Microbial community in brucite-carbonate chimneys discovered in the Shinkai Seep Field, the deepest serpentinite-hosted vent system in the Southern Mariana Forearc

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Serpentinite-hosted fluid vent systems have attracted great interest as unique modern deep-sea chemosynthetic ecosystems and as analogues for the origin and early evolution of early on Earth as well as for extraterrestrial life such as on Mars and Enceladus. During expeditions since 2013 to 2016, brucite-carbonate chimneys were discovered from the deepest known (~5700 m depth) serpentinite-hosted ecosystem –the Shinkai Seep Field (SSF) in the southern Mariana forearc [1]. Here we report geobiological characteristics of the SSF chimneys, as a new type of chemosynthetic microbial habitat at a serpentinite-hosted vent system.
Previous explorations of SSF led to the discovery of fourteen vesicomyid clam colony sites and five chimney sites occurring within an area of 500 square meters. Textural observations and geochemical analysis reveal three types (I-III) of chimneys formed by the precipitation and dissolution of constituent minerals [2]. Type I chimneys are bright white to light yellow, have a spiky crystalline and wrinkled surface with microbial mat and mainly consist of brucite; these formed as a result of rapid precipitation under high discharge conditions of alkaline fluid. In this type of chimneys, filamentous microbial cells were often mineralized by brucite. Type II chimneys exhibit white to dull brown coloration, tuberous fluid pass textures, and are covered with grayish microbial mats and colonies of *Phyllochaetopterus*. This type of chimney is characterized by inner brucite-rich and outer carbonate rich zones and is thought to have precipitated from lower fluid discharge conditions than type I chimneys. Type III chimneys are ivory colored, have surface depressions and lack living microbial mats or animals. This type of chimneys mainly consist of carbonate, and are in a dissolution stage after alkaline fluid input ceased.
Small subunit rRNA gene tag sequences showed that prokaryotic community compositions varied with the chimney types, reflecting the hydrologic and biogeochemical processes. For example, alkaliphylic bacteria were abundant in type I chimneys and diverse symbiotic bacterial strains were identified in type II chimneys. The former likely reflects higher flux of alkaline fluid, whereas the latter possibly reflects higher biomass of faunal community on type II chimneys. Unique characteristics observed in the SSF chimneys shed light on the variability of subseafloor and seafloor geochemical and geobiological processes supporting the serpentinite-hosted exosystems.
References
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