MAGELLAN LOS GRAVITY OF VENUS PLAINS REGIONS: LITHOSPHERIC PROPERTIES. AND IMPLICATIONS FOR GLOBAL TECTONICS. D.L. Bindschadler, Dept. Earth and Space Sciences, University of California, Los Angeles, CA 90024-1567, bindsch@mgnvax.ess.ucla.edu

Although the plains of Venus represent over 70% of the surface area of the planet, they have remained largely unstudied. These regions are an important constraint on models for Venus tectonics. "Catastrophic" models postulate that Venus' plains were resurfaced ~500 million years ago [1], while "steady-state" models imply a spectrum of ages for plains [2]. With regards to the plains, one can identify two end-member possibilities. In the first, the plains are tectonically homogeneous and at approximate thermal equilibrium with the interior. Such a scenario might arise, for example, as the result of a catastrophic overturn of the Venus mantle [3] and subsequent resurfacing. In the second, they are tectonically diverse regions characterized by a complex loading history, and may be significantly heterogeneous with respect to thermal gradient and apparent elastic thickness. This latter possibility would tend to suggest a more protracted period of Venusian tectonics. In addition, lowlands with relatively large negative gravity anomalies have been suggested to be regions of mantle downwelling [4]. The high spatial resolution of Magellan altimetry and line of sight (LOS) gravity data can be used to test these hypotheses for Venus' plains regions. Initial results for the Rusalka Planitia region (10°S - 15°N, 155°-180°E; north of Central Aphrodite Terra) include a best-fit apparent depth of compensation of 135±38 km and very low coherence of gravity and topography at spatial wavelengths less than ~700 km. Preliminary analysis suggests that the effective elastic thickness of the lithosphere in this region is large, perhaps more than 40 km. The large ADC is primarily an expression of the longest wavelengths in gravity and topography and suggests either a very thick thermal lithosphere, or dynamic support of long-wavelength topography by mantle downwelling.

LOS gravity data are obtained from Magellan via two-way coherent Doppler tracking of the spacecraft by Deep Space Network stations [5]. To obtain the highest possible spatial resolution, LOS anomalies are used to model the vertical gravity field over localized regions of Venus using a linear inversion technique made available by R.J. Phillips and R.E. Grimm. Once a suitable solution for the local vertical gravity is obtained, the relationships between gravity and topography can be examined in both the spatial and spectral domains. In the spectral domain, both admittance and coherence of gravity and topography are calculated [6] and can be compared to simple models of lithospheric and crustal properties (e.g., Airy isostatic or elastic flexure models).

As part of the initial analysis of Magellan gravity data, I am studying the gravity and topography of several lowland plains regions. Results obtained for Rusalka Planitia show a substantial negative gravity anomaly (Fig. 1) associated with the topographic low, a large apparent depth of compensation (135±38 km), and very low coherence of gravity and topography at wavelengths less than ~700 km (Fig. 2.). A lack of coherence at these long wavelengths is suggestive of a strong elastic lithosphere, comparable in strength to old oceanic lithosphere on Earth. Values of spectral admittance between gravity and topography shows that an Airy model based on the ADC estimate overpredicts gravity at all but the longest wavelengths (>~1000 km). This is consistent with a model in which there is downwelling convective flow at long wavelengths beneath the plains lithosphere, as well as shorter-wavelength loads emplaced at the surface and/or on an intra-lithospheric density interface such as a Venus Moho. If similar results are obtained for the other plains regions under study, this would tend to support more "catastrophic" models of plains formation.

Following the approach of *Forsyth*[6] and coworkers [7], it may also be possible to confirm the presence of a mantle downwelling and to place constraints on its physical properties. Current efforts are focused on obtaining estimates of lithospheric thickness and producing local inversions for a number of plains regions. Results of analysis of Rusalka Planitia and of other near-equatorial plains regions (including parts of Guinevere, Aino, Niobe, and possibly Navka Planitiae) will be presented in March.

References: [1] Schaber, G.G., *et al.*, (1992), *J. Geophys. Res.* **97**, 13, 257-13,302. [2] Phillips, R.J., *et al.*, (1992) *J. Geophys. Res.* **97**, 15,923-15,948. [3] Parmentier, E.M., and P.C. Hess, (1992), *Geophys. Res. Lett.* **19**, 2015-2018. [4] Bindschadler, D.L., *et al.*, (1990) *Geophys. Res. Lett.* **17**, 1345-1348; Bindschadler, D.L., *et al.*, (1992) *J. Geophys. Res.* **97**, 13,495-13,532; Phillips, R.J., *et al.*, (1991), *Science* **252**, 651-658. [5] Konopliv, A.S., *et al.*, (1993), *Geophys. Res. Lett.* **20**, 2403-2406. [6] Forsyth, D.W., (1985), *J. Geophys. Res.* **90**, 12623-12632. [7] Bechtel, T.D., *et al.*, (1987), *Geophys. J. R. astr. Soc.* **90**, 445-465; Zuber, M.T., *et al.*, (1989), *J. Geophys. Res.* **94**, 9353-9367.

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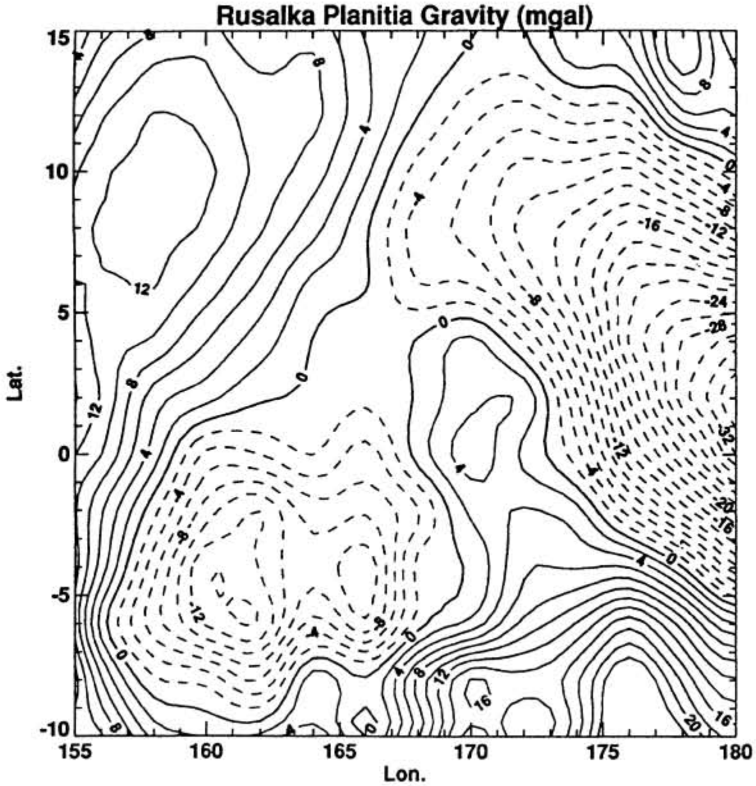
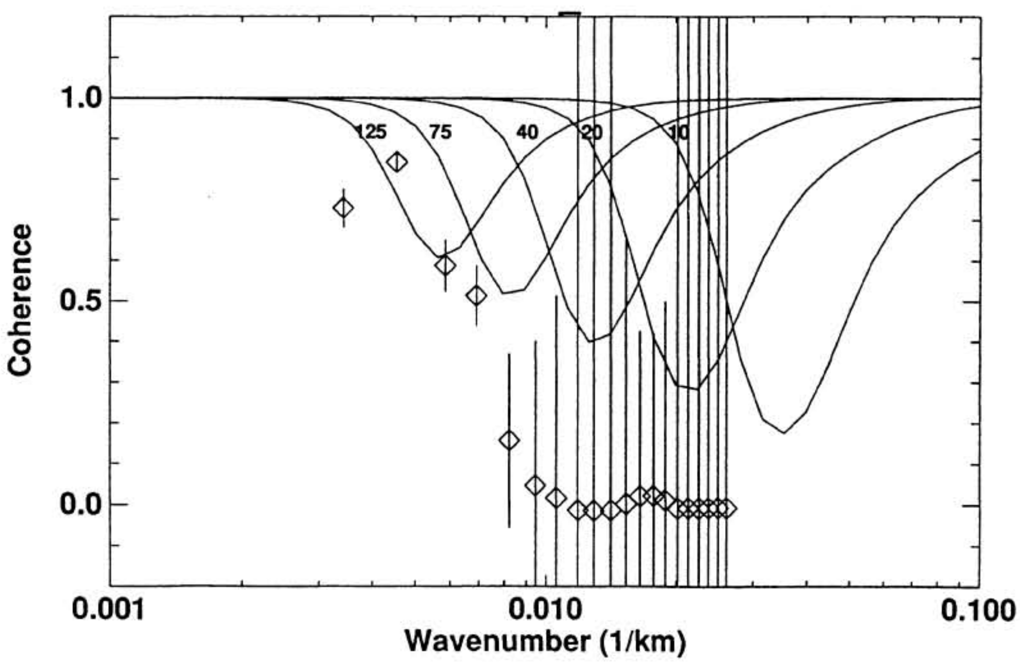


(Fig. 1) Contours of vertical gravity at an altitude of 250 km above the surface as obtained from inversion of LOS data. Contour interval is 2 mgal. Negative contours are dashed..



(Fig. 2) Free-air coherence of gravity and topography. Solid lines are theoretical curves for elastic plates of varying thickness (10-125 km) with loading equally partitioned between the top and bottom of the plate. They provide a poor fit to observations and are included solely for reference. Incoherence at wavelengths < 700 km suggests a thick elastic lithosphere.