# Fe-Ni-H2O reaction at high pressure and high temperature

# Yuh Ishida[1]; Tadashi Kondo[2]; Tatsuhiro Sakaiya[2]; Takumi Kikegawa[3]

[1] Earth and Space Science, Osaka Univ.; [2] Osaka Univ.; [3] PF,KEK

Seismic data and high pressure study of iron suggested that some light elements should exist in the Earth‘s core. Hydrogen is one of the important candidates of light elements considering the reaction between iron and water in the early Earth. In this reaction, FeH and FeOOH were produced up to 10GPa, and FeH and FeO were produced at high pressure. Although the reaction between pure iron and water or hydrogen has been studied so far, studies on iron-nickel-water system has not been done.

We have studied the reaction of iron nickel alloy and water by a laser-heated diamond anvil cell and in-situ X-ray diffraction measurements at KEK-PF:BL-13A in order to evaluate the effect of nickel. The starting material of iron-nickel alloy with 20 mol% of Ni was prepared in an arc furnace in a pure Ar atmosphere. The foiled iron-nickel alloy was loaded into the sample hole of Re gasket, with distilled water. Pressures were measured by ruby fluorescence R1 line shift or calculated using the equation of state of ice VII. Nd:YAG laser was used to heat the alloy. The temperatures were determined by the thermal radiation from the heated sample. The experimental conditions were up to about 100GPa and 2000K.

(Fe,Ni)OOH, which structure was same as delta-AlOOH, was observed up to 32 GPa and 1400K, while (Fe,Ni)O was produced above 40GPa and over 1000K. The stability field of (Fe,Ni)OOH expands significantly to higher pressure region compared to the reaction of pure iron and water, which covers a 1000km depth of magma ocean. Therefore the reaction product would be (Fe,Ni)OOH rather than (Fe,Ni)O in the early Earth. In that case, there is a possibility that hydrogen in (Fe,Ni)OOH was not carried to the core because (Fe,Ni)OOH may react with the surrounding hydride minerals. Moreover, the slope of the reaction boundary becomes steep above 40GPa, which shows that iron-nickel alloy is difficult to react with water at the deeper mantle. In results, total hydrogen in the core was much less than the case of pure iron.