tectonic style on Venus (*12–15, 24–26*). In this article we adopt a complementary approach and focus on several specific morphological and geological tests for the presence of segmented lithospheric plates and lateral crustal spreading in this area on Venus.

Evidence for the presence of lithospheric plates and crustal spreading at divergent plate boundaries on Earth includes: (i) linear oceanic rises, (ii) the broad bilateral symmetry of topography associated with these rises, (iii) the link of this topography to the evolution of the thermal boundary layer as it moves away from the plate boundary, (iv) median valleys along the crests of many rises, (v) fracture zones that are generally orthogonal to the rises, (vi) lateral offsets of the oceanic rise or ridge at fracture zones, (vii) transform faults located along fracture zones between ridge offsets, (viii) seismic activity localized along transforms, (ix) symmetric magnetic stripes parallel to the rise and their increasing age with distance from the rise crest, (x) volcanism (intrusion and extrusion) concentrated at ridge crests as new crust and lithosphere are created, (xi) localized anomalies in the topography of rises (plateaus) linked to enhanced volcanic activity (for example, Iceland), and (xii) the eventual splitting and separation of such plateaus (*27*) to produce mirror-image topographic highs away from the ridge crest. Lack of seismic and magnetic data for Venus preclude testing for the presence or absence of localized earthquakes (item viii) or magnetic anomalies (item ix), two very significant indicators of divergent activity. Most other characteristics of terrestrial divergent plate boundaries cited above have topographic or morphologic manifestations. Our purpose in this article is to test for the possible presence of such features on Venus. In doing so, we recognize that owing to the distinctive environmental conditions on Venus an exact one-to-one similarity of details of topography may not be expected.

Linear topographic rises. One of the most distinctive characteristics of the topography of Venus is Aphrodite Terra, a broad, linear highland region that stretches for 21,000 km (*28*) along the equatorial region (Fig. 1). Indeed, the linear topographic belt extends well beyond Aphrodite and it has been named the "equatorial highlands" (*14*). Aphrodite is characterized over much of its extent by linear troughs along the same trend, which are interpreted to be rifts (*28*), and by a broad topographic symmetry. In assessing whether linear highland topographic features on Venus could be spreading centers, Kaula and Phillips (*13*) found that they satisfied two of their proposed tests for seafloor-like spreading: (i) linear highlands are elevated with respect to a broad reference plain that could act as the boundary layer of a mature "ocean" basin, and (ii) the ridge shapes are predominantly concave. Kaula and Phillips further noted, however, that these topographic features failed two other important tests, being unlike the terrestrial ridge system in that the ridge heights do not have a narrow distribution about a mode and that they do not form a global interconnected system. Kaula and Phillips (*13*) and Phillips and Malin (*14*) concluded that if plate creation occurs on Venus, only a small amount of heat is transferred to the surface by this process. Thus, on the basis of low-resolution topography and criteria related to the nature of present-day terrestrial divergent plate-boundary topography and map patterns, these prior analyses concluded that there are extensive areas on Venus characterized by a broad, generally symmetrical topographic rise, but that these areas differ from terrestrial oceanic rises in two important ways: rise heights are variable, and there does not appear to be a mosaic of interconnected rises.

We begin with the assumption that broad linear topographic rises are of fundamental significance in understanding the tectonics and heat transfer mechanisms on Venus, and that they are the best candidates for possible divergent plate boundaries, as indicated in previous studies (*13, 14*). We focus on the nature of the western part of Aphrodite Terra (Ovda and Thetis Regio, Fig. 1) in this context, using moderate-resolution imaging (*6*) and high-resolution altimetry data (*7*), in addition to the low-resolution topographic data discussed above. In particular, we concentrate on the identification of additional geological (topographic and morphologic) features that might reveal the nature of these topographic rises and further test the idea that they might represent lithospheric plate boundaries.

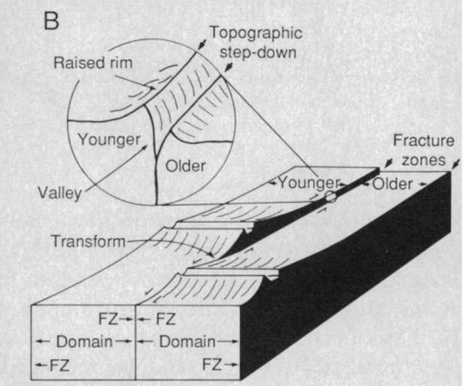

Fig. 2. Earth oceanic fracture zones. (**A**) Map view of the North Atlantic showing offset of rise crests along fracture zones and the differing characteristics of linear rise crests (trough to the south, Icelandic plateau to the north, and the Reykjanes Ridge in between). [Reprinted with permission of the National Geographic Society, copyright 1968]. (**B**) Generalized block diagram showing topographic and morphologic characteristics of oceanic fracture zones.

Fracture zones. On Earth, fracture zones are long, narrow linear regions up to about 60 km wide, which consist of irregular ridges and valleys aligned with the overall fracture zone trend, and which cut across both rises and the surrounding abyssal plains for distances up to several thousand kilometers (*29*). Fracture zones are commonly parallel to each other, ocean floor depth commonly changes across a fracture zone in a step-down fashion, and the crests of oceanic rises are often offset by many hundreds of kilometers at fracture zones (Fig. 2). Fracture zones represent the propagation of an initial stair-step–like boundary between newly formed lithospheric plates along ridges and transform faults. Active horizontal (strike-slip) shearing and deformation is limited to the zone between the two ridge crests (the transform fault) and the fracture zone extending away from each ridge crest in the opposite direction is the scar remaining from the intense shearing activity that takes place between ridge crests.

Crumpler *et al.* (*18–20, 23*) have recently identified a series of linear discontinuities cutting across the strike of western Aphrodite Terra (Fig. 3A). Using topographic data and images, they documented the presence of numerous parallel linear features defined by linear highland topographic segments, aligned individual topographic features, regional changes in topography in the lowlands, steep gradients in radar backscatter values in images, and linear boundaries in the radar properties of surface materials. Individual