

Complexities in the phase relations of MgFe_2O_4 at high pressure and temperature: evidence for new oxides such as $\text{Mg}_5\text{Fe}_2\text{O}_8$

LAURA UENVER-THIELE¹, ALAN WOODLAND¹, TIZIANA BOFFA BALLARAN², NOBUYOSHI MIYAJIMA², DAN FROST²

¹Institut für Geowissenschaften, Universität Frankfurt, 60438, Frankfurt am Main, Germany

²Bayerisches Geoinstitut, Universität Bayreuth, 95440, Bayreuth, Germany

Magnesioferrite, with an ideal chemical composition of MgFe_2O_4 , belongs to the spinel structured minerals, which are present in most parts of the deep upper mantle and transition zone. Because of the incooperation of trivalent and divalent cations, spinel group minerals are of particular interest. Some endmember compositions (e.g. FeFe_2O_4 , FeCr_2O_4 , FeAl_2O_4) differ in their high pressure behavior from each other whilst others do not show significant differences. For example, FeFe_2O_4 breaks down at ~ 10 GPa to $\text{Fe}_4\text{O}_5 + \text{Fe}_2\text{O}_3$ whilst FeAl_2O_4 breaks down to its constituent oxides [1, 2]. For MgFe_2O_4 [3] proposed a direct transformation to a hP-modification at $> 1500^\circ\text{C}$ and 17 GPa, and decomposition to $\text{MgO} + \text{Fe}_2\text{O}_3$ at lower T and P. However, hP- MgFe_2O_4 was never produced in their experiments.

In order to investigate the phase relations of MgFe_2O_4 multi-anvil experiments have been performed at 8-18 GPa and $900\text{-}1600^\circ\text{C}$. Stoichiometric mixtures of $\text{MgO} + \text{Fe}_2\text{O}_3$ or pre-synthesized MgFe_2O_4 were used, along with PtO_2 to insure high oxygen fugacities. Run products were analysed by microprobe, X-ray diffraction and TEM.

Our study confirms the breakdown of MgFe_2O_4 to its constituent oxides, but the phase boundary is shifted to somewhat lower P-T conditions (8-9 GPa and $900\text{-}1200^\circ\text{C}$) than proposed by [3]. At $T > 1200^\circ\text{C}$ and ~ 9 GPa MgFe_2O_4 breaks down to $\text{Fe}_2\text{O}_3 +$ a new Mg-rich phase. Although this new phase is unquenchable, microprobe data, as well as TEM observations indicate that this new phase has a $\text{Mg}_5\text{Fe}_2\text{O}_8$ stoichiometry. Depending on P and T, phases with other stoichiometries also appear to be stable, although they are not quenchable. Above 10-12 GPa $\text{Mg}_2\text{Fe}_2\text{O}_5$ (isostructural with Fe_4O_5 [4]), becomes stable together with Fe_2O_3 .

[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 [4] Boffa Ballaran et al. (2015) *Am. Min.* 100, 628-632