EPSC Abstracts
Vol. 7 EPSC2012-42 2012
European Planetary Science Congress 2012

Regular structural and compositional characteristics of Mercury predicted by the wave planetology

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In 1995 based on available at that time data for terrestrial planets a chart was built connecting them in respect of their chemistry, relief, and tectonic pattern. Mercury before the MESSENGER era has supplied very limited data on these characteristics. Thus, the chart was based mainly on understood regularities of changing cosmic parameters and Mercury as the nearest to Sun planet was assigned in advance as a dull low albedo variations, low relief, tectonically fine grained and with high Mg/Fe in the crust. To justify and explain by a wave interference action its fine tectonic granulation (πR/16) a radar image of its silhouette was used [1] (Fig. 1). The MESSENGER data later confirm this conclusion providing preliminary results of magnetic and gravity surveys [2, 3] (Fig. 2). The radar experiment shown very low altitude variations (1-5 km), very smooth surface [4]. X-ray measurements shown very high Mg and low Fe abundances in the crust [5] that was quite a surprise to many planetary scientists but not for us, adherents of the wave planetology.

The wave planetology [6-7 & others] states that any celestial body moving in non-circular but elliptical keplerian orbit with periodically changing acceleration suffers from a warping action of the inertia-gravity waves. In rotating bodies they have four ortho-and diagonal interfering directions producing uplifted, subsided, and neutral tectonic blocks. Their sizes depend on the warping wavelengths. The longest fundamental wave1 produces antipodean segments-hemispheres (2πR-structure), its first overtone wave2 gives superposed tectonic sectors (πR-structure). On these already complicated pattern are superposed tectonic granules size of which is inversely proportional to orbital frequencies. Hence there is a regular row of tectonic granules sizes: Mercury πR/16, Venus πR/6, Earth πR/4, Mars πR/2, asteroids πR/1(coincidence with the tectonic dichotomy).Thus, the mercurian tectonic granule size about 500 km across was predicted and now observed by the MESSENGER measurements: magnetic field variations, gravity anomalies, topographic uplifts [2-4, 8].

As was shown earlier [9], there is a direct correlation between tectonic granule radii and relief ranges of terrestrial planets. The small relief range of Mercury (a few kms) corresponds with its fine tectonic granulation. Using petrography terms one may say that Mercury is "fine grained", Venus "medium grained", Earth "coarse grained", and Mars "pegmatoid". These tectonic structures of rotating terrestrial planets force them to build subsided blocks of denser material than uplifted ones to keep more or less equilibrated their angular momenta. Higher relief range more significant must be density difference between risen and fallen tectonic blocks. In the row of terrestrial planets their subsided "oceanic" areas become more Fe-rich (thus, denser) in direction from Mercury to Mars; their uplifted "highland" areas become more Si and alkalis-rich (thus, less dense) [10]. Mercury having the smallest tectonic granules and relief range has the smallest density difference between "up" and "down" blocks and Mg-rich magmatic lithologies in both [10, Fig. 3]. That is why Mercury has so dull appearance contrary to Mars with very high albedo difference between fallen north and risen south.

In full agreement with the above regularity is an important conclusion of [11] about a regular rising K/Th in crusts from Mercury to Mars. To this one could add our earlier observation on decreasing atmospheric masses in the same direction due to diminishing "wave shaking" – "sweeping out" volatiles from the solid bodies (the warping waves become larger and less frequent). Ratio of radiogenic to primordial argon in atmospheres regularly increases outwards: Venus 1, Earth 300, Mars 3000 [12]. Mercury shows very pronounced traces of very intensive degassing (numerous pits [13], contracting features). Surprising high sulfur content in X-ray measurements of Mercury should be considered as "tails" of intensive degassing left on surface as fumaroles deposits. Thus one might conclude that its atmosphere, now lost, due to very intensive degassing could have been rather significant.

One important structural peculiarity of rotating globular planetary bodies is their tendency to destroy tropical zones with the larger angular momentum to diminish it and to add some mass to extra-tropics to increase their angular momentum [14]. With this in mind one should interpret X-ray data showing some increase of Fe content in Mg-rich rocks of the higher latitudes of Mercury [15]. The additional Fe instead of Mg increases rock density. In conclusion one should say that Mercury is the regular continuation of the terrestrial planets wave row with predictable characteristics.

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Fig. 3. 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 [10].

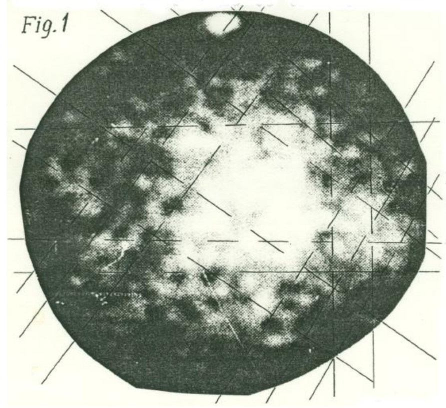

Fig. 1. Mercury is covered by dark or bright circles of similar sizes evenly distributed through its surface [1]. It seems that the circles are disposed along not random lines (aligned). This regularity is rather caused by a more regular process than random impacts.

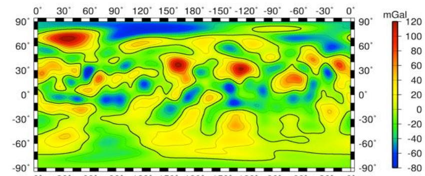

Fig. 2. Mercury's gravity [3]. Granules ~500 km across (πR/16)

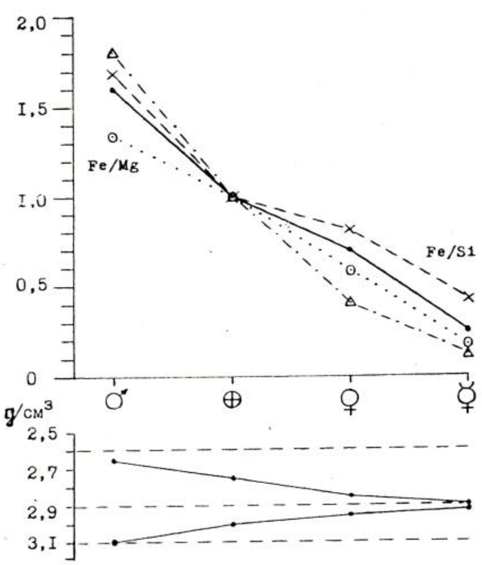

Fig. 3.