Impact of volatiles on the processes of formation and evolution of the Earth’s interior

Convener: *Bjorn Mysen (Geophysical Laboratory, Carnegie Inst. Washington), Eiji OHTANI (Graduate School of Science Tohoku University 6-3 Aoba, Aramaki, Aoba-ku Sendai 980-8578), Tatsuhiko KAWAMOTO (Univ. Kyoto Kyoto, 606-8502, JAPAN), Chair: Eiji Ohtani (Department of Earth and Planetary Materials Science, Graduate School of Science, Tohoku University)

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Characterization of the processes that govern the behavior, budget, and recycling of volatiles in the Earth’s interior is fundamental to our understanding of the formation and evolution of the solid Earth, its oceans, and atmosphere. In the proposed session, we will focus on theoretical, experimental, and observational characterization of solubility and solution mechanisms of C-O-H-N-S volatiles in molten and crystalline materials and of oxide components in C-O-H-N-S fluid in the pressure, temperature, composition and redox range of Earth’s past and current interior. The major session foci will be:

- Modeling the impact of C-O-H-N-S fluids on composition and evolution of the Earth via metasomatic and magmatic processes.
- Characterization of structure and properties in silicate-C-O-H-N-S melt, mineral, and fluid systems via theoretical modeling and high-temperature/-pressure experimental studies.
- Experimental characterization, at high temperature and pressure, of fractionation of components, compounds and isotopes in the C-O-H-N-S system between minerals, melts, and fluids.
- Element complexing in individual phases, interaction between silicate and trace and minor elements in fluids and melts at high temperature and pressure.
- Examine the principles on which to quantify property behavior and its application to natural processes that include fluids and melts.

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Stability of Hydrous phase H MgSiO2(OH)2 in the lower mantle

3-min talk in an oral session

*Yohei AMAIKE¹, Eiji OHTANI¹, Seiji KAMADA¹, Tatsuya SAKAMAKI¹, Suguru TAKAHASHI¹, Naohisa HIRAO², Yasuo OHISHI² (¹Department of Earth and Planetary Materials Science, Graduate School of Science, Tohoku University, 2Japan Synchrotron Radiation Research Institute)

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Subducting slabs transport water to Earth’s deep interior and its circulation on a global scale is the key to understanding the evolution of the planet. However, it is still a matter of debate how deep water can be transported. Therefore, there are many studies on phase relationships in hydrous minerals or MORB-H2O systems. Most dense hydrous magnesium silicates (DHMS) are stable up to 50 GPa (e.g., Komabayashi et al., 2004). Recently, the synthesis of Mg- and Si-bearing δ-AlOOH, which is a solid solution between 2AlOOH-MgSiO2(OH)2, was reported and it might be transported with Mg-perovskite or Mg-post perovskite up to 135 GPa (Ohira et al., 2012, AGU). Tsuchiya (2013) theoretically reported Phase H, the end member of the system, was stable above 45 GPa and up to 55 GPa. And also it was experimentally synthesized at 50 GPa (Nishi et al., 2014). Although the previous studies claimed that Phase H was broken down above 55 GPa, it may be a host phase of water in the deep Earth interior. Here, we report the stability field of a new candidate phase of water reservoir at the lower mantle conditions by investigating the MgO-SiO2-H2O system up to 75 GPa and 2000 K. A mixture of quartz and brucite (molar ratio 1:1) powders were used as starting materials. The high pressure and high temperature
experiments were performed by using a double-sided Laser heated diamond anvil cell. A pellet with thickness of about 15 μm was made by a cold compression technique. In situ XRD experiments in the MgO-SiO2-H2O system were performed at BL10XU, SPring-8. In this study we confirmed that hydrous phase H does exist in the MgO-SiO2-H2O system and its stability fields expands at least up to 75 GPa and above 2000 K in contrary with previous reports (Tsuchiya, 2013; Nishi et al., 2014). If Phase H exists under high pressure conditions corresponding to the pressure of CMB, it may transport water to CMB and thus the core may contains hydrogen as a light element.