
Attempts to characterize the detailed morphology of mare wrinkle ridges have been limited by the lack of topographic data for the Moon. Previous efforts have been confined to wrinkle ridges that fall within areas covered by Lunar Orthophotomaps (LTO's) [1, 2], or that were traversed by the Apollo 17 Lunar Sounder Experiment [3, 4, 5, 6, 7]. Photogeologic studies of mare ridges clearly indicate the variable nature of their morphology. This is reflected in the variety of kinematic models that have been proposed [see 1, 2, 5, 8, 9].

Where wrinkle ridges are associated with ridge-scarp transitions, as is the case for the Lee Lincoln and West Serenitatis scarps, the mare surface is offset by as much as 100 m [8]. These offsets are likely the result of high-angle reverse faulting [1, 8]. Golombek et al. [2] have reported that mare ridges (not associated with wrinkle ridge-scarp transitions) exhibit elevation offsets from one side of a ridge to the other. They suggest that these offsets are caused by thrust faults beneath the ridges that separate the mare into structural blocks at different elevations.

The topographic profiles they constructed using LTO's, however, could not be corrected for the influence of the regional slope of the mare surface. Thus the existence of true structural offsets associated with the mare ridges has not been confirmed. Using altimetry data returned by Clementine's laser ranging instrument (LIDAR), the topographic setting of mare ridges is examined and the contribution of the regional slope of the mare surface to ridge morphology is assessed. Preliminary results indicate that there is no evidence of significant structural offsets across mare ridges.

The LIDAR instrument has provided a wealth of new topographic data for the Moon between -75° and +75° latitude [see 10]. Clementine's polar orbit provided altimetry data along north-south orbital tracks (roughly along lines of longitude) spaced by approximately 2.5° at the equator [11, 12]. LIDAR data (from [13]) along two orbital tracks that cross wrinkle ridges in Mare Serenitatis have been examined. One track located along approximately 20°E longitude crosses Dorsa Lister and the other at approximately 17°E longitude crosses Dorsum Buckland. The altimetry data has sufficient spatial and vertical resolution to define mare ridges (Figure 1). In some locations the spatial resolution within these orbital tracks is less than 200 m. The first-order contribution of the regional slope is evaluated by performing a least squares fit to the topography. The regional slope is then removed by subtracting the linear fit from the observed topography. In the case of Dorsa Lister, a significant apparent elevation offset exists across the ridge (Figure 1). Subtracting the linear fit from the observed topography indicates that the apparent elevation offset is an artifact of the regional slope of the mare surface (Figure 2). In the case of Dorsum Buckland, the results show that there is only a small contribution to the profile of the ridge from a sloping mare surface, and that there is no significant elevation offset. It is apparent that the ridges are imposed on regional slopes that are part of broader trends that define the mare surface in Serenitatis (Figure 3). Thus it is important that the mare ridges are studied in the context of the basin topography. Preliminary analysis of two other orbital tracks that cross wrinkle ridges in Mare Imbrium indicate that apparent elevation offsets across the ridges are also the result of a significant regional slope of the mare surface. These preliminary findings thus do not support the observations of Golombek et al. [2]. They are in agreement with the observations of Sharpton [7] (based on east-west profiles across Mare Serenitatis obtained by the Apollo 17 Lunar Sounder Experiment) that apparent offsets on some ridges disappear when the regional trend is removed. The plan to use monoscopic photogeoclinometry on images acquired by Clementine to obtain elevation profiles across mare ridges. Overlying LIDAR profiles on the image data will allow more accurate selection of the horizontal digital number (HDN), which describes the brightness value of a horizontal surface. Further, the HDN will be adjusted so that the photogeoclinometric profile accurately reflects the regional slope. These "controlled" photogeoclinometric profiles will provide the most detailed morphologic data for mare ridges ever obtained. With this data refined estimates of the horizontal shortening across these structures will be made.

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Figure 1. LIDAR profile located at 19.9° E longitude crossing Dorsa Lister in Mare Serenitatis with least squares fit is shown. Elevations are in meters above an ellipsoid of radius 1738 km at the equator.

Figure 2. LIDAR data crossing Dorsa Lister in Mare Serenitatis with the linear fit subtracted.

Figure 3. LIDAR topographic profile located at 19.9°E longitude crossing Mare Serenitatis. Profile shown in figure 1 is a portion of the LIDAR data in this orbital track. Elevations are in meters above an ellipsoid of radius 1738 km at the equator.