HIGHLAND WRINKLE RIDGES ON MARS: Jouko T. Raitala, Jet Propulsion
Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena
CA 91109, USA

The formation of wrinkle or mare ridges is usually coupled with the existence of a lava load. This explanation nevertheless fails when inspecting some lunar mare-ridge-like terra ridges (1,2) and numerous Martian ridged highland areas (3). The importance of lava loading and mascons must be ignored in the case of widely-distributed Martian terra wrinkle ridges, for example around the Hesperia Planum area. The importance of lava load in increasing the crustal shortening and compression is evident within Hesperia Planum, where an extremely intense wrinkle ridge formation has taken place. When approaching the adjoining terra areas there are none of the tensional structures or straight rilles which might be expected if the compressional environment was mainly caused by lava load on the surface. Instead of tensional fractures there are more compressional ridges, indicating that the basic cause of the compressional environment was not a surface load but rather an areal contraction of the Martian interiors below Hesperia Planum and surrounding areas. The role of lava loading, which seems to have had an additional importance within Hesperia Planum, must be largely ignored in the case of terra wrinkle ridges.

The previous existence of hot interiors (cf. 1,2) below this Martian region may well be responsible for crustal compression after a series of events of extrusion and energy dissipation. The Martian internal energy is thought to have been responsible for lavas now found within Hesperia Planum and the building of Tyrrhena Patera. The near-by Hadriaca Patera and other volcanic formations also promote the active interiors. The main regional compression -- according to the existence of wrinkle ridges indicative of crustal shortening -- seems to have been located within the wide Hesperia Planum area. There is no reason to restrict this Martian internal heat below mare-type areas alone. The basin was simply the most appropriate place to be filled by low-viscous extrusives. The high-relief highland areas over the draining and cooling interior may thus have only small lava extrusions in craters and depressions.

In the case of the Moon, where igneous activity was limited areally and in amount, this kind of crustal tectonics has led to a situation in which wrinkle ridges are located mainly -- but not solely -- within mare basins with only a few compressional ridges within the near-by terra areas (1,2). The lunar near-mare terra areas were stretched by tension, which opened up graben-like straight and arcuate rilles. There are also few straight rilles within maria, indicating that even in the Moon the situation was not solely one of simple lava load but that there were endogeneous variations in the lunar stress field (2). The tectonic structures thus provide additional evidences of the lateral variations in the ancient lunar interior.

In the case of Martian Hesperia Planum there are no tensional formations resembling lunar straight rilles. Over the whole region there are only compressional wrinkle ridges, both on mare and terra, indicating compressional tectonics over a wide area. Lava extrusions, drying up of magma reservoirs, and subsequent secular cooling of interiors must have been important in the shortening of the Martian crust within this area. Similar compressional crustal tectonics, evidently subsequent to interior drainage and secular cooling was extended over large areas of the Martian globe as indicated by the distribution of wrinkle ridges (3,4).
Wrinkle ridges on highland
Raitala, Jouko T.

The wide occurrence of mare-ridge-like terra ridges clearly implies some constitutional information about Martian tectonics. Ridges and adjoining scarps indicate compressional terra circumstances (5) which cannot be considered to have been caused by lava load. These terra ridges have to be connected more to the drainage, cooling and contraction of the Martian interiors below these areas. Phase transitions could also have caused volume decrease like also differentiation and core formation. It is thus difficult to identify the one-and-only process responsible for internal shrinkage. The main cause of this contraction may nevertheless have been the secular dissipation of internal energy. The locations and intensities of the terra ridges may give some hints of the dimensions and importance of the internal processes linked with this energy dissipation. We may see a few more details of early planetary development by relating the compressional structures of different planets to indicate a series running from the only slightly active Moon (1,2) via Mars with its numerous terra ridge areas (3) to Mercury with its intense lobate scarp overthrusts (6,7,8,9).