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Tectonomagmatic evolution of the Earth: from the primordial crust to Phanerozoic type of activit

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There are two dominating hypotheses about composition of the primordial Earth's crust now: basic or sialic. Both models require a global melting of primary chondritic material, and final result would depend on degree of melt differentiation during hardening of global magma ocean some hundreds km deep. Such solidification, due to difference in adiabatic and melting point gradients proceeded in bottom-top direction and resulted in accumulation of low-temperature derivates in outer shell of the planet. Geological data, namely granite-dominated Archean crust, composed mainly by tonalite-trondhjemite-granodiorite (TTG) rocks, and Hadean detrital zircons from Australia with U-Pb age 4.4-4.2 Ga supports the primordial-sialic crust hypothesis. Formation of the sialic crust was responsible for the depletion of the upper mantle matter.

Tectonomagmatic activity in the Early Precambrian was rather different from the Phanerozoic. Granite-greenstone terranes (GGTs) and their separating granulite belts were major Archean tectonic structures. The GGTs consisting of irregular network of greenstone belts with high-Mg komatiite-basaltic and boninite-like magmatism, "submerged" in TTG granite-gneiss matrix, probably, strongly reworked primordial sialic crust. They were areas of extension, uplifting and denudation, whereas the granulite belts were dominated by compression, sinking and sedimentation.

By the Proterozoic the crust became rigid resulting in formation of rift structures, huge dike swarms and large mafic-ultramafic layered intrusions. In early Paleoroterozoic character of the tectonomagmatic activity remained almost the same: cratons, separated by granulite belts, appeared on the place of GGTs. Magmatism was dominated by siliceous high-Mg (boninite-like) series (SHMS), which formed large igneous provinces. SHMS are close in composition to the Phanerozoic subduction-related magmas; however, instead of them, SHMS had intracontinental tectonic settings. Negative Nd in these rocks suggests an important assimilation of the Archean lower-crustal rocks. We assume that origin of the SHMS magmas was linked with floating up of magma chambers of high-temperature mantle-derived ultramafic melts through the crust according to zone refinement principle, i.e. by melting of roof accompanied by crystallization at bottom.

It suggests that the Early Precambrian tectonomagmatic activity was linked with ascending of the first generation mantle superplumes, composed by depleted ultramafic material

Cardinal change of tectonomagmatic processes occurred in the period of 2.35 to 2.0 Ga, which was characterized by voluminous eruption of Fe-Ti picrites and basalts similar to the Phanerozoic within-plate magmas, derived from geochemical-enriched mantle source. Simultaneously, important compositional changes occurred in the atmosphere, hydrosphere and biosphere (Melezhik et al., 2005). The first Phanerozoic-type orogens (Svecofennian of the Baltic Shield, Trans-Hudson and others of the Canadian Shield, etc.) appeared ca. 2 Ga. Since then, subduction of the ancient sialic continental crust (together with newly-formed oceanic crust) is a permanent process and the crustal material has stored in the "slab graveyard", revealed in the mantle by seismic tomography.

We believe that the ascending of the second generation mantle plumes (thermochemical), enriched in Fe, Ti, P, LREE, etc., was responsible for those changes. Those plumes were generated at the core-mantle boundary and this process is active so far. The thermochemical plume matter possessed less density and could reach shallower depths; triggering plate tectonics processes.

So, previously absent geochemical-enriched material started to involve from $\sim$2.3 Ga in the Earth's tectonomagmatic processes. Where such material was "conserved" and how it was activated? The established succession of events could be provided by a combination of two independent factors: (1) the Earth originally was heterogeneous, and (2) the downward heating of the Earth (from the surface to the core) was followed by the cooling of its

outer shells. The most evidently cause of the centripetal heating of the Earth was a zone/wave of heat-generating deformation, appeared after it’s accretion completion, which moved inside the planet.