χ than that given by (1), although attention must be directed to the fact that the determination of indices is seriously affected by possible errors in the observations of f_0E at high latitudes because such data are restricted to large values of χ.

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GEOPHYSICS

Satellite Geoid and the Structure of the Earth

PROF. EGYED postulates[1] that harmonics of low degree of the geopotential arise from undulations of the core–mantle interface, and argues that the correspondence between highs and lows of the geoid surface and the isoporic foci of the vertical component of the geomagnetic field support this view. This argument is surely untenable. First, the correlation between magnetic and gravity fields is weak. This may be shown using either of Izsak's geoids[2,3] and the secular variation of the vertical (Z) or the eastward horizontal (Y) components of the geomagnetic secular variation field for the epoch 1942·5, given by Vestine *et al.*[4]. Values of the geoid heights and the magnetic field components were taken at corresponding 10° intervals. A weak correlation exists between the Y-components and the 'old' geoid but no correlation between any of the others:

Correlated variables	Correlation coefficient
Izsak's old and Z	+0·19749
Izsak's new and Z	−0·00536
Izsak's old and Y	+0·51797
Izsak's new and Y	−0·01935

Only the Z and the Y isopores were chosen because all other geomagnetic maps, whether isoporic or not, do not correlate as well.

Secondly, it does not seem possible to explain the 200 km high corrugation, which Egyed suggests in the core–mantle interface, by variation of chemical composition or temperature differences. As the density difference between the mantle and the core is 4 g/c.c., this undulation implies stress differences of 10^{11} bars, greater than the breaking stress of iron or silicates at ordinary temperatures. If the phenomenon exists, the mechanism must be a hydromagnetic one. The magnetic field at the Earth's surface may only be a weaker secondary field and the toroidal field threading and sustaining these undulations may be much greater. Equating the magnetic and hydrostatic pressures and assuming a density difference, ρ, of 4 g/c.c., a value for g of 981 cm/sec^2 and a value of the undulations' height h to be 2×10^7 cm, then:

$$H = \sqrt{\rho g h 4\pi} \approx 10^6 \text{ öersteds}$$

This value of the toroidal field at the core–mantle boundary is four orders of magnitude greater than those assumed by Bullard and Gellman[5] in their dynamo theory of the field. There is, however, a third and fatal objection to Prof. Egyed's idea.

The geomagnetic field drifts westwards at an average rate of 1/5° per year. Prof. Egyed's hypothesis must mean that the gravity anomaly is also rotating at the same rate of 30° every 150 years. The width of the gravity anomalies is of the order of 30°, so that the geoid surface must rise or fall by 30 m every 150 years. If the mantle is rigid over this short time scale, then this must mean that the ocean-levels change by about 50 m. As there is certainly no such recorded anomalous 'tidal' phenomenon, which, of course, would have flooded major cities, it must be concluded that the geoid does not drift.

In conclusion, the gravity anomalies of low degree arise from density differences in the mantle and it has been shown[6] that these are likely to arise from convection currents and, as a result, it does not seem possible to relate the geoid with the core–mantle boundary.

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THE aim of my article was to show that the theoretical result derived by Cook[1] (that the low-degree harmonics of the geopotential originate from the area of the core–mantle boundary) is in accordance with the results obtained by the reflexions of seismic waves from the core–mantle interface showing undulations of ± 200 km (ref. 2). It was shown also that the order of magnitude of geoid undulations corresponds to the gravity effect of the core undulation.

It was also mentioned that there is a correlation between the distribution of isoporic foci of vertical magnetic intensity and the geoid undulations, a positive centre being found always in the neighbourhood of a positive geoid height, and a negative centre in the vicinity of a geoid depression. This was valid except as to the geoid depression of Antarctica. Prof. Runcorn's remark, that the correlation became worse in the case of the new Izsak–geoid, is true. This can be interpreted, however, according to the results of Cook, in the sense that the

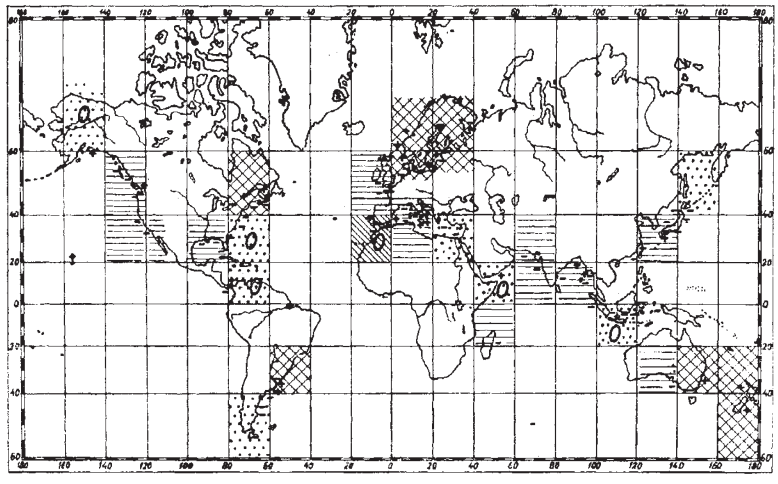

Fig. 1. Correlation between the vertical coastal movements and the satellite geoid, according to the data of Izsak and S. Polli. Cross-hatching, positive geoid undulation with uplifting coasts; horizontal lines, negative geoid undulation with sinking coasts; diagonal lines, no undulation and no change in the coast levels; dotted areas, contrasting undulations and coastal movements (zero undulations contrasting with positive or negative coastal movements are indicated by 0)