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ON THE RELATIONSHIP OF VOLCANISM IN THARSIS REGIO WITH THE FORMATION OF THE VALLES MARINERIS.

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Abstract. It is believed that the Valles Marineris was formed as a result of tectonic processes directly caused by the formation and huge mass of the Tharsis plateau. Prolonged volcanic activity led to the accumulation of a colossal mass of volcanic rocks in the Tharsis Regio region, which created enormous loads on the lithosphere. They caused significant stresses in the planetary crust. Therefore, the lithosphere bent under the weight of Tharsis Regio, stretched along the edges and this led to the lowering of entire blocks of crust between the faults. Noctis Labyrinthus, located at the western end of the Valles Marineris , with its chaotically scattered network of canyons, is considered an example of the initial stage of such cracking. This canyon system is located around the equator from the Noctis Labyrinthus region to a region with chaotic relief for more than 4000 km from east to west, up to 700 km from south to north, reaching a depth of up to 8 km. It is one of the largest in the Solar System.

Key words: Mars, stresses in the planetary crust, Valles Marineris, canyon network.

One of the most dramatic examples of the impact of volcanism on the geology of Mars is the possible connection between the formation of the Tharsis volcanic region and the formation of the vast Valles Marineris canyon system (Fig. 1a).

It is believed that the Valles Marineris was formed mainly as a result of tectonic processes that were directly caused by the formation and enormous mass of the Tharsis highlands. The mechanism of such a connection is as follows.

Prolonged volcanic activity [12, 15-17] led to the accumulation of a colossal mass of volcanic rocks in the Tharsis Regio , creating enormous loads on the lithosphere. This mass caused significant compressive and tensile stresses in the surrounding part of the planetary crust [2, 3]; especially to the east of the highlands. Therefore, the lithosphere literally bent under the weight of Tharsis Regio and significantly stretched along the edges. These tensile stresses greatly exceeded the strength of the planetary crust, and this caused it to crack and form a system of giant parallel grabens, that is, to the lowering of entire blocks of crust between faults. Noctis Labyrinthus, located at the western end of the Mariner Valley, with its chaotically scattered network of canyons, is considered a vivid example of the initial stage of such cracking.

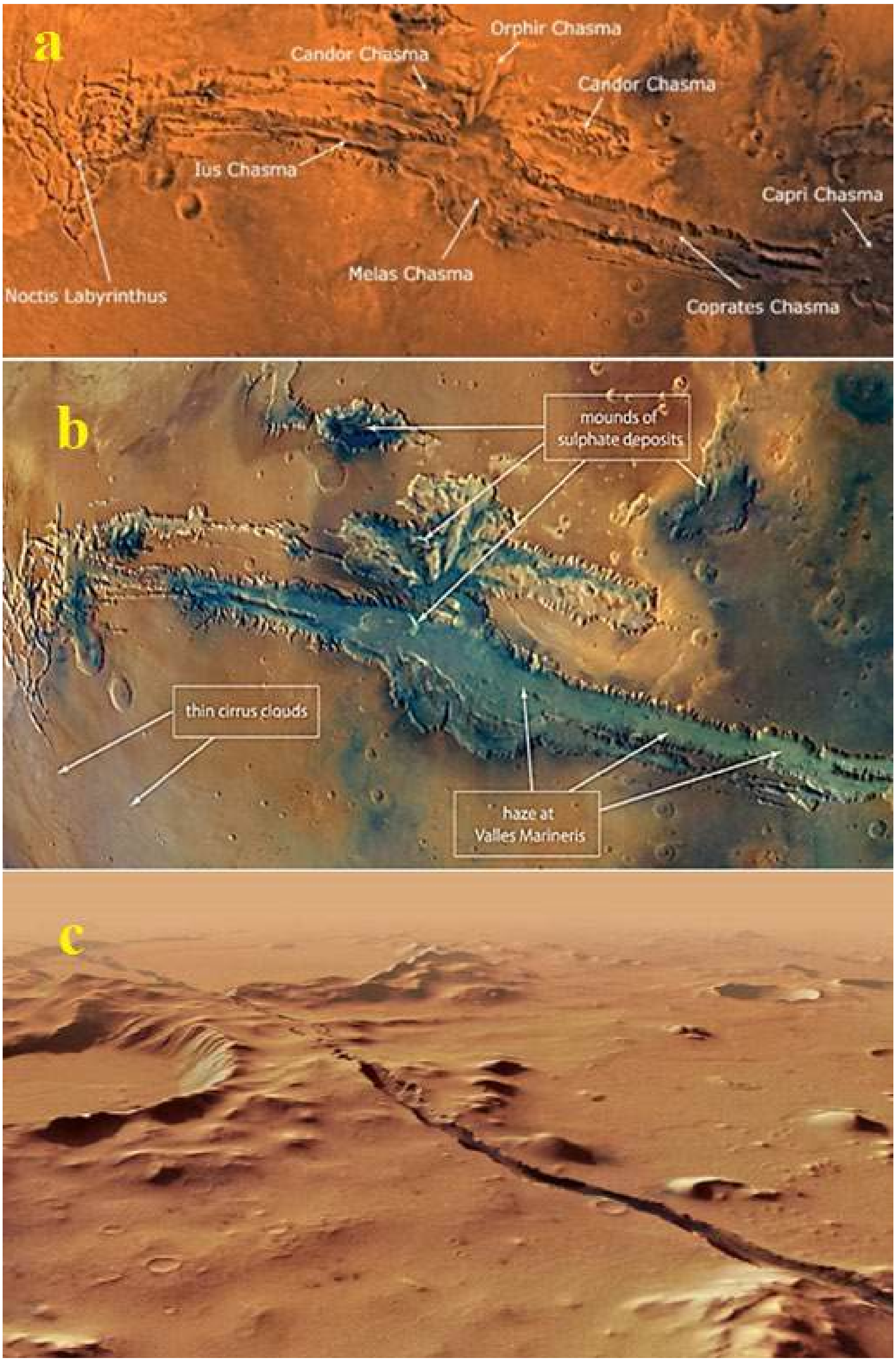

Figure 1. a – Valles Marineris canyon systems with names of details (https://dic.academic.ru/pictures/wiki/files/118/vallesmarinerisnames.jpg). b – mosaic of the canyon system near Valles Marineris with marked surface details: sulfate deposits, haze, fog and cloud cover (https://www.esa.int/var/esa/storage/images/esa_multimedia/images/2023/05/close-up_of_valles_marineris_from_global_mars_colour_mosaic_annotated/24894597-4-eng-GB/Close-up_of_Valles_Marineris_from_global_Mars_colour_mosaic_annotated_pillars.png). c – perspective view from southeast to northwest over the young tectonic cracks of Cerberus Fossae thousands of kilometers long (https://www.dlr.de/en/images/2018/3/view-south-east-to-north-west-cerberus-fossae/@@images/image-1000-809458fcb55e124e5352b685fe0f2d01.jpeg).

The earliest tectonic cracks and grabens were subsequently significantly widened and deepened under the influence of various erosional processes (Fig. 1c). This canyon system is located around the equator from the Noctis Labyrinthus region to a region with chaotic relief for more than 4000 km from east to west, up to 700 km from south to north, reaches a depth of up to 8 km and is one of the largest in the Solar System. Many vast ancient river channels originate from the rugged region [21, 25] and extend northward [4, 11, 14, 20].

Faintly bright, bluish areas indicate cloud formations in the atmosphere [1, 6, 22]. Deeper parts of Valles Marineris are also covered by haze and fog that form near the surface in Martian depressions (Fig. 1b). These include massive collapses on canyon walls, wind erosion [8, 9, 26], and the possible influence of liquid water in the early history of Mars, which could flow along faults from underground horizons [13].

That is, the formation of the Tharsis Regio highlands was not some local phenomenon of volcanic activity [19, 24, 27], but a planet-wide event that could fundamentally change the global geology and general topography of Mars. A direct consequence of this event is the formation of Valles Marineris, which became evidence of the colossal forces that acted in the Martian crust.

The landscape in the Cerberus Fossae region looks as if it has been cut with a knife. These tectonic, crack-like structures were formed less than 100 million years ago, and perhaps even less than 10 million years ago.

This is evident from their profile, which is bounded by very steep, and sometimes almost perpendicular walls, the height of which in places is more than 500 meters. On the Elysium Planitia plain [9] all the elongated cracks of Cerberus Fossae extend only from northwest to southeast.

The forces that caused the rupture of the planetary crust acted perpendicular to this direction. The smooth areas are composed of solidified lava with very low viscosity. And the small number of impact craters [7, 10, 18] on its surface indicates that volcanic eruptions could have occurred in the very recent [23] geological past. This makes the equatorial region of Cerberus Fossae one of the geologically youngest structures on the planet Mars.

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THERMAL BEHAVIOR OF REINFORCED COMPOSITES FEATURING LONGITUDINAL THERMAL CONDUCTIVITY NON-UNIFORMITY

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Abstract. This research provides an extensive computational investigation into the complex mechanisms of heat propagation within rectangular composite structures reinforced with high performance fibers. The study employs a refined finite element framework to analyze the transient thermal response of these heterogeneous materials. The underlying mathematical formulation is established upon the classical Fourier law of heat conduction, which serves as the fundamental governing principle for determining the temperature evolution over time. To ensure superior spatial resolution