

**COMPARISON OF OBSERVED AND PREDICTED GRAVITY PROFILES OVER APHRODITE TERRA, VENUS; M. T. Black, Astronomy Program, Univ. of Maryland, College Park, MD 20742, M. T. Zuber, Geodynamics Branch, NASA Goddard Space Flight Center, Greenbelt, MD 20771, and D. C. McAdoo, National Geodetic Survey, National Oceanic and Atmospheric Administration, Rockville, MD 20852.**

Aphrodite Terra, the largest highland area on Venus, is a long east-west trending feature in the equatorial region. Its size makes its origin and geological nature of great importance in understanding Venusian tectonics. Several suggestions have been made for the nature of these highlands [1-5], but the differing natures of these analyses make comparison of the various models difficult.

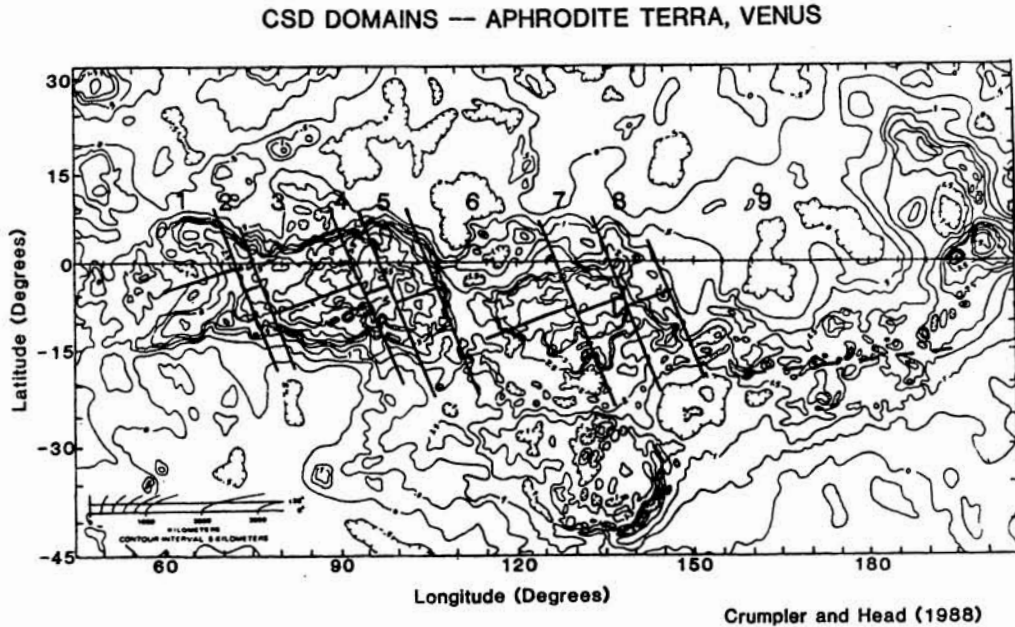
We have compared observed Pioneer Venus Orbiter (PVO) line-of-sight gravity profiles over Aphrodite to profiles predicted from various models of isostatic compensation. By using the same method of analysis with each model we can assess how well they can be distinguished using the PVO gravity and topography data. We have taken Crumpler and Head's [3] cross-strike discontinuities and centers of bilateral symmetry, obtained from a study of PVO and Arecibo radar data, as a convenient framework for our analysis (Fig. 1).

The models that we have employed are simplified Airy compensation [6], dynamic compensation [7], and thermal isostasy (half-space spreading ridge model) [8]. In the case of the Airy and dynamic compensation models the gravity and topography data from each orbit are isolated within one of the nine domains in Fig. 1 and projected perpendicular to the 'ridge axis.' The model gravity is computed at each data point using a finite impulse response filter convolved with the topography profile, and a least-squares best-fit of predicted to observed gravity is obtained. The adjustable parameter for Airy compensation is the depth of compensation and for dynamic compensation it is the convecting layer thickness. In the case of the spreading ridge model the observed topography is not used to generate the model gravity, as the model implicitly assumes the theoretical topography profile. Here there are two adjustable parameters: the spreading rate and ridge half-width. Figure 2 shows the model fits for a typical profile, this one from domain 3 at about 90° east longitude in western Aphrodite (Fig. 1).

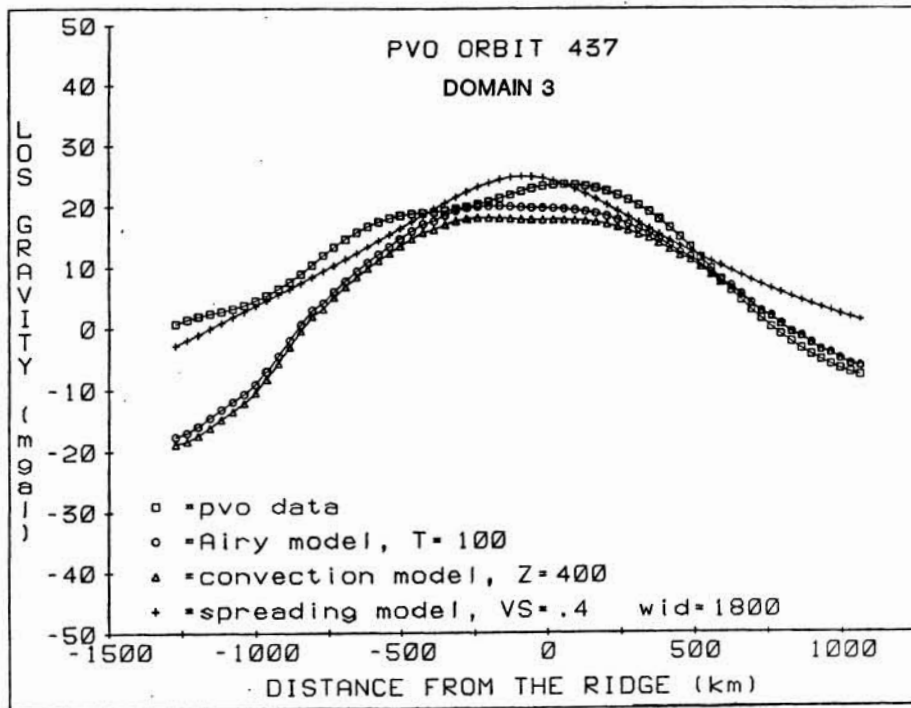
We find that the best-fit Airy compensation depths increase from about 20 km in western Aphrodite to over 200 km in the east, in agreement with Herrick and Bills [9], and the best-fit convecting layer thicknesses increase from about 100 km in the west to about 800 km in the east. The length scales of tectonic features imply that the crustal thickness in at least some areas of Aphrodite is less than the Airy compensation depths obtained in the eastern part of Aphrodite [10], suggesting that at least this part of the ridge is dynamically supported. The spreading ridge model yields best-fit spreading rates of about 1 cm/yr or less in western Aphrodite. All three models provide a reasonable fit to the observed gravity for most of the profiles in western Aphrodite, but in eastern Aphrodite the gravity does not closely correspond to the topography, suggesting that sub-lithospheric sources are important in this region. Nowhere are we able to distinguish Airy compensation from dynamic compensation.

**References:**

- [1] Phillips and Malin (1983), in *Venus*, Univ. Arizona Press, 159-214.
- [2] Crumpler et al. (1987), *GRL* 14, 607-610.
- [3] Crumpler and Head (1988), *JGR* 93, 301-312.
- [4] Kiefer and Hager (1987), *LPSC* 18, 489-490.
- [5] Kiefer and Hager (1988), *LPSC* 19, 601-602.
- [6] McKenzie and Bowin (1976), *JGR* 81, 1903-1915.
- [7] Parsons and Daly (1983), *JGR* 88, 1129-1144.
- [8] Haxby and Turcotte (1978), *JGR* 83, 5473-5478.
- [9] Herrick and Bills (1988), *LPSC* 19, 481-482.
- [10] Zuber (1987), *JGR* 92, E541-E551.



**Figure 1.** Topography of Aphrodite Terra with cross-strike discontinuity domains superimposed. Adapted from [3].



**Figure 2.** PVO gravity profile plotted along with the best-fit model profiles. Symbols are defined on the plot. The best-fit Airy compensation depth is 100 km, best-fit convection layer thickness is 400 km, best-fit spreading velocity is 0.4 cm/yr, and best-fit ridge width is 1800 km.