Phase relations of $MgFe_2O_4$ and the stability of the new Fe^{3+} -oxide $Mg_2Fe_2O_5$ at conditions of the deep upper mantle and transition zone

LAURA UENVER-THIELE[1], ALAN WOODLAND[1], TIZIANA BOFFA BALLARAN[2] AND DAN FROST[2]

[1]Institut für Geowissenschaften, Universität Frankfurt, 60438, Frankfurt am Main, Germany
[2]Bayerisches Geoinstitut, Universität Bayreuth, 95440, Bayreuth, Germany

Most parts of the deep upper mantle and transition zone are characterized by the presence of spinel-structured phases that can incorporate Fe^{3+} and Fe^{2+}. Information about their stabilities, as well as the behaviour of Fe^{3+} at high-P-T conditions is available for some endmember compositions. For example, the stability limit of magnetite lies at ~10 GPa, where it breaks down to Fe_4O_5 + Fe_2O_3 rather than transforming into a post-spinel structure [1]. Other spinel-structured phases like $FeAl_2O_4$ break down to their constituent oxides [2]. Based upon P-V-T data on $MgFe_2O_4$ and available thermodynamic data, [3] proposed a phase diagram of $MgFe_2O_4$ composition including a large stability field of its constituent oxides MgO + Fe_2O_3 at intermediate P and T, and assumed the stability of a hP-$MgFe_2O_4$ phase at pressures > 17 GPa. However, [3] never produced the hP-$MgFe_2O_4$ phase and reported no direct evidence for the existence of a MgO + Fe_2O_3 stability field at room T even up to 35 GPa.

In order to determine the phase diagram of $MgFe_2O_4$ multi-anvil experiments were performed at 8-18 GPa and temperatures of 900-1550 °C with either stoichiometric mixtures of MgO + Fe_2O_3 or pre-synthesised $MgFe_2O_4$. PtO_2 was added to insure high oxygen fugacities. The run products were analysed by microprobe and powder X-ray diffraction.

Preliminary results confirm the breakdown of $MgFe_2O_4$ to MgO+ Fe_2O_3, but at lower pressure (ca. 7-9 GPa at 900-1300°C) than proposed by [3]. At temperature >1300°C $MgFe_2O_4$ is stable up to 9 GPa, but breaks down to Fe_2O_3 + a new phase. At 18 GPa another new oxide phase $Mg_2Fe_2O_5$ was detected which is isostructural with Fe_4O_5. This indicates that the phase relations in the $MgFe_2O_4$ system are more complicated than originally thought and further experiments are underway to constrain the high-pressure high-temperature phase relations.

[1] Woodland *et al.* (2012) *Am. Min.* **97**, 1808-1811 [2] Schollenbruch *et al.* (2010) *Phys. Chem. Min.* **37**, 137-143 [3] Levy *et al.* (2004) *Phys. Chem. Min.* **31**, 122-129