Hydrogen incorporation to the Earth's core

HIDENORI TERASAKI[1], EIJI OHTANI[1], TAKESHI SAKAI[1],
SEIJI KAMADA[1], YUKI SHIBAZAKI[1],
HIDETOSHI ASANUMA[1], HIRAO NAOHISA[2],
YASUO OHISHI[2], NAGAYOSHI SATA[3],
TATSUYA SAKAMAKI[1], AKIO SUZUKI[1]
AND KEN-ICHI FUNAKOSHI[2]

[1]Dept. Earth Planetary Materials Science, Tohoku Univ
[2]Japan Synchrotron Radiation Research Institute
[3]IFREE, JAMSTEC

Water can be transported to the Earth's mantle in hydrous minerals. However, most of them are decomposed at a pressure smaller than 44 GPa (1250 km depth). Recently, δ-AlOOH phase is focused as a water carrier in the Earth's deep mantle. δ-AlOOH is a hydrous sediment component in the subducted slab and stable up to at least the core-mantle boundaty. If δ-AlOOH is transported to the core-mantle boundary by subducting slab, a reaction between δ-AlOOH and FeNi metal, the core material, is key factor for the light element in the Earth's core. Only a small amount of hydrogen may possibly acount for the density deficit of the core due to its small atomic weight. In this study, *in situ* X-ray diffraction study was conducted to determine hydrogen partitioning behavior between Fe-Ni metal and δ-AlOOH up to the core-mantle boundary conditions.

High pressure experiments were performed using multi-anvil press and diamond anvil cell at BL04B1 and BL10XU beamlines, SPring-8 synchrotron facility in Japan. Starting material was $Fe_{0.95}Ni_{0.5}$ foil or powder embedded with AlOOH powder. In the multi-anvil press experiment, the sample was enclosed in hBN capsule and heating was performed using TiB_2 cylindrical furnace. In diamond anvil cell experiment, heating was conducted using the fiber/YLF laser. X-ray diffraction of the sample was collected at high temperatures with 100-200 K step.

The results show that δ-AlOOH does not react with FeNi metal at low temperatures and then hydrogen dissolves into FeNi and hydride is formed together with (Fe, Ni)O and Al_2O_3 at high temperature in the wide pressure range of 19 – 121 GPa. Although the temperature of Fe-Ni hydride formation (hydrogenation) tends to increase with increasing pressure, this hydrogenation temperature is well below the mantle geotherm. Therefore, hydrogen is likely to dissolve into the Earth's core and only a small amount of hydrogen can account for the density deficit of the core.

In situ monitoring of the diurnal evolution of the dynamic metal species in the Riou-Mort river

M.-L. TERCIER-WAEBER*, T. HEZARD AND M. MASSON

University of Geneva, Dept.. of Inorganic, Analytical and Applied Chemistry, 1211 Geneva 4, Switzerland
(*correspondence: marie-louise.tercier@unige.ch)

The past decade studies performed in rivers and streams demonstrated that many trace metal and metalloid experience diurnal cycles, with total dissolved metal concentrations often changing one- to five-fold during a 24h period. However, most of these studies were performed in summer under low-flow conditions. Moreover, samples were collected hourly by hand for later laboratory analysis. This laborious sample collection and processing approach limits hourly sampling to 1–3 days at maximum. More frequent analysis is required to understand the seasonal occurrence and amplitude of diel metal cycles, and the processes controlling these cycles.

With this goal in mind, we applied an automated voltammetric analyzer to study, at time scale of hour and under contrasting bio-chemical and hydrological conditions, the diurnal evolution of Cd, Cu and Pb in the Riou-Mort river (France) impacted by polymetallic pollution resulting from former open-cast coal mining and Zn ore treatment. This analyzer is based on a bioanalogic microsensor which allows in situ real-time monitoring of the dynamic fraction, i.e. the potentially bioavailable fraction, of the target analytes. In parallel, T, pH, dissolved oxygen and conductivity were monitored in situ and water samples were collected for complementary analyses of the water composition.

Here, we summarise the original results of this work [1]. The data revealed that, in the studied river, the diurnal cycles of the Cd, Cu and Pb dynamic species were controlled by redox and sorption effects induced by either: pH diurnal cycle linked to metabolic activity of benthic biofilms; photoreduction of colloidal Mn oxides; and/or biofilm exudation of extracellular polymeric substances. We also observed that: the dynamic fraction of a given cationic metal can show diurnal cycle with opposite trends depending on the bio-chemical conditions; the trends of the diurnal dynamic metal species cycles may be different that those reported for the dissolved metal species. The importance of these findings is discussed in the context of interpreting existing data banks, assessing metal ecotoxicity impact, and designing more appropriate monitoring control strategies.

[1] Tercier-Waeber *et al*. (submitted) *Env. Sci. Technol.*