Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.10155

Secondary fluorescence effect quantification of EPMA analyses of olivine grains embedded in basaltic glass

DR. MAXIM GAVRILENKO, PHD[1], VALENTINA G. BATANOVA[2], XAVIER LLOVET[3], STEPAN P. KRASHENINNIKOV[4], ALINA KOSHLYAKOVA[5], DARIA GAVRILENKO[1] AND ALEXANDER V. SOBOLEV[1]

[1]Université Grenoble Alpes
[2]ISTerre Université Grenoble Alpes
[3]Universitat de Barcelona
[4]Leibniz Universität Hannover
[5]Vernadsky Institute of Geochemistry and Analytical Chemistry RAS

Presenting Author: maxim.gavrilenko@univ-grenoble-alpes.fr

Trace element analysis in olivine is challenging but vital, since trace element concentrations in olivine could potentially record conditions of olivine crystallization and, correspondingly, conditions of magma generation, evolution, and/or transport dynamics. Currently, electron microprobe analysis (EPMA) for olivine remains the most popular for many reasons including but not limited to high spatial resolution and high precision. Specially designed EPMA protocols with high beam current and long counting time provide low detection limits. However, the effect of secondary fluorescence (SF) should be considered for analysis of certain trace elements in olivine near the olivine-glass boundaries to avoid overestimating the elements' contents [1]. The global database of synthetic olivine compositions contains thousands of olivine/glass measurements used for olivine/melt partitioning studies. However, the olivine EPMA data accuracy is dependent on quantifying the SF-effect from surrounding glass. Here we report the direct measurement of the SF-effect from basaltic glass on trace elements in olivine obtained in specially designed experiments combined with SF-modeling using the PENEPMA software.

Olivine grain fragments with known compositions were embedded in basaltic powder, heated to 1250°C in a 1-atmosphere furnace for a few minutes (to avoid olivine crystallization and olivine-melt exchange), and quenched. The olivines used as starting material in experiment are characterized by homogeneous composition within the selected grain fragments, but ranged in the FeO content ($Fo_{77.3}$-$Fo_{90.7}$) between experiments. As a result, we produced olivine pieces of different sizes embedded in glass, both with known composition (Fig.1). EPMA analyses of olivine before and after the experiments were used to quantify the SF-effect. The data show that the SF-effect, which comes from basaltic glass adjacent to olivine, is most significant for concentrations of titanium and calcium. The main factor is the distance from the interface and grain geometries. Although the most significant SF-effect is observed next to the glass boundary, the SF-effect was detected even in the centers (Fig.2) of large olivine grains (up to 100µm in diameter). Considering that experimental olivines are usually smaller than 50µm, we have developed analytical expressions for SF-correction for isometric olivine grains embedded in basaltic glass.

[1] Llovet et al. (2012) J.Phys.D:Appl.Phys.45