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Major geological catastrophe in the history of the Earth: evidence from evolution of tectonomagmatic processes in the Paleoproterozoic

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The study of the Fennoscandian Shield in combination with available data on all other Precambrian shields points to the Earth's largest geological catastrophe, which occurred at 2.0-2.2 Ga ago and caused a change from Archean-type plume-dominated tectonics to a modern plate tectonics. This change within Paleoproterozoic led to the opening of first oceans at about 2.0 Ga, posterior orogenesis, and cratonization of the Earth's crust. Subsequent evolution of the Earth followed the plate tectonic scenario. Obtained data indicate that the Paleoproterozoic history can be subdivided into four stages. The first stage (2.5-2.3 Ga) represented the gradual cessation of Archean tectonomagmatic processes within stabilized upper crust. The main tectonic structures of that time were stable cratons separated by granulite belts with intervening zones of gently sloping tectonic flow of the crustal material (Belomorian and Tersk-Lotta belts). The cratons were formed as the areas of extension and upwrapping above the upwelling heads of mantle superplumes with the predominance of mantle magmatism of siliceous high-Mg (boninite-like) series (SHMS). The granulite belts were the zones of downwrapping and accumulation of sediments above descending mantle flows. During the second stage (2.3-2.05 Ga), the magmatic activity of previous stage was replaced by the appearance of geochemcial enriched Fe-Ti picrites and basalts typical of the Phanerozoic within-plate magmatism, whereas tectonic style was inherited from the previous stage. Only third stage (2.0-1.8 Ga) marked the cardinal tectonic and structural rearrangement (catastrophe on a geological time scale), as is indicated by the development of plate-tectonic processes, including opening of the Svecofennian ocean and subsequent orogenesis with formation of typical ophiolites, island arc complexes, back-arc seas, batholiths, collision zones, and other tectonic structures with

corresponding magmatism. The fourth stage (1.8-1.5 Ga) began after stabilization of the orogens and was expressed in the formation of giant intracontinental mainly magmatic silicic belts, including large anorthosite-rapakivi granite complex. These belts were formed owing to the within-plate activity on the places of orogens with anomalously thick crust.

It was shown that the similar global crucial point in the evolution of tectonomagmatic processes presumably occurred on the Moon about 3.9 Ga, when the prevailing magnesian suite (analogues of the Earth's Paleoproterozoic SHMS) were replaced by the formation of large depressions of mares with intense basaltic volcanism dominated by low-Ti basalts and less abundant high-Ti rocks resembling the Earth's within-plate volcanic rocks. From this It follows that such tendencies could also occur at other solid planetary bodies.

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