# Planetesimals – rich and poor in heavy minerals

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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. 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. In the Earth accretion zone a wave scattering is large enough to produce a separated outer future lunar lighter subzone (in distinction from Venus' and Mercury's zones where the smaller amplitude wave scattering cannot produce the separated outer subzones) (Fig. 1, 2) [3, 4]. Thus the lighter satellite of Earth, later captured by the planet, is formed (Fig. 1,black dot). The Main asteroid belt shows the same regularity: the 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.

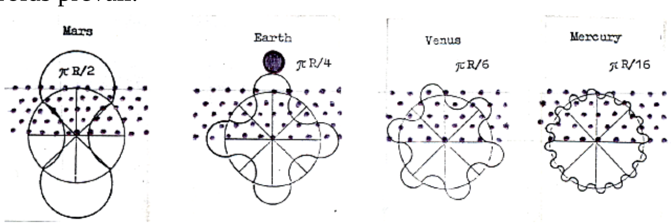


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**Fig. 1.** A geometric model of tectonic granulation of planets is a schematic row of even circles adorned with granules radii of which increases in direction from Sun to the outer planets. It was shown that the granule radii are inversely proportional to the orbital frequencies of planets [3]. So, this relief-forming wave potential is rather weak in Mercury and Venus, rather high in Mars and intermediate in Earth. In debris zones of the planets accretion wave scattering of debris material occurs. This scattering was small at Mercury' and Venus' zones, large at the Mars' zone and intermediate at the Earth's zone. Consequently, gravity kept debris in the first zones, allowed them escape in the martian zone, and allowed to separate an outer sub zone in the vicinity of the Earth's zone or around not fully consolidated (accreted) Earth. And what is important in this wave debris scattering process, the outer zones become enriched in less dense and volatile satiated material, the inner zones relatively rich in heavy minerals.

**Fig. 2.** Earth and the Moon from the Saturn orbit. PIA17170. The cameras on NASA's Cassini SC captured this rare look at Earth and its Moon on July 19, 2013.

**References:**

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