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Slope stability analysis for Valles Marineris, Mars: a numerical analysis of controlling conditions and failure types

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Valles Marineris (VM hereafter) in the equatorial area of Mars exhibits several gravitative failures often involving the whole 6-8 km thickness of the valley walls. The failures have resulted in a series of long-runout landslides up to several hundred cubic kilometres in volume (Quantin et al., 2004), and the formation of sub-circular alcoves perched on the top. Several questions arise as to forces at play in the stability of the walls of VM, the geometrical shape of the alcoves and the shape and long-runout of the landslides (see for example Lucas et al., 2011). In this work, we concentrate on the stability analysis of the walls of VM with two precise questions in mind starting from past studies (Bigot-Cormier and Montgomery, 2006; Neuffer and Schultz, 2006, Schultz, 2002).
The first concerns the properties of the materials that give origin to instability. We performed several finite element and discrete element calculations tailored to slope stability analysis based on the genuine shape of the walls of VM taken from the MOLA topographic data. We considered stratified and differently altered/degraded materials to define the range of physical mechanical properties required for failure to occur and to explain the discrete distribution of failures along the VM valley flanks.
A second question addressed in this work is the geometrical shape of the sub-circular alcoves. Normally, these shapes are commonplace for slopes made of uniform and isotropic properties, and are also observed in subaqueous environment. We performed calculations taking into consideration the progressive failure in the slope showing the final results in terms of surface failure geometry.

Bigot-Cormier, F., Montgomery, D.R. (2007) Valles Marineris landslides: Evidence for a strength limit to Martian relief? Earth and Planetary Science Letters, 260, 1–2, 15, 179–186
Lucas, A., Mangeney, A., Mège, D., and Bouchut, F., 2011. Influence of the scar geometry on landslide dynamics and deposits: Application to Martian landslides, J. Geophys. Res. - Planets, 116, E10001, DOI: 10.1144/1470-9236/05-042
Quantin, C., Allemand, P., Delacourt, C. (2004) Morphology and geometry of Valles Marineris landslides. Planetary and Space Science, 52, 11, 1011-1022
Neuffer, D.P., R.A. Schultz (2006) Mechanisms of slope failure in Valles Marineris, Mars. Quarterly Journal of Engineering Geology and Hydrogeology, 39,.3, 227-240
Schultz, R.A. (2002) Stability of rock slopes in Valles Marineris, Mars. Geophysical Research Letters, 29, 1932, doi:10.1029/2002GL015728