LAKSHMI PLANUM ON VENUS: LOCUS CONVERGENCE OR RADIAL SPREADING?

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1. Continent-size highland of Ishtar Terra recognized by PV altimetry data (1) is known to display prominent morphological asymmetry: in the E there is Fortuna Tessera with patterns which have been interpreted as vast areal deformations (2,3) and in the W there is a compact roughly concentric feature of Lakshmi Planum with two major volcanic centres and a system of mountain belts which conformly surround the Planum (4,5).

2. Asymmetry of slopes was found to be typical for the Lakshmi mountain surrounding: Inner elevated part of the surrounding adjointed to the Planum is represented by mountain system of Akna (NW), Freyja (N), Maxwell (E), Danu (S) (FIG.1) all of which have a relatively steep inner slopes (FIGS.2 and 3), look like terrestrial orogenic belts (6) and have been interpreted as compressional structures (i.e. 7,8,5). Outer surrounding is composed by tessera pattern nearly everywhere and involve tesserae Atropos (NW), Itzpapolotl (N), Fortuna (E), Klotho (SE), Moira (SW) (FIG.1). The tesserae have been interpreted as a result of gravitational spreading (2,3).

3. In whole, toward periphery of the Lakshmi surrounding a structural disordering was found to increase, as evidenced by the linear elements of the structure become shorter and more chaotic in strikes, though the most of them are oriented conformly to the Lakshmi structure (5). Taking in mind that on Venus we see a direct tectonic relief because of low-effective exogenic resurfacing (9), the more disordered relief can imply the longer history of deformations. So the outer surrounding can be considered relatively older than inner one. In this case it could be formed through orogenic belts gravitational degradation (spreading) and/or through rearrangement of the preexisting tessera fields in such a way to be conform to the Lakshmi structure outline.

4. Movement of the top layer material outward has been argued for southern surrounding features such as Moira Tessera ("flow of plastic material" (5)), black depressions to the S and SE of Klotho Tessera ("giant landslidings" (5,10)), unnamed tessera islands to the SE of Rangrid Fossae (5)(FIG.1).

5. Within Lakshmi Planum some extension features were described to be the relatively older, the more extended (5). The extension was evidently complementary to the compression argued for orogenic belts in the inner surrounding. That combined with the observations prezented here is consistent with spreading of the top layer material from the centre of Lakshmi structure to its periphery.

6. According to another hypothesis proposed by a group of geologists from Brown University the Lakshmi structure formation is associated with convergence of the crust material to its centre(e.g.7,11,12). Their basic arguments include: (i) the presence of "syntaxis structures" within Lakshmi surrounding as an evidence of compression along orogenic belts axis (13), (ii) asymmetry of hypsometric profiles across northern surroungding as an evidence of subduction inward Lakshmi structure (14), and (iii) the high elevations indicative for the crust thickenning due to process of tectonic piling.

7. However, besides above mentioned evidences of the top layer material spreading outward Lakshmi structure, there are additional ones: the presence of the depressoins interrupting the mountain surrounding (5) and the gentle symmetric broad moat (FIGS.2 and 3), characteristic for gravity relaxation in the W, S, and E of the structure, as well as the possibility of another interpretation of the "subduction" profile asymmetry. An interpretation is shown in FIGS.5 and 6, where the decipheried discontinuity lines are found to divide the massif of Freyja Montes on tectonic blocks which look like giant landslidings whose offset surfaces are regularly oriented down to slopes, as based on the present topography. The northward landslidings can be explained by asymmetry of gravitational potential due to the difference of the elevations between Snegurochka Planitia-Freyja Montes and Lakshmi Planum-Freyja Montes is about 4 km. Also, the profile asymmetry of Maxwell Montes (FIG.4) could be resulted from normal gravitational relaxation complicated by some dynamical process.

8. Altimetry data indicate the high elevations within Lakshmi structure. In principle, this fact can be explained by either crustal thickenning or dynamical supporting. In the last case the radial spreading would be consistent with a giant hot spot drived the surrounding deformations (5). The case of crustal thickenning would be favorable to both large-scale tectonic convergence and abnormal crust prodution, that is hot spot scenario, in fact. So, the available arguments for every models do not allow to reject either one.

9. A way out of the controversial situation can be found in a suggestion of spreading within the top layer in combination with convergence within the underlaying crust.

Magellan gravity data and images will be useful for understanding of the nature of high elevations within Lakshmi structure and for more detailed structural analysis, thus for the testing of the proposed hypothesis.

Ref.: 1) Masursky H et al.(1980) JGR,85,8232-60. 2)Sukhanov A.L.(1987)LPSC XVIII,972. 3)Kozak R.C.,Shaber G.G. (1986)LPSC XVII,444. 4)Pronin A.A. et al.(1986) Solar System XX,2,83-98. 5)Pronin A.A.(1986)Geotectonica,4,26-41. 6)Crumpler et al.(1986)Geology,14,1031-4. 7)Head J.W.(1986)LPSC XVII,323. 8)Crumpler L.S.,Head J.W.(1986)LPSC XVII,1031. 9)Basilevsky A.T. et al.In: Venus geology, geochemistry,geophisics:Soviet point of view, Arizona Univ.Press (in press).10)Sukhanov A.L.(1989)Priroda,11,17-23(in Russian).11)Magee K.P.,Head J.W.(1988)LPSC XIX, 713. 12)Vorder Bruegge R.W. et al.(1989)LPSC XIX,469.14)Head J.W.(1988)LPSC XIX,467. 15)Shaded relief map of part of northern hemyspere of Venus, scale 1:15 000 000 (1989),MapI-2041,USGS.

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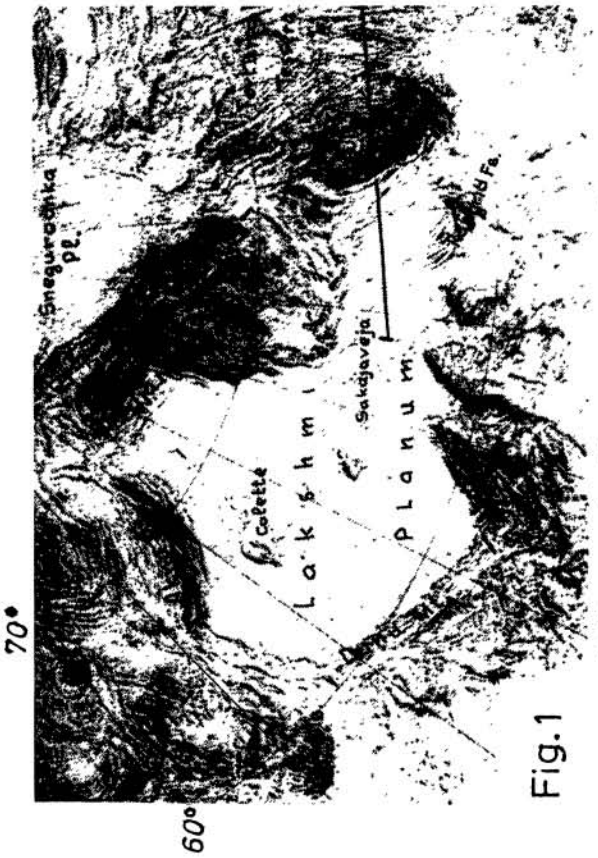


Fig. 1

(From [15])

Fig.2

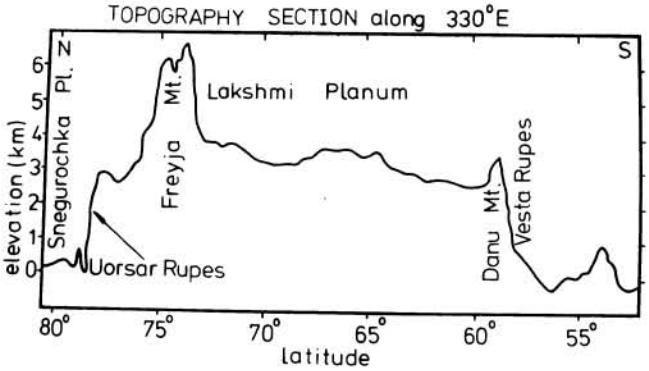
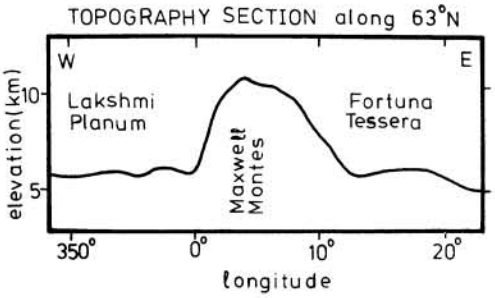


Fig.3



-Fig.4

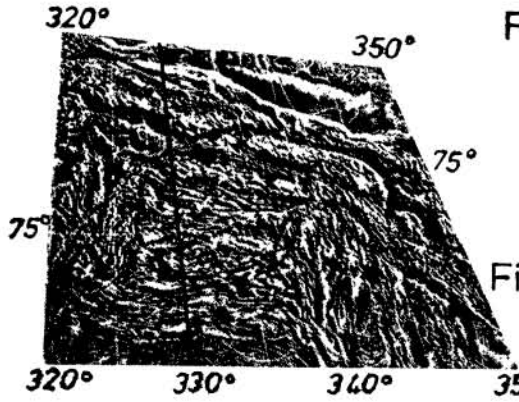


Fig.5

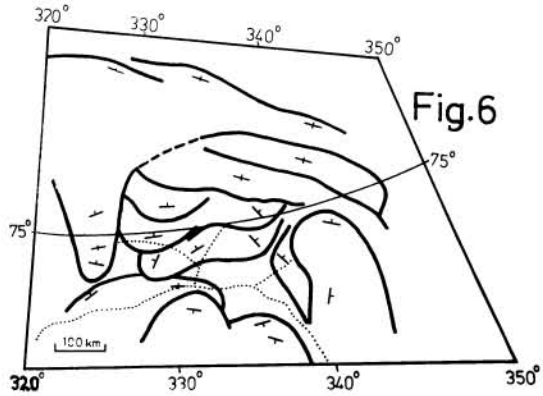


Fig.6