THE COMPOSITION AND GEOLOGIC SETTING OF LUNAR FAR SIDE MARIA.

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The dichotomy in the distribution of maria between the Earth facing side and the far side of the Moon has evoked many questions concerning the emplacement mechanisms, compositional variation, and source regions of lunar basalts. The near side maria have been well analyzed using a variety of Earth based, and lunar surface and satellite information. The Clementine mission has provided the first global mineralogical and chemical maps for the Moon. These data will allow us to gain knowledge of many lunar far side basalt deposits for the first time. Although the far side maria (Figure 1) represents only about 1% of the surface of the Moon [1], these deposits provide insight into the crustal evolution, thermal history, and the interior of the Moon. Information on the composition, age, and volume of mare deposits will further our understanding of these questions. We are now studying several data sets, including multi-spectral images, crater statistics, and altimetry, to reconstruct and understand lunar volcanic evolution. Ultraviolet/visible (UVVIS) image data provide information of the composition of mare deposits. Ratios 415/750 provide information of titanium content [2,4] and the 950/750 absorptions is correlated with the concentration of Fe^{2+} and mafic minerals [2, 3]. Crater statistics provide relative age determination, which can be used to estimate absolute ages. Knowing the range in ages of all the mare units on the far side will allow us to determine the duration of magmatism on the far side. Digital elevation maps from the Clementine altimetry allow us to estimate the deviation of mare units relative to the mean lunar radius to test if a systematic correlation in height of lava eruption surfaces and age might reflect a corresponding increase in depth of the zones of magma generation with time [5].

Preliminary calibrations and multi-spectral mosaics have been generated for mare deposits within Antoniadi, Campbell, Compton and for Mare Moscoviense. Antoniadi (69°S, 172°W) is an upper Imbrian age crater, 135 km in diameter [6]. The mare confined within the crater is 2800 km^2 in extent and Eratosthenian in age [6]. Clementine images reveal a rille radiating from the central peak of the crater. The northwestern area of the mare deposit surrounding the rille contains a region of elevated Fe^{2+} and mafic material relative to the surrounding basalt. Quantitative differences will not be available until further calibrations of the data are made. The change in composition reflects either the thickness of deposit, thicker deposits are less contaminated by mixing with highland material, or the mare composition has changed over time to a more mafic component. It is conceivable that the rille is the source for the higher iron unit because the basalt embays the rille. This would indicate a changing magma composition over time.

Campbell (46°N, 152°E) is a 280 km diameter, pre-Nectarian crater [7]. The mare covers an area of 2400 km^2 within the central eastern portion of the crater and is Imbrian in age [7]. No rilles, vents or volcanic effusive features are apparent in the images. The basalt has a moderate 950/750 absorption, rendering a value of 4.5 - 5.5 wt % FeO [3], and a moderate 415/750 absorption yielding 1 - 3 wt% TiO_2 [4]. The high concentration of mafic material is constant and does not vary across the expanse of mare. To the west of the main mare deposit, a previously undescribed dark halo crater has penetrated through the cover material and excavated underlying mafic material (Figure 2). The cryptomare in Campbell is the result of a two phase volcanic history: first, eruption of basalt unto the surface then highland ejecta from a near by crater conceals the deposit, second, continuation of mare volcanism, creating the main mare fill [8].

Compton, 180 km across, is a lower Imbrian age crater located at 56°N, 105°E, with an Imbrian age mare deposit [9]. The basalt is exposed as one elongate patch on the eastern half of the crater and two smaller patches in the western half. The FeO content for these deposits is 4 - 4.5 wt% [3]. The images also reveal an older mare unit proximal to the central peak of Compton that Lucchitta ascribed as undivided plains, the FeO content is indeterminable at this time. The geologic history of the two basalt deposits is the older unit erupted then mixed with highlands material, increasing its albedo. Later, isostatic rebound occurred forming the prevalent grabens and uplifting the central region of the crater. Finally, a second pulse of magma was extruded around the outer edges of Compton.

Mare Moscoviense (26°N, 147°E) is a Nectarian age basin with a 210 km diameter inner ring and a 445 km diameter outer ring [1]. The Imbrian age mare [7] is contained within a crude figure eight pattern of the inner and

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outer rings that trends northeast-southwest. The total area of the mare is approximately 28,350 km^2. Two units within Mare Moscoviense can be delineated by their different spectral signatures. They bisect the basalt deposit into two equal halves. The northwestern half has a higher 415/750 absorption component, 5-8 wt% TiO_2 [4], than the southeastern half, 1-4 wt% TiO_2 [4]. There is a less pronounced difference in iron content between the two halves, the northwestern half is 8-9 wt% FeO [3] and the southeastern half is 10-11 wt% FeO [3]. An estimated crater density shows that the High Ti unit is relatively younger than its lower Ti counter part. Dark halo craters outside the inner ring to the south, reveal the presence of cryptomare. A limited occurrence of lunar swirl material is present in the southeast corner of Mare Moscoviense. Although not as prevalent as other deposits of this type, this find is the fourth occurrence of swirls on the Moon (others at Reiner γ, Mare Marginis, Mare Ingenii; [10]).

The Clementine data set has provided the images, spectral data, chemistry, crustal thickness and topography needed to comprehensively classify lunar far side maria in space and time. Comparison of the far side maria with existing information for near side maria will place the far side maria into the global temporal and compositional scheme of the Moon. Our awareness of the geological setting of volcanic units will allow us to speculate on the presence and location of regions or centers of magma production in the lunar interior and magma transport mechanisms.

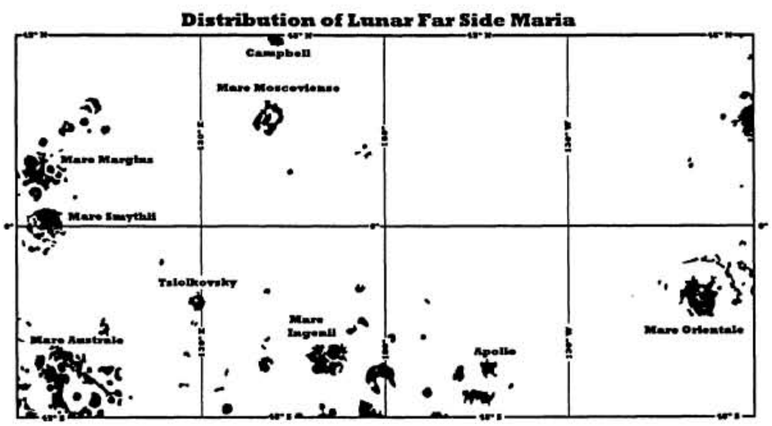

Figure 1 Diagram showing the surface distribution of basalt on the Lunar far side from 100°E - 100°W and 45°S - 45°N. Antoniadi and Compton are not represented because they are out of the latitude and longitude range of this map.

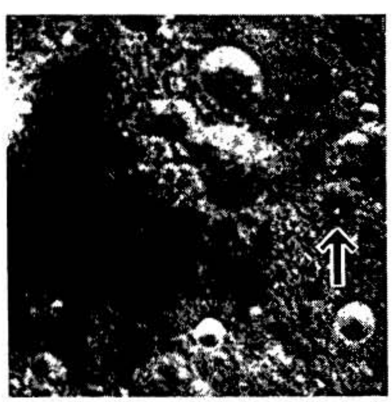

Figure 2 Image of mare within Compton. Arrow points to dark halo crater.

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