relation between youth and radar backscatter cross section. In some places the relatively youngest flows appear dark (Fig. 2, E and F), while in others (for example, Theia and Sif) many of the youngest flows are bright (Fig. 2, A and C). The generally mottled nature of the plains is clearly a result of the ponding of flows and flow deposits in regions of low slopes, relative to the more distinctive flows seen in many areas of the steeper flanks of the isolated edifices. The general style of volcanism is similar to plains volcanism on Earth (*13*), in which abundant small shields and vents are the source of numerous flows that coalesce to form regional plains deposits.

Irregular deposits with extremely low radar backscatter (indicating smooth surfaces or materials of low dielectric constant, or both) have been observed in the lowest terrain of central Guinevere Planitia (Figs. 1 and 2, G and H) and northeast of Western Eisila Regio (*4*). Such deposits are also common at low northern latitudes in the Pioneer Venus imaging data (*5, 14*). These dark deposits occur in relatively low-lying areas. In addition to their anomalously low radar backscatter, these areas, which range in width from 300 to 1000 km, are characterized by diffuse boundaries with the surrounding plains and an interior radar bright spot that typically displays a craterlike morphology with associated bright deposits. These central features and their halos could be either impact craters or volcanic craters and surrounding deposits (*5, 15*). We tentatively interpret the central bright spots in Fig. 2G to be of volcanic origin on the basis of the size of the extensive bright deposits relative to that of the crater and their flow-lobe like nature, as compared to other craters interpreted to be of impact origin on Venus (*15*). The dark halos may be smooth flow deposits associated with the central structure, but the diffuse nature of the outer halo boundary suggests that they may be related to pyroclastic deposits, even though explosive volcanic eruptions in the Venus environment would require magmas with a high volatile content (*16*). Three dark-halo deposits containing a total of nine bright central features have been identified.

In the region covered by the new data, volcanic deposits occur over most of the area, and we have documented two distinct associations and styles of volcanism. In edifice volcanism (Theia and Sif Mons), large 200- to 600-km-wide volcanic constructs occur on regional topographic rises, and the location of the edifice is closely linked to regional structural and topographic trends; the majority of the volcanism occurs at or near the central part of the edifice. The structural and topographic control of the edifice deposits commonly results in a butterfly-like array of deposits. In the case of Theia, there has been a constant interplay between rifting and volcanism. Sif Mons appears more isolated but is associated with en echelon structures along the linear crest of Western Eisila Regio, and it may represent an earlier stage of evolution of volcanism and rifting compared to Beta Regio. These volcanic edifices, which are clearly associated with topographic rises that may be related to larger scale mantle anomalies, appear to dominate the volcanic activity and output in the region and, in the case of Theia Mons, are intimately linked to extensional deformation. In plains volcanism, which occurs in the lowlands between and adjacent to Beta and Eisila Regiones, there are abundant source vents. These source vents display a variety of styles, are rather subdued topographically, and are characterized by flows and related deposits that coalesce and overlie one another in the relatively flat lowlands to produce the mottled radar-bright and -dark appearance of the plains. The large number and wide distribution of vents in the lowlands (12 to 15 per 10^6 km^2) strongly suggest that plains volcanism is an important aspect of surface evolution and contributed to heat loss on Venus, in addition to the topographic rises and localized central edifices (such as Beta and Theia, and western Eisila and Sif).

Individual flow units and the mottled nature of the plains are much more apparent in these data than in Venera 15 and 16 data for much of the northern high latitudes (*17*). The moderate radar illumination characteristic of the Arecibo viewing geometry and incidence angles (12° to 60°) enhances the detection of variations in surface roughness relative to the lower incidence angles characteristic of the Venera 15 and 16 systems (*3*). This difference may account for some of the differences in images, although additional study of the regions where the two data sets overlap is required. The detection of individual flows and flow units at the incidence angles of the recent Arecibo data indicates that data from the upcoming Magellan mission, where incidence angles will be in the same range, will be extremely useful in the study of volcanic deposits and stratigraphy.

In all, 127 probable impact craters with diameters greater than 15 km have been identified in the Venera 15 and 16 data for the northernmost quarter of the planet's surface (*15*). Seven of these fall within the coverage of the new Arecibo data, and a comparison of the images of these seven craters for the different incidence angles of the two radars provides a model for the identification of probable impact (or, at least, the same type of) craters in the Arecibo data. Approximately 24 circular features of possible impact origin and with diameters >15 km have been identified (black circles and stars in Fig. 1). However, less than half of them have a general appearance similar to the probable impact craters in the Venera data. Virtually all of these (stars in Fig. 1) are located on the margins of Beta and Eisila Regiones whereas most of the remaining features (black circles in Fig. 1) are located on the plains.

Estimates of the mean crater retention age of the northernmost quarter of the surface of Venus based on the number of probable impact craters in the Venera 15 and 16 data vary from about 150 million years (*18*) to approximately 1 billion years (*15*), depending on the model used for the cratering rate. If all 24 of the circular features in the Arecibo data are impact craters, then the density of craters greater than 15 km in diameter is approximately 0.7 per 10^6 km^2, slightly lower but not significantly different from the average value of 1.1 per 10^6 km^2 derived from the Venera data. However, if only the circular features in the Arecibo data that resemble the probable impact craters in the Venera data are counted, then the density is less than 0.4 per 10^6 km^2, significantly less than that for the more northerly regions and indicative of a younger surface. The absence of these most likely candidates for impact craters in the volcanic plains may imply that the surface is very young or that the radar signatures of impact craters in the volcanic plains and on the margins of the rises are different.

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