RESURFACING IN THE TRANSITION ZONE IN EASTERN MARS: EVIDENCE FOR VARIATION IN EFFICIENCY IN PLAINS FORMATION; Herbert Frey and Jo Anne Semeniuk, Geophysics Branch, NASA/Goddard Space Flight Center, Greenbelt, MD 20771.

We previously presented evidence from cumulative frequency curves for individual morphologic terrain units within the transition zone between the cratered highlands and northern lowland plains that there were multiple but common age resurfacing events and that one of these events was of Lunae Planum age (1). More specifically we found that most transition zone units in eastern Mars had an old underlying surface with crater age (cumulative number with D≥1km per 10^6km^2) ~90,000(±10,000), an intermediate age surface (Lunae Planum age) of ~24,000(±4,000) and an upper surface with crater age that varied with location: 5000(±200) in Amenthes-Aeolis and 9600 and 6500(±200) in Ismenius-Casius. Figure 1 shows a representation of these ages plotted as a function of the crater diameters over which they are defined.

It is clear that despite the strong clustering of ages found in Amenthes-Aeolis and Ismenius-Casius (which suggests common timing of the erosional events), the diameter ranges over which a given age surface is defined are different. This suggests either the nature of the resurfacing process was different or (more likely) that the efficiency of the process varies with location.

For example, the Lunae Planum Age (LPA) surface which is common to all the terrain units along the transition zone in eastern Mars represents a resurfacing "event" which ceased at a crater age of ~24,000(±4000). From this time the new "surface" has accumulated craters roughly in accord with a Neukum-Hiller (2) production curve until the most recent resurfacing event which terminated at age <10,000 in Ismenius-Casius and at <5000 in Amenthes-Aeolis. But the 24,000 age is defined by craters in the 10-25 km range in most of Amenthes-Aeolis but in the 20-45 or 10-35 km range in parts of Ismenius-Casius. The widespread B8 unit, consisting of knobby plains much like that seen in the Elysium-Amazonis knobby terrain complex (3), has its 22,000 age surface defined by craters 20-45 km diameter in Ismenius-Casius but its 25,500 age in Amenthes-Aeolis defined by craters only 10-25 km in diameter. That is, the older surface on which to resurfacing occurred has had craters removed by the resurfacing down to diameters of 25 km east of the Isidis Basin and down to 45 km (actually to even larger diameters as there are no craters in B8 in Ismenius-Casius in the 45-90 km range) west of Isidis.

Likewise, craters smaller than 35 km have been removed from the other terrain units in Ismenius-Casius (perhaps smaller than 70 km in unit B1) by the LPA resurfacing event. In Amenthes-Aeolis the limiting diameter is less, only 20-25 km. The obvious conclusion is that the resurfacing process was more efficient in Ismenius-Casius than in Amenthes-Aeolis. If the process was the same, then inferences can be made. For example, the thickness of plains-formation could have been roughly twice as great west of Isidis as it was to the east.

Similar reasoning applies to the most recent resurfacing events in the two regions. In Ismenius-Casius the upper age surface is older (9600 or 6500) than in Amenthes-Aeolis, and is defined by craters in the 5-20 km range (except for unit B1). The 5000 age surface in Amenthes-Aeolis is specified by diameters 5-10; craters larger than 10 km are "preserved" on the underlying Lunae Planum Age surface. East of the Isidis Basin the final resurfacing event not only terminated later but also was less efficient in removing larger craters than the resurfacing to the west of Isidis (except for unit B1).
The diameter range over which a "surface" is defined provides useful information not only on the efficiency of the resurfacing process, but also on the spatial extent of the underlying unit. Plotting the location of all craters within the diameter range that defines a given age surface within each terrain unit marks the minimum extent of that age surface below the present day surface (the morphology of which was used to define the terrain unit). We plot, for the case of the LPA surface, the location of craters 10-25 km across in unit B8 east of Isidis and 20-45 km across in unit B8 west of Isidis, craters 12-20 km across in unit B1 in Amenthes-Aeolis and craters 10-35 km across in B1 in Ismenius-Casius. The same procedure can be applied to the older or younger age surfaces as well.

One of the interesting results of such a plot is the distribution of the large craters that define the oldest recognized surface with age ~90,000. There is an abrupt decrease in the density of craters larger than ~20 km diameter across the boundary between the cratered highlands and the transition zone in Amenthes-Aeolis. Across the transition zone there is no obvious monotonic decrease in these craters, (within the ability to resolve such spatial relations) as might be expected if progressive mass-wasting were the dominant process. The same is true for the 10-20 km diameter craters which define the LPA surface in this region. These results suggest that depositional processes (plains formation superimposed on the older surfaces) was more important than removal processes (mass wasting of the older underlying surfaces) in the development of the transition zone in Amenthes-Aeolis.