COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

1959/28

AN AERIAL RECONNAISSANCE OF PORTION OF THE FREW RIVER AREA, NORTHERN TERRITORY.

by

K.G. Smith and M.A. Condon

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CONTENTS

INTRODUCTION

In 1956 a field party from the Geological Section of the Bureau of Mineral Resources, Geology and Geophysics mapped about one third of the Frew River four-mile Sheet. The area mapped was mainly that of the Davenport Range; the remainder of the sheet consists of "semi-desert" country.

The results of the 1956 ground survey were plotted on a controlled base map provided by the Division of National Mapping. Vertical ~~aerial~~ photographs, taken in 1947 by the Royal Australian Air Force, were available for all of the Frew River four-mile Sheet except two small areas where gaps in the photography had occurred. The scale of the photographs is approximately 1 : 50,000.

The ~~aerial~~ photographs are not clear and reliable photo-interpretation of the "semi-desert" area was impossible. A study of the photographs revealed ~~that there were~~ some small areas of rocks which probably were extensions of the Hatches Creek Group, of Precambrian age; and ~~that there were~~ some indistinct outcrops which probably were of Cambrian age. The experience of the 1956 field party had been that on good quality photographs of the adjoining Bonney Well four-mile area it was seldom possible to distinguish sediments of the Lower Proterozoic Warramunga Group from sediments of Cambrian age.

During the 1956 survey, K.G. Smith flew in an Auster aircraft, operated by the Geophysical Section of the Bureau, to examine a small group of low hills some sixty miles north-east of the Hatches Creek settlement (see Plate 1). This examination confirmed that the outcrops were arenites of the Hatches Creek Group. During this flight the impression gained was that the country was easily accessible to four-wheel-drive vehicles, but that a ground survey would experience considerable difficulty in locating low outcrops and in plotting their positions. In the north-western quadrant of the four-mile a number of streams provide useful landmarks, but there are very few landmarks of any sort ~~in the eastern half of the sheet~~.

Therefore it was decided to try an aerial reconnaissance as a quick method of achieving results which would, in all probability, be superior to those of a slow ground survey. The objects of the survey were:

(a) to discover the nature of whatever outcrops were present in the "semi-desert" area, in order to add to the knowledge of sedimentary basins of Precambrian and Palaeozoic age;

(b) to collect sufficient information to compile the Frew River four-mile Sheet without additional ground survey, or, alternatively, to select areas where a future ground survey might operate most profitably and economically.

The following factors were known to at least one of the geologists who would carry out the reconnaissance flights:

(i) the photo-pattern and the outcrop appearance of the Hatches Creek Group and of igneous rocks which intrude that Group;

(ii) the photo-pattern and outcrop appearance of the Warramunga Group;

(iii) the photo-pattern and outcrop appearance of Cambrian sediments which overlie, unconformably, both the Warramunga Group and the Hatches Creek Group in the Tennant Creek and Davenport Range areas;

(iv) the existence of Cambrian sediments in the Wonarah region, which is a short distance north of the north-eastern corner of the Frew River four-mile. (Opik, 1957, p41).

THE SURVEY

The reconnaissance was made from Hatches Creek aerodrome on September 6th and September 7th, 1958 in a Cessna aircraft chartered from Connellan Airways, Alice Springs. Two flights were made; the flight lines and deviations from the proposed tracks, together with observations made, are shown on Plate 1. The geological personnel for each flight were:

Flight No. 1. -- M.A. Condon, T. Quinlan, K.G. Smith.
Flight No. 2. -- M.A. Condon, K.G. Smith, B.L. Wood (of the New Zealand Geological Survey and D.S.I.R.)

D.R. Woolley manned a radio post at Hatches Creek aerodrome during the flights. Details of each flight are:

FLIGHT NO. 1. p.m., Sept. 6th, 1958.

As shown on Plate 1, the aircraft was off course for about three-quarters of this flight. Of necessity, navigation was on a "time and distance" basis mainly; the deviation was due to an unknown change in wind direction which was experienced when a change in altitude was made to avoid turbulence. The aircraft was flown first at an altitude of 1000 feet and during the crossing of the Davenport Ranges checks were made for drift; although a south wind had been forecast (~~officially~~), a slight drift to the south was experienced in the aircraft.

Later, a change of altitude to 3,000 feet was made and apparently a strong south wind operated at this level. At the turn from the eastern to northern leg of the flight the aircraft was on the correct longitude (verified by the position of Annitowa homestead, visible to the south), but from this point onwards it was not realised that the aircraft was off course, until a large fire-burn was crossed on the south-western leg.

From times and courses recorded on flight diagrams it was possible to reconstruct the approximate flight line.

Observations

One outcrop of steeply-dipping grey arenite of the Hatches Creek Group was checked. Two sets of north-east-trending "lines" were observed. They trend irregularly across the (north-west) trend of sand dunes; no rock is visible. They may be sand-covered faults in Precambrian rocks, or sand-covered rocks of this age. During the compilation of the Tectonic Map of the Northern Territory, in July and August, 1958, numerous similar "lines" were observed on photographs of areas of similar latitudes, west of the Stuart Highway. Therefore it was desirable to get additional information on these features, but no conclusion is possible from observations made during this flight.

Numerous outcrops of almost-certain Cambrian sediments were located. These are low (less than twenty feet), often

nearly circular and have a ferruginous (probably lateritic) surface. Radial micro-drainage is common in some. No steep dips were observed on the margins beneath the lateritic surface.

Several low, scattered, white outcrops were observed. These are similar in appearance to soft, white, amorphous limestone of ? Tertiary age which have been mapped on the Barkly Tableland and also west of the Stuart Highway on the Bonney Well four-mile sheet.

Numerous sand dunes were observed. All were low (less than ten feet) with broad, rounded crests. The dunes have a regular north-west trend.

Vegetation was generally very sparse and consisted of spinifex and low shrubs. Near the eastern edge of the Davenport Range vegetation was more abundant. Several varieties of Acacia were observed here in 1956.

FLIGHT NO. 2. a.m., Sept. 7th, 1958.

Because Flight No. 1 covered some of the territory selected initially for Flight No. 2, the latter flight was rearranged. The track, and observations made, are shown on Plate 1. No strong winds were experienced and more landmarks were available. The aircraft was off course for a short period but the deviation was observed at the Frew river.

Observations

Several low outcrops of sediments of the Hatches Creek Group were located and three small areas of steeply-dipping, intersecting fractures (probably in the Hatches Creek Group) were seen. One set of "lines" similar to those observed on Flight No. 1, and several outcrops of almost-certain Cambrian outcrops were plotted. These ? Cambrian outcrops were generally larger and higher than those observed on the previous flight. Near Epenarra homestead a comparison was made by observations on outcrops where Redlichia had been obtained in 1956.

CONCLUSIONS

(a) There are two main areas of ? Cambrian outcrops. One is in the eastern third of the four-mile sheet, the other is in the north-west of it. The eastern area extends to the east and to the north of the four-mile and it is probable that it was once continuous with the Wonarah Beds of Opik (1957, p41).

The outcrops in the north-west are probably extensions of the Gum Ridge Formation of lower Middle Cambrian age (Opik, 1951). This correlation is supported by Gum Ridge fauna located west of Epenarra homestead in 1956.

(b) Although no unconformity was observed between the Hatches Creek Group and the ? Cambrian sediments in the easternmost areas of the four-mile sheet, it is regarded as extremely likely that the ? Cambrian sediments are very thin and that the Palaeozoic basin or basins are very shallow. This infers that Precambrian rocks underlie, at a shallow depth, much of the "semi-desert" area of the Frew River four-mile. Some of the Precambrian rocks observed were undoubtedly of the Hatches Creek Group. The total eastern extent of this Group is unknown but ground observation by K.G. Smith

in October, 1958, in the south-western portion of the Ranken four-mile sheet suggested that Precambrian arenites akin to the Hatches Creek Group and to the Ashburton Sandstone may occur in that area. Photo-interpretation later tended to confirm this impression, but a closer ground examination is necessary. For the present it must be regarded as a possibility only.

(c) The information gained on the flights is sufficient to complete the four-mile sheet. If more positive identification of Cambrian sediments is required, one traverse from near Wonarah on the Barkly Highway should suffice. The geology of the four-mile sheet is plotted on Plate 3.

TECHNICAL DETAILS

Type of Aircraft:	Cessna 180; a single-engined, high-wing monoplane, four-seater, with excellent visibility.
Operator:	Connellan Airways, Alice Springs.
Charter Cost:	£15 per hour.
Cruising Speed:	120 m.p.h.
Total Flying Time; (Alice Springs - Alice Springs)	9 hours

SAFETY MEASURES

Connellan Airways maintains its own round-the-clock rescue service. The aircraft was fitted with radio and maintained its normal half-hourly position report to Dept. of Civil Aviation radio stations.

A transceiver, equipped to transmit to the Air Radio station at Alice Springs, was manned at Hatches Creek aerodrome whilst flights were in progress. The proposed flight lines were drawn on each of three four-mile mosaics; two of these were retained by the ground radio operator to provide sufficient mosaics for both ground and air search if such became necessary.

It may be of interest to all Bureau personnel to note some additional safety measures. The type of safety precautions required will differ from area to area, but it is believed that some items should be standard for Central Australia. They are simple and inexpensive, and can be carried out without "over-organising" any survey. It is statistically unlikely that an aircraft will be forced down (and no criticism of Connellan Airways is here intended) but the statistics are no excuse for failure to prepare for the event. It is considered that the following equipment should be carried:

(i) Headgear. Some form of protection is desirable. After a successful forced landing the wing would provide shade; after an unsuccessful one there may be no wing available.

(ii) Footwear. Footwear suitable for walking should be worn. In normal circumstances, no walking would be required -- rescue would be awaited. But the pilot would attempt to land in the clearest space available;

if this happened to be in the middle of a large fire-burn then it may be a long trek to light a signal fire in the nearest spinifex.

(iii) Matches. All members of the crew should carry a box of matches --- a spinifex fire is one of the best signals available.

(iv) Water. On this survey five gallons of water were carried in the aircraft. It is considered that the addition of two or three freshly-filled Army-type water bottles is desirable. In the event of a forced landing, the main water container may be punctured. If the aircraft burned, it would be relatively easy to evacuate whilst clutching a water bottle. Also, a trek to light signal fires would require a handy water container.

CREW OF AIRCRAFT

Normally, one geologist will be required to act as navigator. This is a fairly constant occupation and leaves little time for geological observations. Therefore the maximum number of geologists should be on board. This requires the navigator to occupy a front seat, with both rear seats filled by geological observers.

All geologists on board should record times when observations are made and in general keep adequate records so that the whole picture may be built at the end of the flight. The navigator must maintain records of times and courses and geological observations so that if the aircraft drifts off the flight line, the actual course may be reconstructed.

The pilot is an integral part of the team, quite apart from his normal flying duties. On the Frew River reconnaissance the pilot was supplied with a scaled-down copy of the flight diagram before the flights began. This diagram showed the courses, and their duration in minutes; the application of the plan relieved the navigator of a considerable amount of work and thus left him with more time for geological observations.

MAXIMUM USE OF AIRCRAFT

To avoid "dead" flying time on the forward and return journeys between Alice Springs and Hatches Creek, geological observations were made en route. On the forward journey M.A. Condon and T. Quinlan made observations on the Palaeozoic sediments of the Barrow Creek four-mile sheet. On the return journey, T. Quinlan endeavoured to locate an unconformity at the base of the Dulcie Sandstone, on the Huckitta four-mile sheet.

LIST OF REFERENCES

NOAKES, L.C. and TRAVES, D.M. 1954.	Outline of the geology of the Barkly Region. in Survey of the Barkly Region, 1947-48, C.S.I.R.O. Land Research Series No. 3.
" OPIK, A.A. 1951	Progress in the study of Cambrian fossils from the Northern Territory and N.W. Queensland. Bur. Min. Resour. Aust. Rec. 1951/26.
" OPIK, A.A. 1957	The Cambrian Geology of Australia. Bur. Min. Resour. Aust. Bull. 49.

LIST OF PLATES

PLATE 1. Flight Diagrams and observations.

PLATE 2. Tectonic Map of portion of the Northern Territory.

PLATE 3. Geological Map of Frew River four-mile sheet.

Plate 1

FREW RIVER
NORTHERN TERRITORY

SHEET No. F53-3

Observations Made on Aerial Reconnaissance, 1958

135°00' 136°00' 137°00'

20°00' 21°00'

Barkly Highway

Fire - burn

Flight No 2. (proposed and actual)

? Fracture

Flight No2 (proposed)

Flight No.2 (Actual)

Joints dow bearing Steep dips ?Puh

(?Puh Red brown

?€ outcrop (dark brown)

Flight No.1 Deviation Altitude 3000'

?€ Scattered Outcrops

Fractures in ?Puh

Approximate Edge of Fire-burn

Qrs

Fire - burn.

Fractures in ?Puh

Whistleduck Creek

FREW RIVER

Flight No. 2

Approximate Boundary of Area Mapped in 1936

EPENARRA

NMH 80 993 WOODENBERRIE P.W.H.

COCKATOO W.H.

Kurundi and Stuart Highway

Teatree Creek

Lennee Creek

TARACAN W.H.

FREW RIVER

DAVENPORT RANGE

"Dempseys" 1229

Mia Mia Creek

Hatches Creek P

Gastrolobium Creek

Hanlon Creek

Parson Creek

Low hills

Puh

Stand of timber

Flight No.1 (proposed)

Steep Dips

Flight No2

? Puh

Altitude 3000'

Flight No.1 Altitude 1000'

Flood-out of Gastrolobium Creek

?T Low scattered white outcrops

Scattered Outcrops of ?€

?Fractures

Flight No.1 Deviation Altitude 3000'

Flight No.1 (proposed)

?Fractures

Murray Downs and Stuart Highway

Elkedra

CONTROL
Astronomical Fixations by the Division of National Mapping.
AIR PHOTOGRAPHY:
Survey Squadron, Royal Australian Air Force. Sept. Oct. 1947

Road	
Highway (Sealed)	
Aerodrome	⊙
Permanent Waterhole	P.W.H.
Waterhole	W.H.
Watercourse	
Mine	X
Yard	▫
Police Station	P
Astronomical Station	N.M.H. 77
Elevation (in feet) above mean sea-level	·940'
Homestead	■

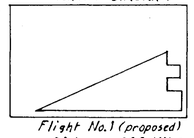
SCALE: 4 MILES TO 1 INCH

2 0 2 4 6 8 10 12 14 16 MILES

INDEX TO ADJOINING SHEETS

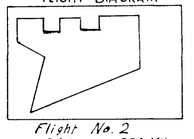
TENNANT CREEK	ALROY	RANKEN
BONNEY WELL	FREW RIVER	AVON DOWNS
BARROW CREEK	ELKEDRA	SANDOVER RIVER

FLIGHT DIAGRAM



Flight No.1 (proposed)
Distance: 242 Miles
p.m. Sept. 6, 1958

FLIGHT DIAGRAM



Flight No. 2
Distance: 250 Miles.
a.m. Sept. 7, 1958

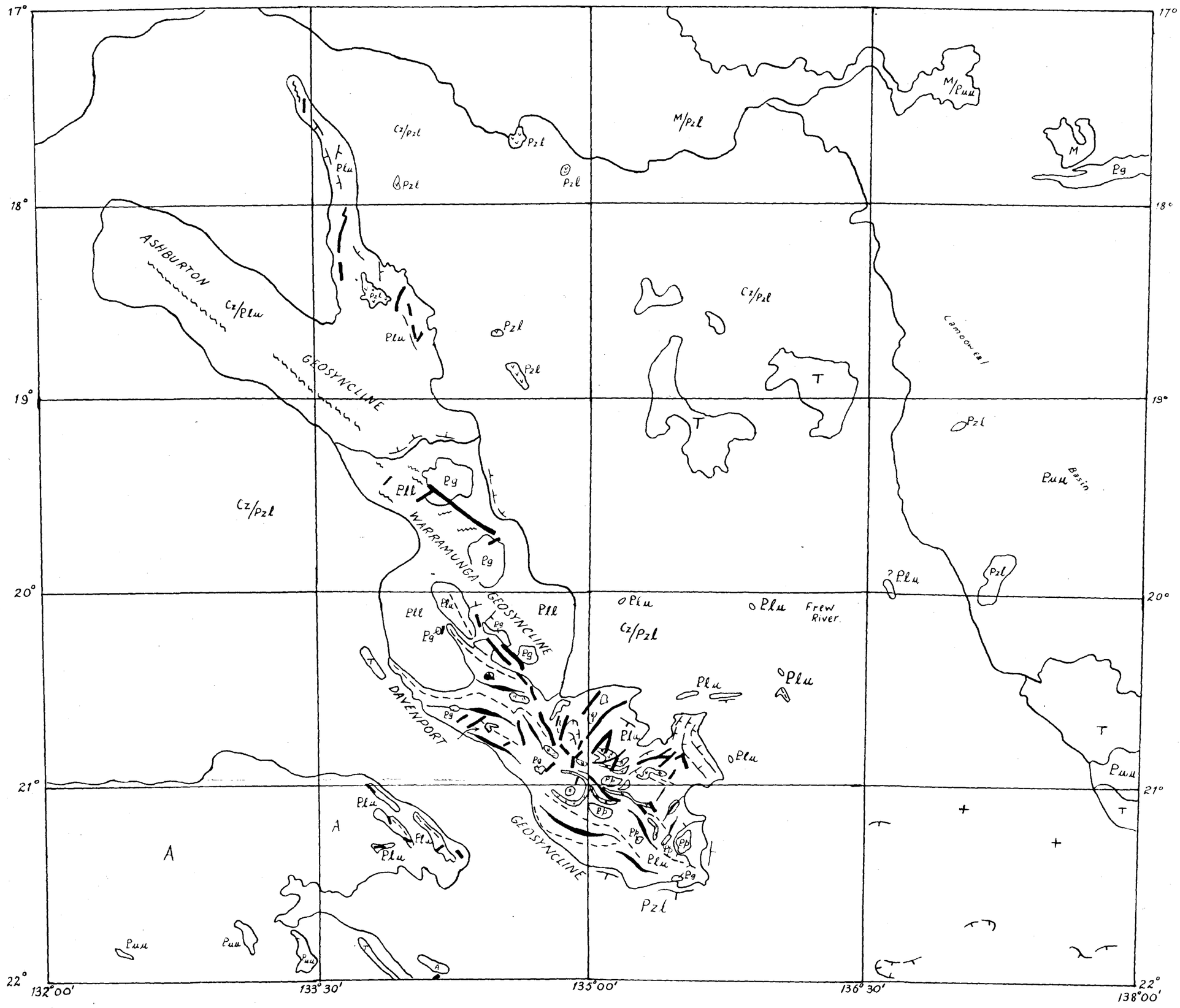
Plate 2.

TECTONIC MAP

of

portion of the Northern Territory

(Based on Tectonic Map of Northern Territory, compiled by B.M.R., 1958.)



Scale: 32 miles to 1 inch.

Reference.

- Geological boundary
- Axes of tight folds.
- Synclinal axis.
- Anticlinal axis
- Fault
- Strike and dip of bedding

Cz	Cainozoic	
T	Tertiary	
M	Mesozoic	
Pzl	Cambrian – Silurian.	
Puu	?upper Upper Proterozoic.	
Plu	?upper Lower Proterozoic	{Ashburton Sandstone and Hatches Creek Group.}
Pll	lower Lower Proterozoic	(Warramunga Group)
A	Archaean.	(Arunta Complex)

Igneous Rocks

Proterozoic Granite.	Pg
Proterozoic Porphyry.	Pp
Basic Volcanic Rocks.	
Acid Volcanic Rocks.	

FREW RIVER
NORTHERN TERRITORY

F 53-3

CONTROL:
Astronomical Fixations by the Division of National Mapping
AIR PHOTOGRAPHY:
Survey Squadron, Royal Australian Air Force
Sep.Oct. 1947.

Road	=======
Aerodrome	⊕
Permanent Waterhole	P.W.H
Waterhole	W.H.
Watercourse	~~~~
Mine	X
Yard	□
Police Station	P
Astronomical Station	○ NMH 77
Spot Height	•916'
Homestead	■
Bore	•B
Well	•W

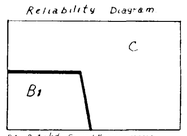
SCALE: 4 MILES TO 1 INCH

MILES 2 1 0 2 4 6 8 10 12 14 0 MILES

INDEX TO ADJOINING SHEETS

TENNANT CREEK	ALROY	RANKEN
BONNEY WELL	FREW RIVER	AVON DOWNS
BARROW CREEK	ELKEDRA	SANDOVER RIVER

Reliability Diagram



B1 Detailed Ground Reconnaissance
C Aerial Reconnaissance and photo interpretation

- Established Geological Boundary, position accurate
- Established Geological Boundary, position approximate
- Probable Geological Boundary
- Strike and dip of inclined strata
- Strike and dip of vertical strata
- Established Fault, position accurate
- Established Fault, position approximate
- Probable Fault, concealed
- Established Synclinal Axis, position accurate
- Mineral Localities
- Sand-ridge
- Joint

Quaternary: Sand, soil, alluvium
Tertiary: Limestone
Cambrian: Sandover Beds
Gum Ridge Formation
Upper Proterozoic: Undifferentiated Sediments
Granite
Quartz feldspar porphyry
Basic flows or sills
Lower Proterozoic: Hatches Creek Group
Igneous Members
Unconformity
Warramunga Group