TECTONICAL AND CHEMICAL DICHOTOMY OF MARS AND EARTH: COMMON AND DISTINCTIVE FEATURES. G. G. Kochemasov, IGEM RAS, 35 Staromonetny, Moscow 119017, Russia, kochem@igem.ru

As planetary bodies both Mars and Earth share common features developed in all celestial bodies [1-3 & others] just because they all move in non-round (elliptical, parabolic) keplerian orbits and rotate. A fundamental statement: "Orbits make structures" could be unfolded in form of 4 theorems: 1. Celestial bodies are dichotomic; 2. Celestial bodies are sectoral; 3. Celestial bodies are granular; 4. Angular momenta of different level blocks tend to be equal [2]. All these tectonic features are a result of standing waves warping spheres of rotating celestial bodies in 4 directions. The fundamental wave1 (long 2πR, where R is a body radius) makes the ubiquitous tectonic (and, as a consequence, chemical) dichotomy. Overtones of the wave1 make smaller sectoral structures (most important wave2 warps spheres giving them features of a structural octahedron). Individual waves, inversely correlated with orbiting frequencies, make tectonic granulas. Hypsometrically (tectonically) different level blocks of a rotating body tend to keep their angular momenta compensating changing radius by changing density of composing blocks materials.

A principal difference between Earth and Mars, among others, is in their orbiting frequencies. 1/1 year for Earth makes granula size πR/4 (wave4), 1/2 years for Mars makes granula size πR/2 (wave2). 4 waves in the terrestrial great planetary circle produce 8 alternating highs and lows. 2 waves in the martian great circle produce 4 alternating highs and lows. 4 waves warp the terrestial sphere more or less evenly, 2 waves warp the martian sphere inevitably in such a manner that it is extended in one direction and squeezed in the perpendicular one (Fig.4). That is why Earth could be compared with a watermelon and Mars with a melon. This wave shaping immediately tells on the planetary relief range. On Earth it is about 20 km, on Mars ~30 km (or 56 km brought to the Earth's diameter). The dichotomy relief (an average between the northern lowlands and southern highlands) is about 6 km. The Earth's dichotomy relief is not so sharp.

The fourth theorem is satisfied at Earth by an average density range between lowlands (the western Pacific hemisphere) and highlands (the eastern continental hemisphere) about 0.25 g/cm^3 , that is the difference between densities of oceanic tholeiites and continental andesites (an average composition of continents). No doubt, at Mars this density range must be higher, say, 0.45 g/cm^3 [4]. Martian lowlands composed of Fe-basalts are denser than the Earth's oceanic lowlands (tholeiites). Consistently, the martian highlands must be less dense than the Earth's continents, this means less dense than andesites. In [4, 5, 6] before the "Pathfinder"mission we have proposed contasting rocks at the martian lowland/highland contact, mentioning albitites, syenites, granites as highland lithologies. "Pathfinder" found at the contact andesites. We interpreted them as contact rocks (compare to the circumpacific andesite belt at Earth) and insisted at lighter (less dense) rocks inside the highlands.

Albedo and gravity (MGS) data and gamma-spectrometry (Odyssey) do not contradict to these not dense light alkaline and acid rocks. But *in situ* study of highland rocks is possible only now. "Opportunity" on Meridiani Terra and "Spirit" at Gusev crater indeed discovered light layered rocks. But rinds of salts (sulphates, chlorides, bromides) and eolian Fe-rich sediments (hematite) cover outcrops and separate blocks causing difficulties to analysers trying reach fresh rocks. It seams that drilling to depths about 5-10 mm is not always enough to get desirable rocks. Nevertheless, partially published in Internet results indicate at silicate rocks rich in Al (high Mg and Fe can be partially explained by surface rinds), containing Na, K, Ca, Ti. Al/Ca steadily increases from lowland basalts ("Viking" data) to highland rocks. Mg/Fe does the same. On the whole, one might think about sharp transition of Fe-rich lowlands to Al, Mg, alkali-rich highlands. Some flood-basalts can be found on highlands but these basalts are Mg-rich in contrast to Fe-rich dense basalts of lowlands (The same situation but not so sharp with flood-basalts at Earth: Mg/Fe in them increases from oceans to continents, that means their density diminishes in this direction).

In [7, 8] we paid attention to high chlorine in martian rocks and soils (0.3-0.6%) attributing this to alkaline rocks (at Earth, normally, these rocks are the highest in Cl among magmatic rocks). Accumulation of Cl means the utmost magmatic fractionation. Namely, this kind of fractionation is expected wide-spread at Mars. At Earth there are only a few examples of such advanced fractionation. The best example is probably the Lovozero alkaline ring complex at Kola peninsula. Perfectly thinly layered ring complex of nepheline syenites occupies an area of 650 km^2 . Alkaline pyroxene-rich rocks alternate with nepheline-rich ones. There are many Ti, Nb, Zr –minerals. In some rocks sodalite prevail over nepheline and Cl content in rocks can reach upto 2.5% (tavite). On an average the Lovozero massif contains 0.2% Cl.

Feldspathoids (nepheline, sodalite) are often replaced by zeolites (hydrothermal alteration and weathering). These water-containing minerals are very wide-spread at Earth and probably at Mars. In [9] we proposed that zeolites can be water-sinks and suggested that the martian near-equatorial anomalous hydrogen can be related to zeolites (water-containing salts are already discovered by two landers).

So, “dull” entirely basaltic Mars does not exist any more. But only a few years ago the majority of planetologists believed in it! The comparative wave planetology from the beginning [4] insisted at highly fractionated Mars. It means that the regular wave planetology having the predictive power really exists and adequately reflects natural processes.

Fig.1 shows similar wave produced tectonic dichotomies of Mars (N-S) and Earth (E-W);similarities are in shape of subsiding segments and their relative areas (~1/3 of the globes surfaces). Fig.2 shows dichotomy of Mars and the wave produced antipodality of remarkable martian tectonic features: “lows” on highlands and “highs” on lowlands being parts of tectonic sectors. Fig.3 shows haw tectonic sectors look in nature. Fig.4 explains successes and failures of martian landers: the overall score is fifty/fifty.

References: **[1]** Kochemasov G.G. (1998) Proceedings of international symposium on new concepts in global tectonics (’98 TSUKUBA), Tsukuba, Japan, Nov. 1998, 144-147; **[2]** Ibid. (1999) Geophys. Res. Abstr., v. 1, # 3, 700; **[3]** Ibid. (1999) The 30th microsymposium on comparative planetology, Abstr., Moscow, Vernadsky Inst., 47-48; **[4]** Ibid. (1995) Golombek M.P., Edgett K.S., Rice J.W. Jr. (eds) Mars Pathfinder landing site workshop II: Characteristics of the Ares Vallis region and Field trips to the Channeled Scabland, Washington. LPI Tech. Rpt. 95-01, Pt. 1, LPI, Houston, 1995, 63 pp. (p. 18-19); **[5]** Ibid. (1997) Annales Geophysicae, Suppl. III to Vol. 15, Pt. III, 767; **[6]** Ibid. (1998) Annales Geophysicae, Suppl. III to Vol. 16, Pt. III, C1027; **[7]** Ibid. (2001) In: Eleventh Annual V.M. Goldschmidt Conference, Abstr. # 3070, LPI, Houston, CD-ROM; **[8]** Ibid. (2001) In: Field Trip and Workshop on the Martian Highlands and Mojave Desert Analogs, 20-27 Oct. 2001, Las Vegas, Nevada and Barstow, California, LPI Contrib. #1101, LPI, Houston, 35-36; **[9]** Ibid. (2002) 36th Vernadsky-Brown microsymposium “Topics in comparative planetology”, Abstr., Oct. 14-16 2002, Vernadsky Inst., Moscow, Russia, CD-ROM; **[10]** Zuber M.T., Solomon S.C., Phillips R.J., Smith D.E. et al. (2000) Science, v. 287, # 5459, 1788-1793.

Fig.1 Similar formation of Mars’ and Earth’s tectonic dichotomy: a model of wave interference. **A** –Vastitas Borealis of Mars. Crustal thickness inside the contour is less than 50 km [10] (as viewed from inside the globe what makes the contour mirrored). **B** –Pacific basin. **C** – Flat geometric model of wave interference (4 wave directions). One needs mentally to wrap up it around the globe. **Fig.2** Martian hemispheres with the dichotomy boundary. Antipodality of Hellas (1) to Alba patera and Tempe terra (2) and Argyre (3) to Elysium planum with Phlegra montes (4). **Fig.3** Mars’ sectoral structure. Hubble Space Telescope image on 26.8.2003, eleven hours before the closest approach of Mars to Earth (Image courtesy of NASA, J. Bell & M. Wolff. ESA Bulletin # 115, Aug. 2003, cover). **Fig.4** A scheme of successful (Spirit, Opportunity) and failed (Beagle2) landings on the martian surface through heterogeneous atmosphere produced by wave processes (wave2 structure).