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BOUGUER ANOMALY MAP OF SOUTH FLORIDA

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INTRODUCTION

This map is based on gravity anomaly values established by the authors at 420 stations during 1968-1970 and an additional 165 stations listed in the Department of Defense's Gravity Library. All values were corrected to the National Gravity Base established at Miami International Airport by the United States Coast and Geodetic Survey in February 1967.

The formula used for calculation of Bouguer anomaly values is:

BA=G observed + 0.06594 (h) - G theoretical

where BA is the Bouguer anomaly in milligals; G observed is the observed gravity in milligals; 0.06594 is a constant resulting from combination of the free air correction of 0.09406 mgl/ft with the Bouguer correction of minus 0.1276 (2.00 gm/cm^3) mgl/ft; and h is the elevation in feet above sea level.

The standard density value used by the Coast and Geodetic Survey in making the Bouguer correction is 2.67 gm/cm^3. This value is suitable in many inland areas of North America where igneous or metamorphic bedrock is overlain by a thin soil cover but in Florida a value of 2.00 gm/cm^3 better represents the density of the material between sea level and the land surface.

Florida lacks sufficient relief to require terrain corrections. For instance at Jay in extreme northwest Florida terrain variations of 200 feet result in a correction of less than 0.1 milligal. The "G theoretical" are the theoretical gravity values interpolated from tables published by the United States Coast and Geodetic Survey for each minute of latitude according to the international formula of 1930.

INTERPRETATION

Gravitational attraction varies from place-to-place around the Earth because the normal terrestrial gravity field is subject to disturbing forces. These variations in gravitational attraction can be measured by a variety of methods. The gravimeter, used in this survey, consists of a spring balance from which a small mass is suspended; the mass remains constant, but its weight varies as the total acceleration of gravity varies from place-to-place. Variations in weight of the mass suspended from the spring can be detected to approximately 1 part in 100 million.

The observed differences are corrected for standard disturbances in the Earth's gravity field caused by its rotation, latitude and elevation changes. The corrected values are plotted on a base map and contoured. The result is a Bouguer anomaly map.

The Bouguer anomaly map of South Florida can be used for interpretations of the regional subsurface structure, particularly by persons acquainted with the subsurface data available from deep oil tests.

The authors intend to describe the anomalies disclosed by this map in forthcoming publications, which will contain additional data. It is anticipated the forthcoming descriptions will help define subsurface structures which may be associated with accumulations of petroleum or other minerals.

CORRECTIONS TO OBSERVED GRAVITY READINGS

The Earth's gravity field is determined in accordance with the simple equation derived by Newton:

$$F = \frac{Gm_1 m_2}{d^2}$$

F=force (acceleration) of gravity in Gals (for Galileo).

G=A constant which, in c.g.s. units, is the attraction in dynes between two (spherical) masses of 1 g. each, when their centers are separated by a distance of 1 cm.

m_1=Earth's mass

m_2=Mass of object under investigation

d^2=Distance squared between m_1 and m_2.

If the Earth were a true sphere, homogeneous throughout, the measureable disturbing gravitational forces at any point on its surface include only the sun, moon, and centrifugal force of rotation. However, the earth is not a sphere; it approximates an ellipsoid of revolution, and the density of the Earth from its center outward decreases. The crustal material is not concentrically homogeneous like "the layering of an onion" but varies from place to place with the rock type present. Furthermore, tectonism causes vertical and horizontal displacements of different rock types, thus effecting densities from place-to-place, which in turn effects gravity values. Moreover, as the elevation of a place of gravity measurement is related to its distance from the center of the earth's mass, the difference between the elevation and the surface, or sea level, effects the gravitational attraction. The changes in elevation are not due solely to raising or lowering the instrument with regard to sea level, but rather to variations of elevation caused by topographic features, such as hills and lakes. These features are composed of rock or water and have mass, consequently the "free air" correction due to distance from the Earth's center of mass must be modified by a deduction of the added mass of the material interposed between the center of the Earth and the elevation above or below sea level. This is designated the Bouguer correction.

In order to utilize gravity measurements for interpretation of the distribution of subsurface rock masses and their structural attitude, the following corrections to the observed gravity values, measured at each point of observation, are made:

1.) "Drift" correction: this is to eliminate the combined effect of the disturbing Solunar tidal forces and diurnal instrument drift caused by temperature and barometric changes. Relaxation of spring tension, whether gradual or rapid, is an effect known as "tares" rather than diurnal drift. It can be detected by repeated measurements between stations.

2.) Latitude correction: The figure of the earth has been calculated as a theoretical ellipsoid of revolution about its axis minor (polar). A theoretical value of gravity for each parallel of latitude, at sea level, can be calculated from the figure of the theoretical ellipsoid. Differences between theoretical values of gravity and measured values are applied in the formula previously quoted to obtain resultant Bouguer anomaly values.

Reference: Theoretical gravity at sea level for each minute of latitude by the International Formula G53, 1942, U.S. Department of Commerce, Coast and Geodetic Survey, Washington, D.C.

EXPLANATION

Location of Gravity Station.

6 — Contour line showing positive Bouguer Anomaly Value.

-2 — Contour line showing negative Bouguer Anomaly Value.

Contour Interval = 4 Milligals.

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