THE MOON - CRUSTAL EVOLUTION, H. Masursky, U.S. Geological Survey, Flagstaff, Arizona 86001

The data on lunar shape from the laser altimeter on Apollos 15, 16, and 17 confirms the sparse information from Ranger, Surveyor and Lunar Orbiter and details the figure of the Moon with its low frontside and high farside. Only the lunar limbs, where astrometric determinations were made, lie at radii of 1738 kilometers.

This assymmetry strongly implies that during the early moon-wide differentiation a thin low density (anorthositic) crust formed on the earth side and a thick crust on the far side. One hypothesis that would explain the data states that mantle convection was active during the differentiation resulting in this assymemetric distribution of crustal material. The Moon would had to have been gravitationally locked to the Earth to impose the observed geometry. Two other observations confirm the hypothesis of mantle convection proposed by Runcorn several years ago: first, the remnant magnetism in ancient rocks indicates possible dynamo action early in the Moon's history; second, the concentration of gamma radiation in the middle of the front and far sides reconfirms a possible biconvection cell with enhanced gamma activity over the vertical edges of the cells. Results from the x-ray fluorescence experiment confirm this distribution. That is, the highest areas topographically have the highest alumimum/silicon ratios. They are the most differentiated rocks and underlie the areas where the crust is thickest.

In this view, Oceanus Procellarum and the other irregular mare areas would indicate stripping of the low density crust and exposure of mare basalt overlying mantle in some areas and piling up of this crustal material in other areas. The circular mare basins with mascons record impacts with uplifted mantle in the central peak protruding into the crust overlain by a minimum thickness of mare basalt. The positive gravity anomaly is due to the lateral flow and intrusion of the denser mantle into the low density crust. This proposal is confirmed by the lack of coincidence of the circular positive anomalies around the Imbrium and Orientale basins with the mare basalt troughs. That is, the positive anomalies underlie the uplifted crustal blocks where the mantle lies at the highest elevation; negative anomalies lie under the troughs underlain by mare basalts rather than positive anomalies as in the conventional explanation.

Two areas on the front side overflown by Apollo 16 stand high and are underlain by low density crust according to laser altimetry and radio tracking. The one is a volcanic crater chain east of Ptolemaeus; the other is the Apollo 16 landing site. This coincidence indicates that the peculiar textures in the Kant Plateau that lie athwart the Imbrium Sculpture may indicate a continuation of upland volcanism after the formation of the Imbrium basin by impact. In these two areas on the front side and in large areas near the crater Van de Graaff, on the far side, extrusion of volcanic rocks continued.

These volcanic rocks were reworked by impact so that surface samples are impact breccias whose composition indicates differentiation to a rock entirely composed of feldspar before metamorphism by impact.

Recrystallization of the matrix of regional impact breccias strongly implies the emplacement of the continuous ejecta blanket as hot base surge deposits. Many orbital photographs as well as the collection of ray material from Copernicus at the Apollo 12 site validates the separation of impact ejecta into the ballistically deposited ray material and the surface flowage of the base surge deposits that form the continuous ejecta blanket. The ray material can form secondary surges that are seen in high speed films of experimental craters. No ubiquitous secondary surges make Cayley-like deposits that would cover the near side of the Moon as has been proposed. The interpretation of wide spread deposits as secondry surges is inconsistent with experimental cratering records and lunar photography.

The largest topographic difference on the Moon occurs between the eastern edge of the floor of Mare Smithii and the western edge of Van de Graaff. This relief of about 9.5 km is similar to the topographic difference between the floor of the Amazonis Basin and the top of the Tharsis ridge on Mars and the floor of the Pacific Ocean Basin and the top of the Andes on the Earth. Like these, it must represent a global-testonic feature.