MULTI-RINGED BASIN INTERIORS: STRUCTURE AND EARLY EVOLUTION OF ORIENTALE. Suzanne Church, James W. Head, Dept. Geo. Sci., Brown University, Providence, RI 02912; and Sean C. Solomon, Dept. Earth and Planet. Sci., Mass. Inst. of Tech., 54-522, Cambridge, MA 02139.

Multi-ringed basins are known to influence significantly the nature and evolution of planetary crusts and lithospheres.[1] Two major types of structural or tectonic features are associated with these basins: (1) ring structures formed during basin excavation and transient cavity collapse[2], and (2) longer-term features associated with basin evolution and filling. Examples of the latter class are lunar linear rilles and mare ridges formed in response to loading during and subsequent to the emplacement of mare basalts[3], hundreds of millions of years after basin formation. A major question is: Are there any features indicative of deformation over shorter time periods (post-cavity collapse, but prior to, or separate from, mare loading) and what are potential sources of energy for stresses during this time period? Two sources of energy include that delivered by the projectile during the impact event, and that derived from uplift of isotherms during cavity collapse.[4] In this study we have examined the interior of the relatively fresh and unflooded Orientale basin in order to document the structure and facies of the basin interior and correlate these with topography and basin chronology.

The geology of the Orientale basin interior has been previously described[5] (Figs. 1,2). The Cordillera Mts. form the major outer ring outside of which lies the radially textured basin ejecta. A domical facies dominates the region between the Cordillera Mts. and the outer Rook Mts., the next major ring. Inside the outer Rook Mts. lie the inner Rook Mts. (a peak ring), and the corrugated and plains facies (interpreted to be of impact melt origin). Mare deposits are found in the basin center, and along the base of the Outer Rooks and Cordillera in the NE quadrant of the basin, with the central mare being oldest.[6] The basin topography[7] is illustrated in Fig. 2. Five types of surface features of potential tectonic origin exist within the outer Rook Mt. ring and are discussed in chronologic order: (1) first, a <u>pitted and cracked</u> texture associated with the corrugated facies, comprised of linear pits and depressions less than two km in length, and interpreted to be related to the cooling and minor movement of the impact melt sheet; (2) <u>fissures</u> are elongated cracks distinguished by their size, V-shaped cross-section and their general lack of a flat floor. They may range up to a km or two in width and tens of km in length, are heavily concentrated in the corrugated and plains facies, are oriented either radially or concentrically to the basin, and are concentrated in a wide band generally within the inner Rook Mts. (r = 150-230 km). They appear to predate the outer mare patches and graben, to postdate the impact melt sheet (corrugated plains facies) and to predate the majority of the inner mare fill; (3) <u>scarps</u> are linear step-like structures up to several hundred meters high and tens of km in length, are associated with the fissures in both location and chronology, and are concentrated in the SW part of Orientale. They appear to be normal faults and often surround depressions and hills; (4) <u>graben</u> are found inside the outer Rook Mts., but exterior to the central mare; they are linear flat-floored depressions 1-4 km wide and several tens of km long, are located primarily to the N and NE, are concentric to the basin, and are locally flooded by Lacus Veris, a mare deposit. They form subsequent to fissures and are believed to be related to loading and deformation of the lithosphere by the inner mare fill[3]; (5) <u>mare ridges</u> are found only in the central mare, and postdate the central mare fill.

On the basis of geologic mapping, we conclude that the band of fissure

structures represents a set of deformational features that formed subsequent to cavity collapse and impact melt emplacement and cooling, but prior to major mare emplacement and associated graben and ridge formation. On the basis of age estimates for the central mare[6] and a post-Imbrium age for the Orientale event, this deformation occurred during a 100-200 m.y. time period. We note the correlation of the location of this band and the edge of the inner topographic depression in Orientale. It is proposed that 1) the interior topographic depression may have been formed or enhanced by subsidence due to cooling of the central region influenced by Orientale impact heating and isotherm uplift, and 2) the concentric band of fissures resulted from thermal stresses associated with this cooling. Thermal modelling is presently underway in order to assess the distribution of heat in cavity formation and collapse, and the timing and location of stresses associated with subsequent cooling[4].

References. 1) J. Head and S. Solomon, (1981) LPSC XII, 424; 2) J. Melosh and W. McKinnon (1978) GRL, 5, 985; J. Head (1974) Moon, 11, 327; 3) S. Solomon and J. Head (1979) J.G.R., 84, 1667; (1980) R.G.S.P. 18, 107; 4) S. Bratt, et al. (1981) LPSC XII, 109; 5) H. J. Moore, et al. (1974) PLSC 5, 71; J. Head (1974) Moon, 11, 327; D. Scott et al. (1977) USGS Map I-1034; 6) R. Greeley (1976) PLSC 7, 2747; G. Ulrich (1968) USGS Int. Dept. Astrogeology 7; 7) J. Head et al. (1981) LPSC XII, 421.

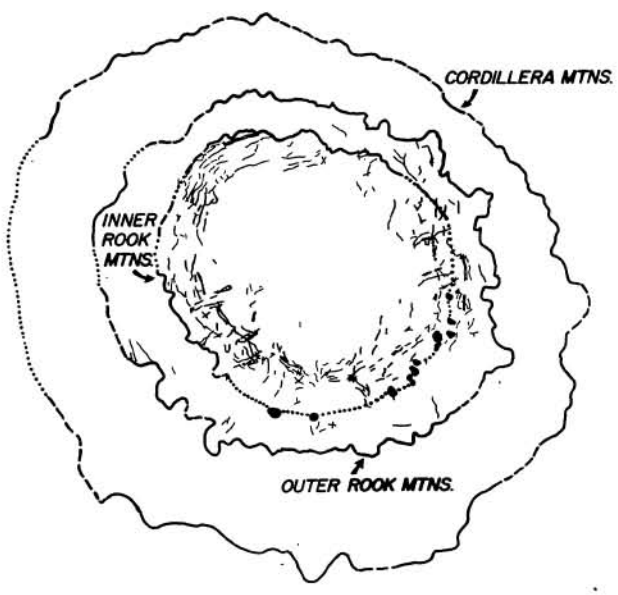


Figure 1. Sketch map of basin rings, fissures (single lines), and graben (double line with hatch). Width of basin is approximately 900 km; mapped from LO IV M-194, which is a slightly oblique view.

Figure 2. Distribution of rings, facies, and structural features plotted on a generalized topographic profile of Orientale[7]. Facies and structural features are arranged in chronological order, oldest at base.