There are several tens of circular ridges within the Hesperia Planum area. Most of them are located within the low-lying lava-flooded areas. Their absence on the near-by higher terra, with only a few shallow lava areas but with numerous mare-ridge-like ridges, indicates that circular mare ridge rings are generated over buried craters (1) rather than caused by ring dykes (2,3). The area where circular ridges are found is a buried old basin. Lava extrusions have covered the low-lying parts of the basin, its megaregolith and most of the craters, leaving only the highest hills and crater rims to elevate over lava plains.

The occurrence of circular mare ridges, here assumed to be caused by thrust faults in accordance to Plescia and Golombek (4), may be the result of different preconditions. (i) There must have been a buried crater with a lava-cover thicker in its centre than on the crest. (ii) There was a megaregolithic discontinuity below the lava cover. (iii) Horizontal compression was approximately symmetrical towards the crater. (iv) The formation of an upward thrust along the uphill slope of the buried crater was more active than any other activated zone of weakness. (v) The lava cover depth and properties over the buried crater rim must have been critical in thrust fault formation. (vi) The areal compression and the mechanical properties of the megaregolithic discontinuity may nevertheless have been the most critical in focusing compressional forces to break crustal lavas and cause circular ridges over the buried crater rim.

The factors coupled with large-scale lava extrusions, surface lava loads, drying-up of internal magma reservoirs, phase transitions, differentiation, energy transport and subsequent secular cooling of Martian interiors can be seen to have led to compressional surface phenomena. The crust was shortened within loaded areas and over contracting interiors. Tectonic structures were activated and new ones generated within this compressional environment. A brecciated megaregolithic zone, forming a discontinuity between the lower old bedrock and the upper younger strata, may have acted as a conduit focusing tectonic during compression (5). This discontinuity is proposed as the reason for the common occurrence of normal fault features in planetary tectonics instead of strike-slip movements (6,7).

The original crater rims consisted for the most part of rocks excavated by the impact-induced explosion and ejected from the impact. The uphill slopes of the megaregolithic crater rims may have been the most obvious places to guide the horizontal compressional forces, raised by areal crustal shortening, to deflect upwards. The lava cover is at its thickest in the centre of a crater and far outside the crater whereas the closer one approaches the crater rim crest the thinner it becomes. If a horizontally symmetrical compression is directed towards the crater, the upward deflecting discontinuity and the considerable thinning of the lava-cover over the rim crest may result in surface faulting and the formation of circular thrust faults, approximately above the buried crater rim.

The dimensions of circular mare ridges cannot, however, be used to estimate the dimensions of buried craters. Instead of indicating true crater rim crests just reaching the lava surface, circular ridges may depend on a group of variables connected with (i) the lava cover depth, (ii) the amount of crustal shortening and the compressional environment generated by this shortening, and (iii) the mechanical properties of the megaregolithic discontinuity and the intensity of other surface faulting. The more extensive was the crustal shortening, the more extensive was also the faulting. Any increase in faulting...
may nevertheless have destroyed or modified the dimensions of the circular ridges so that they do not any more counterpart exactly the local buried topography. With increasing compression the activation of other zones of weakness also becomes more important. Even pre-existing zones of weakness may thus become important although the megaregolithic discontinuity interlayer has moderated the effects of the previous faults and especially of shear movements (6, 7). Circular mare ridges within circular mare areas may have been controlled by the rounded shape of the old multiring impact basin and the contraction- and load-induced compression (8). The possible existence of a buried intra-basin ring topography may have had similar effects on the circular mare ridge location as had buried craters more locally.


Viking Orbiter mosaic 211-5967 of the south central Hesperia Planum area displays a wide variety of impact craters (black) with ejecta blankets (dotted), and circular mare ridges (line) with adjoining old crater rim remnants (broken line).