AN ORIGIN OF VALLEY NETWORKS AND OUTFLOW VALLEYS ON THE MARTIAN SURFACE.

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The analysis of planets evolution is of interest for comprehension of global dynamics of Earth development. On the other hand, the correct use of knowledge about dynamics of Earth processes, first of all about volcanism subject to Martian specificity, releases from the mass of problems and contradictions, which have arisen at analysis of Martian relief-forming.

The problem of a source of water arose at once after discovery on Mars of outflow valleys. Two versions of their possible formation have the greatest dissemination and recognizing: 1) Potent outflow of underground waters. 2) The catastrophic outflow of lake's water (for outflow valleys from Valles Marineris).

Both versions explain the water excess in highlands and its subsequent catastrophic outflow into lowlands by a warm climate which was existing in ancient epochs. Besides they have problems with an explanation of accumulation conditions of large water volumes and experience difficulties with an explanation of mechanisms ensuring stormy outflow.

Other group of problems is generated by attempts of an explanation of valley networks origin. By and large all versions of their formation envision aqueous erosion, that contradicts the fact of domination on Mars of low temperatures. There are two basic directions of attempts to eliminate this contradiction.

1. Supposition about a possibility of global climatic changes on Mars in ancient epochs. These concepts have problems with an explanation of a heat source sufficient for increasing of mean temperature of Martian surface approximately on 70 degrees.

a) the external heat source - higher solar activity in ancient epochs. The version contradicts with the representations about lower solar constant (on 40 %) in ancient epochs and with the fact of wide spread of glacial deposits - tillites - in most ancient epochs of Earth's development.

b) the internal heat source - thermal flux from depths. The thermal flux should exceed the Earth level up to five orders of magnitude for guaranteeing of sufficient temperature increase on Martian surface. But endogenic activity of Mars should exceed the Earth level up to five orders of magnitude too in this case. The exogenic processes can be neglected.

c) the rise of temperature of the planet at the expense of greenhouse effect. Mars should have volcanic activity higher up to three orders of magnitude for support of sufficient greenhouse effect. In this case endogenic (volcanic) processes should dominate in relief-forming too, while the role of possible aqueous erosion is insignificantly small.

2. Gradual formation of valley networks at the expense of a replenishment by groundwater. This direction is compelled to use the suppositions about a non-equilibrium water distribution which was formed in Martian crust in hypothetical epochs of past warming.

The concepts of aqueous erosion on Mars have one more general problem. There is water volume more up to two orders of magnitude in Earth's hydrosphere, and wide-ranging glaciating were usual in a geologic history. Nevertheless the relief forms bound with catastrophic water outflow are extremely rare, and the peak discharges of water are lower up two order of magnitude than it calculated for Mars. Mars has underdeveloped atmosphere and hydrosphere. Therefore considerable and wide-ranging processes of aqueous erosion are still more improbable for Mars.

Thus **all concepts of aqueous erosion have serious difficulties and are forced to resort to the various speculative suppositions**. However there is no necessity in it. It is enough to take into account specificity of planetary evolution on Mars for comprehension of relief-forming conditions for this planet.

Now it is generally accepted, that the hydrosphere and the atmosphere of the Earth were generated during a degassing of a crust and upper mantle first of all at the expense of volcanic activity. It is naturally to consider, the similar degassing processes was developing on Mars during ancient epochs too.

Accretionary lapilli - spherical concretions of ash particles on drops of a moisture - are generated at presence of water condensate in Earth’s eruptive clouds. Martian lower gravitation provides more long-lived existence of eruptive clouds. A step-by-step condensation of all juvenile water and sticking on a condensate of ash particles occurs in accordance with slow cooling of gas-pyroclastic contents of these clouds in conditions of low temperatures of a surrounding atmosphere. Generated accretionary lapilli fall out from eruptive clouds as mudraindrops or mudhailstones. So **the volcanic activity on Mars was accompanied by wide-ranging formation of accretionary lapilli and by intensive mudfalls**.

The intensive volcanic activity should have as result the creation of frozen mud-pyroclastic cover on

Mars surface. This cover can mask centers of eruptive activity and impact-meteoritic forms of relief. The cover has greatest thickness in zones with most long-lived and intensive activity. Thickness should be maximal in zones of huge volcanoes of Mars.

The volcanic shields of Mars were identified with volcanic structures of the Hawaiian type erratically. Martian lower gravitation is the cause of the slower promoting of lava flows with identical viscosity in comparison with Earth conditions. The Hawaiian lava should harden on closer distance from eruptive center and at more steep angles in Martian conditions. Most likely that the huge central-volcanic structures of Mars are formed as a result of accumulation of frozen mud-pyroclasts. It explains presence of series of vague concentric terraces on slopes of volcanoes, which contour zones of most intensive mudfalls.

The accumulation of large volume of frozen mud-pyroclasts nearby of volcanic centers should result in displacement of volcanic activity to phreatic processes and, therefore, to formation of large volumes of pyroclastic material at the expense of phreatic explosions without dependence from a chemical composition of eruptive material. Two stages may be determined in the forming of the frozen mud-pyroclasts cover:

1. The ancient epoch of global degasification of the planet with occurring everywhere volcanic activity and with formation of planetary mud-pyroclasts cover. This oldest parts of the cover is kept in ancient areas with densely cratered terrain.

2. The epoch of areal degasification of the planet. The epoch was bound with localization of volcanic and magmatic activity within separate regions of Mars. This process was accompanied by the regional increasing of mud-pyroclasts thickness and was ended by the forming of protocontinental structures (Tharsis and Elysium).

So **the intensive volcanic activity on Mars was accompanied by formation of frozen mud-pyroclasts cover with maximal thickness in areas of most active volcanic centers**.

The cleaning up of water in considerable volumes is impossible on Mars because of low temperatures and poor atmosphere. The cleaning up of water at the expense of endogenic processes, for example under temperature effect of intruding of magmas, is impossible because intensive convective intermixing starts simultaneously with thawing of mud-pyroclasts. There are no interred glaciers and big stores of pure water on the Mars and basic volumes of water combined with tiny pyroclastic particles is concentrated in frozen mud-pyroclasts cover with its maximal thickness on continent-like elevations.

During Martian volcanic eruptions numerous small lahars were forming because of intensive mudfalls under the condition of sufficient incline of surface. Lahars were forming from both the fresh falling material and the mud-pyroclasts deposits of the previous eruptions. Erosive effect of these processes was enough for formation of valley networks. Lahars in comparison with water flows have high density, more strong eroding effect and a little bit different rheology. These circumstances determine set of differences of Martian valley networks from a relief of terrestrial catchment basins: low density of catchment networks, small number of inflows, practical absence of inflows with width less than 1-3 km.

The frozen mud-pyroclastic cover obtains high mobility in case of thawing. Therefore erosive effect of lahars could increase, if lahars were formed not only for the mudfalls material, but also due to eruption of large volumes of pyroclastic and lava flows. The high temperatures of magma and products of volcanic eruptions provide mobilization of the greater volumes of mud-pyroclasts in comparison with the volume of high-temperature source up to 1,5-2 orders of magnitude. So **valley networks on Mars were formed by post-eruptive lahars which arose because of both the intensive mudfalls and the eruptions of large volumes of pyroclastic or lava flows**.

There is a probability, that there were vast eruptions of mediasilicic magmas on final stages of Martian protocontinents formation. Pyroclastic flows are more typical than lava flows for this eruptions. The large-fragmental juvenile material in pyroclastic flows has a number of specific features. The large plastic fragments obtain the rolled form during motion, and their surface is exposed to potent effect of gas-pyroclastic mixture ("gas-pyroclastic abrasion"). These features can erroneously be considered as the evidences of presence of atmosphere and hydrosphere on the Mars in ancient epochs. Besides the rolled form the presence of autoexplosive and contraction cracks for juvenile blocks is characteristic. The rocks on the Mars Pathfinder land site have the same character.

Large volumes of hot mobile mud-pyroclasts were arising in the case of intrusions of magmas into frozen mud-pyroclasts cover. This material was ejected outside under large pressure, forming outflow valleys. Therefore it is quite natural, that upper parts of the gigantic canyons system - Valles Marineris - are located nearby of the gigantic volcanoes of Tharsis. Thus, **the outflow valleys were formed as a result of magmatic intrusions into frozen mud-pyroclasts cover and of subsequent ejection of very mobile and hot mud-pyroclasts onto Martian surface**.