Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10936, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10936
EGU General Assembly 2008

Reconstruction of the Development of Complex Mass-Wasting Landforms at the Western Scarp of Olympus Mons

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Slope deposits related to the gravitational movement of debris masses and rock-slope material in high-relief terrain on Mars are important estimators for the near-surface volatile budget and are relevant paleogeomorphic witnesses which help to reconstruct and understand processes involved in the formation of regional landform assemblies. Such deposits can range from deep-seated short-term slumpings to generally slow movement of volatile-rich surface layers, commonly known as solifluction and ice/water-assisted creep.

This work focusses on a set of small-scaled landforms located on large-scale slope deposits and situated below the western escarpment of Olympus Mons that were interpreted as either landslides, rock-glaciers or glaciers.

Results of our analysis suggest that despite the striking morphological similarities to certain terrestrial rock-glacier landforms the probable formation mechanism of the tongue-shaped flow units is related to a volatile release from footslope talus at the western Olympus Mons escarpment. The release of volatiles and mixture with talus debris ultimately led to formation of two coalescing tongue-shaped lobes which are draped over the underlying topography and which are characterized by well-pronounced marginal and terminal ridges and levees. Geomorphic patterns suggest flow conditions comparable to volatile-rich materials Topographic analyses suggest post-emplacement modification in connection with thermokarstic degradation of volatile-rich debris. Investigation of the exact source areas of these tongue-shaped

units have led to the conclusion that talus destabilization occurred at several locations at the western escarpment. Observations point towards a formation by a single and sudden release of volatiles from either ice-rich talus and/or from ice-rich avalanche deposits. While the exact mechanism for the release of intra-talus volatiles remains uncertain but is considered to be triggered by erosional effects at the footslope/foreland boundary, the release of volatiles and debris from the southern avalanche unit is most probably related to interaction of young shield lava flows and ice rich talus units. Among other possible explanations it is conceivable that formation of the tongue-shaped flow units have been triggered in the course of degradation and removal of a much larger fan-shaped unit causing finally hillslope destabilization and oversteepening of lower, i.e., basal, units as a result of paraglacial mass-wasting processes in the geologically recent history of Mars.