Detailed age determinations for Tsiolkovskiy crater floor

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INTRODUCTION

On the lunar farside, located at 20.4° S, 129.1° E lies Tsiolkovskiy crater a ~ 200 km-diameter crater formed by a NW-SE oblique impact [1]. It presents a basaltic infilling covering a surface area of approximately 12 000 km^2 which represents one of the few mare exposures of the lunar farside.
Different crater size-frequency distributions (CSFDs) measurements performed for this crater led to different results for its age of formation and subsequent infilling. Indeed, measurements performed on Tsiolkovskiy's landslide and surroundings returned a formation age of ~ 3.6 Ga [2-3] whereas the mare infilling yielded a younger age of ~ 3.2 Ga [4].

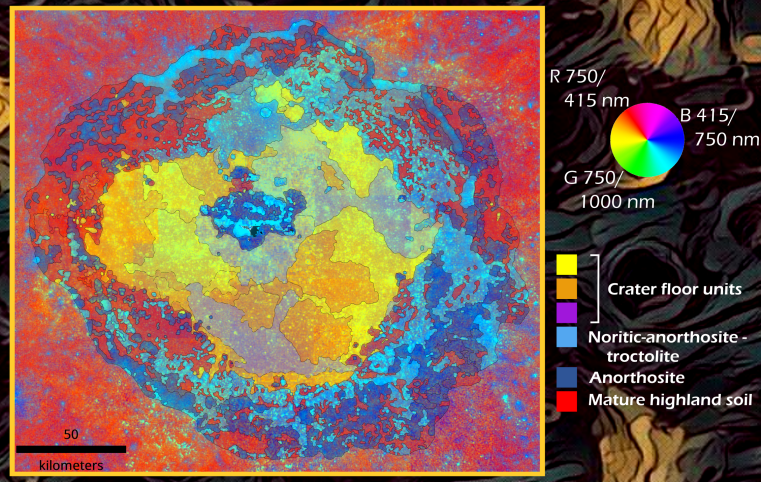

Fig. 1. Spectral mapping produced on the Clementine UVVIS Color Ratio mosaic [7] with related legend. Refer to [5-6] for units description.

An update to the previous version [5-6] of the spectral mapping produced on the ~ 200 m/pixel Clementine UVVIS Color Ratio mosaic [7] (R: 750/415 nm; G: 750/1000 nm; B: 415/750 nm) suggests the presence of three different floor units (Fig. 1). These units are characterized respectively by higher 415/750 nm ratio (i.e. violet unit), higher 750/415 nm ratio (i.e. orange unit) and average 750/415 nm and 750/1000 nm ratios (i.e. yellow unit) probably ascribable to a different composition and/or age formation.

AIM

On the basis of the units defined in the spectral (i.e. yellow, orange and violet) and geomorphological (i.e. hummocky material) mappings [5-6] we defined several areas for measuring the CSFDs and i) discriminating possible age differences among the spectral units of the crater floor and ii) determining the formation age of Tsiolkosvkiy crater through its impact melt material.

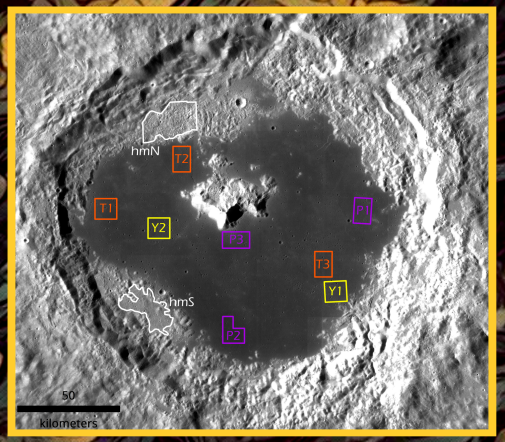

Fig. 2. Polygonal areas defined for CSFDs measurements. White polygons are selected on hummocky geomorphological units [5-6], yellow, orange and violet polygons are selected respectively on yellow, orange and violet spectral units.

DATA AND METHODS

We selected several areas (Fig. 2) with minimum surface area extent of ~ 100 km^2 and performed the CSFDs on LRO-NAC [8] images with resolution ranging between 0.5 and 1.5 m/pixel in the ESRI ArcGIS software by means of the CraterTools add-on [9]. The exported summary files have then been plotted in the Craterstats2 software [10] and fitted with the Neukum et al. (2001) production and chronology functions.

RESULTS

The CSFDs measurements for the two hummocky areas (Fig. 2 white polygons) determined a formation age of ~ 3.6 Ga (Fig. 3 white dot), in accordance to the crater formation age indicated by [2-3]. More variegated results have been obtained from the age determinations for the crater floor. The measurements have been performed on two areas for the yellow unit (Fig. 2 yellow polygons), and on three areas each for the orange unit (Fig. 2 orange polygons) and violet unit (Fig. 2 violet polygons). The results distinguish three different age ranges with average age of 3.57 Ga, 2.87 Ga and 3.39 Ga respectively for yellow, orange and violet units (Fig. 3 colored dots).

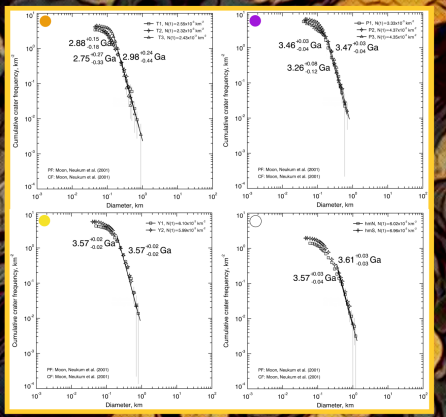

Fig. 3. CSFDs measurements results for orange (orange dot), violet (violet dot) and yellow (yellow dot) spectral units and hummocky (white dot) geomorphological units [5-6].

CONCLUSIONS

The CSFDs measurements return for Tsiolkovskiy crater a formation age of ~ 3.6 Ga. For the spectral units of the crater floor, instead, the age determinations allow to discriminate three different age ranges with increasing average age of 2.87 Ga, 3.39 Ga and 3.57 respectively associated to the orange, violet and yellow units. As from these results it is possible to reconstruct the succession of infilling events and to redefine the stratigraphic order for the crater floor units, with the orange unit being the youngest and the yellow one being the oldest. These results, finally, probaly reflect also a compositional variation over time, possibly associated to a change in the mantle source.

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