DEPARTMENT OF MINES
SOUTH AUSTRALIA

GRAVITY INVESTIGATIONS

IN THE LEIGH CREEK AREA

OF SOUTH AUSTRALIA

by

D.M. Begum, B.Sc.
Geophysicist

GEOPHYSICS SECTION
GEOLOGICAL SURVEY OF SOUTH AUSTRALIA

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ABSTRACT:

Gravity surveys have previously been made in The Leigh Creek Area in Northern South Australia, a region in which Triassic coal basins occur, underlain by Precambrian and Cambrian sediments and overlain by more recent deposits. The results of these surveys have been re-examined and new gravity stations have been established to fill gaps in the coverage of previous work. It is concluded that the gravity method has been proved successful at Leigh Creek, that further investigation of at least one of the anomalies found previously is warranted, and that the survey should be extended into areas considered geologically likely to contain further coal basins.

INTRODUCTION:

The Leigh Creek Coalfield lies on the main northern railway 360 miles north of Adelaide in South Australia. Triassic coal deposits were discovered towards the end of the last century and have been actively worked since 1943.

A review of the coal exploration carried out by the South Australian Mines Department in the area has shown that there is scope for a further search for additional coal basins. As a first step in this work the results of previous gravity surveys carried out by the Commonwealth Bureau of Mineral Resources and The South Australian Department of Mines have been reduced to absolute values, replotted and recontoured. 140 new gravity stations were established to cover gaps in the coverage of the previous surveys. The work which forms the subject of this report was carried out in February 1961.

Leigh Creek Coalfield" by L.W. Parkin (1953) in which references are given to previous work.

The earliest rocks present in the area are those of the Adelaide Geosyncline. They form a complete sequence of the Adelaide System (Precambrian) and overlying Cambrian Rocks, and consist of quartzites, dolomitic slates, dolomites, magnesite beds, arkosic sandstones, grits, boulder tillites, slates, flagstones, limestones and sandstones. These rocks were subject to intensive orogeny and were peneplaned prior to the Triassic.

The Triassic coal measures consist of a thin basal grit overlain by a series of grey shales, carbonaceous shales, and coal seams with interbedded sandy shales and occasional sandstones and have a total thickness of over 2000 feet. Subsequent to the deposition of the coal measures there was extensive erosion and regional downwarping with pronounced local buckling and folding of the floor leading to the preservation of the present coal basin remnants with steep dips and folded structure.

The Post-Triassic history of the area is obscure. Possibly Jurassic sandstones and quartzites outcrop to the south of Copley. In the Telford area and northward the coal measures and basement rocks are overlain by a coarse conglomerate approaching 20 feet in thickness, and to the north of the Northern basin an extensive plateau of gypseous clays and sands occurs, capped by "gibber" formation of case-hardened quartzite and some sand ridges.

PREVIOUS GEOPHYSICAL WORK:

Regional gravity surveys were carried out between 1947 and 1952 by the Commonwealth Bureau of Mineral Resources and the South Australian Mines Department. References to all the original reports are given in Geol. Survey of South Australia, Bulletin No. 31 "The Leigh Creek Coalfield" by L.W. Parkin (1953).

The initial surveys were made with a gradiometer and

and 3 milligals in the Northern basin. The coal seams were also found to produce an appreciable effect on gravity profiles across their outcrop. The detection of the anomaly due to the coal was found to require closely spaced gravity observations along the line of traverse and this was only carried out in limited areas.

A regional survey was commenced with stations located on a half mile square grid and a considerable area to the north of the known basins was covered. A number of negative anomalies were discovered comparable to that over the Northern basin. Six vertical boreholes were drilled to test the gravity anomalies. Four of these reached bedrock at shallow depth but the other two failed to reach bedrock at 300 feet. Presumably they located bedrock depressions although both bores failed to intersect coal-bearing formations.

Resistivity measurements were also made in the Leigh Creek area by the South Australian Mines Department in an attempt to measure the depth and thickness of the coal seams. No satisfactory result was obtained as there was insufficient differentation of resistivity between the coal and overlying and underlying shales and sands.

PRESENT SURVEY

The gravity stations established in all the previous gravity surveys were plotted and absolute gravity values were determined by tying the surveys to the Pendulum Station established at Leigh Creek Airport by the Commonwealth Bureau of Mineral Resources in 1950-51. A value of 979-3204 gals was used for this station. An elevation correction of 0.068 milligals per foot, the value used for all previous surveys, was used. 140 new gravity stations were established on a half mile square grid to fill in gaps in the previous coverage to the west and northwest of the Northern basin and between the Northern and Telford basins.

The Bouguer anomaly values for the entire area were recontoured and a plan was prepared showing the positions of the gravity stations (with values) the contours of Bouguer gravity

anomaly, and the areas of basement outcrop.

RESULTS AND RECOMMENDATIONS:

The extension of the survey did not reveal any significant gravity anomaly but from the recontouring of the previous results it would appear that the northernmost anomaly found, some 6 miles southeast of Farina is probably very similar in character to the anomaly over the southern basin. The anomaly is one of those previously drilled and bedrock was not reached at a total depth of 315 feet.

It is recommended that stations on the half mile square grid be extended to the Precambrian outcrop in this area. Further investigation of the anomaly could be made by drilling to bedrock in the centre of the anomaly or by running a number of detailed gravity traverses across the anomaly with closely placed and accurately levelled gravity stations, in an attempt to locate directly shallow coal seams around the margin.

After further investigation has been made of this anomaly consideration should be given to further examination of the other bedrock depression located by gravity survey.

The gravity method has been proved successful in the Leigh Creek area in that it located two probable basins as yet incompletely tested. It is recommended that regional gravity surveys be extended into other areas in the Leigh Creek district considered geologically likely to contain further coal basins.

D M Pegum

D. M. PEGUM
GEOPHYSICIST

DMP:PAL
10/3/61

30° 5′

138° 10′

138° 30′

G.A.17
160′
5
315′
-35
-30
-25
Hut
G.A.18
80′
-20
4
50
Avondale H.S.
6
400
G.A.16
160′
Creek
Leigh
-20
LYNDHURST
Lyndhurst R.S.
Dam
Mundy
Creek
1
115
Tin Hut Dam
2
50
G.A.15
160′
G.A.8
80′
New Railway Line 4′-8½″
Old Railway Line 3′-6″
Main Road
N2
-15
3
114
G.A.14
20′
G.A.9
100′
N1
G.A.7
60′
Mt. Playford Well
G.A.10
60′
NW1
G.A.11
40′
G.A.12
6′
Donaldson Tank
G.A.13
3′
Myrtle Springs H.S.
Telford R.S.
LEIGH CREEK
-10
COPLEY

LEGEND

Areas of basement outcrop

Rotary Drill holes with depth to basement — G.A.15 160′

Boreholes with depth to basement — 6 400

Early exploration drill holes (no coal intersected) — N1

Contour interval 1 milligal — -25

Gravity Station

Datum Arbitrary. To convert to absolute values (based on Leigh Creek Pendulum Station 979·3204 milligals) subtract 810 gravity units.

SCALE IN MILES

1 0 1 2 3 4 5 6 7

61-108 D. Pegum Geophysicist S.A. Dept of Mines

30° 35′