THRUST AND STRIKE-SLIP FAULTING IN MARE RIDGE TECTONICS; Jouko T. Raitala, Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109, USA

Wrinkle or mare ridges are long and narrow topographic heights whose origin has been the subject of a long controversy of various theories interpreting their formation as having been caused by buried topography (1), volcanic processes (2,3,4) or tectonic forces (5,6,7,8). Tectonic explanations seem to be the most persuasive, although the control of some mare ridges by the buried topography, especially in the case of some circular or terra-related mare ridges, must also be taken into account (1,9). In places, even volcano-tectonic events may have been important to explain some aspects of the mare ridge pattern (10). Those models which describe the way in which tectonic forces affected the crust and mare ridge formation include folding (8,11,12), vertical movements (7), thrust faulting (8,13) and strike-slip faulting (14,15,16). Folding may have been far less important when compared to faulting. Overthrust faulting seems to have been more effective than shear movements along mare ridge zones. All of the theories may nevertheless present only one side of the mare ridge formation processes and at the same time they may exaggerate the uniqueness of the one-and-only process they present to be valid in some certain circumstances.

The en echelon -like offsets, thought to be caused by strike-slip faults (14,15,16), have been difficult to explain because no well-established horizontal movements are to be found on the Moon (17,18,19). It has, however, been pointed out (10,20,21) that the locations, orientations and arrangements of mare ridges of Oceanus Procellarum have a strong tectonic control, consisting of both compressional lava-loaded and shortened crustal environment, and shear stresses in the lithosphere. It resembles the situation during the initial phase of the compressional shear faulting where synthetic Riedel fractures are developed in compressional environment and their orientations and locations are controlled by a shear component (22). Riedel shears appear even before there are any clear signs of movements along them and Freund (23) has described the initial stage strike-slip movement progress along Riedel fractures as being sluggish and weak.

Golombek (18,19) proposed that while lunar and Martian mare surface strata overlie a mechanically weaker fall-back ejecta and regolith of the basin floor, this mechanical discontinuity may favor compressional stresses to fault the uppermost surface. It may moderate the effect of other than thrust fault movements, especially those of strike-slip stresses originating below this discontinuity. Besides being shallow thrust structures (8,13,24) in the upper surface strata of the basin, mare ridges may also be indications of tectonic movements along deeper crustal zones of weakness (20,21). The mechanical megaregolithic discontinuity then causes some delay when crustal movements are transmitted to fault the surface strata above the megaregolith, thereby moderating the effects of the movements and allowing the overall crustal compression to prevail in surface tectonics. This results in a more direct and forthright surface fault response and development in areas where surface layers and the megaregolith are thin or fault movements large. On the other hand there are only minor surface strike-slip structures in areas with thick surface strata and megaregolithic interlayer or with minor original strike slip fault movements.

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