CLEMENTINE HIGH RESOLUTION IMAGING OF THE LUNAR SOUTH POLE. D.B.J. Bussey¹, M.S. Robinson², and P.D. Spudis³, 1. ESA/ESTEC Code SO, PO Box 299, 2200 AG Noordwijk, The Netherlands; bbussey@estec.esa.nl. 2. Northwestern University, Evanston IL 60208. 3. Lunar and Planetary Institute, Houston, TX 77058.

Introduction: Clementine has provided for the first time, a high resolution digital data set which can be used to investigate the lunar south pole. [1] Clementine orbited the Moon for 71 days. During the first month of data acquisition, perilune was in the southern hemisphere, resulting in a resolution of roughly 25 m/pixel while the second month data (perilune in the northern hemisphere) has a slightly lower resolution of approximately 40 m/pixel [2]. Our first attempt at a high resolution mosaic of the south polar region has utilised Clementine second month data as this is easier to co-register with the UVVIS data. This image has a resolution of 40 m/pixel, a factor of 6 better than any previous image of the region, thus making it possible to study the south pole in unprecedented detail.

Method: Creation of the high resolution mosaic required the production of a new improved control grid for the Clementine UVVIS images as the standard lunar control was found to be insufficiently accurate near the pole [3]. Refinement of the control network was achieved by registering UVVIS frames to an Arecibo radar image (which itself had been tied to the lunar control grid at lower latitudes where the current control is reliable). The high resolution images were then spatially controlled to this new UVVIS basemap. We estimate average accuracy of this new control grid to be approximately 500 m.

Results: A study of the illumination conditions of the south polar region [4,5] has revealed unusual lighting conditions. Nowhere, at the spatial scale of the Clementine data, receives constant illumination. However, several places exist which do receive large amounts of illumination (> 70%) and are therefore of interest as potential landing sites. Not only would such sites offer abundant amounts of solar energy, but they also permit surface operations in a relatively benign environment. The most illuminated area lies on the rim of Shackleton crater and appears to be sunlit for > 80% of the lunar day in winter. Interestingly a second highly illuminated site exists only 10 km away. The two areas considered collectively receive illumination for more than 98% of the time.

The high resolution mosaic extends to within 2 degrees of the pole and includes all available second month data, consisting of approximately 70 images. It is shown in Figure 1. Within this region, surface coverage is not total, but fortunately it does include most of the sites that have anomalous illumination profiles. The four most illuminated regions in the south pole are all covered by our mosaic. It can be

seen that the pair of highly illuminated points mentioned in the previous paragraph lie on a ridge which emanates from the rim of Shackleton approximately following the 120°W meridian. The illumination map also reveals the presence of three small well lit areas on the rim of the nearby 30 km diameter (centered at 88.5°S 85°W). The high resolution mosaic indicates that these correspond to three small topographic rises superposed on the rim of the crater. It also shows that there are what appear to be other similar sized hills in this region that lie outside the spatial coverage of the illumination map. Thus it is entirely possible that these hills also experience lighting extremes. Of particular interest from a future landing site point of view is the fourth region of high illumination located at 88.5°S 120°E. The high resolution mosaic suggests that the slope of the terrain from the highly illuminated massif to the nearby region of permanent shadow is relatively shallow. This makes this area important as a potential landing site for a mission aimed at sending a rover to investigate such a shadowed region. The relatively shallow slopes makes this much more possible here than trying to send a rover down into Shackleton where the steep slopes would cause numerous problems.

Conclusion: The high resolution mosaic (40 m/pixel) has allowed us to investigate the surface characteristics of the lunar south pole environment in unprecedented detail. For example it has revealed that 2 areas, only 10 km apart, which collectively receive illumination for greater then 98% of a lunar day actually are two massifs located along a ridge. Other previously identified regions of high illumination can now be seen to consist of small hills located on the rim of a nearby 30 km diameter crater. Apart from being interesting scientifically our high resolution mosaic (and a future higher resolution mosaic based on first month data that is currently being produced) will facilitate the selection of potential landing sites in this region. The south polar region is a prime candidate for future lunar missions, due to the discovery of ice deposits [6,7] in the permanently shadowed regions that exist there.

References: [1] Nozette S. et al. (1994) *Science* **266**, 1835. [2] McEwen A.S and Robinson M.S. (1997) *Adv. Space Res.* **19**, 1523. [3] Lee et al. (1996) *LPS* **XXVIII**, Abs. #1705. [4] Bussey D.B.J. et al. (1998) *LPS* **XXIX**, Abs #1373. [5] Bussey D.B.J. et al. (1999) *Science* submitted. [6] Nozette S. et al. (1996) *Science* **274**, 1495. [7] Feldman W.C. et al. (1998) *Science* **281**, 1496.

HIGH RESOLUTION IMAGING OF THE LUNAR SOUTH POLE: D. B. J. Bussey et al.

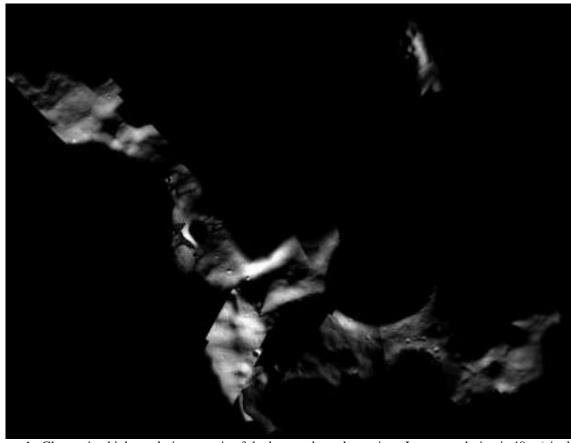


Figure 1. Clementine high resolution mosaic of the lunar solar polar region. Image resolution is 40 m/pixel