



Landslides as Indicators of the Past Extent of Interior Layered Deposits in Valles Marineris, Mars

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Mounds of layered deposits, often several kilometres in height, are common in the canyons of Valles Marineris [1,2] and impact craters such as Gale Crater [3]. These interior layered deposits (ILDs) are important because they not only potentially preserve long sequences of Mars' stratigraphic record, but also because the common presence of abundant hydrous mineral phases implies aqueous activity crucial to studies of habitability. Despite their importance, no consensus exists regarding how ILDs form.

Here we use landslides in Valles Marineris to gain insight into the previous extent and state of two large-scale ILDs. Using visible wavelength images and stereo digital terrain models we have identified three major occurrences of landslide deposits in Ophir Chasma, which are indicative of diversion or obstruction by material that is no longer present. The landslides in this study differ from most other landslides by increasing in height towards their front edges, showing distinctive concave scarp faces that are up to 500 m above the base level, and up to 400 m higher than the preceding part of the landslide deposit. These scarps are 1 – 2 km from, and mimic the shape of, the current extent of the ILD outer boundaries. Although not continuous throughout Ophir Chasma, the scarps extend between 20 and 50 km in length at different landslides, suggesting a common boundary at the northern edge of Ophir/Baetis Mensae.

The most likely explanation for the formation of these scarps is that the leading edge of a landslide has piled up in front of an obstacle that has since been removed. Given the short timescale between landslide formation and the removal of the ILD obstacle material [4], it is likely that erosion alone is incapable of removing the material unless unrealistically high rates are assumed. Instead ice sublimation processes are likely to have been the dominant removal method, which implies that a significant amount of ice was present in the ILDs during the Amazonian [4].

References: [1] Nedell, S.S., et al. (1987), *Icarus*, 70, 409-441. [2] Lucchitta, B.K., et al. (1994), *JGR*, 99, 3783–3798. [3] Malin, M.C., K.S. Edgett (2000), *Science*, 290, 1927-1937. [4] Quantin, C., et al. (2004), *Icarus*, 172, 555.572.