



実験報告書様式(一般利用課題・成果公開利用)

(※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。)

 Experimental Report 	承認日 Date of Approval 2015/6/29 承認者 Approver Takanori Hattori 提出日 Date of Report 2015/6/29
課題番号 Project No. 2014B0044 実験課題名 Title of experiment Property of iron hydride formed by the reaction of iron, silicate, and water under high pressure and high temperature 実験責任者名 Name of principal investigator Takehiko Yagi 所属 Affiliation University of Tokyo	装置責任者 Name of Instrument scientist Takanori Hattori 装置名 Name of Instrument/(BL No.) PLANET (BL 11) 実施日 Date of Experiment 2015/3/12~2015/3/17

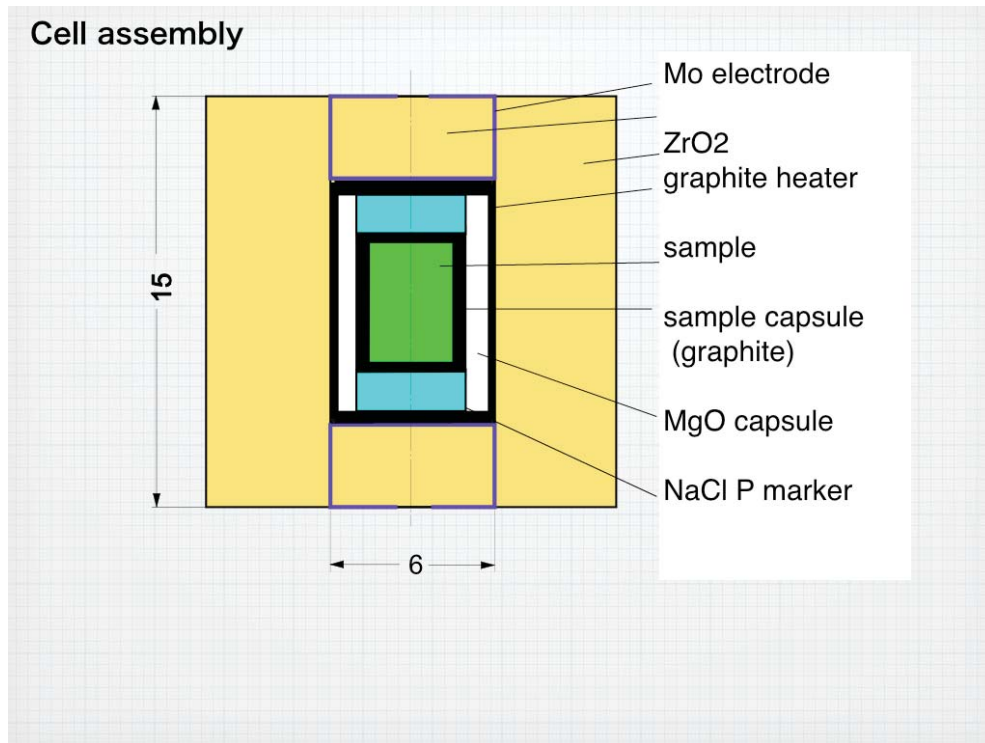
試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)
 Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

<p>1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.</p> <p>We made three high-pressure runs in the present machine time. Starting materials of these runs were an iron rod embedded in a 1 to 1 powder mixture of $Mg(OH)_2 + SiO_2$ or $MgO + SiO_2$. These samples were compressed to about 5 GPa at room temperature and then heated up to about 1000K. Powder neutron diffraction data were obtained on iron and silicates by changing the P-T conditions of the sample.</p>

2. 実験方法及び結果（実験がうまくいかなかった場合、その理由を記述してください。）

Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

Sample assembly of the present experiments is shown below.



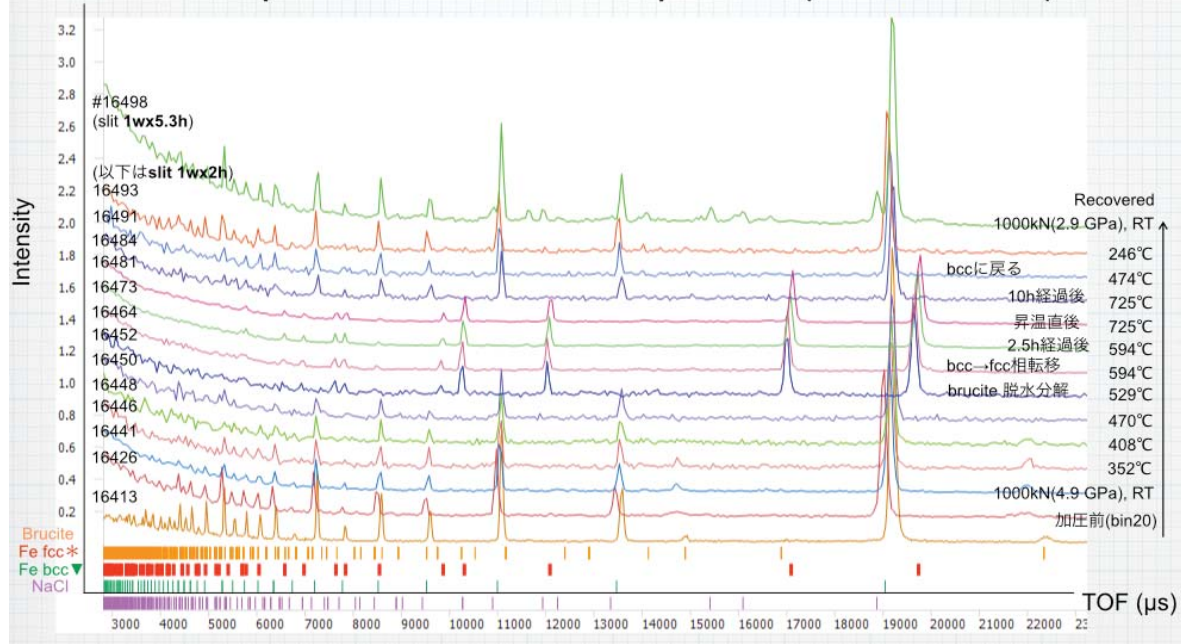
P-T conditions and the results of the experimental runs are summarized in the table below.

Summary of experiments

Run#	A0156	A0157(-8)	A0159	A0160	A0161
2nd Anvil	TEL10mm new TMS05	TEL10mm new TMS05	TEL10mm used TMS05		TEL10mm new TMS05
Cell assembly	ZrO ₂ cube (15mm) with baked pyrophyllite pre-gaskets				
Sample capsule	graphite capsule (initial sample V: Φ3.0mmx4.5 mmH)				
Target Load	1000 kN	1000 kN	-		1200 kN
Maximum P.	4.9 GPa	4.8 GPa	ambient pressure		~5.4 GPa
Maximum Temp.*1	725°C	725°C	RT		683°C
Initial Sample	Fe-Mg(OD) ₂ -SiO ₂	Fe-MgO-SiO ₂ without H ₂ O	Empty	Vanadium	Fe-Mg(OD) ₂ -SiO ₂
Recovered Sample*2	Fe + FeO Olivine Pyroxene	Fe + SiO ₂ Olivine	-	-	Fe + FeO Olivine Pxroxene

Examples of the diffraction patterns obtained in run A0156 are show below.

Examples of the diffraction pattern (Run #A0156)



2. 実験方法及び結果(つづき) Experimental method and results (continued)

Results and discussions

It was clearly showed in the present experiments that when the mixture of iron and hydrous silicates were heated at around 5 GPa, dehydration of hydrous mineral occurs at around 800K and then released water reacts with iron to form iron hydride. In this pressure range, iron transforms from bcc phase into fcc phase at around 900K and the amount of hydrogen dissolved into iron is much higher in fcc phase than in bcc phase. Volume increase of the fcc phase of iron was observed over the time period of 10 hours when the P-T condition was kept constant at around 4GPa and 1000K , This result suggests that the hydration of iron in this system occurs relatively slow, in contrast with the reactions in the system with pure iron and hydrogen.

It has been believed that the Earth was formed by the accumulation of meteorite which is a mixture of silicates and iron together with some amount of water contained in the hydrous minerals. After the formation of proto Earth, temperature inside the proto Earth started to increase by the released gravitational energy of the accumulated materials and heating by the radioactive elements. From the present study, we can say that through these processes, hydrogen or water contained in the primitive materials are inevitably dissolved into iron. Therefor we can conclude that at least part of the density deficit of the present Earth's core can be explained by the dissolution of hydrogen as a light element.