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On the Morphology and Transition of Valles Marineris Landforms: Rock Glaciers/Protalus Lobes vs. Landslides

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The Valles Marineris canyon system exhibits a variety of different landforms associated with landslide mechanisms, ranging from several tens of meters to kilometers in length. They usually cover a surface of 1000 km^2 and have an average volume of up to 5000 km^3 [1–2]. It is assumed that they have been emplaced under wet as well as dry conditions from destabilized wall-rock and from surrounding sapping valleys [e.g., 1–3]. Absolute age determinations have furthermore shown that landslides in Valles Marineris span much of Martian history with ages as young as 50 Myr up to 3.5 Gyr [1]. Notwithstanding their individual ages and timespan during which they have been emplaced, landslides seem to have formed repetitively producing comparable morphologies and do not show substantial modifications throughout the last 3.5 Gy [1].

We here put our focus on a set of complex tongue-shaped landforms situated in the central parts of Valles Marineris at 283°E, 8°S which were previously identified as a single feature and for which a possible rock–glacier origin had been proposed [5]. This assumption implies environmental conditions which are not met today at such latitudes near the equator and which would contradict all observations related to the distribution of periglacial landforms on Mars, such as thermal contraction polygons, thermokarst features, and -– especially — lobate debris aprons [e.g., 6–11] which are considered to be Martian analogues for terrestrial rock glaciers.

On the basis of our observations we come to the conclusion that the landforms discussed herein form a complex set of landslides derived from wall-rock sliding and/or from surrounding valleys. Consequently, different sources areas are reflected by the complexity of the landslides with several overlapping lobes and individual tongue-shaped features. Although the tongue-shaped morphology is characteristic of rock-glacier landforms, the assembly of furrows and ridges strongly suggests an origin caused by several short-termed events rather than slow creep mechansims. Overlapping lobes and faint compressional ridges as seen at this location are not caused by creep of mountain debris but by multiple events that took place at least as early as 300 Myr ago (with several resurfacing events) as crater counts suggest. Morphometric characteristics fit quite well to the trends proposed by others for landforms indicative of landsliding [12–13].

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