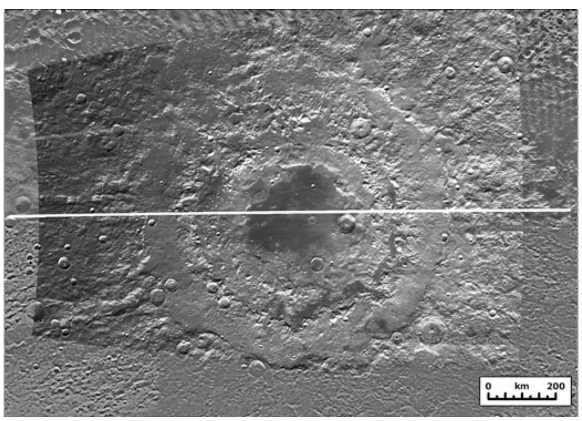
LUNAR ORIENTALE BASIN AND VICINITY: TOPOGRAPHIC CHARACTERIZATION FROM LUNAR ORBITING LASER ALTIMETER (LOLA) DATA. J. W. Head[1], D. E. Smith[2], M. T. Zuber[3], G. Neumann[2], C. Fassett[1] and the LOLA Team. [1]Brown Univ., Providence, RI (james_head@brown.edu), [2]NASA GSFC, Greenbelt, MD, [3]MIT, Cambridge, MA.

Introduction: The 920 km diameter Orientale basin is the youngest and most well-preserved large multi-ringed impact basin on the Moon [1-10]; it has not been significantly filled with mare basalts, as have other lunar impact basins, and thus the nature of the basin interior deposits and ring structures are very well-exposed and provide major insight into the formation and evolution of planetary multi-ringed impact basins [1-10] (Fig. 1). New data from the armada of recent and ongoing lunar spacecraft are providing multiple data sets, new characterization, and new insights into the origin and evolution of the Orientale basin [11-15].

Lunar Orbiting Laser Altimeter Data: We report here on the acquisition of new altimetry data for the Orientale basin from the Lunar Orbiting Laser Altimeter (LOLA) on board the Lunar Reconnaissance Orbiter.



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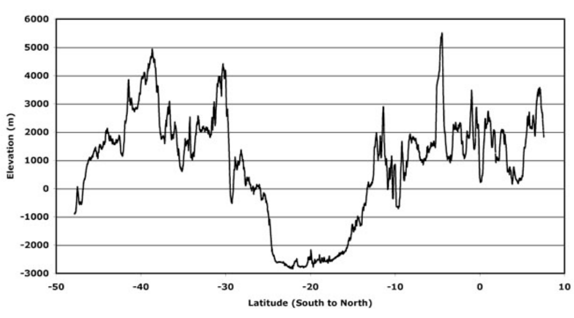
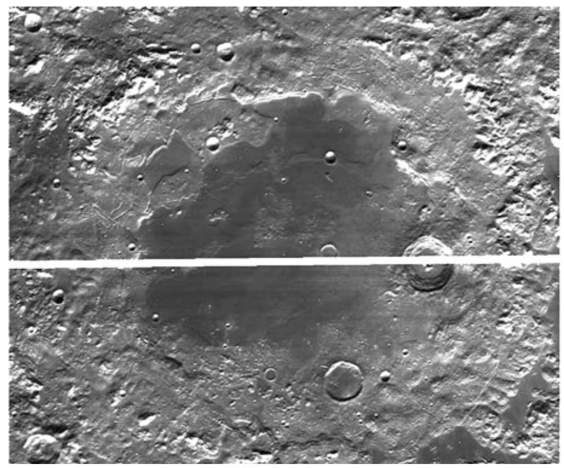


Fig. 2. LOLA profile 092020050 through the center of the Orientale basin and into the pre-Orientale Mendel-Rydberg basin to the south (left).

Pre-Basin Structure: Pre-basin structure had a major effect on the formation of Orientale; we have mapped dozens of impact craters underlying both the Orientale ejecta (Hevelius Formation-HF) (see the rough terrain between -5 and +10 degrees in Fig. 2) and the unit between the basin rim (Cordillera ring-CR) and the Outer Rook ring (OR) (known as the Montes Rook Formation-MRF) (Fig.1), ranging up in size to the Mendel-Rydberg basin just to the south of Orientale (Fig. 2, left); this crater-basin topography has influenced the topographic development of the basin rim (CR), sometimes causing the basin rim (see peaks in Fig. 2) to lie at a topographically lower level than the inner basin rings (OR and Inner Rook-IR). New LOLA data show that the pre-Orientale Mendel-Rydberg basin (Fig. 2, left) just to the south may be larger, younger, fresher, and more comparable in size to Orientale than previously suspected.



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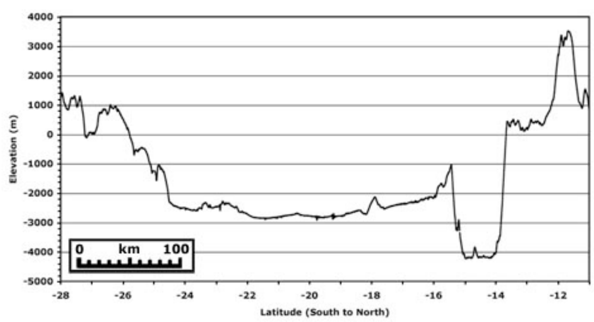

Fig. 3. LOLA profile 092012251 through the center of the Orientale basin and the 55 km diameter crater Maunder on the northern part of the inner basin floor (right).

Location of the basin rim and excavation cavity: In contrast to some previous interpretations, the distribution of these features supports the interpretation that the OR ring (Fig. 1) is the closest approximation to the basin excavation cavity.

Basin Interior Topography: The total basin interior topography is highly variable and typically ranges ~6-7 km below the surrounding pre-basin surface, with significant variations in different quadrants (Fig. 2-3).

Nature of the Inner Basin Depression: The inner basin depression is about 2-4 km deep below the IR plateau

(Fig. 3) and these data permit the quantitative assessment of post-basin-formation thermal response to impact energy input and uplifted isotherms. The Maunder Formation (MF) (Fig. 1) consists of smooth plains (on the inner basin depression walls and floor) and corrugated deposits (on the IR plateau); this topographic configuration supports the interpretation that the MF consists of different facies of impact melt. The inner depression is floored by tilted mare basalt deposits surrounding a central premare high of several hundred meters elevation and deformed by wrinkle ridges with similar topographic heights (Fig. 3); these data permit the assessment of basin loading and by mare basalts and ongoing basin thermal evolution.

Post-Basin Impact Craters and Sampling Depths: The depth of the 55 km diameter post-Orientale Maunder crater, located at the edge of the inner depression, is in excess of 3 km (Fig. 3); this depth permits the quantitative assessment of the nature of the deeper sub-Orientale material sampled by the crater. The mineralogy of the Orientale deposits favor the interpretation that the Orientale basin sampling depth was largely confined to the upper crust [13-15]; the mineralogy of the central peaks of the post-Orientale 55 km diameter Maunder crater, located in the basin interior depression inward of the IR (Fig. 2), are somewhat enriched in low-Ca pyroxene and may have sampled noritic lower crust, but apparently not mantle [15].

References: 1. J. Head, Moon 11, 327, 1974; 2. K. Howard et al., RGSP 12, 309, 1974; 3. J. McCauley, PEPI 15, 220, 1977; 4. J. Head et al., JGR 98, 17149, 1993; 5. S. Bratt et al., JGR 90, 3049, 1985; 6. P. Spudis et al., JGR 89, C197, 1984; 7. B. Hawke et al., JGR 108, 5050, 2003; 8. B. Hawke et al., GRL 18, 2141, 1991. 9. C. Pieters et al., JGR 98, 17127, 1993; 10. B. Bussey & P. Spudis, GRL 24, 445, 1997; JGR 105, 4235, 2000; 11. T. Matsunaga et al., GRL 35, L232012008, 2008; 12. M. Ohtake et al., Nature 461, 236, 2009; 13. C. Pieters et al., LPSC 40, 2052, 2157, 2009; 14. S. Kumar et al., LPSC 40, 1584, 2009; 15. J. Head, Micro 50, 2009.

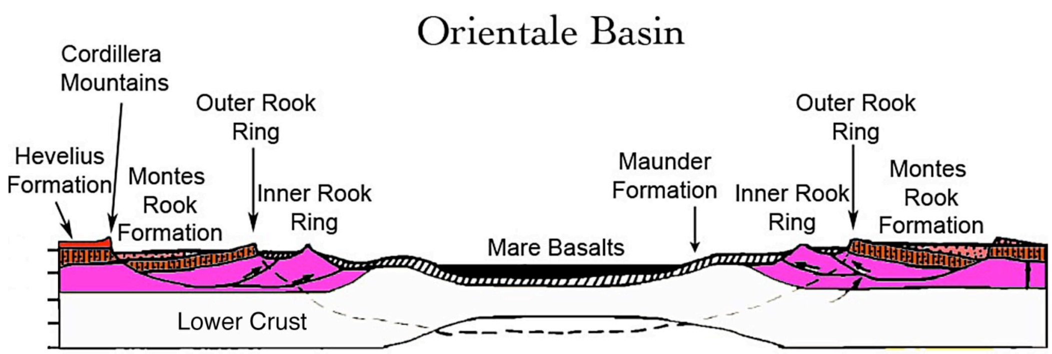

Fig. 1. Schematic cross section of the Orientale basin illustrating the relation of the basin rings to basin deposits (interior and exterior) [4].