MODEL OF THE EARTH'S ACCRETIVE DIFFERENTIATION

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The analysis of impact processes in falling large bodies onto the accreting Earth when the selective evaporation of the matter is to be taken into account as well as the experimental data on redistributious of the elements inside both impact formations and lunar regolith (1,2) lead to the conclusion that the upper layer of the planet must be enriched by the elements with higher volatility (Na, K, Si, Al and so on).

To estimate them quantatively the distribution accept in (3) of falling bodies was considered during accretion. The source of the upper layer enrichment by the mentioned elements was assumed to be large-scale lenses of a melt from which the volatile elements are passing into the upper layer of the accreting Earth during accretion period as a whole. The melt lens layer thickness was estimated using the distribution of (3) and taking into account numerous theoretical and experimental data about crater formation given in (4).

In this problem the processes of accretive differentiation were assumed to occur in some layer with H-thickness defined by the distribution of falling bodies. For example, for a body with sizes of about 300 km H 20 km. It was suggested that the total mixing of the matter occurs in some layer h

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0.1H and some concentration Csur. depending on the melt thickness and the efficiency of selective volatilization becomes steady.

The change of the concentration of volatiles in the surface layer Csur. relative to the initial concentration in a planetesimal Cpl. is determined by the relationship:

$$Csur. = \frac{(1.39\alpha + 1.16)\, Cpl.}{1.39\alpha\, Cpl. + 1.16}$$

where α is the relative impoverishment of volatiles in the layer H - h due to selective evaporation. For example, in case of SiO_2 Csur. can reach the values of about 1.1 to 1.4 of Cpl. In the modeles of chemical compositions of planetesimals (chondrite and achondrite) the concentration of SiO_2 is about 30 to 50 % that results in enriching the surface layer up to 40 to 60 % within the frameworks of the problem discussed. This fact is in agreement with SiO_2 content in the crust matter of the Earth.

So, the proposed models makes it possible to conclude that the impact processes at the accretion stage provided for the initial differentiation of the Earth with forming the protocrust.

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