THE DARK RING OF ORIENTALE: IMPLICATIONS FOR PRE-BASIN MARE VOLCANISM AND A CLUE TO THE IDENTIFICATION OF THE TRANSIENT CAVITY RIM. P. H. Schultz, Lunar Science Institute, Houston, TX 77058; P. D. Spudis, Arizona State Univ., Tempe, AZ 85281.

Several conflicting scenarios currently exist for the development of the multiple rings of large basins and consequently the identification of the rim of the excavation cavity (1,2,3,4,5). The proper identification of the transient basin rim is important in estimating the input energy represented by such enormous impacts, determining the provenance of lunar samples, and understanding the formational history of multi-ringed basins in general. The results presented here offer additional observations that may aid in identifying the primary basin rim.

The Russian spacecraft, Zond 8, returned an invaluable new perspective of the Orientale Basin under full solar illumination. Of particular interest is an enigmatic dark annulus that crosses the outer Montes Rook in the southwestern sector of the basin (Fig. 1). Low illumination Lunar Orbiter photography complements this view and reveals that the low albedo ring corresponds to a dark deposit mantling the hummocky inter-ring facies and the fissured Maunder Formation (6) between the inner and outer Montes Rook, where the deposit is generally darker. Along the ring the mantle appears to be locally concentrated, and at one of these sites in the southeastern portion of the ring, a crater is nearly completely buried by the deposits. In general, well-defined topographic features do not correspond with the dark annulus although a poorly defined system of arcuate fractures, scarps, and crater chains may be related. More notable is the discontinuation of the outer Montes Rook within the annulus, a feature that is readily seen in oblique Zond 8 views. The annulus is surrounded by what appears to be the broken rim of a large crater that forms a pronounced scallop of the Montes Cordillera ring.

The origin of the dark annulus could be attributed to a variety of imagined processes. However, the annular placement of volcanic vents characterize lunar craters that have been modified volcanically (7). Drawing on this analogy, we interpret the ring as a remnant of a system of vents established prior to the formation of the Orientale Basin within an old basin having an inner ring diameter of 175 km and perhaps an outer ring diameter of 350 km. In order for such a vent system to survive the Orientale impact, the original basin rim must have been <u>within</u> the outer Montes Rook, perhaps corresponding with the present inner Montes Rook, which is not well defined in the region of the dark annulus. Subsequent collapse of the transient cavity producing the outer Montes Rook and Cordillera scarps did not destroy the conduits of the previously established vents. The possibility that Orientale postdated early mare-flooding stages is suggested by the presence of mare-basalt clasts in some lunar highland breccias that predate or are contemporaneous with the Imbrium Basin (8). It is also suggested by dark-haloed impact-like craters (e.g., west of Schickard, south of Einstein) that have excavated dark, pre-Oriental materials below the Orientale ejecta facies. Finally, another slightly smaller dark annulus can be identified that has been buried by Orientale ejecta (see Fig. 1a).

Although other craters overlapping the Orientale inner mountain rings are not identified, large degraded craters can be identified up to the outer Orientale ring where the Montes Cordillera becomes a discontinuous scarp (1). This perhaps is best illustrated just west of the crater Lowell where a newly identified 300 km hummocky plains-filled crater is bisected by the outer scarp (Fig. 2). If the outer Cordillera indicate an excavation rim, then it seems highly unusual that a pre-existing crater could remain identifiable. Such preservation is more consistent with the Cordillera representing an adjustment of the lunar crust to the impact cavity. Similar craters can be identified along Montes Cordillera and contribute to its scalloped plan (Fig. 3). Similar relations are seen in the presence of highly degraded pre-Imbrian craters in the Imbrium Basin Montes Apennines (9). An additional clue to the primary basin rim is provided by a radial furrow and scarp that cross both Montes Cordillera and Montes Rook in northwestern Orientale. This feature is exposed in only the last medium-resolution frames from Lunar Orbiter IV (LO-IV-193, 194-M). The transection of this linear structure across basin rings again indicates the transient rim location within the outer Montes Rook ring.

In summary, preserved craters and crater remnants revealed in the near-terminator Lunar Orbiter and full-illumination Zond 8 photography suggest that the excavation basin rim was within the outer Montes Rook ring. The remaining outer rings appear to be best interpreted as crustal adjustments to the impact-produced cavity as previously suggested (1,4,5,10).

References:

1) Head J. W. (1974) Moon 11, 327-356.

2) Moore H. J., Hodges C. A., and Scott D. H. (1974) Proc. Lunar Sci. 5, 71-100.

3) Hodges C. A. and Wilhelms D. E. (1977) Proc. Int. Geol. Congr., Sydney, N.S.W., 1976 (in press).

4) McCauley J. F. (1977) Physics of Earth and Plan. Interiors 15, 220-250.

5) Dence M. R. (1976) Imb. Consort. Vol. 1, LSI-Contrib. 267D, 147-155.

6) Scott D. H., McCauley J. F. and West M. N. (1977) U.S.G.S. Map I-1034.

7) Schultz P. H. (1976) Moon 15, 241-273.

8) Ryder G., Taylor G. J. (1976) Proc. Lunar Sci. 7, 1741-1755.

9) Spudis P. D. and Head J. W. (1977) Proc. Lunar Sci. 8, 2785-2798.

10) Mackin J. H. (1969) Geol. Soc. Amer. Bull. 80, 735-748.

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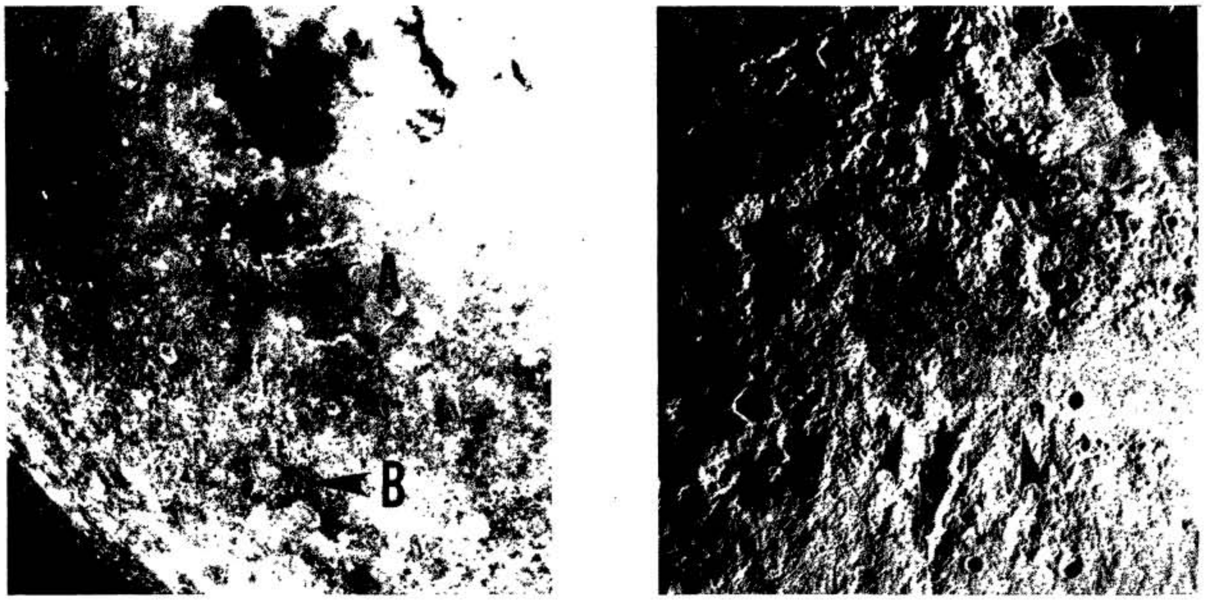

Figure 1a) Zond-8 photograph showing the dark ring (A) of Orientale that crosses the inner Montes Rook ring and a dark ring buried by Orientale ejecta (B). Fig. 1b) Lunar Orbiter IV-194-M revealing location of dark ring and possibly related outer ring of old basin.

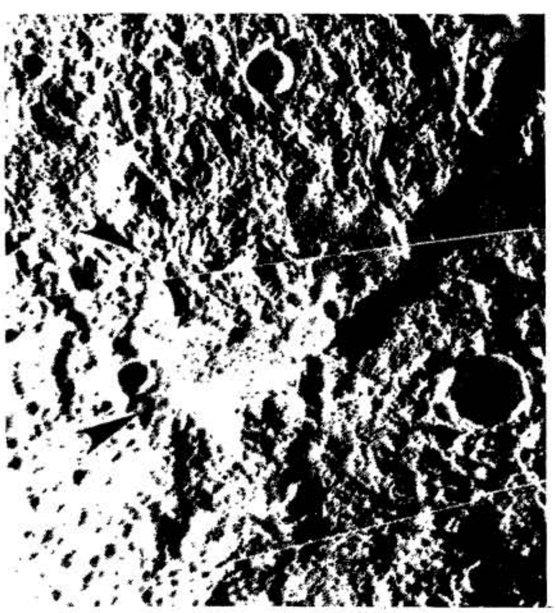

Fig. 2) Large severed crater (300 km) containing hummocky plains and Orientale ejecta flow. (LO-V-22-M).

Fig. 3) Radial furrow crossing Cordillera and outer Rook rings.