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The Earth core evolution as a result of protocore erosion

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The hypothesis is offered according to which the Earth's core evolution and geodynamo are conditioned by thermal erodion of solid protocore that is the most ancient relict in the Earth interiors [1, 2]. This hypothesis can be developed if the core heating generated by any source of energy is enough for compensation of its heat losses. In this case liquid core could not be crystallized and the inner solid core should be considered the remnant of protocore. Following the known idea radioactive decay of U and Th extracted by the liquid core during its formation could be such source of energy [4-6]. The initial mass of the protocore estimated on the basis of the whole Earth iron excess in as compared to chondrite iron content, corresponds to about half mass of the modern core. Thus, the modern inner core is near 10% remnant of this protocore. The protocore consists of Fe, Ni and small amount of lighter component identical to silicate material of chondrites that contains primordial noble gases. Maximal weight content of such light component in the modern inner core is about 7% as it is assessed by comparison of the inner core density with the density of pure iron. The liquid core melts the protocore. The protocore erosion releases light component which floats up to the core-mantle boundary where it forms D" layer. Thus, the protocore is the hidden reservoir containing the primordial noble gases. This allows to explain the xenon isotopic paradox probably in more realistic way than it was done by I.Tolstikhin and A.Hofmann [3]. The light component floating up initiates compositional convection which requires some energy on the early evolution stage. Firstly this energy is provided by the liquid core segregation. Through some time the energy which is needed in order to support the convection connected with protocore erosion progressively decreases. The convection stops to consume energy at certain time depending on distribution of the protocore's light component. Later on the convection increases energy supporting the geodynamo. Besides the model offered conforms to the estimations of Archaean rocks remnant magnetization contradicting the hypothesis of late beginning of the inner core crystallization. Our model is also in agreement with megacyclic changes of geodynamic activity and corresponding to it irregular thermal-mass-transfer in core-mantle system.
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References

1. Pushkarev Yu.D. D" layer and primordial noble gases in the lower mantle derivatives as evidence of the Earth solid protocore? Geophysical Research Abstracts, 2008, 10, EGU2008-A-05729.
2. Pushkarev Yu.D. D" layer as a result of the Earth protocore disintegration and as a source of primordial noble gases? Geochimica et Cosmochimica Acta, 2008, 72, 12s, p. A767.
3. Tolstikhin I., Hofmann A.W. Early crust on top of the Earth's core, Physics of the Earth and Planetary Interiors. 2005, 148, p.109–130.
4. Furst M. J., Stapanian M.I., Burnett D.S. Observation of non-lithophile behavior for U, Jeophys. Res. Lett., 1982, 9, p. 41-44.
5. Malavergne V., Tarrida M,. Combes R., Bureau H. Uranium and lead in the early planetary core formation: new insights given by high pressure and temperature experiments, Lunar and Planet. Sci. 2005, XXXVI, p. 1823.
6. Bao X., Secco R.A., Gagnon J.E., Fryer B.J. U Solubility in Fe and Fe-10wt% S: Implications for Radioactive Heating in Planetary Cores, American Geophysical Union, Fall Meeting, 2005, Abstract MR21A-07