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The Late Cenozoic global activation of tectonomagmatic processes as a result of physico-chemical processes in the solidifying Earth's core?

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Most researchers believe that large igneous provinces (LIPs) are formed by adiabatic melting of heads of ascending mantle plumes. Because the LIPs have existed throughout the geological history of the Earth (Ernst, 2014), their rocks can be used to probe the plume composition and to decipher the evolution of deep-seated processes in the Earth's interior.

The early stages of the LIPs evolution are discussed by the example of the eastern Fennoscandian Shield, where three major LIP types successively changed each other during the early Precambrian: (1) Archean LIP composed mainly of komatiite-basaltic series, (2) Early Paleoproterozoic LIP made up mainly of siliceous high-Mg series, and (3) Mid-Paleoproterozoic LIP composed of picrites and basalts similar to the Phanerozoic LIPs (Sharkov, Bogina, 2009). The two former types of LIPs derived from high-Mg depleted ultramafic material practically were extinct after the Mid-Paleoproterozoic, whereas the third type is survived till now without essential change. The magmas of this LIP sharply differed in composition. Like in Phanerozoic LIPs, they were close to E-MORB and OIB and characterized by the elevated and high contents of Fe, Ti, P, alkalis, LREE, and other incompatible elements (Zr, Ba, Nb, Ta, etc.), which are typical of geochemically enriched plume sources.

According to modern paradigm (Maruyama, 1994; Dobretsov, 2010; French, Romanowicz, 2015, etc.), formation of such LIPs is related to the ascending thermochemical mantle plumes, generated at the mantle-liquid core boundary due to the percolation of the core's fluids into overlying mantle. Thus, these plumes contain two types of material, which provide two-stage melting of the plume's heads: adiabatic and fluid-assisted incongruent melting of peridotites of upper cooled margins (Sharkov et al., 2017).

These data indicate that the modern setting in the Earth's interior has existed since the Mid Paleoproterozoic (~2.3 Ga) and was sharply different at the early stages of the Earth's evolution. What was happened in the Mid Paleoproterozoic? Why thermochemical plumes appeared only at the middle stages of the Earth's evolution? It is not clear yet. We suggest that this could be caused by the involvement of primordial core material in the terrestrial tectonomagmatic processes. This core survived from the Earth's heterogeneous accretion owing to its gradual centripetal warming accompanied by cooling of outer shells (Sharkov, Bogatikov, 2010).

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