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NOTES ON A FIELD TRIP TO THE NORTHERN TERRITORY, 1965

by

P.R. Dunn

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CONTENTS

SUMMARY

These notes set down the results of a visit - July 27 to August 25th 1965 - to The Granites - Victoria River Region to obtain background knowledge to assist in planning future geological investigations. Some comments are made on the Ashburton Range area, the Katherine - Darwin region and a copper deposit at Mount Skinner.

INTRODUCTION

Between July 27th and August 25th I visited the Northern Territory and toured through The Granites - Tanami, Mount Skinner, Ashburton Range, Victoria River and Katherine - Darwin regions.

The main purpose of the trip was to obtain a background knowledge of the areas as a guide to the planning of future field work. It was also hoped to obtain information which might help in the compilation of a geological map of the Northern Territory.

On returning to Canberra sketch maps of The Granites - Tanami and Victoria River areas were compiled at 1:1,000,000 scale using information from previous investigations and from the author's observations in the field.

THE GRANITES - TANAMI AREA

As a single regional mapping project The Granites - Tanami area is envisaged as including the following 1:250,000 Sheet areas. BIRRINDUDU (N.T.), TANAMI (N.T.) and THE GRANITES (N.T.), and parts of BILLILUNA (W.A.), LUCAS (W.A.) and STANSMORE (W.A.). BILLILUNA, LUCAS and STANSMORE were previously mapped as part of the Canning Basin project but very little time had been spent on the Precambrian rocks which cover a large part of the Sheet areas.

Access to the area is from Alice Springs via Yuendemu, from Katherine or Dunmara via Hooker Creek, or from Halls Creek. At the time of the tour (August, 1965) the track from Yuendemu to The Granites was in very good condition - particularly to a point 45 miles south-east of The Granites where a new (1963) beef road left the main track and passed through Mongrel Downs Station and Balgo Hill Mission before joining the Canning Stock Route at Billiluna. The road from The Granites to Tanami and thence to Hooker Creek Settlement had been recently (1964) graded and was in a reasonable condition except for some wash-outs near the Wade Range and Mount Winnecke. The road fron Tanami to Gordon Downs Homestead was overgrown but passable to 4-wheel drive vehicles. At the time of writing there is news of a new track from the Mongrel Downs - Billiluna road at the Northern Territory border, south to Lake White and then east to Point Moody; from Point Moody a track goes north to Balgo Hill Mission - these are bulldozed roads which give access to the oil-drilling activities at Point Moody on the Stansmore Sheet.

There are no permanent creeks in the area but a number of permanent rockholes and springs provide some natural surface water. However a rockhole visited in the Gardiner Range and Coomarie Spring north of Tanami were of little use for drinking water. Government bores at The Granites and Tanami provide abundant drinkable water. New bores have been drilled along the Mongrel Downs - Billiluna stock-route every 15 to 20 miles - some are too salty for general use but several are reported to produce excellent drinking water. In 1964 three bores were drilled on Supplejack Downs Station of which only one at the Homestead, is at present equipped with a pump. Other bores in the project area are on Sturt Creek and Birrindudu Stations, and just outside the project area at Billiluna Station, Balgo Hill Mission, Hooker Creek Settlement, and at the projected oil-drilling site at Point Moody.

Movement off the tracks is very slow; most of the areas between rock outcrops are sand and spinifex-covered. Clark and Blockley (1961) quote a petrol consumption of 5 m.p.g. for a land-rover working off the tracks in the Northern Territory areas; spinifex seed clogs the radiators and causes boiling which may use up to 5 gallons of water per day. Casey and Wells (1956) have described conditions for travelling in the West Australian areas where the presence of sand dunes is more common but do not seem to have been greatly worried by loss of water through boiling; they say that travelling over granite areas is good but that most other areas with a Precambrian base have a short thick acacia scrub cover.

Previous Investigations

Casey and Wells (1960) give a comprehensive account of previous investigations in the West Australian portion of the region some of which also involved the Northern Territory portion (i.e. Davidson (1905), Talbot (1910), Warburton (1875), and Traves (1955)). H.Y.L. Brown visited the Tanami Field travelling from the Victoria River area in 1909 (Brown, 1909). Brown was followed by Gee (1911) and Jensen (1915). Hossfeld (1940) mapped both The Granites and Tanami Goldfields. Little regional work had been done in the Northern Territory portion until Traves (1955) published his map of the Ord-Victoria region which included the Birrindudu Sheet. Phillips (1961) working for Consolidated Zinc Pty. Ltd. mapped areas of THE GRANITES and TANAMI. Geological sketch maps of THE GRANITES and TANAMI were prepared by K. Phillips for inclusion in a report by A.G. Spence on an aeromagnetic survey of the two Sheet areas carried out in 1962 (Spence, 1964). A.B. Clark and J.G. Blockley (1960) mapped portions of the western part of THE GRANITES and TANAMI during an investigation for uranium following the discovery of the Killi Killi Hiss prospect.

Geology

The geology on Plate 1 is compiled from the published BILLILUNA, STANSMORE, and LUCAS Sheets together with information from Traves (1955), Phillips (1961), Clark and Blockley (1960), Spence (1964) and several observations by the author.

The area consists of steeply dipping, low-grade metamorphics, mainly shale and greywacke, intruded by granite and basic rocks and unconformably overlain by gently folded quartz sandstone and conglomerate with minor siltstone and dolomitic sediments. In the west this sequence is unconformably overlain by Palaeozoic and Mesozoic sediments of the Canning Basin. Outcrops are scattered through a sand-plain which occupies about 75% of the surface area of the sheets. Tertiary laterite and kunker deposits are also scattered throughout the area. The low-grade metamorphics are tentatively regarded as Lower Proterozoic. They include hematite shale, micaceous shale, silty shale, quartz greywacke, sandstone, siltstone and tuffaceous sandstone. They also include quartz hematite ironstone bodies and have been extensively intruded by quartz veins. A drill-hole at Black Hills intersected carbonaceous pyritic shale below an ironstone outcrop. The Lower Proterozoic rocks are steeply-dipping but do not have as complex a structure as the Warramunga or Halls Creek sequence. Information available to date does not show any single distinct structural trend in the Lower Proterozoic but it is generally northerly. Small areas of granite-gneiss and garnet mica schist have been noted by Phillips, Spence and Clark and Blockley; they may represent Archaean basement. A complex of basic rocks and metamorphosed calcareous rocks have been noted by Phillips in the Black Hills and just south of Officer Hill. He also recognises basic sills or lava flows within the Lower Proterozoic sediments.

Granites are common throughout the Lower Proterozoic areas. Casey and Wells have mapped the Lewis Granite in W.A. and mention extensive areas of granite soil apart from the areas mapped as granite. Areas with granite soil photopattern in the Northern Territory have been shown on the map as granite with a question mark.

The sandstone and conglomerate which unconformably overlies the Lower Proterozoic is Adelaidean and/or Carpentarian. Casey and Wells (1960) have subdivided these rocks in W. A into three groups of beds but have been unable to relate them to each other; their Kearney Beds appear to be equivalent to Smith's (1963) Albert Edward Group and are therefore Adelaidean. The Gardiner Beds which feature a massive boulder conglomerate at their base, appear to be equivalent to Traves' (1955) Winnecke Beds which he claims are intruded by the Winnecke Granophyre. A porphyritic rhyolite which overlies the granophyre and, apparently, underlies the Winnecke Beds is similar to the Whitewater and Edith River Volcanics and suggests that the Winnecke Beds (and hence possibly some of the Gardiner Beds) are equivalents of the Kimberley or Katherine River Groups. Phillips (1961) also records porphyritic rhyolite at the base of the sandstone in the Black Peak area south of Tanami. The Carpentarian-Adelaidean rocks are almost flat-lying in the Gardiner Range, but, particularly where they occur in areas of predominant Lower Proterozoic rocks, they are also found in steep-sided structures with dips of 30° and over. They vary considerably in thickness and may exceed 5000 feet in places.

Glauconite has been found in sandstone near the Black Hills (E. Milligan pers.comm.) and sampling of these rocks may produce material for age determinations.

Near Supplejack Downs I found amygdaloidal basic or intermediate volcanics. The eastern side of the outcrop was marked by a prominent quartz blow and on the western side Proterozoic sandstone appeared to be dipping shallowly off the volcanics. The volcanics may therefore be in sequence with the Carpentarian-Adelaidean rocks or represent an outlier of Antrim Plateau Volcanics. However, they did not weather in the form characteristic of the Antrim Plateau Volcanics.

Traves (1955) has mapped Antrim Plateau Volcanics and sediments of the Victoria River Group in the north of the Birrindudu Sheet. They are the southern-most exposures of rock-types in the Victoria River Basin.

Economic Geology

Gold was discovered at The Granites and Tanami by Davidson in 1900. Soon afterwards traces of gold were found in a number of Lower Proterozoic outcrops to the south and south-east of Tanami. Talbot (1910) also obtained gold values from the Lower Proterozoic rocks in Western Australia. Only The Granites and Tanami fields have produced gold in economic quantities. H.Y.L. Brown (1900), Gee (1911), and Hossfeld (1940) describe the Tanami field and Hossfeld (1940), Hall (1953) and Crohn (1961) describe The Granites field. At Tanami the gold occurs in two types of lode (Hossfeld, 1940): small lenticular quartz veins with enrichment of favourable beds nearby, and quartz-jasper hematite reefs. At The Granites Crohn (1961) also recognises two types of lode: in narrow quartz stringers which do not persist in depth and in a mineralized zone which consists largely of quartz and calcite veinlets and disseminated sulphides and extends down to at least 400 feet. Geopeko are at present (1965) interested in The Granites field.

New Consolidated Goldfields (Australasia) Pty. Ltd. found uranium mineralization in conglomerate at the base of the Gardiner Beds at Killi Killi Hills (Clark and Blockley, 2960) but were unable to prove any economic concentrations. Several airborne radiometric anomalies were indicated by the B.M.R. (Spence, 1964) on TANAMI near the base of the sandstones and are worthy of further investigation.

Between 1959 and 1961 Consolidated Zinc Pty. Ltd. investigated quartz-hematite lodes at Black Hills, Black Peak, Schist Hills, Mount Ptilotus and Officer Hill. They took geochemical samples across the lodes and eventually drilled one hole into the main lode at Black Hills to 400 feet. No further work has been carried out.

VICTORIA RIVER REGION

The Victoria River Region within AUVERGNE, DELAMERE, WATERLOO, VICTORIA RIVER DOWNS, LIMBUNYA and WAVE HILL. It also extends into part of PORT KEATS and FERGUSSON RIVER.

Despite its accessibility via the Victoria River and its settlement in the earliest days of Northern Territory pastoral history the Victoria River area has received scant attention from geologists. To date the area has produced no economic deposits of minerals.

Access to the area is obtained from Katherine on the Stuart Highway via the main road from Katherine to Wyndham; between Katherine and Willeroo this road is at present (1965) being sealed. Access is also possible along a new beef road from Dunmara on the Stuart Highway to Top Springs. A large part of the region is covered by a network of roads and tracks; however the Pinkerton Range area is penetrated by only one recently built four-wheel-drive track to Bullo River Homestead. North of the Victoria River the only track is from Coolibah Homestead to Bradshaw Homestead and north along the Angalarri Creek Valley.

Previous work

Early explorers (e.g. Stokes, Gregory) made cursory geological observations in the Victoria River area; H.Y.L. Brown (1895) carried out the first geological survey of the area. Later visits by Brown (1909), Jensen (1915) and Wade (1924) provided more information but it was not until 1950 that with the aid of aerial photographs a reasonable reconnaissance map of the area was produced (Traves, 1955). Laing and Allen (1956) and Harms (1959) have added some detail to knowledge of parts of the area and N.J. McKay in 1958 compiled maps of WAVE HILL and VICTORIA RIVER DOWNS incorporating all the information then available. Plate 2 is a modification of Traves' map incorporating information available to date (1965).

Geology

The oldest rocks in the Victoria River region crop out in the north-west corner. They are within the Halls Creek Mobile Zone and include Halls Creek Metamorphics, Lamboo Complex and Carpentarian rocks. The Carpentarian rocks appear to be mainly sandstone and may be equivalent to the Carr Boyd Group in the Lissadell area (Dunnet & Plumb, 1964).

A major fault separates the Halls Creek mobile zone from younger, gently folded Proterozoic sediments to the south-east. The younger sediments include dolomitic limestone, cherts, shale, siltstone and sandstone and possible glacigene sediments; they comprise the "Victoria River Group" as described by Harms (1959) after Traves (1955). Traves originally included the rocks in the Halls Creek Mobile Zone in his Victoria River Group. Harms suggested the rocks in the Mobile Zone were not in sequence with those to the south-east and confined the Victoria River Group to the rocks outside the Mobile Zone. Laing and Allen (1956) have subdivided the Victoria River Group and shown the presence of at least one widespread unconformity which will require the eventual redefinition of the Group; the name is therefore used here in inverted commas.

The lowest rocks in the "Victoria River Group" mapped by Laing and Allen consist essentially of carbonate sediments; they divided them into the Skull Creek Limestone and Timber Creek Formation which are considered to be lateral equivalents. The Skull Creek Limestone contains blocky and massive beds of dolomitic limestone commonly containing Collenia and bands and beds of chert; green and purple calcareous siltstone is a minor constituent. The Timber Creek Formation occurs to the west and south of the Skull Creek Limestone and consists of

purple siltstone and siliceous limestone with minor fine sandstone and chert. The boundary with the Skull Creek Limestone is along a distinct change in photo-pattern at which the siltstone in the limestone sequence exceeds about 10%. Siliceous limestone predominates near the top of the Timber Creek Formation. Both formations exceed 1,000 feet in thickness.

The Skull Creek Limestone is unconformably overlain by the Coolibah Formation, which consists mainly of green and red flaggy siltstone, and fine sandstone, commonly calcareous. The Coolibah Formation nowhere overlies the Timber Creek Formation; at the north end of the Sandford Gorge on the Wickham River the Jasper Gorge Sandstone is underlain by Coolibah Formation while at the southern end of the gorge the sandstone is underlain by Timber Creek Formation but between these two exposures no outcrop was seen which clarified the relationship of the two underlying formations. The Coolibah Formation is about 500 feet thick.

The Jasper Gorge Sandstone overlies or is interfingered with the top of the Coolibah Formation. The formation consists of massive, medium-grained, red quartz sandstone; parts of the sandstone are strongly jointed. The sandstone has a maximum thickness of about 200 feet in the Jasper Gorge area; north of the Victoria River the sandstone occurs in two bands each 25 feet to 50 feet thick separated by about 200 feet of Coolibah Formation. The Sandstone lenses similarly to the south-east of Victoria River Downs Homestead. Laing and Allen noted that the sandstone contained more feldspar to the south - the probable provenence area is in the south-west.

West of Timber Creek, along the valleys of the Angalarri and West Baines Rivers the Jasper Gorge Sandstone is conformably overlain by green, flaggy and fissile micaceous shale and siltstone of the Auvergne Shale. The Shale is not well exposed except in creek beds. It dips gently north-westwards across a valley about 16 miles wide and is probably of the order of 1,000 feet thick. Near the Victoria River the Auvergne Shale is apparently conformably overlain by the more resistant Pinkerton Beds. However in the Keep River Crossing near Newry Homestead a purple tuffaceous-looking rock is exposed topographically below the Pinkerton Beds: the rock is fine-grained and contains scattered boulders, some of gneiss and quartzite, with apparently facetted sides. The rock was deeply weathered and no sample was taken; it may be a tillite. Harms (1950) has recorded erratic boulders also of possible glacial origin 15 miles north-west of Limbunya Homestead.

The Pinkerton Beds form a prominent scarp up to 600 feet high on the north-western side of the Baines and Angalarri River valleys. The Beds consist of blocky fine to medium-grained sandstone, siltstone and limestone. No top to the Beds has been seen and they will probably be subdivided into 2 or more formations on more detailed mapping. The Beds are more than 1,000 feet thick and are the topmost unit in the "Victoria River Group".

Near Wave Hill the Jasper Gorge Sandstone is conformably overlain by siltstone, calcareous siltstone and limestone which McKay has referred to as Wave Hill Beds - they are probably equivalent to the Auvergne Shale and Pinkerton Beds in part at least.

The lithologies and relationships of the various units in the "Victoria River Group" tempt correlation with the sequence in the Osmond Range in the West Kimberley. The apparent correlations together with Randal's correlations from the Fitzmaurice River area are presented below.

Osmond Range, Kimberley region (Dow et al 1964)	Victoria River Region	Fitzmaurice River Area (Randal 1962)
Ranford Formation	Pinkerton Beds	Yambarra Beds
Fargoo and Moonlight Valley Tillites	Glacials?	
Helicopter Siltstone	Auvergne Shale	Angalarri Siltstone
Wade Creek Sandstone Mount John Shale Member	(Jasper Gorge Sandstone (Coolibah Formation	Palm Creek Beds
Bungle Bungle Dolomite	(Skull Creek Limestone (Timber Creek Formation	

On the track to Bullo River Homestead a purple conglomeratic sandstone unconformably overlies the Pinkerton Beds. The sandstone crops out as a number of monoliths scattered through a valley. On air photographs the monoliths appear to be remnants of a massive jointed sandstone which crops out on higher ground. The age of the sandstone is unknown but it overlies the Pinkerton Beds with an angular unconformity on an erosion surface approximating that on the Pinkerton Beds today. The sandstone may be Palaeozoic and equivalent to sediments in the Bonaparte Gulf Basin.

The Antrim Plateau Volcanics unconformably overlie the "Victoria River Group" in the south-west, south and east of the Victoria River Region. They occupy about one third of the total area of the region. Considering their extent the Antrim Plateau Volcanics have received little attention. The petrology of some occurrences in Western Australia have been described by Edwards and Clarke (1940) and Glover (1948, 1954) has described several specimens from near Limbunya and Wave Hill Homesteads in the Northern Territory. However the samples were only collected at random and no systematic study has been attempted.

The Palaeozoic sediments in the Victoria River Region are the subject of a separate project or projects being handled by the sedimentary section.

Economic Geology

No economic mineral deposits have yet been mined; the best prospects for economic mineral deposits in the region appear to be the possibility of syngenetic ores being present in the "Victoria River Group" sediments. Jensen (1915) reported the presence of galena "20 miles from the Wickham" which is probably in the Skull Creek Limestone or Timber Creek Formation. Harms (1959) reports malachite and magnesite in limestone between Coolibah and Bradshaw Homestead and I have seen possibly cupriferous green minerals in the Coolibah Formation east of the Victoria River.

The "Victoria River Group" may also contain phosphate and the Coolibah Formation may offer the best prospects.

The Antrim Plateau Volcanics contain minor deposits of native copper and copper minerals; crystal quartz, with some poor quality amethyst, agate and prehnite occur as fillings in amygdales and fissures. Lateritization of the volcanics may have produced concentrations of copper and the laterite on the volcanics is therefore worthy of investigation for the presence of any such deposits.

D.B. Dow (pers.comm.) noted the presence of barite in the limestone of the Negri Group in the eastern part of the Hardman Basin.

MOUNT SKINNER

Cupriferous shale occurs in the Central Mount Stuart Beds at Mount Skinner on ALCOOTA 115 miles N.N.E. of Alice Springs. Smith and Milligan (1964), Milligan (1964) have described the lithology of the Central Mount Stuart Beds which they consider to be of Upper Proterozoic (Adelaidean) age. At Mount Skinner over 500 feet of section is exposed; the dominant lithology is a medium-grained, flaggy, red-brown feldspathic, micaceous sandstone with mud-pellets; some beds appear to be dolomitic. The cupriferous shale occurs in two horizons, one near the bottom of the exposed section and the other a hundred feet or so higher up the section. Milligan (1964) states that the Central Mount Stuart Beds at Mount Skinner represent the upper part of the unit which is over 1,000 feet thick in nearby areas; the Beds unconformably overlie the Arunta Complex. Smith and Milligan (1964) suggest that the lower part of the Beds may be equivalent to the glacial beds which occur elsewhere in Central Australia.

Kennecott Corporation have bull-dozed costeans across the strike on the north-eastern flank of Mount Skinner and have exposed malachite-bearing shales at intervals over a strike-length of about 4 miles. The cupriferous material is only about 2 feet thick and dips into the hillside at about 5 degrees. This initial exploration is not particularly encouraging for the establishment of an ore-body at Mount Skinner. Both the thickness and grade (which I do not know but I assume is not particularly high) are not sufficient to warrant present development in this isolated location. However, the Central Mount Stuart Beds together with their possible stratigraphic equivalents, the Field River Beds and Grant Bluff Formation, crop out through a large area of eastern central Australia and may offer further prospects; a study of the mode of occurrence of the copper mineralization and the sedimentary environment of the Central Mount Stuart Beds at Mount Skinner would be an invaluable guide to further prospecting in this area and in similar situations elsewhere .

ASHBURTON RANGE AREA

Observations made in the Ashburton Range area will be incorporated in the report of the Helen Springs Party. One of the purposes of the visit to this area was to try to establish points in common between the Ashburton Range sequence and sequences in the Carpentaria area. No direct correlations could be made and possible correlations with either Roper Group or Tawallah Group sediments remain open.

KATHERINE-DARWIN REGION

Only two days were spent in the field in the Katherine-Darwin region, mainly for the purpose of taking photographs with C. Zawartko for inclusion in the Katherine-Darwin Bulletin.

The main activity in the areas visited was the re-opening of the Evelyn silver-lead mine. United Uranium N.L. had de-watered the old shaft and were open-cutting the area of oxidised mineralization near the surface. Most of the lead minerals had been mined before the turn of the century but some rich zinc mineralization occurs in a series of north-north-west trending shear zones in marble of the Golden Dyke Formation about half a mile east of the Cullen Granite. United Uranium N.L. is also investigating the market potential of marble from the mine for the manufacture of Terrazo and building stone.

Work in the South Alligator Valley uranium field has ceased and the camps at El Sherana and Rockhole are being looked after by a care-taker. Most of the open cuts are flooded and the access roads to most mines are becoming washed out.

RECOMMENDATIONS

Regional mapping requirements in the areas visited can be divided into the following projects

(1) Victoria River area
(2) Granites-Tanami area (N.T.-W.A.)
(3) Tennant Creek area
(4) Arunta Complex

(1) The Victoria River area project would involve the mapping of 6 1:250,000 Sheet areas plus reconnaissance of parts of two other 1:250,000 Sheets (Port Keats and Fergusson River). A small part of AUVERGNE has already been mapped by John Veevers party this year (1965) and the Sedimentary Section plans to map the small areas of Cambrian limestone on DELAMERE, VICTORIA RIVER DOWNS and WAVE HILL during the next year or two. The whole project would take about 2 years to map with 4 geologists or three years with two or three geologists. The first season's work should concentrate on mapping AUVERGNE and extending correlations on to PORT KEATS; with four geologists WATERLOO could also be attempted during the first year. The first year would require about 60 hours helicopter flying to give access to the rocks in the Halls Creek Mobile belt (i.e. north-west of the Pinkerton and Yambarran Ranges.) The subsequent work can be divided into two: DELAMERE, VICTORIA RIVER DOWNS and part of FERGUSSON RIVER; and WAVE HILL, LIMBUNYA and if necessary WATERLOO. These could be tackled on consecutive years by a small party or by two two-man parties in the same year - most time would need to be spent on the carbonate sequence below the Jasper Gorge Sandstone.
A petrological and trace element study of the Antrim Plateau Volcanics is a project, which could be carried out in conjunction with the regional mapping. The Antrim Plateau Volcanics are one of the most widespread occurrences of plateau basalts in the world and as such are worthy of investigation particularly with the current interest in the Upper Mantle Project. From an economic viewpoint the basalt is a possible source for metals which could have become concentrated in its extensive cover of laterite.
Note: Photo-scale compilations of the 6 main sheets are now available from National Mapping - two, WAVE HILL and AUVERGNE, have been published at 1:250,000 scale. PORT KEATS compilations are available from the Army.

(2) The Granites-Tanami project again involves six 1:250,000 Sheet areas. However there is only about 25% to 30% outcrop in most areas and the Western Australian Sheets are half Palaeozoic which has already been mapped. The whole project should only take two years - the first year with a 3 or 4-man party principally involving landrover traverses in the Northern Territory with about 60 hours helicopter. The second year to mainly involve a helicopter survey of the 3 Western Australian sheets (about 150 hours) with additional help from W.A.G.S. geologists. The Western Australian data may be presented at 1:500,000 scale only, to avoid bringing out a second edition of the maps already produced by Casey and Wells.

The Granites-Tanami project is quite distinct from the Victoria River project and if manpower is available they could be carried out at the same time as each other.

(3) Tennant Creek 1:250,000 Sheet area.

The Tennant Creek Sheet is the only unmapped 1:250,000 Sheet in that general area of the Northern Territory; now that most of the area of Warramunga sediments has been mapped at 1-mile scale it should only require a season's work for a two-man party to complete the mapping of the 1:250,000 Sheet - most time would be required to map the Hayward Creek 1-mile area which should clear up problems on the Ashburton Range sequence - Warramunga associations and help in the interpretation of the data the Helen Springs Party has obtained this year. The Cambrian in the Sheet area would also require checking by a geologist from the sedimentary section to complete the sheet.

(4) Arunta Project

This project will involve the mapping of thirteen 1:250,000 Sheets - many of these have been partly mapped by the sedimentary section. The sheets are MOUNT RENNIE (½), MOUNT LIEBIG (½), HERMANNSBURG (2/3), ALICE SPRINGS (½), ILLOGWA CREEK (¾), LAKE MCKAY, MOUNT DOREEN (1/3), NAPPERBY (½), ALCOOTA (2/3), HIGHLAND ROCKS, MOUNT THEO, MOUNT PEAKE and MOUNT SOLITAIRE (2/3). With the type of detail required to map the Arunta Complex I would anticipate 3 to 4 season's work for a full (3 to 4 man) party. MOUNT RENNIE, LAKE MCKAY, HIGHLAND ROCKS, MOUNT THEO and MOUNT SOLITAIRE would be best mapped by helicopter and could possibly be covered in the last season of the project. With the recent discovery of copper minerals in Proterozoic rocks overlying the Complex it may also be worthwhile to have a second look at the Proterozoics - they have already been mapped in more than adequate 1:250,000 detail so that any other work on them can be concentrated on the economic aspect with a view to possible later detailed mapping.

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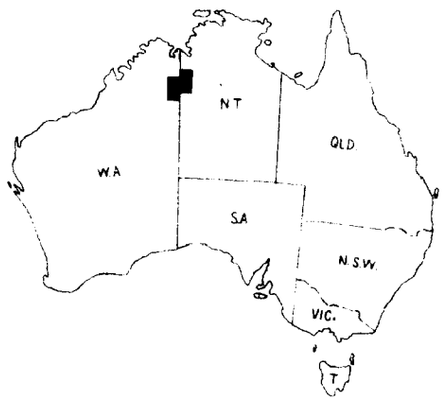
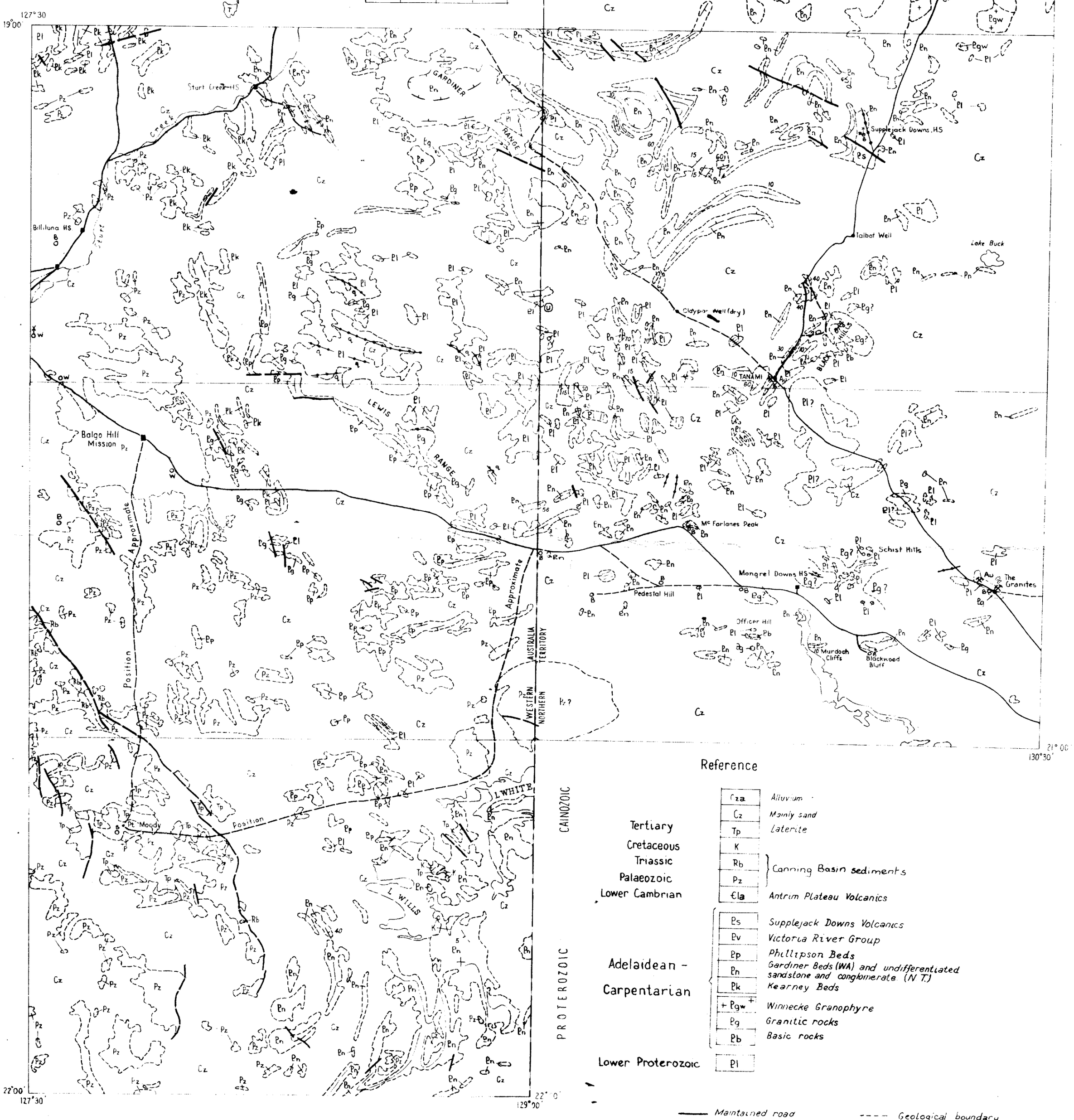
The Granites – Tanami Area
N.T. - W.A.

Scale

10 0 10 20 30 40 50 MILES



LANSDOWNE	DIXON RANGE	LIMBUNYA	WAVE HILL
MT RAMSAY	GORDON DOWNS	BIRRINDUDU	WINNECKE CREEK
MT BANNERMAN	BILLILUNA	TANAMI	TANAMI EAST
CORNISH	LUCAS	THE GRANITES	MT SOLITAIRE
HELENA	STANSMORE	HIGHLAND ROCAS	MT THEO
WILSON	WEBB	LAKE MACKAY	MT DOREEN



Reference

	Cza	Alluvium
	Cz	Mainly sand
Tertiary	Tp	Laterite
Cretaceous	K	
Triassic	Rb	Canning Basin sediments
Palaeozoic	Pz	
Lower Cambrian	€la	Antrim Plateau Volcanics
	Ps	Supplejack Downs Volcanics
	Pv	Victoria River Group
	Pp	Phillipson Beds
Adelaidean - Carpentarian	Pn	Gardiner Beds (WA) and undifferentiated sandstone and conglomerate (N.T.)
	Pk	Kearney Beds
	+ Pgw +	Winnecke Granophyre
	Pg	Granitic rocks
	Pb	Basic rocks
Lower Proterozoic	Pl	

- Maintained road
- Track
- B O Water bore
- W O Well
- Au Mine Au - Gold
- U Prospect U - Uranium
- Geological boundary
- Fault
- Dip and strike of strata
- Trend of bedding and direction of dip
- Quartz reef

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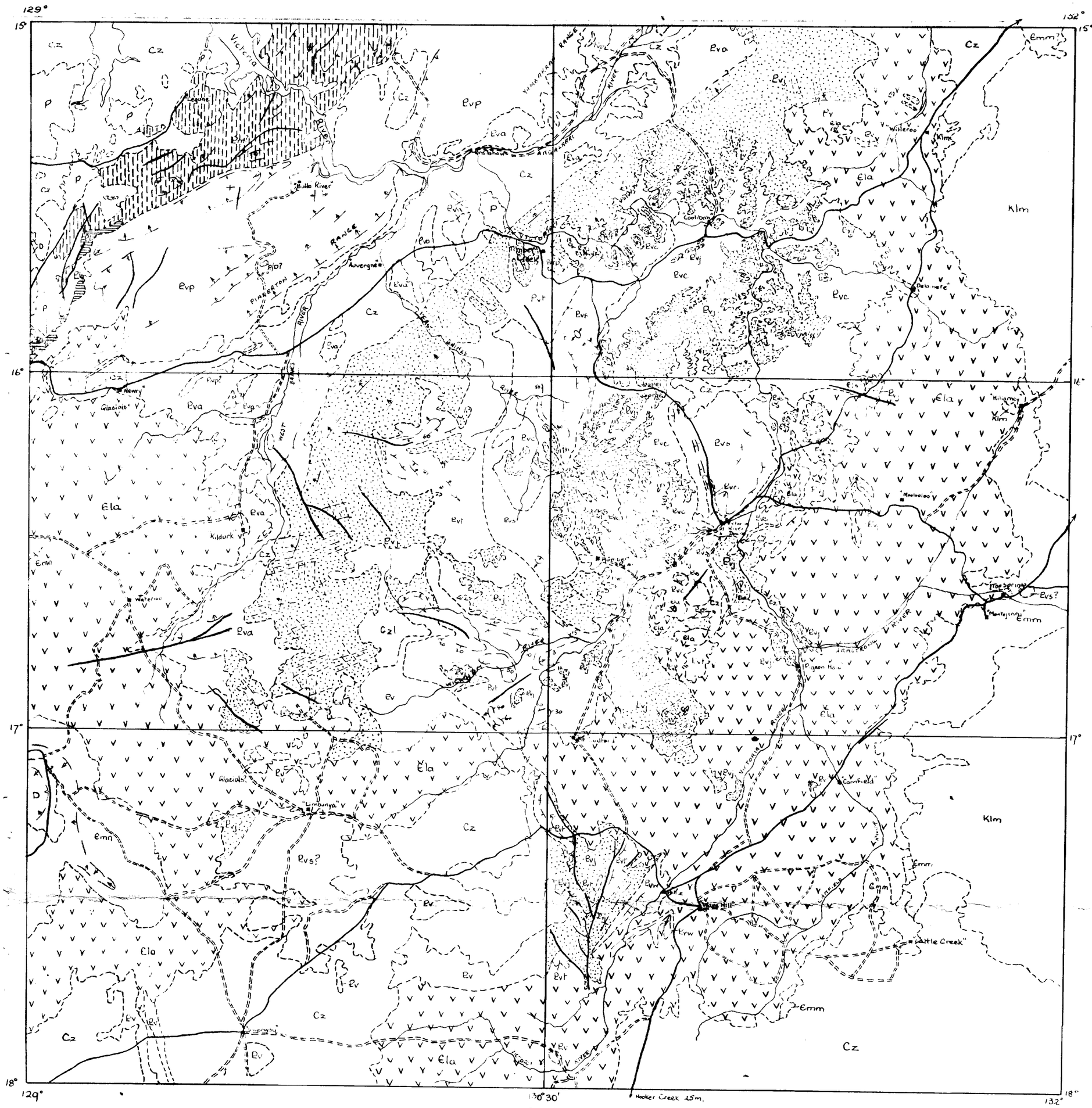
VICTORIA RIVER REGION N.T.



Reference

	Cz	*Sand, soil, alluvium, laterite*
	Czl	*Laterite*
Cretaceous	Klm	*Mullaman Beds*
Permian	P	
Devonian	D	
Middle Cambrian	€mn	*Negri Group*
	€mm	*Montejinni Limestone*
Lower Cambrian	€la	
		"Victoria River Group"
	Ev	*Undifferentiated*
	Evp	*Pinkerton Beds*
	Eva	*Auvergne Shale*
Adelaidean – Carpentarian	Evw	*Wave Hill Beds*
	Evj	*Jasper Gorge Sandstone*
	Evc	*Coolibah Formation*
	Evt	*Timber Creek Formation*
	Evs	*Skull Creek Limestone*
Carpentarian		
Lower Proterozoic	Pl	*Halls Creek Metamorphics*
	Plg	*Lamboo Complex*

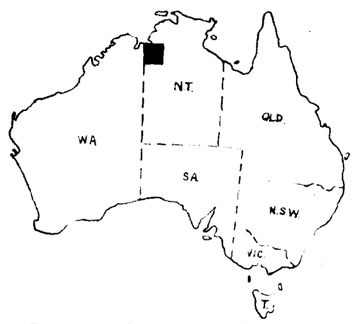
- *Geological boundary*
- *Fault*
- *Strike and dip of strata*
- *Dip 0-15°*
- *Dip 15°-45°*
- *Trend of bedding showing direction of dip*
- *Joint pattern*

air-photo interpretation

- *Maintained road*
- *Track*
- "Camfield" *Homestead or store*

Scale

10 0 10 20 30 40 50 MILES



MEDUSA BANKS	PORT KEATS	FERGUSSON RIVER	KATHERINE
CAMBRIDGE GULF	AUVERGNE	DELAMERE	LARRIMAH
LISSADELL	WATERLOO	VICTORIA RIVER DOWNS	DALY WATERS
DIXON RANGE	LIMBUNYA	WAVE HILL	NEWCASTLE WATERS
GORDON DOWNS	BIRRINDUDU	WINNECKE CREEK	SOUTH LAKE WOOD

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