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Similarities and Distinctions of Terrestrial Oceanic and Lunar Mare Magmatism: Evidence from Geochemical Data

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Maria with dark basaltic floors form large rounded depressions of the lunar relief. They appeared at the middle stage of the Moon's evolution and evolved from 3.9 until 3.2 Ga ago (Snyder et al.,1994). It is assumed that origin of maria was related to catastrophic impact events (Spudis,1996). However, despite of their relatively small size, maria on their structure and basaltic rocks composition resemble the Earth's oceanic segments or continental flood basalt (CFB) provinces, are which often defined as the first stages of oceanic opening. Like on the Earth, two types of basalts are typical for the maria: low-Ti and high-Ti varieties, which could be correlated with the mid-oceanic ridge basalts (MORB) and oceanic island Fe-Ti basalts (OIB) respectively. Such type of tectonic-magmatic activity began to develop on the Earth only from c.2 Ga ago, on the continental-oceanic stage of its evolution, and have existed up till now (Bogatikov et al., 2000). It is considered that its origin have been linked with ascending of the mantle plumes, generated on the core-mantle boundary(CMB). Specific feature of these plumes is a presence of fluids enriched in Fe, Ti, alkalis, P, Ba, Zr, LREE, etc. Concentration of such fluids is the lowest in the MORB and the highest in the OIB (and other within-plate Fe-Ti basalts and picrites). Using our database on the terrestrial oceanic magmatism and lunar mare magmatism, we defined that there are close tendencies in the major and rare earth elements distribution in the low-Ti and high-Ti varieties of basalts from both planetary bodies. The main differences are higher TiO_2 (up to 15 wt% in the high-Ti mare basalts), FeO and MgO, lower SiO_2, Al_2O_3 and CaO, essential lower alkalis (Na_2O+K_2O) content (from 0.2 to 0.8 wt%) and practically absence of H_2O in the lunar samples. Instead of the terrestrial basalts and picrites, mineral phases, formed under reducing conditions, play essential role in the both high-Ti and low-Ti mare basalts. The main gas phase in them was, probably, CO (Spudis, 1996) different from the terrestrial plume-related magmas where CO_2 predominates. By analogy to the Earth, we suggest that petrogenesis of the mare basalts could also be linked with plumes which were ascended from the lunar CMB of that time. Instead of the Earth, the lunar liquid metallic core did not survive till today, however, judging from paleomagnetic data (Rancorn, 1983),it could exist during all period of the maria activity. The main difference in fluid components of the lunar plumes from the Earth's analogues were higher Ti and Fe contents, significant lower alkalies and absence of H_2O. Beneath the lunar maria the lunar crust becomes essentially thinner and excess of masses (mascons) occur. We suggest that the mascons are solidified mantle-plume heads which are close to the terrestrial large lens-like bodies of anomalous mantle beneath mid-oceanic ridges and the present-day CFB provinces. So, there are essential similarities in geology, structure and composition of rocks both of the lunar maria and terrestrial oceans, and, particularly, CFB provinces; that probably means that they had similar origin, linked with the mantle-plume activity. It is important that such type of activity appeared both on the Earth and on the Moon only during the middle stages of their evolution, after a period, when in the both cases only magnesian suites predominated. From this follows that the development of both planetary bodies was governed by the same regularities.

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