

Influence of physical-chemical properties on accumulation of the iron-sulfide phases in partial molten silicate melt

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The modeling is carried out on a high-temperature centrifuge at temperatures 1440–1460°C and in the controlled conditions of oxygen potential, with a high degree of extraction of iron from silicate melt. Calculations of the values of oxygen fugacity were also performed on the basis of chemical composition of the phases of the quenched samples after the experiments, using the empirical relationship and also on the program of Terra.

Key words: experimental study, magmatic melts, metallic phases, accumulation, segregation, oxygen fugacity, calculations

Citation: Lebedev, E. B., I. A. Roschina, N. N. Kononkova, E. A. Zevakin, V. V. Averin (2012), Influence of physico-chemical properties on accumulation of the iron-sulfide phases in partial molten silicate melt, *Vestn. Otd. nauk Zemle*, 4, NZ9001, doi:10.2205/2012NZ_ASEMPG

As expected that on the early stages of the evolution of planetary bodies differentiation processes of magmatic melts, accumulation and segregation of metallic phases and the separation of siderophile elements occur at high temperatures and low oxygen fugacity, at several orders of magnitude lower than the iron-wustite buffer (IW), $\Delta \log f_{O_2}$ (IW), = \sim -(4.5–5.5). The processes of magmatic differentiation have complex dynamics. During experimental study of the possible mechanisms of formation of metallic cores of planetary bodies (Moon) the greatest difficulties arise in the accumulation of metallic phases from partially molten model planetary matter, especially when the maximum extraction of small amounts of the metallic phases [Lebedev, Galimov, 2012]. Modeling is carried out on high-temperature centrifuge at 1440–1460°C and controlled oxygen potential. When a high degree of extraction of iron (up to 0.16% FeO) of the olivine silicate melt can become almost forsterite, silicate phase becomes almost non ferriferous melt. This indicates to the fact that the chemical composition of the products of the experiment corresponds to a high reduction of phases. Calculations Kadik A.A. also show high reduction conditions [Kadik, 2008].

Calculations of the values of oxygen fugacity (f_{O_2} , fig. 1) were also performed on the basis of chemical composition of the phases of the quenched samples after the experiments, using the empirical relationship [Ariskin et al., 1992]. $\lg f_{O_2} = -22446,53 / T + 1,948 [\lg (X_{FeO}) - s]$, where: s-is the regression parameters, X_i components of silicate melt in the form of oxides (mol%). The obtained value of oxygen fugacity $\Delta \log f_{O_2}$ (IW) = - (5.8 ± 0.3) correspond to 0.16% FeO.

A diagram of the concentrations of $P_{f_{O_2}}(\text{atm})-T$ for the initial composition: (SiO₂ - 57.81) + (MgO - 16.59) + (FeO - 0.16) + (Al₂O₃ - 11.71) + (CaO - 7.37) + (TiO₂ - 0.38) + (ZrO₂ - 3.79) + (C - 0.3) + (S - 0.65) + (P - 0.2).

The basis of the method used by the program "Terra" [Trusov, 2002] is the principle of maximum entropy, which is valid in accordance with the second law of thermodynamics for any system equilibrium, regardless of the way in which the system has reached equilibrium.

The program allows to display of the concentration of the reaction products in different scales: in the mass fraction (mol%), in the partial pressure of the reaction in M-Pas or atm.

Both methods of calculation of oxygen fugacity for the experimental data show similar values.

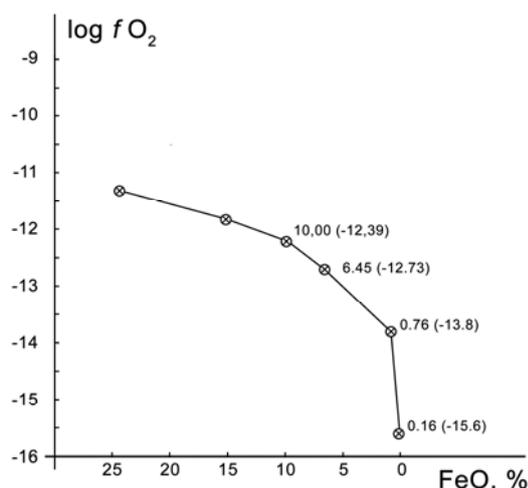


Fig. 1. The dependence of oxygen fugacity, in depending from the iron content in the melt, T=1440°C

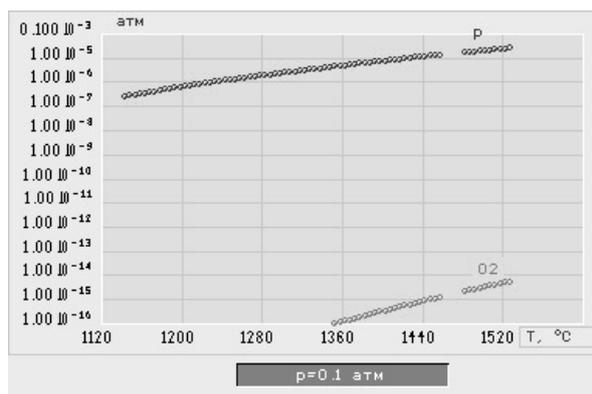


Fig. 2. The dependence of oxygen fugacity in model the melt

This work was supported by RFBR Grant 07-05-00630 and Grant Program of the Presidium of RAS № 24.

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