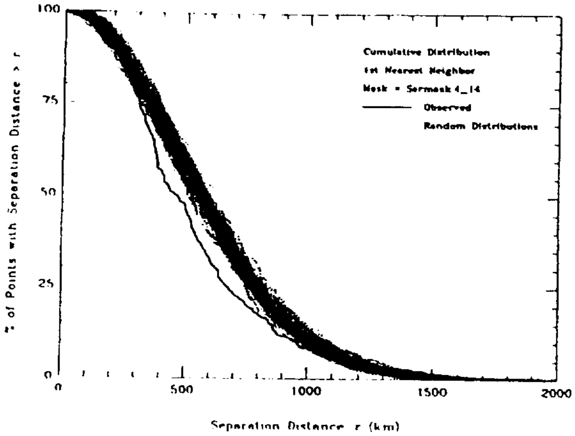

Fig. 2. Nearest-neighbor plots for the observed corona distribution (solid line), and 100 random distributions (dashed lines). Random distributions contain no points in the Magellan data gaps.

Fig. 2 for randomly distributed points on a sphere. Such treatments, however, do not readily allow for inclusion of the effects of data gaps. We therefore take a Monte Carlo approach. We have generated 100 distributions of 311 points on a sphere that are randomly distributed except that they are not allowed to fall within the Magellan data gaps. We then produce nearest-neighbor curves for these distributions, also shown in Fig. 2, and compare them to the observed curve. For separation distances ranging from about 300 to 800 km, the observed curve lies below all 100 of the random curves. We therefore conclude that coronae on Venus are clustered over this range of length scales, with a statistical certainty of >99%.

We next investigate the distribution of coronae as a function of elevation. Again, we take a Monte Carlo approach. For each planetary radius R, we plot the fraction of coronae that lie at an elevation higher than R (Fig. 3). We have also generated such plots for 100 randomly distributed points that fall outside the Magellan data gaps. Interestingly, the observed curve lies above all of the random curves for elevations between about 6050.5 and 6051.7 km, but crosses all the random curves and lies below them between about 6052.4 and 6053.4 km. This shape means that coronae on Venus tend to be concentrated away from both the lowest and highest elevations on the planet, instead clustering around an elevation of roughly 6052 km.

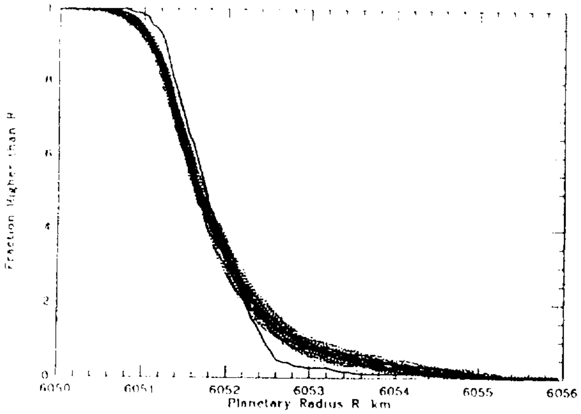

Fig. 3. Fraction of coronae lying at a planetary radius greater than R as a function of R (solid line), and 100 random distributions (dashed lines). Random distributions contain no points in the Magellan data gaps.

Fig. 4. Grey-scale map of the concentration of coronae and related features on Venus. Latitude limits are ±90°, central longitude is 180°.

We are exploring several statistical models for the spatial clustering of the coronae on Venus, including clustering along great circles and clustering about a point. The best of these simple models appears to be clustering about a point near the equator at around 240°E longitude. The reason for this is shown by Fig. 4, which is a grey-scale representation of a map (Plate Carrée projection) of corona concentration on Venus. The large cluster of coronae at this location is evident, and our results show that this cluster is significant at a high level of certainty.

Two aspects of the observed corona distribution may have significant geologic and geophysical implications. The clustering at intermediate elevations may reflect preferential preservation of coronae at such elevations. The highest elevations on Venus tend to be the ones that are most tectonically disrupted [3]. With severe tectonic disruption, coronae in these higher regions may be more difficult to recognize amid other forms of tectonic overprinting. The lowest elevations on the planet, on the other hand, might be expected to be regions of preferential accumulation of lavas, covering coronae that lie there. The clustering of coronae around one geographic location we interpret as related to mantle processes. We have argued on the basis of Magellan SAR and altimetry data that coronae form when rising mantle diapirs impinge on the underside of the venusian lithosphere [2,4,5]. If this is correct, then our observations suggest that the deep mantle of Venus is anomalously hot below the large corona cluster, and hence is an especially effective source of the mantle diapirs that we believe produce coronae.

References: [1] Phillips R. J. et al., *JGR*, in press. [2] Squyres S. W. et al., *JGR*, in press. [3] Solomon S. C. et al., *JGR*, in press. [4] Stofan et al., *JGR*, in press. [5] Janes et al., *JGR*, in press.

N93-14384

MICROWAVE SCATTERING AND EMISSION PROPERTIES OF LARGE IMPACT CRATERS ON THE SURFACE OF VENUS.

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Many of the impact craters on Venus imaged by the Magellan synthetic aperture radar (SAR) have interior floors with oblique incidence angle backscatter cross sections 2 to 16 times (3 dB to 12 dB) greater than the average scattering properties of the planet's surface. Such high backscatter cross sections are indicative of a high degree of wavelength-scale surface roughness and/or a high intrin-

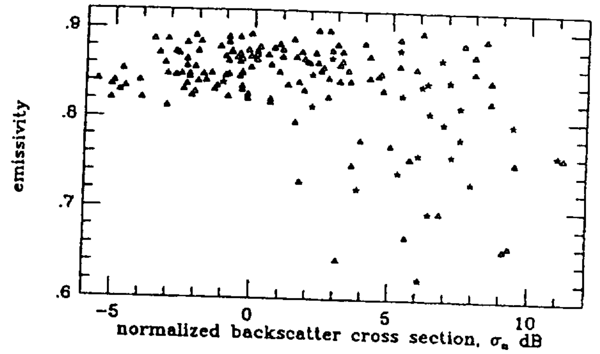

Fig. 1. Microwave emissivity vs. normalized backscatter cross section σ_n of the floors of 158 impact craters with diameters >30 km. Impact craters associated with parabolic-shaped radar-dark halos are shown as ★, craters without an associated parabolic halo are shown as △. σ_n values are dB with respect to the normalizing scattering used in the processing of Magellan SAR data [3].

sic reflectivity of the material forming the crater floors. Fifty-three of these (radar) bright floored craters are associated with 93% of the parabolic-shaped radar-dark features found in the Magellan SAR and emissivity data, features that are thought to be among the youngest on the surface of Venus [1]. It was suggested by Campbell et al. [1] that either the bright floors of the parabolic feature parent craters are indicative of a young impact and the floor properties are modified with time to a lower backscatter cross section or that they result from some property of the surface or subsurface material at the point of impact or from the properties of the impacting object. As a continuation of the work in [1] we have examined all craters with diameters greater than 30 km (except 6 that were outside the available data) so both the backscatter cross section and emissivity of the crater floors could be estimated from the Magellan data.

A plot of the emissivity vs. normalized backscatter cross section of the floors of 158 craters with diameters >30 km (Fig. 1) shows little direct correlation between crater floor backscatter brightness and emissivity. One-third of the measured crater floors have normalized backscatter cross sections greater than 3 dB above average and 36% of these have an associated radar-dark parabolic feature. Most of the crater floors have emissivities near 0.85, the typical value for the venusian surface, but many are slightly higher, which may be due to the slight increase in emissivity observed with increased surface roughness [2]. Twenty-five (or 16%) of the craters have floor emissivities <0.81. In an attempt to understand if these low emissivities are the result of elevated Fresnel reflectivities and hence compositional differences in the crater floor material, we plotted the measured emissivities vs. incidence angle along with the theoretical emissivity for a smooth surface with dielectric constant $\varepsilon = 5.0$ (Fig. 2). At the highest incidence angle of the cycle 1 Magellan observations the theoretical emissivity drops to ~0.76, indicating that some of the low emissivities measured at the higher incidence angles may not be the result of compositional differences.

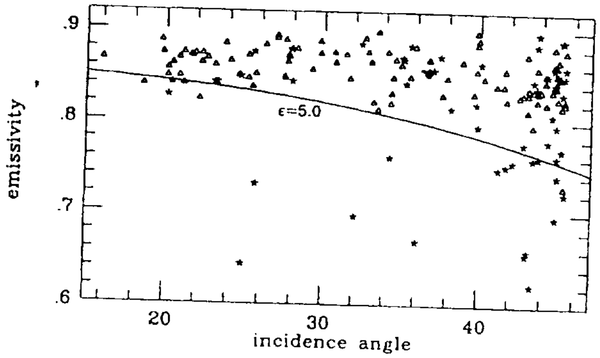

Fig. 2. Microwave emissivity vs. incidence angle of the floors of 158 impact craters with diameters >30 km with the theoretical emissivity for a smooth surface material with dielectric constant $\varepsilon = 5.0$. Impact craters with $\sigma_n \geq 3.0$ dB are shown as ★ and with $\sigma_n < 3.0$ dB as △.

References: [1] Campbell D. B. et al. (1992) *JGR*, in press. [2] Ulaby F. T. et al. (1982) In *Microwave Remote Sensing Active and Passive*, 2, 949–966, Addison-Wesley. [3] SDPS-101 (1991) *NASA/JPL Magellan Project SIS F-BIDR*, Appendix F, 31–33.

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THE EFFECTS OF VENUSIAN MANTLE CONVECTION WITH MULTIPLE PHASE TRANSITIONS.

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Recently there was a flurry of activities in studying the effects of phase transitions in the Earth's mantle. From petrological and geophysical considerations, phase-transition would also play an important role in venusian dynamics. The basic differences between the two planets are the surface boundary conditions both thermally and mechanically. In this vein we have studied time-dependent mantle convection with multiple phase transitions and depth-dependent thermal expansivity ($\alpha \sim \rho^{-6}$, based on high-pressure and temperature measurements by Chopelas and Boehler [1]). Both the olivine-spinel and spinel-perovskite transitions were simulated by introducing an effective thermal expansivity, as described in [2]. Used together with the extended Boussinesq Approximation [3] this method serves as a powerful tool to examine the effects of phase transitions on convection at relatively low computational costs.

In comparison to models with constant α the decrease of α injects vigor into lower mantle convection and stabilizes long aspect ratio flows. Hence the tendency to layered flows is increased.

Due to its positive Clapeyron slope the olivine-spinel transition increases the effective Rayleigh number in the upper mantle. This effect also stabilizes layered convection. Consequently, layered flows with a third thermal boundary layer at around 700 km depth and very long aspect ratio flows in the upper mantle can be observed (Fig. 1). The amount of exchange of matter between upper and lower mantle depends on the Clapeyron slopes and the "widths" of the

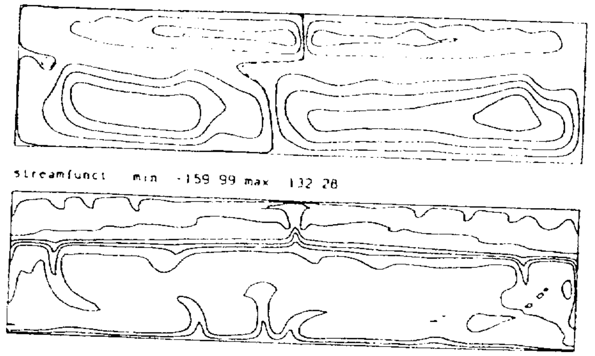

Fig. 1. Streamlines (top) and isotherms (bottom) of a flow with two phase transitions. Rayleigh number (Ra) is 10^7.