Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

BGM22-09 Room:105 Time:May 26 11:30-11:45

Ecological and mineralogical characteristics of Fe-oxidizing microbial communities in a shallow hydrothermal mound

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Microbial Fe-oxidation has been mainly studied at deep-sea hydrothermal vents because the low concentration of oxygen and high concentration of ferrous ion was preferable for Fe-oxidizing bacteria that have to compete with abiotic Fe-Oxidation. However, microbial Fe-oxidization in shallow, fully oxygenated environments has been still largely unknown. In this study, we aim to reveal the ecology and role for mound formation of Fe-oxidizing bacteria at iron oxyhydroxide-rich hydrothermal mounds developing in Nagahama Bay, Satsuma-Iwojima where we observed dense assembly of twisted stalks, typical signature of microbial Fe-oxidation. Core samples were taken from the iron oxyhydroxide-rish mound and used for sequencing and microscopic analysis. Microscopic observation indicated the highest occurrence of stalk structure was observed at around 20 cm from the surface. Sequencing of 16S rRNA gene of prokaryotic communities (>100,000 reads/sample) revealed that Anaerolineae known as obligately anaerobic heterotroph was highly dominated at ˜40% throughout all depths down to 40 cm from the surface of the mound, inferring anaerobic circumstances in the sediment. We also found Fe-oxidizing Zetaproteobacteria in all depths and its population was determined to be up to 4%. Network analysis of microbial communities revealed that appearance of the Zetaproteobacteria coincided with some anaerobic sulfur reducing bacteria, indicating that the Zetaproteobacteira lived in ecological niche of oxic-anoxic interface in the mounds. Seismic data indicated that those mounds grow ˜1cm/yr which is much faster than the abiotic deposition occurring at the surrounding diffuse hydrothermal venting seafloor. Overall, our results indicated that Zetaproteobacteria may accelerate deposition of Fe species in hydrothermal fluid and formation of iron oxyhydroxide-rich mounds in the Nagahama-bay, Satsuma-Iwojima.

Keywords: Hydrothermal mound, Fe-oxidizing bacteria, microbial ecology