Synthesis of Fe_5O_6 and the high-pressure stability of Fe^{2+}-Fe^{3+}-oxides related to Fe_4O_5

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Following from the systematics of the Ca-ferrite family of structures [1] and the recently discovered phase, Fe_4O_5 [2] [3], there is the potential for Fe-oxides with a variety of stoichiometries and oxidation states to be stable at high pressures and temperatures corresponding to the Earth's transition zone. For example, Fe_5O_6 and Fe_6O_7 would be candidate phases, having progressively lower Fe^{3+}/Fe^{2+} ratios than magnetite and Fe_4O_5.

We have explored the stability of such phases in a series of multi-anvil experiments performed at 10-12 GPa and 1200°C using mixtures of Fe_3O_4 and metallic Fe and Ag as capsule material to prevent Fe-loss. We have successfully synthesised Fe_5O_6, which has $Fe^{3+}/\sum Fe = 0.4$ This phase appears to have an orthorhombic structure analogous to $CaFe_4O_6$ [1], with a = 2.885, b = 9.943 and c = 15.369. However, the exact crystal structure remains to be determined.

In an experiment a mixture of Fe_5O_6 and Fe_4O_5 was produced, demonstrating the coexistence of these two phases. A further experiment produced Fe_5O_6 + wüstite. This assemblage effectively excludes Fe_6O_7 and other hypothetical stoichiometries being stable phases at ~ 10 GPa and high temperatures. At such P-T conditions three Fe-oxide assemblages can be stable depending on oxidation state: hematite + Fe_4O_5, Fe_4O_5 + Fe_5O_6 and Fe_5O_6 +wüstite. Study of the effect of Mg on these phase relations is currently in progress.

[1] Evrard et al. (1980) *J Solid State Chem*, **35**, 112-119. [2] Lavina et al. (2011) *PNAS*, **108**, 17281-17285. [3] Woodland et al. (2012) *Amer Mineral*, **97**,1808-1811.