AFMECO PTY LTD

ALICE SPRINGS BASE

Report No. AS.80.3

DRILLING IN THE FINKE AREA - 1980

by

D.J. FRENCH

NORTHERN TERRITORY
GEOLOGICAL SURVEY

ALICE SPRINGS

OCTOBER, 1980
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1. INTRODUCTION

THE AREA

In conjunction with an exploration programme in South Australia, two areas south of Finke, adjoining areas held in South Australia, were drilled in 1980. The areas are along an existing track on New Crown Station (see Figure 1).

WORK PROGRAMME

This programme formed part of a programme largely conducted in South Australia, which proceeded as follows:

Following on the 1979 diamond drilling programme, a work schedule was undertaken as follows:-

1. Geophysical and structural interpretation of available data.
2. Roads and airstrips were graded for improved communications.
3. A follow up drilling campaign was undertaken in two stages:-
   a) an initial 6 "Air Core" holes, of which two were in the N.T., followed by a review and then,
   b) a further 9 "Air Core" holes, to determine the location of the Redox Front, of which one was in the N.T.

The first stage began in the N.T. on June 23rd and finished on 25th June, giving a total of 229 metres in the N.T.

A review was undertaken at the end of June, noting a broad facies change between Enungarena Hill, in South Australia and the Finke areas in the Northern Territory.

A second drilling programme commenced at Tiejon on 30.8.80, reaching the Territory on 10.10.80, and 119.5 metres were drilled, before a mud rush sealed off the hole and no further drilling was possible.

This report on the investigation was prepared in late October, 1980.

CONTRACTOR AND EQUIPMENT

Wallis Geochemical Drilling Co. Pty Ltd of 54 Beaconsfield Avenue, Midvale, Western Australia, 6056, were given the contract.

The drill was an H.22 with International body, Gemco drill and mast and a Schramm Compressor of 250 psi, mounted on a separate Mercedes truck. The type of drill was of the Reverse Circulation type called "Air Core" using NQ rods with liners and tungsten bits.

A separate Bedford Water Truck and a 4 x 4 utility vehicle accompanied the drill.

A single crew of three men were accommodated in a caravan.
The "Air Core" system, using a cyclone, recovers 100% of the rock cuttings, occasionally including approximately "A" size core sticks with the cuttings.

DISCUSSION OF DRILLING METHODS

This variant of Reverse Circulation type drilling was immensely superior to the diamond drilling results of the previous year, at relatively shallow depth. The presence of water (either too little or too much) reduced the capabilities of the drill fairly readily, and a sophisticated drilling technique is required to attain depths approaching 200 m. "Torquing up" or bogging of the rods, due to an inability to ream the hole behind the bit when withdrawing the rods, along with sanding of the rods, was a constant hazard, especially in the N.T. holes where trouble was had with almost every hole.

THE LOGGING PROGRAMME

The logging was done by Geoscience Associates, of 26-28 Pambula Street, Regency Park, S.A., 5010, with a logging truck mounted on a P350 chassis.

The holes were logged using Gamma and Neutron-Neutron logging methods. A crystal size change from 1/2" x 1/2" crystal to 1 1/2" x 1/2" crystal occurred at the commencement of the second stage of the drilling programme, in the Gamma method, giving twice the previous values (see section ).
### TABLE 1

**LIST OF GEOPHYSICAL LOGS**

<table>
<thead>
<tr>
<th>Description</th>
<th>CUR Nrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gamma log/Neutron-Neutron log of Afmeco Drilling</td>
<td>S 10, 11, 19</td>
</tr>
<tr>
<td>Scout Gamma log in Water Bore:</td>
<td>Coglin Bore</td>
</tr>
</tbody>
</table>

Only very minor anomalies are present in association with shale bands in CUR S19 and CUR S10.
2. GEOLOGY OF THE FINKE AREA

(Refer to Finke Geological Sheet Map Plate 1)

Post Eromanga Sediments

Windblown sand and river alluvium.

Albian - Aptian - Cenomanian of the Cretaceous

Klo - Oodnadatta Formation

Fossiliferous, grey, argillaceous siltstone and shale, concretionary limestone and calcareous sandstone with lithic components, glauconite and plant fragments.

Klk - Coorikiana Member

Olive, cross-bedded, fine to medium glauconitic sandstone, subordinate dark clay-shale and fawn limestone. Occasionally pyritic quartz, pebbly sandstone lenses.

Klb - Bulldog Shale/Wallumbila Formation

Grey, silty, carbonaceous shale and subordinate siltstone, occasional boulders and fossil wood in the lower part. Ellipsoidal concretions of hard marly limestone, fossiliferous, some coquoid.

Klc - Cadna-owie Formation

Laminated, very fine sandstone, minor siltstone, and shale, thin calcareous (Fountainbleau) sandstone; pebbly coarse sandstones, in part ferruginous, oolitic, siliceous. Brown calcareous, gritty sandstone with prominent boulder horizon.

Upper Jurassic - Neocomian

Jkh - Hooray Sandstone

White cross-bedded kaolinitic sandstone with pebble horizons; basal quartz pebble conglomerate. Contains plant fossils.

Permian Pedirka Basin Sediments

The Purni Formation

Sands, white, fine to medium-grained, well-sorted and kaolinitic. The clays and silts are varicoloured, micaceous and generally sandy. They display convolute and contorted bedding, slumping, climbing-ripple laminae and fluvialite depositional features.

(After Bridget C. Youngs of S.A.D.M.E.)

The Crown Point Formation

Series of diamictites, pebbly sandstones and clays which are at least 50 m thick. Some of the boulders show evidence of glacial striae.
The Adelaidean to Lower Palaeozoic or Amadeus Basin Succession

This includes:
The Finke Group
The Larapinta Group
Winnall Beds
Inindia Beds
Bitter Springs Formation

Musgrave Block
(Crystalline Basement)
Dolerite dykes

Granite
Massive medium-grained biotite-rich granite.

Gneisses
Undifferentiated, including biotite gneiss and retrograde chlorite gneiss and metasediments (ages 1050 m.y. - 1110 m.y.)
3. RESULTS OF GEOPHYSICAL/STRUCTURAL INTERPRETATION

An interpretation, based on information from the S.A.D.M.E. and AFMECO data, was made for the Tieryon area. Owing to the lack of a published 1:250 000 scale map giving detailed magnetic coverage for the Finke sheet it was not possible to extend that interpretation northwards.

B. Harvey did some preliminary mapping of the basement on the Finke sheet area, to assist in defining the source rocks.

The COGEMA and AFMECO Head Office personnel then had a look at this magnetic interpretation and in their turn interpreted faults, lineaments and flexures and sited a line of drill holes at about 20 km spacing across from Enungarenna Hill to Finke to get an overall understanding of the geology. This formed the basis for Stage I of this year's drilling programme.

The lineaments identified are to be seen on the Geological Sheet Map - Plate 1.

STRUCTURES AND LINEAMENTS

1. The Duffield Fault
   This is a major feature trending south-west to north-east across the Abminga Sheet and portion of the Finke Sheet. It was interpreted from magnetic data, then found to be recognisable on aerial photographs, in the Duffield Siding area, on New Crown Station.

2. The Old Crown Flexure
   This is based on regional magnetic data and was interpreted by AFMECO personnel in 1972 on the Finke Sheet.

3. The Claude Bore Lineament
   This was interpreted from magnetic data, and is not visible on the aerial photographs.

4. The Coqlin Lineament
   This was interpreted by the COGEMA team on the basis of geological and geophysical criteria.

5. The Mount Squire Flexure
   This was named by the AFMECO personnel of 1972 and is an obvious demarcation between outcrops and the Simpson Desert and is partially followed by the Finke River.

6. The Mount Cecil Fault
   Recognised by the 1972 personnel, this feature was confirmed by B. Harvey as separating the Kulgera Granites of the Tieryon Homestead area, from the basement schists, gneissess and dolerite dykes of the Umbeara Homestead area.
7. Further features are of no concern to the present investigation and will not be discussed here.
4. RESULTS OF SUBSURFACE STUDY

PEDIRKA BASIN SEDIMENTS

A great deal of difficulty has been experienced in recognising these sediments from cuttings. Where indicated in drill sections they are believed to be Pedirka Basin sediments on the basis of:

a) visual similarities with core obtained from Hole 3 near Frieger Bore, on Tileyon Station, in 1979,

b) from Neutron-Neutron log correlation, and
c) from discussions with Geoff Knott, Water Investigation Branch, Dept of Transport and Works, Alice Springs.

Petrological and palynological studies of the completely oxidised sediments were of little or no assistance, in isolating these sediments.

Pedirka Basin Sediments outcrop in the general Finke area and are believed to underlie all holes drilled.

In Hole 10 possible Pedirka Basin Sandstones occur between 108 m and 132.5 m, the bottom of the hole. The rock consists of essentially coarse-grained sandstone, kaolinitic, with exotic sandstone grains of possible Amadeus Basin provenance.

In Hole 19 possible Pedirka Basin sediments occur from 118-119.5 m at the bottom of the hole. As medium-grained kaolinitic sandstones, they are finer grained than the overlying Unit IV sandstones, and when penetrated by the drill formed a slurry and the drill was pumping out vast amounts of sand without making any real progress.

THE EROMANGA BASIN SEDIMENTS

1. The Bulldog Shale/Wallumbila Formation and related groups such as the Coorikiana Formation and the Godnadatta Formation

These are mapped separately on the Abminga Sheet, extrapolated across into the Northern Territory (see Plate 1) but only as far as Finke township, after which everything is referred to the Wallumbila Formation. No attempt has been made to differentiate these various formations in the subsurface.

On the geological logs and sections this succession is designated Unit I.

Of the 3 holes drilled only Hole 19 drilled through a segment of Unit I.

In Hole 19 Unit I is essentially a clay, green in colour, with minor sandstones overlying. 19 metres of sediment were intersected.

2. The Cadna-Owie Formation or Unit II

This unit varies from 17 to 42 m, due to the amount of erosion, or lack of it, as is the case for Hole 19, off the top of the Unit.
The sandstone is essentially coarse-grained to medium-grained, with conglomeratic and kaolinitic lenses. There is an abundance of ferruginous nodules, and the colour varies from pink to brown.

3. The Hooray Sandstone (Lower) - Units III and IV

The boundaries of the Units III and IV are based on Neutron-Neutron logs, and they are both believed to belong to the Upper Jurassic-Lower Cretaceous fluviatile sequence, on the strength of a Neocomian age for a sample from near the top of Unit III in Hole 16 (in South Australia). This non-marine sample would thus be younger than all the remainder of Units III and IV - thus according with the age given of Upper Jurassic to Lower Cretaceous (Lower Hooray Sandstone).

Unit III - A capping of fine to medium sandstone and shale or siltstone up to 6 metres thick shows up clearly on the Neutron-Neutron log. The remainder of the Unit is a sequential to rapidly alternating succession with conglomerates, with from granule to 1 cm-sized pebbles, and an abundance of medium to coarse-grained sandstone. Ferruginous nodules, possibly after pyrite, and hollow spheroidal concretions are present in Hole 19. The colour varies from greyish through brown to varicoloured, especially in Hole 19, suggesting a varied source area for the grains and pebbles.

Unit IV - Of variable thickness, 47 m in Hole 10 and 25 m in Hole 19, depending on the proximity to the source area, perhaps.

Over 50% of this unit is coarse-grained, the remainder medium-grained, but gritty, rounded to subangular (0.1-1.5 mm); illite and kaolinite are present, with zircon leucoxene, magnetite, hematite and brown tourmaline as accessories. Some muscovite is present towards the base (see Petrological Report Appendix I).

A prominent conglomerate at 107-108 m in Hole 10 is taken as the base of the Eromanga Basin Succession.

Conglomerates (up to 5 cm pebbles) are present in Hole 19. They are varicoloured, and composed of quartz, quartzite and even feldspar pebbles. Ferruginous nodules after pyrite are also present.

POST EROMANGA SEDIMENTS

These superficial sediments range from a thin veneer in Hole 10, through 3 m of alluvium in Hole 11 to 7 m of river alluvials, including a conglomerate with pebbles to 3 cm, in Hole 19.
5. **ECONOMIC GEOLOGY**

Because of the general lack of shales, even though the Eromanga Basin sandstones are generally sequential, a ratio of coarse-grained and conglomeratic material to medium to fine sandstone, and silts/shales has been calculated (the G.S.R.).

<table>
<thead>
<tr>
<th>Hole No.</th>
<th>10</th>
<th>11</th>
<th>19</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.S.R.</td>
<td>1.89</td>
<td>1.59</td>
<td>1.4</td>
<td></td>
</tr>
</tbody>
</table>

These suggest intermediate depth positioning with respect to the basin margin.

**RADIOMETRY**

No anomaly of any serious consequences is present in any of the three holes, although the background does rise over shaley material.

**WATER**

Good water is present in Hole 19, and is probably comparable with that found in Coglin and Claude Bores nearby. Collapse of the holes, with an infill of sand is however a major hazard.
APPENDIX I

DRILLING IN THE FINKE AREA – 1980

MINERALOGICAL REPORT
APPENDIX I

Central Mineralogical Services

Mr. D.J. French
Project Geologist
AFHECO Pty. Ltd.
P.O. Box 1946
ALICE SPRINGS / N.T. 5750

28th July, 1980

REPORT CMS 80/7/11

YOUR REFERENCE: Order No. 4672

DATE RECEIVED: 7th July, 1980

SAMPLE NOS.: 8048 - 32, 35, 38,
41, 44, 47,
50, 53, 54

8045 - 40, 42, 44,
46, 48, 50

Hole No. Cut 10

Hole No. Cut 9

SUBMITTED BY: D.J. French

WORK REQUESTED: Comparison

Copy & Invoice to:
The Chief Geologist
AFHECO Pty. Ltd.
P.O. Box 526
WEST PERTH / W.A. 6005

H.W. Fander, M. Sc.
Fifteen samples of unconsolidated material were received for comparison. They were dried and examined as grain-mounts using an immersion oil. Each sample is briefly described in the accompanying table.

A number of factors were considered when examining each sample:

a) Constituents, including clay, ferruginous coatings and heavy minerals.

b) Quartz grainshapes and grainsizes.

Broad correlations and comparisons were possible, mainly on the basis of grainshape/grainsize considerations; heavy minerals were too sparse and too similar to permit comparisons, but the technique of heavy mineral comparisons can be very useful in problems of this type, providing that heavy minerals are first concentrated by heavy-liquid separations. Such concentrates usually contain a much greater variety of heavy minerals, making differences or similarities more distinctive and meaningful. Such an investigation can be carried out if needed, or if the present information is inadequate.

Samples 804844-47-50-53-54 appear to form a distinct group, with 804853-54 perhaps comprising a subgroup within that larger grouping; on the basis of grainsizes, it is suggested that this group represents marine sediments, showing much better sorting and closer sizing. 804550 may well be correlatable with this group.

All the remaining samples are quite similar to each other; on the basis of a much wider size range, poorer sorting/sizing, and the presence of grit- and pebble-sized grains in some samples (804838, 804544), it is suggested that they are fluviatile. The only sample which may not fit into this group is 804548.

Probably, more significant results would be obtained by comparing these samples with known samples, so as to provide reference standards.

H.W. Fander, M. Sc.
<table>
<thead>
<tr>
<th>Depth</th>
<th>Sample No.</th>
<th>Brief Mineralogical Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>82</td>
<td>804832</td>
<td>Rounded-subrounded quartz, 0.1 - 1.0 mm, average 0.3 mm, some quartz overgrowths; very minor kaolinite. Zircon, leucoxene, magnetite-hematite.</td>
</tr>
<tr>
<td>85</td>
<td>804835</td>
<td>Subrounded (minor rounded and subangular) quartz, 0.1 - 1.5 mm, average 0.4 mm; very minor kaolinite. Zircon, rare magnetite.</td>
</tr>
<tr>
<td>88</td>
<td>804838</td>
<td>Rounded-subrounded quartz, 0.1 - 1.0 mm, average 0.3 mm, a few rounded quartz pebbles, minor kaolinite cement. Zircon, leucoxene, magnetite.</td>
</tr>
<tr>
<td>91</td>
<td>804841</td>
<td>Subrounded quartz, 0.1 - 1.5 mm, average 0.4 - 0.5 mm; very minor kaolinite. Zircon, brown tourmaline, leucoxene. Faint Fe-coating. Rutilated quartz.</td>
</tr>
<tr>
<td>94</td>
<td>804844</td>
<td>Subangular quartz, Fe-coated, 0.05 - 0.3 mm, average 0.1 mm; minor kaolinite cement. Euhedral green tourmaline, zircon, leucoxene, oxide opaques, ?rutile - conspicuous.</td>
</tr>
<tr>
<td>97</td>
<td>804847</td>
<td>Subangular quartz, Fe-coated, 0.03 - 0.3 mm, average 0.1 mm; kaolinite flakes, aggregates. Zircon, leucoxene. Tourmaline absent. Trace carbonate.</td>
</tr>
<tr>
<td>100</td>
<td>804850</td>
<td>Subangular quartz, Fe-coated, 0.05 - 0.5 mm, average 0.1 mm; kaolinite, illite, muscovite flakes. Zircon, leucoxene, oxide opaques.</td>
</tr>
<tr>
<td>103</td>
<td>804853</td>
<td>Subrounded-rounded quartz, clay-coated, 0.1 - 0.3 mm, average 0.2 mm; clay and white mica flakes; brown tourmaline, leucoxene, conspicuous rounded and euhedral zircon.</td>
</tr>
<tr>
<td>104</td>
<td>804854</td>
<td>Subrounded-rounded quartz, lightly clay-coated, 0.05 - 0.3 mm, average 0.2 mm, very minor clay, white mica flakes; brown tourmaline, leucoxene, conspicuous zircon.</td>
</tr>
<tr>
<td>150</td>
<td>804540</td>
<td>Subangular-subrounded quartz, very lightly clay-coated, 0.15 - 1 average 0.4 mm. Brown tourmaline, magnetite, rutile, conspicuous zircon.</td>
</tr>
<tr>
<td>152</td>
<td>804542</td>
<td>Subrounded-rounded quartz, lightly clay-coated, with quartz overgrowths, 0.15 - 1.5 mm, average 0.4 mm. Leucoxene, zircon.</td>
</tr>
<tr>
<td>154</td>
<td>804544</td>
<td>Subangular-rounded quartz, 0.1 - 3.0 mm size range (0.1 - 1.0, 1.5 - 3.0 bimodal); very little clay; brown tourmaline, leucoxene, ilmenite, zircon.</td>
</tr>
<tr>
<td>Sample No.</td>
<td>Brief Mineralogical Description</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------</td>
<td></td>
</tr>
<tr>
<td>156 804546</td>
<td>Subangular-subrounded quartz, very lightly clay-coated, 0.05 - 2.0 mm; ferruginous clay aggregates; leucoxene, zircon, green tourmaline.</td>
<td></td>
</tr>
<tr>
<td>158 804548</td>
<td>Subrounded-rounded quartz, lightly clay-coated, 0.1 - 0.4 mm, average 0.2 mm. Green tourmaline, leucoxene, zircon. Quartz overgrowths.</td>
<td></td>
</tr>
<tr>
<td>160 804550</td>
<td>Rounded to subangular quartz, clay-coated, 0.05 - 0.3 mm, average 0.15 mm; clay aggregates, white mica flakes; zircon, leucoxene, oxide opaques.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX II

DRILLING IN THE FINKE AREA - 1980

PALYNOLOGICAL REPORT
Palynological Report No. 375

Carbonaceous clay submitted by Afmeco September 1980

Abstract

A rich and diverse plant microfossil assemblage was recovered from the following sample:

Field No. AFMECO 8018993 — HOLE CUR 16, DEPTH 103 M.
Palynological Sample No. 6254
Lithology: Black carbonaceous clay
Age: Early Cretaceous (Neocomian)
Suggested depositional environment: non-marine, open-water.

Plant microfossils identified (partial list)

Algal cysts:
- Horologinella sp.
- Lecaniella sp.
- Zygnemataceous cysts.

Cryptogam spores:
- Lycopodiumsporites spp. COMMON
- L. facetus Dettmann
- L. circolumenus Cookson & Dettmann
- Januaspores spinulosus Dettmann
- Osmundacidites wellmanni Couper
- Cyclosporites hughesi Dettmann
- Neoraistrickia truncatus (Cookson)
- Stereispores antiquasporites (Wilson & Webster)
- Cyathidites spp.
- C. asper (Bolkhovitina)
- Gleicheniidites circinoides (Cookson)
- Ischyosporites cf. crateris Balme
- Dictyophyllidites sp.
Ceratosporites aequalis Cookson & Dettmann
Coronatisporites perforata Dettmann
Densoisporites velatus Weyland & Krieger
Matonisporites crassiagnulatus Balme
Foveosporites sp.
Cicatricosisporites ludbrooki Dettmann
cf. Dictyotosporites complex Cookson & Dettmann

Gymnosperm pollen:

Classopollis sp.
Alisporites similis Balme
Podocarpidites ellipticus Cookson
Araucariacites australis Cookson
Callialasporites dampieri Balme
C. segmentatus Balme
Microcachryidites antarcticus Cookson

Age and depositional environment

The extraordinarily diverse assemblage is unusual even for Early Cretaceous associations. It compares closely with those recorded by Burger (1973) from non-marine sediments (Mooga Sandstone, Lower Hooray Sandstone) in the Great Artesian Basin, Queensland. These, Burger believes, are 'middle' Neocomian.

No obvious dinoflagellates or spinose acritarchs were recognised. This negative evidence together with the presence of fresh or brackish water algal cysts and the abundance of microfossils of terrestrial plants indicate a non-marine origin. Zygnemataceous algae are common in present day lakes, estuaries, and open-water swamps and the unusually high proportion of lycopsid spores suggests that swamp plants were important contributors to the palynological spectrum. From the excellent preservation of the plant microfossils biological activity was low at the depositional interface.

The likeliest depositional environment therefore appears to have been an extensive heavily vegetated marshland with bodies of poorly oxygenated standing water.

9th October 1980.

B.E. Balme
Reference

APPENDIX III

DRILL LOGS - CUR 10
     - CUR 11
     - CUR 19
Hole 10
252 m.o.d.

Hole 13
282 m.o.d.

ALLOUVUM

PEDIREA BASIN SEDIMENTS?

GAMMA
1/2" x 1/2" CRYSTAL
G.S.R. = 1.5

LEGEND
SYMBOLS: AS FOR ORIGINAL LOGS.

OXIDISED
MIXED
REDUCED
NEUTRON - NEUTRON LOG.

G.S.R. - GRAIN SIZE RATIO = \( \frac{M - C9}{F.G. + SILT/SEIME} \)

PLATE 2

AFMCO PTY. LTD.

DRAWN:
M. Johnson

DATE:
February 1981

GEOLOGY:
D.J. French

APPROVED:

SCALE:
Vertical - 1:1,000
Horizontal - 1:100,000

FINKE AREA - NORTHERN TERRITORY

GEOLOGICAL SECTION