

Spatial Distribution and Characteristics of Graben on the Lunar Nearside

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Faults and fractures are visible records of the stresses operating on and in planetary bodies. On the Moon, tectonic structures are concentrated on the nearside and are spatially associated with the maria. Large-scale graben may be the oldest tectonic structures on the Moon, with current estimates suggesting cessation of normal faulting around 3.6 Ga [e.g., 1, 2]. However, recent work [3] has found that normal faulting at Rupes Recta is younger than 3.2 Ga, indicating that the timing of graben formation and extensional tectonics on the Moon may be less well constrained than previously thought.

Mapping of graben on the lunar nearside (270° to 90° E, 70°N to 70°S) at a scale of 1:500,000 has been completed, a significant improvement over earlier maps produced using low resolution pre-Lunar Reconnaissance Orbiter (LRO) data at scales of 1:5 million and 1:1 million. Based on map view morphology, the mapped graben have been divided into 4 categories: arcuate graben, graben in floor fractured craters, lineaments, and linear graben. The general graben morphology is similar for 3 of the groups: steep walls, relatively flat floors, and resolvable (near constant) widths. However the map view morphology differs in detail; linear graben are roughly linear, while arcuate graben are highly curved along their length and often are concentric to basin margins. Floor fractured craters (FFC) are craters with floors cut by radial, concentric, and/or polygonal fractures and mapped graben that occur within these craters are classified here as graben in FFC. Lineaments are defined here as structures that may follow the trends of identified graben in the area, but are narrow, shallow, V-shaped depressions. These lineaments may not be graben, but are likely to have formed in a similar stress field.

Generally, mapped graben are concentrated near the margins of the nearside maria as observed previously, but some structures have been mapped within the maria or in the highlands far from mare margins. In some places within and on the margins of the maria, graben are observed to cut 'highland islands,' that is, graben cut older highland terrain but not mare. This observation indicates that graben in these locations are younger than the highland material but older than the maria, providing a means with which to constrain the timing of faulting, critical for understanding the temporal distribution and evolution of stresses on the lunar nearside. In addition, these observations will help determine the source(s) of stress responsible for the formation of graben on the lunar nearside.

References: [1] Lucchitta and Watkins (1978), Proc. Lunar Planet. Sci. Conf. 9, 3459-3472. [2] Watters and Johnson (2010), in Planetary Tectonics, pp. 121-182, Cambridge University Press. [3] Nahm and Schultz (2013), Geol. Soc. Sp. Pub. 401, 377-394.