

**GEOLOGIC EVOLUTION OF THE HIGHLAND/LOWLAND TRANSITION ZONE IN THE
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The topographic dichotomy on Mars has been a major subject of study for planetary geologists for over fifteen years. The northern 1/3 of the planet constitutes a region of 2-3 km average lower elevation than the southern 2/3 with the boundary between the 2 provinces approximating a small circle inclined at 28 degrees to the equator. This transition also separates 2 geologic areas of different age and genesis with the northern portion of the planet appearing in general as a more sparsely cratered younger surface and also being characterised by smoother surface materials. The prime cause for the dichotomy has been the topic of many studies which have placed the timing of this event in or before the Early Noachian, regardless of whether an endogenic [1,2] or exogenic [3,4] origin is considered.

This study is concentrating on a portion of the dichotomy boundary in the Ismenius Lacus (MC5) quadrangle where it is present both as a series of NW trending scarps and a complex set of eroded features forming a transition zone from the uplands into the lowlands; i.e. fretted terrain [5]. The purpose of the study is to constrain the number and timing of the identifiable resurfacing and fracturing events both on the upland and lowland sides of the boundary. This will enable the determination of relative age of the boundary zone itself in this area.

Geologic mapping at 1:15M scale [6] in this area has identified the upland surface material as ridged and etched plateau units of inferred volcanic origin which themselves exhibit various episodes of resurfacing. Preliminary investigation of this area using the 1:2M MC5-SE and MC5-SC control photomosaics as bases has revealed a systematic subduing of topography and a lessening of the crater density towards the transition zone in MC5-SE within the northern portion of the plateau sequence. However, cumulative crater counts also in MC5-SE on several geologic units have revealed a statistically significant older crater retention age for the ridged unit of the plateau sequence than for the etched unit. The etched unit is present here in the southern part of the subquad further away from the boundary zone than the ridged unit. At least one episode of resurfacing is therefore more clearly exhibited away from the transition zone. The boundary itself shows evidence of mass wasting, slumped crater rims have been produced by erosion and valleys have been enlarged in an irregular manner back into the uplands. On the lowland side fretted terrain is present, representing eroded remnants of an upland surface up to 400 km north of the well defined boundary scarp. The fretted terrain is characterised by angular to subangular smooth and flat topped blocks standing proud of a lobate debris apron [7] presumably derived from the block and also of surrounding lowland plains material. In areas where fretted terrain is absent lowland plains embay the scarps at the margin of the upland, but evidence of an older surface underlying the lowland plains can be seen by the presence of "knobby terrain" [8]. This older surface is presumably the same as on the upland side but is at a 2km lower elevation.

Studies in the Amenthes area [9] have shown that fracturing and resurfacing experienced a peak in activity around the Late Noachian and Early Hesperian boundary. The dating results within even this restricted region indicate different resurfacing and fracturing chronologies for different areas. More recently, an attempt to combine all the disparate pieces of evidence for global Late Noachian/Early Hesperian tectonic and volcanic activity has been made [10], with an endogenic origin for the dichotomy being proposed.

Work underway in the Ismenius Lacus area includes detailed geologic mapping of critical areas using the 1:2M controlled photomosaics and crater counting of units based upon stratigraphic position, degradation state and cross-cutting fracture orientation relationships. This will enable harder constraints to be placed on the dichotomy forming events in this area.

References

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