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Volcanic system of Isidis Planitia

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1. Introduction

In the 1970s, data sent by the Viking probes showed fields of cones of unknown origin on images from the northern areas of Mars. Ideas for the genesis of these forms were many, from post-glacial forms through cryovolcanic so-called pingo to forms generated by volcanic processes. Volcanism on Mars was certainly there because in the area of Tharsis we have the largest volcanoes in our Solar System. The age of volcanism is estimated for the Noachian/Hesperian period. Little is mentioned about later or quite recent volcanism on the planet [1].

2. Origin of cones on Isidis

Fairly known HiRISE camera images, for example PSP_009177_1985; PSP_006936_1945 [2] caused much trouble for scientists because in general the interpretation of these cones was not clear. Such cones are found especially in the Isidis, Acidalia and Amazonis regions. Cones on Isidis attract special attention of scientists because it is not known why they are arranged in a kind of linear structure with a characteristic arched shape (Figure 1). Such system of cone cover an area of about half of Isidis. They are distinguished from the cones in other regions of Mars by the characteristic furrow through the center. Comparing them with their analogue in Myvatn in Iceland [3] gives rise to such problem that the Icelandic cones are arranged in a chaotic manner and the caldera are quite wide and most importantly Icelandic cones from Myvatn do not have that characteristic furrow through the center. The exception are the cones on Acidalia in the image THEMIS V55617012, which are arranged parallel to the lava tongue and are probably rootless cones. Lava had to flow on the area covered with ice or saturated with water. Cones on Acidalia are much smaller (50 m at the base) than those on Isidis (500 m at the base). It is worth to mention another similar place in Iceland namely the cones from recent eruption in Laki. They have that characteristic furrow and are formed on the line of the magma plume. In the work of Gudmundsson, et al. (2007) [4], depth of the magma chamber's seating and the tension system causing cracks in the characteristic circular structures are calculated. The magma from volcanic chamber penetrates these cracks. The magma from the volcanic chamber penetrates these cracks. We do not see such large chains conical structures on Earth as on Isidis. . There are only volcanic systems with the main central volcano or without the main volcano, but on a comparative scale to Isidis, these are very small cone fields. For example, the Pinacate system created from subduction of the Pacific Plate occupying an area of 30 x 60 km, or in similar scale Etna with its cone system, and Mauna Kea with a system of cones in Hawaii [5]. Tensions that are involved in the formation of arc like volcanic forms can be compared to the passing of a bullet through the glass, where a series of cracks is arranged in a circular and radial form. Tensions of magma penetrating the crust and piercing it can generate a series of circular structures around the volcano. Therefore, the area of the Syrtis Major volcano may be the main volcano, which generated a series of circular cracks around itself, which were filled with magma creating a volcanic system with chains cones on Isidis (Figure 2), [2]. Magma chamber under Syrtis preferred load model is approximately 300 × 600 km in size. Only Bushveld volcanic complex on Earth from 2 billion years ago is of similar size [6]. The Pavonis Mons volcano is an example around which there are such circular cracks and volcanic structures. The works are at the stage of modeling the Isidis volcanic system.

Figure 1: Fields of cones on Isidis with a characteristic furrow through the center, forming arched structures. (Google Mars, width of the image 40 km)

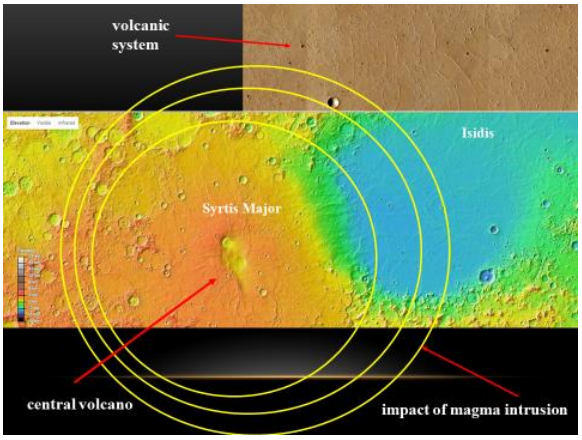

Figure 2. The impact of the magma chamber at Syrtis Major on the surrounding area around the volcano. (Altimeter map is from Google Mars, prepared from MOLA)

References

[1] Kerr R.: Ice or Lava Sea on Mars? A Transatlantic Debate Erupts, Science, Vol. 307, pp. 1390-1391, 2005

[2] Ghent R., Anderson S., Pithawala T.: The formation of small cones in Isidis Planitia, Mars through mobilization of pyroclastic surge deposits, Icarus, Vol. 217, pp. 169-183, 2012

[3] Noguchi R., Höskuldsson A., Kurita K.: Detailed topographical, distributional, and material analyses of rootless cones in Myvatn, Iceland, Journal of Volcanology and Geothermal Research, Vol. 318, pp. 89-102, 2016

[4] Gudmundsson A., Ruth A.: Mechanical interaction between active volcanoes in Iceland.: Geophysical Research Letters, Vol. 34, pp. L10310, 1-5, 2007

[5] Zalewska N.: Global Martian volcanism as a new interpretation of geological past of terrestrial bodies and moons in the Solar System, EPSC Abstracts, Vol. 11, EPSC2017-372, 2017

[6] Kiefer W.: Gravity evidence for an extinct magma chamber beneath Syrtis Major, Mars: a look at the magmatic plumbing system, Earth and Planetary Science Letters, Vol. 222, pp. 349– 361, 2004