

## **Complexities in the phase relations of $\text{MgFe}_2\text{O}_4$ at high pressure and temperature: evidence for new oxides such as $\text{Mg}_5\text{Fe}_2\text{O}_8$**

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Magnesioferrite, with an ideal chemical composition of  $\text{MgFe}_2\text{O}_4$ , 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.  $\text{FeFe}_2\text{O}_4$ ,  $\text{FeCr}_2\text{O}_4$ ,  $\text{FeAl}_2\text{O}_4$ ) differ in their high pressure behavior from each other whilst others do not show significant differences. For example,  $\text{FeFe}_2\text{O}_4$  breaks down at  $\sim 10$  GPa to  $\text{Fe}_4\text{O}_5 + \text{Fe}_2\text{O}_3$  whilst  $\text{FeAl}_2\text{O}_4$  breaks down to its constituent oxides [1, 2]. For  $\text{MgFe}_2\text{O}_4$  [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- $\text{MgFe}_2\text{O}_4$  was never produced in their experiments.

In order to investigate the phase relations of  $\text{MgFe}_2\text{O}_4$  multi-anvil experiments have been performed at 8-18 GPa and  $900$ - $1600^\circ\text{C}$ . Stoichiometric mixtures of  $\text{MgO} + \text{Fe}_2\text{O}_3$  or pre-synthesized  $\text{MgFe}_2\text{O}_4$  were used, along with  $\text{PtO}_2$  to insure high oxygen fugacities. Run products were analysed by microprobe, X-ray diffraction and TEM.

Our study confirms the breakdown of  $\text{MgFe}_2\text{O}_4$  to its constituent oxides, but the phase boundary is shifted to somewhat lower P-T conditions (8-9 GPa and  $900$ - $1200^\circ\text{C}$ ) than proposed by [3]. At  $T > 1200^\circ\text{C}$  and  $\sim 9$  GPa  $\text{MgFe}_2\text{O}_4$  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  $\text{Fe}_4\text{O}_5$  [4]), becomes stable together with  $\text{Fe}_2\text{O}_3$ .

[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