

## Enegetic insight into geo-electricity generation at deep-sea hydrotehmals vents

R. NAKAMURA

<sup>1</sup> RIKEN Center for Sustainable Resource Science, 2-1 Hirosawa, Wako, Saitama 351-0198, Japan (ryuhei.nakamura@riken.jp)

The black-smoker-type hydrothermal vent has been envisioned to act as a natural device for thermo-electrochemical fuel cells, where geo-electrical current is sustained by the steep geochemical disequilibrium with its unique slender columnar structure[1,2]. With the aid of electrocatalytic functions of hydrothermal chimney mounds, the geo-electricity has been also hypothesized to trigger the abiotic CO<sub>2</sub> reduction to form CH<sub>4</sub> and CO [3] and the formation of NH<sub>3</sub>, N<sub>2</sub>O, and NO via the reduction of nitrate and nitrite[4]. Therefore, understanding the energetics of electricity generation could provide valuable information for the comprehension of chemical evolution in the prebiotic ocean and, consequently the early evolution of energy metabolisms in the ancient Earth. In this presentation, I will present the physicochemical mechanisms how the steep disequilibrium of pH, redox, and temperature at hydrothermal vents is converted into electricity, which is followed by the conversion into chemical energy with the aid of electrocatalytic functions of Fe-sulfides and Mo-sulfides minerals. Recently discovered thermoelectric effects of chimney minerals[5] will be also introduced to gain physicochemical basis to understand the chemical/thermal/electricity conversion at the deep-sea hydrothermal vents.

[1] Nakamura *et al.* (2010) *Angew.Chem.Int.ed.*, **49**, 7692-7694. [2] Yamamoto *et al.* (2013) *Angew.Chem.Int.ed.*, **52**, 1075-10761. [3] Yamaguchi *et al.* (2014) *Electrochim. Acta.*, **141**, 311-318. [4] Yamei *et al.* submitted. [5] Ang *et al.* (2015) *Angew.Chem.Int.ed.* 54, 12909-12913.