GRAVITY METHOD OF PROSPECTING: BASIC PRINCIPLES OF GRAVIMETER.

Disclaimer:

This presentation is a part of the assignment for MSc III Semester Mineral Exploration theory paper. This is an attempt to enable the students to collect and review the literature, prepare powerpoint presentation and present the work, independently. The data and literature used here has been taken from various sources, and duly acknowledged. This can help as a guideline, and should not be treated as final.

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INTRODUCTION

- It is based on the masurment of density contrast between the anamoly producing body and the surrounding rocks may be used for exploration of minerals(metalic and non-metalic) ground water, oil and gas.
- Gravity method make use of the natural gravity field of the earth.
- This method is useful for the exploration of paticularly for heavy mineral Barite and Chromite.
- In exploration of oil and gas gravity survey including aerogravity is used in the reconnaissance stage for finding out thickness of sedimentary columm.

PRINCIPLE

- In gravity method, the nature of distribution of gravity 'g' on the surface is analysed. The gravity is influenced positively if the causative body is heavier, larger and occurs at a shallow depth.

- Thus, in a particular region, if subsurface bodies (such as ore deposit, coal seam and salt domes) whose density are different from the surrounding rock exist, the gravity field deviated from the normal value that is expected if the inhomogenites are not present.

- Newton's law of gravitation states that the mutual attraction force between two point masses (m_1 and m_2) is proportionality to one over the square of the distance between them.
- The law of gravitation ,

$$F = \frac{G\, m_1 m_2}{r^2}$$

- The constant of proportionality is usually specified as G, the gravitational constant.

PARAMETERS

- The physical parameters of gravity which are measured during investigation are:-

1. Variation of gravity field
2. Horizontal gradient of gravity field
3. Curvature of equipotential surface

- The variation in gravity field is measured in **the units of milligals** (one gal= 1000milligal) and the other are measured in terms of **Eotvos units**.

INSTRUMENTS

1. **Pendulum :-**

- The use of the pendulum in gravity measurements is known for quite a long time, and the value of gravity can be obtained from the equation,

Where, $g = 4\prod 2\ n2\ L$

g = gravity (acceleration)

L = length of pendulum

n = No. of oscillations of the pendulum in unit time

- The pendulum has been used in geodetic surveys.

2. **Tortion balance:-**

- In the tortion balance, the most popular design for geophysical work is the Eotvos balance.

- This instrument consists of a beam suspended from a fine wire.

- The beam is either horizontal or inclined and two equal weights are attached to the ends of the beam, either directly or by suspension as illustrated.

3. Gravimeter :-

- This instrument is widely use in oil exploration. Gravimeter is a very sensitive balance it is based directly on Hooke's low is called a stable type.
- The zero-length spring first introduced is the La coste- Rombery gravimeter

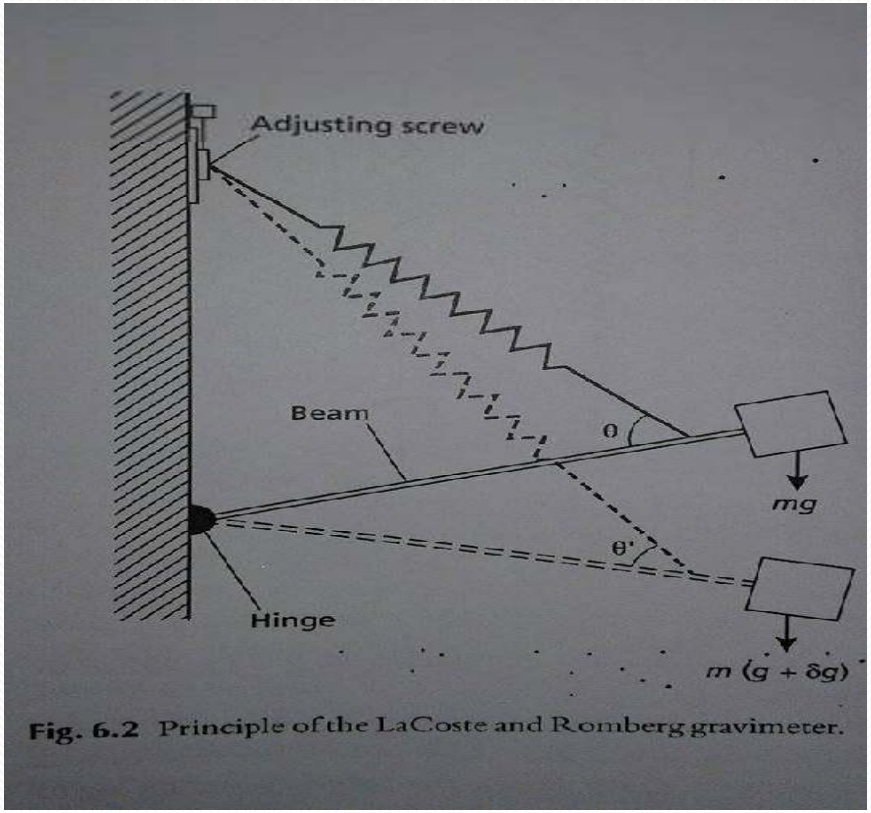

Fig. 6.2 Principle of the LaCoste and Romberg gravimeter.

METHODS

- The different kinds of gravity methods that are followed during the investigation are:-

1. Gravity prospecting (ground)
2. Gravity logging
3. Airborne gravimetery
4. Shipborne gravimetery

- The field gravity data collected on the ground represent the influence of not only subsurface geological causes but also the shape of the earth, topographical irregularities, terrain feature, tidal pulls of sun and moon.
- The field data is first reduced to "geoid" level by applying various correction such as: Lattitude correction, Free air correction, The bouguar correction, Terrain correction, Tidal correction and Drift correction.
- Then the residual 'g' values can be directly interpret to inter subsurface geological causes. This process of appying various correction, which is obviously nessary is know as reduction of gravity data.

Anamoly correction

1. Bouger anamoly:-

- It is Mesured -
  - on land
  - In shore, shallow water ares.
  - Not appropreate for deeper water survey- Large positive Bouger anamoly value without signification change local gravity factor or geographycal origin.
- It must be subtracted from the measured gravity difference if station lie above the level of the basis station and added if lies below.

2. Free air correction:

- the free air correction is apositive quantity, and it is to be added to the measured value, in order to obtain the actual value.
- The free air correction comprises two parts:

a. The determination of the value of gravity, at mean sea level, at the point. This can be obtained from the formula

Where, $go = G\frac{M}{R2}$

M = mass of the earth,

R = radius of the earth.

b. The determination of 'g' the value of gravity, at an elevation of h above the mean sea level.

In the formula is constant for the area.

3. Lattitude correction:-

- The value of gravity incrsed with geographical Lattitude. (978.049 gals equator) (983.221 gals poles)
- The correction most be substracted or added to measure gravity difference depending on whether the station is on a high or lower latityd than the base station.
- For mid latitude the correction is about 0.08 mgal/100m.

APPLICATION

Gravity investigations are useful:-

1. In exploration of ore deposits
2. In solving regional geological problems
3. In sub-surface geological and structural mappimg
4. In exploration of oil and natural gas deposits
5. In solving some enginering problems
6. In the study of isostasy, shape of the earth etc.

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Thank you