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Filamentous microbial fossils from Paleozoic metabasalts of Northern Chichibu Belt in western and central Shikoku Japan

Masayuki Sakakibara^{1*}, Hisanari Sugawara¹, Tomohiro Tsuji³, Minoru Ikehara²

¹Ehime University, ²Kochi University, ³Shikoku Research Institute Inc.

Metabasaltic rocks from Northern Chichibu Belt in western and central Shikoku, Japan, were found to contain filamentous microbial fossils that indicate that seafloor microbial life once proliferated within these rocks.

These fossils occur as mineralized filaments in carbonate, quartz or pumpellyite domains. Microbial clay authigenesis analogous to the encrustation of prokaryotes in modern iron-rich environments led to the preservation of filaments. The filaments predominantly consist of iron oxide, phengite and pumpellyite. They were found from the northern Chichibu metabasalt.

Delta 13C values in calcite from fossil-bearing metabasalts range from -2.49 to +0.67 per mil in the northern Chichibu belt.

The biogenicity of the filaments is indicated by (1) their size, shape, and branching patterns, which resemble those of modern microorganisms, especially in terms of a constant diameter along the length of curved filaments; (2) the lack of a relationship between filament location and crystal faces or cleavage planes; and (3) their spatial clustering in interstitial domains within basalt.

The putative filamentous microorganisms thrived after the formation of basalt, during the late Paleozoic but before the Early Jurassic timing of accretion. The present results indicate that cryptoendolithic life was once present within water-filled vesicles of pre-Jurassic intraplate basalts. The filament mineralogy can be explained by the low-grade metamorphic recrystallization of authigenetic microbial clay formed by the encrustation of prokaryotes in modern iron-rich environments. This finding suggests that a previously unrecognized niche for life exists within intraplate volcanic rocks in low-grade metamorphosed accretionary complexes.

Keywords: western and central Shikoku, accretionary complex, Northern Chichibu Belt, Paleozoic, basalt, filamentous microbial fossil