GEOMETRY AND RELATIVE AGE OF LARGE PATTERNED FRACTURES IN SOUTHERN ACIDALIA PLANITIA, MARS

Murray C. Borrello, Department of Geology and Geography
University of Massachusetts, Amherst, MA 01003

Extraordinary patterned fractures occur in Elysium, Utopia and Acidalia Planitiae of Mars. Theories as to their origin range from permafrost patterning to tectonic fracturing (reviewed by Pechmann, 1980). Recent studies indicate the patterned fractures may be a surface reflection of rough, buried terrane in which fracturing occurs as a result of differential compaction (McGill, 1986).

The patterned terrane in the southern portion of the Acidalia region (MC4-SE, MC4-SC) is being studied to determine its age relative to other terranes and events, and to constrain models for the origin of the fractures. Fracturing in this area occurs between 5 and 25 degrees west longitude and 37 and 50 degrees north latitude. Many fracture patterns are roughly polygonal, with polygons ranging in size from approximately 11 to 32 kilometers in diameter. Fracture traces range from the limit of resolution (10's of meters) to 35 kilometers in length.

Two types of fracture patterns occur in the Acidalia region: straight-sided and circular.

Straight-sided fracture patterns occur near 12 degrees west longitude, 41 degrees north latitude and are extremely well exposed (Fig. 1). These features are roughly polygonal, and the fractures are graben-like in appearance. Curved-sided and circular fracture patterns occur near 17 degrees west longitude, 45 degrees north latitude and appear more subdued due to a thin cover of younger material (Fig. 2).

The area included in MC4-SE subquadrangle contains six distinct geomorphic and structural domains:

Domain 1 is distinct because of its curved to circular fractures and abundance of younger cover material. Also prevalent are features interpreted as volcanic landforms. These include flat-topped hills, domes, flows and cinder cones (Allen, 1979; Greeley and Spudis 1981; Scott 1982; Frey and Jarosewich, 1982). These volcanic landforms appear to be superposed on the fractures and in some cases lie over fracture traces undisturbed indicating they are younger.

Domain 2 exhibits well-developed, straight-sided, roughly polygonal fracturing. There is partial burial of the fractures near the center of the area, probably by ejecta from a nearby impact centered at 15 degrees west longitude, 42 degrees north latitude. Cinder cones are present and appear to be superposed on fracture traces.

The boundary between domains 1 and 2 is marked by a fairly abrupt change in the degree of exposure of the fractures. Domain 1 has subdued to completely buried fractures, while domain 2 has little to no cover over the fractures.

South of domains 1 and 2 is modified southern highland terrane (domain 6) which grades northward into a dissected, hummocky terrane (domain 5). This terrane appears in many erosional states from large blocks (44 km by 30 km) to small knobs and ridges. These knobs and ridges appear superposed on and unaffected by the fractures in domain 2 and are, therefore, interpreted as younger.

Domains 3 and 4 exhibit most of the main features discussed except the features mentioned are partially to completely buried.

On a broad scale, then, what is seen are progressively younger terranes northward from the modified southern highlands to the buried circular fractures. The window of fractured terrane in domain 2 provides evidence of structural activity in older terrane below the northern cover material and, therefore, gives clues to the origin of the fracture patterns themselves. It is important to keep in mind that although the circular fractures in domain 1 are covered by relatively younger plains materials, there is no evidence to indicate the fractures were active after the deposition of this younger material.

The fractures making up the patterned terrane appear to be among the oldest features in the Acidalia region. An age sequence has been constructed based on cross-cutting relationships and superposition:

Youngest	Volcanism; cinder cones and other volcanic landforms
	Dissection of hummocky terrane
	Deposition of hummocky terrane material
	Patterned fracturing in fracture terrane
	Deposition of fractured terrane material
	Modification of southern highland material
Oldest	Deposition of southern highland terrane

REFERENCES

1. Allen, C.C. (1979) J. Geophys. Res., 84, 8040-8059.
2. Frey, H. and Jarosewich (1982) J. Geophys. Res., 87, 9867-9879.
3. Greeley, R. and P. Spudis (1981) Rev. Geophys. and Space Phys., 19, 13-41.
4. McGill, G.E. (1986) Geophys. Res. Letters, 13, 705-708.
5. Pechmann, J.C. (1980) Icarus, 42, 185-210.
6. Scott, D.H. (1982) J. Geophys. Res., 87, 9837-9852.

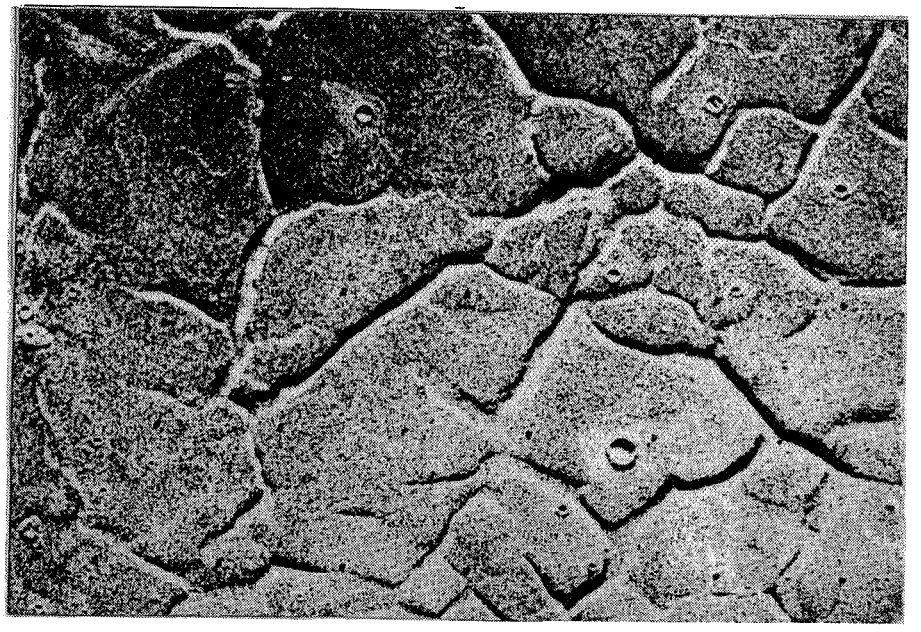

Figure 1. Well-exposed, roughly polygonal straight-sided fractures. Picture width is approximately 40 km.

Figure 2. Circular fracture patterns. Note the subdued nature of these fractures in comparison with those in Figure 1. Picture width is approximately 55 km.