# ****EBS-Workshop on Nuclear Resonance Scattering**** Chemistry at extreme conditions: Fe-O system at ultra-high pressure

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The structure, properties and high-pressure behaviour compounds in the Fe–O system have been extensively investigated because of their high importance in Earth sciences, solid state physics and technology. The chemical, electronic, and magnetic states of iron oxides can be strongly influenced by pressure, giving rise to unexpected chemical reactions, structural and other types of transformations.

X-ray diffraction methods are widely applied for studying behaviour of iron oxides at extreme conditions. Even simplest compounds (such as FeO or Fe2O3) are found to have very complex phase diagrams. Certain oxides (like Fe2O3 and Fe3O4) decompose with crystallization of unusual Fe5O7 and Fe25O32 phases and release of oxygen [1]. Nevertheless, X-ray diffraction data lack information on electronic and magnetic states of iron atoms, which in turn can be studied using synchrotron Mössbauer source spectroscopy and nuclear forward scattering. While it is believed that magnetism in FeO should disappear above 100 GPa [2], our SMS data collected at ID18 beamline suggest that magnetism still remain at least until 2 megabar. The experiments with tiny samples below 10 microns (typically used in studies above 100 GPa) are challenging: the resulting spectra are weak and have high background noise, while the collection times are long. Application of a small fine-focused beam would greatly improve the data and enable studies of iron oxides at pressures above megabar.

**References**

[1] - E. Bykova *et al.*, Nat Commun. **7**, 10661 (2016).

[2] - J. Badro *et al.*, Phys. Rev. Lett. **83**, 4101 (1999).