Solubility of magnetite-hematite assemblages in slab-derived saline fluids

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In subduction zones, aqueous fluids derived from devolatilization processes of the oceanic lithosphere and its sedimentary cover, are major vectors of mass transfer from the slab to the mantle wedge and contribute to the recycling of elements and to their geochemical cycles. In this setting, assessing the mobility of redox sensitive elements, such as iron, can provide useful insights on the oxygen fugacity conditions of slab-derived fluid. However, the amount of iron mobilized by deep aqueous fluids and melts, is still poorly constrained.

We experimentally investigate the solubility of magnetite-hematite assemblages in water-saturated haplogranitic liquids, which represent the felsic melt produced by subducted eclogites. Experiments were conducted at 1 GPa and temperature ranging from 700 to 900 °C employing a piston cylinder apparatus. Single gold capsules were loaded with natural hematite, magnetite and synthetic haplogranite (Na$_{0.56}$K$_{0.38}$Al$_{0.95}$Si$_{5.19}$O$_{12.2}$). Two sets of experiments were conducted: one with H$_2$O-only fluids and the second one adding a 1.5 m H$_2$O-NaCl solution. The capsule was kept frozen during welding to ensure no water loss. After quench, the presence of H$_2$O in the quenched haplogranite glass was checked by Raman spectroscopy, while major elements were determined by microprobe analysis.

Preliminary results indicate that a significant amount of Fe is released from magnetite and hematite in hydrous melts, even at relatively low-pressure conditions. At 1 GPa the FeO$_\text{tot}$ quenched in the haplogranite glass ranges from 0.60 wt% at 700 °C, to 1.87 wt% at 900 °C. In the presence of NaCl, we observed an increase in the amount of iron quenched in the glass (e.g., at 800 °C from 1.04 wt% to 1.56 wt% of FeO$_\text{tot}$). Our results suggest that hydrous melts can effectively mobilize iron even at low-pressure conditions and represent a valid agent for the cycling of iron from the subducting slab to the mantle wedge.