

PLANETARY CRATERING: RATES OF MODIFICATION OF LUNAR

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A number of lunar craters have been studied to understand their morphological evolution. The first step was the reconstruction of the original morphology of a crater. Topographic details of fresh craters suggest that the original shape of an impact crater is conical. The topography was derived from a population of fresh craters with diameter ≤ 20 Km appearing on LM 104 and LM 60.

The geographic coordinates and spot elevation of the craters were digitized. Algorithms were derived to determine the goodness of fit between the digitized morphology of the crater and either a cone or the frustum of a cone (if the crater has a flat floor). Statistical tests suggest that a cone is a good approximation of an impact crater. The observed shape of a crater is the result of its modification by several processes after formation. The crater floor may be modified by a) isostatic adjustment; b) infilling by impact melt; c) infilling by locally derived ejecta; or d) gravitationally induced rim failure.

Using the conical model, volumetric differences of material between the theoretical and observed shape of craters were computed. We were able to estimate the cumulative sum of volumetric difference. If the sum is equal to or nearly zero, the observed shape of the crater is the result of redistribution of material forming the original crater without external contributions. If the sum of the volumetric differences is greater than zero, an external contribution of materials modified the shape of the crater. The difference in altitude (Δh) between the theoretical and the observed walls of a crater describes the roughness of the crater with respect to the theoretical shape: the longer the modification processes act, the larger the amount of material accumulated in the lower parts of the crater will be. The direction of motion of the materials into the crater can also be identified.

This method is a useful tool for a quantitative approach to the study of crater morphology and allows the comparison of the shapes of different craters using a reference model. The definition of a time scale of the modification processes for craters of comparable sizes and belonging to similar terrains can be obtained utilizing the relative ages of the terrains where the examined craters are located.