CLEMENTINE COLOR MOSAICS OF LUNAR FAR SIDE MARIA.

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Introduction: In our studies of lunar basaltic volcanism [1, 2, 3, 4], we have needed to relate remote sensing information to surface features. We have developed techniques that allow us to correlate remotely sensed data with geomorphic features on the lunar surface. In our process, a digital shaded relief map is combined with data from any of the Clementine sensors. This technique is not Clemen-tine specific nor unique to digital data. A hard copy (e.g. low sun angle photograph) can be digitized and superposed with other data sets provided limited cartographic knowledge (projection and scale) can be supplied. Integrated Software for Imaging Spectrometers, (ISIS) [5, 6], is used to append or modify cartographic information to images. The processing technique is to transform a red, green and blue data image into hue, intensity and saturation space. The intensity channel is then replaced with the grayscale shaded relief map. Finally, the new hue, intensity, and saturation image is converted back into a red, green and blue image. The resulting image now displays both structural and compositional information (Fig. 1).

Discussion: Clementine images were acquired with moderate to low phase angles ($< 30^o$) [7]. The absence of shadows causes structural and topographic information to be washed out. The correlation of color boundaries with structural features is an important step in understanding processes that have taken place on the lunar surface. Merging the Clementine mosaics with the digital shaded relief map or oblique images allows us to correlate changes in composition with geomorphic features such as mare flow fronts and crater ejecta. This method can also help to pin down the boundary between two stratigraphic units that are discriminated by accumulated crater density but were so fluid that they have no flow fronts (e.g. Mare Moscoviense [4]). In instances where Clementine data is missing, because of a lapse in data collection, this overlay method allows the continuation boundaries between areas of missing data.

Merging the Clementine UV/VIS data (≈250 m/pixel) with higher resolution Lunar Orbiter (100 meter), Apollo metric (50 meter) or panoramic (1-2 meter) photographs yields an apparent increase in resolution of the Clementine data. This allows the association of compositional variations with small lunar features. We have used this technique to estimate the thickness of mare basalt ponds [2]. Mapping the distribution of craters and observing whether their ejecta has a mafic or non mafic spectral signature. Aware that crater diameter is proportional to it's depth of excavation [8], we can map the thickness of the basalt by bracketing the depth at which craters have excavated highland material (maximum thickness) and which they have not (minimum thickness). We are also perfecting a technique utilizing the volume of crater ejecta to reconstruct lithologic thickness [9].

The technique of combining remote sensing data and shaded relief maps can also be used to confirm photogeologic observations. It is much easier to detect dark halo craters [10] using Clementine multiband spectra than photographs [3]. Fresh craters may have very bright ejecta blankets even though they contain mafic material, making it difficult to identify if they are dark halo craters. The appearance of a mafic signature in the Clementine spectra uniquely identifies a dark halo crater.

Clementine altimetry data can confirm the existence of previously mapped basins and the detection of undiscovered ones [11]. The Clementine laser altimeter data is merged with shaded relief map to confirm the existence and location of basin rings. This is an important key in describing the geologic position of mare basalts. Mare deposits such as Kohlschütter (15^oN, 154^oE) and Lacus Solitudinis (27^oS, 104^oE) do not occur within a known basin.

Conclusions: Merging Clementine compositional data with either a digital shaded map or low sun angle imagery reveals the connection of surface composition and physical surface features (e.g. flow fronts, & crater ejecta). These observations have allowed us to map unit boundaries, estimate mare thicknesses, and more easily detect dark halo craters and ancient buried mare deposits. This image processing technique also can be applied to altimetry data to identify the presence and configuration of basin rims. Moreover, integrating the shaded relief map with the gravity data reveals changes in Moon's gravity field associated with basin and mare deposits can be observed.

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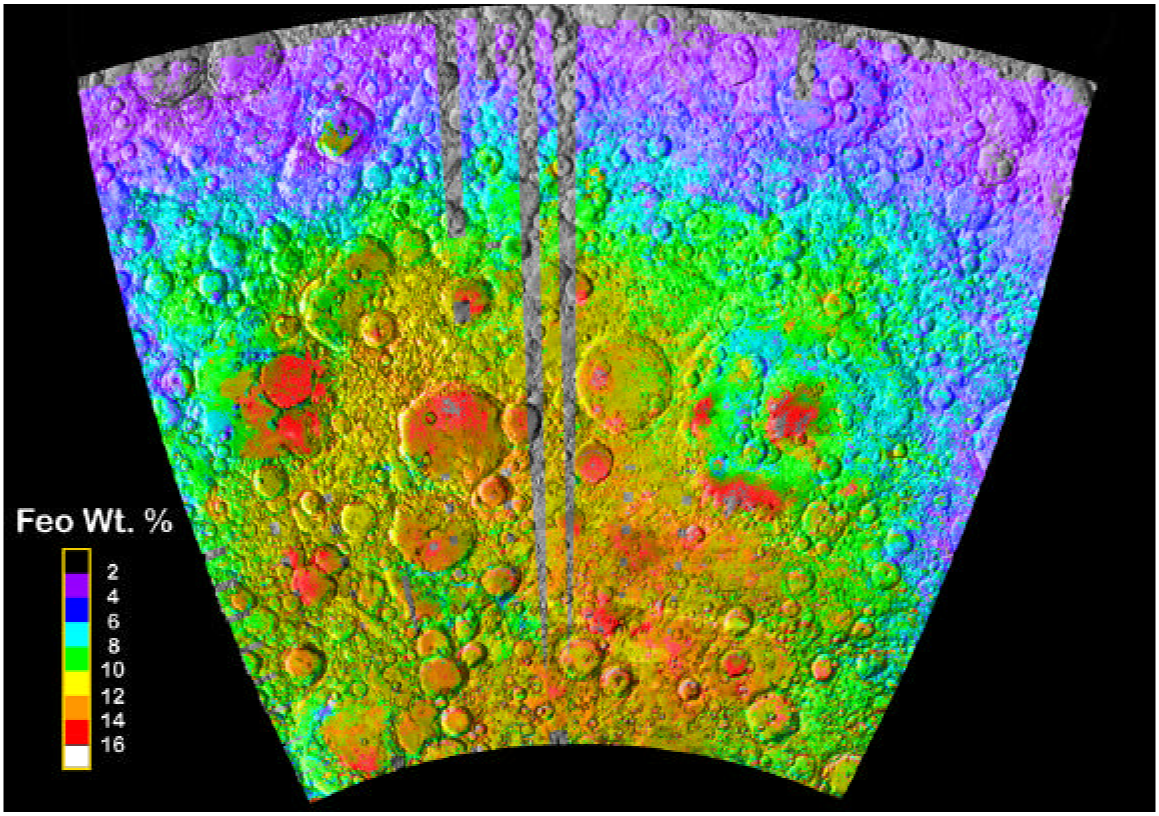

Fig 1. This is an example of the Clementine iron map merged with the shaded relief map. The image is in orthographic projection, centered on -34.5°, 190°. The longitude range is from 150° to 230° and latitude ranges from -60° to -9°. The original image was processed with a resolution of 1.25 km/pixel.