ABOUT THE FORMATION MECHANISM OF SUBMARINE MOUNTAINS

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Galactic comets are recently open class of space bodies and now they have not enough study [1]. This comets fall on the Earth through 20-37 million years solely at the moments of the Sun stay in jet streams and spiral branches of the Galaxy [2]. Galactic comets falls on the Earth in form of "comets downpours" when $\sim 10^4$-10^6 this space bodies may bombard the Earth during several millions years. All such epochs in a history of our planet are the times of global catastrophic events (geological, climatic, biological etc.). These epochs pick out as borders of modern geologic time scale. Last bombardment took place into period 1-5 million years back on border neogene and quaternary. This boundary is marked by powerful geodynamic raisings of earth's crust [3].

Consequences of falls of galactic comets on the Moon, Mercury and Mars, which has strong rarefied gas environment, are most clear and can be explained [1,4]. In these cases in the place, where comet strike a blow about planet surface, a crater in diameter 10÷200 km is created. Such craters sharply differ from the craters created by asteroids and comets of the Solar system. They have superiority in number, complex structure, asymmetric disposition concerning equator of a planet, other formation time and diameters distribution function (fig. 1).

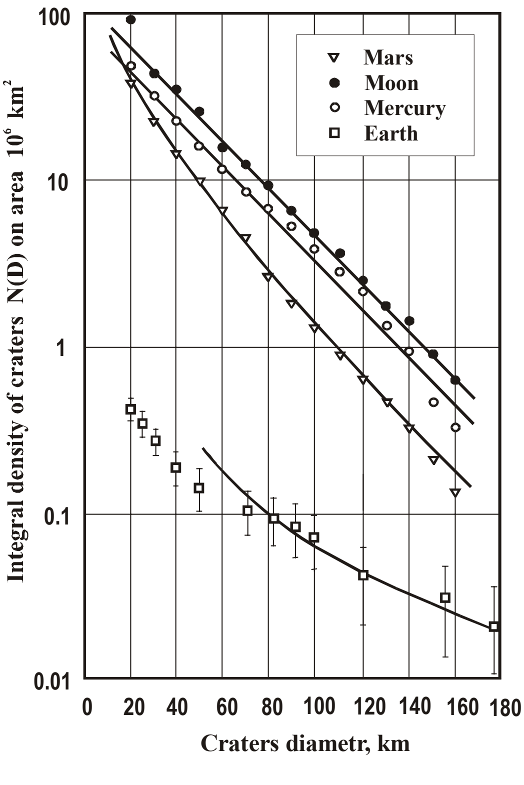

Fig 1. Integral distributions function of craters density on the Mars, Mercury, Moon and Earth in half-logarithmic system of coordinates.

Distributions of craters for Mars, Moon and Mercury are constructed on the data [5], and for the Earth on the data [6] for phanerozoic craters. The lower curve of terrestrial craters follows equation of back square-dependence. Distribution of terrestrial craters in the field of small diameters is deformed by the effect of observant selection [7].

There is a row of the theoretical models, which allow calculating diameter of an arising crater on parameters of cosmic bodies falling on a planets surface [8]. These models are intended, first of all, for calculation of craters created by asteroids. Their application for calculation of diameter of the craters created by galactic comets gives very big divergences [1]. The additional account of loss of comets mass in gas environments of planets decreases divergence of theoretical estimations. Distinctions in distributions of craters on the Mars and on the Moon (see fig.1) allow to conclude the density of substance of galactic comets is close 1000 kg/m^3, their nucleus has the sizes 0.1÷3.5 km, mass 10^9÷10^{14} kg and kinetic energy 10^{20}÷10^{25} J [9].

The atmosphere of the Earth (and more so the Venus) is an absolute obstacle for galactic comets. In gas environments of these planets a comet inevitably collapse and reach a firm planetary surface as the hypersound shock-wave, which has not capability to form a crater [1]. All large craters of the Earth are created solely by falls of asteroids. Their diameters distribution submits of back square-dependence. The quantity of these craters at ~100 times is less, than craters quantity on planets, which have not atmosphere (see fig. 1).

These hypersound shock-waves on the Earth and the Venus lose energy not on crater formation, but on creation in this place of the large magmatic camera, which is located deep under a surface of a planet, probably, on border lithosphere and astenosphere [4]. Given conclusion receives the most convincing substantiation for modern World Ocean with his thin oceanic lithosphere. In this case magmatic camera is located rather close to a terrestrial surface. Therefore lava, which goes from the camera, reaches ocean bottom, forming submarine mountains.

By submarine mountains name the isolated volcanic constructions on ocean bottom with height ≥ 500 m [10]. Usually they have the conic forms, approximately half from them has craters of erosion that allows considering them as underwater volcanoes. Quantity of such volcanoes is huge. There are about 130 000 volcanoes only in one Pacific Ocean. This estimation quickly grows in process of studying of an ocean bottom. Submarine volcanoes at the bottom of World Ocean at thousand times exceed number of volcanoes on the land. If volcanoes of the land are concentrated to seismically active belts in zones of collision of large lithospheric plates and to active continental outskirts, submarine mountains cover all oceans bottom uniformly. Less all Submarine mountains are on median oceanic ridges. In the process of age increase of ocean bottom the density of accommodation and the sizes of mountains are conformity increased, reaching a maximum in zones of deep-water hollows. This law is executed for submarine mountains of all oceans [10].

Submarine mountains, as well as craters from galactic comets on planets without an atmosphere, may be characterized by exponential distribution of the sizes (fig. 2).

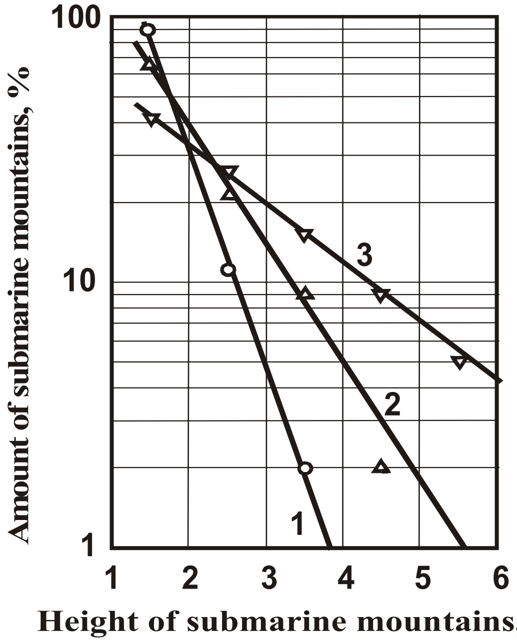

Fig. 2. Distribution of heights of underwater mountains at the bottom of Atlantic Ocean of different age [11]: 1 - pliocene-oligocene (0÷37 ma), 2 - eocene (37÷65 ma), 3 - late cretaceous (65÷100 ma).

The distributions of submarine mountains on heights at the bottom of Atlantic Ocean of different age are given. All distributions follow dependence: N (h) = N_0 exp (-h/η)., where η – a constant. For mountains on pliocene-oligocene crust η = 0.6 km, on eocene crust – η = 1.0 km, and on crust of late-cretaceous age – η = 2.0 km. The volume of mountains is connected to their height as V = 23.7 h^3

[11]. Therefore volumes of submarine mountains also are distributed to the exponential law. The average volume of mountains on a crust of the appropriate age is: 95, 190 and 640 km^3. Volume of the oldest and large submarine mountains is about 3000 km^3 [10].

Structures similar to submarine mountains are observed and on Venus. Here they have received the name of tectonic domes which are interpreted as small shield volcanoes. Domes have diameter of 1-20 km and their height achieves hundreds meters. Distribution of domes diameters is subordinated all to the same exponential dependence. Average diameter of a dome is 4 km. The volume of the volcanic breeds composing an average dome is ~0.73 km^3, that in $\sim 10^2$-10^3 times less than volume of submarine mountains on the Earth. The total of volcanic domes on Venus is estimated by $\sim 10^6$ [12].

By geophysical methods it is established [13], that under the basis of underwater mountains usually there is a large magmatic chamber (sometimes not one) size of her is ~n×10 km. From this chamber magmatic lava within the channel in diameter of ~1 km moves to top. After then lava will arrive at a bottom surface she creates submarine mountain. A degree of fusion of rocks of the chamber is ~10 %. Thus, at volume of the magmatic chamber is $10^3 \div 10^4$ km^3 the volume of lava may be $10^3 \div 10^4$ km^3, that it is enough for creation of very large submarine mountains. Life time of magmatic chamber is ~100 million years [13], therefore, process of outpouring of lava may occur during all time of existence of modern oceans bottom.

Character of change of submarine mountains sizes with increase of bark age (see fig. 2) testifies that two active processes take place on ocean bottom. On the one hand, this occurrence at the bottom of new young mountains, and with another - gradual growth of mountains during of bottom movement. The first process can be explained by periodic bombardments of the Earth by galactic comets, and the second may be connected with long existence time of magmatic chambers.

Let's make elementary calculation. We shall estimate quantity of energy E_k required for galactic comet on making the magmatic chamber in volume $V_0 = 10^5$ km^3, which may create submarine mountain in volume $V_r = 10^3$ km^3 and weight $m_r \approx 3\times10^{15}$ kg due to lava outpouring. The amount of this energy will make: $E_k = C\rho_S V_0 \Delta T + \xi\lambda\rho_S V_0 + m_r gH$. The first member defines the quantity of energy necessary for heating of chamber substance up to temperature of smelting. The second characterises the quantity of warmth required for transformation of a part ($\xi \sim 10\%$) of the heated up breeds into lava. And the third member defines expenses of energy required for lava to rise from depth H to a surface (we shall neglect by friction of lava at a channel walls). This rise is provided with increase of volume of breeds of the magmatic chamber at heating on $\Delta V_0 = V_0\,[\beta\Delta T + \xi(\rho_S/\rho_L - 1)]$. Suppose that acceleration of gravitation $g = 9.8$ m/s^2, coefficient of specific heating of rocks $C = 1.2$ kJ/kg·K°, coefficient of their specific smelting $\lambda = 210$ kJ/kg, coefficient of volumetric expansion $\beta = 3\times10^{-5}$ $(K°)^{-1}$, and also density of rocks before smelting $\rho_S = 3300$ kg/m^3 and after smelting $\rho_L = 2700$ kg/m^3, we receive, that in case of heating of rocks on $\Delta T = 500°$ and transformation $\xi = 10$ % of a part of rocks into lava the volume of the magmatic chamber will increase on $\Delta V_0 = 3.5\times10^3$ km^3.

As this surplus of volume basically is eliminated by outpouring of lava the given process may create very large submarine mountains. Thus formation of a magmatic chamber requires 3×10^{23} J energy, out which ~2/3 goes on heating of rocks and ~1/3 on their smelting. Transport of lava to a surface requires less energy. Expenses of energy here is $\sim 3\times10^{19}$ J on 1 km of depth. If to admit that the given process occupies 10 % of energy, what is need on the chamber formation, this quantity is enough to provide lava transportation from depths H ~ 1000 km.

At disclosing oceans in mid-ocean ridges a speed of horizontal movements of oceanic lithosphere is reduced with depth. The speed is maximal for a superficial layer of cooled crust and a little bit less at mantle substance under a crust. Therefore in the case when the magmatic chamber is situated superficially and goes together with a bottom, lava outpouring forms single mountain which in process of bottom movement increases volume, keeping conical form. If spreading speed of a bottom from mid-ocean ridge is higher than speed of a chamber movement the mountain gets the asymmetric form during the own growth. Such asymmetry is usual for many submarine volcanoes. And, at last, if the chamber is located so deeply, that does not move almost, lava outpouring creates the effect of "hot point". In this case instead of a single mountain there is appearing a volcanic ridge or chain of underwater mountains. Length of these systems reaches sometimes 2500 km as on Hawaii.

Comparing estimations of energy of mountains growth with energy brought by galactic comets, we find, that, at least, 5% of comets downpour bodies have energy above 3×10^{23} J. Supposing, that at one bombardment on the Earth fall down average $10^3 \div 10^4$ galactic comets [1,2], they are capable to create $10^3 \div 10^4$ large submarine mountains. If taking at attention, that age of modern ocean crust does not exceed 200 million years and that for this time 8 comets bombardments has taken place, the general number of the large submarine volcanoes created by them will achieve many tens thousands. The quantity of little submarine mountains will be $\sim 10^6$ that quite well coordinate to the actual data not only for the Earth, but also Venus.

Thus, the mechanism of formation of underwater mountains by galaxy comets is offered. The mechanism includes: 1) destruction of galactic comets in an atmosphere of the Earth with occurrence of a hypersound shock wave; 2) passage of a shock wave through thickness of ocean waters and rocks ocean lithosphere; 3) dissipation of wave energy in terrestrial crust and mantle with creation of the magmatic chamber; 4) lava outpouring of the chamber in form of plumes with creation of submarine mountain on ocean bottom.

Processes of interaction of hypersound comets shock wave with external liquid and firm environments of the Earth are investigated today in the least degree. To theoretical studying of these problems in the near future it is necessary to direct the basic efforts.

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