Developing a laboratory technique to probe volatile transport in the deep mantle

*Catherine McCammon[1], Serena Dominijanni[1], Leonid Dubrovinsky[1], Nobuyoshi Miyajima[1], Egor Gennadievich Koemets[1], Dan Frost[1]

1. Bayerisches Geoinstitut, University of Bayreuth

Transport of volatiles as melts or fluids is influenced not only by pressure, temperature and chemical composition, but also by oxygen fugacity. Scenarios that investigate volatile transport at mantle conditions to depths of around 700 km can be explored through high pressure and high temperature experiments in large volume presses where oxygen fugacity is monitored, for example using metal alloys as sliding redox sensors. However, so far oxygen fugacity has only rarely been measured in diamond anvil cell experiments, which are the gateway to the extreme pressure and temperature conditions of Earth’ s deep interior. To address this deficiency, we are developing a new approach to measure and control oxygen fugacity in a diamond anvil cell. In preliminary experiments we reacted ferropericlase and iridium metal in a laser-heated diamond anvil cell to produce iron-iridium alloy and ferropericlase, and used the composition of the iron-iridium alloy to calculate oxygen fugacity. We traced the progress of redox reactions through Mössbauer, XANES and EELS and determined chemical compositions using EMPA, SEM and FIB-TEM. Results provide a quantitative picture of mass balance and transport of oxygen during the diamond anvil cell experiments. We will present the latest results including a comparison to a parallel experiment carried out using a multianvil press.

Keywords: volatiles, oxygen fugacity, diamond anvil cell

