RIDGE BELTS ON VENUS:
MORPHOLOGY AND ORIGIN*

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Abstract. Ridge belts, composed of closely spaced individual ridges 5-20 km wide, form sinuous patterns 30-400 km wide and 200-2000 km long in the plains of northern Venus. They are not homogeneously distributed, but occur primarily in two regions: between 0°E and 90°E ridge belts are associated with large blocks of tessera, and have a cumulative length of about 13,200 km; and between 150°E and 250°E, the ridge belts form a fan-shaped pattern and have a total cumulative length of about 25,800 km. Most ridge belts trend within 10° of N-S. Five morphologic components exist within the ridge belts: (1) broad ridges, which have no sharp crest and usually occur individually in the plains; (2) discontinuous ridges, with short ridge segments less than 20 km long; (3) paired ridges, with closely spaced ridges (less than 10 km apart) that never merge; (4) parallel ridges, with widely spaced (10-50 km), less prominent ridges; and (5) anastomosing ridges, in which ridges splay at angles up to 30°. Subtle cross-strike lineaments cut the ridge belts at angles of 30-90° to the ridge belt, and augen-shaped plains are often present in anastomosing ridges. We examine the relationships between the components, plains, cross-strike lineaments, and augen-shaped plains in five ridge belts. Broad arches similar to the arches associated with wrinkle ridges on the Moon, Mars and Mercury appear in all of the ridge belts examined. Through studying each of these components individually and in the context of five specific ridge belts, we conclude that these ridge belts formed by compressional forces. The ridge belts form a continuum of deformation, from the simple broad arches (Nephele Dorsa), representing small amounts of shortening, through asymmetric ridge belts in the plains (Pandrosa Dorsa) and adjacent to tessera (Kamari Dorsa), to ridge belts in troughs representing underthrusting (Ausra and Lukelong Dorsa). Underthrusting is also observed along the borders of Lakshmi Planum, associated with Freyja and Dantu Montes.

The interpreted compressional origins for the ridge belt components suggests that many of the other ridge belts are of compressional origin, although complex origins (involving a combination of extension, shear, and/or compression) for some ridge belts cannot be ruled out. Global high resolution data from the Magellan mission will permit global mapping of the characteristics and distribution of ridge belts and allow further tests for their origin and evolution.

1. Introduction

Ridge belts are long (200-2000 km), sinuous features of a variety of widths (30-400 km) which are common in some regions of the northern high latitudes of Venus (Figure 1) in the 25% of the surface imaged by Venera 15/16 (Barsukov et al., 1986). The majority of ridge belts are 100-300 km wide and 300 to 1000 km long, with a few at more extreme values, and they are generally rough at the half-meter to ten meter scale (Bindschadler and Head, 1989). Ridge belts are composed of individual elements (arches and a variety of ridges) which appear generally symmetrical in radar images and which are 5-30 km wide and up to 200 km long. Numerous lineaments cross the strike of the belts at a variety of angles, and augen-shaped plains a few kilometers to 100 km wide are common (Frank and Head, 1990).
Coronae, which are circular features 200–600 km in diameter, are often surrounded by an annulus of ridges (Stofan and Head, 1990; Stofan and Pronin, 1990). Ridge belts commonly occur in smooth plains which are interpreted to be volcanic in origin on the basis of flow morphology and volcanic centers visible in these plains (Barsukov et al., 1986). Evidence for low erosion rates on Venus (McGill et al., 1983; Ivanov et al., 1986; Head et al., 1985; Bindschadler and Head, 1989) suggests that the observed components of ridge belts may be primary, rather than erosional or erosion-modified.