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A DETERMINATION OF THE CRUSTAL THICKNESS OF THE EARTH IN THE GENERAL REGION OF ADELAIDE, SOUTH AUSTRALIA

World wide geophysical investigations show that there is a regular relationship between the crustal structure, density, elevations of the continents, and the related gravity anomalies. Such equations were applied to the Adelaide region where the writer carried out both elevation and absolute gravity measurements.

Geophysical work has shown that the earth's crust floats on a vitreous substratum referred to as the mantle. The discontinuity between the outer crust and the mantle rocks is a zone of marked seismological discontinuities and is called the Mohorovicic Discontinuity. Seismological information suggests that the mantle (which is the zone beneath the Mohorovicic Discontinuity) has a constant density of 3.32 grammes per cc., and the mean crustal density increases from a minimum value below the ocean of 2.86 grammes per cc., to 3.08 grammes per cc., beneath the high plateaus and mountains.

In spite of the fact that geophysical work shows that the earth's outer crust is the region of the greatest density variations, never-the-less regional isostatic balance occurs everywhere on the earth's surface, and consequently a regular relationship between crustal structure, density, elevations of continents and the related gravity anomalies occurs.

In obtaining an average Bouguer gravity Anomaly for the Adelaide Region, the writer determined an average gravity value for a large number of absolute gravity stations located in the region with a Carter gravimeter.

These absolute gravity values are based on an absolute gravity value of 979.7237 gals for the absolute gravity station located at the New Adelaide Observatory. The average Bouguer Anomaly value obtained was -II.2 milligals.

Elevations for these stations were obtained by tieing the stations read with the gravimeter into railway benchmarks by optical and microbarometric measurements. The average elevation was 320 metres.

The Bouguer gravity Anomalies were computed for the gravity stations by subtracting the theoretical gravity values, for the gravity stations, (from the observed gravity values), by applying the 1930 International Gravity Formula, after applying elevation and terrain corrections.

DETERMINATION OF THE CRUSTAL THICKNESS IN THE AREA INVESTIGATED.

(1) Applying Andree's formula,

$$H = 0.1 \Delta g + 30$$

where H is the crustal thickness in Kilometres, and Δg is the Bouguer Anomaly, we obtain a value of 30 kilometres.

(2) Applying Woollard's equation relating elevation and depth to the Mohorovicic Discontinuity, we obtain a value of 34 kilometres.

(3) Applying Woollard's equation relating gravity anomaly and depth to the Mohorovicic Discontinuity, we obtain a value of 32 kilometres. (as these results were graphically represented, the equation is not given.

(4) Applying equation relating elevation and crustal thickness used by the Russian and Chinese Seismologists,

$$H = 33 \tanh. (0.38 \Delta h - 0.18) + 38$$

where H is the crustal thickness, and Δh is the elevation,

we obtain a value of 35 kilometres.

(5) Applying equation relating gravity Anomaly and crustal thickness used by the Russian and Chinese Seismologists,

$$H = 35 (1 + \tanh. 0.0037 \Delta g)$$

where H is the crustal thickness, and Δg is the gravity anomaly,

we obtain a value of 36 kilometres.

(6) Applying Heiskanen's and Vening Meinesz's formula, namely,

$$Tc = T + 4.45h + h,$$

where Tc is the normal thickness of the earth's crust at the place of elevation h,

T is the normal thickness of the earth's crust, and

h is the elevation of the area where the crustal thickness is Tc, we obtain a value of 32 kilometres.

Summarising these results, we have;

CRUSTAL THICKNESS	EQUATION APPLIED.
(1) 30 kilometres.	Andreev's equation.
(2) 34	Woollard's elevation method.
(3) 32	Woollard's gravity method.
(4) 36	Russian and Chinese gravity equation.
(5) 35	Russian and Chinese elevation equation.
(6) 32	Heiskanen and Vening Meinisz equation.

(average - 33 kilometres.)

An average value of 33 kilometres for the crustal thickness in this area is accepted from an analysis of the above results.

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