GROUND PATTERNS ON EARTH AND MARS; L.A. Rossbacher, Geological Sciences Department, California State Polytechnic University, Pomona, CA 91768-4032.

Polygonally fractured ground can be quantitatively described by nearest-neighbor analysis; the R-statistic indicates the degree to which a pattern deviates from an expected random distribution of vertices and intersections of outlining fractures. For patterns observed on Mars and in cold regions on Earth, most are statistically more regular than random (1).

Because nearest-neighbor analysis is scale independent, patterns with a range of sizes can be compared with each other. The value of this is in being able to compare patterns regardless of size, but the scale of the features cannot be ignored. Preliminary data suggest that, for both Earth and Mars, larger polygons have more random patterns than the smaller, more regular polygons (Figure 1).

Possible explanations for this relationship between size and randomness include evolutionary and process-dependent models. (a) The evolutionary model suggests that the patterns begin as smaller, more regular patterns that are then modified into larger, less regular patterns by enhanced erosion of some fractures and infilling of others (1,2). Processes that modify terrestrial polygons include wind (3,4), flowing water (5,6,7), and vegetation (5,8). The first two of these could also have been effective on Mars. (b) The process-dependent model suggests that both size and regularity of ground patterns are controlled by the processes that form them. In general, thermal contraction processes on Earth create more random patterns - and larger polygon diameters - than ice wedging processes (1). If process is the independent variable, then both pattern randomness and size may follow from that. The role of climate and material are not known yet, but the terrestrial relationships shown in Figure 1 include data from Scandinavia, Alaska, and Canada, and the Martian data come from 4 different places along the boundary between the cratered upland and the northern plains (9).

The similar relationships between size and pattern on Earth and Mars, despite the different absolute sizes of the polygons, suggests an underlying similarity in the factors that control the size, randomness, and origin of the patterns. Further study of the relationship between pattern randomness and size of both terrestrial and Martian polygons should help clarify the relationships among size and randomness, the mechanism of formation, and perhaps the agents of modification.

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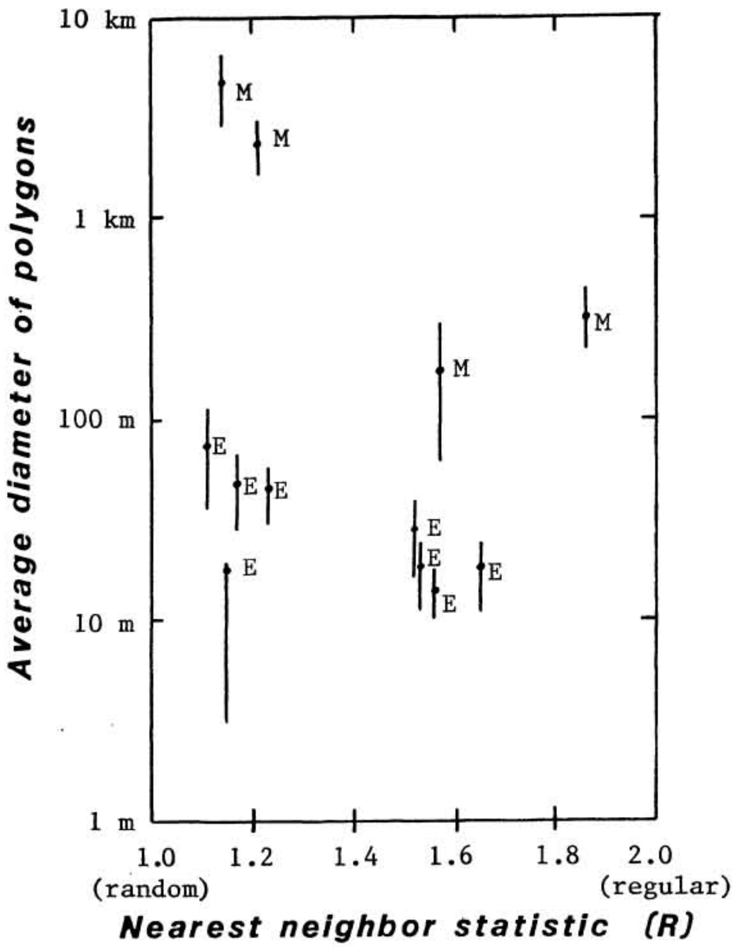

Fig. 1. Polygonal ground patterns on both Earth and Mars are generally less regular with increasing diameter. The nearest-neighbor statistic (R) is a measure of the departure from a random pattern (1); only the random (R=1.0) through regular (R=2.0) values are shown here. Error bars represent 1 standard deviation for polygon diameter; complete data listed elsewhere (9). Data for Mars and Earth are labeled M and E, respectively.