EGU Galileo Conference
GC4-Subduction-9, 2018
Exploring new frontiers in fluids processes in subduction zones

The Metasomatic Influence of Silicic HDF on the Sub Continental Lithospheric Mantle

Amit Meltzer

The Hebrew University of Jerusalem, Earth Sciences, Jerusalem, Israel (amit.meltzer@mail.huji.ac.il)

The mantle beneath cratons (the sub-continental mantle lithosphere, SCML) is characterized by a complex history involving melting followed by fluid metasomatism. These fluids are responsible for shaping the mineralogy and rheology of the mantle as well as being the source from which diamonds are formed. Fluids found as inclusions in diamonds (high-density fluids, HDF) are thought to be the metasomatic agents. Latest models demonstrated a connection between experimental fluids and melts and HDF end members. It was suggested that alkali-rich hydrous fluids, originated from the dehydration of the subducting slab, interact with the mantle and initiate melting to form the silicic HDFs. Despite its important role in mantle processes, the interaction of volatile-bearing fluids, in general, and silicic HDF, in particular, with harzburgitic lithologies beneath cratons was only rarely investigated experimentally.

This study examines the interaction of silicic fluids with harzburgite at pressures of 3-6 GPa and temperatures of 800-1100˚C, conditions relevant for metasomatism of the SCLM. This study will enable us to further investigate the fluids' role in the metasomatic processes, will shed light on the metasomatic changes in the harzburgite, and on the stability of metasomatic phases in the cratonic mantle. H_2O- and CO_2-bearing silicic fluids, similar to those found in diamonds, are mixed with a primitive harzburgite at high-pressure and temperature in order to evaluate the compositions of the equilibrated fluids and the metasomatic mineral assemblage. The experiments are performed in a rocking multi-anvil apparatus using a diamond-trap setup. The compositions of the fluid and melt phases are determined using the cryogenic LA-ICP-MS technique and the QTS technique. Using these innovative methods, we can directly measure the fluid compositions in the system. The minerals' composition is determined using EPMA.

The fluids in this study are alkali-rich, containing 45-50 wt% H_2O and 25-30 wt% CO_2. With increasing temperature, the melts were found to contain 15-23 wt% H_2O and 14 wt% CO_2. The results so far indicate the location of the solidus to be between 900 and 1000oC at 3 GPa and between 1000-1100oC at 4-5 GPa. The solidus found in this study is similar to previously determined solidi for lherzolite+H_2O and lherzolite+H_2O+CO_2 systems. The near solidus fluid and melt compositions differ from the silicic HDF starting composition, but similar to low-Mg carbonatitic HDF fluids.