BASALTS IN MARE SERENITATIS, LACUS SOMNIORUM, LACUS MORTIS AND PART OF MARE TRANQUILLITATIS.

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Introduction. We have identified a number of discreet basaltic units in the area being studied. An assessment of their ages, their extent, trends in their chemistry and an indication of the volume of basalt within the basin may provide new information about the geological history of the area. A number of previous studies have tried to determine the existence and boundaries of basaltic units within the area we examined. For example, [1] described a few units using Earth-based telescopic spectral reflectance techniques while [2] identified more units, and in greater detail using images from the Galileo spacecraft. We have used the higher resolution Clementine ultraviolet-visible data (down to 200m/pixel [3]) to try and determine the boundaries of units within the region. Additionally we have used Clementine FeO and TiO_2 wt% data using the method described in [4] to see if they can suggest variations in the thickness of basalts in the region. We have also used crater depths to suggest the volume of basalt within Mare Serenitatis.

Method. We used Clementine FeO, TiO_2 wt%, "true" colour and "false" colour images and the method described in [5] to suggest the boundaries of possible basaltic units in the area. A potential unit was considered to exist if its average TiO_2 wt% value was statistically different from adjacent ones. 54 units were identified by this method. Our work in [4] suggests that impacts that penetrate through to the highland material under the basalt contaminate the basalt by vertical mixing. However, we noted that the inefficiency of vertical mixing means that only relatively thin basalts become contaminated to any extent while thicker ones are much less affected. In Fig. 1 we plot FeO against TiO_2 wt% for each of the 54 units. They have been categorised, somewhat arbitrarily, into low, intermediate and high FeO/TiO_2 wt%.

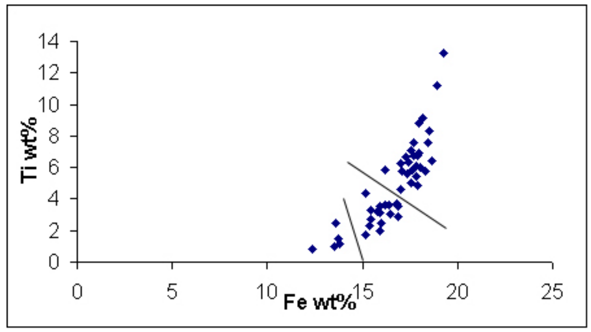

Fig. 1. FeO plotted against TiO_2 wt% for the 54 units.

The units have been colour-coded and are displayed in Fig. 2.

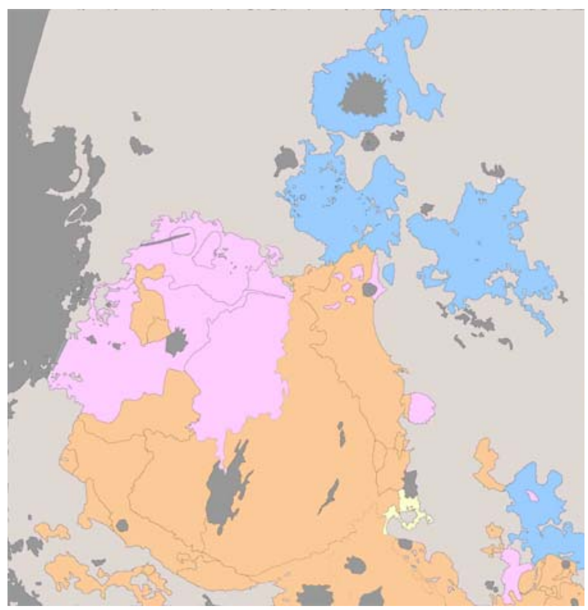

Fig. 2. Low FeO/TiO_2 wt%: blue. Intermediate: pink. High: brown. Highland: light grey. Large craters, ejecta and very small units: dark grey. Dark mantling material: yellow.

Discussion: Lunar Orbiter IV images suggest that the volcanic pile forming the low FeO/TiO_2 wt% units in Fig.2 is relatively thin. The high FeO/TiO_2 wt% units generally occur where the basalt would be expected to be deeper. Most intermediate FeO/TiO_2 wt% units occur around the edge of the basin. Here the slope of the basin occurs and the depth will be somewhere between shallow and deep. The exception is the large area in northwest Serenitatis. [6] suggests that a smaller impact may have created this area of the basin and therefore it is probably shallower than elsewhere. The area may be shallow enough to allow sufficient contamination by vertical mixing to put the area into our intermediate category. Inspection of a free-air gravity map, e.g. [7], shows the free-air anomaly to be lower in this area which also suggest the basin floor may be shallower than in the centre of the basin.

Lateral transport of highland material from adjacent highland areas may have caused some contamination but the boundaries between the basaltic units are generally sharp which would not be the case if considerable transportation of ejecta had occurred across them. Additionally, all units that are adjacent to the highlands might be expected to be in the intermediate category if lateral transport were significant but this is not apparent from Fig. 2. Our discussion in [4] suggested a correlation between highland contamination due to vertical mixing and depth of basalt in Mare Humorum and S.E. Procellarum and our work in this area appears to support it.

The second part of this work has been to determine the volume of basalt within Mare Serenitatis. Fig. 3 shows a radial profile obtained by turning an imaginary radius around 360° from the centre of Mare Serenitatis and noting the depth and distance from the centre of the craters. From this, a minimum volume of basalt was calculated.

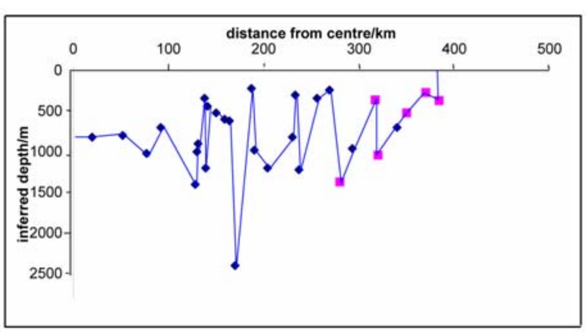

Fig. 3. Profile of minimum basalt depth based on inferred crater depths. Pink data points represent craters that pierce through to the highland. Blue points represent craters that have only excavated basalt. Depth is inferred from the depth-diameter ratio of 1:10 [8].

This profile suggests a minimum volume of 350,000km^3. Fig. 4 shows the same crater depth points but with a more realistic basin floor. This profile suggests a volume of 690,000km^3.

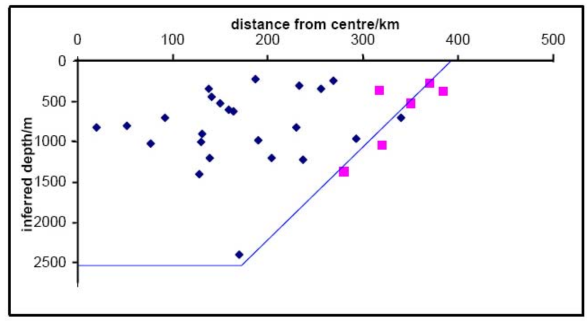

Fig. 4. Radial profile of Mare Serenitatis based on crater depths. The blue line represents the floor of basin.

References: [1] Pieters *et al.* (1978), LPSC IX, p2825-2849. [2] Hiesinger *et al.* (2000), JGR, 105, 29239-29275. [3] Nozette *et al.* (1994) Science 266, 1835-1839. [4] Hackwill *et al.* (2005), this conference. [5] Hackwill *et al.* (2004) LPSC XXXV, CD ROM 1062. [6] Scott (1974), Proc. 5th Lunar Conference, p3025-3036. [7] Watters and Konopliv (2001), Planetary and Space Science, 49, 743-748. [8] Croft (1980), LPSC XI, p2347-2378.