ORIGIN OF CURVILINEAR GRABEN IN SOUTHWEST LUNAE PLANUM, MARS.

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The southwest Lunae Planum region of the Tharsis Plateau is being mapped at the 1:500,000 scale as part of the Mars Geologic Mapping program. The western margin of the ridged plains and plateau plains units in this region is marked by a steep, 3 km high erosional scarp. The plateau units in this region are cut by sets of curvilinear graben that occur within a 150 km zone of the scarp. There are three sets of graben in the region, set A cuts Noachian cratered uplands, set B cuts Hesperian plateau material and set C cuts both Hesperian plateau and ridged plains material (see A, B and C, fig. 1). The graben in set A have a mean direction of N12°E and are partially covered by ridged plains material that embays the cratered uplands (fig. 1, see A). Graben set B cuts plains material that appears to be continuous with the ridged plains material but lacks wrinkle ridges (fig. 1, see B). The trend of many of these graben (mean direction N10°E) are parallel to those in the adjacent cratered uplands. This suggests that these graben are the result of reactivation of a preexisting extensional fabric.

The orientation of graben in set A and B is not consistent with any phase of Tharsis radial extension (1). Circumferential oriented extensional stresses are predicted in this region in isostatic adjustment models (2,3,4), however, the curvature of the graben suggests that they were part of a circular swarm with a radius of approximately 300 km. Circular graben swarms are not uncommon in the Tharsis region. The most likely origin of the extensional stresses is local uplift resulting from the emplacement of an intrusive body. If this is the case, the initial intrusion may have coincided with some of the earliest tectonic activity in the Tharsis region.

The third set of graben (C) cut ridges plains material forming non-orthogonal ridge-fault crosscutting angular relationships (fig. 1, see C). This clearly indicates that graben formation postdates the deformation that resulted in the wrinkle ridges (5). The orientation of the graben in set C (mean direction N49°E) is also not consistent with Tharsis radial extension. However, unlike the other graben sets, the C graben parallel the scarp (mean direction of scarp segments is N52°E). Although the graben in set C do not appear to be related to the other sets, the orientations of the graben in sets B and C become parallel where they cut the same unit (fig. 1, see arrow). This suggests that in this area, the graben in set C were influenced by the same preexisting extensional fabric. The parallel nature of the graben and scarp suggests that the two are related. Possible explanations are: 1) the graben influenced scarp retreat, or 2) graben formation was influenced by, or a result of, the scarp. Extensional stresses near the scarp will result from the release of confining pressure, however, the magnitude of the stress would be expected to decay rapidly with distance from the wall. Another possibility is that extensional stresses resulted from loss of support. If the ridged plains overlie a thick megaregolith that was exposed by erosion, material may have been removed by undercutting and/or sapping. A finite element analysis is planned to determine under what conditions, if any, graben could form at the observed distances from the scarp.

CURVILINEAR GRABEN: Watters, T.R., and M.J. Tuttle

References Cited:
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Fig. 1. Photomaps of southwest Lunae Planum. The three sets of graben in the region are marked A, B and C.