GL01047

GRAVITY AND MAGNETIC SURVEY OVER THE HUMBOLDT SALT MARSH DIXIE VALLEY, NEVADA

DOW CHEMICAL COMPANY

EXPLORATION DATA CONSULTANTS, INC.
DENVER, COLORADO
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LIST OF MAPS

Map	Scale	Contour Interval
Bouguer Gravity	1/62,500	1 mgal
Bouguer Gravity	1/24,000	1 mgal
Total Magnetic Intensity	1/62,500	40 gamma
Total Magnetic Intensity	1/24,000	40 gamma
Bouguer Gravity (Profile Locations and Fault Locations Interpreted from Gravity)	-	-

INTERPRETIVE PROFILES

Profile	Scale
AA'	1/24,000
BB'	1/24,000
CC'	1/24,000

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INTRODUCTION

Gravity and magnetic data were acquired in Dixie Valley, Nevada during the period October 30 through November 10, 1976. Much of the control was acquired over the muddy, salt marsh surface using a light-weight, wide-tired vehicle.

The principal results of the survey work are a Bouguer gravity map, a magnetic total intensity map, and three interpretive profiles showing the depths to the high-density basement along east-west lines across the valley.

DATA ACQUISITION

INSTRUMENTATION

Gravity Meter

The gravity meter used for this survey is a LaCoste and Romberg Model G Meter, number G-353. The gravity meter is equipped with variable damping and an electronic readout which facilitate reading the gravity meter in noisy environments. LaCoste and Romberg gravity meters are characteristically low drift instruments typically drifting approximately one milligal per month. During the period of this survey, meter G-353 drifted less than one milligal.

Magnetometer

A Geometrics Model G-836 "UniMag" was used for this survey. The UniMag has a digital readout that displays the total magnetic intensity to the nearest ten gammas. The resolution and repeatability of the instrument is ten gammas.

Surveying Instruments

With the exception of 26 stations, elevations for all of the gravity and magnetic stations acquired were surveyed using a Hewlett Packard Model 3810A Total Station surveying instrument. Three basic measurements are made using the 3810: slope distance to target, vertical angle to target, and horizontal angle. The slope distance measurement is accomplished by a phase comparator system where amplitude modulated infrared light is transmitted from the instrument and reflected back to the instrument by a retroprism at the survey target. The distance measurement is based on measurements of phase lag of the returned light at low and high frequencies. The instrument is capable of distance measurements to an accuracy on the order of one part in 100,000.

The vertical angle measurement is derived from the output of a fluid filled transducer. Both the slope distance and vertical angle are converted to digital form within the instrument. Through calculator circuits the instrument will display not only the basic measurements of vertical angle and horizontal distance but also vertical and horizontal distance to the target. The accuracy of elevation measurements made using a total station instrument is limited by the accuracy of the vertical angle measurement which is plus or minus 30 seconds at best.

The instrument is mounted on a 20 second horizontal angle circle similar to that used in many theodolites. The horizontal angle is read through a microscope mounted at the base of the instrument.

Elevation control for stations acquired in the mountains as well as station number 131 was obtained using an American Paulin model M-2 surveying altimeter. The M-2 surveying altimeter is marked in two-foot graduations and has a resolution of one foot. When measurements are carefully made, the altimeter has a repeatability of two feet. Surveying accuracy suffers relative to short-term repeatability because of local and time-dependent changes in barometric pressure not related to changes in elevation. In rugged topography, the expected accuracy of elevations obtainable using altimetry is on the order of 15 to 30 feet.

SURVEY VEHICLES

Two conventional four-wheel drive vehicles plus a light-weight, wide-tired Honda Odyssey were used during the survey. The Honda is a one passenger recreational vehicle designed for sand dunes. The vehicle weighs approximately 400 pounds and is supported by low pressure, high flotation tires approximately 10 inches wide. The Honda provided access to the area near the center of the salt marsh which was inaccessible by conventional four-wheel drive vehicles. The Honda is capable of passing over muddy areas where walking is difficult because of the softness of the mud. In the four instances where the Honda became stuck, knee-deep mud seriously hindered walking and extracation efforts.

FIELD OPERATIONS

Field operations began on October 30, 1976, when a base network of four base gravity stations was established. Three base stations were established on the west side of the valley and one base station on the east side of the valley. The base stations are numbered FB-1, FB-2, FB-3, and FB-4 on the gravity and magnetic maps. The general mode of operation was to first survey in station locations using the Hewlett Packard surveying instrument. On most days the survey crew consisted of a rod man and a surveyor/gravity meter operator. The rod man would position a tripod with retroprism reflector and target at each station location. While instrument readings were being made by the surveyor, the rod man would walk approximately 100 feet away from his vehicle and read the magnetometer. Near the end of a day of surveying the gravity meter operator would read the gravity at the surveyed stations while the rod man would make repeat magnetometer readings, repeat altimetry readings, or prepare for the next day's surveying.

Work on the salt marsh went slowly, mainly because of time lost because of the vehicle becoming stuck in the mud. Also, only one vehicle could be used on the salt marsh surface so that it was necessary for the rod man to come back and pick up the instrument and surveyor each time the instrument had to be moved to a new location.

The target and retroreflector were mounted on the Honda at a fixed distance above the ground. Typically three to four station locations were surveyed from a single instrument set up.

In the eleven days of survey work, 211 stations were acquired. The weather conditions during the survey period were excellent and the only serious hindrance to survey station production was poor accessibility to many of the stations. As many as 35 stations were acquired in a single day where access is along roads on the west side of the valley. Unfortunately the salt marsh was wetter than normal during the survey period because of a flash flood and heavy rains during September. In an extremely dry year, most of the salt marsh surface is accessible by conventional four-wheel drive vehicles. However, during the survey period the center four to six square miles of the salt marsh was under water and inaccessible with the Honda. Many stations were acquired at the water's edge on the salt marsh. Because of the water and the softness of the underlying mud, additional coverage nearer the center of the salt marsh was virtually impossible to obtain.

DATA REDUCTION

SURVEY DATA

Station locations were plotted relative to benchmarks and other landmarks shown in the USGS 15' Quadrangle Maps. The 15' Quadrangle Maps were photographically enlarged to a working scale of 1/24,000. Locations were plotted in the field and rechecked at the end of each day. Relative locations were plotted based on the horizontal angle measured between the station and a known point and the distance from the station to the surveying instrument. All station locations are estimated to be accurate to within 200 feet.

Station elevations were surveyed from numerous benchmarks along the West Road. Most of the Survey traverses tied to better than one foot. No tie to a benchmark was in disagreement by more than two feet, and the discrepancy between the elevation surveyed from the west side of the valley to the black elevation posted at the Dyer Flat Well is one foot. Where the 3810A Total Station instrument was used it is estimated that the probable maximum survey error is on the order of two feet.

Stations surveyed using the altimeter were located by inspection on the topographic maps. The probable maximum location error is 300 feet and the probable maximum elevation error is 30 feet.

GRAVITY DATA

A base constant for the survey was chosen such that Bouguer Gravity values (before terrain correction) at benchmarks agreed with those published by the USGS.

Latitude corrections were computed using the 1930 International Gravity Formula.

Terrain corrections were made to Hayford Bowie Zone I. Three test corrections were made to determine the relative terrain correction error incurred by truncating the correction at Zone I. The difference in the total correction for zones J, K, and L taken at extreme locations in the mountains and in the valley is less than two milligals. The variation of this far zone correction over the central area of interest is negligible and would not effect the interpretation of the data. Variation in the terrain corrections to Zone I was significant: the minimum terrain correction was zero mgal and the maximum terrain correction was over 12 mgal.

25 repeat gravity meter readings were made during the survey: 23 of the repeats differed by less than 0.15 mgal's the average difference in the repeats is 0.073 mgal with a standard deviation of 0.077 mgal; the maximum difference in repeated values is 0.33 mgal.

Free-air and Bouguer gravity are listed for three correction densities in the listing of basic and reduced data. Bouguer gravity computed with a correction density of 2.67 g/cc has been mapped.

MAGNETIC DATA

Total magnetic intensity, in tens of gammas as displayed on the magnetometer, has been plotted on the map minus a datum of 53,000 gammas. Repeat magnetometer readings were taken at several stations and in most cases readings did not vary by more than 10 gammas. In cases where repeat readings varied by more than 30 gammas, additional repeat readings were taken and a value close to the two closest readings was chosen. Where a third repeat was not obtained the value which appeared to fit the map most reasonably was chosen.

The magnetic data acquired in the mountains was erratic because of near surface magnetic rocks and judged unmapable given the regional spacing of the control.

INTERPRETATION

PROFILE MODELING

Three interpretive profiles have been constructed along east-west profiles AA', BB', and CC' as shown on the Bouguer gravity map with profile locations and fault locations interpreted from gravity.

A gravity modeling calculation was performed using GF-2, EDCON's two-dimensional grid-oriented gravity modeling computer program. Two-dimensional vertical prisms 2000 feet in width and infinitely long in the directions perpendicular to the profile were used as the basic model elements. The top of each element is at ground level and the base of each element represents the base of the valley fill and the top of crystalline basement.

Before a model was computed a regional gravity field was determined as shown at the top of each profile. The difference between the regional and the Bouguer gravity is the negative residual field attributed to the effect of valley fill contrasting with basement rocks.

A density contrast function was then derived and is shown at the lower right of profile AA'. The sedimentary density-depth function was derived from velocity data taken from the 1965 AFCRL report and an empirical velocity-density relation. The derived sedimentary density-depth function is also shown on profile AA'. An assumed basement density of 2.7 g/cc yields the density-depth contrast function which was used in the calculation of all three profiles.

GF-2 was used to compute the bottom of the valley fill. Input data were: a. top of valley fill at ground level b. a density-depth contrast function c. negative residual gravity. GF-2 is an iterative program that alters the depth of each 2000 foot column in the calculation such that the difference between calculated gravity and the observed negative residual gravity is made as small as possible. The basement surface found by GF-2 is shown on the profile.

The maximum depth to basement found was just over 7000 feet. This is believed to be a conservative estimate of the maximum depth to basement because of the low densities assumed for the valley fill below 4000 feet. Higher velocity sedimentary and volcanic fill could exist below the intermediate velocity refractor above the basement as a refraction blind zone. Such a situation is likely and would imply higher valley fill densities below 4000 feet and lower density contrast thus requiring a greater thickness of valley fill to satisfy the observed anomaly. The existence of higher density rocks below 4000 feet could only be proven by deep drilling. However, by assuming valley fill densities higher than the 2.3 g/cc used in the calculation such as 2.4 g/cc increasing with depth to 2.5 g/cc, maximum basement depths in excess of 10,000 feet would be calculated

GRAVITY MAP

A Bouguer gravity map with "Profile Locations and Fault Locations Interpreted from Gravity" is included with the maps supplied with this report. The fault locations are based on the profile modeling as well as inspection of the gravity map..

The Bouguer gravity map reflects the general shape of the basement surface as can be seen by studying the interpretive profiles. Faulting on the west side of the valley is quite steep compared to the faulting on the east side. The deepest valley fill occurs in sections 7 and 8 of T22N, R36E where Bouguer gravity is most negative. A strong positive nosing from the east side of the area indicates a major basement structural high.

Sharp, local anomalies observed in sections 11 and 23 of T23N, R35E and section 36 of T24N, R35E are probably associated with shallow faulting and possibly mineralization.

MAGNETIC MAP

Sharp anomalies along the western side of the valley are probably associated with shallow faulting and mineralization. One very sharp, elongate, ESE - trending anomaly correlates with a sharp gravity anomaly in section 11 of T23N, R35E.

The broad magnetic high centered at section 14 T22N, R36E correlates well with the major basement structural high indicated by gravity on the east side of the valley.

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