GRAVITY SURVEY

of the

749-08-04-001

LA BICHE RIVER AREA, YUKON - NORTHWEST TERRITORIES

PHASE ONE

60° to 61° North latitude
124° to 125° West longitude

by

OVERLAND EXPLORATION
SERVICES (1969) LTD.

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INTRODUCTION

During part of September and October 1972 Overland Exploration Services (1969) Ltd. conducted a gravity survey in the La Biche River area of the Yukon - Northwest Territories. Actual location of the survey was between 60° and 61° North latitude, and 124° and 125° West longitude. An area of approximately 2,500 square miles was covered in this Phase One.

A Hughes 500 series helicopter was obtained from McCord Helicopters Ltd., Calgary and was used to move the gravity meter operator from station to station within the project area. The base camp was established at the west end of the Beaver River airstrip and all operations were conducted from this locality. Gravity stations were established at suitable helicopter landing spots throughout the area and in all approximately 740 stations were recorded. All the usual corrections were applied to the gravity data and in addition, terrain corrections to the "M" ring were made on every station.

The results of the survey are shown on a Bouguer Gravity Map, a Ring Residual Gravity Map and a Second Vertical Derivative Gravity Map. All three maps are machine contoured on a scale of 1:100,000. The data was digitized by CDP Computer Data Processors of Calgary, who also prepared the three machine contoured maps.

Gravity readings were recorded with a LaCoste & Romberg Model G gravity meter and station elevations were established by altimeters. Three altimeters were carried by the meter operator and read at each gravity station. In addition, a second

altimeter operator was stationed on one side of the work area each day and a recording barograph was stationed on the other side. By recording the barometric changes at two base stations located on each side of the work area accurate elevations can be obtained by the use of altimeters.

GENERAL GRAVITY STATEMENT

Exploration by gravitational methods is the technique of measuring the differences or deviations of the gravitational field at the earth's surface and using the data thus obtained to predict subsurface features. Gravitational methods are analogous to magnetic methods in that quatitative investigations are made of a natural field of force. The physical property of the subsurface materials which produce the significant or diagnostic gravitational anomalies is density of subsurface materials; it is necessary that they be of large enough magnitude to overcome the effects of near-surface, topographic and regional effects. The magnitude of any gravity anomaly is dependant upon the density, geometric configuration, depth and location of the structure with reference to the point at which the effect of the structure was measured.

If the earth were a homogeneous, stationary, isolated sphere, the sphere would exert a radial force on objects at its surface and the force per unit mass would be the same at all points on its surface. However, the earth is neither homogeneous, stationary, isolated nor spherical. The result is that the force of gravity per unit mass varies, both in direction and in magnitude, from place to place and from time to time. Furthermore, data on gravitational anomalies furnish information about the deviation of the earth from a homogeneous, stationary, isolated sphere. Interpretation of the field measurements made in gravity surveying is based on these variations.

The earth's deviation from a sphere is cause by two factors: (a) topographic features, hills, valleys, mountains, etc.; and (b) the oblate spheroid shape resulting from its rotation. This latter factor introduces a variation in the force of gravity which is a function of latitude. This variation plus the effect of the centrifugal force of rotation are usually combined and called the "latitude, or north-south correction". From a knowledge of the mean shape of the earth and its speed of rotation, the latitude correction may be calculated mathematically; the correction amounts to about $1/194 \sin.^2$ (latitude).

In the survey conducted in the La Bicha River area, Yukon-Northwest Territories, the "Relative Gravity" was the value recorded and calculated. It is the value of gravity at any station in reference to the known or assumed absolute value of gravity at some base station. Direct determination of the relative gravity with a gravity meter consists of "weighing" the same object with very great precision, at various localities. The weight of an object at any location of the earth's surface is equal to the force of attraction exerted by the earth on the object. That is, the weight is equal to the product of the mass "m" of the object (which remains the same at all locations) and the acceleration "g" due to gravity. Hence, the weight of a constant mass "m" at any station is affected by the nature of the subsurface materials. For example, it is larger at stations where the subsurface material is relatively dense. The observed changes in weight are very small, being of the order of one part in ten thousand, or one part in ten million of the total value of gravity.

TECHNICAL DATA

Bouguer Free-Air Correction Constant	– 0.0609
Latitude Corrections	– 6080.00 ft/mg.
Density	– 2.6
Diurnal Drift	– Taken from base plots
Terrain Corrections	– Taken to "M" ring every station
Meter Number	– LaCoste & Romberg 239
Meter Constant	– 1.06473
Base Value	– Arbitrary value of 500 milligals
Datum	– Sea level

BOUGUER GRAVITY MAP

The Bouguer Gravity Map shows the total gravity intensity and contrast in gravity emanating from all depths from the surface to the earth's core. In most cases, especially where the sedimentary rocks are flat-lying, the Bouguer Gravity values must be refined in order to enhance the appearance of gravity anomalies which emanate from shallow depths. However, in the area covered by the present gravity survey the density contrasts in the upper 10,000 to 15,000 feet of sedimentary rock are so great that they completely dominate the Bouguer Gravity Map and this map becomes useful as a Residual Gravity Map.

Reference to the Bouguer Gravity Map and surface geological maps of the area shows that in many cases there is a strong coincidence between positive gravity features on the Bouguer Gravity Map and structural highs on the geology map. Similarly, areas of mass deficiency (i.e. gravity lows) are often coincident with synclinal areas on the geology map. Because of the length and breadth of the geological features present within the area and the mass of rock involved in them we have prepared a single ring residual and second vertical derivative map, both of which are focused at a depth of 10,000 feet below average surface elevation. These maps are similar in appearance and the second vertical derivative map is the most useful of the two and it will be discussed in the next section of this report.

SECOND VERTICAL DERIVATIVE MAP

The Second Vertical Derivative Map has been coloured so as to better illustrate the areas of high and low gravity. Areas of gravity low have been coloured yellow and the blue shows the areas of gravity high. We have also shown in red pencil the axes of known surface geological features such as anticlines, synclines and faults. A legend at the bottom of the map will serve to identify these features.

It should especially be noted that the gravity highs are coincident with surface anticline features and areas of low gravity appear to be coincident with synclinal areas. The coincidence of geology and gravity is so strong that where there is any contrast between the two we would recommend that further work should be done to clarify the discrepancies. Two such areas are immediately north and then immediately east of the C.P.O.G. La Biche River well where gravity highs on the Second Vertical Derivative Map do not correspond directly with surface anticlines. We would recommend that more work be done in both these areas. In addition, more work should be done on the west side of the Phase One map so as to provide some indication of the west side of the large gravity high which shows up on the Bouguer Gravity Map. This feature is not mapped by the Second Vertical Derivative Map or the Ring Residual because it is located too close to the edge of the data and the computer program will not honour any point which cannot be completely enclosed by the gradicule.

This present survey will be extended to the north and northeast in the 1973 field season.

William H. Crook
PRESIDENT