VENUS GRAVITY: NIOBE-APHRODITE. W.L. Sjogren, R.N. Wimberly, R.S. Saunders and W.B. Banerdt, Jet Propulsion Laboratory, Pasadena, California

Doppler data acquired from the orbiting Pioneer Venus spacecraft have been reduced to determine apparent depths of isostatic compensation of the topography near 100° longitude. Several profiles have been compared to show the consistency of the data.

Two orbits of real data are shown in figure 1. The solid line is orbit 446 and the dashed line is orbit 445. Their ground tracks are approximately 150 km apart and in general they cover very similar terrain. As a result one would expect them to have very similar gravity profiles which indeed is the case. Niobe has approximately a -20 milligal minimum and Aphrodite has about a 25 milligal maximum. These are line-of-sight accelerations at spacecraft altitudes. Orbits adjacent to these have similar characteristics, confirming the data validity. The gravity data from orbit 445 was selected as the profile that should be matched with the simulated theoretical isostatic modeling results.

The data simulation incorporated the dynamical effects caused by the surface topography and the compensating masses at depth. The trajectories of the spacecraft were numerically integrated about a large central mass term, representing the total mass of the planet, plus 3496 additional masses representing the topography from 54°N to -20°S latitude and from 74°E to 164°E longitude (i.e. ORBSIM, Phillips et al., JGR, 83, 1978). A density of 2.7 gm cm^{-3} was used with the $2^{o} \times 2^{o}$ topography data obtained from USGS, Flagstaff, Ariz. For the models with varying depths of compensation a 20 degree band along the orbit path was used and the variation followed the Aphrodite contours.

The results are shown in figure 2. The heavy solid curve is a repeat of the curve in figure 1, but stretched out in latitude. The uncompensated topography is not plotted for it is -120 milligals at Niobe and 330 milligals at Aphrodite. A constant 100 km depth of compensation (dashed line) is not a very good match. Even the dotted line with 170 km at Niobe and 75 km at Aphrodite is still poor. A fairly good match is obtained (fine solid line), when 200 km is used for Niobe and a near surface, varying depth is used for Aphrodite.

It is interesting to note that these results agree in a gross sense with the independent data for the global isostatic map reported in our 10th degree and order spherical harmonic solution (Mottinger et al., JGR, March, 1985).

In our model the topography and underlying mantle are held at constant density, with depth of compensation as the only parameter that is allowed to vary. Density variations in both the crust and mantle probably occur. The resulting solution gives an apparent depth of compensation. Such models are not physically realistic, but provide a qualitative indication of variations in crust and mantle density. It is unlikely that the lithosphere of Venus can be thicker than about 50 km, so much of the model variation is indicating mantle variation. Work by Banerdt and Saunders (LPSC, XV, 29) has previously shown that Western Aphrodite and Ishtar Terra may have a relatively thick crust and dense (cold) lithosphere compensated at about 75 km. The apparent depth of compensation of Niobe of 200 km could result from a low density fill. The models that we have used with single orbits have higher resolution than the global harmonic models and reveal details of the margins between plains and highlands. In this area, we show quite different lithosphere structure in Western Aphrodite and the Niobe plains. The margin is possibly a region of higher density near-surface material.

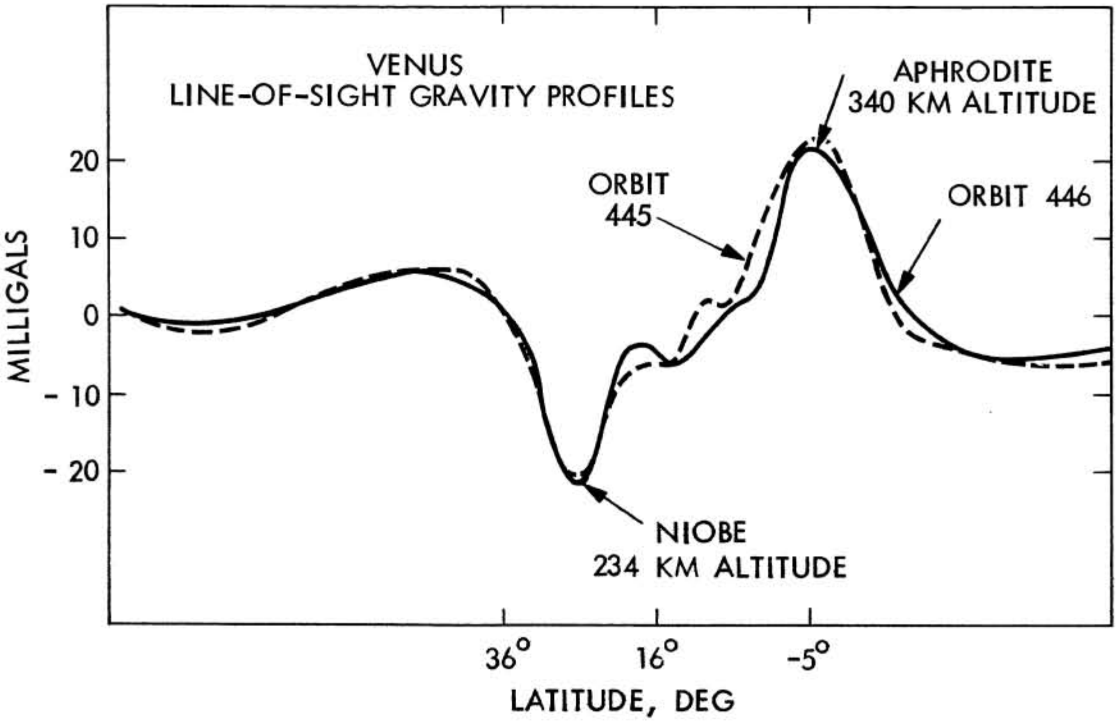
VENUS
LINE-OF-SIGHT GRAVITY PROFILES
APHRODITE
340 KM ALTITUDE
ORBIT 445
ORBIT 446
NIOBE
234 KM ALTITUDE
MILLIGALS
20
10
0
- 10
- 20
36°
16°
-5°
LATITUDE, DEG

FIG. 1

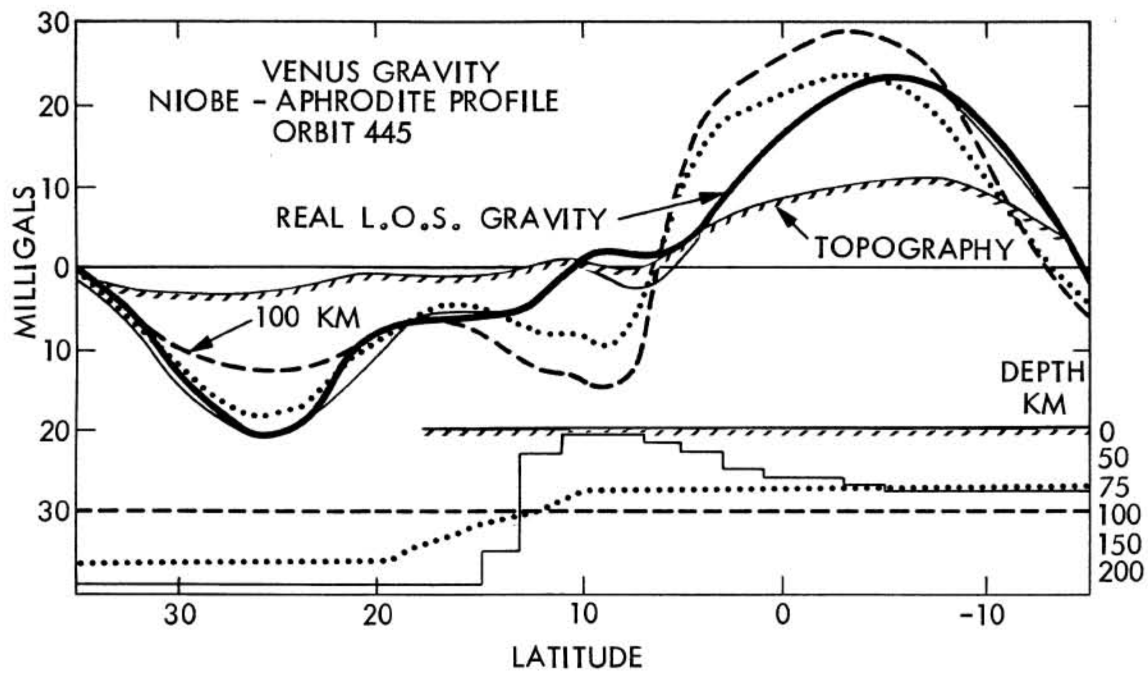
VENUS GRAVITY
NIOBE - APHRODITE PROFILE
ORBIT 445
REAL L.O.S. GRAVITY
TOPOGRAPHY
100 KM
MILLIGALS
DEPTH
KM
0
50
75
100
150
200
30
20
10
0
-10
LATITUDE

FIG. 2