Correlation of Pioneer Venus Orbiter Gravity Data With Venera 15 and 16 SAR Imaging

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The Soviet synthetic aperture radar data from Venera 15 and 16 that are now available in published reports covers an area from 25° N latitude to the north pole and over almost the entire 360° of longitude. We have overlaid these images with gravity contours determined from analysis of the Pioneer Venus Orbiter (PVO) data. A complete report on the gravity reduction was published in the J. of Geophysical Research (1), where the gravity contours overlaid a Mercator map of PVO altimetry data (2). This previous analysis revealed the high correlation between gravity and surface relief. Now in this report we evaluate specific types of visual SAR features with positive or negative gravity anomalies. We have found several SAR features that appear to correlate with gravity anomalies that previously were overlooked because of no obvious feature in the altimetry data or were relatively low amplitude. For example, near latitude 35°N and longitude 35°E there is a nest of arachnoid features that are centered on a five milligal gravity high which rather conversely is in a topographic low. Suggesting that the materials in this region may be of higher density than its neighbors; possibly recent extrusions which have not yet undergone any significant isostatic adjustment. The extensive low regions of Sedna Planitia (250° longitude to 360° longitude) are relatively void of visual SAR features and seem to reflect this with a broad gravity low and no localized gravity anomalies. The same is true over Niobe Planitia, a low topographic region, void of many SAR features and again a broad gravity low. Within the working band of the line-of-sight gravity data which can be interpreted to approximately 50°N latitude, SAR images that are prominently visible are also the ones that have positive gravity anomalies correlated with them. From 5°E longitude to 90°E longitude and from 150°E to 230°E there appear to be gravity highs associated with specific features which also follow definite trending directions.

Near 10° to 20°E longitude and 30°N latitude there is knobby terrain that possibly could be a field of volcanoes. This region has a gravity high associated with it that extends directly northward into an area of arachnoid type features. To the east at 35°E longitude and 35°N latitude there is a nest of arachnoid features with a gravity high. There is also Bell Regio at 50°E longitude and 30°N latitude with a sizeable gravity high. All these anomalies reside on

a gravity high trending N.W. towards Maxwell Montes. Possibly indicating this region as a tectonically active area.

Leda Planitia at 65°E longitude and 35°N latitude, a lowland block, has again a broad negative gravity signature and is relatively featureless. However just south of it there is the Hatshepsut Patera, and to the west there is Tellus Regio with its tessera terrain. Both of these features have positive gravity anomalies. Tellus Regio is just part of a large gravity anomaly that extends northward where more tessera terrain is evident in the SAR images.

The Niobe longitudes (90°-155°) again display only a board negative gravity. Near 155°E longitude and 193°E longitude at 35-40°N latitude, there are ridged terrain areas which have local gravity highs correlated with them. These small highs are imbedded in the western portion of Niobe and trend northeast. Then just east at 228° longitude and 35°N latitude is a strong gravity signature which correlates with the N-S topography from Ulfrun Regio. The Venera SAR data is missing in this area but the existing SAR data to the north of this region is similar to that where gravity highs were predominant in the east at 20-30° longitude. Gerry Schaber (USGS, private communication with work in progress (3)) believes these two gravity zones, which are approximately 180 degrees apart, tie together crossing over the pole, and are consistent with his 1982 work (4).

In general, correlating the gravity data and the SAR imaging in this overlapping region of 25°N-50°N latitude, one sees that the broad negative anomalies of Sedna Planitia, Leda Planitia, Niobe Planitia and Atalanta are areas which lack prominent SAR features. However, where there are significant structural features of many kinds in the SAR images, there are positive gravity anomalies associated with them. Since the gravity data are so attenuated at the high latitudes, no definite statements can be made for the polar areas. Only inferences can be drawn by correlating similar SAR terrains with those definitely mapped to gravity anomalies. It does appear that the 0-90 quadrant and the 180-270 quadrant have more positive gravity anomalies and contain the prominent SAR structures. This may be indicative of tectonic zones in the northern latitudes.

References:

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