In situ observation of electrical current generation in deep-sea

HASHIMOTO4 KEN TAKAI2,3 AND HYDROTHERMAL ENVIRONMENTS RYUHEI NAKAMURA1, MASAHIRO YAMAMOTO2,3, KAZUMASA OGURI2, SHINSUKE KAWAGUCCI2,3, KATSUHIKO SUZUKI1, AND KAZUHITO

1RIKEN Center for Sustainable Resource Science, Wako, Saitama 3510198, Japan, (ryuhei.nakamura@riken.jp)
2Institute of Biogeosciences, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Yokosuka, Japan
3Submarine Resources Research Project, JAMSTEC, Yokosuka, Japan
4Department of Applied Chemistry, School of Engineering, The University of Tokyo, Japan

Deep-sea hydrothermal vents discharge subsea floor hot and reductive fluids into cool and oxidative seawater. The inter-fluidal oxidation-reduction potential substantially drives various abiotic and biotic oxidation-reduction reactions and supports chemosynthetic ecosystems in the mixing zones. It is predicted that electric current is generated if the two solutions are connected by conductor with electrodes [1]. Here we conducted in situ electrochemical analyses of high temperature of hydrothermal fluids and ambient seawater. We succeeded in measurement of the oxidation-reduction potential as about -39mV at high temperature about 309˚C in deep-sea hydrothermal fluid. The voltammetry analyses indicated that the open circuit voltage between the hydrothermal fluid and ambient seawater bridged by platinum electrodes was up to 0.74 V but the average current density generated in the seawater cathode was much lower than that in the hydrothermal-fluid-anode. By harvesting the natural setting of potential steep, we for the first time show proof of in situ generation of electricity in a newly developed fuel cell installed in deep-sea hydrothermal vents and witness light emitting diode lamp lighting in dark deep-sea environment. The results provide important clues not only to understanding of extracellular electron transports in the deep-sea vent microbial communities but also to future development of in situ electric power plants that will supply the electricity for the exploration of deep-sea resources and the following observatories of the deep-sea environments and ecosystems.


Millennial-scale wet and dry climate changes during the last glacial maximum in the south Siberia

F.W. NARA1*, T. WATANABE1*, T. KAKEGAWA2, K. MINOURA3, S. YAMASAKI1, N. TSUCHIYA1, T. NAKAMURA3 AND T. KAWAI4

1Graduate School of Environmental Studies, Tohoku University, Sendai 980-8579, Japan. (narafumi@m.tohoku.ac.jp)
2Department of Earth and Planetary Materials Science, Graduate School of Science, Tohoku University, Sendai, 980-8578, Japan
3Center for Chronological Research, Nagoya University, Nagoya, 464-8602, Japan
4Association of International Research Initiatives for Environmental Studies, Tokyo, Japan

To investigate the millennial-scale wet and dry climate changes in the south Siberian region for the last 33 kyr, the centennial scale analysis (less than 70 years) of the the inorganic elements (e.g. K and Ti) for the Lake Baikal sediment core (VER99G12) were carried out. The fluctuation of the K/Ti ratio during the last glacial maximum period (LGM; 26–19 cal kyr BP) was observed (Fig. 1). Because of the susceptible to water leaching of K comparing to Ti in soil environment, this fluctuation indicates the millennial-scale wet and dry climate changes during the LGM in the south Siberian region. Also, the increase in the precipitation at the climate transition period between OIS2 and 1 (OIS2/1, 11.5 cal kyr BP) was indicated by the significant decrease in the K/Ti ratio. The result of the grain size distribution of the same core is also discussed as well.