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# D" layer and primordial noble gases in the lower mantle derivatives as evidence of the Earth solid protocore?

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This work is based on the results of identifying primitive mantle (PM) material among mantle xenoliths [1]. This material demonstrates U and Th deficiency in silicate geosphere, as compared to their concentration which must have arisen after the formation of the core that is sterile as to these elements. Keeping the balance during the PM formation these deficient elements must be concentrated in a liquid core, which is complementary to the PM. The estimation of U and Th concentration in the core against their deficiency in the PM results in the values of 30 - 70 ppb, which are sufficient for energy activity to be attributed to the core and equal to 7TW. Moreover, according to the experimental estimation of potassium solubility in the liquid core (about 250 ppm) [2], approximately 20% of the total heat produced in the core may be generated by $^{40}$K decay. So, the hypothesis of radioactive sources of the core energy activity looks quite realistic. Such view on the nature of the core energy activity entails a new approach to explaining D" layer origin and the presence of primordial noble gases in the lower mantle derivatives.

According to the new concept, D" layer is a result of undegassed material disintegration in the inner part of the Earth interior. It could be the material of the Earth protocore or undifferentiated protoplanetary material which was located on the place similar to that of the modern solid core. Its disintegration occurred due to interaction with the liquid core after degassing of the main part of silicate geosphere. In case of protocore version this protocore is now completely or partly destroyed. Moreover, it can be covered by products of the outer core crystallization (then it can demonstrate the heterogeneity similar to that observed for inner core [3]) or can be entirely substituted by them. In case of protoplanetary material disintegration, D” layer consists of silicate remnants of this material.

A model is offered now according to which the Earth accretion began on a solid protocore. This protocore consisted of a mixture of metal iron and a small amount of material similar to carbon chondrites. Subsequently, the liquid outer core was formed due to partial melting of material, which was accreted on the protocore. At the same time U, Th and K from this material were partly extracted by the liquid core. The energy from these elements’ radioactive decay not only kept the external core in the liquid state but also in some time activated the internal protocore disintegration. As a result of such disintegration, the silicate component of the protocore floated to the core-mantle boundary and formed D" layer. The silicate component composition is similar to the PM one, but principal difference between them is that the silicate component of D" layer has to contain volatiles (including primordial noble gases) connected with the silicate and carbon material of the protocore. Besides such cumulate-like silicate component, D" layer must also contain some quantity of dense intercumulus liquid of the external core. Its amount decreases toward the top of D" layer because silicate particles floating in this liquid are packed. Due to volatiles presence, partial melting of silicate material in D" layer begins, and blocks of less dense and more plastic material appear. These blocks form diapirs and can trigger “plum” streams. Formed and detached diapirs are responsible for D” layer’ upper boundary being uneven.

Thus, it is possible to meet the constraints formulated by Tolstikhin and Hoffman [4]. The existence of two reservoirs of the mantle material with noble gases of a different isotope composition, the solution of xenon paradox and the explanation of D" layer origin don’t necessarily require assuming subduction of the most ancient crust (together with regolith on it) down to the core-mantle boundary and the crust preserving there during over 4 billion years, as these authors suppose. The model presented puts the idea of the liquid core interaction with the solid protocore preserving primordial noble gases, and is in the agreement with all this constraints.

This idea logically follows from the hypothesis of the core power activity caused by U, Th and K radioactive decay. If, indeed, the energy of these elements’ decay is capable of maintaining the liquid state of the core, why should it not activate the interaction between the liquid core and the solid protocore containing primordial rare gases? Theoretically, the idea of the Earth solid protocore relics has been suggested. Thus, in 1989 D.Anderson supposed that "in the inhomogeneous accretion model the early condensates, calcium-aluminum-rich silicates, heavy refractory metals, and iron accreted to form the protocore". Moreover it was suggested that "the present solid inner core could be remnant solid iron (or iron-nickel) from the segregation event" [5, p.72].

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**References**

1. Pushkarev Y.D., Nikitina L.P. U and Th deficit in primitive mantle xenoliths and the nature of core power activity, Geochimica et Cosmochimica Acta, 2007, 71, N15, p. A814.

2. Gessmann C.K., Wood B.J. Potassium in the Earth's core, Earth and Planetary Science Letters, 2002, 200, 1-2, p.63-78.

3. Ishii, M. & Dziewo ski, A. M. The innermost inner core of the earth: Evidence for a change in anisotropic behavior at the radius of about 300 km, Proc. Natl. Acad. Sci. USA, 2002, 99, 14026-14030.

4. Tolstikhin I., Hofmann A.W. Early crust on top of the Earth's core, Physics of the Earth and Planetary Interiors, 2005, 148, 109-130.

5. Anderson, Don L. Theory of the Earth, Boston: Blackwell Scientific Publications, 1989, 361 p.