IMPLICATIONS OF SMALL-SCALE FRACTURING ON GUINEVERE PLANITIA, VENUS; D.D. Bowman and C.G. Sammis, University of Southern California, Los Angeles, CA 90089-0740.

One of the earliest areas imaged by the Magellan spacecraft was the Gridded Plains of Guinevere Planitia. This region gets its name from the distinctive set of orthogonal fractures visible in Fig 1. The more linear north-east trending fractures were discussed in earlier works [1,2] which described their formation in terms of a shear-lag model, in which the fractures formed in a thin surficial layer in frictional contact with the substrate. The frictional coupling between the cooling and contracting upper layer and the substrate has the effect of making the fracture spacing independent of the layer thickness. Previous work has shown that this pattern can be seen in various different regions on the surface of Venus [2].

The more irregular north-west trending lineations were discussed by Bowman and Sammis [3]. A close inspection of the northwest trending fracture set (Fig. 1 inset) shows that each fracture is composed of a series of curvilinear *en echelon* fractures. This morphology is similar to the appearance of terrestrial fractures in soil layers above a basement fault. We believe that the fractures observed in the Gridded Plains are roughly analogous structures. In this case, the surficial layer which is accommodating the *en echelon* fractures is the same layer called for by the shear-lag model to describe the regularly spaced northeast trending fractures. However, the more irregular set is formed by motion on pre-existing basement, or "lithospheric", fractures. As the basement shear cracks propagate upwards through the surface layer, they produce the *en echelon* fractures observed on the Gridded Plains.

When they are short, these lithospheric fractures can be approximated as semi-circular crack fronts propagating in a semi-infinite elastic half-space. In this case, the length of the surface trace will be equal to the diameter of the circular crack front, while the depth to which the crack penetrates is the radius of the crack front. Thus, as different cracks propagate to different depths in the lithosphere, a range in surface crack lengths will develop. However, when the radius of a crack approaches the thickness of the elastic lithosphere, the base of the crack begins to widen by ductile flow, forcing the fracture to grow much faster laterally. At this point, the fracture no longer has a simple semi-circular shape in two dimensions, but grows increasingly elongate while maintaining a fixed depth. Because these through-fractures elongate more rapidly than the circular fractures, they will have a different distribution of surface lengths. Thus, when the distribution of fractures in a given region is plotted as a function of fracture length (Fig. 2), two different populations of fractures can be seen. The first population (labeled I on Fig. 2) consists of the semi-circular cracks, while the second population (labeled II) represents the fractures which span the entire depth of the elastic lithosphere. The longest population I fractures in the distribution therefore represents cracks which are deep enough to have ruptured through the lithosphere, but have not yet begun propagating at the higher velocity. Since this crack was assumed to be semi-circular in two dimensions, we know that the length of the surface trace of the fracture must be twice the thickness of the elastic lithosphere. In the Gridded Plains, the longest

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population I fractures have a length of 80 km. Thus the thickness of the elastic lithosphere in the region of the Gridded Plains may be inferred to be 40 km.

References: [1] Banerdt , W. B. and Sammis, C. G. (1992) *JGR, 97*, 16149. [2] Bowman, D.D. *et al.* (1994) *LPSC XXV*, 155. [3] Bowman, D.D. and Sammis C.G. (1994) *EOS Trans. AGU, 75*, 413.

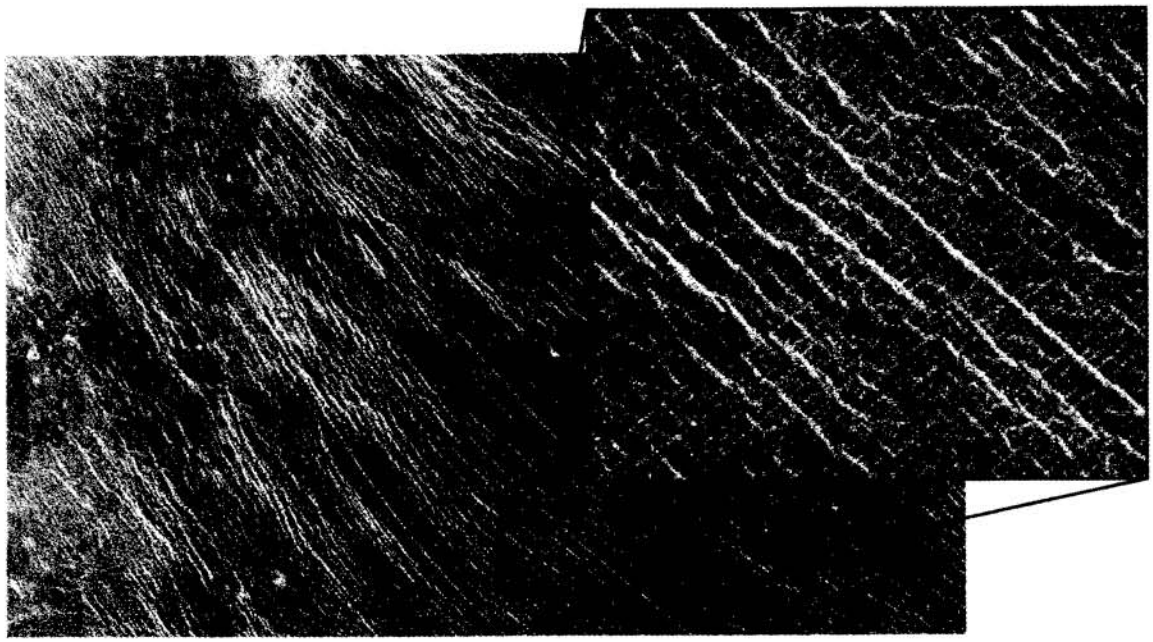

Figure 1. A portion of the Gridded Plains of Guinevere Planitia. North is at top. From C1-MIDR 30N333.

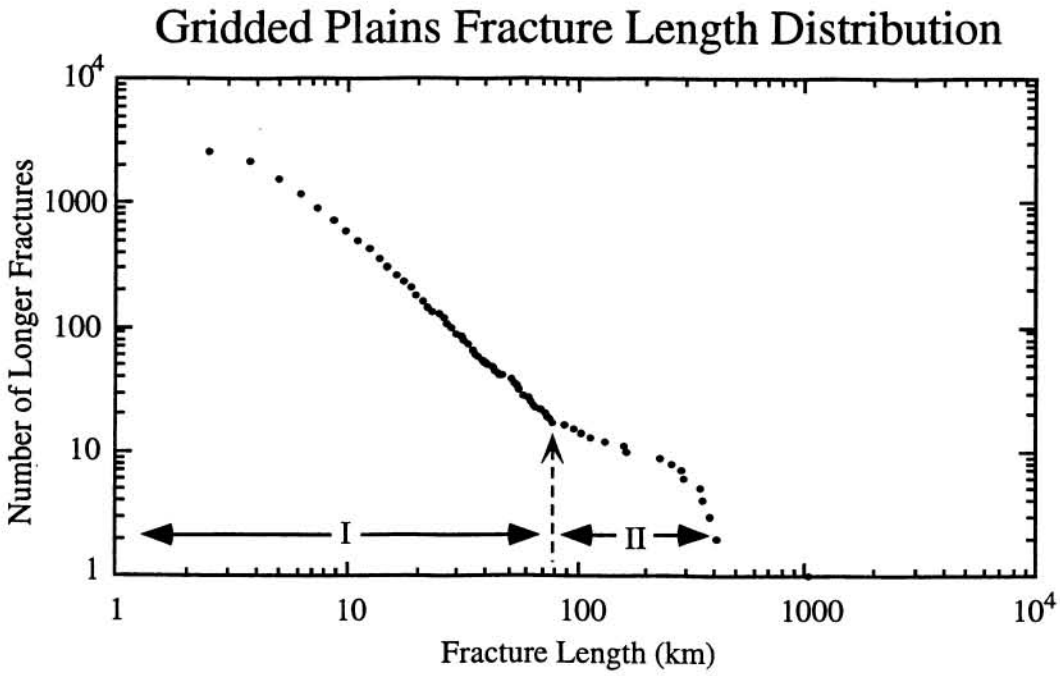

Figure 2. Gridded Plains fracture length distribution.