radar data with elevation would be required to assess the effect of small-scale roughening on the estimates of ρ. Visual correlation of the PV imaging radar data with topography indicates at best a minor increase in roughness [*Masursky et al.*, 1980], so that the decrease in ρ with increasing elevation could represent a phenomena associated with an increase in high-porosity materials.

Nozette and Lewis [1982] and others [cf. *McGill et al.*, 1983] have assessed chemical weathering phenomena on Venus in terms of theoretical mineral equilibria as a function of elevation and hence PT conditions. The breakdown of simple silicates such as wollastonite to produce carbonates such as calcite is expected to occur preferentially near the plains/highlands boundary at 2.0 km [*Garvin et al.*, 1984*d*]. In addition, the carbonation of metallic oxides such as ilmenite to produce simpler oxides and carbonates such as rutile and siderite are also predicted to occur at PT conditions corresponding to ~2.0 km elevations on Venus. Perhaps enhanced chemical weathering in the highest plains produces fine materials which serve to lower the radar ρ at such elevations. The Venera 9 landing region is near the 2.0 km boundary. The panorama from the Venera 9 site [*Keldysh*, 1979; *Florensky et al.*, 1983*a*] displays a soil substrate on top of which there are abundant blocks. From the image, as well as that from Venera 10 (at 1.5 km elevation), a semicontinuous layer of low-albedo soil can be observed. Lower-elevation landing regions such as Venera 14 apparently contain less soil at least in terms of their local scale and PV radar characteristics. The Venera 14 site is almost devoid of fine materials; in contrast, apparent exposures of low-porosity layered bedrock abound [*Florensky et al.*, 1983*b*, *c*; *Garvin et al.*, 1984*a*; *Basilevsky et al.*, 1985]. As a consequence of these observations, we feel there is a real increase in the abundance of high-porosity materials (e.g., soils) in the highest plains which could be caused by the combination of enhanced chemical weathering and mass-wasting due to the relatively high regional slopes at these elevations [*Sharpton and Head*, 1984].

Zone V represents the lower highlands from 2 to 3.5 km. There is little or no increase in the mean or standard deviation of ρ in this zone until 3.2 km. An increase in the range of ρ in the upper part of this interval can be observed in Figure 4. This behavior could mark the onset of the foothills to the major mountains which generally commence their sharp increases in relief by 3.5 km (as well as being more steeply sloped).

Zone VI marks the beginnings of mountainous terrain, the peaks of which occur at ~4.5 km. A high positive correlation of mean ρ and elevation occurs in this zone (Table 1), as was the case with roughness (Figure 5). An increase in ρ of almost 0.05 km^{-1} is observed. This increase is probably not caused by enhanced roughening (e.g., diffuse scattering) and indicates a real increase in density or in the abundance of high dielectric materials. Part of this increase could be attributed to geologically youthful volcanic materials such as basaltic lavas which have not had the time to be highly eroded under ambient Venusian conditions. The flanks of Theia and Rhea Mons in Beta Regio are representative of this zone. Evidence for basaltic volcanism in such areas is strong on the basis of recently acquired high-resolution Arecibo radar images [*Campbell et al.*, 1984*a*, *b*]. The upper part of this interval (~5 km elevation) represents the summit areas of mountains such as Theia and Rhea where abrupt changes in the radar properties have been documented at several scales [*Campbell et al.*, 1984*a*, *b*]. The 100-km baseline regional slopes are highly variable in this zone [cf. *Sharpton and Head*, 1984] which most likely reflects the flank to summit transition in topography.

Zones VII and VIII represent the summit regions of the highest mountains such as Maxwell, Atla, and Ovda. There is a highly variable character to the ρ versus elevation trend in such regions, yet for Maxwell it is apparent (Table 1) that ρ actually decreases with increasing elevation. Most of the materials at these extreme elevations are either abnormally dense or enriched to a significant extent in high dielectrics. Theoretical mineral equilibria for ilmenite (a Fe/Ti oxide) suggest it would be stable at these PT conditions, while mafic silicates such as forsterite (Mg olivine) would be broken down to produce carbonates. The stability of pyrite (FeS_2) cannot be unambiguously determined due to the lack of reliable data on the fugacities of O_2 and H_2O for Venus [*Nozette and Lewis*, 1982; *Garvin et al.*, 1984*d*].

On the basis of the geologic interpretation of the radar data and the character of the mean ρ versus elevation correlation (Figures 4 and 5) we have produced a threefold subdivision of reflectivity which is presented in map form in Plate 3. Before turning to the map, a brief discussion of the comparison between the ρ and α correlations with elevation is required (Figure 5). Except for zone IV, where ρ and α are strongly anticorrelated (see Figure 5 and Table 1), and zone VI, where ρ and α are highly correlated, there appears to be little control of either radar parameter on the other. A scatter diagram of ρ versus α (not presented) supports this interpretation. From Figure 5 and the previous discussion of the zone trends, it would appear that the radar ρ is a very local scale parameter which is not controlled on any regional or global scale by topography or roughness (or regional slope). Because of this observation, it is tempting to speculate that the radar ρ properties of Venus reflect real differences in the porosity structure (e.g., rock versus soil) and composition of the surface. These differences are partially a function of PT conditions and thus elevation (zone VI) but could also relate to differences in styles of volcanism and surface ages. Without water the degree of chemical fractionation that occurs on Venus when rocks are weathered should be minimal so that the weathering products should reflect the original bulk composition of the parent materials; this is evidently the case from in situ geochemical measurements [*Florensky et al.*, 1978, 1983*b*, *c*]. Thus changes in ρ are probably most strongly affected by the porosity and density of the surface materials, both of which are properties that relate to the age of the surface, the degree of weathering, and the mode of origin (e.g., styles of volcanism, impact cratering, sedimentation). If the highest-elevation features were geologically young volcanic structures or centers, then dense lava flows enriched in iron and titanium could explain the high ρ values observed near and at their summits. Decreases in ρ at the summits of some of these features (e.g., Theia, Maxwell) could be the result of caldera structures filled with modified or explosive volcanic materials. Scenarios such as these can be developed to explain the observed radar data, but only high-resolution radar images from Arecibo, Veneras 15 and 16, and the Venus Radar Mapper (VRM) can constrain the models sufficiently to make them unambiguous. We will attempt to define radar property related subregions on Venus in a later section.

The map in Plate 3 adopts the subdivisions of ρ outlined previously. The 0.0–0.1 materials are most likely soil dominated and probably most resemble the surfaces of the moon and Mars in their radar ρ and dielectric properties. They comprise only about 15% of the surface. The 0.1–0.2 surfaces are