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Nature of cone distribution at aureole of Olympus Mons, Mars

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Abstract

Olympus Mons is suspected as a site of latest volcanic activity on Mars and various theories have been suggested for the origin of deposit surrounding the main dome. The analysis of cone is expected to enhance our knowledge with regard to the origin of deposit and the region condition. In our study, we analysed distribution and variation in size of aureole cones by using high resolution CTX and HiRISE images along with topographic information.

1. Introduction

The analysis of large cone fields may provide new line of evidence to understand relationship between climate, volcanism and hydrothermal systems on Mars [7].

For our study purpose we have chosen the north region of Olympus Mons known as aureole deposit (Lat: 30° N to 36° N, Long: 133°W to 140° W). The shield volcano, Olympus Mons is one of the largest volcanoes in the Solar System [5]. The volcano consists of main dome with calderas at the top. The aureole deposit is widespread from the bottom of dome and makes groove terrain that can be easily differentiate. The entire region is believed to contain water and lava in past [7]. In fact, the presence of lava floods and water/ ice has been proposed on the surface of Mars [2, 11]. The source of water or lava floods is not clear yet, but it generated relatively young smooth surface (probably mid to late Amazonian period) on Mars [7, 8] by resurfacing process. The smooth plain is characterised by some of the distinct targets, one of them is large cone fields.

In the current study, we identified and analysed cone structure on the north of Olympus Mons aureole. The cone fields are easily distinguished due to their bright steep slope and high elevation. Similar cone structures are present in Iceland on Earth [4, 9]. The Iceland cones resemble the cones which are observed on Mars [3, 6]. By taking these cones as a reference, we can identify the cone group on Mars. The cones form due to the explosive interaction between lava and water which may be in the form of liquid or solid [1]. The identified cones depict a large variety of morphologies and sizes.

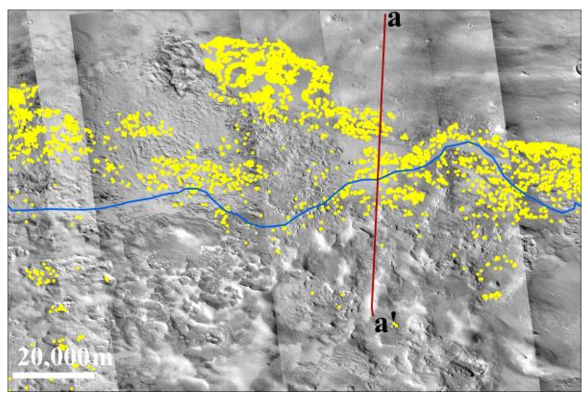

Figure 1 Red dots indicates identifies location of cones in CTX and HiRISE. Maroon (a- a’): is a counting line for cone, perpendicular to the basin. Blue line: primary flow line. North up.

2. Methodology

Our aim is to analyse the distribution patter, size and morphology of cones and understand possible formation mechanism for the observed features. For detail distribution pattern analysis we counted number of cones along the line (a-a’, Fig. 1), parallel to flow line (blue line in Fig. 1) and divided the region into 1.7 km^2 boxes each (counting method adopted from Noguchi & Kurita, 2015).

3. Observations

The cones of aureole follows unique distribution pattern: large number of cones is concentrated on the flanks of the flow channel (Fig. 2B) and parallel to the flow direction. The cones concentrated at the flank are dominantly of small in size (<300m, Fig. 2C) where as large cones (>300m, (Fig. 2C) are confined in the center part of the valley in aureole. Similar phenomena is seen in case of Athabasca valley, where double cones and lotus cones are confined at the central part of the channel in low elevated area [10].

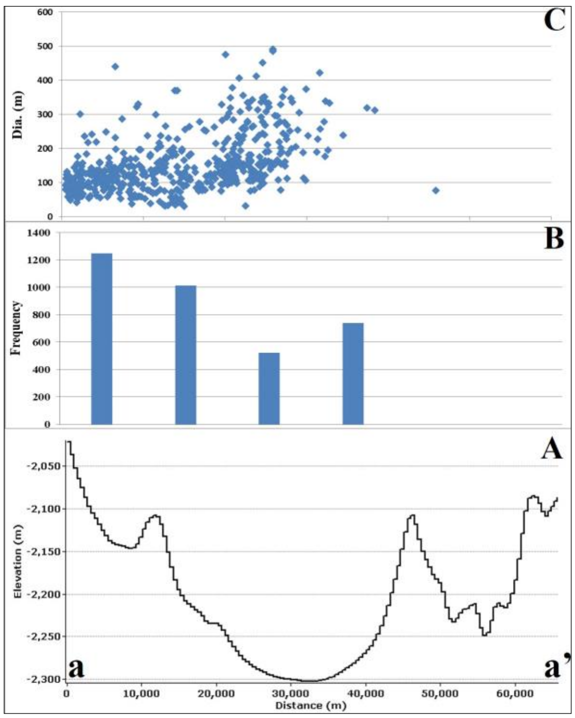

Figure 2 (A) Elevation graph of basin perpendicular to the primary flow (a-a')(B)Distribution graph of cone perpendicular to the flow direction. Large number of cone group is clustered at the flank of the basin. The topographic information taken from MOLA MEGDR (NASA/Cal-Tech/ASU). (C)Distribution of cones according to its crater size.

The large spectrum of variation in cones depends upon the availability of resources (water and/or lava) during the time of formation [10]. In case of Asthabasca Valley, the thick lava flow in the central part channel and large amount of water/ ice in the pore space are thought to be one of the reason for large double cones and lotus cones [10]. We are assuming similar mechanism could be the reason for larger cone size in our stud region.

Furthermore, DEM from HiRISE stereo pairs will be generated to study detail cone morphology and measurement of slope, height of cones.

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