HYPSOMETRIC CURVE APPLIED TO IMPACT CRATER ANALYSIS – PRELIMINARY RESULTS FOR HELLAS PLANITIA REGION, MARS

Gomes, E.B.[1], Haag, M.B.[1]
[1]Universidade Federal do Rio Grande do Sul

ABSTRACT: Impact craters are common landforms on rocky planets, particularly on Mars. Those landforms are characterized by roughly circular depressions with variable sizes, and its morphology defined by the impactor size and the mechanical properties of the target. Impact craters are subject to diverse post-impact modifications including mass wasting, alluvial fan, and canyons development as well partial filling by volcanism and ice. In this sense, the study of crater degradation helps us to understand planetary evolution and constrain climate patterns. Currently, impact craters are either classified using visual attributes, which can be subjective, or simple morphometric parameters (e.g. diameter:depth ratios), making the algorithm processing and crater comparison a difficult task. The hypsometric curve allows the reduction of a 3D relief to a 2D altitude-area graphic and, on Earth, this approach has been applied to drainage basin analysis, enabling the recognition of paleosurfaces, denudation rates, and subsidence. This technique also allows the comparison of different basins and their evolutive stage. In this work we test the applicability of hypsometric curves to study impact craters, exploring the connections between curve patterns and crater morphology. The test was performed in 150 complex craters defined in the literature, with diameters ranging from 30 to 90 km, on the Northern Hellas Planitia (17 to 30°S, 51 to 85°E), a Noachian region on Mars. The data were obtained using the software JMARS and the Planetary Data System. The targets were first delimited using imagery from the Context Camera (~6 m/pix) and the High Resolution Imaging Experiment (~0.5 m/pix). Then, we used ArcMap® to extract normalized hypsometric curves of the internal area of the craters using topographic data from the Mars Orbiter Laser Altimeter (~463 m/pix) and the High Resolution Stereo Camera (~10 m/pix). Two patterns of hypsometric curves for the studied targets were identified. Older craters show concave-up profiles with lower hypsometric integral values (HI) and broad areas (reaching up to 60% of the total area) with the same elevation suggesting a flattened base, which may be caused either by partial filling or structural constraints during the cratering process. These craters often present nested impact craters (i.e. later impacts), accounting for 10 to 40% of the elevation and usually covering less than 4% of the total area. In contrast, recent craters with similar diameters show almost straight profiles, higher results for HI and usually do not present a flattened base, indicating a lower degree of degradation. The presence of central peaks and alluvial fans returned a concave-down profile for specific segments of the hypsometric curve. This study introduces a new quantitative methodology to compare impact craters, with promising results. At this point, more studies and a higher sample population are necessary in order to better understand the relationship between crater geomorphology and the hypsometric signal. This approach may be useful for code writing and automatic recognition of craters based on their hypsometric attributes.

KEYWORDS: IMPACT CRATERS, PLANETARY GEOLOGY, MARS.