Moon-Earth: global basaltic effusions, their different ages, common chemical trends (alkalinity, iron content)

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Global basaltic covers are very characteristic phenomena in the inner solar system. Basaltic effusions of different ages and compositions originated in asthenospheric layers of the planetary mantles. To heat and melt some parts of the mantle, a part of enormous mechanical energy of orbiting cosmic bodies was transferred to the heat energy.

"Orbits make structures" – a main point of the new wave planetology based on one important property of the Keplerian elliptical planetary orbits [2, 3] . The ellipticity implies periodical changes of accelerations and, thus, orbital forces structuring cosmic bodies. The Earth and the Moon sharing the same circumsolar orbit have similar main structural features. Among them there are terrestrial Oceans and lunar Basins. The most obvious are two tectonic triads: Pacific Ocean – Malay Archipelago – Indian Ocean on Earth and Procellarum Basin – Mare Orientale – SPA Basin on the Moon. The planetary depressions of both bodies are covered with basalts, but basaltic effusions are drastically different in age: the AR on Moon and Mz-Cz on Earth. These ages well correlate with the bodies masses. The more massive and inert Earth has heated and melted mantle much later (The Newton's law of inertia). Energy of movement transfers to the heat energy.

The both cosmic bodies, as well as the rest of them, are tectonically dichotomous. Their subsided hemispheres, for keeping angular momentum of hemispheres equal, are filled with dense basaltic material. But times of the fillings are significantly different.

The Earth-Moon system expands with time, that is increases its angular momentum. A natural response to it is in slowing down rotation of both bodies diminishing their angular momentum (action - opposite action). Diminishing momenta are compensated by melting and uplifting to surfaces dense basaltic material. But on the Moon it happened much earlier (4.5-3 billion years ago) because of diminished inertia of the small mass satellite. At much larger and massive with large inertia Earth this process was significantly "delayed" in time.(Mz-Cz). Earth is 81 times more massive than Moon. (3-4.5 billions) : 81 = 37-55 million years. According to this calculation, a "peak" of the basaltic reaction of Earth, filling in by basalts the oceanic depressions is in the boundary of Mesozoic and Cenozoic [3]].

Despite of enormous age differences between lunar and terrestrial basaltic covers (billions of years!) some common chemical shift of their compositions is notable and significant. Let us compare Procellarum Basin and Pacific Ocean basalts. The oldest parts of their covers occur mainly in the West of Procellarum (KREEP) and SW of the Pacific (Ontong Java Plateau – the largest LIP of Earth). Potassium, phosphorus, rare earths, thorium enrich the older lunar KREEP basalts. The older terrestrial oceanic Ontong Java basalts (Cretaceous age-about 122 mln. y) also show "KREEP trend". They belong to E-MORBs and have elevated values of potassium, lithium, chlorine, REE, thorium. Elevated Fe/Mg (and siderofile platinum group elements) also is in Ontong Java basalts [1]. All these chemical peculiarities distinguish them from the younger N-MORBs of other parts of the Pacific Ocean (EPR, for example). As all considered basalt melts of both bodies originate in asthenopheres, the older parts of these melts derive from relatively earlier "cool" asthenosphere. It means that only easily melted alkali and iron rich parts were involved in the process. Later on, significantly heated asthenospheres produced enormous volumes of chemically different (less alkaline and more magnesian) basalts. In this sense, rather impressive is a comparison of the lunar iron and thorium geochemical maps stressing coincidence of their anomalies in the Procellarum KREEP terrain area (Fig. 1, 2).

The considered time development of basaltic magmatism could be paralleled with the development of alkaline terrestrial magmatism. Its earlier older parts often are more alkaline than later Cenozoic parts. Famous large agpaitic massifs are mainly Proterozoic-Paleozoic in age. Again, early "cold" asthenosphere produces more easily melted relatively small alkaline parts than the later "hot" asthenosphere making large volumes of deeply melted more magnesian less alkaline ones.

References:

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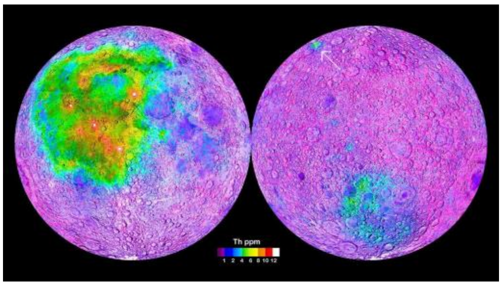

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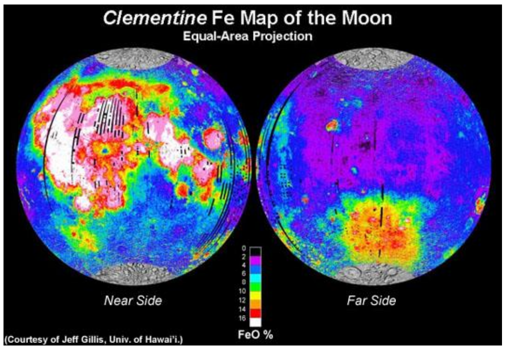

2