Diversity and Potential Availability of Polar Microbial Resources

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Related International Research Project
No related international research projects

Description of the Program
Objectives.
Extremely cold and dry terrains of the Antarctica are among the most severe habitats on the Earth, and may be inhabited by selected extremophilic or extremotolerant microorganisms, at least more dominantly than in other normal habitats. On the other hand, the Arctic terrains may have experienced microbial successions due to the change in ice coverage by cyclic glaciation and deglaciation. Those polar microbial communities are expected to involve novel and/or beneficial species, and thus the construction of a polar microbial culture collection has been needed. This research program targets at: 1) basic understanding of evolution and phylogeny of polar microorganisms, and 2) industrial assessment of unique characteristics of polar microorganisms as potential biological resources.

Study sites.
This research program focuses on four study areas of 1) vegetated terrains, 2) dry terrains, 3) ponds and lakes, and 4) glaciers and sub-glacier lakes.

(1) Vegetated terrains: Mosses are the highest plants in the Antarctic...
vegetation, except part of Antarctic Peninsula. Rich moss vegetations are known and well investigated at Yukidorizawa near Syowa Station (Japan) and Edmonson Point near Terra Nova Bay Station (Italy). In addition, the Arctic field laboratory in Ny-Ålesund, Svalbard, accommodates plant ecological surveys to be linked with systematic microbiological investigations.

(2) Dry terrains: Antarctic deserts are characterized with extreme cold and dryness, which is supposed to be analogous to Martian terrains. These deserts are found in McMurdo Dry Valleys and around Terra Nova Bay Station.

(3) Ponds and lakes: Limonological data of the ponds and lakes near Syowa Station have been accumulated as the results of the Research on Ecology and Geohistory of Antarctic Lakes (REGAL) Project, National Institute of Polar Research (NIPR, Japan), and are available at the web site http://polaris.isc.nipr.ac.jp/~penguin/Terrestrial/regal/DataBase/index.htm.

(4) Glaciers and sub-glacier lakes: Glaciers are regarded as "time capsules" over the past 500,000 years or so, and sub-glacier lakes are taken as "lost world" isolated from the outer world over the past several hundred thousands years. These unique habitats may harbor "less evolved" microorganisms and thus provide mines of "living microbial fossils". Target sites are the Vostok Station and Lake Vostok (US and Russia), Dome C (France-Italy), and Dome F (Japan).

F-3 Study term.

It will take 5 years to conduct the full-scale investigation at any study sites listed above as follows, and totally 8 years (2007-2014) will be needed if studies at different sites (4 areas) start in different years:

(1) Year 1: General sample collection (for constructing a primary culture collection)
(2) Year 2: Specific sample collection (for determining physiological and biochemical activities)
(3) Year 3: In situ measurements of physiological and biochemical activities (working hypotheses)
(4) Year 4: Long-term in situ monitoring of targeted parameters (accumulation of continuous data)
(5) Year 5: Test of the working hypotheses

Study methods and requirements.

Standard microbiological methods will be applied, including the following factors:

(1) Logistics: Microbiological samples often require prompt experimental treatments and fast transportation accordingly. Such transportation may include the uses of helicopters and other aircrafts, rather than the surface-moving snowmobiles. It is very realistic that microbiological surveys would make "piggy bag" expeditions on other large-scale flight transportations.

(2) Field laboratories: Microbiological surveys often need temporal or long-term field laboratories for promptest treatments and in situ experiments.

(3) Ice-core boring: It is more realistic to conduct ice-core boring with experts from other fields than to do only by microbiologists or to do...
without microbiologists. Special cares and protocols must be taken into account to prevent or minimize contamination.

(4) Routine protocols: Microbiological sample should be cared for prevention or minimization of unnecessary contamination. Using cared samples, common basic data such as (i) total counts and (ii) 16S rDNA-based microflora should be collected as routine measurements.