**Introduction**

- **Radiation Cold Dry**
- **Mars?? Earth**

**ROCK, Refuge of LIFE !!!**

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**Study area & Materials**

- Svalbard
  - Norwegian archipelago by the Arctic Ocean
  - Location: 74° ~ 81° north latitude
  - 10° ~ 35° east longitude
  - Average temperature: 4 ~ 6 °C (summer), −16 ~ −12 °C (winter)
  - Martian analogue sites: AMASE program
  - Materials: Limestone and Sandstone (triplicate)

**Objectives**

- **To investigate the major members of microbial communities colonizing lithic environments of cold and dry region**
- **To examine the effects of rock type on community structure in a single geographic location**

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**Results**

1. **Microbial Community Composition in Rocks**

   **Fig. 1 Relative abundances of dominant microbial taxa in rock samples.**
   - (A) Archaeal community composition at family level
   - (B) Bacterial community composition at phylum level
   - (C) Eukaryotic community composition at family level
   - (D) Fungal community composition at class level

   **Fig. 2 Principal coordinate analysis (PCoA) of rock-inhabiting archaeal communities (A), bacterial communities (B), eukaryotic communities (C), and fungal communities (D).** The analysis was based on the Bray-Curtis similarity matrix constructed using the square-root-transformed OTU.

   - Points that are closer together on the ordination have communities that are more similar.

2. **Distinct Microbial Communities between Limestone and Sandstone**

   - At high level of taxonomic resolution, we did not detect any significant correlations between rock type and community composition (Fig. 1). In both limestone and sandstone, archaeal communities were dominated by Thaumarchaeota.
   - At the phylum level, the bacterial communities were dominated by five bacterial phyla, Actinobacteria, Acidobacteria, Proteobacteria, bacteroidetes, and planctomycetes in both rock types.
   - In eukaryotes, opisthokonta was the most abundant group across the entire rock samples. For fungi, Ascomycota was the most abundant phylum across the entire sample set. At the class level, the rock fungal communities were dominated by two fungal classes: Eurotiomycetes, Lecanoromycetes.

3. **Distinctly Abundant OTUs between Limestone and Sandstone**

   - Given the distinct clustering pattern in community composition by rock types, we further investigated in more detail what microbial taxa determine more strongly the distinct community composition in different rock type (Table 1).
   - Various genera were preferentially abundant in each rock type. For example, Nitrososphaera, Hymenobacter, Acreobasidiaceae, and Herpotrichiellaceae were more abundant in limestone, whereas CP012850_g, Angustibacter, and OTU00193 were found more abundantly in sandstone.
   - These results suggest that substrate preferences are found when one looks at fine taxonomic resolution.

**Further study**

- Ongoing work examining site-specific factors such as substrate chemistry, microclimate, and host rock structure will help clarify how microbial populations and population diversity have evolved in this high Arctic cold desert habitat.

**Conclusion**

- **Rock-inhabiting microbial communities living in high Arctic region revealed a high diversity of organisms.**
- **Rock-inhabiting microbes seem to be influenced by ROCK TYPE at fine taxonomic level.**
- **Some microorganisms show preference according to rock type.**

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