EPSC Abstracts
Vol. 8, EPSC2013-416, 2013
European Planetary Science Congress 2013

Quantitative and Statistical Analysis of Floor Fractured Craters

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Abstract

Floor-Fractured Craters (FFCs) present a certain impact crater type. The floors are refilled and dissected into knobs/plates of different size and shape. Several origins for the fracturing systems are discussed in previous studies. The origins are related to the location and environmental conditions of the crater itself. To affirm this hypothesis, a quantitative and statistical analysis of FFCs is presented here.

1. Introduction

A classification of FFCs concerning location and origin has been done on Mars based on various image data [1, 2]. Two very diverse craters are used as a case study and we compared them regarding appearance of the surface units, chronology, and geological processes in previous research [1]. Six potential models of floor fracturing have been discussed. The analysis suggests an origin due to volcanic activity, groundwater migration or convection. But also subsurface ice reservoirs, fluvial or tectonic activity are taken into account [1]. In order to understand the relationship between location and geological environment not only qualitative but quantitative analysis has to be done.

2. Statistical Parameters

The morphological analysis of FFCs is challenging because they represent often old, highly weathered and resurfaced morphologies. Quantitative analyses and evaluations are used to support the qualitative observations. Statistical parameters are the numerical characteristics of surface features. The parameters regard location, scale and shape of FFCs. Here we show those parameters for two FFCs, which were used for the case study.

2.1 Location

421 potential FFCs have been identified on Mars [1] by using High Resolution Stereo Camera (HRSC) [3] and Context Camera (CTX) [4] images. FFCs are found within 50°S and 45°N (Fig.1). Three clusters have been identified: along the dichotomy boundary, close to the outflow channels and in the Martian highlands.

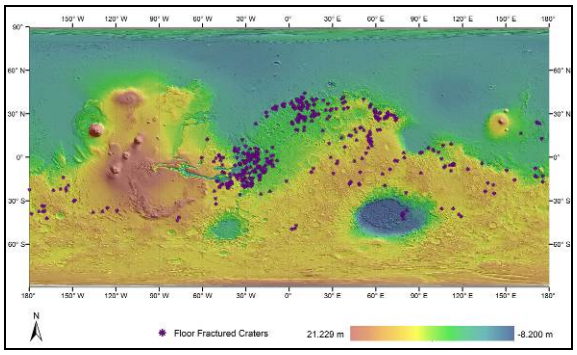

Figure 1: Location of FFCs on Mars, based on CTX and HRSC images shown on the MOLA elevation map.

2.2 Scale

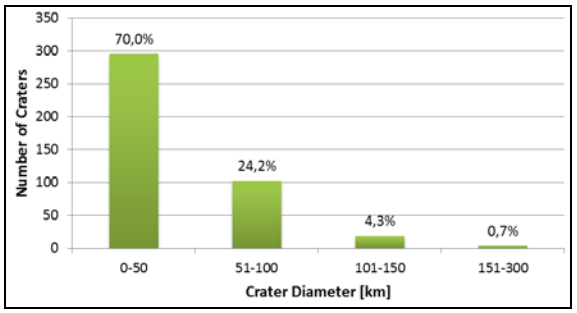

Table 1: 421 FFCs on Mars divided in certain diameter ranges visible in percentage and absolute number.

The craters range in diameter between 5 and 281 km. A size distribution indicates 300 FFCs (70%) smaller than 50 km. 100 FFCs (24%) are within 50 and 100 km in diameter. 20 craters (4%) have a diameter between 100 and 150 km. A diameter larger than 150 km was only found at 3 FFCs (1%) (Tab.1). The mean diameter is approximately 43 km.

2.3 Shape

Our work focusses on FFCs, therefore impact crater analysis has to be done to define and characterize the shape of the craters. Measurements and calculations help to classify observed surface details. Crater rim, floor, knobs (filling), fractures, ejecta, channels, linear features and central peak are analysed concerning length, depth, height, orientation, thickness, amount and number (Fig.2).

The classification and calculations are based on former research done on impact craters and FFCs on Mars [2, 5]. The transient crater depths and central peak height are calculated [6]. Impact craters are classified concerning the level of erosion [7]. Furthermore, a classification of FFCs into closed and open basin lakes can be achieved [8].

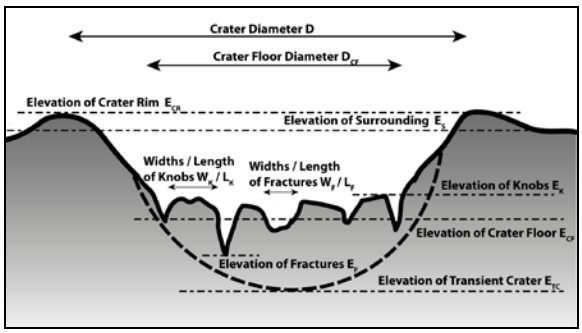

Figure 2: Sketch of a FFC including measurements of diameter and elevation of the surface features.

4. Discussion

The detailed statistical analysis is a strong and useful tool to support the geological and geomorphological interpretation of FFCs. The craters are classified concerning the surface features and therefore the most likely origin will be investigated. Measurements, calculations and classifications are taken into account. This statistical analysis will help to classify FFCs in a more objective way based on calculations and measurements. This research will be done on a global scale and not in particular regions, like it has already been done [e.g. 3, 4]. So all identified FFCs will be classified, this will give new insights concerning the possible origins, locational abundance and involved processes that include volcanic, tectonic, fluvial and glacial activity.

Acknowledgements

This work was supported by the Helmholtz Association through the research alliance “Planetary Evolution and Life“.

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