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Microbial methane cycling in Subglacial Lake Whillans, West Antarctica

Alexander B. Michaud, John E. Dore, Mark L. Skidmore, Trista J. Vick-Majors, John C. Priscu

Department of Land Resources and Environmental Science, Montana State University, Bozeman, MT 59717

Department of Earth Sciences, Montana State University, Bozeman, MT, 59717

Abstract:
Aquatic microbial ecosystems have recently been shown to exist beneath the Antarctic ice sheet. We present the first data on methane dynamics in the water column and sediments of Subglacial Lake Whillans, West Antarctica. $\delta^{13}C\text{-}CH_4$ values ranged from -77‰ to -70‰ indicating that the methane was produced biologically by methanogenic Archaea. A potential carbon and energy source for these microorganisms is relict marine organic carbon deposited during past interglacial cycles. Profiles of methane in the water column and sediment indicate that the methane is diffusing upward towards the water column and oxidized in the surficial sediments. Methane monooxygenase, an enzyme that catalyzes the first step of aerobic methane oxidation, was detected through molecular analysis of the *pmoA* gene sequence. *pmoA* gene sequences found in SLW sediments are highly (>95%) related to *Methylobacter tundripaludum*, which was one of the most abundant taxonomic units in the bacterial community 16S rRNA gene sequence library. Our data suggest that sediment methane is oxidized via methanotrophic bacteria indicating that, despite a large sedimentary methane pool beneath the ice sheet, oxidative processes may be a large sink for subglacial methane.