping and geochemical anomalies located in 1961 were to be further examined.

The results of the survey are still being analysed and there are several features about the area which are not yet clearly understood. As a general statement at this stage of the investigation, the area for prospecting for alluvial tin at Mt. Garnet has been considerably reduced (see plate 11). At Smith's Creek the limit of payable ground was reached by the dredge and although a concealed channel was located by the survey, it did not contain tin. Wurruma and ATR prospects were investigated and abandoned. One hole drilled in Lower Return Creek about one mile south of previous boring obtained payable values and there is scope for further work in this area. The lode deposits of the area warrant detailed investigation.

Mapping of the area north of the Palmerston Highway was completed, except for an area between Battle and Nettle Creeks (see plate 12). Several new areas of granite and sediment outcrop were located. No mapping was carried out west of Smith's Creek and few traverses were made south of the Palmerston Highway and Northern Inland Highway.

General Geology. The area consists mainly of distinctive grey and pink-coloured Upper Carboniferous granite intruding sediments of the Silurian Mt. Garnet Formation (mainly greywacke with lesser siltstone, shale, basic volcanic rocks and limestone). A north-west trending belt of acid volcanics crosses the area and these rocks are genetically related to the pink granite. Iron, copper, zinc, and possibly lead mineralization is associated with the grey Herbert River Granite. The pink Elizabeth Creek Granite intrudes the Herbert River Granite. It is very acid with few ferro-magnesian minerals, and is the source of tin, wolfram, molybdenite, monazite, fluorite, beryl and some of the copper, lead and zinc mineralization in the area. Roof pendants of sediment are common in the granite. A small block of Precambrian rocks containing some gold copper and zinc deposits occurs at Mt. Garnet. Tertiary to Recent basalt flows occur in the Herbert River valley and extend northwards along most of the tributary valleys. The basalt flows have mostly been buried by more recent, unconsolidated alluvium, e.g. as disclosed by bore holes MRW 12 and 14. This knowledge of the subsurface extent of the basalt is very important in alluvial prospecting, e.g., in Return Creek because it defines limits to favourable areas and also indicates the position of ancient channels.



Bureau of Mineral Resources, Geology & Geophysics. November, 1962.

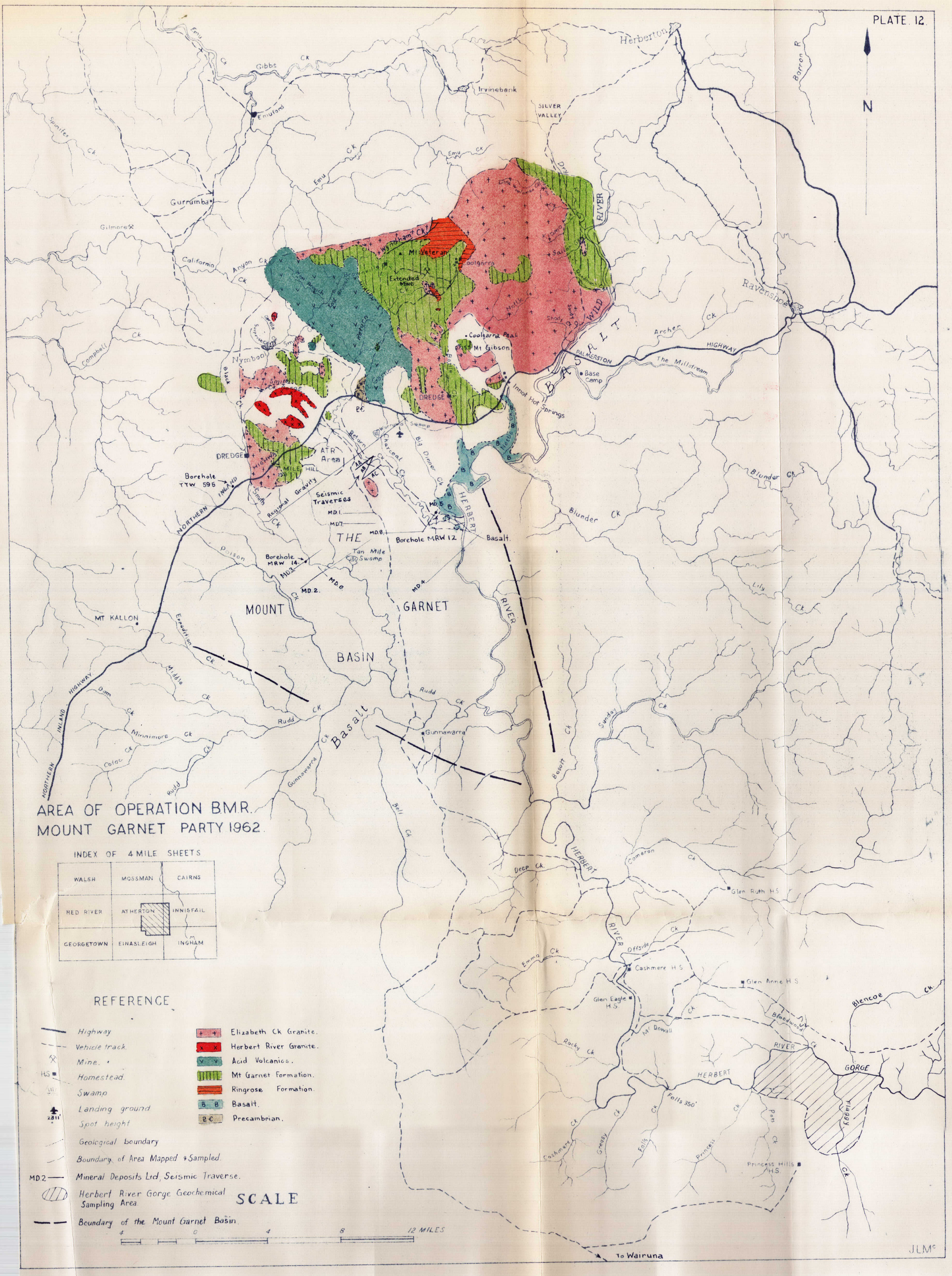


PLATE 12.
N
AREA OF OPERATION B.M.R.
MOUNT GARNET PARTY 1962
INDEX OF 4 MILE SHEETS
WALSH
MOSSMAN
CAIRNS
RED RIVER
ATHERTON
INNISFAIL
GEORGETOWN
EINASLEIGH
INGHAM
REFERENCE
Highway
Vehicle track
Mine
Homestead
Swamp
Landing ground
Spot height
Geological boundary
Boundary of Area Mapped & Sampled
Mineral Deposits Ltd, Seismic Traverse
Herbert River Gorge Geochemical Sampling Area
Boundary of the Mount Garnet Basin
Elizabeth Ck Granite
Herbert River Granite
Acid Volcanics
Mt Garnet Formation
Ringrose Formation
Basalt
Precambrian
SCALE
4
0
4
8
12 MILES
JLMc
Herberton
Irvinebank
SILVER VALLEY
Emuford
Gibbs Ck
Emu Ck
Gurrumba
Gilmore
California
Anyon Ck
Mt Veteran
Coolgarra
Extended Mine
Coolgarra Peak
Mt Gibson
Nymbool
DREDGE
Ravenshoe
WILD RIVER
BASALT
PALMERSTON HIGHWAY
The Millstream
Archer Ck
Base Camp
Innot Hot Springs
Blunder Ck
ATR Area
Borehole TTW 595
Regional Gravity
Seismic Traverses
NORTHERN INLAND HIGHWAY
MD.1
MD.7
MD.8
MD.5
MD.3
MD.2
MD.4
Borehole MRW 12
Borehole MRW 14
Ten Mile Swamp
THE MOUNT GARNET BASIN
HERBERT RIVER
Basalt.
Poison Ck
MT KALLON
Rudd Ck
Gunnawarra
Basalt
Sunday Ck
Lily Ck
Glen Ruth H.S.
Cashmere H.S.
Glen Anne H.S.
Glen Eagle H.S.
Deep Ck
Cameron Ck
Emma Ck
Offside Ck
Blencoe Ck
McDowall
Rocky Ck
HERBERT RIVER GORGE
Falls 350'
Princess Hills H.S.
To Wairuna

Geomorphology.

Dr. M. Bik of the C.S.I.R.O. Division of Land Research and Regional Survey, visited the party from 16th August to 2nd September, and is currently preparing a report on the geomorphology of the area. Briefly he confirmed the previous opinion of some Bureau officers that the extensive 'flat' area south of Mt. Garnet was a basin of sedimentation, probably dating back to the pre-Tertiary times. Bik also recognised a mappable sequence in the sediments of this basin and attempted to interpret seismic profiles in terms of this sequence using geomorphic principles. These interpretations remain to be tested.

The available evidence suggests that the source area for the Mt. Garnet Basin is much the same now as it was in Pliocene times. Thus all the sediments of the Basin are potentially stanniferous. However drilling in the area has shown that most alluvial cassiterite occurs within 100 feet of the surface. In turn this suggests that/primary tin mineralization has only been exposed in the latter phase of sedimentation in the Basin.

Alluvial Tin.

Mapping, geophysics and drilling all failed to locate any new alluvial prospects. All indications of mining and prospecting were recorded during the detailed mapping and the plot of this information clearly illustrates the mineralized and barren areas; the drainage from tin-bearing areas has invariably been worked for alluvial tin although the converse rarely holds.

The only chances for extending the large alluvial deposits in the area lie in Lower Return Creek and Lower Smith's Creek, i.e., in the Mt. Garnet Basin. Of these, Return Creek currently offers the most encouraging prospects. Small, though comparatively rich, alluvial tin deposits occur in Upper Return Creek and its tributaries, and Broken Hill Proprietary Ltd is currently appraising this area.

Indications of a southerly extension of the Return Creek deposits were found in borehole MRW 15 on Lower Return Creek. This hole averaged approximately 4.75 ozs cassiterite per cubic yard down to 80 ft. depth. It is located on seismic traverse Ac, approximately a mile downstream from where payable holes were drilled by Tableland Tin Dredging Ltd (seismic traverse AA).

60 ppm Sn was found spectrographically in the minus 80 mesh fraction of soil on Lucey's Knob, at the intersection of seismic traverses AB and AC. This outcrop was previously mapped as Precambrian but it probably represents a mineralized contact zone between Elizabeth Creek Granite and sediments; as such it may represent a local source supplying tin to channels in the nearby alluvium.

We do not yet know whether Return Creek always followed its present course. The 60 ft. of basalt in drill hole MRW 12, Lower Return Creek, may represent flow up an old channel of Return Creek although it could also be an old channel of the Herbert River. More work is necessary to determine the direction of this flow, and drilling in the troughs on either side of the basalt will be warranted if it does represent part of the Return Creek system.

A considerable amount of geophysical work was carried out in Smith's Creek, downstream from the crossing of the Northern Inland Highway. Detailed geological studies of borelogs in this area were also made to assist in interpreting the geophysical data. Tableland Tin Dredging Ltd. hoped to continue dredging south of the highway but had been unable to find a payable channel there despite extensive drilling. In the early stages of the geophysical work a channel was indicated west of Smith's Creek, and appeared to flow out to the south-west. Seismic evidence indicated that two of Tableland Tin's drill holes over the centre of this channel were unbottomed and both holes were subsequently deepened approximately 95 feet onto solid granite. However, they did not encounter significant tin values or channel gravels. Reinterpretation of the information in the area then suggested that the western 'channel' was only a tributary, eventually leading into Smith's Creek, and that it had never formed the course of Smith's Creek except perhaps in times of high flooding, when it could have been filled by overflowing from the main channel. Dr. Bik, in a geomorphological appraisal of the information, suggested that the ancient Smith's Creek channel probably flowed over rock bars in a gorge type bedrock topography near the highway crossing of Smith's Creek, thus explaining the sudden falling off in the values in this area.

BMR drill hole MRW 14, 6 miles downstream from the Highway, found only traces of tin and no gravels, but there remains a considerable area to be prospected before the entire valley below the highway can be considered as uneconomic.

Drilling and geophysical work proved conclusively that Return Creek never flowed through the Wurruma Swamp area and that no alluvial tin deposits occur in this area; evidence collected during 1962 has also discounted the ATR area as a prospect.

When drilling ceased in mid-November, a total of 1600 feet had been used. The remaining 400 feet will be used early in 1963 after detailed study of the 1962 season's results.

The results obtained from geophysical work, seismic and gravity, could not be correlated with drilling information in many places. Both methods give a reliable measure of the depth to solid bedrock but this is not of particular value here because the alluvial tin occurs in small gravel lenses anywhere within the upper 100 feet of the alluvial profile. Rarely do the stanniferous gravels rest directly on hard bedrock, the only surface which the geophysical methods can accurately define. Geophysical work is also hampered by deep, and variable, weathering thicknesses over the various rock types in the area. The variations in bedrock type make the calculation and interpretation of gravity results difficult, especially as paucity of outcrop in the critical areas prevents close control of the gravity work. Closely spaced boreholes (200 ft. apart or less) in lines across the valleys appear to be the only reliable method of assessing the alluvial potential of the valleys. The chances of missing payable ground by drilling isolated boreholes are so great, even when the holes are sited from geophysical evidence, that it is desirable to spend the greater part of any available funds on drilling.

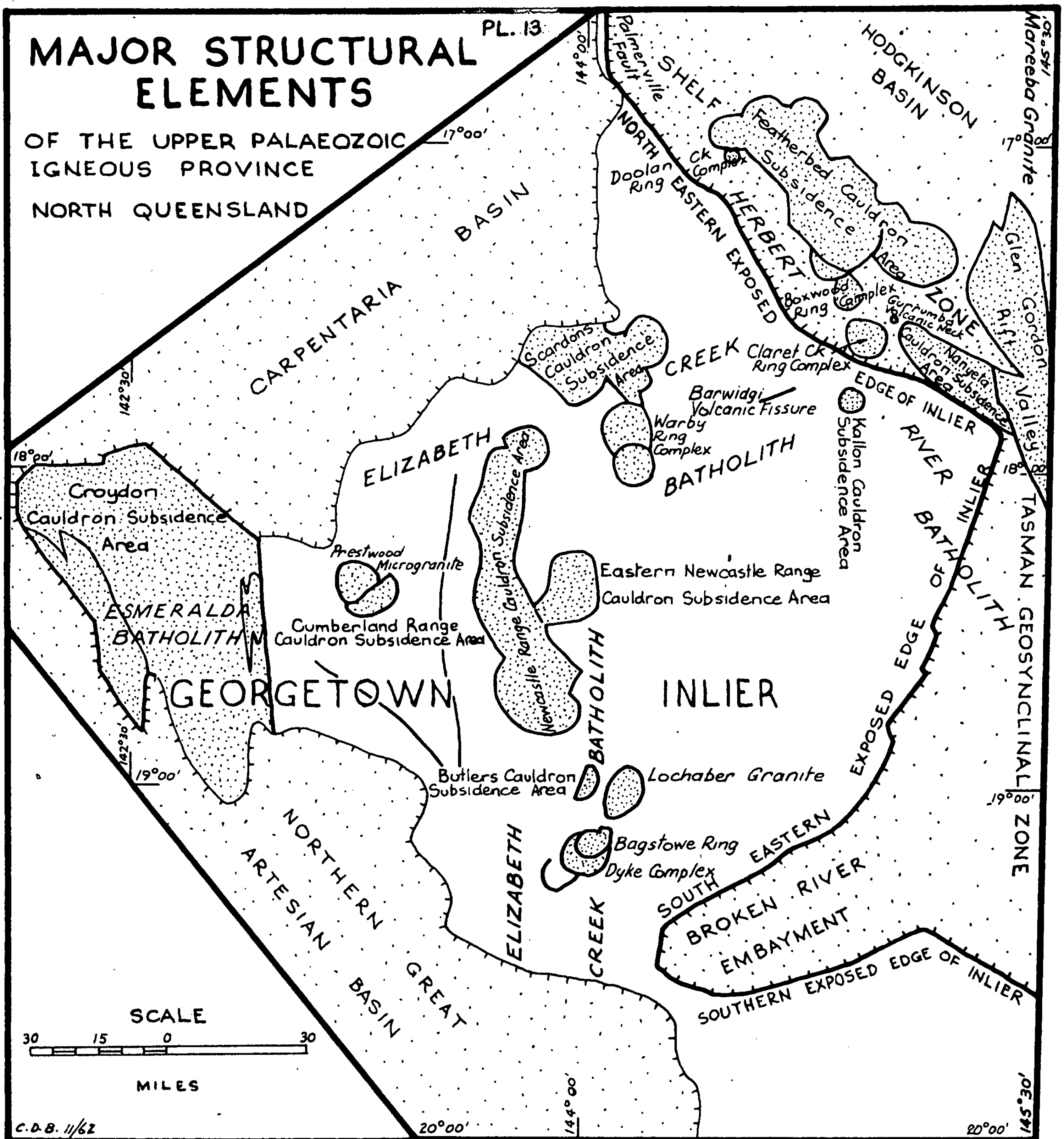
Primary Tin Mineralization.

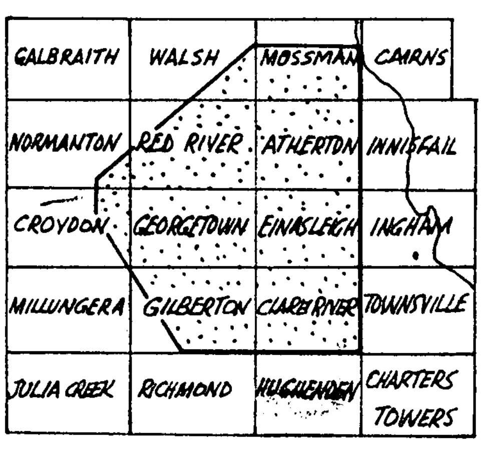
In the Mt. Garnet area cassiterite occurs in granite mainly in quartz-mica greisen lodes, and commonly with associated topaz and fluorite. The greisen bodies mostly trend north-west and are aligned on joints in the granite. They commonly consist of a central core of fine grained silica, or quartz veins, enclosed by mica. Large areas of greisen occur at Geebung Hill, Mt. Gibson and Coolgarra Peak and these warrant further investigation. The best lode-tin prospects appear to be the iron-chlorite lodes within the roof pendant of Mt. Garnet Formation between Brownville and Coolgarra. The largest tin mines in the area occur near Coolgarra and a small but rich discovery near Coolgarra this year, proves that the area has not been fully prospected. The lodes are mostly visible at the surface as intermittent outcrop of siliceous ironstone, in some places marked by old workings. Some lodes appear to be up to a mile long and detailed mapping and sampling of some of these is warranted.

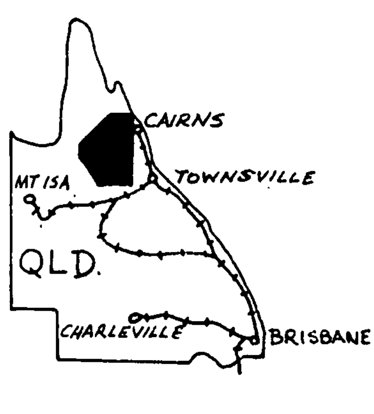
Geochemical.

Geochemical drainage sampling was carried out in conjunction with the geological mapping. Detailed sampling was carried out over anomalous areas found during 1961 near the Herbert River Gorge, north of Princess Hills homestead, and near the junction of the Tate and Sandy Tate Rivers. Most analyses are completed but the results have yet to be evaluated. Pyritic granodiorite was found during sampling in the Herbert Range area and specimens have been submitted for analysis to see if copper is present; several gossans from this area are also being tested.

During a flight planned mainly to assist in the regional geomorphological interpretation, a previously unknown lens of limestone was noted 8 miles west of Wairuna homestead. Ground checks subsequently revealed fossils (crinoids and corals) and this occurrence helps to locate more exactly the Silurian shoreline in the area.


PL. 13
MAJOR STRUCTURAL ELEMENTS
OF THE UPPER PALAEOZOIC IGNEOUS PROVINCE
NORTH QUEENSLAND
CARPENTARIA BASIN
Palmerville Fault
SHELF
HODGKINSON BASIN
Mareeba Granite
NORTH EASTERN EXPOSED
Doolan Ck Ring Complex
Featherbed Cauldron Subsidence Area
HERBERT
ZONE
Glen Gordon Rift
Gordon Valley
Boxwood Ring Complex
Gurrumba Volcanic Neck
Nanyeta Cauldron Subsidence Area
Scardons Cauldron Subsidence Area
CREEK
Claret Ck Ring Complex
EDGE OF INLIER
Barwidgi Volcanic Fissure
Warby Ring Complex
BATHOLITH
Kallon Cauldron Subsidence Area
RIVER BATHOLITH
EDGE OF INLIER
TASMAN GEOSYNCLINAL ZONE
ELIZABETH
Croydon Cauldron Subsidence Area
Prestwood Microgranite
Newcastle Range Cauldron Subsidence Area
Eastern Newcastle Range Cauldron Subsidence Area
ESMERALDA BATHOLITH
Cumberland Range Cauldron Subsidence Area
GEORGETOWN
BATHOLITH
INLIER
EXPOSED EDGE
Butlers Cauldron Subsidence Area
Lochaber Granite
Bagstowe Ring Dyke Complex
EASTERN
SOUTH
BROKEN RIVER EMBAYMENT
ELIZABETH CREEK
NORTHERN ARTESIAN BASIN
GREAT
SOUTHERN EXPOSED EDGE OF INLIER
SCALE
30 15 0 30
MILES
C.D.B. 11/62
17°00'
18°00'
19°00'
20°00'
142°30'
144°00'
145°30'


GALBRAITH
WALSH
MOSSMAN
CAIRNS
NORMANTON
RED RIVER
ATHERTON
INNISFAIL
CROYDON
GEORGETOWN
EINASLEIGH
INGHAM
MILLUNGERA
GILBERTON
CLARKE RIVER
TOWNSVILLE
JULIA CREEK
RICHMOND
HUGHENDEN
CHARTERS TOWERS


CAIRNS
TOWNSVILLE
MT ISA
QLD.
CHARLEVILLE
BRISBANE

PETROLOGICAL INVESTIGATION OF UPPER PALAEOZOIC GRANITES AND VOLCANICS OF THE GEORGETOWN INLIER.

The main project, which occupied the whole of the year, entailed the completion of laboratory studies on the acid igneous rocks of North Queensland and writing a bulletin entitled: 'The structural and magmatic relationships between acid lavas, pyroclastic flows, and granite of the Georgetown Inlier, North Queensland (see plate 13). This is the culmination of five years of field and laboratory research which has shown that the acid magma for extensive pyroclastic flow sheets is probably derived by fractionation of basic material in either the upper mantle or lower crust. The generation of this magma created tension in the crust allowing the magma to rise by block-stoping. At the same time, the volatile-rich part of the magma was extruded from fissures as pyroclastic flows. The final phase was the intrusion of the pyroclastic flows by the magma, which crystallises as a medium-grained granite under an insulating cover of welded tuff only 500-2000 feet thick.

The generation of the acid magma is believed to be an integral part of the mantle phase of orogenic cycle. The magma accumulated under more stable zones ((?) shelf areas) beside a developing geosyncline, and was intruded during the post-orogenic phase of the cycle. In addition, it is considered that ring complexes are related to volcanic calderas, but that they represent the vents for voluminous gaseous eruptions giving mainly air-fall deposits; fissures are the source for extensive pyroclastic flow sheets.

INGHAM PARTY

The Ingham Party commenced work on the Cairns, Innisfail, and Ingham 1:250,000 sheet areas, as part of the mapping programme of North Queensland by combined field parties of the Bureau and the Geological Survey of Queensland. The party was in the field from the middle of May to the middle of October. Mapping of the Cairns and Innisfail Sheet areas was completed; the Ingham sheet area could only be reconnoitred in the time available and its completion is planned for 1963.

Airphotos on the scale of 1:80,300, taken by Adastra in 1961, were used for navigation, and geological data were transferred, after plotting on photo overlays, to tracings of planimetric bases which were available for the Innisfail and Ingham sheet areas. Numerous stream sediment samples were taken for geochemical analysis.

General Geology (See Plate 14 and Stratigraphic table).

Lower to Middle Palaeozoic geosynclinal formations were folded and faulted, and intruded by Upper Palaeozoic granites and massive volcanic porphyries. After a period of levelling and non-deposition during the Mesozoic and Lower Tertiary, the area was uplifted and tilted to the west, and then olivine basalt and pyroclastics were extruded over wide areas. Recent alluviation of estuaries and lagoons gave rise to the coastal plains.

The Palaeozoic geosynclinal formations include the Kangaroo Hills Formation (south-west corner of the Ingham sheet area), the Ewan Metamorphics (small segment on the southern border of the Ingham sheet), the Barron River Metamorphics (Cairns and Innisfail sheet areas), and, probably, the Barnard Metamorphics (some of the islands and coastal stretches of the Innisfail sheet).

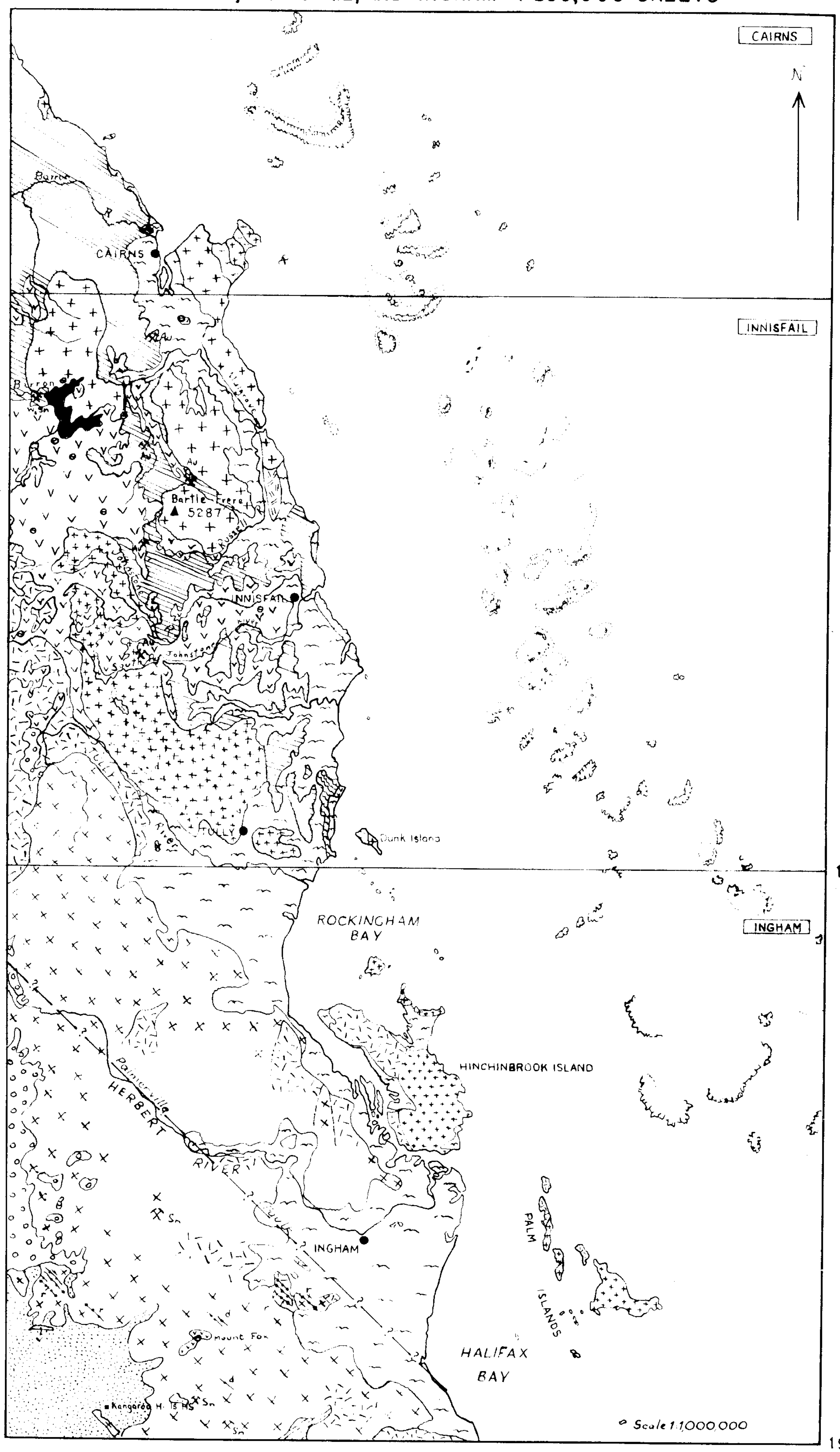
Lithology and bedding characteristics of the Kangaroo Hills Formation show it to be a geocynclinal flysch deposit, of unknown, but undoubtedly considerable, thickness. The formation is, like the others, tightly folded and extensively faulted.

The Ewan Metamorphics are considered by the Geological Survey of Queensland to be the metamorphic equivalents of the Kangaroo Hills Formation. It is reported that fossils found in the Ewan Metamorphics indicate an (Upper?) Silurian age.

The Barron River Metamorphics crop out in the Cairns and Innisfail sheet areas. There is little doubt that they are, in the Cairns - Mossman area at least, the low-grade metamorphic equivalent of the Hodgkinson Formation, and are thus of Middle to Upper Devonian age: but farther south they may include the equivalents of other Palaeozoic formations. The lithology is similar (if metamorphic appearance is overlooked), but fossil evidence is lacking. The regional strike is north-west to north-north-west.

The Barnard Metamorphics, as defined by Jones and Jones in 1956, crop out on some of the islands and on some coastal stretches between Innisfail and Cardwell. Jones and Jones considered them to be Archaen, but field work in the past few months suggests that they are intergrading with the Barron River

GEOLOGICAL SKETCH MAP OF THE CAIRNS, INNISFAIL, AND INGHAM 1:250,000 SHEETS



REFERENCE

CAINOZOIC

- Recent — Alluvium, coastal swamps, old beach sands.
- Pliocene-Pleistocene — Olivine basalt, pyroclastics, basal clay, shale, sandstone.
- Miocene? — Laterite, lateritic soil, billy.

PALAEOZOIC

Carboniferous - Permian

- Granites and massive porphyries, undifferentiated. (Ingham sheet only)
- Mareeba Granite: grey biotite granite, in places with muscovite or tourmaline.
- Biotite and hornblende granites to granodiorites of different composition, grain size, texture, colour.
- Pink, mafic-poor, generally coarse-grained biotite granite, and subordinate grey biotite-hornblende (grano) diorite.
- Massive quartz-feldspar porphyry and flow-banded rhyolite.

Undifferentiated lower to middle Palaeozoic.

- "Graham Range Amphibolite": plagioclase amphibolite, possibly member of the Barron River Metamorphics.
- Barron River Metamorphics: low-grade phyllite, slate, quartzite, greywacke, chert, greenschist, rare marble and talc schist.
- Barnard Metamorphics: mica schist, gneiss, migmatite.

Upper Silurian-Lower Devonian

- Kangaroo Hills Formation: feldspathic greywacke, siltstone, shale, slate.

(Upper?) Silurian

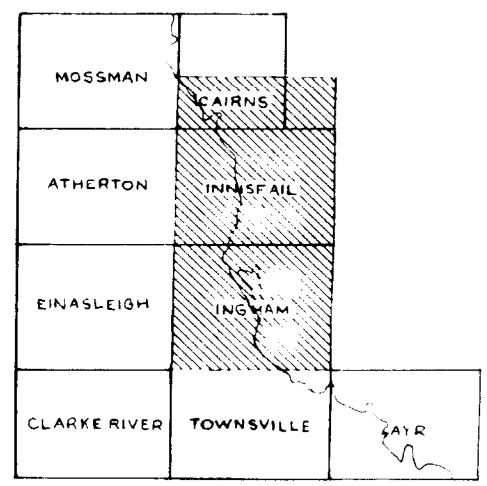
- Ewan Metamorphics: amphibolite, gneiss, schist, marble.

dyke r: rhyolite and other acid rocks; d: dolerite

volcanic vent or group of vents.

mine or group of workings. Au = gold, Sn = tin, W = tungsten

fault



Index to adjoining sheets.

STRATIGRAPHY, CAIRNS - INNISFAIL - INGHAM AREA.

PERIOD	ROCK UNIT	LITHOLOGY	STRUCTURE AND TOPOGRAPHY	AGE	RELATIONSHIPS	ECONOMIC INTEREST	REMARKS
Quaternary	Alluvium	sand, soil, gravel	flat, horizontal; two or three terraces common in coastal plain	Recent, grading back into Tertiary	Unconformable veneer on olde r formations	Sugar cane; alluvial tin and gold.	Thickness probably less than 100 feet inland, over 100 feet in coastal plains.
	Coastal swamps	saltwater silts and muds	Low swamps with tidal channels	Recent	Estuarine and lagoonal deposits often behind fossil sandbars and spits.	-	-
	Beach sand	coarse and fine sand	flat, horizontal	Recent, possibly grading back into Pleistocene	stretches along the coast, locally for a few miles inland.	-	-
Tertiary	Atherton Basalt	olivine basalt, pyroclasts, locally underlain by shales, sandstone, clay, conglomerate	forms Atherton Tableland and flow remnants in coastal plains. Eruption centres preserved as conical hills, crater lakes, and pit craters.	Ranging from Pliocene to Recent.	Unconformably overlying all older rock units	Gold and tin in deep leads	Thickness ranging up to 1000 feet. Plant fossils in shales.
	Laterite	laterite, lateritic soil, billy; in places underlain by Tertiary sandstone, conglomerate, grit, and clay (fresh water deposits)	forms Lucy Tableland and scattered cap remnants, and other less defined patches	Miocene?	Cover on granites and porphyries in Ingham sheet area.	Alluvial tin in Tertiary wash.	Generally about 50 feet thick.
Carboniferous - Permian	Mareeba Granite	Grey, medium-grained biotite granite ± muscovite, tourmaline.	forms main mountain masses in Cairns and Innisfail sheet areas	Carboniferous to Permian	Intrudes Palaeozoic Formations, and is overlain by basalt	Rssponsible for gold, tin, tungsten, molybdenum mineralization.	Locally gneissic and foliated.
	(Tully River Complex)	wide variety of biotite and hornblende granites to diorites	Tableland area and mountains west of Tully.	" "	" " Intruded by dolerite dykes.	Gold, tin.	Possibly part of Herbert River batholith.
	-	Pink, mafic-poor, coarse and fine-grained biotite granite and microgranite; subordinate biotite-hornblende granodiorite.	forms the mountains and tablelands on Ingham sheet.	" "	" " Intruded by acid and basic dykes.	Gold, tin, some lead, copper, tungsten.	Relationship with porphyries uncertain.
Lower to Middle Palaeozoic	(Graham Range Amphibolite)	low-grade plagioclase amphibolite, lineated	forms the Graham Range, east of Babinda.	Pre-carboniferous, probably middle Palaeozoic	Possibly a member of Barron River Metamorphics. Intruded by granite	-	-
	Barron River Metamorphics	low-grade phyllite, schist, slate, quartzitic greywacke, chert, greenschist; rare marble and talc schist.	Tightly folded and sheared.	Middle to Lower Palaeozoic?	Low-grade metamorphic equivalents of geosynclinal formations further west. Intruded by granite, overlain by basalt.	(iron, talc, limestone, manganese)	-
	Barnard Metamorphics	Mica schist, gneiss, migmatite. Locally contains kyanite, sillimanite, andalusite, cordierite.	" "	Lower to Middle Palaeozoic ?	Have regarded as higher grade metamorphic equivalent of geosynclinal formations further west.	-	Considered Archaeic by Jones & Jones.
Upper Silurian - Lower Devonian.	Kangaroo Hills Formation	Feldspathic, greywacke, shale, slate, siltstone; graded bedding and sole markings common.	Tightly folded and faulted.	Upper Silurian - Lower Devonian ?	Intruded by granite, acid and basic dykes; overlain by basalt.	-	-
(Upper?) Silurian.	Ewan Metamorphics	Hornfels, amphibolite, mica schist, gneiss.	Forms roof pendant in granite. Strongly folded along NE - SW axes.	(Upper?) Silurian	Intruded by granite and acid dykes. Possibly metamorphic equivalent of Kangaroo Hills Formation.	-	Reported fossiliferous.

Metamorphics, and are more probably the higher-grade metamorphic equivalents of Barron River Metamorphics, migmatized in places. The contorted and crumpled phyllites and schists in the Flying Fish Point - Etty Bay - Mourilyan Harbour area, included by Jones and Jones in the Barnard Metamorphics, are now grouped with the Barron River Metamorphics, and their (Jones and Jones) impression of higher-grade metamorphism is in fact due to intense deformation along closely-spaced dislocation zones, superimposed upon the earlier, regional shearing and schistosity.

These geosynclinal formations were folded and faulted during orogenesis - probably during the Carboniferous. Evidence exists for more than one phase of deformation, and it is here assumed that the Barnard Metamorphics were migmatized during this period. After the paroxysmal phase of deformation, the formations were intruded by Upper Palaeozoic granites and porphyries and by acid and basic dykes and dyke swarms.

A major structure that deserves special mention here is the Palmerville Fault, a fundamental feature which has now been mapped from Princess Charlotte Bay through Almaden to Townsville and which may continue farther south. In the Ingham Sheet area this fault is evident on photomosaics as a strong lineament running along the Herbert River gorge and to the coastline at Halifax Bay. Movements along the fault have occurred several times since the Silurian.

An attempt was made in the field to distinguish between the various types of granite, and to correlate them with granite types previously described in surrounding areas: Mareeba Granite, Herbert River Granite, and Elizabeth Creek Granite. This could not be accomplished in the time available and we have, moreover, reached the conclusion that they probably overlap considerably in time of emplacement. There is possibly a tendency for the intrusions to become younger from south to north. Broadly speaking the generalized distribution of the various types of granite is as follows:

In the southern regions the most common granite is pink, leucocratic, poor in mafics (biotite), generally coarse-grained but with micro-granitic phases. Grey biotite-hornblende granodiorite is subordinate.

In the northern parts the common variety is the grey, medium-grained biotite granite, usually containing some muscovite and tourmaline (Mareeba Granite), grading in a few places into a tourmaline granite.

Between the northern and southern regions, a highly varied granite complex in the Tully River - Cochable Creek area displays a wide range of granites to granodiorites and diorites, varying in composition, grain size, colour, and texture. Both biotite and hornblende are present as mafic constituents. Contamination and, perhaps, hybridization seem to have taken place.

The relationships between the granites and the massive quartz-feldspar porphyries have not been established with certainty yet, and, moreover, there is again the possibility of overlap in times of emplacement. On the islands the granite appears to intrude the porphyries. Assuming that most of the acid dyke swarms are genetically related to the massive volcanic porphyries, it seems that the pink, mafic-poor granites in the south may be older, the other granites younger, than the porphyries.

Ages for the porphyries and granitehave been accorded tentatively by comparison with igneous units in surrounding areas: samples are to be collected for age determination.

Some of the granites, particularly between Gordonvale and Babinda, are gneissic or foliated, owing to shearing during and after crystallization. It can also be shown that the large feldspar phenocrysts common in many parts of the Mareeba Granite are a late-stage product of crystallization or, more probably, of metasomatism (and hence are actually porphyroblasts). It follows that periods of deformation and the formation of granite overlapped each other.

The Mesozoic and part of the Cainozoic was mainly a period of levelling and probably, in this part of North Queensland, of non-deposition. During the Lower Tertiary the area was elevated, valleys were filled with clays, sands and conglomerate, soon followed by extrusions of basalt and deposition of pyroclastic rocks, which blanketed the uplifted plateau and ran down the valleys of the Mulgrave, Russell, and Johnstone Rivers to the coast. About 50 eruption points were recognized during the 1962 field season, many of them new discoveries, and judging from their morphology, the volcanic activity may have extended from Pliocene to Pleistocene and even Recent.

In Recent times the coastal plains were formed by alluviation of estuaries and lagoons.

Economic Geology.

The upper Palaeozoic granites introduced tin, gold, tungsten, molybdenum, silver-lead, and copper; but mining never reached the scale of that in the surrounding Herberton, Chillagoe, and Hodgkinson mineral fields. Other minerals in the area include iron, manganese, limestone, talc, and clay; these are generally not of sufficient grade or quantity to allow mining.

The principal metals mined were gold and tin, from lodes as well as from alluvial deposits. Workings were concentrated mainly in the following fields: Mount Peter (gold), Mulgrave River (gold), Russel River (gold and tin), Jordan Creek and Johnston River (gold), Kangaroo Hills (tin), and Garrawalt Creek (tin). Most of the production probably came from Mount Peter. Recent activity is restricted to some tin workings in the Garrawalt Creek, the Kangaroo Hills area, (where North Broken Hill Pty are testing the stannite/copper deposits at the Sardine mine), and to a few gold mining leases in the Russel River and Johnstone River areas. Production at present is negligible.

A little wolframite and molybdenite occurs in small lodes in an area some 5 miles north-east of Tolga, near the granite boundary; west of Kirrama station; and in places in the Kangaroo Hills area.

Unimportant silver-lead and copper occurrences are known from the Kangaroo Hills mineral field. Lead mineralization has also been reported from localities south and west of Ingham.

Iron and talc occur at Mourilyan Harbour, but are of low grade and purity. Reserves appear to be small.

Limestone leases were taken up on marble lenses at Mount Peter, and Little Mulgrave River, and at Christmas Creek 4 miles NE of Lamonts Hill, but production has been non-existent or negligible.

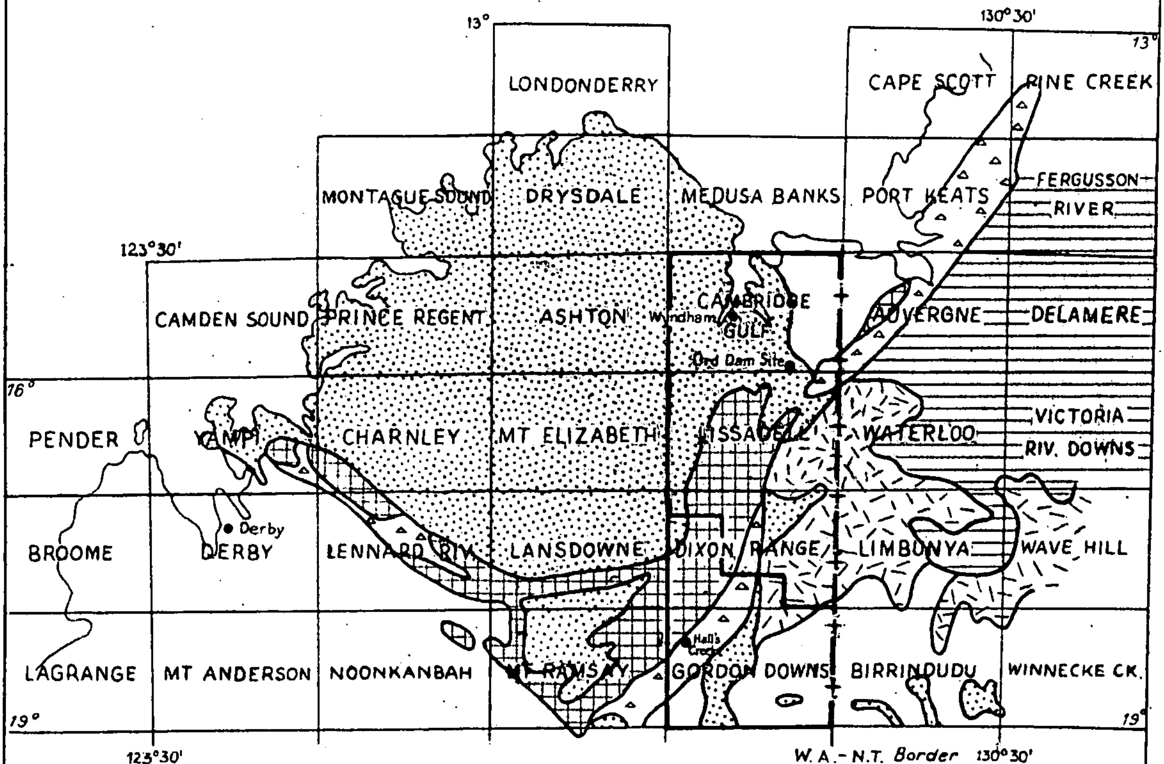
Manganese is known from various quartzose lodes between Cairns and Gordonvale; again, grade and reserves are not enough to allow mining.

Brick clay is being taken from the Clohesy River (Cairns sheet) and from the Silkwood (Innisfail sheet) areas.

Plate 15

KIMBERLEY AREA - WESTERN AUSTRALIA

Showing General Geology and 1 : 250 000 - Sheet areas.



Scale

100 50 0 100 200 Miles

Reference

CAMBRIAN		*Antrim Plateau Volcanics - includes Negri Group.*
UPPER PROTEROZOIC		*Victoria River Group*
		Undifferentiated
LOWER PROTEROZOIC		*Lamboo Complex*
		Halls Creek Metamorphics - includes Macadam Beds in north-east.

Area mapped 1962

Area proposed to be mapped 1963

Bureau of Mineral Resources Geology & Geophysics, August 1962.

W5

A.M.

WESTERN AUSTRALIA

KIMBERLEY GEOLOGICAL PARTY

Regional geological mapping of the Kimberley area, Western Australia, was begun this year by the Party. This party was composed of two Bureau geologists and two from the Geological Survey of Western Australia, and was in the field from the 12th May to the 12th October. The Gordon Downs 1:250,000 Sheet area and four 1-mile areas (Springvale, Turner, Alice Downs, and Luman) of the Dixon Range Sheet were mapped, (see Plates 1 and 15).

GENERAL GEOLOGY:

Precambrian and Cambrian rocks are exposed in the area. Up to 40,000 feet of Lower Proterozoic sediments, the Halls Creek Metamorphics, occupy a fifteen-mile wide and a fifty-mile long belt trending north-north-east in the north-western part of the Gordon Downs Sheet area and extending north into the central part of the Dixon Range Sheet area. Six units (which have not yet been formally named) were mapped within the Lower Prtoerozoic succession: their relationships are shown on Plate 16.

Unit 1, the basal unit, consists of amygdaloidal basalt, greywacke, mica schist, greenstone, and minor acid volcanics and occupies the core of the Saunders Creek Anticline, and the core of an anticline about five miles east of Saunders Creek. Unit 2 overlies Unit 1 with a probable umconformity. Unit 2 consists of conglomerate, crossbedded-quartz sandstone, and feldspathic sandstone; the sandstones contain thorianite in places and are radioactive. They were drilled by the Bureau during the course of a previous survey.

Units 3 and 4 are the most widespread rocks in the Halls Creek Metamorphics. Unit 3 crops out in the core of an anticlinorium, which pitches south-west near the Brockman gold mine. It consists of greywacke, slate and schist, with lenses of dolomite and calc-silicate rocks, and acid and basic volcanics. The dolomite and calc-silicate rocks form major beds around the north-western part of the intrusive Sophie Downs Granite.

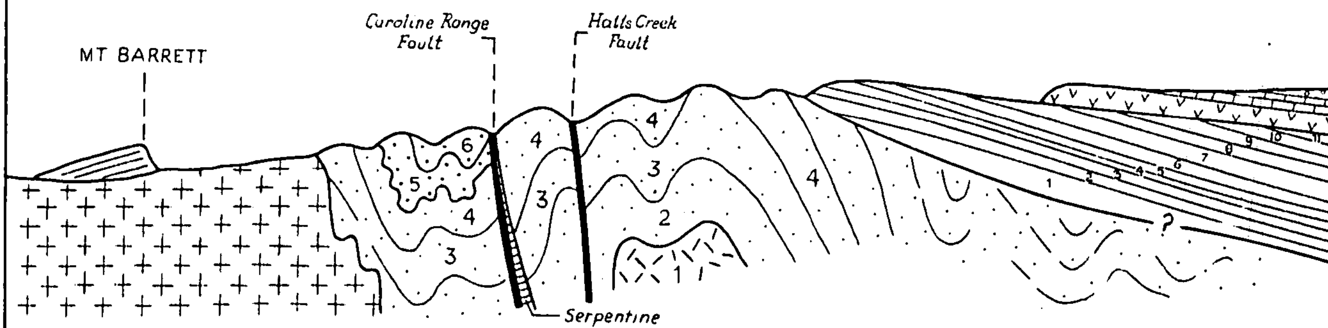
Unit 4 is another greywacke unit which conformably overlies Unit 3 and occupies the eastern and western flanks of the anticlinorium. Unit 4 differs from Unit 3 in containing more greywacke, and turbidity - current structures, and less acid and basic volcanics. Units 3 and 4 are faulted against each other by a major north-north-east trending fault - the Halls Creek Fault - which is about sixty miles long in the Gordon Downs Sheet, and continues farther north into the Dixon Range Sheet.

Units 5 and 6 are essentially shallow-water deposits - sandstone and conglomerate - which crop out between Old Halls Creek and New Halls Creek townships. Unit 5 unconformably overlies Unit 4, and Unit 6 probably unconformably overlies Unit 5.

The Lower Proterozoic succession is tightly folded into an anticlinorium, which trends and pitches south-west in most of the Sheet area, except north of the Saunders Creek/Sophie Downs Granite area, where it pitches north-east. Dips are generally steep and overturning is common; dips are steeper on the western limb of the anticlinorium than the east, where, east of Saunders Creek and south-west of Ruby Plains Homestead dips average 40°. The Lower Proterozoic succession is extensively faulted and one of the major north-easterly faults - the Caroline Range Fault has been intruded by serpentine.

Plate 16

GENERALIZED SECTION OF GORDON DOWNS 1:250000 SHEET AREA



Reference

? MIDDLE CAMBRIAN	(85')		*Sandstone*
	(50')		*Hedleys Limestone*
?LOWER CAMBRIAN	(1550')	V V V	*Antrim Plataou Volcanics - basalt*

〰 Unconformity 〰

UPPER PROTEROZOIC	(7,500')	11	*Purple shale, siltstone, calcareous sandstone*
		10	*Felspathic sandstone*
		9	*Shale, minor siltstone and sandstone*
		8	*Flaggy dolomite, minor chocolate shale*
		7	*Chocolate shale, siltstone*
		6	*Sandstone, shale*
		5	*Quartz sandstone, pebble conglomerate*
		4	*Shale, flaggy sandstone*
		3	*Flaggy dolomite, sandstone, conglomerate*
		2	*Flaggy dolomite*
		1	*Flaggy quartz sandstone; minor pebble conglomerate, dolomite*

〰 Unconformity 〰

LAMBOO COMPLEX (ARCHAEAN TO LOWER PROTEROZOIC)	*Rhyolite and fine-grained granite*
	Dolorite
	Coarse-grained porphyritic granite
	Coarse-grained gneissic granite
	Fine-medium grained gneissic granite
	Diorite
	Gabbro, ultrabasic rocks

Intrusive and metamorphic contact

"LOWER PROTEROZOIC (HALLS CK. METAMORPHICS)"		6	*Sandstone, boulder conglomerate, slate*
		5	*Quartz sandstone, basalt*
			〰 ?Unconformity 〰
	40,000'	4	*Greywacke, minor slate, sandstone, dolomite, acid to basic volcanics*
		3	*Greywacke, slate, dolomite, calc-silicate rocks, acid to basic volcanics*
		2	*Conglomerate, quartz sandstone, felspathic sandstone*
			〰 ? Unconformity 〰
		1	*Amygdaloidal basalt, greenstone schist*

Bureau of Mineral Resources Geology and Geophysics, November 1962

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Igneous rocks, which intrude the Lower Proterozoic rocks are the 'Sophie Downs Granite' in the northern part of the Gordon Downs Sheet and the 'Lamboo Complex', which occupies the north-eastern corner of the Gordon Downs Sheet area, and most of the western half of the Dixon Range Sheet area. Most of the metamorphic roof pendants in the Lamboo Complex are considered to belong to the Hall's Creek Metamorphics, but some may be basement rocks to the Lower Proterozoic succession. Six intrusions were recognised in the Lamboo Complex.

6. Rhyolite and fine-grained granite dykes
5. Dolerite dykes
4. Coarse-grained porphyritic (rounded feldspar phenocrysts) granite.
3. Coarse-grained gneissic granite.
2. Fine to medium-grained gneissic granite.
1. Gabbro and ultrabasic rocks.

The gabbro and ultrabasic rocks form two major layered lopoliths in the Rose's Bore region on the south-western part of the Dixon Range Sheet area: one, the 'McIntosh Lopolith' is exposed over an area about nine miles by three miles and is twelve to fifteen thousand feet thick. The lopolith consists of peridotite at the base, melagabbro, gabbro and leucogabbro at the top. The smaller lopolith - known as the 'Panton Lopolith' is exposed over an area about 5½ miles by 1½ miles and it is three to four thousand feet thick. Many small magnesite-chromite veins cut the lower part of the lopolith.

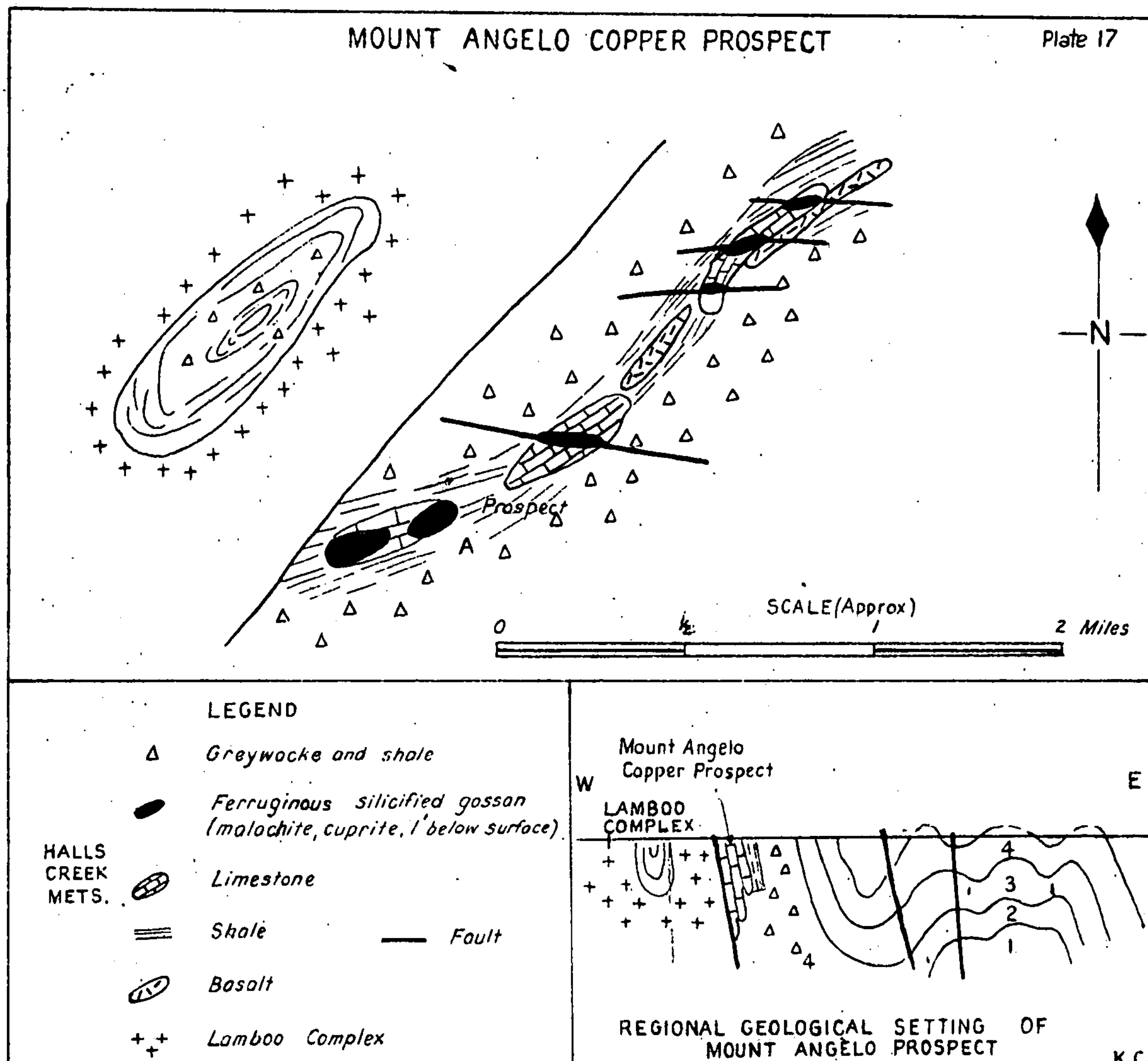
Hybrid dioritic rocks were found in the Lamboo Complex as the result of granitic rocks (2, 3, and 4) intruding the basic and ultrabasic rocks. (1)

Upper Proterozoic sediments unconformably overlie and are faulted against the Lower Proterozoic succession in the central part of the Gordon Downs and Dixon Range Sheets, and in the north-western part of the Dixon Range area. The sediments consist of shale, sandstone, dolomite, conglomerate and siltstone. A thickness of seven thousand five hundred feet of Upper Proterozoic sediments was measured in two sections; the lower section is 6 miles north of Flora Valley Homestead, and the upper section is east of Mount Timperley. Eleven units were recognised in these sections, the thickest of which was about four thousand feet of green and grey shale containing minor siltstone and sandstone. The Upper Proterozoic rocks in the north-western part of the Dixon Range Sheet area consist of two thousand feet of the lower part of the section only; they include rhyolite and welded tuff, thought by previous workers to be Lower Proterozoic in age.

About seventeen hundred feet of Cambrian rocks of the Hardmann Basin unconformably overlie the Upper Proterozoic succession in the eastern part of the Gordon Downs and Dixon Range Sheet areas. The rocks consist of the Antrim Plateau Volcanics, overlain with a probable unconformity, by the Hedleys Limestone and by sandstone.

Mineralization.

Gold. Both alluvial and lode gold have been mined in the area. The gold occurs in numerous quartz leaders, most of which are in the Lower Proterozoic greywacke units, 3 and 4, near the Old Halls Creek township. Some of the mineralization is undoubtedly related to the basic intrusions or flows in units 3 and 4 near the Halls Creek Fault.



Bureau of Mineral Resources Geology and Geophysics September 1962

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Copper. A recent discovery of copper at Mount Angelo about 30 miles south-west of the Halls Creek township, near the junction of the Mount Ramsay and Gordon Downs Sheet areas, appears promising. Plate 17 is a generalized sketch of the prospect.

Mineralization is confined to silicified and ferruginous limestone lenses interbedded with basalt and shale, which are in turn interbedded with greywacke. The largest area of mineralization is at Prospect 'A', and is about 150 feet long by 50 feet wide. It is being drilled by the Peko Company.

Other Mineralization and prospects.

Low-grade manganese occurs in minor quantities replacing limestone beds and filling faults. Chromite is contained in small magnesite veins, which intrude the ultra-basic and basic Panton Lopolith. Minor amounts of sulphide minerals (type unknown) were seen in the ultrabasic rocks and these rocks warrant a close geochemical study.

Thorianite occurs in the sandstone of the Lower Proterozoic Saunders Creek Formation (Unit 2); this was tested by the Bureau in 1960 and found to be of no economic value. The discovery of copper in the limestone beds in the Mount Angelo area suggests that the limestone, ferruginous (?pyritic) shales and carbonaceous shales in the Sophie Downs Granite area are worthy of testing and prospecting.

Hydrology.

During the regional mapping in the Kimberley area K. Morgan (W.A.G.S.) sited many water bores at the request of the local cattle-station owners; water samples were taken of all bores, some analytical field tests were carried out on these samples, and bore core details were obtained.

NEW SOUTH WALES

CAPTAIN'S FLAT FIELD PARTY

The Captains Flat Party completed field work on March 16th, and the rest of the year was spent in writing up the report and compiling the geological and geochemical maps. (The Party Leader W. Oldershaw was on extended sick leave or did not have full use of his right arm during much of this time).

The results of the mapping and geochemical work are summarized below:-

GENERAL GEOLOGY (Plate 18)

Structure

The overall structure at Captains Flat is a series of fault blocks - horsts and grabens including the Captains Flat Synclinorium, a complex synclinorium of Silurian shales and volcanic rocks occupying a graben between the Ballallaba Fault to the east and the Narongo fault to the west: the Rocky Peak Horst, composed of contorted Ordovician chlorite schists and greywackes intruded by a large granite mass: and the Harrisons Peak Horst-a complex north-plunging anticlinorium of Ordovician greywackes and shales intruded by a small granite mass.

Stratigraphic Correlation

The geological literature was studied in an attempt to correlate the stratigraphic column of the Captains Flat Area with surrounding areas (plate 19). The Bullongong Shale can be correlated with the upper Ordovician black slate found over large areas of N.S.W. (e.g. the Acton Shale). The Kohinoor Volcanics occur at Michelago and at Queanbeyan.

The Copper Creek Shale contains disseminated mineralisation, and small mineral deposits have been found along its outcrop southwards from Captains Flat to Anembo, Jerangle and Cowaree; and northwards from Captains Flat to Bungendore and Breadalbane - a total distance of 70 miles.

Geological History

The oldest rocks in the area are the Ordovician greywacke and slate exposed in the Rocky Peak and Harrisons Peak Horsts. These sediments were folded on north-trending axes at the end of the Ordovician (see plate 20). Sedimentation Commenced again in Wenlock times with the deposition of a quartzite conglomerate unconformably on the Ordovician. A period of intense volcanic activity, probably associated with structural instability, resulted in the deposition of three thousand feet of dacite tuffs and flows (the Kohinoor Volcanics) over the area. The overlying Carwoola beds, contain no volcanics, but volcanics reappear in the succeeding Captains Flat formation. These last two formations do not seem to be as fully represented elsewhere in New South Wales. At the end of the Silurian the strata were again folded on north-trending axes, faulted and overthrust, broken up into horsts and graben and intruded by granite.

Neighbouring granites have been dated by K/A methods at 390 million years.

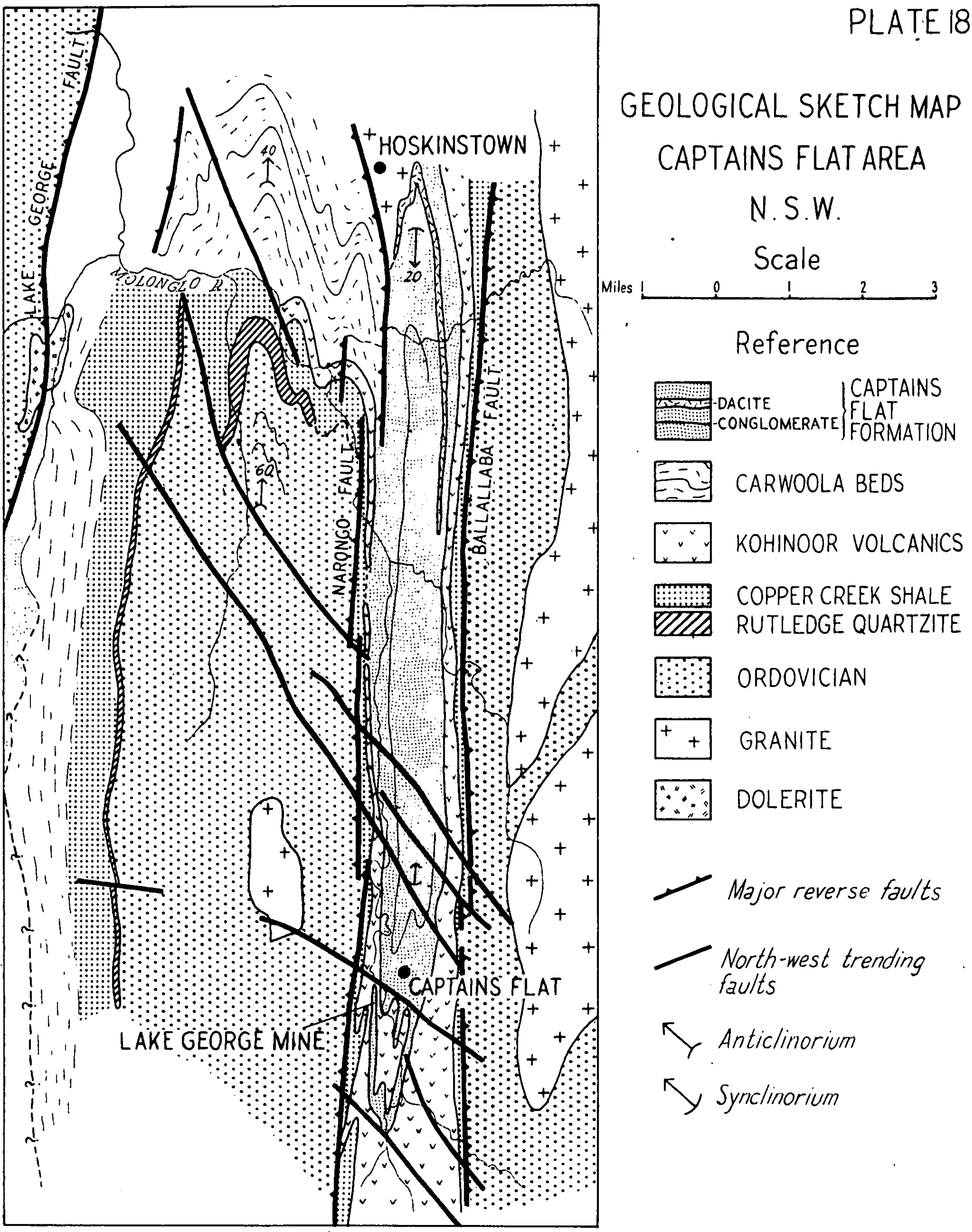
GEOCHEMISTRY

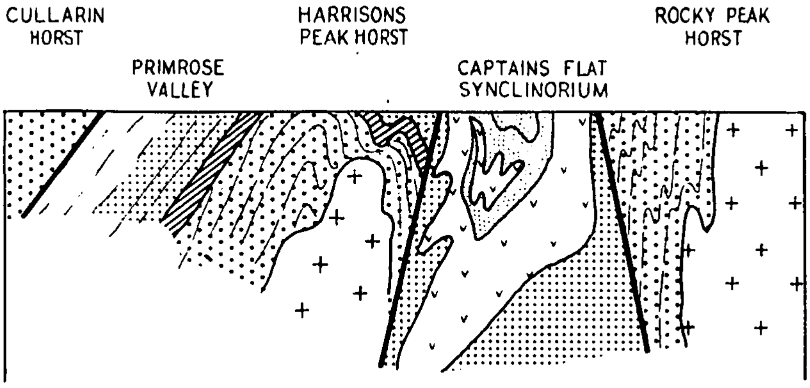
Six thousand soil samples were taken over the area shown in plate 21. Background for copper and zinc was found to be 20 p.p.m. One hundred and ten anomalies of over 100 p.p.m. zinc were found in the area and ninety-three of these occurred over the Copper Creek Shale. Four are recommended for further investigation. Of these the most impressive is the Bollard Prospect which was originally located by Lake George Mines. It contains values ranging up to 5,000 p.p.m. Zn. and occurs in contorted quartzites and shales containing disseminated mineralisation. Four holes were drilled in the northern end of the anomaly but the main part has not been tested thoroughly. Other anomalies which warrant further work are the Foxlow Gossans which consist of small gossans around a mineralised spring containing 10 p.p.m. Zn (water sample). The adjacent soils contain 100 p.p.m. Cu.; Roaches Gossans which occur in contorted quartzites and shales and from which 300 p.p.m. Cu. was obtained from overlying soil samples; and Forster's Gossan occuring in sheared Kohinoor Volcanics four hundred yards south-west of Keatings Orebody. The surrounding soil samples contain up to 100 p.p.m. Zn.

This information was given to Lake George Mines but the company had already decided to abandon any further prospecting and no testing was carried out. It is intended to review the anomalies when further mapping and geochemical sampling has been carried out in the Canberra 1:250,000 Sheet area.

PLATE 18

GEOLOGICAL SKETCH MAP CAPTAINS FLAT AREA N.S.W.





DIAGRAMMATIC CROSS-SECTION

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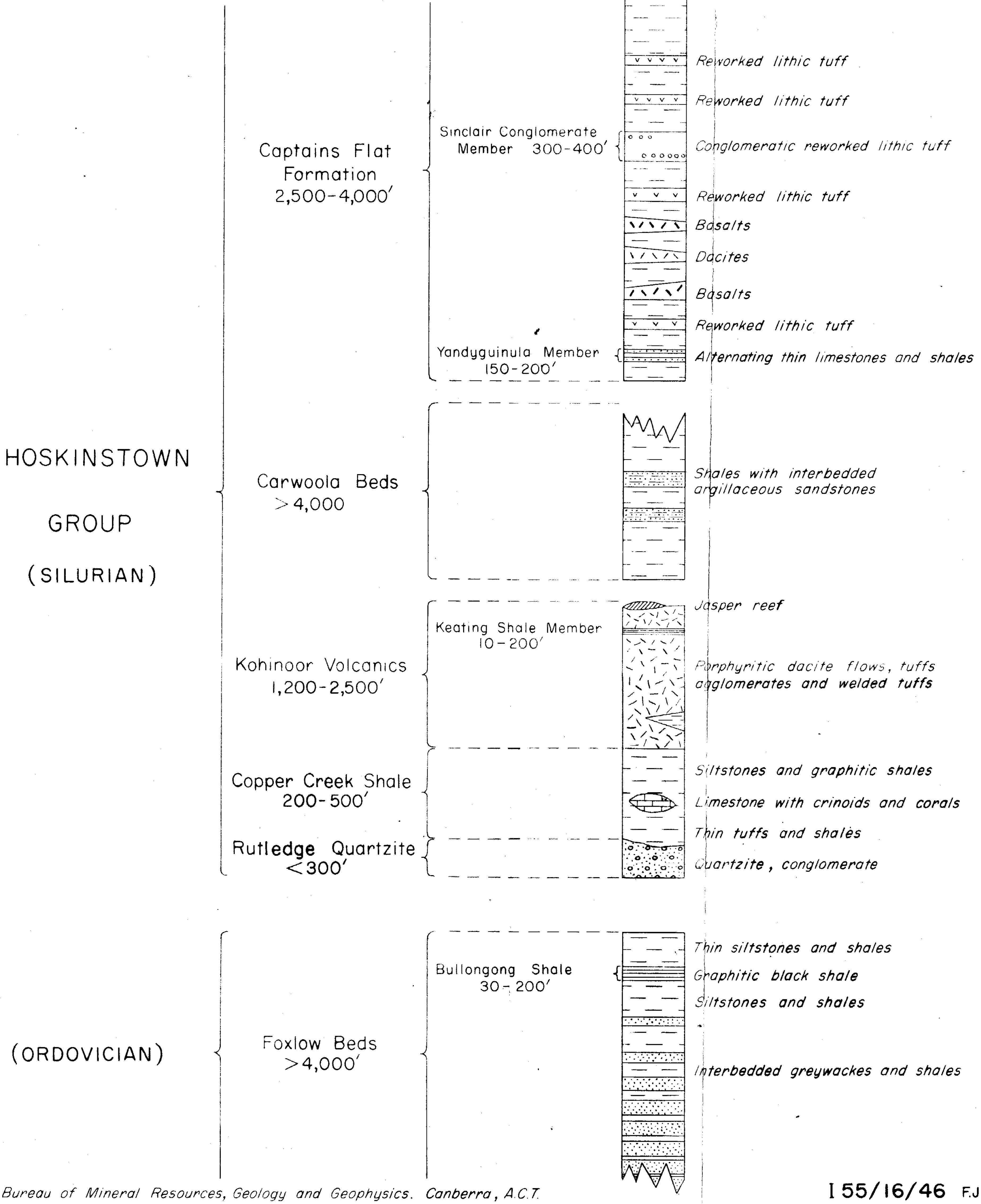
PLATE 19.

STRATIGRAPHIC SUCCESSION IN THE CAPTAINS FLAT AREA



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STRUCTURAL DEVELOPMENT OF THE CAPTAINS FLAT AREA

PLATE 20

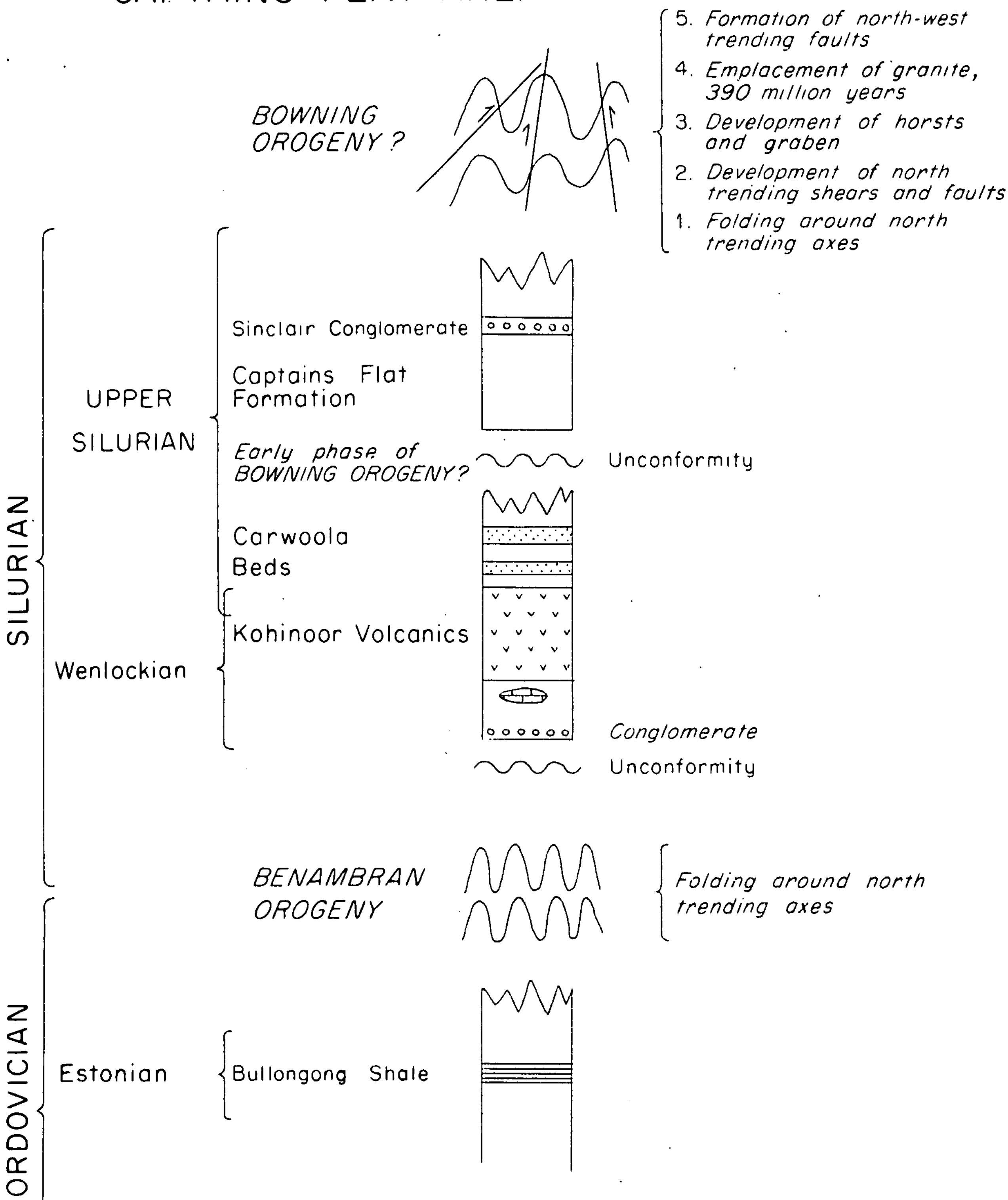

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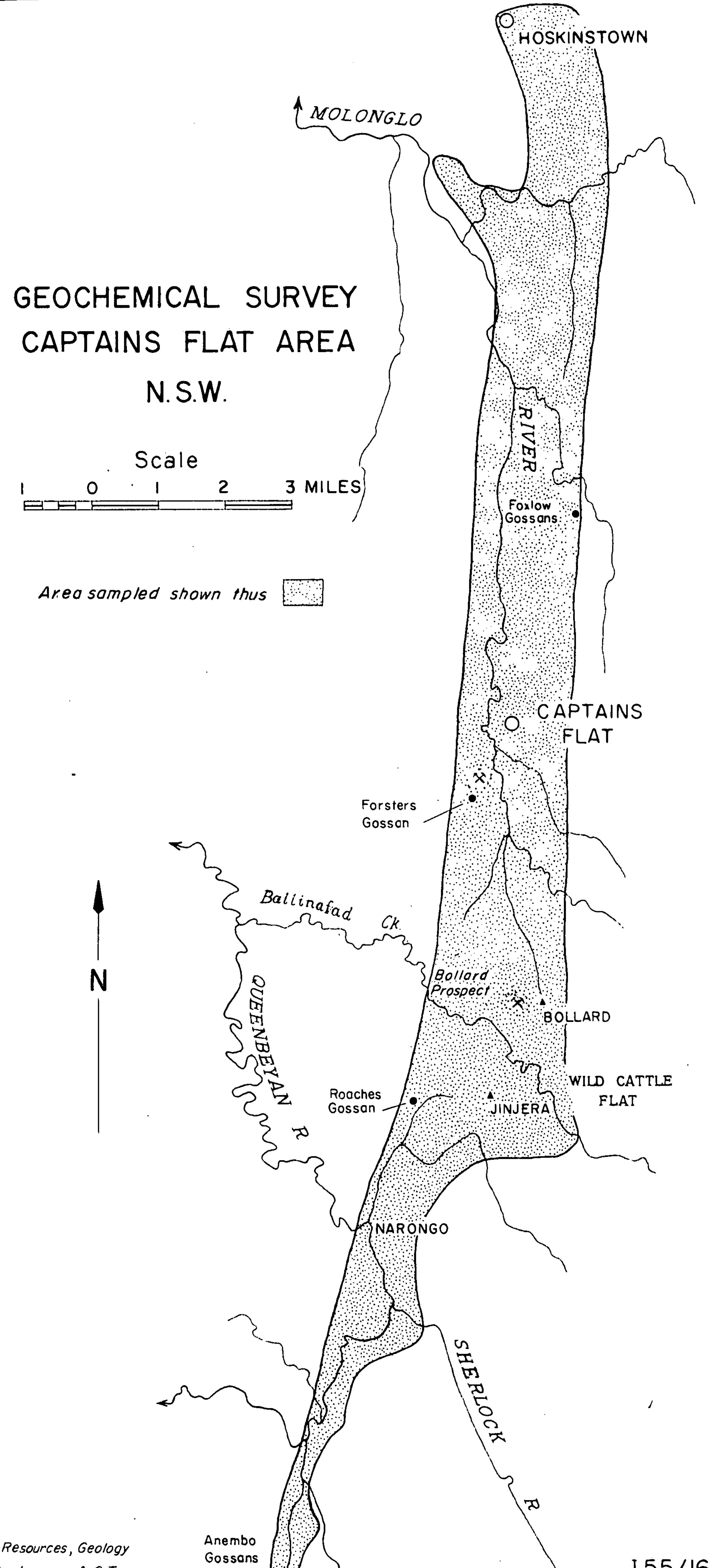
PLATE 21.



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NEW GUINEA

WESTERN HIGHLANDS PARTY.

The Western Highlands Party was in the field from 1st July to 19th October 1962 and mapped an area of about 900 square miles of very rugged country between the Jimi and Lower Ramu Rivers north-west of Mount Wilhelm (see Plate). This mapping joined with previous mapping to the east, south, and to the north-west. A large area of basic and ultrabasic rocks was suspected from previous reconnaissances between Bundi and the Lower Simbai River, and one of the objectives of the survey was to investigate the economic potential of these rocks.

It was also hoped to establish the age of the Bismarck Granodiorite which had previously been regarded as pre-Permian. No more evidence was obtained; the granodiorite could be as old as Palaeozoic or as young as Lower Tertiary.

GENERAL GEOLOGY

The Mesozoic sequence cropping out in the map area is the most complete known in New Guinea. The succession is as follows:

		Asai Beds (mostly Tertiary)	phyllite, siltstone
CRETACEOUS	Upper	Kumbruf Volcanics	basic marine volcanics
	Middle	Genjinji Beds	shale, siltstone greywacke
	Lower	Kondaku tuff	tuffaceous greywacke basaltic agglomerate.
JURASSIC	Upper	Maril Shale	shale
		Mongum Volcanics	basic marine volcanics
	?Middle	Mami Greywacke	
---UNCONFORMITY---			
		Herbert Beds	Feldspathic sst. (?tuff) red siltstone
TRIASSIC	?Upper	Jimi Greywacke	medium-grained greywacke

Tertiary rocks are represented by the Asai Beds which are Eocene to Miocene in age.

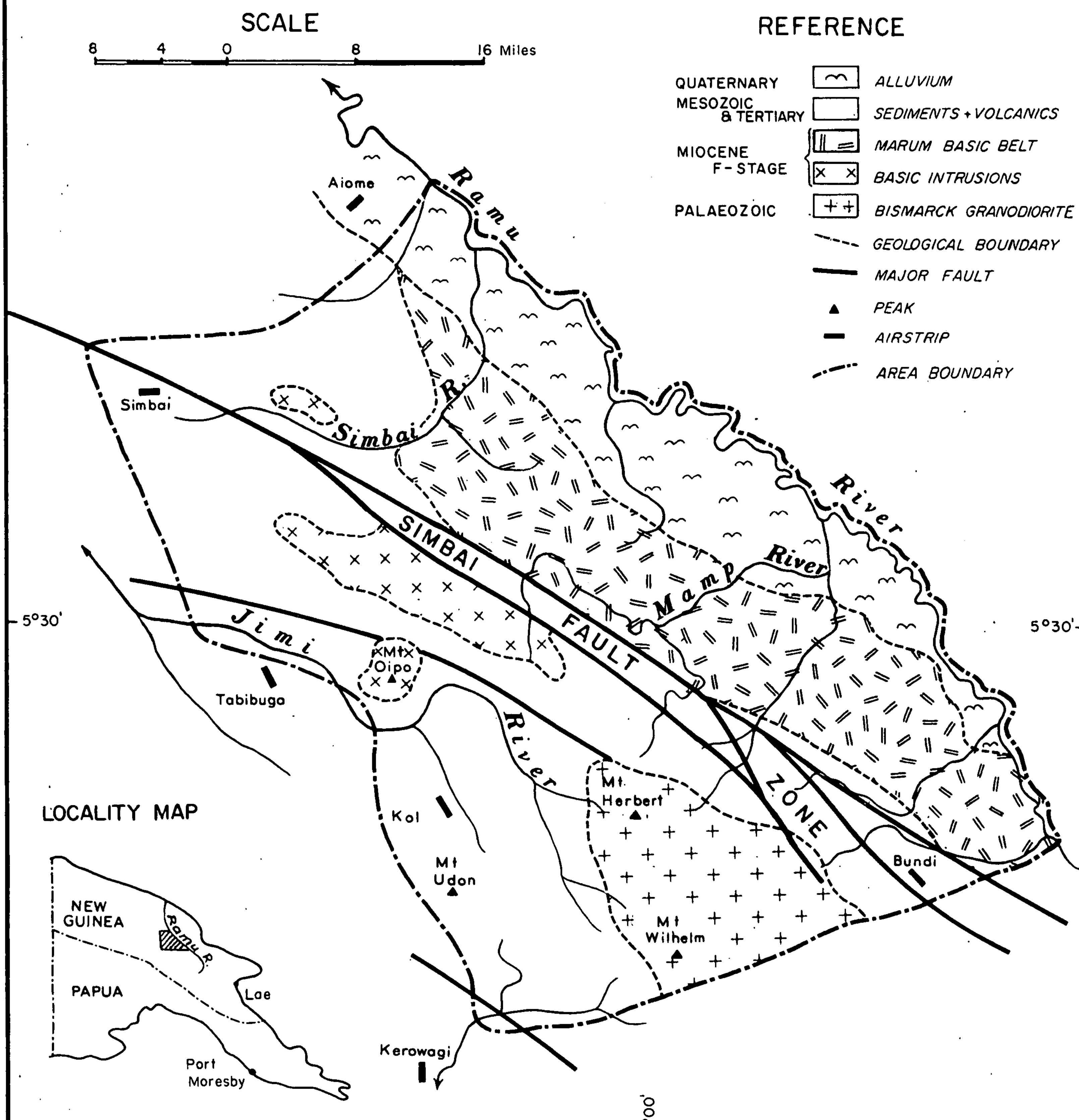
MARUM BASIC BELT

The Marum Basic Belt is 50 miles long by an average of 8 miles wide and lies between the Simbai Fault Zone and the Lower Ramu River (Plate 22). It consists mainly of banded gabbro with a mass of ultramafic rocks near the south-eastern end. Soils more than 30 feet thick have been developed on the ultramafic rocks and three auger holes were put down to test for nickel content. Analyses are not yet available.

PLATE 22

GEOLOGICAL SKETCH MAP

WESTERN BISMARCK RANGE T.N.G.



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Rocks of the basic belt intrude the Asai Beds and they were probably emplaced in the Miocene f-stage.

SIMBAI FAULT ZONE

The major structure in the area is the Simbai Fault Zone, which was traced for 70 miles from Simbai Patrol Post south-eastwards to the Ramu River. The zone averages about four miles wide, consists of many anastamosing faults marked by zones of shearing up to ¼ mile wide. Movement on the fault is predominantly transcurrent.

ECONOMIC GEOLOGY

Minor copper mineralisation was found at several scattered localities. Of these, only one, about 12 miles north-west of Bundi, is considered worthy of further investigation.

Sediments of all the larger streams and tributaries were sampled but analyses are not yet available. Areas of known mineralisation were sampled more closely to test the method as a means of finding orebodies in the conditions of rapid runoff found in most of the Highlands of New Guinea.