**CORONA STRUCTURES ON VENUS: EVIDENCE FOR A DIAPIRIC ORIGIN,** E.R. Stofan, J.W. Head and E.M. Parmentier, Dept. Geological Sciences, Brown Univ., Providence, RI 02912

Coronae are irregular to circular structures on Venus characterized by an annulus of concentric ridges and a complex interior, with widths of over 150 km (Fig. 1) (1). Coronae generally have raised relief (<1 km) (2, 3) as seen in the Pioneer Venus topographic profile across Nightingale Corona (Fig. 2). Some coronae are also surrounded by a peripheral trough. Coronae are characterized by volcanic activity, with flow-like features and domes in the interior and flows overlapping and/or surrounding the rim. In this abstract, we review a diapir model of corona origin, and present evidence that the characteristics of coronae described above are most consistent with a diapiric origin.

Diapirism involves movement of lithospheric material, either rising or sinking, due to a Rayleigh-Taylor instability. Density contrasts caused by heating of material would result in upward motion of lithospheric material (Fig. 3). Lithospheric instabilities could also involve sinking of material, which became denser due to a phase change. We investigate the effects of both rising and sinking instabilities, utilizing both a 2 layer and an n-layer model. The two layer model consists of two layers overlying a half space, with shear stress and vertical velocity going to zero at the upper boundary and at infinity. Between the layers, shear stress and horizontal and vertical velocity are matched. We prescribe a buoyancy force (the diapir) at a given level with respect to the upper surface, and vary the viscosity contrast between the layers. Horizontal strain rate and topography are calculated at the surface for various positions of the diapir with respect to the upper surface. The n-layer model has the same boundary and matching conditions, but allows more complex viscosity structures to be introduced (4).

The two layer model has been used to analyze the effects of a rising instability. If the viscosity of the upper layer is very much greater than the lower layer, the rising force in the lower layer causes uplift of the surface, increasing as the diapir approaches the surface. For a very weak lower layer, downward flow is induced at the periphery of the uplift. As the viscosity of the lower layer is increased with respect to that of the upper layer, the rising anomaly is transmitted less to the upper surface. The weaker the lower layer, the more easily is vertical stress transmitted to the upper layer, resulting in higher uplift for a rising anomaly in the same position. Strain rates were also analyzed for a rising anomaly. Highest strain rates are produced at the center of the uplift, with a broad zone of extension predicted over the region of uplift. Near the periphery of the uplift, strain rates are predicted to become more compressional as the diapir approaches the surface. For a sinking anomaly, a depression is predicted, with compressional strain rates over the region of sinking and more extensional strain rates near the periphery.

Previously, we have presented a number of possible modes of origin for coronae, including a relaxed or deformed surface load, a near surface intrusion, and diapiric processes (5). Detailed mapping and quantitative modeling has led to the following conclusions on these models. 1) Relaxed/deformed surface load - no features transitional between smaller scale volcanic loads and coronae have been identified and the large scale of coronae (including some features over 600 km across with over 0.5 km relief) indicate that a surface load is not a likely model of coronae origin. 2) Near surface intrusion - to produce an uplift the size of a coronae, a melt body on the order of the size of a coronae must be intruded into the crust (5). The large size of coronae indicates that deeper seated processes such as those occuring in the mantle are more likely to be involved in coronae origin. 3) Diapiric processes - quantitative modeling of diapirism produces several results that are consistent with coronae origin, including prediction and scale of uplift and resulting strain rates. The possibility of extension in the central region is consistent with the volcanic features (domes and flows) found in the center of most coronae, as well as interior deformation that could be extensional in origin. Peripheral compression could produce the annulus of ridges, or the annulus could result from later modification of the uplift by gravitational relaxation. We interpret these results to indicate that a diapiric model is most consistent with the key characteristics of coronae.

If coronae have been formed by diapiric processes, is the distribution of the features homogeneous or heterogeneous? The majority of coronae are located in two clusters, located at the eastern and western margin of Ishtar Terra (1). A smaller number of coronae are scattered in the plains, with a number of corona-like features associated with ridge belts (1). The presence of the two corona clusters indicates that the present distribution of coronae is heterogeneous. As these areas are in the upland rolling plains, it could be argued that the distribution was homogeneous and that most of the features have been covered by lava in the lowlands. This does not seem likely as an extremely large amount of volcanic material would be needed to completely cover a corona and the differing morphologies of the plains units seem to indicate differing amounts of volcanic cover. We conclude that the distribution of coronae is heterogeneous, with some element of the environment of the cluster regions enhancing their formation.

The key characteristics of coronae are most consistent with an origin by diapiric processes. Other models, such as relaxation or deformation of a surface load or near surface intrusion are not favored with the current data. The population of coronae is heterogeneous, with the majority of coronae located at the margins of Ishtar Terra. Ishtar Terra and its margins have been linked to large-scale compressional deformation (6). We are currently combining detailed information of individual coronae with their distribution to understand better how coronae are linked to the tectonic evolution of the northern hemisphere of Venus.

**References.** 1) A.A. Pronin and E.R. Stofan, *LPSC XIX*, this volume. 2) A.T. Basilevsky *et al., JGR, 91*, 399, 1986. 3) E.R. Stofan and J.W. Head, *LPSC XVII*, 1033, 1986. 4) D.L. Bindschadler *et al., LPSC XIX*, this volume. 5) E.R. Stofan *et al., LPSC XVIII*, 1987. 6) L.S. Crumpler and J.W. Head, *Geology*, 1031, 1986.

Figure 1. Venera 15/16 radar image of Nightingale Corona.

PIONEER VENUS TOPOGRAPHY:
NIGHTINGALE CORONA


VE = 50x

Figure 2. Pioneer Venus altimetry profile across Nightingale Coron

DIAPIR MODEL

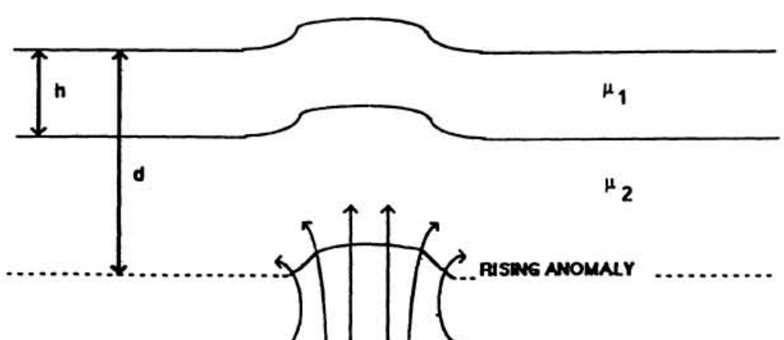


Figure 3. Schematic of a two layer diapir model, with a rising anomaly.