

Petrologic and geochemical study of microbial alteration in the Ibara greenstones, southwestern Japan

Hisanari Sugawara^{1*}, Masayuki Sakakibara¹, Minoru Ikehara²

¹Ehime Univ., ²CAMCR, Kochi Univ.

Study of microbial alteration textures in oceanic crust gives a huge impact on the actual amount of total biomass, diversity of life, elemental cycles in the earth, and searching life on other planets. Present ocean-floor basaltic rocks have been the primary targets for most studies of microbial alteration, and little have been discussed on recrystallized bioaltered textures by metamorphism. Most ancient oceanic crust outcropped on land have experienced metamorphism, and the criteria to identify recrystallized alteration textures as microbial alteration textures is critical. Therefore in this study, metabasalts from early to middle Permian Ibara dismembered ophiolite from the Maizuru tectonic belt, southwest Japan are examined by means of metamorphic petrology and carbon isotopic analysis. Original structures and textures are well-preserved in the Ibara metabasalts. The Ibara metabasalts are divided into three zones based on their metamorphic mineral assemblages; zone I for prehnite-pumpellyite facies, zone II for greenschist facies, and zone III for amphibolite facies. The mineral assemblages and chemistry suggest that all zones have experienced a low-pressure metamorphism, and the distribution of metamorphic mineral assemblages indicates it as the ocean-floor metamorphism. Microbial alteration textures found from clacks within quench glass of the basaltic pillow lavas are morphologically divided into tubular and granular textures. Tubular alteration textures are observed as less than 150 micrometers in length, and they are made up with granular textures with approximately 10 micrometers in diameters. SEM observation revealed that alteration textures have substituted as titanites with their original textures preserved. These alteration textures resemble reported microbial alteration textures along clacks of modern oceanic pillow lavas. The total of 67 carbonate samples from calcite veins and pools present in 23 metabasalt rock samples are measured by the mass spectrometer in order to obtain $d^{13}C_{PDB}$ values. Resulted data vary from -14.1 to +3.0 per mil., and 18 carbonate samples exhibit $d^{13}C_{PDB}$ values lower than -7.0 per mil. which imply the bacterial activity prior to the formation of calcite veins or pools. The observation suggests that microbial alteration textures are well-preserved thorough prehnite-pumpellyite metamorphism. The criteria for the identification of microbial alteration textures are as follows: (1) Target rock samples should not be suffered from shearing deformation so that it preserves its original structure; (2) Alteration textures should preserve its original amorphous morphology after recrystallization by ocean-floor metamorphism; (3) Morphological characteristics should resemble with previously reported microbial alteration textures discovered from in-situ ocean floor ; and (4) $d^{13}C_{PDB}$ values of carbonates in rock samples should be lower than -7.0 per mil. which implies the bacterial activity.

Keywords: bioalteration texture, Permian, metabasalt, pillow lava