CRISIUM BASIN GEOLOGY FROM CLEMENTINE DATA

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Crisium is a Nectarian-age multi-ring basin on the eastern near side of the Moon [1]. We have been studying the geology of this feature and the composition of its deposits for several years [2-5] in order to understand the mechanics of formation of impact basins and to characterize the composition of this region of the lunar crust [2]. With the advent of the new, global Clementine data [6], we can now map the variations in the composition of basin ejecta for the entire feature, a significant improvement over previous compositional studies, which were largely limited to the southern portion of the basin. In this paper, we present some initial results from our study of the full resolution Clementine data.

Method We have constructed full resolution image mosaics of Clementine UVVIS images in the 415, 750, and 950 nm bands. These images are mosaicked to cover the approximate extent of the deposits of the chosen basin (in the case of Crisium, from 40°-75° E longitude and 0°-40° N latitude). Image mosaics are produced in the 750 nm band (albedo), false-color composites (blue=415/750, green=750/950, red=750/415), and iron concentration maps using the method described by Lucey et al. [7]. Basin topography has been studied using the Clementine laser altimetry to create a topographic map of the basin [8,9].

Basin Configuration Controversy has attended the determination of the dimensions of the Crisium basin. The original estimate of the basin diameter [10] corresponded to the ring of rugged massifs bounding Mare Crisium, about 740 km in diameter. This interpretation was later questioned [1, 11] and a discontinuous, scarp-like ring about 1000 km in diameter was proposed as the rim crest of the basin. The topographic data provided by Clementine marginally supports the smaller estimate of the rim diameter [9]. Patches of relatively high topography (elevation=0.5-1.0 km) are concentrated along the trace of the 740 km ring. However, portions of the 1000 km ring also display zones of comparable elevation. This important issue thus remains contentious; on the basis of analyses of basins of comparable morphology (e.g., Humorum; [9]), we favored our previous estimate that the 740 km diameter ring represents the rim crest of Crisium basin. Results presented here have provided another important compositional clue (discussed below) to the location of the basin rim.

Composition of the Crisium Basin Clementine color data show that the deposits of Crisium basin resemble the typical highlands compositions seen around other basins (e.g., Orientale; [12]). General compositions appear to be feldspathic and iron-poor (FeO= 2-6 wt.%). In general, basin terrain to the north of Crisium appears to be somewhat lower in FeO (i.e., more feldspathic) than that surrounding the southern rim of the basin, the zone in which our previous estimates [3-5] were largely based. Basin deposits north of Crisium show large areas of relatively low FeO content, including some regions as low as 2-4 wt.% FeO, whereas the highlands south of the basin are somewhat more mafic, with FeO contents between 6-8 wt. %. In part, these more mafic areas correspond to structural troughs which display light plains with dark halo craters [2,5]. Thus, some of these areas may not correspond to true basin ejecta, but are ancient mare deposits, partly covered by highland plains deposits [2]. Such a relation is supported by the observation of numerous, post-basin inter-trough mare deposits, such as Lacus Bonitatis (24°N, 45°E), north of the crater Macrobius. Such areas are created by inter-ring flooding by mare basalt, partly masking the underlying basin (highland) deposits. In addition, examination of the full resolution color image shows many small craters with mafic (strong 750/950) signatures, supporting the idea that inter-trough basalt flooding has occurred in many areas of the southern basin deposits.

In addition to the broad, large-scale division of deposits, numerous small peaks and fresh crater deposits occurring on or near the topographically prominent 740 km ring display an extremely "blue" (i.e., very low mafic content) signature and also the lowest FeO concentrations (FeO=0-2 wt.%). Examples include a small (5 km) crater south of Eimmart B, Cleomedes GA (4 km), and part of the walls of Proclus (28 km). On the basis of analogy with similar deposits seen at the Orientale [12], Humorum [13, 14], Grimaldi [15], and Humboldtianum basins [16], we believe that these features are exposures of pure anorthosite. The pattern of anorthosite distribution at Crisium basin parallels that seen in these other basins, i.e., the isolated exposure of numerous peaks within an inner basin ring. Thus, pure anorthosites are confined to exposure almost exclusively to the mare-bounding 540 km basin ring; the topographically prominent 740 km ring shows anorthosite only in the vicinity and walls of Proclus. If the 740 km ring were an "inner" basin ring, as required by the "large-basin" models of Crisium [1,11], it might be expected to display some of these anorthosite deposits. However, at Orientale, anorthosite deposits are confined mostly to the inner (500 km) Rook ring, while the outer (700 km) Rook ring show much fewer anorthosites [12]. Thus, by analogy, the 540 km ring of the Crisium basin is most definitely an inner ring while the 740 km ring *may* be an inner ring.

Mare deposits within the Crisium basin [17] show very high FeO contents, up to 20 wt.% for areas of the central maria. In addition, the craters Pierce (19 km), Picard (23 km), and Lick D (= Greaves; 14 km) are windows into the subsurface mare stratigraphy of the basin. Each of these craters (and many others of comparable diameter) show strong mafic signatures (green on the false-color composite), indicating that they have been largely confined to basaltic targets. The largest of these craters (Picard) shows extremely high concentrations of FeO in its (very dark) rim deposits. This excavation indicates subsurface heterogeneity of basalt deposits in Mare Crisium and that none of these craters have penetrated the basalt of Mare Crisium to excavate the underlying highlands basin floor. Thus, on the basis of the sizes of these craters and their likely depths of excavation [e.g., 1, 2], the basalt fill must be greater than 2-3 km within central Mare Crisium.

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