Elevated H_2O and Cl contents in komatiite melts from Abitibi and Belingwe

E. V. ASAFOV*[1], A. S. SOBOLEV[12], A. A. GURENKO[3], N. T. ARNDT[2] AND V. G. BATANOVA[12]

[1]Vernadsky Institute of Geochemistry and Analytical Chemistry, Moscow, Russia (evasafov@gmail.com)
[2]ISTerre, University J. Fourier, Grenoble, France
[3]CRPG/CNRS, BP 20, 54501, Nancy, France

Komatiites are ultramafic volcanic rocks that represent high melting degree of the mantle (>30%) and hence are best indicators of the composition of their sources. In order to estimate composition of komatiitic melts including contents of volatiles we used melt inclusions in olivine from two 2.7 Ga sample suits, one from Abitibi greenstone belt, Canada and the other from the Belingwe greenstone belt, Zimbabwe.

Fresh olivine grains 0.2-0.5 mm across were heated for 5 minutes and quenched at 1350°C in a C-O-H atmosphere with QFM buffer. Exposed melt inclusion were analyzed by electron and ion microprobes for concentrations of Mg, Si, Ti, Al, Fe, Mn, Ca, Na, Cr, P, K, Cl, S, F, H_2O and CO_2. The contents of volatile components were obtained for the first time for Abitibi komatiites melt inclusions.

Corrected for iron loss melt inclusions from Abitibi range from 22.3 to 27.3 wt.% MgO and from 19.9 to 23 wt.% MgO for Belingwe. All elements except K, Cl and H_2O show strong negative correlation with MgO following the olivine control line. K/Ti, Cl/Ti and F/Ti ratios of Abitibi melt inclusions show negative correlation with host Fo and the most Fe rich olivines (Fo_{91}) contain >600 ppm of Cl. Since all of these elements are highly incompatible in olivine their ratios cannot be affected by its fractionation. We thus interpret these ratios being result of fractional crystallization and assimilation process (AFC), which likely occurred during the early stage of melt evolution at shallow crustal depth.

The highest H_2O contents are observed in melt inclusions from the most MgO rich olivines in Abitibi samples (Fo 94.3-94.7) and reach 0.9 wt.%. These olivines are considered to be the most primitive and yet unaffected by the AFC process because of the lowest Cl contents and Cl/Ti ratios in their melt inclusions. The primary melt for Abitibi komatiite calculated from the most primitive melt inclusions contains 28 wt. % MgO, 0.80 wt% H_2O, 30-40 ppm of Cl, and 25 ppm of F. If these volatiles are primary, for 40-50 % of melting this suggests significantly elevated concentrations of H_2O (3000-4000 ppm) and Cl (12-20 ppm) in the mantle source of Abitibi belt komatiites.