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Rosanne Heistek, Yan Lavallée, Cristina De Campos, Daniele Morgavi, Kai-Uwe Hess, and Donald B. Dingwell
LMU München, Earth and Environment, Germany (hei_roos@hotmail.com)

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Rosanne M. Heistek, Yan Lavallée, Cristina De Campos, Daniele Morgavi, Kai-Uwe Hess, Donald B. Dingwell

Department of Earth and Environmental Sciences, Ludwig-Maximilians Universität München (LMU), Theresienstrasse 41/III, 80333 München, Germany

Volcanic activity in the Snake River Plain (SRP) and Yellowstone is characterized by voluminous basaltic lava flows and rhyolitic, rheomorphic ignimbrite. The driver for explosive eruptions in the SRP is enigmatic as the magmas are considered to be hot (> 900 °C) and dry to be explosive, although recent chemical analysis on the interstitial glass and melt inclusions reported the presence of the halogens, fluorine and chlorine. Halogens may substitute for O2- and alter the degree of polymerization of silicate melts, consequently affecting the rheology of magmas.
We performed chemical analysis of fluorine and chlorine present in the glass of several volcanic rocks from the SRP and Yellowstone, using an electron microprobe. The glasses are peraluminous rhyolites and some (e.g., Obsidian Cliff at Yellowstone) contain an unusually high content in Cl (up to ca. 1% wt) and an absence of F. The high content of Cl in the volcanic products provides an opportunity to investigate the effects of this halogen on the rheology of natural magmas.
To date, the role of Cl has been studied on synthetic glass and is tied to the chemical composition. Cl slightly increases the viscosity of peralkaline melts, whereas it decreases the viscosity of peraluminous melts; exceptions however exist at high temperatures where the presence of Cl increases the viscosity of peraluminous melts (Zimova and Webb, Am. Min. 2006). Here we present rheological measurements on the relationships between Cl and the viscosity of rhyolites from the Obsidian Cliff and test whether Cl has similar effects on natural magmas as on synthetic melts.