THE DEGRADATIONAL HISTORY OF ETCHED/CHANNELED TERRAINS WEST AND NORTHWEST OF ISIDIS; J.A. Grant and P.H. Schultz, Brown University, Providence, RI 02912.

INTRODUCTION: Landforms and crater statistics provide evidence for early epochs of enhanced degradation in etched and channeled terrains west (center 310°W, 10°N; Area 1) and northwest (center 292°W, 29°N; Area 2) of Isidis Basin. Results indicate that two common degradational epochs affected both areas: A) the earliest dating from the time of Isidis formation until possibly as late as initial Tyrrhena Patera activity, consistent with previous studies (1,2); and B) a later epoch contemporaneous with emplacement of unconformable deposits (3,4) and increased geomorphic activity (5) elsewhere on Mars (Fig. 1a–d). Two additional periods of apparently local degradation affected only Area 2 (Fig. 1c). In general, the intensity of degradation in both areas appears to have decreased through time.

DESCRIPTION: Both Areas 1 and 2 are incised by valley networks and appear etched; however, the density of valley networks is higher in Area 1 and the degree of etching is greater in Area 2. Inverted craters and valleys are found in both regions, but are more common in Area 2. The substrate in Area 2 appears to consist of a thick lower layer (100's of m) topped by 2 or 3 thin layers (10's of m). The 400 km diameter crater Antoniadi (300°W, 21°N) lies between Area 1 and 2, and the 200 km diameter crater Baldet (294°W, 23°N) is adjacent to Area 2. Crater statistics obtained for each area were normalized to the Neukum and Hiller standard curve (6) in order to determine both the number of craters per unit area $\geq$5 km diameter (Fig. 1d, referred to as the N5 age) and departures from the production slope (Fig. 1b).

DISCUSSION: Crater statistics compiled from all craters reveal that the oldest identifiable surface in both areas has an N5 age of ~3.5, similar to the age of the Isidis impact (Fig. 1d). An intense period of at least regional degradation followed the establishment of this base level as demonstrated by: A) a paucity of craters <20 km diameter in the statistics of both areas; B) the deeply eroded nature of large craters in Area 2; and C) the formation of numerous valley networks mainly in Area 1 that incise the surface, but are partially buried by younger units. Because similar size craters have been lost in the intermassif ring of Isidis (2), degradation probably reflects a period of intense reworking of post–Isidis deposits by both fluvial and eolian processes. The unit incised by the valley networks in Area 1 and the thick base layer in Area 2 formed during this interval. Cumulative crater statistics derived from all craters superposed on the Area 1 valley networks and on the thick base layer in Area 2, show retention of a production population of craters >7 km diameter and therefore cessation of significant degradation by an N5 age of 2.7.

A second regional degradational epoch is recognized in the incremental statistics compiled from craters post–dating valley networks in Area 1 and craters superposing the lower unit in Area 2. These statistics show that departure from a production slope at crater diameters <7 km diameter observed in cumulative statistics of the same population are due to a scarcity of craters 5 to 7 km in diameter. Cumulative statistics of only small craters (<5 km diameter) in both areas follow a production slope; consequently, this second period of degradation ended by an N5 age of 1.85 to 1.95 and may have resulted in the formation of one of the upper layers in Area 2. The end of this degradational epoch coincides with emplacement of unconformable deposits in Isidis, Sinus Meridiani (3), and Electris (4), and the ending of increased geomorphic activity in Margaritifer Sinus (5), thereby indicating a possible late and very widespread period of increased degradation.

In addition to the two common periods of degradation, two other periods of degradation were apparently unique to Area 2. The first was probably related to the formation of crater Baldet at an N5 age of 2.45, contemporaneous with Syrtis Major Planum. Statistics compiled from pristine craters in Area 2 suggest the local emplacement of Baldet ejecta (Fig. 1a) may have been associated with this period of crater removal and contributed to formation of one of the observed upper layers noted above. Because the second widespread degradational epoch occurred about when Baldet formed, the maximum size of the craters affected by Baldet is difficult to resolve.

Cumulative statistics of small craters superposing Baldet and small pristine craters superposing Area 2 (<3 km diameter) reveal a second period of local degradation that removed craters up to 3 to 5 km diameter. The present etched appearance of Area 2 and Baldet indicate this latest epoch was

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primarily erosional. Furthermore, an apparent absence of basal talus along most scarps indicates that eolian processes, perhaps facilitated by rapid physical/chemical weathering, must have been important.

Both areas have undergone periods of degradation of at least regional and perhaps global extent. Differences in the expression of such epochs between Area 1 and Area 2 (e.g. channeling in Area 1 and etching in Area 2 during the first epoch) may be due to variations in substrate composition, thickness, grain-size and/or volatile content which increase/decrease the efficiency of certain degradational processes. Periods of local degradation may result from smaller impact events (such as the formation of crater Baldet) or reflect global climate changes which decreased the number of active degradational processes and limited degradation to surfaces possessing a specific set of physical characteristics. The second period of local degradation affecting both Area 2 and the crater Baldet probably provides an example of the latter possibility. The physical properties of the surface in this area likely make it susceptible to eolian erosion while properties of adjacent areas such as Syrtis Major Planum and Area 1 prevent efficient eolian erosion.

IMPLICATIONS: Degradation in etched and channeled terrains to the west and northwest of Isidis occurred during a series of epochs of local to perhaps global extent whose duration and intensity decreased through time following formation of the last major impacts (1,2). Destruction of craters during these times may reflect burial by ejecta from nearby impact basins such as Isidis or Baldet, while others may have been the result of intervals of more equable climate created by release from recycled endogenic/exogenic volatiles (2) or juvenile magmatic (7) sources. Changes in the expression and/or degree of degradation in different locations during certain periods imply that wide variations in lithology, grain-size, and/or volatile content exist on Mars.

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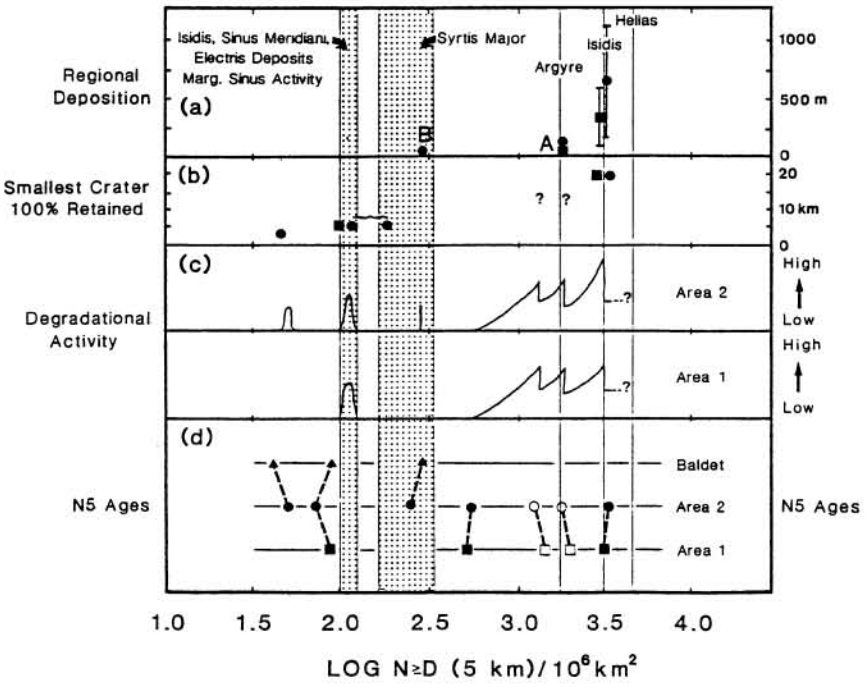

Fig. 1 Summary of degradational history for Area 1 (squares), Area 2 (circles), and crater Baldet (triangles) (a) Expected mass/area of ejecta arriving at each area from Isidis, Antoniadi (A), and Baldet (B) impacts. Calculated using relations given in (8). (b) Minimum diameter of craters 100 % retained during degradational epochs. (c) History of degradational activity (depositional and erosional) affecting Area 1 and 2. (d) N5 ages of surfaces in Area 1, Area 2, and around crater Baldet. Open symbols represent possible degradational epochs not discussed in text.

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