Geophysical Research Abstracts
Vol. 19, EGU2017-3143, 2017
EGU General Assembly 2017

Viscous dissipation of energy at the stage of accumulation of the Earth

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In the papers [1,2] it is published the differentiation model of the proto planet cloud during the accumulation of the Earth's group planets. In [2] it was shown that the energy released during the decay of short-lived radioactive elements in the small size more than 50 km, it is enough that the temperature inside of the protoplanet becomes larger than the temperature of iron melting. It provides a realization of the matter differentiation process and convection development inside the inner envelopes. With increasing of the Earth, the forming region of the outer core remains in a molten state, although the power and viscosity of the layer changed. In [3] it is shown that during the sequence of growth changes of accumulated protoplanets, the main contribution of heat is provided first by radioactive sources, and then heated from above by converting the kinetic energy during the growing impact inside the Earth, and finally heated from below. That provides three types of driving mechanisms of convection: internal heat sources; heated top; heated from bottom and chemical-thermal convection. At all stages of proto Earth's development the convective heat-mass transfer becomes a most significant factor in the dynamics of the planet. However, the heat release due to friction in the viscous liquid of the outer core up to now was not still considered, or it was considered only for the formed planetary envelopes with a constant radius.
In this paper we present the first results of thermal evolution numerical modeling of 3D spherical segment for a protoplanet with increasing radius and accounting random falling of bodies and particles. To describe the planetary accumulation Safronov equation is used [4]. For the quantitative account of the released heat by viscous friction a system of hydro dynamic equations for a viscous liquid is used. The obtained results show that the heat input due to viscous friction heat release at the early stage of planetary accumulation was very significant. That influence is defined by a set of factors. It was changed the width of the formed outer core. It was changed the distribution of the temperature and hydrostatic pressure inside the core and reciprocally the viscosity of the matter. It had been changed the orbit parameters of the system Earth-Moon. The received results depend from the parameters, the values of which are known with large degree of uncertainty. They have to be specified during next researchers.

This work was supported by grant RFBRI №16-05-00540
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