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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1969 / 150

Geophysical Survey of Diamond-drill Holes at Chewton, Victoria 1968

by

B.B. Farrow

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ILLUSTRATIONS

SUMMARY

Drill core testing for induced polarisation effects and geophysical drill hole logging were carried out by the Bureau of Mineral Resources on three diamond-drill holes in the Chewton area, near Castlemaine, Victoria, in the period June to September 1968. The results of these tests suggest that most induced polarisation anomalies in the area are caused by carbonaceous shales.

1. INTRODUCTION

A survey had been conducted by the Bureau of Mineral Resources (BMR) in the Chewton area, Victoria (Plate 1) in February and March 1967 (Farrow, 1968) in which an attempt was made to apply geophysical methods to the search for gold-bearing reefs. The induced polarisation (IP) method gave the most promising results, and three diamond-drill holes were drilled by the Victorian Department of Mines in the period June to September 1968 in order to test the geophysical interpretation. Two of the holes (Chewton 72 and Castlemaine 3) were drilled on an IP anomaly in the Mona area, and one (Chewton 73) based partly on IP indications and partly on geological grounds, was drilled on reconnaissance Traverse C to the south.

The area was visited on the completion of each hole by geophysicist B.B. Farrow, who was accompanied on his second visit by geophysicist M.J. Smith. Samples of core were tested for IP effect and the drill holes were logged with resistivity, self-potential, and gamma-ray probes. The results are presented in this report.

2. PREVIOUS WORK

The geology of the Chewton goldfield has been described by Baragwanath (1903) and Thomas (1940; 1953), and is summarised in the report on the geophysical survey (Farrow, 1968). Essentially the structure comprises alternate beds of shale and sandstone tightly folded into north-trending anticlines. Gold occurs in quartz reefs, frequently associated with strike faults and usually accompanied by pyrite.

It was hoped to delineate these pyritic bodies with the IP method and, following a test survey in 1965 (Williams, 1965), the author conducted a detailed geophysical survey in February and March 1967 (Farrow, op. cit.). An IP anomaly was outlined in the Mona area, and diamond-drill holes were recommended to establish the cause of the anomaly.

Three drill holes were put down in the Chewton area by the Victorian Department of Mines, two on the Mona IP anomaly and one on reconnaissance Traverse C. The location of the drill holes is shown in Plate 1.

3. METHODS

Samples of drill core were spot tested for IP effects using the following semi-quantitative time domain method devised by BMR. The sample was placed in a plastic bowl over four short, parallel line electrodes, equally spaced one inch apart. The bowl was filled with water and a current from a dry cell passed between the two outer electrodes. The voltage decay between the two inner electrodes after the current had been switched off was recorded on a Mosely X-Y plotter, model 2D. The ratio of remanent voltage one second after switching off to the voltage immediately before switching off was recorded as the "apparent chargeability" and expressed in millivolts per volt. The method is described further by Haigh and Smith (in prep.). Samples were selected for testing at about five-foot intervals along the cores, taking care to test all variations in rock type.

All drill holes were logged with a Widco 2000-foot logger, giving logs of single-point resistance and self-potential. Gamma-ray logging was not successful on drill holes Chewton 72 and Castlemaine 3 because of a faulty probe, but drill hole Chewton 73 was logged successfully.

4. RESULTS

The geological and geophysical logs for drill holes Chewton 72 and Castlemaine 3 are shown in Plates 2 and 3 respectively; the results of the IP testing also are shown as bar graphs. No lode material was intersected by the drill holes, and most of the samples tested showed no significant IP activity even when pyrite was visible in the sample. However, short sections of soft, black carbonaceous shale gave a very high IP response with values of apparent chargeability up to 400 mV/V. The total amount of black shale in the core from the first hole (Chewton 72) was considered to be insufficient to account for the IP anomaly at the surface. A second drill hole (Castlemaine 3) was put down vertically onto the same target on the assumption that the first had passed below the source. The core from this drill hole gave IP results similar to those of the previous drill hole: just a few feet of very reactive black shale and no sulphide mineralisation of the type expected. At this stage the two drill holes were logged with resistivity and self-potential methods. The logs showed a large difference in resistance between the sandstones and shales, with generally high resistances throughout, indicating low groundwater conductivity. It is also evident from the logs that the reactive black shales give a characteristic response with low resistance and large positive self-potential readings. Thus it was possible to infer the existence of more reactive black shale in the drill hole than appeared in the core.

A cross-section at 900N of the Mona anticline was constructed by correlating the sequences in the two drill holes with the surface geology and is shown, together with the IP survey results, in Plate 4. When the section was compared with the IP survey results it became plain that the Mona IP anomaly was caused almost entirely by the carbonaceous shales, since they correspond approximately in depth and position to the inferred source. Although these shales make up but a small part of the rock sequence, occuring as thin beds, they exhibit a very high induced polarisation effect, and because of their low resistivity would constitute a preferred current path.

The third drill hole (Chewton 73) on reconnaissance Traverse C was put down on a target in the eastern limb of the Blacksmiths Gully, Specimen Hill, and Chewton anticline (Plate 1) where there was an IP anomaly. This anomaly was less definite than the Mona anomaly but geological conditions were considered to be favourable for a quartz reef to occur.

The core from this drill hole contained but a few inches of quartz, minor pyrite, and a few bands of the reactive carbonaceous shale. As previously, the geophysical logs (Plate 5) indicated more of this shale than appeared in the core, although the logs were less satisfactory because of the low angle with which the drill hole intersected the bedding (about 12 degrees). In this case also the IP anomaly can be attributed to the carbonaceous shales.

The gamma-ray log also is shown in Plate 5. Logging was not possible below 537 feet depth owing to a decrease in the diameter of the hole. The log shows a general increase in activity in the shales compared with the sandstone, but there is no distinction between the normal shale and the carbonaceous shale. The general level of radioactivity was about 0.006 milliRöntgens per hour.

5. CONCLUSIONS

It is evident that, in the two areas drilled, the IP anomalies were due almost entirely to carbonaceous shales and not pyritic quartz reefs. It is reasonable to assume that many of the other IP anomalies in the Chewton area are caused by similar material. The conclusion to be drawn is that the IP method cannot be used successfully to delineate gold-bearing reefs in the Chewton area.

6. REFERENCES

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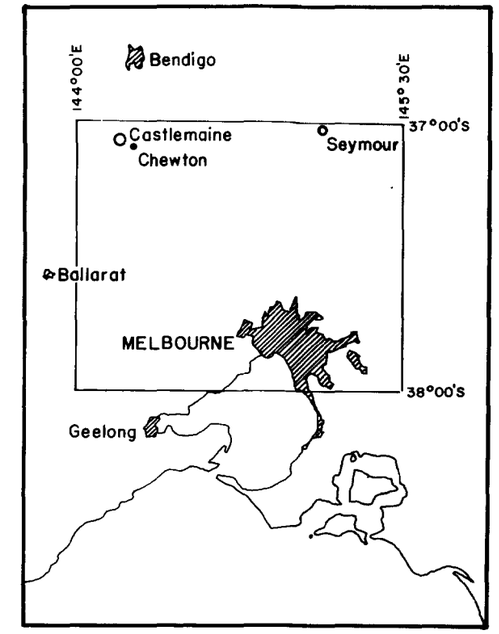
PLATE I



REFERENCE TO AUSTRALIA STANDARD 1:250,000 MAP SERIES: MELBOURNE

LEGEND

- Traverse, Mona Area
- IP Reconnaissance Traverse
- Anticlinal Axis
- Lease Boundary
- Railway
- Fault
- Road
- Track
- Definite IP Anomaly
- Possible IP Anomaly
- Shaft
- Diamond-drill hole

GEOPHYSICAL SURVEY, CHEWTON, VICTORIA LOCALITY MAP

SHOWING GENERAL GEOLOGICAL STRUCTURES, I P ANOMALIES AND DIAMOND-DRILL HOLES

FEET

1000 500 0 1000 2000

TO ACCOMPANY RECORD No. 1969/150

J55/B7-13-1

PLATE 2

SELF-POTENTIAL LOG

50 millivolts

GEOLOGICAL LOG

SINGLE-POINT RESISTANCE

2000 ohms

Surface

DEPTH (feet)

50 100 150 200 250 300 350 400 450 500 550

Joint
29°
Pug
31°
31°
28°
Limonite stain
23°
27°
29°
30°
27°
29°
Fault zone?
32°
28°
31°
28°
25°
20°
22°
27°
25°
Distorted
19°
37°
32°
45°
42°
43°
37°
42°
39°
47°
42°
38°
Fault zone?
30°
45°
45°
BXM
AX
48°
45°
45°
50°
44°
47°
38°
30°
27°
27°
27°
26°
28°
519'2"

LEGEND

Apparent chargeability of core
1" = 200mV/Volt

Alluvium

Sandstone

Shale

Bedding angle to core axis 28°

Quartz stringer

Zone of high IP effect recognisable in core.

Zone of high IP effect interpreted from log.

TROPARI

Depth	Bearing	Depression
264'00"	S84°W	-60°W
500'00"	S85°W	-55°W

DDH CHEWTON 72
GEOLOGICAL AND GEOPHYSICAL LOGS

TO ACCOMPANY RECORD No. 1969/150

J55/B7-18

PLATE 3

SELF-POTENTIAL LOG

50 millivolts

GEOLOGICAL LOG

SINGLE-POINT RESISTANCE

2000 ohms

SURFACE

50

100

150

200

250

300

350

400

450

500

DEPTH (feet)

21° 21° 24° 15° 21° 35° 29° NX BX 27° 26° 25° 28° 25° 30° 28° 36° 39° 44° 40° 41° 38° 38° 38° 39° 38° Fault pu 16° 18° 20° 16° 12° 10°

501' 4"

LEGEND

Bedding angle to core axis → 16°

Apparent chargeability of core 1"=200mV/Volt

Alluvium

Sandstone

Shale

Quartz stringer

Zone of high IP effect recognisable in core

Zone of high IP effect interpreted from log

TROPARI

Depth	Bearing	Depression
Surface	—	Vertical
450'0"	W 72°E	86°

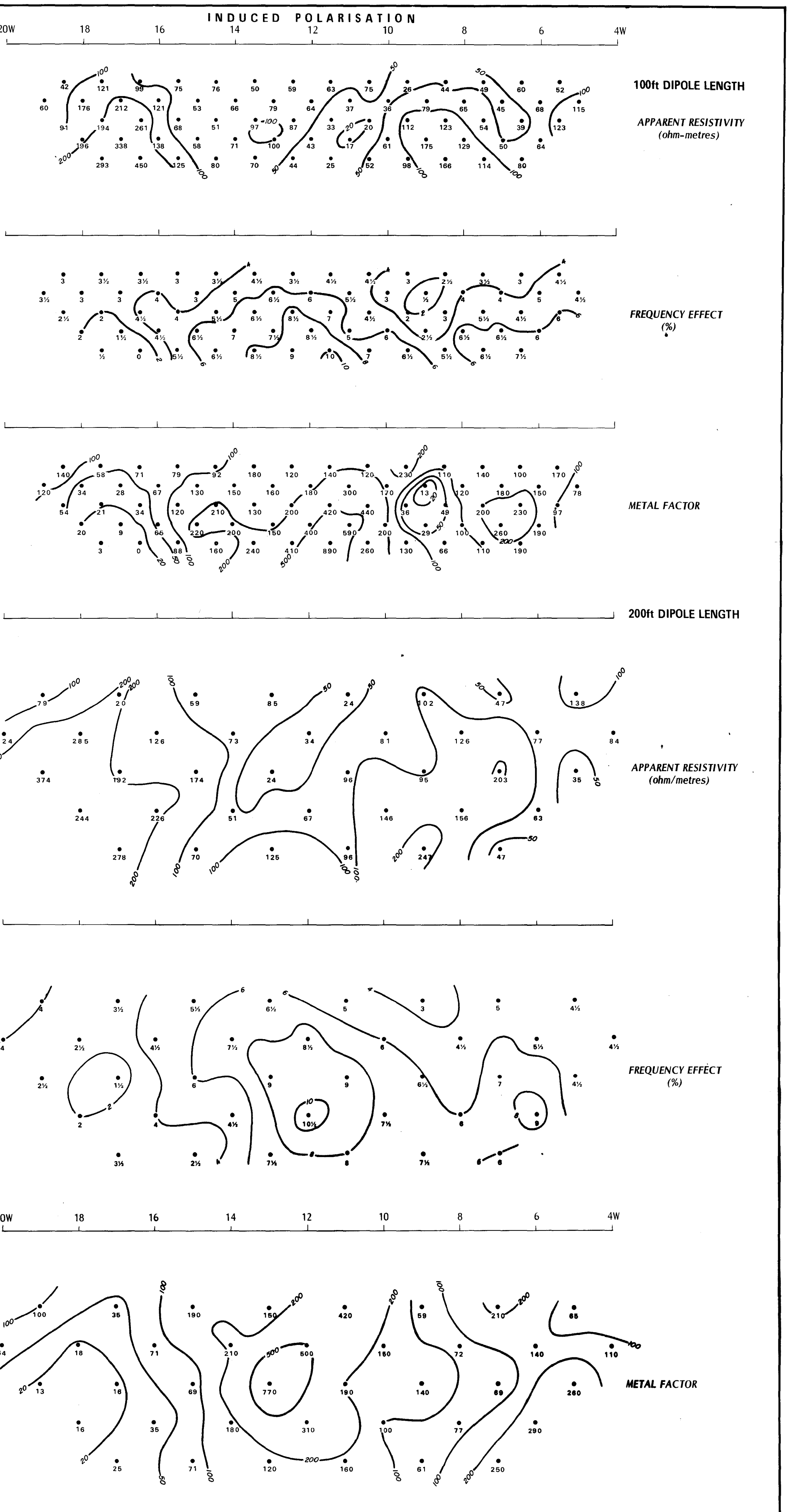
DDH CASTLEMAINE 3
GEOLOGICAL AND GEOPHYSICAL LOGS

TO ACCOMPANY RECORD No. 1969/150

J55/B7-17

CHEWTON VIC. 1968

INDUCED POLARISATION



GEOLOGICAL SECTION

TRAVERSE 900N

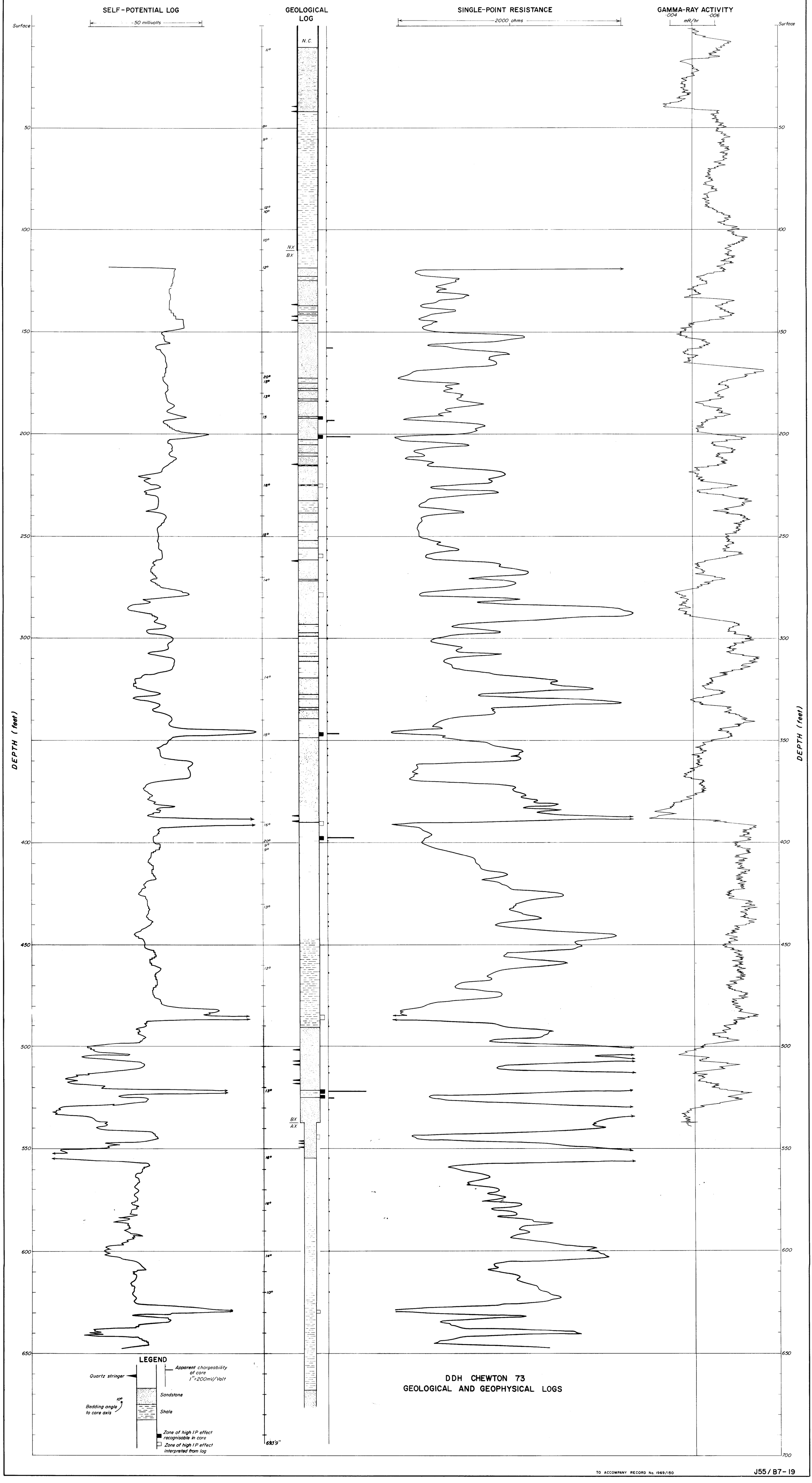
GEOPHYSICAL PROFILES AND DRILLING RESULTS

(Based on J55/B7–16)

TO ACCOMPANY RECORD No. 1969/150

J55/B7–20

PLATE 4



DDH CHEWTON 73
GEOLOGICAL AND GEOPHYSICAL LOGS