In situ neutron diffraction of iron hydride under high pressure and temperature in Fe-silicate-water system: Implications for the Earth's evolution

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Hydrogen is the most abundant element in the solar system and considered to be one of the promising candidates of the light element in the Earth’ s core. However, the amount of hydrogen dissolved in the core and its process are still unknown because hydrogen cannot be detected by X-ray and it easily escapes from iron by the release of pressure. In this study, we have conducted high-pressure and high-temperature *in-situ* neutron diffraction experiments on the iron-hydrous mineral system using high-pressure “PLANET” beamline at J-PARC. We observed that the water which is released from hydrous mineral at about 4 GPa reacts with iron and they form both iron oxide and iron hydride. The obtained iron hydride remained stable after further increase in temperature. This formation of iron hydride occurred below 1000K, at the temperatures where no materials melted. This suggests the possibility that hydrogen had preferentially dissolved into iron before any other light elements have dissolved in the very early stage of Earth’ s evolution.

Keywords: Hydrogen, Neutron diffraction, In situ high pressure and high temperature observation, Core-mantle formation

