Mantle-Plume Activity on the Moon: Evidence for Lunar Maria

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Maria with mafic basaltic floors are the second major type of morphostructures of the Moon, which evolved on the late stages of its evolution from 3.8 till 3.2 Ga ago (Snyder et al., 1994). They form large rounded depressions of the lunar relief. On their structure and on basaltic rocks composition they resemble the Earth's oceanic segments or trap (continental flood basalt, CFB) provinces. Such type of the terrestrial structures began to evolve on the Earth only from c.2 Ga ago, on the oceanic-continental stage of its evolution, which are active till nowadays (Bogatikov et al., 2000). It suggests that origin of such type of activity on the Earth is linked with superplumes ascending. Traps appearance often preceded to oceans opening and in this sense they could be defined as the first stage of the oceans development.

Like on the Earth, two types of basalts are typical for the lunar maria: low-Ti and high-Ti, which could be correlated with the mid-oceanic ridge basalts (MORB) and oceanic island (OIB) Fe-Ti basalts consequently. This type of tectonic-magmatic activity survived till now on the Earth; its petrogenesis associated with ascending of the mantle plumes which are generated on the core-mantle boundary (CMB), in the layer D''. For the plumes it is characteristic a presence of specific fluid components, enriched in Fe, Ti, alkalies, Ð, Âà, Zr, LÐÇÝ, etc. Concentration of the fluid components is low in MORB and the highest in the within-plate Fe-Ti basalts.

By analogy to the Earth, we suggest that petrogenesis of the mare basalts could be also linked with plume activity, which were ascended from the lunar CMB of that time. Instead of the Earth, the lunar outer (liquid) core did not survived till nowadays, but had to be active during the maria formation. The main difference in fluid components of these plumes from the Earth's analogues were practical absence of H_2O in them: its indicate a mineral composition of the mare basalts, where important role play mineral phases formed under reduce conditions.

Beneath the lunar maria excess of masses (mascons) occurs and the lunar crust becomes thinner above them.. Probably, the mascons are solidified mantle-plume head, which are known on the Earth as large lens-like bodies of anomalous mantle beneath mid-oceanic ridges and the present-day CFB provinces.

So, there are essential similarity in structure and composition of rocks both of the lunar maria and terrestrial oceans and, particularly, trap provinces; that is, probably, means that they have similar origin, linked with the mantle-plume activity

References:

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