Geophysical Research Abstracts
Vol. 21, EGU2019-7801, 2019
EGU General Assembly 2019

The Effect of Structure and Composition of Silicate Melts on the Oxygen Isotope Fractionation

Elena Dubinina and Alexander Borisov
IGEM RAS, Russian Federation (elenadelta@gmail.com)

The effect of silica melt composition and structure on the oxygen isotope fractionation was studied at the multi-component ($SiO_2 \pm TiO_2$ + Al2O_3 $\pm$ Fe2O_3 + MgO $\pm$ CaO) system at 1500° and 1 atm. The experimental data show that the significant oxygen isotope effects can be observed in silicate melts even at such high temperature. The comparison of isotope and chemical composition of the experimental glasses show that the ability of silicate melt to concentrate 18 isotope is mainly determined by its structure. An increase of the NBO/T ratio in the experimental glasses from 0.11 to 1.34 is accompanied by a systematic change of oxygen isotope difference between melt of interest and internal standard melt by values from –0.85 to +1.29 ‰. The experimental data were tested using the different indices (i.e. I-18O, NBO/T, Garlick index, optical basicity). Only for NBO/T ratio, strong correlation with oxygen isotope composition was obtained.
The data obtained were described using the mass-balance equations at the framework of Toop and Samis model when three types of oxygen ions are existent in a silicate melt: the bridging, non-bridging, and free oxygen. An application of the model to the experimental data shows that the intra-structure isotope fractionation between bridging and non-bridging oxygens should take place. Calculations show that the intra-structure isotope fractionation between bridging and non-bridging oxygens in our experiments can be as large as 4.2 $\pm$ 1.0 ‰.
The work was supported by the RSF grant 18-17-00126.

REFERENCES
Toop, G.W. and Samis, C.S., Activities of ions in silicate melts, Transactions of the Metallurgical Society of America, 1962, vol. 224, pp. 878–887.
Garlick, G.D., Oxygen isotope fractionation in magmatic rocks, Earth Planet. Sci. Lett., 1966, vol. 1, pp. 361–368.
Mysen, B.O., Virgo, D., and Seifert, F.A., Relationships between properties and structure of aluminosilicate melts, Am. Mineral., 1985, vol. 70, pp. 88–105.
Zheng, Y.F., Calculation of oxygen isotope fractionation in anhydrous silicate minerals, Geochim. Cosmochim. Acta, 1993, vol. 57, pp. 1079–1091