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From Mercury to Vesta: present studies confirm conclusions of the wave planetology about regularly changing rocky planets characteristics with increasing solar distance

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Introduction: I. Kepler has shown that all heavenly bodies move in elliptical orbits. After about 100 years I. Newton has shown that the bodies are not simple points but have certain masses influencing orbits. After about 300 years now one may say that the bodies are not simple structureless masses but have vertical and horizontal structural and compositional characteristics tied to their orbits. The comparative wave planetology (Kochemasov, 1992-2012) deals with these characteristics in relation to orbital characteristics of planetary bodies. Warping bodies waves appear in them due to keplerian orbits with changing bodies' accelerations. Mercury's data were predicted before the MESSENGER era due to an extrapolation of known regularities. Vesta's convexo-concave shape is a feature (consequence) of the warping fundamental wave present in all bodies, for example, in Ceres, Hyperion, Earth, and Mars. A protrusion of mountain on the concave subsiding side (hemisphere) is also typical: the Hawaii in the Pacific, the Pl. Boreale, Elysium Mons on the northern lowlands of Mars. Planetary atmospheres as a product of "sweeping out" volatiles from solid bodies increase their masses with diminishing solar distance (increasing orbital frequencies) and diminishing relief range, and tectonic granulation.

Recent MESSENGER's data on Mercury [1, 10-12] characterize it as a planet with relatively low surface relief range, low albedo contrast, Mg-rich basaltic (komatiitic, enstatitic) surface, a relatively fine tectonic granulation (magnetic field tight undulations, Fig. 4[11]). These features were predicted long ago based on some indirect evidences and mainly on regularities of the wave planetology [2- 9 & others]. This branch of planetology connects physical-chemical characteristics of celestial bodies with their orbital frequencies. Terrestrial planets from Mercury to asteroids (the mini-planet Vesta) according to their orbital frequencies increase sizes of tectonic granules (Mercury $\pi R/16$, Venus $\pi R/6$, Earth $\pi R/4$, Mars $\pi R/2$, asteroids $\pi R/1$), relief range (=radius of tectonic granules, Fig. 1): 2-5 km, 14 km, 20 km, ~30 km, 25 km for Vesta's south depression!), densities of filling lowlands basalts (densities of highlands diminish), range of lowland/highland densities (Fig. 5-6). Dull appearance of Mercury contrasts with bright Mars and highly contrasting lithologies of asteroids (irons against carbonaceous chondrites), "black-&-white" areas on Vesta (Fig. 7). Thus, a predictive force of the wave planetology once more was confirmed with help of brilliant results of the MESSENGER and DAWN missions (Fig. 2-3).

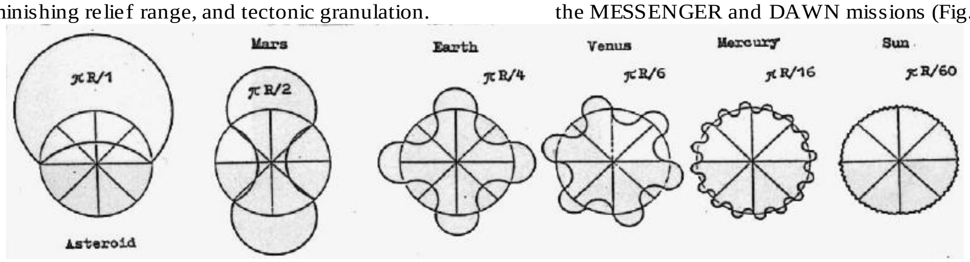
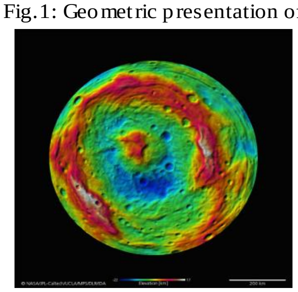


Fig.1: Geometric presentation of warping waves in the planetary system. All bodies are reduced to one size.



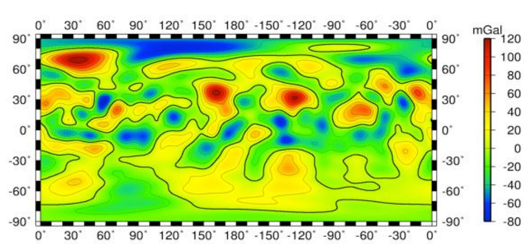


Fig. 2. PIA14711-Vesta, southern subsided hemisphere. Compare to the Pacific basin with protruding Hawaii
Fig. 3. Mercury's gravity (Mazarico et al, 2012). Granules ~500 km across ($\pi R/16$)

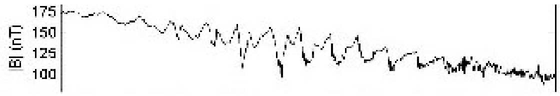


Fig. 4. MESSENGER magnetometer measurements on 15 May 2011 [11]. Undulations can be interpreted as reflecting tectonic granulation of Mercury (πR/16).

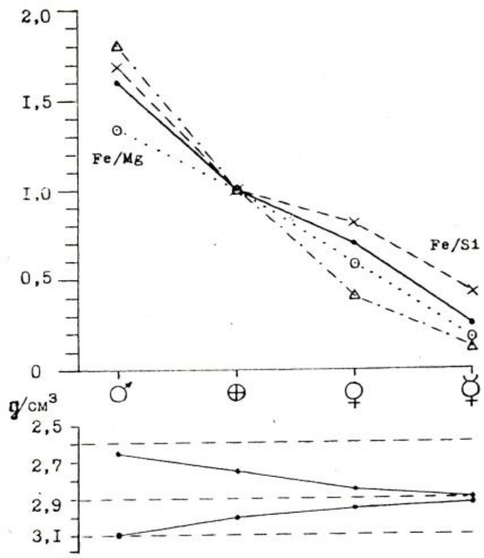


Fig. 5. Ratios of some planetary crust parameters compared to the terrestrial ones taken as 1:solid line – relief, dashed line – Fe/Si, dots – Fe/Mg in basalts of lowlands, dot-dashed line – highland/lowland density contrast. Below: increasing highland/lowland density contrast with increasing solar distance [4].

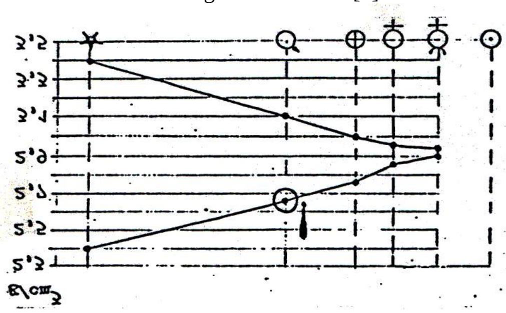


Fig. 6. Average densities contrast of planets' highlands and lowlands increasing with the solar distance [6].

[12] Zuber M.T. et al. (2011) Orbital observations of Mercury with the Mercury laser altimeter // EPSC-DPS Joint Meeting 2011 EPSC Abstracts, vol. 6, EPSC-DPS2011-278.

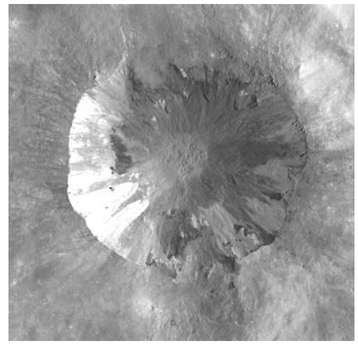


Fig. 7. "Black & White" sharp albedo contrast on Vesta' surface. Portions of DAWN images IOTD_63_full.jpg (crater diameter ~20 km)

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