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About the temperature, pressure and viscosity distributions in the Earth's mantle on it's accumulation.

Yurie Khachay (1) and Vsevolod Anfilogov (2)

(1) Institute of Geophysics, Ural's Department of RAS, Yekaterinburg, Russian Federation (Yu-Khachay@yandex.ru, +73432678872), (2) Institute of mineralogy, Ural's Department of RAS, Miass, Russian Federation.

Geological Earths evolution significantly depends from its initial origin. In the paper [1] we suggested a new accumulation model of planets of terrestrial group, which use the modern estimations of concentration of short-living natural radioactive isotopes in the matter of the proto planet cloud. It had been qualitative new estimations of temperature distributions in the growing pre planets in the Earth "feed" zone. For the velocity of proto planet mass increasing we use the model of Safronov. The temperature distribution in the body with the increasing radius is obtained numerically using the solution of the boundary problem for the equation of thermal conductivity with account a possibility of melt occurring without explicit marking of the boundary of crystallization front and parametrical account of convective heat transfer in the melt [2]. It is shown, that in proto planet bodies with dimensions about 100km in the main part of the inner area the temperatures achieve higher that the iron melting temperature. On that stage the relative bodies impact velocities are sufficient for crashing the upper brittle envelope and support the coupling of the inner melted parts. The mass of the growing proto planet is not sufficient to merge the mainly silicate envelope fragments. So on the stage of bodies coupling with radiuses (100-500) km it could occur the effective separation of the W-Hf system between the melted iron and cold silicate reservoirs during the period, which satisfy the experimental data a period equal to or less 10 million years. In that model on the growing stage of the iron core the impacts occur inelastic. The main gravitational potential energy transfers into the heat energy and accumulates by the planet. By the increasing of core mass the gravitational radius increases and it can keep the increasing part of cold silicate fragments. The impacts become more elastic and the less part of potential energy transfers into the heat energy. By solution of the boundary for heat balance it is needed to calculate the distribution of the pressure and matter viscosity, because the viscosity distribution depends from the intensity of convective heat transfer. Additionally using known estimations the matter viscosity significantly depends from the content, temperature and pressure. By numerical modeling on each step by time we had defined a new density distribution. Then we calculated a new distribution of litho static pressure and melting pressure. Then for different model relations for viscosity from temperature and pressure we define the viscosity distribution and calculate the effective thermal conductivity, which approximate the convective heat transfer. Then we calculate the new temperature distribution. As results we had obtained a set of possible changing of viscosity and temperature in the mantle matter with depth during the accumulation process.

References

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