Microbial communities and their activities in deep crustal environments

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Igneous rocks have been massively produced on Earth, since ~4.0 Ga, an age of the oldest rock known as Acasta Gneiss originally composed of granite. Bio-signatures are also reported from the ~3.5 Ga old Barberton and Pilbara greenstone belts. Given that the photosynthetic ecosystem emerged after ~3.5 Ga, the early life appears to be independent of photosynthetic products in igneous rocks. In contrast to the surface ecosystem substantially influenced by photosynthesis, deep igneous rocks produced by cooling of magma are considered to be devoid of organic matter and analogous to the early Earth’s habitat. Although the deep crustal biosphere is potentially distributed over 80% of the current Earth’s surface area, it is unknown if microbial activities are supported solely by energy sources available within igneous rocks. To unveil the deep crustal biosphere, it is necessary to drill deep igneous rocks without introducing photosynthetic products. Granite drilling from underground tunnels in Japan and Switzerland and basalt drilling in South Pacific Gyre will be presented to show the habitability and microbial communities of deep igneous rocks and the possibility of methane as the major energy source.

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