LUNAR LIGHT PLAINS DEPOSITS (CAYLEY FORMATION)--A REINTERPRETATION OF ORIGIN, E. C. T. Chao*, L. A. Soderblom**, J. M. Boyce**, Don E. Wilhelms**** and Carroll Ann Hodges***
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Apollo 16 sampled a typical occurrence of lunar light plains deposits designated Cayley Formation. The dominant rock types returned are light-colored plagioclase-rich breccias that apparently are nonvolcanic (1,2,3). Inasmuch as premission photogeologic studies predicted that old mare-type basalts or more felsic flows or tuffs had formed the plains, a reinterpretation of the plains' origin is necessary.

We believe that most Cayley-type plains deposits including the Apollo 16 site, at least at and near the surface, are composed of ejecta from the Orientale basin, the youngest multi-ringed impact basin. These surface and near surface materials are not locally derived and they are not a part of the Imbrium ejecta. This reinterpretation is based on the distribution and apparent age of the plains and preliminary data on the collected Apollo 16 breccias.

The plains at the Apollo 16 site are typical in topography, albedo, and crater density of Imbrian light plains deposits that are abundant on the near side of the Moon and also occur, in lesser amounts, on the far side. They constitute the youngest widespread non-mare plains unit, hence are not related to any local impact structure of limited size.

Abundant plains deposits lie at the outer limits of the lineated ejecta (Fra Mauro Formation) of the Imbrium basin and outside of the lineated ejecta (Hevelius Formation) of the Orientale basin. Many of the plains around Orientale, and some of the plains around Imbrium have lobate contacts, flow textures, and stratigraphic relations suggesting that they are a facies of the basin ejecta (4). Where relation of light plains deposits to the basin of their origin can not be established on the basis of distribution, an origin must be inferred from dating by crater density or crater erosional morphology, or from the rock types, age, and composition of the materials of the plains.

Photogeologic determinations of stratigraphic relations (5) and dating by erosional morphology of superposed craters (6) have established Cayley light plains deposits as younger than the Imbrium basin and older than the mare material. All such crater-dated occurrences on both the near and far sides are approximately or exactly contemporaneous (6). Furthermore, comparisons (by Boyce and Soderblom, unpublished data) of the crater size-frequency distributions of the Hevelius Formation and the adjacent plains show that the Cayley and Hevelius Formation are indistinguishable in age. Hence, the surface and near-surface part of the Apollo 16 plains is contemporaneous with the circum-Orientale plains and the Orientale basin. It is not contemporaneous with the Imbrium basin or the Fra Mauro, where crater densities are 2 to 3 times greater than those of the light plains. Moreover,

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the Apollo 16 materials are distinctly more feldspathic than the Fra Mauro Apollo 14 Imbrium ejecta materials (1,3). Imbrium ejecta may well be present at the Apollo 16 site but generally only at some depth. Limited age data on Apollo 16 samples now available are consistent with and do not preclude this revised interpretation.

The Hevelius Formation and the adjacent plains deposits probably were transported as low-angle, largely ground-hugging, ejecta, whereas the plains deposits more distant from the basin, as at the Apollo 16 site (3,000 km from Orientale), probably were part of the suborbital ejecta that were thrown farther because they had higher (moderate) ejection angles and greater ejection velocities. These ejecta apparently arrived with essentially suborbital velocities and collected and spread out in depressions upon landing, but some have stayed on the slopes. They could have produced the mantle that subdues much of the rugged topography of lunar highlands and commonly seems to grade with adjacent light plains deposits.

We expect, therefore, that rocks of Orientale provenance are predominant at the Apollo 16 site. This implies that the catastrophic Orientale impact struck a highland area underlain by highly feldspathic material and spread it over much of the Moon. It is possible, therefore, that much of the other lunar highlands crust is not underlain by anorthositic materials to any significant depth.

The conclusions in this paper apply to the Apollo 16 plains and the majority of other Cayley-type, Imbrian-age, plains. We do not exclude the possibility that some plains of this or other ages are volcanic.

References

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