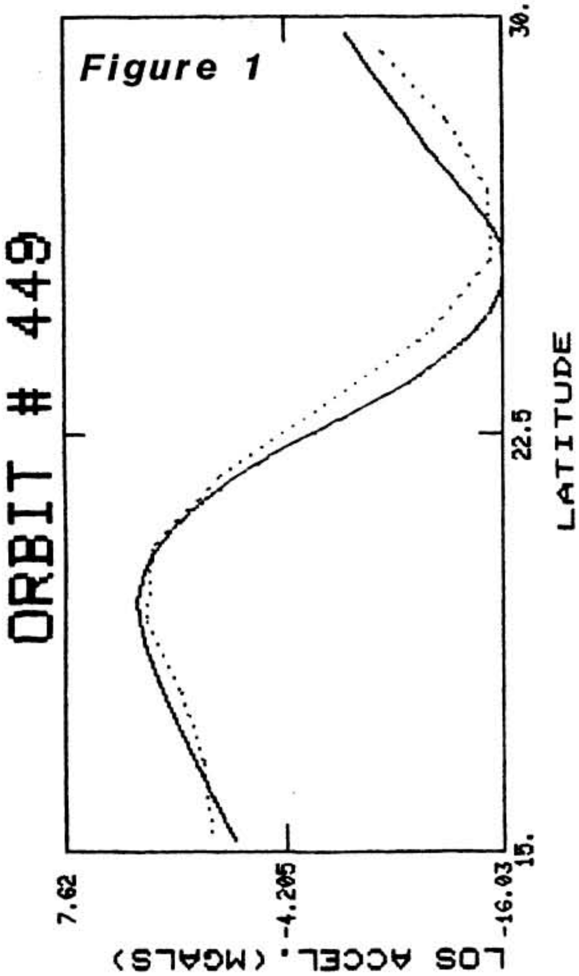
VENUS TOPOGRAPHY AND GRAVITY MODELS: PRELIMINARY RESULTS; P. Morgan (1), R. J. Phillips (2), L. V. Block (3), and M. T. Reagan (1); (1) Dept. Geosciences, Purdue U., West Lafayette, IN 47907; (2) Dept. Geological Sci., Southern Methodist U., Dallas, TX 75275; (3) Lunar and Planetary Inst., 3303 NASA Road One, Houston, TX 77058, present address - College of Geosciences, Texas A & M Univ., College Station, TX 77841.

We have started a systematic evaluation of the mode(s) of compensation of Venus topography using forward modelling techniques with Pioneer Venus orbital gravity data (LOS gravity) to constrain the models. In the modelling, an area of Venus topography is selected (typically a 15 degree square), a geophysical model for the mode of compensation is chosen with various parameters, the LOS gravity predicted by this model are calculated using orbital simulation (ORBSIM) techniques (1) and the results compared with the PV observed data. We are performing this analysis in the spatial domain, with the primary aim of mapping areas of differing compensation characteristics on Venus, and in the wavenumber domain to estimate line-of-sight spectral admittance functions for Venus. Geophysical compensation models to be tested include Airy isostasy, thermal isostasy, flexural and dynamic support.

Morgan and Phillips (2) demonstrated that Venus elevations below a planetary radius of about 6053 km (approximately 93% of the mapped surface area of Venus) could be explained by a thermal isostasy model consistent with estimates of global heat loss for Venus. Preliminary spatial domain topography-gravity modelling has focussed upon testing the thermal isostasy model for compensation of Venus topography below 6053 km. Good agreement has been found between predicted and observed LOS gravity for some areas tested, an example of which is shown in Figure 1 from an area on the southern margin of Niobe Planitia (latitude 15 to 30 deg N, longitude 105 to 120 deg). The estimated range of mean depth of compensation for the thermal isostasy model for this area giving reasonable agreement between observed and predicted gravity was 135 to 185 km. In contrast, significant divergences between observed and predicted gravity were found for other areas tested, an example of which is shown in Figure 2 for an area between Aphrodite Terra and Tellus Regio (latitude 15 to 30 deg N, longitude 75 to 90 deg). Agreement between observed and predicted orbital gravity is good in the central portion of this area, but diverges by a few mgal as Tellus Regio is approached to the north, and by about 10 mgal as Aphrodite Terra is approached to the south. An 8 degree margin was included in all models to reduce edge effects, and increasing this margin did not reduce the divergence between predicted and observed orbital gravity shown in Figure 2.

A spectral approach complements the spatial approach described above. Dimensionless admittance spectra have been calculated for the equatorial regions of Venus, excluding the Beta and Aphrodite areas, by generating the LOS gravity of the topography using the ORBSIM program (1). Fourier transforms along an orbital track of both this quantity and the observed LOS gravity allow us to calculate "LOS admittance functions". Our preliminary analyses show that the LOS admittance <u>estimates</u> are best obtained by averaging spectral quantities for a set of adjacent and homogeneous "like LOS geometry" orbits, requiring that the spatial sample is of a stationary stochastic process. The resultant estimates appear to be independent of orbital geometry; i.e., they can be compared directly to theoretical geophysical models. This implies that the direction cosines of the observed and the topograhic gravity vectors are nearly the same.

The power spectra themselves emphasize that there are regions of Venus where the gravity and topography are poorly correlated. This is sometimes manifested in a peak "at wavelengths less than 1000 km" in an observed spectrum that has no corresponding peak in the topographic spectrum. For wavelengths greater than 1000 km it is difficult to separate various types of geophysical models (isostatic, dynamic, flexural) in the admittance spectrum. Separation may be possible at shorter wavelengths, and this will require isolating the topographically coherent part of the observed gravity signature both spatially and spectrally.



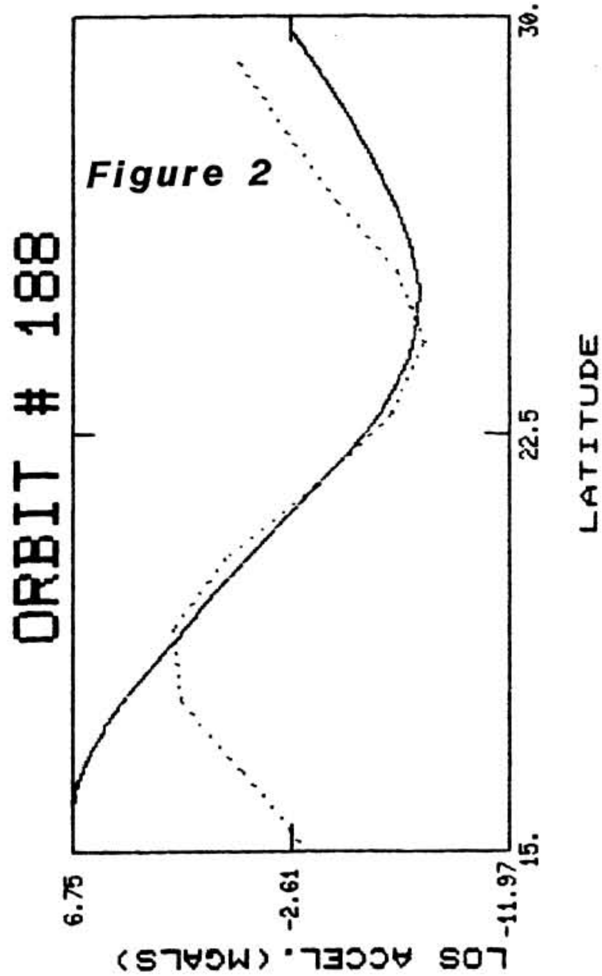


Figure 1. Observed (solid curve) and predicted (dotted curve) LOS gravity (LOS Accel.) for orbit # 449 crossing area bounded by latitudes 15 and 30 deg N and longitudes 105 and 120 deg. Thermal isostasy model used for predicted gravity with mean depth of compensation of 175 km.

Figure 2. Same as Figure 1 for orbit # 188 crossing area bounded by latitudes 5 and 30 deg N and longitudes 75 and 90 deg. Thermal isostasy model used for predicted gravity with mean depth of compensation of 80 km.

References: (1) Phillips, R. J., Sjogren, W. L., Abbott, E. A. and Zisk, S. H. (1978) J. Geophys. Res. 83, 5455-5464. (2) Morgan, P. and Phillips, R. J. (1983) J. Geophys. Res. 88, 8305-8317.