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Morphometric study on striations on Martian landslides and ejecta blankets: a common formation mechanism?

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The formation of longitudinal ridges and grooves (aka ”striations”) on martian and terrestrial long run-out landslides and the ejecta blankets of martian impact craters is a yet unexplained feature. Other common morphological features like perpendicular graben and compressive ridges suggest there might be a common formation mechanism. Former comparative studies focused on qualitative aspects alone and no scheme for characterizing and comparing quantitative parameters exists. Furthermore insight in the formation mechanism of striations might also shed light on the emplacement and dynamics of landslide and ejecta deposits. We conducted a morphometric study of topographic tracks across longitudinal ridges on martian landslides and several types of layered ejecta craters. Main goals were to evaluate the possibility of a common formation mechanism and to develop a valid parametric model that allows comparison across different types of deposits. We used topographic profiles that were extracted from DEMs generated from high-resolution CTX (5 m/px) and HiRISE (0.5 m/px) data. We transformed the profiles to the frequency domain using a Fourier Transform and found fractal distributions where the power spectral density has a power law dependence on wavenumber. This distribution can be fitted in the form of a power law, where α is a scaling factor, β is the power law exponent and the summand γ accounts for noise in the DEM, e.g. introduced during DEM generation or a natural random component in the topography. Power law dependence inherently means that the topography of longitudinal striations is scale-invariant, e.g. there is no characteristic width that can be used to describe those structures. Instead, the power law parameters can be used to quantify statistical properties. β is a roughness estimate that characterizes the distribution of wavelengths in the signal. For profiles perpendicular to striations it can be interpreted as characterizing the distribution of ridge widths in the spatial domain. The scaling factor α characterizes the amplitudes of frequency components and is a measure for overall ridge heights. The comparison of results shows a similar range of power law exponents between β=2.3-3.5 for both landslide and layered ejecta crater deposits. It is common for all deposits that statistical parameter values are in the same range as the direct substrate, which implies that substrate topography properties are transferred during the formation of striations. The comparison between longitudinal and perpendicular profiles shows an anisotropy for β and α for all deposit types, which might allow to put constraints on the emplacement mechanism.