Geophysical Research Abstracts
Vol. 16, EGU2014-9960, 2014
EGU General Assembly 2014

First in-situ monitoring of CO_2 delivery to the mantle followed by compression melting, using synchrotron generated X-ray diffraction.

Tahar HAMMOUDA (1), Julien CHANTEL (1), Geeth MANTHILAKE (1), Jérémy GUIGNARD (2), Wilson CRICHTON (2), and Fabrice GAILLARD (3)

(1) Université Blaise Pascal - Clermont Ferrand, Laboratoire Magmas et Volcans, Clermont-Ferrand, France (t.hammouda@opgc.univ-bpclermont.fr), (2) European Synchrotron Radiation Facility, Grenoble, France, (3) Institut des Sciences de la Terre d'Orléans, France

Melting of peridotite + CO_2 upon compression has been directly monitored in situ, for the first time. We have combined high pressure experiments in the multianvil apparatus with synchrotron-generated X-ray diffraction, in order to monitor sample decarbonation upon heating, followed by melting upon compression. Experiments were performed in the model system CaO-MgO-SiO_2+CO_2, using dolomite and silicates contained in graphite capsules as starting material. Save Al, starting composition was aimed at reproducing peridotitic system. The sample was first compressed at room temperature, then heated. Decarbonation was observed at 2.2 GPa and 1100°C. After further heating to 1300°C, pressure was increased. Melting was observed at 2.7 GPa, while temperature was kept at 1300°C. All transformations were followed using X-ray diffraction. Starting with silicate + carbonate mixtures, we were thus able to keep CO_2 fluid in the experimental sample at high P and T, up to the solidus.

Concerning carbon recycling at subduction zones, it is known that CO_2 is a non-wetting fluid in silicate aggregates. Therefore, any CO_2 resulting from carbonate breakdown likely remains trapped at grain corners either in the subducted lithosphere or in the mantle wedge before eventually being trapped in mantle minerals as fluid inclusions, due to dynamic recrystallization. In this way, CO_2 released from the slab may be spread laterally due to mantle convection. Entrainment to further depths by deep subduction or in convection cells induces CO_2 introduction to depth wherein the solidus can be crossed, due to pressure increase. The solidus corresponds to the so-called carbonate ledge, beyond which carbonatitic melts are produced. Therefore, compression melting of CO_2-bearing lithologies is a way to produce carbonatitic melts at depths corresponding to about 80 km. This mechanism is a viable explanation for the observed geophysical anomalies, such as those revealed by electrical conductivity measurements.