CHARACTERIZING LINKAGES ACROSS SEGMENTED LUNAR GRABEN. E. S. Martin[1] and T. R. Watters[1] [1]Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution (martines@si.edu).

Introduction: Lunar nearside graben formed as the result of mare basalt induced flexure or mascon tectonics [**1, 4-7**], forming radial and/or concentric to mare basins. Lunar graben may also form as the result of dike intrusion [**2,3**]. Recent work suggests graben normal faults that form within mare show evidence of restricted growth with the local thickness of the mare basalts the likely cause of the restriction [**8**].

Linkage of fault segments is the primary way in which faults grow in length, in response to a dominant stress regime. On the Moon, an initial thermal expansion resulted in the formation of large extensional structures [**9**] before transitioning to global contraction [**5,6**]. We are particularly interested in the transition from mare proximal graben formation from post-LHB extension (~3.6 Ga) to the Moon's current compression-dominated stress regime [**10-13**]. This transition may be expressed in the distribution of displacement along the length of graben normal faults. We focus on characterizing the distribution and state of graben linkages across the lunar nearside to determine if they provide insight into the change in state of stress from dominantly extensional to dominantly compressional.

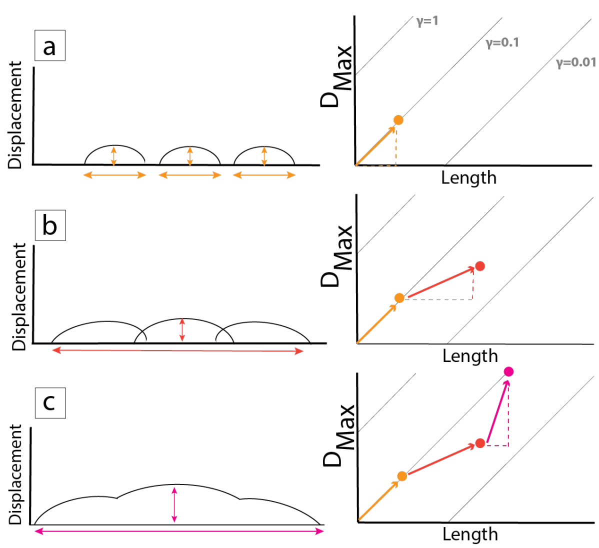

Figure 1: Schematic of the evolution of propagating normal fault segments moving from independent segments (a), partial linkage (b), through to fully-linked segments (c). After [14,15].

Background: The linear scaling relationship between the maximum displacement and total length of a fault is consistent within a single population of faults (Fig. 1a) [e.g. **15**]. Deviations from the linear relationship can occur as faults propagate and link. As smaller segments begin to interact and partially link (Fig. 1b) they gain more length than displacement. Only when the segments are fully linked does the displacements profile return to the characteristic shape of a larger, single fault and the D_{max}/L values return to the population trend (Fig. 1c).

Lunar graben normal faults grow through the linkage of fault segments. Preliminary segmentation analysis of a sample population of nearside graben suggests the geologic setting (i.e., highland, mare, or mixed) does not influence the degree normal faults are segmented. While the mare may tend slightly towards more short segments, overall, mare have a similar distribution of segment lengths when compared to graben within highlands or mixed (mare and highlands) terrains.

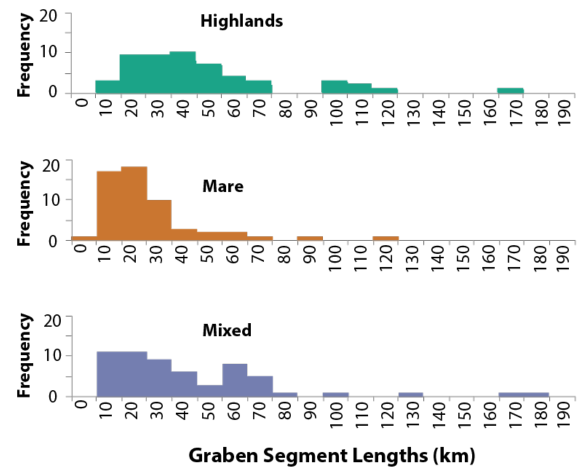

Figure 2: Distribution of graben segment lengths in lunar terrains. The distribution of segment lengths are not significantly different, although mare graben overall have a slight trend towards sower segments.

Our goal is to evaluate the displacement across a sample population of graben to characterize the interaction of fault segments. The measurement of fault displacement is critical for this work, as morphological observations alone cannot identify whether segments are interacting. The degree to which fault segment spatially overlap (in en echelon steps) does not necessarily indicate the degree of linkage. Furthermore, we will assess the spatial distribution of full and partially linked graben with respect mare. Graben forming as the result of lithospheric flexure [e.g., **1**] may be more fully linked and thus have fewer segments proximal to mare centers. Partially linked graben may be more common distal to mare centers with a greater number of segments.

Data Collection: We selected graben that were comprised of at least two segments that were not significantly degraded and cut across multiple terrains including highlands, mare, and mixed (mare and highlands).

Displacement. The throw on graben bounding normal faults was measured at 1 km intervals using LOLA-SELENE gridded data [**16**]. Displacement was inferred from the throw assuming an average fault dip of 60°.

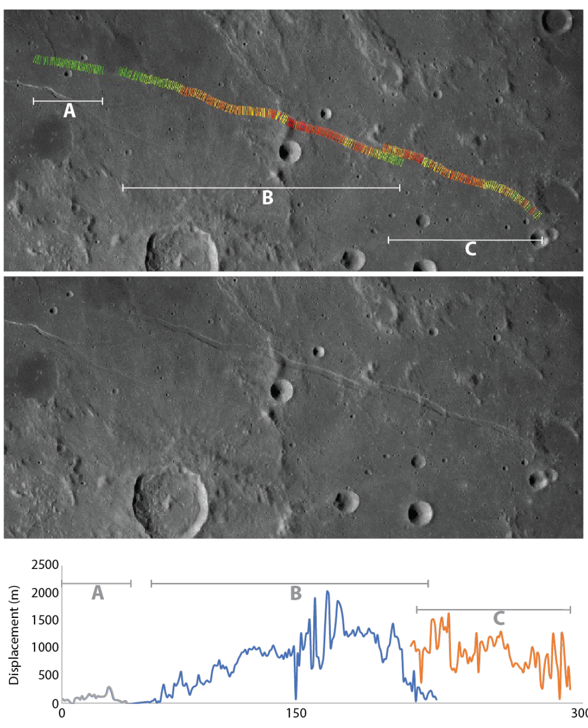

Figure 3: Rima Ariadaeus centered near 6.4°N, 14°E comprised of three segments. Top panel shows locations of displacement measurements across the graben. Color indicates displacement value, with greens indicating lower displacement values, and reds indicating higher displacement values. Bottom panel plots displacement along Ariadaeus.

Discussion & Ongoing Work: Rima Ariadaeus (6.4°N, 14°E) is a 300 km long graben, west of Mare Serenitatis. It is comprised of three primary segments (Fig. 3), where the western most segment (A) does not overlap the central segment (B). Segment A and the eastern most segment (C) overlap by ~20 km. The spacing between segments A and B suggests that segment A did not accumulate a sufficient amount of displacement to overlap B or, that it was initially part of segment B and the gap between the two is the result of degradation. The distribution of displacement where B and C overlap suggests the faults are partially linked. If the two segments were fully linked, the displacement profiles would be expected to more closely resemble Fig. 1c.

Looking at the magnitude of displacement across segmented graben in a spatial context provides a robust set of observations that show how the three segments of Rima Ariadaeus are evolving.

We will measure the displacement along nearside graben-bounding normal faults and determine if there is any spatial relation between the degree of segment linkage and graben location which might be related to the evolution of extensional stresses. Our aim is to have sufficient observations to assess the possible evolution of extensional stresses before they are dominated by compression. We will present our detailed measurements of additional graben as well as characterize their segmentation and linkage.

References:

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