

**Ridge Belts in Lavinia Planitia, Venus: Description and Sequence of Events,**  
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**Introduction:** Lavinia Planitia is a broad regional low about one km deep, which covers about  $5 \times 10^6$  km<sup>2</sup> in the region 35-55°S, 330-0°E. Images returned by the Magellan spacecraft reveal topographically high regions of deformation in Lavinia, which are hundreds of km long, tens of km wide, and up to hundreds of m high. The plains between ridge belts are characterized by numerous small domes (less than 10 km across) and volcanic flows, as well as numerous small ridges and fractures up to three km wide. The pattern of localized deformation on linear topographic highs is similar to ridge belts observed east of Atalanta Planitia in the Venera data [1,2,3]. However, while the belts east of Atalanta Planitia have similar trends, usually within 30° of N-S, the ridge belts in Lavinia trend in three different directions, each associated with a distinct style of deformation; northeast trending belts are dominated by ridges, WNW to NW trending belts by fractures, and E-W trending belts by widely spaced lineations (Fig. 1). The characteristics of these types of ridge belts and their sequence of deformation are discussed below, and possible models for the tectonic evolution of the Lavinia region are discussed in [4].

**Characterization:** *Ridges* are abundant in Lavinia, where they trend either NE-SW or N-S and are often cut by NW-SE trending fractures. These ridges often occur localized on topographic highs, and are similar to ridge belts seen east of Atalanta Planitia in the Venera images, which are believed to be of compressional origin [3,5]. A type area is the southwest leg of Molpadia Linea (50°S, 347.5°E), where ridges are up to five km wide, 5-15 km apart, and parallel to the NE-SW trend of the belt. One example of the age relationship between ridges and grooves exists just north of Molpadia (48°S, 348.5°E), where ridges are cut by NW-SE trending graben. Many isolated ridges lie in the plains, parallel to the Lavinia ridge belts. These ridges are sinuous and up to three km wide, and similar in morphology to lunar, martian, and mercurian wrinkle ridges, giving further support to a compressional origin for the ridges in Lavinia [6,7].

The *fractured terrain* is characterized by narrow scarps (a few hundred m wide), which are parallel to anastomosing, and which often form horsts and graben, suggesting surface extension. In northern Molpadia (47°S, 352°E) sinuous horsts and graben trend N-S, and narrower fractures trend ENE-WSW. The small fractures tend to occur in radar-bright bands, with several fractures each. Individual fractures are spaced up to a few km apart, while deformed bands are on the order of 10-30 km apart.

The third style evident in ridge belts is the region of *widely spaced lineations*, which is common in Molpadia Linea. Both the west-central (48°S, 350°E) and eastern (48.5°S, 356°E) portions of this belt are topographically higher and brighter than the surrounding plains, but do not exhibit the regular ridges or fractures observed elsewhere in the belts. Instead, many of the lineations in these areas appear to be volcanically embayed; the abundance of small domes in these areas provides a possible source for the embaying lavas. Many of the existing lineations in this style of deformation are similar to fractures or ridges elsewhere, suggesting that these regions may be similar to regions with ridges or fractures, but have been covered with lavas from the small volcanoes.

**Volcanism:** Large lava flows and small domes superposed on some ridge belts indicate that volcanic activity has occurred since the formation of these ridge belts. Domes within the ridge belts are usually in locally smooth areas that often appear to embay the ridges and grooves of the ridge belt, suggesting that the small volcanoes formed after the ridge belts. The large lava

complexes in southern and eastern Lavinia [8,9] also appear to be younger than the ridge belts, on the basis of the following observations: (1) the southern lava flow (51°S, 353°E) ends at the southern edge of Molpadia, where the ridge belt begins to rise; (2) the eastern lava flow (45°S, 358°E) is contained by the high topography of the ridge belts on all sides; and (3) graben on the southeastern edge of Molpadia (48°S, 359.5°E) are embayed by lavas. The sources for both of these lava complexes are on the edges of Lavinia, and the flow was directed towards the center [9].

**Sequence of Deformation:** The age relationship between entire ridge belts is not evident at this point, but the relationship between fractures and ridges within the belts is clear. In most cases where ridges and graben intersect, the graben cuts straight through the ridge, indicating that the extension is more recent. Furthermore, large and small lava flows embay both fractured and ridged terrain. Thus, extension followed compression in the ridge belts, and volcanism has occurred more recently. Through additional mapping and modeling [4], we expect to further unravel the geologic history of the ridge belts in Lavinia Planitia.

**References:** [1] Barsukov, 1986, *Proc. LPSC 16th*, D378-D398. [2] Sukhanov and Pronin, 1989, *Proc. LPSC 19th*, 335-348. [3] Frank and Head, 1990, *Earth, Moon and Planets*, in press. [4] Squyres et al., 1991, this volume. [5] Kryuchkov, 1990, *Earth, Moon and Planets*, in press. [6] Watters, 1989, *GSA Sp. Paper 239*, 283-292. [7] Plescia and Golombek, 1986, *GSA Bull.* 97, 1289-1299. [8] Campbell et al., 1991, *Science*, in press. [9] Roberts et al., 1991, this volume.

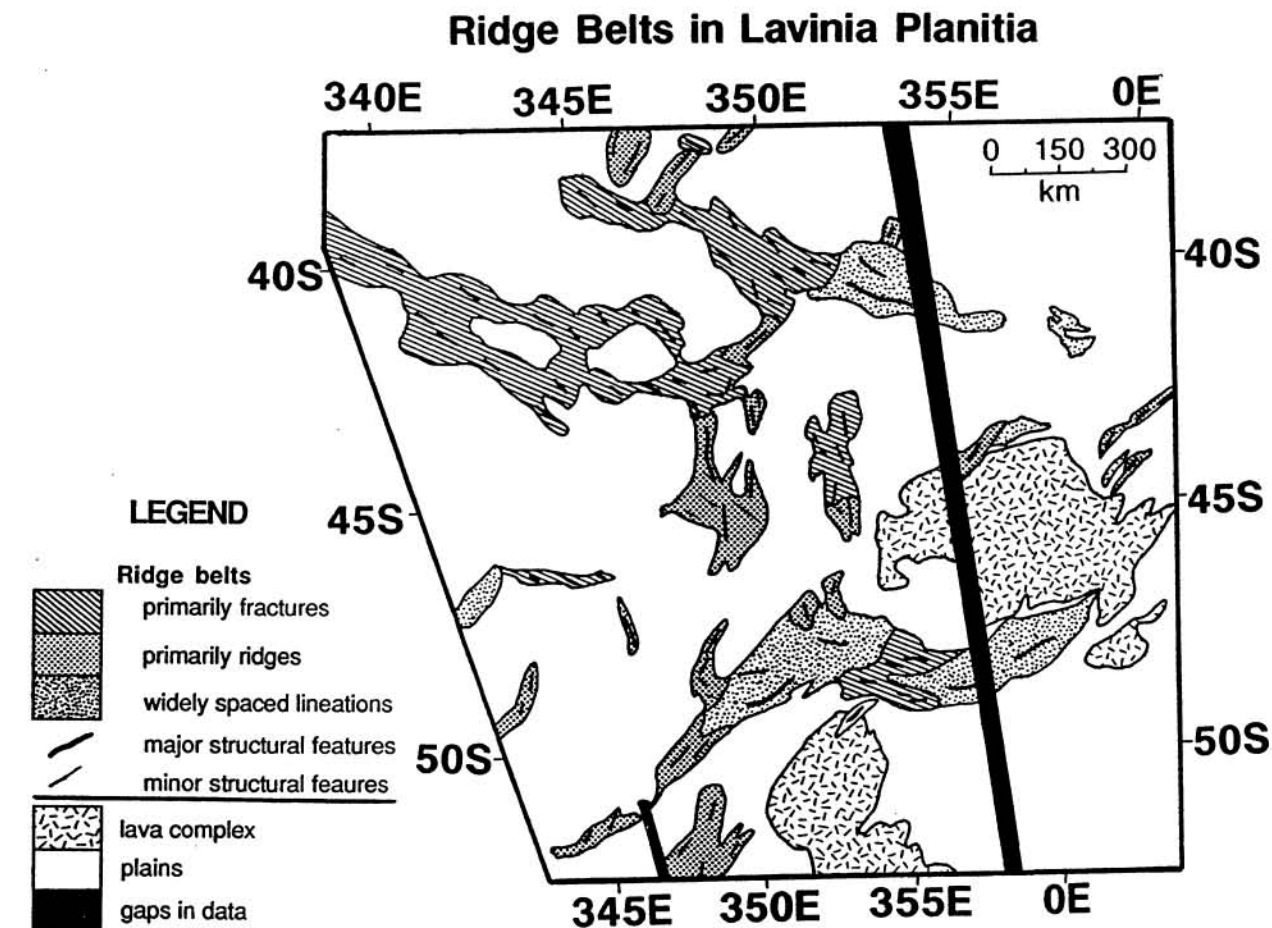


Fig. 1. General map of Lavinia C1-MIDR with distribution of styles of ridge belt deformation.