

Unique microbial ecosystems of Antarctica

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Antarctic freshwater ecosystems are generally considered to be simplified food webs dominated by microorganisms, among which cyanobacteria often form mat consortia on lake bottoms. In association with microbial mats, the aquatic moss *Leptobryum wilsonii* forms unique tower-like structures called “moss pillars” reported so far only in East Antarctica. Previous analyses on rDNA genotyping showed that bacterial communities differed among the exterior, upper-interior, and lower-interior sections of the pillars and that more than 60% of the observed 16S rDNA phylotypes were novel taxa at the species, genus, or class levels (Nakai *et al.*, 2012). In addition, uncultivated ultra-small bacterial groups known as candidate divisions OP11 and OD1 representing new phylum-level lineages, were obtained from the lowest section of the exterior (Nakai *et al.*, 2012). Ultra-small microorganisms, or ultramicrobacteria, that pass through 0.2- μ m-pore-size filters used for removing microorganisms have recently been observed in various Antarctic environments (*e.g.*, Nakai *et al.*, 2013; Kuhn *et al.*, 2014). Although the reduction of cell size has been described as a strategy to maintain cell integrity in extremely cold environments (Ponder *et al.*, 2008), the species diversity and ecological function of ultramicrobacteria was unknown. There is a cultured species in the newly described bacterial class *Oligoflexia* that during their life cycle change in morphology from filamentous to ultrasmall cocci (Nakai *et al.*, 2014). The novel phylotypes belonging to *Oligoflexia* were also found in glacial ice (Nakai and Naganuma, 2015). Ultramicrobacterial populations thus contain some phylogenetically unique species. We have now attempted to cultivate ultramicrobacteria from various samples obtained during the 56th Japanese Antarctic Research Expedition (JARE-56) and will expound on the progress of our research in this presentation.

References

- Kuhn E, Ichimura AS, Peng V, Fritsen CH, Trubl G, Doran PT, Murray AE (2014) Brine assemblages of ultrasmall microbial cells within the ice cover of Lake Vida, Antarctica. *Applied and Environmental Microbiology*, **80**, 3687–3698.
- Nakai R, Abe T, Baba T, Imura S, Kagoshima H, Kanda H, Kanekiyo A, Kohara Y, Koi A, Nakamura K, Narita T, Niki H, Yanagihara K, Naganuma T (2012) Microflorae of aquatic moss pillars in a freshwater lake, East Antarctica, based on fatty acid and 16S rRNA gene analyses. *Polar Biology*, **35**, 425–433.
- Nakai R, Naganuma T (2015) *Oligoflexia*, the newest class of the phylum *Proteobacteria*, consisting of only one cultured species and uncultured bacterial phylotypes from diverse habitats. *Journal of Phylogenetics & Evolutionary Biology*, **3**, 141. doi:10.4172/2329-9002.1000141
- Nakai R, Nishijima M, Tazato N, Handa Y, Karray F, Sayadi S, Isoda H, Naganuma T (2014) *Oligoflexus tunisiensis* gen. nov., sp. nov., a Gram-negative, aerobic, filamentous bacterium of a novel proteobacterial lineage, and description of *Oligoflexaceae* fam. nov., *Oligoflexales* ord. nov. and *Oligoflexia* classis nov. *International Journal of Systematic and Evolutionary Microbiology*, **64**, 3353–3359.
- Nakai R, Shibuya E, Justel A, Rico E, Quesada A, Kobayashi F, Iwasaka Y, Shi G-Y, Amano Y, Iwatsuki T, Naganuma T (2013) Phylogeographic analysis of filterable bacteria with special reference to *Rhizobiales* strains that occur at cryospheric habitats. *Antarctic Science*, **25**, 219–228.
- Ponder MA, Thomashow MF, Tiedje JM (2008) Metabolic activity of Siberian permafrost isolates, *Psychrobacter arcticus* and *Exiguobacterium sibiricum*, at low water activities. *Extremophiles*, **12**, 481–490.