POSSIBILITY OF ELECTRO-ECOSYSTEM AROUND DEEP-SEA HYDROTHERMAL VENTS.

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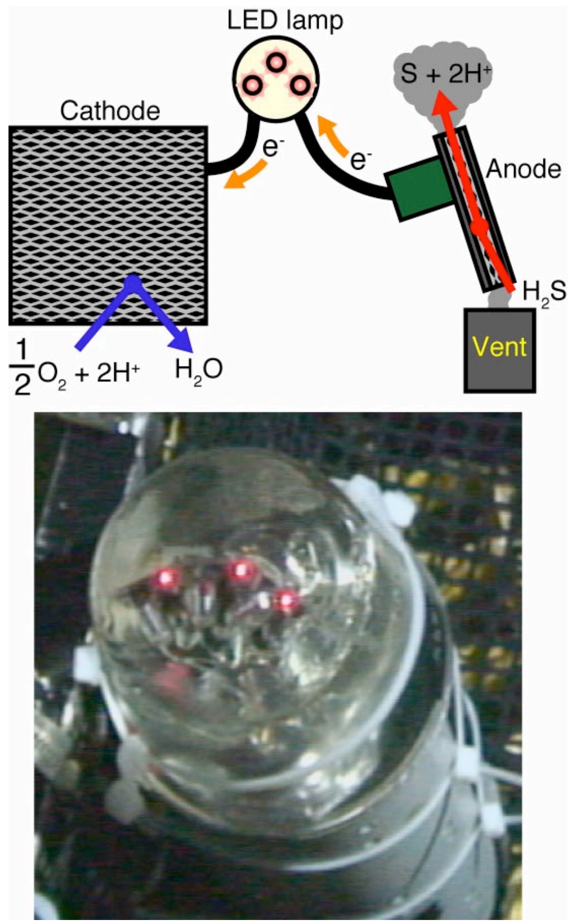
Introduction: A Deep-sea hydrothermal vents discharge subseafloor hot and reductive fluids into cool and oxidative seawater. The inter-fluidal oxidation-reduction potential substantially drives various abiotic and biotic oxidation-reduction reactions and supports chemosynthetic ecosystems in the mixing zones. It has been predicted that an electric current will be generated if the two solutions are connected by a conductor with electrodes. Here, we used in situ electrochemical analyses and installation of a fuel cell on the vents to demonstrate that deep-sea hydrothermal vents have the ability to generate electricity [1]. We successfully measured the oxidation-reduction potential (ORP) at high temperatures of approximately 309˚C in deep-sea hydrothermal fluids (i.e., approximately -39 mV versus standard hydrogen electrode). Deffernce of ORP between the hydrothermal fluid and ambient seawater bridged was 0.52 V. We have provided the first evidence of in situ generation of electricity in a newly developed fuel cell installed in deep-sea hydrothermal vents and witnessed the illumination of a light emitting diode (LED) lamp in a dark deep-sea environment. Moreover, we have shown that sulfide minerals of chimney wall formed around the deep-sea hydrothermal vents have high electric conductivity and electrocatalytic activities [2]. These results suggest that hydrothermal vent chimney walls can generate a continuual flow of electrons from inside hydrothermal fluid to outside seawater. This implies that at least a portion of the chemolithotrophic microbial components living in chimney habitats may directly utilize the electrons transported from the hydrothermal fluids via the sulfide crystal network as not only the reductive electron donors but also an energy source. In addition, the potential electron transfer may be associated with the prebiotic synthesis of organic compounds in ancient deep-sea hydrothermal environments. This expectation of the electroecosystems will provide important insights into understanding of microbial ecosystems and chemical processes in the present and ancient deep ocean.



References:

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