PROGRESS ON THE SEARCH FOR STRIKE-SLIP FAULTING ON VENUS, Richard A. Schultz, Mackay School of Mines, University of Nevada, Reno, NV 89557-0138.

Introduction.

Strike-slip faults are an important element of bulk lithospheric deformation in many tectonic settings on several planets and satellites. For example, strike-slip faults are common on Earth, a planet with plate tectonics, but are also found on Europa and Mars [1,2,3]. The formation of strike-slip faults on Mars demonstrates that plate tectonics is not a necessary prerequisite for this fault type to occur [3,4].

Acquisition and interpretation of high resolution radar images of Venus suggests that large regions of the venusian lithosphere experienced significant amounts of extension and contraction [5]. Curiously, only scant evidence for horizontal shear strain has been reported, mostly in the form of apparent drag features [6] or small distributed offsets along ridge or graben systems [5,7]. This observation stands in contrast to published hypotheses involving large lateral displacements of venusian lithosphere along strike-slip faults. Because faults (particularly normal faults) do occur quite commonly at the Venus surface, there is reason to suspect that other types of faults, such as thrust faults [8] or strike-slip faults can be formed as well.

A search was undertaken to identify discrete strike-slip faults on the F-MIDR mosaics at the Jet Propulsion Laboratory during 1991. Preliminary findings are summarized here.

Method.

The interpretation of possible strike-slip faults on Venus in this abstract is comparable in technique to that used to define them on the sparsely cratered plains of Mars [3]. This approach is emphatically different from previous ones that relied on geometric pattern recognition and lineament statistics. In general, some form of passive offset marker or other objective criterion is (or should be) used to assess the type of offset across a suspected fault. The most common marker used in planetary image interpretation is a preexisting circular impact crater. If a fault happens to transect the crater, adjacent sides of the crater will be displaced vertically and/or laterally. Vertical offsets of craters along faults are the most common on the planets and satellites, whereas lateral offsets are virtually unknown.

The crater-offset criterion is a poor choice for both the younger terrains of Mars or practically anywhere on Venus because of the sparsity of craters, so an alternative method must be used [3,4]. It is well known that geometric irregularities along a strike-slip fault will interfere with the smooth lateral displacement of rocks on either side of the fault [e.g., 9,10]. Irregularities such as bends and gaps typically show characteristic deformation styles such as uplift or subsidence, depending on the geometric details of the fault trace and the direction of displacement along the fault [11]. The combination of fault geometry and style of deformation within the irregularity provides a robust, reliable indicator of strike-slip faulting as well as an exciting alternative to offset craters because it can be applied to recent or active faulting of very young surfaces.

I initially concentrated my search in those areas on Venus where strike-slip faults had been inferred previously, such as western Aphrodite Terra [12], Maxwell Montes [13], Freyja Montes [14], and also in regions of wrinkle ridges similar to those on Mars. The investigation was later expanded to other available mosaics.

Results.

(a) Discrete structures. No unequivocal strike-slip faults have yet been positively identified on the mosaics examined to date. This result must be considered highly tentative because not all F-MIDR's were scrutinized and because several possible candidate features are currently being evaluated.

(b) Cross-strike discontinuities. Examination of the lineaments interpreted as strike-slip faults (or transform faults or transfer structures) in regions of tessera (western Aphrodite) and mountain belts (Maxwell Montes) indicates that they are discontinuous grabens, not strike-slip faults. Thus the interpretations of large-scale lateral motions of the lithosphere in these two regions are not supported by the new Magellan data.

(c) Distributed shear strain. Some evidence for strike-slip faulting that is different from cross-strike discontinuities may exist in western Aphrodite Terra. One large polygonal block located at 11.3° S, 64.9° measures ~85 km along its northwest trending long dimension and ~33 km wide. The block is bounded on its long sides by partially resurfaced depressions that appear unfaulted since their resurfacing, and along its short sides by numerous closely spaced normal faults. The northwestern
part of this block forms a broad (10 km wide) north trending trough within the block, bounded by normal faults; this trough appears to reflect locally more intense extension that apparently did not continue much beyond the boundaries of the polygonal block. Other polygonal blocks can be defined in the region. The relationships noted above are consistent with, but do not mandate, right-lateral strike-slip faulting along northwest trending structures. Unfortunately, no offset markers have yet been identified and unambiguous "drag" structures seem to be lacking, so further work is needed to test this hypothesis.

Conclusions.
The search for strike-slip faults on Venus has so far proven to be inconclusive. Numerous cases can be cited for limited or distributed lateral displacement of crustal rocks, but discrete, large offset strike-slip faults or fault zones appear to be somewhat rare. Examination of the radar images does indicate, however, that many lineaments that were previously interpreted to have accommodated large strike-slip displacements are shallow nested grabens. Thus the apparent lack of demonstrable lateral offsets in western Aphrodite Terra, Freyja Montes, and perhaps Maxwell Montes suggests that models involving lateral shearing of these regions may require revision.

Acknowledgments. I thank Sean Solomon, Steve Saunders, and Ellen Stofan for allowing me access to JPL and the Magellan data, particularly during the times of possible Iraqi terrorist raids on the archives.