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Mercury and Mars: their contrasting features help to disclose essence of planetary "mysteries".

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Two rather near in size planets of the terrestrial group (Mercury- R=2439 km, Mars- R=3394 km) but occurring in differing circumsolar orbits, thus, with strongly differing orbital frequencies, exhibit drastically different physical, geological, and chemical characteristics. Both bodies have rather big orbital eccentricities (Mercury 0.206, Mars 0.093) relative to two other larger bodies of the inner group. Mercury is much denser than Mars – 5.4 against 3.9 g/cm3. Mercury's surface is much smoother than that of Mars: relief range less than 10, mostly less than 3-5 km, against about 30 km. Basalts flooding plains on Mercury are Mg-rich, on Mars Fe-rich. Tectonic granulation of Mercury is much finer – $\pi R/16$ than that of Mars – $\pi R/2$ [3]. Thus, the planets occupy opposite positions by many fundamental characteristics in the regular row of terrestrial planets (Fig.1).

Very interesting position concerns sulfur concentration on surfaces of both planets. If the martian highland surface is rich in sulfur due to wide patches of sediments containing sulfates and chlorides (northern lowland basalts have 2.6-3.8 weight % sulfur), then Mercury's basalts have upto 4 weight % of sulfur. The martian low density highland crust diminishes its tectonically required density probably due to massive involvement of the low density feldspathoids like sodalite and nosean in primary alkaline rocks in depth. The Mercury's sulfur enrichment is tied to widespread sulfides (probably CaS) deposited as fumaroles; their source lies at depth probably in form of a dense troilite layer.

The martian sulfur is not surprising, but that of Mercury is enigmatic because in the innermost body too close to Sun volatile sulfur should not be present. Earlier was proposed solution based on primordial, at stage of planetesimals enrichment by heavy minerals (including troilite) of the inner portion of rotating gas-dust cloud [1, 2]. This process experimentally is known for separation of heavy minerals from sands with help of spiral separator using descending and rotating water-sand mixture [1, 2].

A fundamental cosmogonic question – why volatile sulfur is in remarkable quantities at Mercury? – is difficult to resolve in frames of standard cosmogonic theory based on volatility of chemical components. The volatile sulfur must be expelled from the inner hot parts of the primordial circumsolar cloud. But as earlier as in 1982 we presented at the Lunar and Planetary Science Conference XIII a new model of differentiation in the primordial cloud of solid particles [1, 2]. It was based on experiments for separation of heavy minerals out of sand mixture. For this purpose a spiral separator used by geological prospectors was applied. It consists of a vertical spiral gutter. Descending mixture of sandy material with water rotates and separates into an inner narrow strip of heavy particles and the rest of material poor in heavies. The same principle we applied to rotating primordial grainy material immersed in rotating primordial gas (solar wind)-dust cloud. Such separation leads to formation of protoplanetary disc zones of different compositions where, as a consequence, planetesimals with different compositions form: in the inner part of the terrestrial planets zones planetesimals enriched with heavy minerals – metal iron and troilite – take a significant proportion, in the outer part, on the contrary, they are rare (but still are). A culmination is in the innermost mercurian zone, where planetezimals and finally the planet are very rich in metal and sulfur-bearing troilite [1, 2, 4]. Poor in "heavy" planetesimals more outward accretion zones of planets continue to differentiate by the same manner: the innermost parts of them also are enriched with "heavy' material. Two examples should be mentioned: the Earth-Moon system and the Main asteroid belt. The Main asteroid belt shows that its innermost strip is richer in metal-rich M-asteroids, the wide outer zones is rich in much lighter C-asteroids, in the middle rocky S-asteroids prevail. **Figure 1, 2**

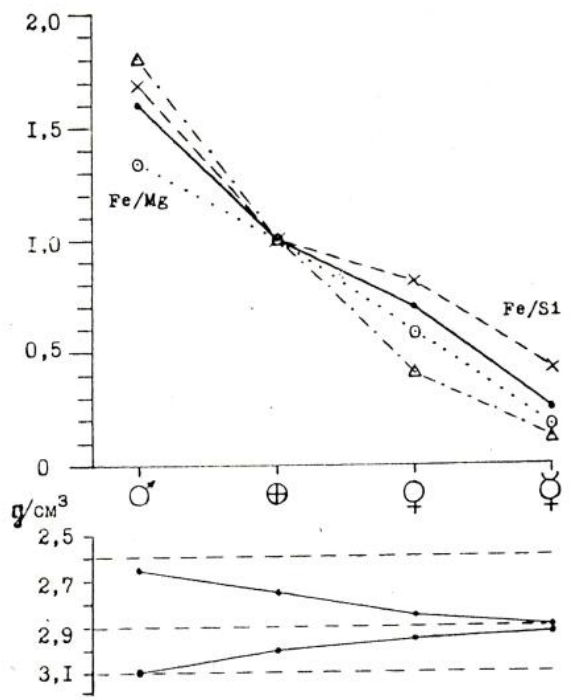

Fig. 1. Ratios of some planetary crust parameters compared to the terrestrial ones taken as 1:solid line – relief, dashed line – Fe/Si, dots – Fe/Mg in basalts of lowlands, dot-dashed line – highland/lowland density contrast. Below: increasing highland/lowland density contrast with increasing solar distance [3].

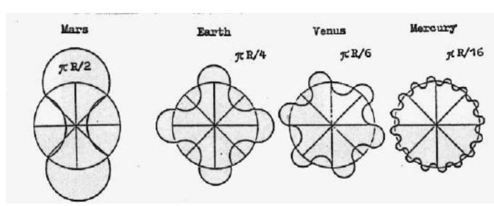

Fig. 2. Geometric presentation of standing wave warping of planets. All bodies are reduced to one size.

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