Interaction between carbon- and H-bearing iron phases in the deep Earth.

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Carbon dioxide (CO_2) and water (H_2O) play an important role in the evolution of the Earth as they strongly influence the chemical and physical properties of minerals, melts, and fluids. Distribution and circulation of H_2O and CO_2 between the mantle and the Earth's surface have dominated the evolution of the crust, the oceans, and the atmosphere, controlling the Earth's habitability. It is therefore crucial to understand the stability and circulation of hydrous and CO_2-bearing minerals in the Earth's interior. A new pyrite-structured iron peroxide (FeO_2H_x) was recently reported [1] with important and yet unclear implications for carrying H atoms down to great depth. However, hydrogen in subducting slabs, coming from sedimentary material and altered mafic and ultramafic rocks, is likely associated with other volatiles such as carbon. It is thus important to investigate the interaction of FeO_2H_x with CO_2. Here we studied the stability of this iron peroxide under high CO_2 fugacity at high pressure and temperature and showed that FeO_2H_x reacts with CO_2 to transform into a tetrahedral iron carbonate similar to a previously described phase [2] at pressures and temperatures relevant to the lowermost Earth mantle. This high pressure iron carbonate phase could be a major carbon-carrier in the deep Earth interior and, in the context of subducted materials, could prevent iron peroxide phases to survive at great depths.

References : [1] Hu et al., *PNAS* 2017 [2] Boulard et al JGR 2012