KING CRATER - SURFACE PROPERTIES DERIVED FROM DIVINER, MINI-RF, AND LROC DATA.

J. B. Plescia[1], D. B. J. Bussey[1], M. S. Robinson[2], and D. A. Paige[3]. [1]Applied Physics Lab, Johns Hopkins University, Laurel, MD 20723, [2]School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85287, [3]Dpeartment of Earth and Space Sciences, University California, Los Angeles, CA 90095.

Introduction: King Crater (Fig. 1) is a fresh complex impact crater on the lunar far side, centered at 5.0°N, 120.5°E and is ~76 km in diameter and 3.8 km deep (Fig. 1). The LRO instrument suite provides a diverse data set with which to study the crater. Here we report on observations using the Lunar Reconnaissance Orbiter Camera (LROC) images, the Mini RF radar experiment and the Diviner Lunar Radiometer Experiment thermal radiometer. Taken together these data provide detailed insight into the surface properties of the various geologic units.

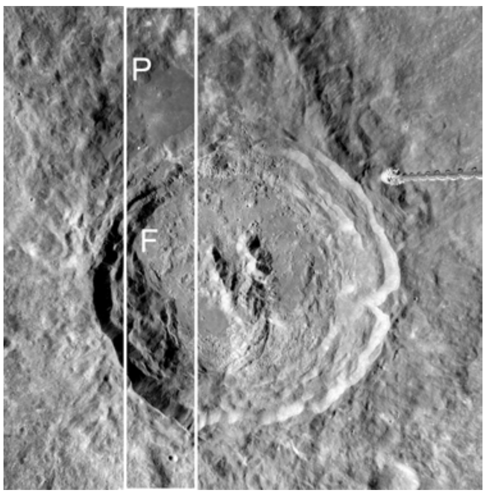

Figure 1. King Crater. The white box outlines the area covered by the Mini RF take. P is the northern melt pool and F is the area of the floor discussed in the text. A boom from the Apollo Command Module is seen on the right hand side of the image. Apollo metric frame AS16-M-1580.

Geology: King Crater is a typical complex impact structure with terraced walls and a central uplift [1 ,2, 3]. Multiple terrace and slump blocks drop rim material into the crater. The northern portion of the wall is lower and the terracing narrower than elsewhere. The central uplift is Y shaped and extends from the southern wall. The floor is covered by plains that embay the central uplift and slump blocks, except in the south. Plains morphology indicates that they formed by impact melt. Ejecta associated with the crater extends out ~100 km. [4] concluded that the asymmetrical structural features as well as the distribution of ejecta and impact melt indicate that King Crater was formed by an low angle impact (~30°).

North of the crater is a small area of plains ~ 15 km across, with a relatively smooth surface filling a topographic low (an ancient crater). Material flows into the area from the southwest and south and the surface displays flow morphology. Small hills are scattered across the plains. The unit is interpreted as a pool of impact melt [1, 2, 5]. This isolated pool may be related to the subdued crater rim in this area, perhaps allowing melt material that would otherwise have been confined to the crater interior to flow out. Spectral data [3] also show a north-northwest trending color difference which overlies the melt pool and covers a larger area.

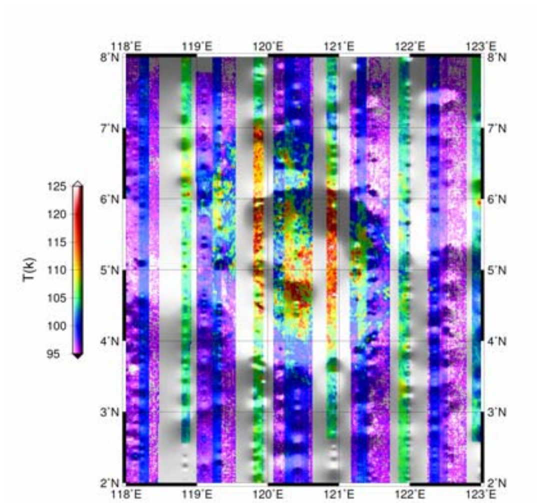

Figure 2. Diviner channel 8 night time temperature. Red is warm, blue cool.

Diviner: Thermal data show that the crater has a distinct thermal anomaly (Fig. 2). Distinct high temperature anomalies are associated with the central uplift and the pond of material (P in Fig. 1) to the northwest. High temperatures associated with the central uplift would suggest that the surface is characterized by bedrock or blocks. Numerous boulders can be seen in the Apollo metric frame (Fig. 1), suggesting shallow bedrock. Melt material on the crater floor and in the pool to the northeast is also warm. Locally, in these areas, such as around fresh craters and along hillsides, boulders are observed, but the surface otherwise appears to be covered with thin regolith. The crater rim does not exhibit a thermal anomaly. Temperatures beyond the crater rim are low, with a highlands mega-regolith lacking boulders or bedrock outcrop.

Mini RF: A west-looking S band (4 cm) radar take was acquired along the western side of King Crater and the area to the north and south (Fig. 3). The image shows the western crater rim and terraces and the crater floor. Aside from the bright returns due to radar-facing slopes, the scene is characterized by a relatively uniform return with small high return anomalies. These anomalies are due to the presence of surface blocks (see examples below).

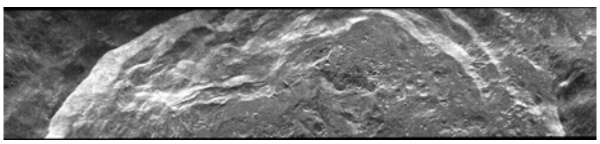

Figure 3. Mini RF image of the western portion of King Crater. North is to the right. The image rotated to conserve space. Part of LSR_CDR_LVZ_01635JOSZ.

LROC – Mini RF Comparisons:

Crater floor: The northern portion of the crater floor (Fig. 4) is characterized by numerous hills ranging from a few hundred meters to about 1.5 km across. The tops of many hills are capped by a rock layer. Along the margins, the layer breaks up and the hill slopes are littered with boulders ranging in size from the resolution limit to ~30 m. These hills were suggested to be volcanoes [1] but they appear to be either remnants from a higher stand of impact melt on the crater floor or topographic highs that were coated with impact melt. The presence of the boulders results in the high radar returns. In the areas between the hills where the rocks are absent, radar returns are lower.

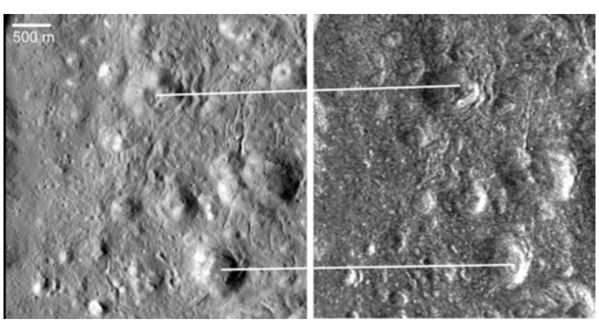

Figure 4. LROC image of a portion of the crater floor (left) compared with Mini RF image of the same area (right). Lines show correlation of features between images. LROC image M103725084L. Centered at 5.45°N, 119.80°E.

Northern pond: Fig. 5 compares the LROC and Mini RF data for the region. The plains unit has numerous small hills a few hundred meters across and fissures. Many of the impact craters have a morphology (concentric ridge / central mound) suggesting that the regolith is relatively thin [6, 7]. The fresh craters have blocky ejecta.

The surface has a more or less uniformly low radar return with the exception of high return around several impact craters. Around craters a and b the area is radar bright; the area around craters c and d does not have a return different from the surrounding plains. Craters a and b have blocky ejecta surrounding the crater with blocks up to 20 m across. Craters c and d have a more subdued morphology and do not have blocky ejecta.

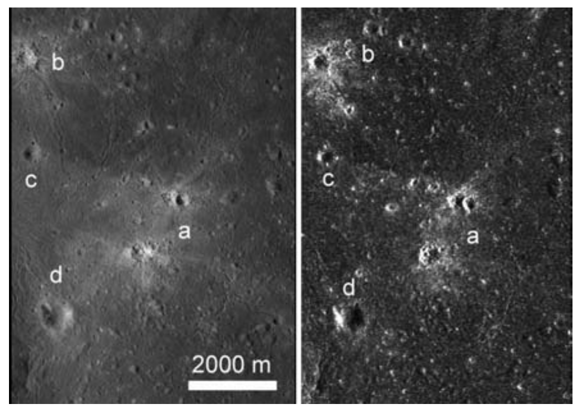

Figure 5. LROC (left) and Mini RF (right) images of a portion of the melt pond north of King Crater. Letters denote the same feature in both images and are discussed in the text. Diameters: crater a is a double - 320 m and 340 m, crater b - 440 m, crater c - 400 m, crater d - 650 m. LROC image M106088433L. Centered at 6.36°N, 119.67°E.

Conclusions: These examples illustrate how the various data sets from LRO can be used to understand details of the surface character and thus the geology of a site. There is a high correlation between radar bright areas, high night time temperatures and the presence of boulders and bedrock.

References: [1] El-Baz F. (1972) Apollo 16 Pre. Sci. Report, NASA SP 315, 29-62 - 29-70. [2] Howard K. (1972) Apollo 16 Pre. Sci. Report, NASA SP 315, 29-70 – 29-77. [3] Heather D. and Dunkin S. (2003) *Icarus, 163*, 307-329. [4] van der Bogert C. and Schultz P. (2002) *LPSC XXXIII*, Abstract 1719. [5] Hawke B. R. and Head J. W. (1977) Impact and Explosion Cratering, 815-841. [6] Oberbeck V. and Quaide W. (1968) *Icarus, 9*, 446-465. [7] Quaide W. and Oberbeck V. (1968) *JGR, 73*, 5247-5270.