CRYPTOMARIA IN THE SCHILLER-SCHICKARD, MARE HUMORUM AND WESTERN OCEANUS PROCELLARUM AREAS: STUDIES USING DARK-HALO CRATERS:

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Summary: A number of dark halo craters were identified in the Schiller-Schickard area, a known cryptomare. Statistical considerations of these DHC's indicate that deposit thicknesses overlying the cryptomaria are consistent with those expected from an Orientale ejecta origin for this unit. Cryptomare thicknesses in Schiller-Schickard were found to be about 1.4 km, and NW of Humorum about 1.0-1.2 km, values comparable to other known maria. Similar approaches for adjacent regions west of Procellarum show evidence for patchy cryptomaria there.

Background: Dark halo craters (DHC) are evidence for the presence of cryptomaria underlying highlands material (1). Spectroscopy (2) and multispectral imaging (3) permit the confident identification of mare components and their mapping over the surface. The size and geometry of DHCs offers clues to the three-dimensional geometry of cryptomaria deposits and the deposits that overly them. Here we examine three areas using DHCs as such a tool. Craters must occur in a specific size range to produce a dark halo in the cryptomaria area. Small craters that do not penetrate to the cryptomare will not produce a dark halo; large craters penetrating through the cryptomare to the underlying highland material, will have highland ejecta which obscures the dark halo signature. The smallest observed DHCs should define the top of the cryptomare, and therefore the thickness of the overlying ejecta, while the largest observed DHCs should define the bottom. Thus, the thickness of the cryptomare can be otained from the difference between the depth of the mare base and the thickness of the overlying ejecta.

Schiller-Schickard Area: Twenty-seven DHCs have been found in this region, located approximately 1400 km SE of Orientale. They are distributed somewhat evenly, ranging in distance 1000-1900 km from the center of Orientale. Depths of excavation for the 27 craters were estimated from their diameter, using Pike's depth/diameter equations (4). The minimum depths, so calculated, are plotted as a function of distance from Orientale (Fig. 1). Column heights represent the thickness of the overlying deposit (interpreted to be the Orientale ejecta unit) as determined from the size of the smallest DHC in each 100 km distance interval. These results are compared to theoretical ejecta decay models for an Orientale diameter of 900 km (6, 5), and of 620 km (6). The data are generally consistant with theoretical predicted values for ejecta from Orientale and thus support an Orientale source for the ejecta. Craters far from Orientale deviate from predicted values and this may be the result of the paucity of DHCs at this distance; i.e., the smallest craters obvserved are not necessarily the smallest craters possible.

Cryptomare thickness estimates can be plotted as a function of distance from Orientale (Fig. 2). Column heights represent the maximum depths minus the minimum depths for each 100 km distance interval. If a distance interval contains only one DHC, no value is thus entered. Cryptomare thickness determined by this technique can be seen to vary from about 1000-2000 m, with the average being approximately 1.4 km. This is a typical thickness for mare (7, 8).

North of Mare Humorum Area: This region is located just north and NE of Humorum, near the crater Gassendi. We have identified numerous DHCs in this area (Fig. 3), mostly south of Procellarum, over an area of about 200,000 km^2, about 3/4 the size of the Schiller-Schickard cryptomaria. This information further supports the hypothesis that this area is the site of a cryptomare deposit (9-11).We have used the major craters identified spectrally (9, 10) as containing mare components to make preliminary estimates of deposit thicknesses. One DHC, Gassendi G, was found to have pure highland debris exposed in the central part of the crater floor. This was interpreted to mean that the crater had penetrated to the pre-mare substrate (10). Application of Pike's equations (4) to the diameter of this crater yields a deposit depth estimate of 1540 m. If the overlying unit is Orientale ejecta and its thickness is comparable to that found at this range (~1400 m) in the Schiller-Schickard area, then we estimate the cryptomare thickness to be ~1040 m at Gassendi G. Examination of a DHC near Gassendi G suggests penetration into mare at depths of about 300 m, indicating a local cryptomare thickness of about 1240 m.

West of Oceanus Procellarum Area: Three DHCs are located west of Oceanus Procellarum (Fig. 3), and they occur as single isolated occurrences, rather than in clusters seen in Schiller-Schickard and NW of Humorum. We are investigating two hypotheses for this distribution: 1) The sparsity of DHCs may be due to the fact that this area is much closer to Orientale, the ejecta should be thicker, and only a few large craters will be able to penetrate to a cryptomare surface. 2) The cryptomaria exposed by the DHCs are small, disconnected, and widespread, more typical of the present distribution of mare ponds in this region (12-14). On the basis of our intial analysis and the results of mixing models using Galileo multispectral image data, we presently favor the latter hypothesis.

Conclusions: Ongoing analyses confirm earlier studies suggesting the presence of cryptomaria in the southwestern lunar nearside and provide additional evidence for their widespread nature, their configuration and deposit thickness, and the thickness of overlying units. Mare volcanism is shown to be an areally and volumetrically significant process in this area prior to the Orientale basin-forming event ~3.84 b.y. ago, a process of potentially comparable significance to that occurring in post-Orientale times.

LUNAR CRYPTOMARE: I. Antonenko and J. W. Head

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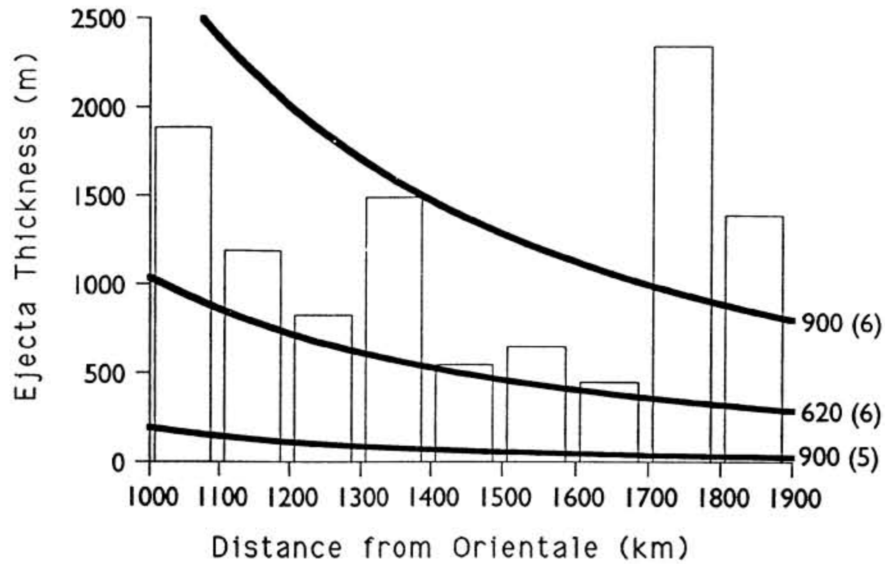

Fig. 1. Estimation of unit thickness overlying cryptomaria.

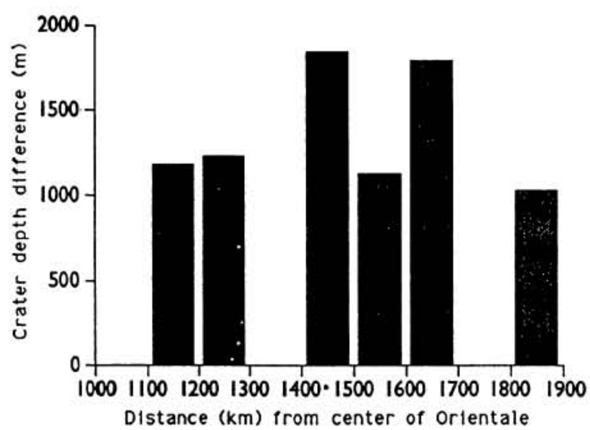

Fig. 2. Estimation of cryptomare thickness from DHC excavation geometry.

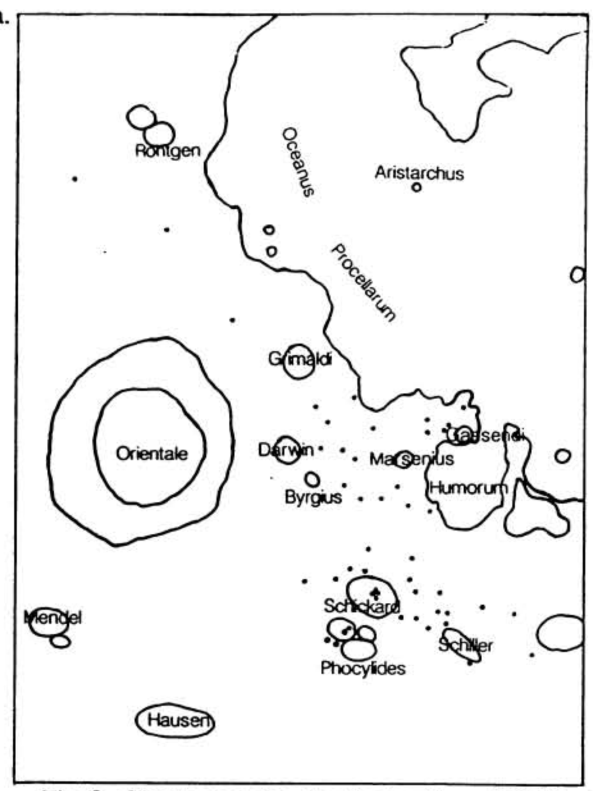

Fig. 3 Sketch map showing the location of DHCs in the area W of Humorum and W of Procellarum.