DICHOTMOTY BOUNDARY GLACIAL MODIFICATION AT MID-LATITUDES: DEGRADATION OF THE WALLS AND CENTRAL PEAKS OF MOREUX CRATER (135 KM DIAMETER).

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Introduction: The dichotomy boundary represents one of the most important geological and geophysical features of Noachian Mars [1] but the scarp currently representing the boundary in many parts of Mars has been heavily modified. Identification, assessment and quantification of the degradational processes operating to modify the original boundary will provide important information on the amount of lateral migration that has taken place since boundary formation, and thus help to constrain models of the dichotomy origin. Processes thought to have been operating to modify the dichotomy boundary include tectonic, volcanic, fluvial, groundwater sapping, mass wasting, eolian, ice-assisted creep, and glaciation [e.g., 2-4]. We have been assessing the nature of modification processes along the dichotomy boundary at mid-latitudes in the Deuteronilus-Protonilus region and have found evidence for extensive regional glaciation [e.g., 5-6] in several areas of lineated valley fill in the fretted terrain. Here we assess the degradational processes operating on the 135 km diameter crater Moreux, superposed on the dichotomy boundary at ~44°E, 42°N (Fig. 1).

The Setting of Moreux Crater: Moreux is located at the edge of the plateau of the southern uplands and its southern portion disrupts the regional scarp representing the dichotomy boundary (Fig. 1). The majority of the crater is superposed on, and destroys or heavily modifies the population of mesas that characterize the dichotomy boundary in this area. On its exterior, ejecta from the crater can be identified to the south, on the plateau; particularly prominent is a crater chain extending SSW from near the rim crest. To the north, ejecta can be seen on the summits of the plateaus and in the intervening valleys in some places, but in others, lobate debris aprons and lineated valley fill clearly postdate the ejecta. Significant mesa formation does not appear to have occurred subsequent to the formation of Moreux and the dichotomy boundary scarp appears not to have migrated laterally subsequent to the Moreux impact event. Thus, Moreux is interpreted to have formed at a time subsequent to the formation of the current dichotomy scarp and the abundant related mesas, but prior to the end of the modification of the scarp and mesas by lobate debris aprons and lineated valley fill. Therefore, Moreaux offers a unique template on which to study degradational processes on a landform at the scale of the dichotomy boundary (many tens of km), but different in morphology and structure. The interior of Moreux is 2-3 km below the rim crest (Fig. 2) and the central peak rises more than 2 km above the crater floor, approaching and sometimes slightly exceeding the rim crest elevation. Although relatively sharp, the rim crest has undergone significant local degradation where it has been eroded into a series of isolated massifs of various sizes. Here we focus on landform degradation of the crater rim crest and interior wall (analogous to the dichotomy boundary scarp) and the central peaks (analogous to the mesas).

Crater Rim Crest and Interior Wall: Topography on the crater rim crest is characterized by a series of rounded massifs and intervening smooth plains (e.g., Fig. 3). Between the massifs the plains change morphology, transitioning into lineated, flow-like lobes, extending 3-15 km down the crater interior walls (Fig. 3, center). Often characterizing the transition are scallop-like alcoves forming convex-outward scarps. Where developed, the alcoves mark the beginning of the lineated lobate deposits. The inter-massif lineated lobate deposits are joined by similar lobate deposits originating in alcoves farther down the crater wall, sometimes resulting in a broad digitate apron deposit extending from the crater wall down toward the crater floor (Fig. 3). Sometimes multiple lineated lobes originate on the crater rim in alcoves, converge and show evidence for the flow-like deformation of their lineations, and then descend downslope through a major break in the rim crest, with their often sinuous pathways controlled by wall topography. In some cases, the lobate deposits terminate in a distinctive moraine-like ridge (Fig. 3). Associated sinuous esker-like ridges and channels suggest that some flow took place.

Crater Central Peaks: At the broad scale, the flanks and margins of the central peaks appear lobate (Fig. 1). More detailed examination of the near summit areas at the top of the broad lobes (Fig. 4) reveals the presence of abundant arcuate alcove-like scarps that are the sources of the linear-ridged, lobate flow-like features. These features display parallel ridges oriented predominantly downslope; the features merge with one another, and merging ridges deform into tight and often crenulated folds. Some lobes remain distinctive and have arcuate concentric ridges at their termini (Fig. 4, lower middle), while others continue to converge (Fig. 4, left side), ultimately merging into the large basal lobes (Fig. 1).

Summary and Conclusions: On the basis of the characteristics and morphology of these lobate lineated flow-like features, their association with alcoves, evidence for their convergence and deformation, the presence of esker-like features and small sinuous channels, and proximity to lineated valley fill interpreted to be glacial in origin [5-6], we interpret these features to be due to the accumulation of snow and ice in alcoves, its compaction and flow, and its eventual sublimation, melting and loss. The presence of these glacial-like features in the interior of an impact crater with morphologies similar to the dichotomy scarp and associated mesas strengthens the likelihood that glaciation was a significant process in the modification of the dichotomy boundary, a process that must have taken place under a climatic regime different than that of today {5-7].

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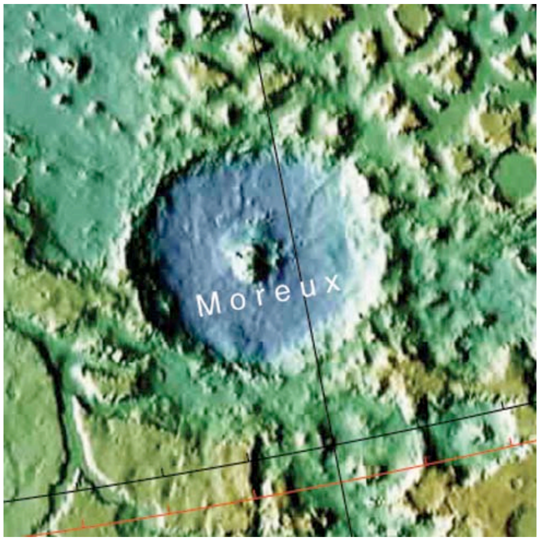

Fig. 1. MOLA gradient and altimetry map.

Fig. 3. Crater rim crest and wall with massifs and lobate flows (THEMISV12805004).

References: [1] S. Solomon et al. (2005) Science, 307. [2] G. McGill (2000) JGR, 105, 6945. [3] M. Carr (1995) JGR, 100, 7479. [4] B. Lucchitta (1984) JGR, 89, B409. [5] J. Head et al. (2005) EPSL, in review. [6] J. Head et al. (2005) GRL, in review. [7] N. Mangold (2003) JGR doi: 10.1029/2002JE001885.

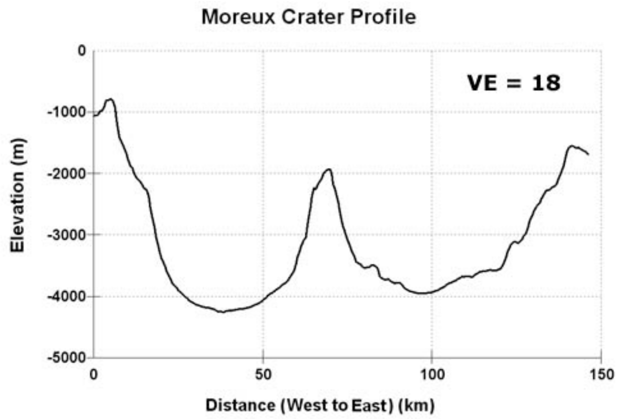

Fig. 2. Altimetric profile of Moreux interior. MOLA gridded data

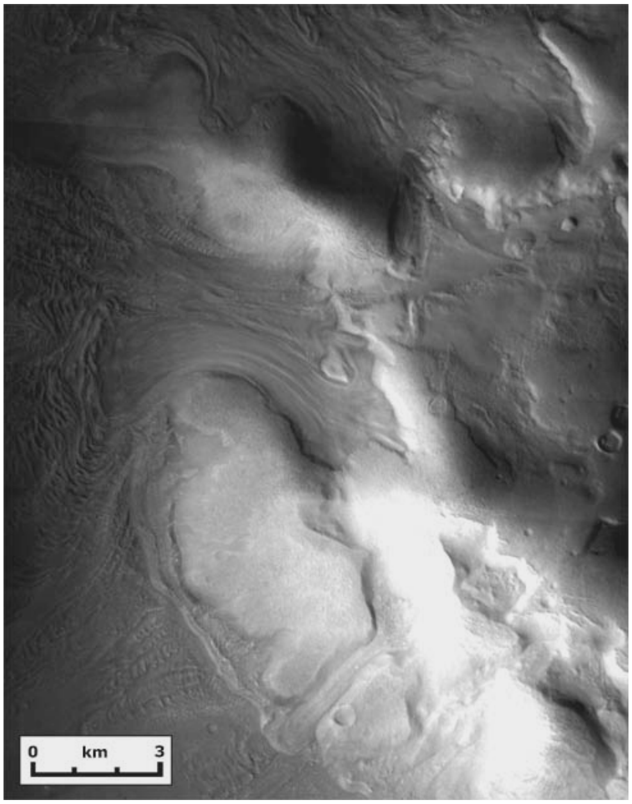

Fig. 4. Central peaks; alcoves, and linear lobate flows converging toward base of peaks (THEMIS V01122003).