INFLUENCE OF OXYGEN FUGACITY ON IRON SEGREGATION UNDER PARTIAL MELTING OF THE SILICATE MIXTURE: STUDY USING A HIGH TEMPERATURE CENTRIFUGE

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Simulation of the migration and accumulation of iron-sulfide phases under gravity, with the partial fusion of a model planetary substance (olivine-picrite mixtures) was carried out. Experiments were carried out in a high-temperature centrifuge at 1400-1450^{o}C under normal pressure at rotation rates of 3000 -- 6000 revolutions per minute, i.e. the Earth's gravitational field was surpassed by 2000-4000 times.

As objects of the study, we used a sample with next compositions:

85 wt. %Ol, 10 wt.% Pic, 5 wt.% FeS (95 wt.% Fe and 5 wt.%S) ;

We also used a sample with next compositions:

85 wt.%Ol, 10 wt.% Bas, 5 wt.% FeS (95 wt.% Fe and 5 wt.%S),

85 wt.%Ol, 10 wt.% Fe-basalt (20 wt.% FeO), 5 wt.% FeS (91 wt.% Fe, 5 wt.%S, 4 wt.%C), where: Ol-olivine, Bas-basalt, Pic-picrite, Fe-iron metallic, FeS – iron sulfide melt (5 wt.%S from Fe) correspond to melt (95 wt. % Fe and 5 wt.%S), what determined by existing conception of the metallic core of planetary body formation (Moon).

The separation is extremely slow when the proportion of viscous silicate liquid is small, so we used a high-temperature centrifuge. The starting materials used in our experiments were mixtures (powder) of natural olivine (Fo_{93}), picrite glass and Fe-S alloy (Fe = 95% wt and S= 5 % wt). The powders had a grain size of 10- 20 μm. The experiments were carried out at 1400^{o}C and $\Delta \log fO_2$ (IW) = -2.1 in two stages. First, the sample was melted at 1400^{o}C without rotation, in order to attain the initial percentage of melt equally distributed in the olivine (75 and 85 % wt)+ pyrite melt (10 and 20 % wt) and molten Fe-S alloy (5 % wt) mixture. And, second, the sample was rotated at the same temperature that corresponded to the initial percentage of silicate liquid

On the metallic liquids segregation essential influence have a surface properties coexisting phases, in which Mg/Fe relation has important significant. Oxygen introducing in a system may be occurring by oxide ferric.

Oxide ferric and iron sulfide introducing in a system decrease the interface tension, and some equilibrate the field of force asymmetry in interface boundary of the system metal-silicate. Experiments were carried out using a corundum, ZrO_2, iron and carbon ampoules. Oxygen regime was made by a container material, initial samples mixture and additional hard buffer. Oxygen fugacity was varied from IW to carbon value.

The permeability of metal increases if the silicate-metal system is subjected to ultrasonic shock deformations, mechanical squeeze deformations, electro-capillarity effects.

Experimental results showed, that mixture consisting of olivine crystals, silicate and iron-sulfide melts, after being separated in a centrifuge, is differentiated in density at high basic conditions at carbon and at lg f_{O2} some low IW at 1450^{o}C.

Experimental results showed also the influence of electro-capillarity effects (without moving and with moving) by a 1,5-2 V/cm potential on the simple at 1400^{o}C showed the feeble iron separation.

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References

1. *Lebedev E.B., Kadik A.A., Kuskov O.L., Dorfman A.M., Lukanin O.A.* The motion of sulfide phases in a partially molten silicate material: application to the problem of the formation of planetary cores // Solar System Research. 1999. V.33. N. 5. PP. 346-355.

2. *Lebedev E.B., Kadik A.A., Galimov E.M.* Segregation of molten metal through partially molten silicate: simulation using a high temperature centrifuge // 32nd IGC – Florence. 2004. "T06.02 Geochemical environment of the genesis of life".

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