EFFECTS OF LATERAL RESOLUTION ON THE INTERPRETABILITY OF GEOLOGIC FEATURES SAMPLED BY THE PIONEER-VENUS ALTIMETER; Raymond E. Arvidson, Department of Earth and Planetary Sciences, Washington University, St. Louis, Missouri 63130.

The Pioneer-Venus altimetry experiment has returned data that unequivocally demonstrates that the hypsometric curve for Venus is different from the curves for Earth, the Moon, or Mars (1). The data have also been used to generate gray-scale, color-coded, and shaded relief maps of Venusian topography that graphically illustrate the distribution of major topographic features (1). The question arises as to what scale of geologic features can be discerned in the maps, given that the typical area sampled for a single altimetry measurement is about 100 km (2). I have used two approaches in an attempt to explore answers to this question. The first approach was to numerically simulate what the measured width and amplitude of various features would be if they were sampled by the PV altimeter (Figure 1). The second approach was to re-sample the NOAA digital bathymetry data base for the Northern Pacific Ocean floor in a manner that produces, to a first approximation, a gray-scale image with the same lateral resolution as the PV map (Figure 2).

The straight line in Figure 1 is meant to indicate the true wavelength and amplitude of a given feature and the curved line is the locus of points defining the apparent wavelength and amplitude of features after being sampled by the PV altimeter. Basically, features with wavelengths smaller than a couple hundred kilometers would appear to have lower amplitudes and longer wavelengths because of under-sampling (spatial aliasing). The volcanoes, oceanic trenches, oceanic rises, and draas (long wavelength dunes) are plotted at their true wavelengths and amplitudes. Clearly, the draas would not show-up in PV data, the smaller volcanoes would be badly undersampled, along with the smaller trenches. Oceanic rises, because of their long wavelength would be reproduced fairly intact. However, such results are somewhat optimistic, since the two dimensional filtering (smoothing) operation used to generate the PV-maps has not been taken into account. Also, because of isostatic readjustments, true relief (and thus apparent relief) would be more subdued if the trenches and rises were transported to Venus without ocean water covering them!

Figure 2 shows the PV gray-scale map together with a map of the Northern Pacific Ocean floor. Both maps are at the same scale and have approximately the same lateral resolution. The vertical resolution for the Pacific is difficult to estimate, but it is probably a factor of three better than the vertical resolution for most of the PV data. The important point is that the Pacific map still shows all the major volcano-tectonic features, including the East-Pacific Rise, the major fractures in the Eastern Pacific, the circum-Pacific trench system, the Hawaiian islands, the Emperor seamount chain, and the Hawaiian swell. The Marianas trench system illustrates the effects of undersampling in that the depth is reduced by a factor of two relative to its true depth. The smaller wavelength features of the Pacific are missing - the abyssal hills and the ubiquitous smaller seamounts. It appears that the PV map of Venus lacks the systematic plate tectonic signature evident in the Pacific data. However, a note of caution needs to be raised since the oceanic rises are subtle features with amplitudes that could easily be hidden in the swells of the rolling plains terrain on Venus. Also, many terrestrial trench systems would be poorly represented in the PV

data because of undersampling.

REFERENCES

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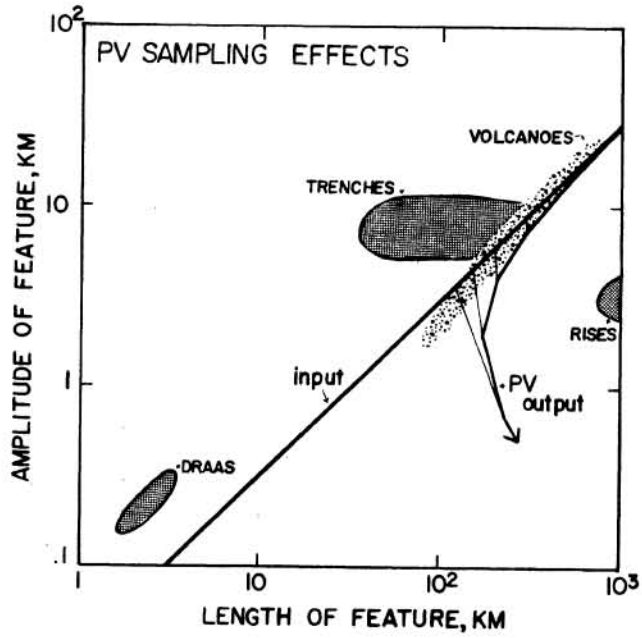

FIGURE 1 - The effects of the PV altimeter 100 km footprint size and approximately 80 km sampling interval (3) are demonstrated in this plot by the straight line and the curved line. The thin lines connecting the straight and curved lines show how the true wavelength and amplitude of a feature would appear after being sampled by the PV altimeter. Note the dramatic undersampling effects as the 100 km wavelength is approached. The geologic features are shown at true wavelengths and amplitudes. Volcano data from (4).

VENUS AND EARTH TOPOGRAPHY

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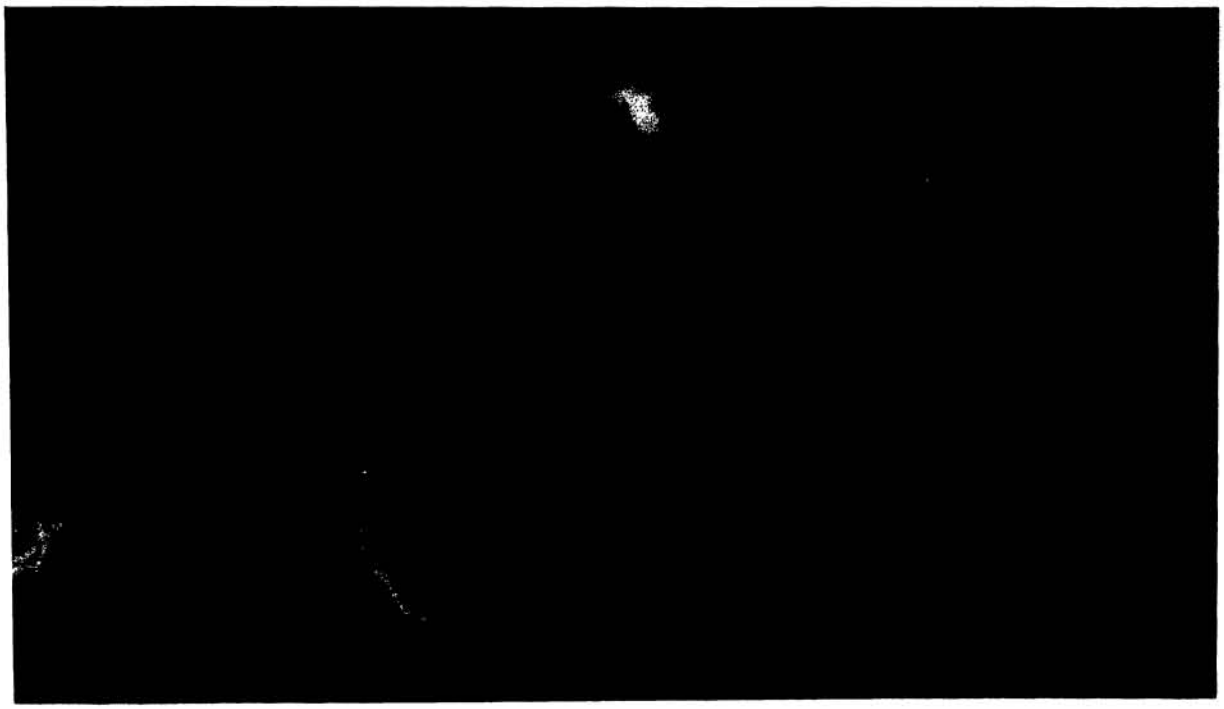

FIGURE 2 - Mercator map of the topography of Venus, derived from Pioneer-Venus altimetry data by (1). The data are coded such that high areas are bright and low areas are dark. Maxwell and Ishtar are the high areas in the middle, top of the frame. The Pacific topography is shown in the lower left at the same scale as the Venus data. The Pacific data were processed in the same manner as the PV data.