Deep Microbial Colonization in Saponite-Bearing Fractures in Aged Basaltic Crust: Implications for Subsurface Life on Mars

*Yuri Sueoka[1], Seiya Yamashita[1], Mariko Kouduka[1], Yohey Suzuki[1]

1. Graduate School of Science, The University of Tokyo

One of the most promising planetary bodies that might harbor extraterrestrial life is Mars, given the presence of liquid water in the deep subsurface. The upper crust of Mars is mainly composed of > 3.7-billion-year-old basaltic lava where heat-driven fluid circulation is negligible. Earth’ s oceanic crust composed of basaltic lava is recognized as the analogous crustal environment to the Martian subsurface. The basaltic crust tends to cool down for 10–20-million-years after formation. However, microbial life in old cold basaltic lava is unknown in large part even in the Earth’ s oceanic crust, because of the lack of vigorous circulation preventing sampling of pristine crustal fluid from boreholes. Alternatively, investigation of deep microbial life using pristine drill cores obtained from basaltic lava is important. We investigated a basaltic rock core sample with mineral-filled fractures drilled during Integral Ocean Drilling Project Expedition 329 that targeted 104-million-year-old oceanic crust. It was revealed that fractures/veins were filled with Mg-rich smectite called saponite and calcium carbonate by mineralogical characterizations of fracture-infilling minerals. The organic carbon content from the saponite-rich clay fraction in the core sample was 23 times higher than that from the bulk counterpart, which appears to be sufficient to supply energy and carbon sources to saponite-hosted life. Furthermore, our method developed newly to detect microbial cells in a thin-section of the saponite-bearing fracture revealed the dense colonization of SYBR-Green-I stained microbial cells spatially associated with saponite. These results imply that the presence of saponite in old cold basaltic crust is favorable for microbial life. In addition to carbonaceous chondrite, saponite is a common product of low-temperature reactions between water and mafic minerals on Earth and Mars. Therefore, it is expected that deep saponite-bearing fractures could host extant life and/or the past life on Mars.

Keywords: water-rock interactions, Fe, Mg-smectite

