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CHIRALITY AS A BIOMARKER: A NEW APPROACH FOR LIFE DETECTION

The extent to which organisms can survive extended periods of metabolic inactivity in cold environments is one of the key questions in the study of life in extreme environments. Viable bacteria have been cultured from million-year-old Siberian permafrost samples, but the relationship between the age of the bacteria and the age of the sediments remains controversial. We analyzed the level of racemization of amino acids in permafrost samples collected from several sites in Northern Siberia as a part of our investigation of prokaryotic and eukaryotic organisms preserved for geological time at low temperatures. We have evidence from preliminary studies of permafrost samples that even during long exposures to negative temperatures the bacterial cells in permafrost are not completely dormant, but continue to metabolize and at least partially control the extent of amino acid racemization. We extended the application of our method based on measurements of amino acid racemization and used it for life detection in water columns of lakes in the McMurdo Dry Valleys and in glacial and accretion ice above subglacial Lake Vostok. We have shown that samples thought to contain viable cells demonstrated the ability to convert D-amino acid into L-amino acid after placing them at positive temperatures. We interpreted these observations as an indication that viable metabolizing cells are present in ice above Lake Vostok, even though cell growth (multiplication) was low or not detected.