MARE RIDGE - HIGHLAND SCARP STRUCTURES AND UPLAND SCARPS ON THE MOON, MARS AND MERCURY. Thomas R. Watters, Michael J. Tuttle, and John Chadwick, Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, Washington, D.C. 20560.

In addition to the wrinkle ridge assemblage of structures that deform the mare basalts on the Moon are related structures that occur at the margins of basins and extend into adjacent highlands or uplands. There are also upland structures on the Moon, Mars and Mercury that cannot be traced to structures in basins or plains material. Such features are significantly different in morphology from the structures in the wrinkle ridge assemblage. The class of structures described by Lucchitta (1) as "mare-ridge, highland-scarp systems" occur in the Taurus-Littrow area of Mare Serenitatis (Lee Lincoln scarp) (1,2) and in western Serenitatis (West Serenitatis scarp) (1). The Lee Lincoln and West Serenitatis scarps offset the mare surface by as much as 100 m (1), are capped by first-order mare ridges and are flanked and crosscut by second-order ridges (figure 1A). Such offsets in the mare surface are not typical of mare ridges and are likely the results of high-angle reverse faulting (1). Where the structures extend into the highlands, a distinct change in the morphology occurs (figure 1B, arrows indicate scarp; figure 2, first-order mare ridge - highland scarp transition shown in fig. 1B). In the highlands the scarps are one-sided, lobate, smooth and segmented with a maximum height of 30 m (1,2). These highland scarps are morphologically distinct from any of the structures in the mare ridge assemblage. Another mare ridge-highland scarp association occurs in the area of Montes Riphaeus where the scarp consists of both one-sided linear and lobate segments. In the central montes there are multiple, overlapping lobate scarps. Another such mare ridge-highland scarp association occurs near Fra Mauro (3). Highland scarps also occur independently of structures in the mare. These scarps are also one-sided, lobate and segmented. One such scarp occurs in the Taurus-Littrow area (see 1). Though it is in proximity to the mare ridge-highland scarp structure there, it cannot be traced directly to a mare structure. Highland scarps may also occur as linear or arcuate segments, such as the one near Mendeleev (4) which appears to be the result of either high-angle reverse or normal faulting. This scarp and other highland scarps measured reach a mean height of roughly 20 m. Upland scarps are also common on Mercury and Mars. Perhaps the best known upland scarp on Mercury is the Discovery Scarp (5). Discovery as well as other major mercurian upland scarps such as Resolution and Adventure are one-sided, lobate structures that often form arcuate patterns. However, these scarps are much higher than their lunar counterparts, reaching mean heights as great as 3 km. Smaller scarps occur in the hummocky plains material east of the Caloris basin. The lobate scarps are often segmented, reaching mean heights of roughly 1 km. The hummocky plains in this area are interpreted as Caloris ejecta

(5). On Mars, a large number of scarps occur in the uplands north and northeast of Hesperia Planum. These features have been described by some as upland or "terra" wrinkle ridges. In fact, these structures are morphologically very similar to upland scarps on the Moon and Mercury. Martian upland scarps in this region are one-sided and lobate occurring in linear or arcuate segments and reach mean heights of about 300 m. The contrast between wrinkle ridges and upland style deformation on Mars is evident in the area just northeast of Herschel basin where the smooth plains (presumably volcanic) of a roughly 80 km basin have been deformed into a first-order ridge. Deformation can be traced along the trend of the ridge outside the basin into the surrounding uplands but the style of deformation is plainly that of a scarp. The contrast in style of deformation is very similar to that observed in the Montes Riphaeus on the Moon. Thus, upland scarps are common structures on the Moon, Mercury and Mars. The clearly different morphology between the upland scarps and the structures of the wrinkle ridge assemblage reflect different styles of deformation which are likely the result of contrasting mechanical properties (i.e. mechanically isotropic uplands, multilayered mechanically anisotropic flood basalts or presumed flood volcanics).

References Cited

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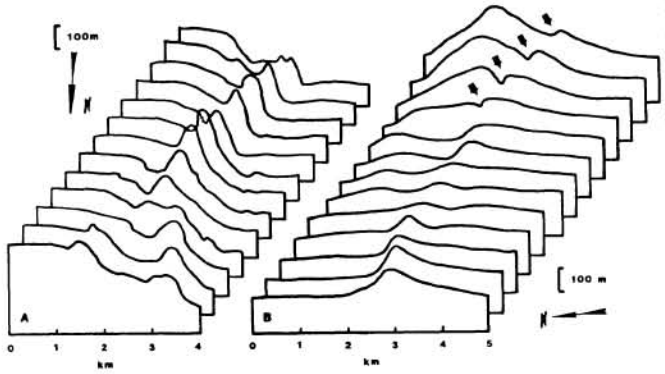

Figure 1.

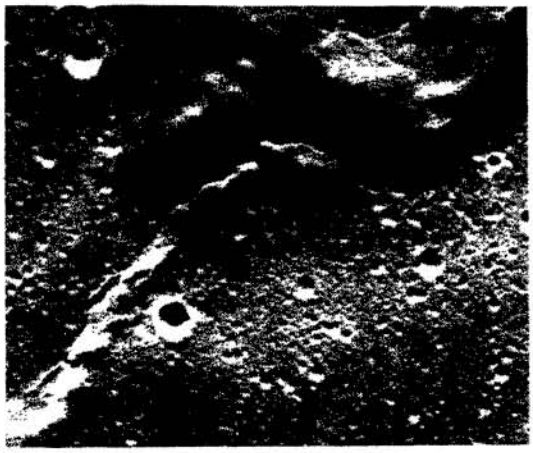

Figure 2.