Subseafloor basalts as fungal habitats

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The oceanic crust makes up the largest potential habitat for life on Earth, yet next to nothing is known about the abundance, diversity and ecology of its biosphere. Our understanding of the deep biosphere of subseafloor crust is, with a few exceptions, based on a fossil record. Surprisingly, a majority of the fossilized microorganisms have been interpreted or recently re-interpreted as remnants of fungi rather than prokaryotes [1-4]. Even though this might be due to a bias in fossilization the presence of fungi in these settings can not be neglected.

We have examined fossilized microorganisms in drilled basalt samples collected at the Emperor Seamounts in the Pacific Ocean. Synchrotron-radiation X-ray tomography microscopy (SRXTM) studies has revealed a complex morphology and internal structure that corresponds to characteristic fungal morphology. Chitin was detected in the fossilized hyphae, which is another strong argument in favour of a fungal interpretation. Chitin is absent in prokaryotes but a substantial constituent in fungal cell walls.

The fungal colonies consist of both hyphae and yeast-like growth states as well as resting structures and possible fruit bodies, thus, the fungi exist in vital colonies in subseafloor basalts. The fungi have also been involved in extensive weathering of secondary mineralisations. In terrestrial environments fungi are known as an important geobiological agent that promotes mineral weathering and decomposition of organic matter, and they occur in vital symbiosis with other microorganisms. It is probable to assume that fungi would play a similar role in subseafloor basalts and have great impact on the ecology and on biogeochemical cycles in such environments.

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Simultaneous measurement of CCN activity and chemical composition of fine aerosols at Noto peninsula, Japan, in autumn 2012

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For the quantitative evaluations of cloud condensation nucleus (CCN) characteristics in the East Asia, CCN activity and chemical composition of atmospheric aerosols in submicrometer size range were measured at Noto Ground-based Research Observatory (NOTOGRO), located at the tip of Noto peninsula, facing the Sea of Japan, in autumn 2012.

In the atmospheric measurement, the CCN efficiency spectra, where CCN number fraction is plotted against the diameter of aerosols, were obtained at four different supersaturation (SS) conditions (0.1%, 0.2%, 0.5% and 0.8%). Hygroscopicity parameters κ [1], which depends on the chemical composition of aerosols, were estimated by the analysis of the CCN spectra. The bulk chemical composition of non-refractory submicrometer-sized aerosols was also measured by an aerosol chemical speciation monitor (ACSM).

The CCN activation diameters of ambient aerosols were clearly larger than those of pure ammonium sulfate under each SS condition. From the relationship between the estimated κ values and the CCN activation diameters, it was suggested that organics contributed to the aerosol mass especially in the size range of less than 100 nm. The contribution of organics observed in this study, based on the analysis of CCN spectra, was more apparent than those for other sites in East Asia [2, 3]. The bulk chemical composition derived by ACSM also indicated the significant mass fraction of organics in the submicrometer size range. The negative correlations between organic mass fraction and cloud droplets' diameters were observed especially under low SS conditions ($<\sim 0.2\%$), suggesting that the initial growth rates of cloud droplets might slow by certain organics.

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