DEPTH-DIAMETER RATIOS OF SMALL CRATERS FROM LOLA MULTI-BEAM LASER ALTIMETER DATA.

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Introduction: The Lunar Orbiter Laser Altimeter (LOLA) **[1]** onboard the Lunar Reconnaissance Orbiter (LRO) **[2]** spacecraft is the first multi-beam altimeter flown to a planetary body. It will allow global mapping of the Moon at sub-meter vertical accuracy, and will help define a new lunar reference frame, important to future exploration goals. In addition, the high firing rate (28Hz) of its redundant laser provides a typical along-track spacing of ~10m between topographic measurements (Fig.1). This enables the characterization of the surface morphology at much finer scale than previously possible (e.g., ~1600m for the SELENE/LALT 1Hz single-beam lidar **[3]**).

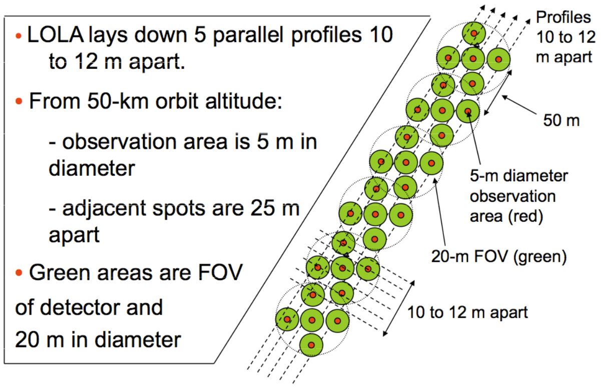

Figure 1. Pattern of the LOLA groundtrack over 6 laser shots (~0.2s). The “landing strip” is made of 5 staggered profiles separated by ~10m.

Rationale: We use the high resolution of the LOLA data to study the small crater population. The unique cross-track information provided by the five-beam configuration enables estimating the position of the track with respect to the center of craters. Over the center, differences among the five profiles are mostly due to small-scale topography. When the track is offset, the profile closest to the center goes deeper into the crater, and has a larger elevation range. This is illustrated in Fig.2a. We will conduct a global survey of small (simple) craters (up to a few kilometers in diameter), by fitting three-dimensional crater models to the numerous profiles obtained by LOLA.

Several *a priori* crater shapes will be considered (e.g., bowl-shaped, conic, flat-floor). The spatial distribution of the goodness of fit for each shape can inform us on the processes and properties that might influence crater formation and degradation. Another estimated parameter, the depth-to-diameter ratio, is important to establish the freshness of the craters, and we will focus on the deepest craters to better understand the formation processes. The distribution of depth-to-diameter ratios could also enable the identification of secondary craters (presumably shallower) in our sample.

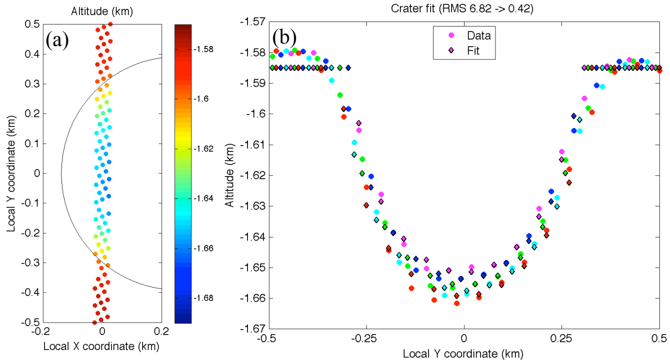

Figure 2. (a) Plane view of the LOLA data (color indicates altitude) and the crater fit (solid line). **(b)** Profiles of the topography data (circles) and of the crater model altitudes (outlined diamonds). Each receiver is plotted with a different color.

Preliminary results: We present early results from LOLA data acquired on November 30, 2009. The assumed crater shape was a simple hemisphere whose depth could be adjusted. The cost function to be minimized included a weighting function favoring the measurements near the middle of the profile with the larger elevation range (depression), in addition to the RMS of the elevation differences between data and model shape. This allowed better cross-track positioning along the crater wall. Fig.2-3 shows the resulting crater fit. Note the good match for all five channels (Fig.2b).

References: **[1]** Smith et al., *Space Sci. Rev.*, 2009. **[2]** Chin et al., *Space Sci. Rev.*, 2007. **[3]** Araki et al., *Science*, 2009.

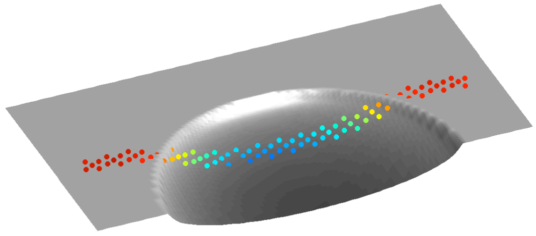

Figure 3. Perspective view of the estimated crater shape. The color scale is the same as Fig.2a. Only half of the crater is shown.