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South Pole-Aitken basin: outcrops and volcanic structures

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Abstract

Since the South Pole-Aitken (SPA) basin is a large structure and has been exposed to subsequent impacts, the composition of SPA and its craters is of high importance for models of the lunar crust. We examined two interesting craters, namely Antoniadi and von Kárάman located inside SPA, which exhibit volcanic structures and patches of anorthosite-rich rock. Our analysis based on the Lunar Reconnaissance Orbiter Camera (LRO) Wide Angle Camera (WAC) mosaic [1] in combination with Narrow Angle Camera (NAC) [2] images for detailed views, and hyperspectral images of the Moon Mineralogy Mapper (M^3) [3] and topographic datasets of the GLD100 [4].

1. Introduction

The South Pole-Aitken (SPA) basin on the farside of the Moon has a diameter of more than 2500 km and was formed probably more than 4 Ga ago [5]. In our work, we investigate sections of the South Pole-Aitken basin (SPA), to gain insights and conclusions of the formation of the SPA. We analyse in detail the craters Antoniadi (Fig. 1) and von Kármán (Fig. 2) in order to study the appearance of anorthositic layers and volcanic constructs inside SPA.

2. Study of conspicuous structures

1.1 Antoniadi

The crater Antoniadi (138 km diameter, centered at 69° S, 173° W) is situated in the southern part of SPA (Fig. 1). Based on a petrological map constructed using the framework of [6], we investigated a large patch of anorthosite in the western part of the Antoniadi crater wall, covering a part of the outer crater floor not covered by lava. This deposit looks like an outcrop rather than a debris flow. Also the highest part of the gently inclined crater terrace show an anorthositic deposit, located exactly between the crater walls of Antoniadi and its neighbor Minnaert, which is partially superposed by the wall of Antoniadi. This anorthositic material was probably excavated by two subsequent large impacts.

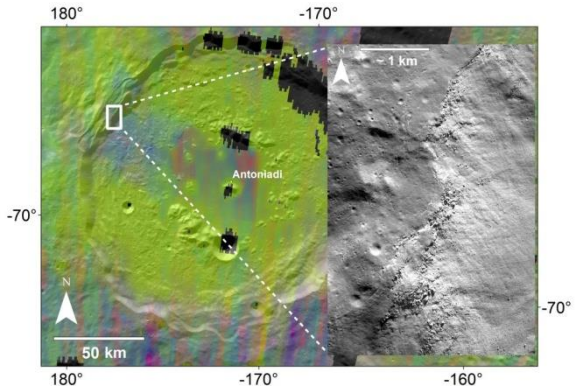

Fig. 1: Petrological map overlaid on LRO WAC mosaic of crater Antoniadi (red: basalt; green: Mg-rich rock; blue: anorthosite) with detail view of an anorthositic outcrop in the crater wall.

1.2 Von Kármán and von Kármán M

The crater von Kármán (186 km diameter, centred at 44° S, 176° E) is located in the inner region of the SPA basin (Fig. 2a). We investigate traces of basaltic volcanic activity in and around the crater von Kármán. The lava-flooded floor of von Kármán exhibits lobate flow structures of 16 x 33 km² size and 115 m height (Fig. 2b). On the lava-flooded floor of von Kármán M, a slightly elliptical dome structure of 15 x 17 km² size and 100 m height is situated (Fig. 2c). Both structures show sharp demarcations with respect to the underlying surface, indicated by white arrows in Fig. 2b and c. The occurrence of such presumably effusive volcanic structures in mare areas is commonly explained by lavas erupting in the

final phase of a long-lasting basaltic eruption, forming cooling-limited flows [7].

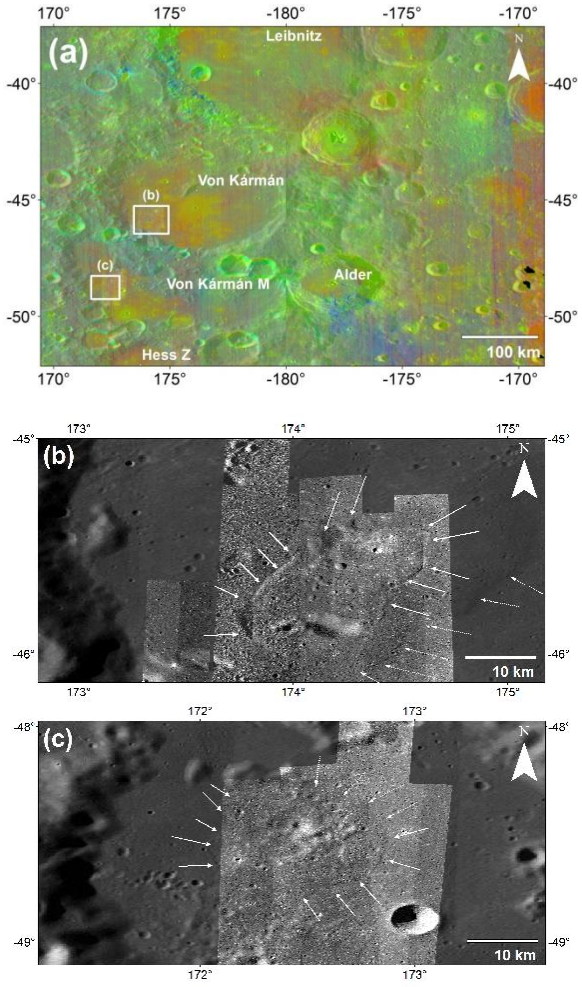

Fig. 2: (a) Petrological map overlaid on LRO WAC mosaic of the crater Von Kármán and von Kármán M (red: basalt; green: Mg-rich rock; blue: anorthosite). The white boxes show the position of the enlarged views. (b) LROC NAC image of the volcanic flow structure on the floor of von Kármán. White arrows indicate the outline of the structure (NAC images: M1110668243, M1174258554, M1183672804, M1102432165, M103375421). (c) LROC NAC image of the elliptical dome structure on the floor of von Kármán M. White arrows indicate the outline of the structure (NAC images: M1113033310, M182394642, M1204865030, M1250789112, M1174265624).

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