THE GEOLOGIC SIGNIFICANCE OF SOME LUNAR GRAVITY ANOMALIES

David H. Scott, U.S. Geological Survey, 601 East Cedar Street, Flagstaff, Arizona 86001

Abstract:

Close correlations between observed negative anomalies associated with unfilled craters and theoretical estimates of gravity determined from crater geometry (Sjogren, Wimberly, and Wollenhaupt, in press; Sjogren and others, 1972) show that little, if any, isostatic adjustment has occurred on the Moon for a long period of time. Recent calculations made by the writer using the latest gravity and topographic control suggest that the Cayley fill within the crater Ptolemaeus has the same density as the adjacent highlands or about 3 gms/cm^3. Thus it is probably not necessary to assume that the Cayley Formation is composed of relatively low density material as proposed by Zisk (1972). More likely, it is made up of breccias similar to those of the highlands.

Many new positive gravity anomalies or small mascons have been found (Sjogren, Wollenhaupt, and Wimberly, in press) on the Moon's nearside. Some are nearly circular and probably represent unrecognized basins or subbasins. Two lie nearly along a line connecting the Serenitatis and Nectaris mascons; one is centered over the crater Lamont and the other is near the old crater Torricelli north of Theophilus. The Lamont anomaly may result from a system of shallow intrusive bodies expressed at the surface as a network of radial and concentric ridges around the 75 km diameter crater Lamont. More probably, the apparent buried rimcrest of Lamont is only the innermost ring of a much larger structure within southwestern Mare Tranquillitatis. This subbasin is more deeply filled with basalt than other parts of the region and may have been the source of the flows which formed Mare Tranquillitatis. A re-examination of lunar photographs covering the Torricelli anomaly indicates that this crater also, like Lamont, may represent the inner ring of an unrecognized basin.

Apollo 17 and Apollo 15 gravity results over part of Mare Serenitatis revealed certain inconsistencies when the data were optimized to a single disk gravitational model (Sjogren, Wimberly, and Wollenhaupt, in press). The resolution of this problem seems to require an additional disk or mascon north of the basin center. This solution by Sjogren and his fellow workers (in press) would substantiate a previous geologic observation (Scott, 1972) that the northwest part of the Serenitatis basin was formed by separate impact and has its own ring structure.

Some of the latest gravity results from Apollo 16 and 17, and Apollo 15 and 16 subsatellites (Sjogren, in press; Sjogren and others, in press) show numerous isolated anomalies throughout central and southern Oceanus Procellarum. When these anomalies, together with those disclosed by previous missions, are plotted and studied in a regional context they clearly show a positive gravity axis extending for about 1000 km along Oceanus Procellarum. The positive axis may be associated with Procellarum intrusive ridge systems, a series of individual basins arranged more or less linearly like those between Serenitatis and Nectaris, or represent a tectonic trough deeply filled with mare material.

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