

Evaluation of Microbial Activity in Antarctic Soils with Amino Acid Concentration and Phosphatase Activity

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Antarctica is a frontier of terrestrial biosphere with a cold, dry, high-UV and high radiation environment. In order to evaluate microbial activities in such extreme environments, we analyzed amino acids and phosphatase activity in Antarctica soil samples.

Antarctic soil samples were collected near Showa Station during the 47th and 49th Japanese Antarctic exploration mission in 2004-5 and 2006-7. Reference samples used were surface soil collected in the campus of Yokohama National University. Sea sand after heated at 773 K was used as blank.

Amino acids in soil samples were analyzed after digestion with 5 M HF and 0.1 M HCl at 383 K for 24 h in a Teflon vessel, followed by acid-hydrolysis with 6 M HCl and desalting with Bio-Rad AG-50 resin. Amino acids were determined by HPLC (Shimadzu LC-10 Amino Acid Analyzer). D/L ratio was measured by GC/MS method after derivatization with chloroformate.

Alkaline phosphatase (APase) activity was directly measured spectrometrically at 410 nm after mixing the soil samples and p-nitrophenyl phosphate (substrate), or fluorometrically with 4-methylumbryferyryl phosphate as a substrate after extraction with Tris buffer. Characteristics of APases in soil samples were also examined with the fluorometrical assay.

Amino acid concentration of Antarctic soil No. 5 (surface) was 112 nmol/g, which was much less than that in soils with higher biological activity. D/L ratio of alanine was 0.18 (Site 5) and 0.06 (Site 8); negative correlation was found between the D/L value and biological activity.

APase activity in soils with high biological activity (e.g., Site 4) was higher than that with low biological activity (e.g., Site 5). APase in Antarctic soil showed lower optimum temperature than that in campus soil. APase activity showed strong positive correlation with amino acid concentration. These results showed that amino acids, their D/L ratio and APase activity are good indicators of biological activity in extreme environments.

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