Role of high-pressure Fe-O-H chemistry in oxygen recycling in early Earth history

L. Dubrovinsky

Bayerisches Geoinstitut, University of Bayreuth, D-95440 Bayreuth, Germany

Iron oxides and oxyhydroxides are major phases among oxidized iron species, commonly called rust, which can be formed in many ways including as a byproduct of anoxygenic prokaryote metabolism that took place from about 3.8 billion years (Ga) ago until the Great Oxidation Event (GOE) roughly 2.2 Ga ago. Rust was buried on the ocean floor and was transported into the mantle as a consequence of plate tectonics that started at least 2.8 Ga ago. The fate and the geological role of rust at pressure and temperature conditions of the lower mantle have been unknown up to now. We studied the behavior of different compounds in Fe-O-H system in 100 GPa pressure range and temperatures over 2500 K using *in situ* synchrotron single-crystal X-ray diffraction and other complementary techniques. At conditions that correspond to the coldest slabs at depths of about 1000 km we observed formation from rust of numerous iron oxides (Fe_2O_3, Fe_5O_7, Fe_7O_{10}, $Fe_{6.32}O_9$) and an oxygen-rich fluid. Our results suggest that recycling of rust in Earth's mantle could contribute to redox conditions of the early Earth.