DETAILED MAPPING OF FRACTURE/GRABEN SYSTEMS IN NORTHERN GUINEVERE PLANITIA, VENUS: RADIATING DYKE SWARM IDENTIFICATION AND UTILITY FOR STRATIGRAPHIC INTERPRETATION. R.E. Ernst[1], E.B. Grosfils[2], D. Desnoyers[1], and J.W. Head[3], [1]Geological Survey of Canada, 601 Booth St., Ottawa, CANADA, K1A 0E8 (rernst@nrcan.gc.ca), [2]Geology Department, Pomona College, Claremont, CA 91711, [3]Department of Geological Sciences, Brown University, Rhode Island 02912.

Systematic study of the surface of Venus using Magellan C1-MIDR data has revealed 163 giant systems of radiating fractures and graben, on average hundreds of kilometers in radius, of which 117 were interpreted to be underlain by dyke swarms [1]. Evidence for underlying dykes includes the presence of grabens which transition into pit chains, alignment of small shield volcanoes with the lineaments, lava flows that clearly emanate from some fractures, and topographic evidence that the radial fracture patterns extend significantly beyond any central domical topography. The remainder of the systems are interpreted to be caused by tectonic stresses related to uplift or a combination of dyke and uplift mechanisms.

On Earth radiating dyke swarms are linked to the arrival of a mantle plume and the centre of the plume is marked by the convergent point of the dyke swarm [2,3]. A similar mantle interpretation has been suggested for many Venusian swarms [e.g. 2] and applying similar criteria we can use the characteristics of the terrestrial swarms as a guide to the interpretation of those on Venus [e.g. 1,2,4,5]. For instance, radiating swarms on Earth are emplaced quite rapidly, i.e. on the order of a few million years, and individual dykes within these swarms probably form in a few weeks [e.g., 2,3]. Assuming that individual Venus swarms and their dykes are emplaced on a similar time scale, then the swarms on Venus can be used as efficient stratigraphic markers. Each swarm on Venus seems to be associated with a volcanic centre, but can extend up to more than 2000 km away from the centre [1,6], and thus it is likely that in many places the swarms from different centres will intersect. If the relative ages of the swarms can be established, then the relative ages of the centres and associated magmatism can also be determined.

In order to test the use of dyke swarms as efficient stratigraphic markers on Venus, and taking advantage of higher resolution data unavailable globally when previous studies were conducted, we have mapped in detail (using FMAP scale imagery) an area in the northern Guinevere Planitia Region about 4000x1500 km in size. In addition to using the radiating dyke swarms identified previously [1] we also considered whether the ubiquitous closely spaced linear fracture patterns observed in volcanic plains regions [e.g. 7] could also be useful. In particular, could these linear systems define part of broader radial dyke swarms whose radiating pattern only becomes obvious after detailed regional mapping at high resolution?

Figure 1 shows the mapped distribution of graben/fracture systems. In Fig. 1A seven small radiating systems mainly 50 to 300 km in radius are shown, and Fig. 1B shows arcuate fracture sets that seem to circumscribe volcanic centres. It remains uncertain, however, whether the lineaments mapped in Figs. 1A and 1B have a purely tectonic or dyke origin. Figs. 1C-F show radiating patterns that may extend up to 2000 km in radius. The swarms in Figs. 1C, 1E and 1F were already known [1], but that shown in Fig. 1D is a new giant radiating system which was not recognized previously in lower resolution C1-MIDR data. The coherence of the fracture patterns shown in Figs. 1G-I is more speculative. In Fig. 1G, three fracture sets are tentatively correlated because they converge to the north and may focus upon Atira Mons (267ºE, 52ºN). Confirmation of this pattern awaits detailed mapping north of the present map area. In Fig. 1H, the fractures are broadly linear (with a north-south trend), but in the southern part of the map area the fractures begin to converge, suggesting that there could be a single source region to the south which has yet to be identified. Fig. 1I probably contains more than one fracture system. However, many of the features in the southwestern part of Fig. 1I may relate to a centre of convergence just south of the map area, an interpretation supported by initial reconnaissance mapping.

Future work involves: 1) detailed mapping in adjacent areas to test the proposed convergence patterns for swarms in Figs. 1G-I, 2) detailed study of graben/fracture system characteristics and their relationship with lava flows and topography in order to test which fracture systems are best interpreted as dyke swarms, 3) building upon previous stratigraphic examinations [e.g., 8,9] by using the interactions between the swarms to constrain the relative ages of the volcanic centres with which they are associated, and 4) evaluating the stratigraphic interactions between the swarms and the regional stratigraphic sequences [e.g., 10,11].

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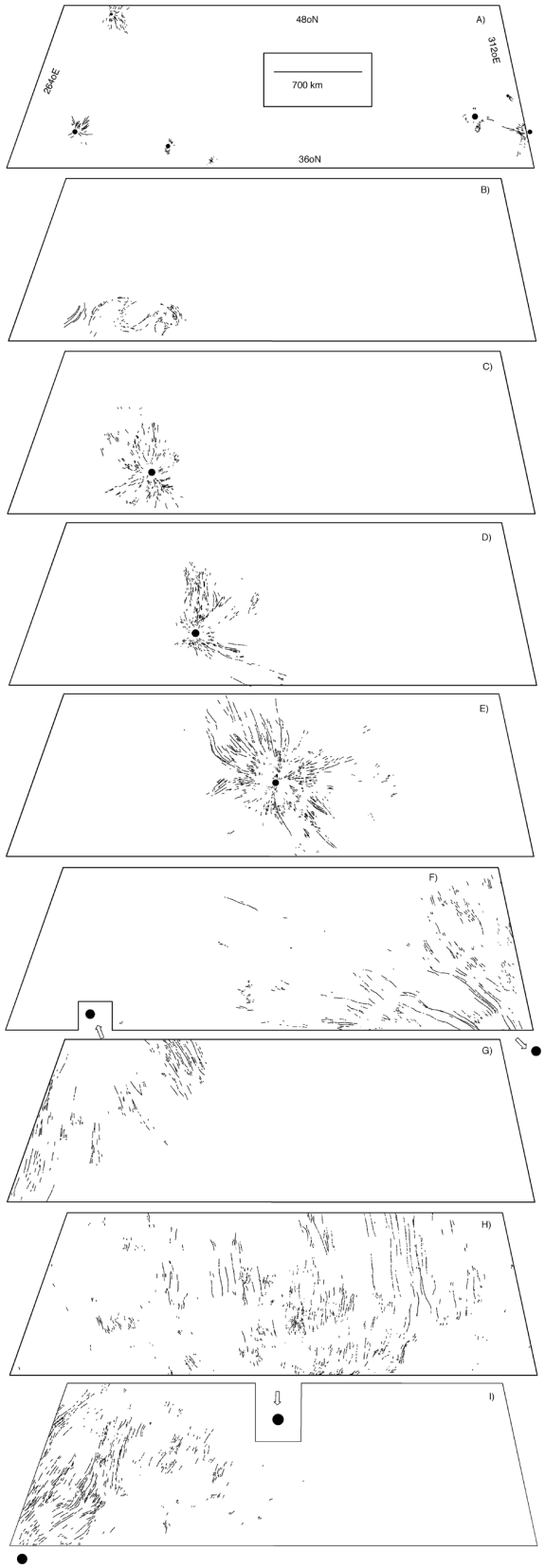

Figure 1: Fracture/graben lineament systems in northern Guinevere Planitia between latitudes 36º-48ºN and longitudes 264º-312º E. Overlapping lineament patterns separated into nine groups. Interpretation in terms of underlying dyke swarms discussed in text.