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Biogeochemical and historical drivers of microbial community composition and structure in sediments from Mercer Subglacial Lake, West Antarctica

Christina L. Davis[1], Ryan A. Venturelli[2], Alexander B. Michaud[3,29], Jon R. Hawkings[4], Amanda M. Achberger[5], Trista J. Vick-Majors[6], Brad E. Rosenheim[7], John E. Dore[8], August Steigmeyer[9], Mark L. Skidmore[9], Joel D. Barker[10], Liane G. Benning[11,12], Matthew R. Siegfried[13], John C. Priscu[14], Brent C. Christner[1✉], the SALSA Science Team*

Ice streams that flow into Ross Ice Shelf are underlain by water-saturated sediments, a dynamic hydrological system, and subglacial lakes that intermittently discharge water downstream across grounding zones of West Antarctic Ice Sheet (WAIS). A 2.06 m composite sediment profile was recently recovered from Mercer Subglacial Lake, a 15 m deep water cavity beneath a 1087 m thick portion of the Mercer Ice Stream. We examined microbial abundances, used 16S rRNA gene amplicon sequencing to assess community structures, and characterized extracellular polymeric substances (EPS) associated with distinct lithologic units in the sediments. Bacterial and archaeal communities in the surficial sediments are more abundant and diverse, with significantly different compositions from those found deeper in the sediment column. The most abundant taxa are related to chemolithoautotrophs capable of oxidizing reduced nitrogen, sulfur, and iron compounds with oxygen, nitrate, or iron. Concentrations of dissolved methane and total organic carbon together with water content in the sediments are the strongest predictors of taxon and community composition. $\delta^{13}C$ values for EPS (−25 to −30‰) are consistent with the primary source of carbon for biosynthesis originating from legacy marine organic matter. Comparison of communities to those in lake sediments under an adjacent ice stream (Whillans Subglacial Lake) and near its grounding zone provide seminal evidence for a subglacial metacommunity that is biogeochemically and evolutionarily linked through ice sheet dynamics and the transport of microbes, water, and sediments beneath WAIS.

ISME Communications; https://doi.org/10.1038/s43705-023-00216-w

A diverse and active community of bacteria and archaea present in Mercer Subglacial Lake, evidence of evolutionary linkages in microbial communities beneath WAIS

First ever lake sedimentation identified in a subglacial lake

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The life and death of a subglacial lake in West Antarctica

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Subglacial carbon cycle reveals timing and extent of deglacial grounding line retreat

AGU Advances

RESEARCH ARTICLE
10.1029/2022AV000846

Peer Review The peer review history for this article is available as a PDF in the Supporting Information.

Key Points:

- We used clean-access hot water drilling to sample water and sediment from an active subglacial lake in West Antarctica
- The presence of natural-level radiocarbon in sediment and water samples enabled us to trace the subglacial carbon cycle
- We find that the deglacial extent of grounding line retreat reached up to 250 km inland of present before re-advancing in the Holocene

Constraints on the Timing and Extent of Deglacial Grounding Line Retreat in West Antarctica

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How to successfully collect subglacial sediment

LIMNOLOGY and OCEANOGRAPHY: METHODS

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A method for successful collection of multicores and gravity cores from Antarctic subglacial lakes

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And from the subglacial bedrock world…

Subglacial bedrock cores reveal Thwaites Glacier was thinner in the last few thousand years than it is today.

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The Cryosphere
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Reversible ice sheet thinning in the Amundsen Sea Embayment during the Late Holocene

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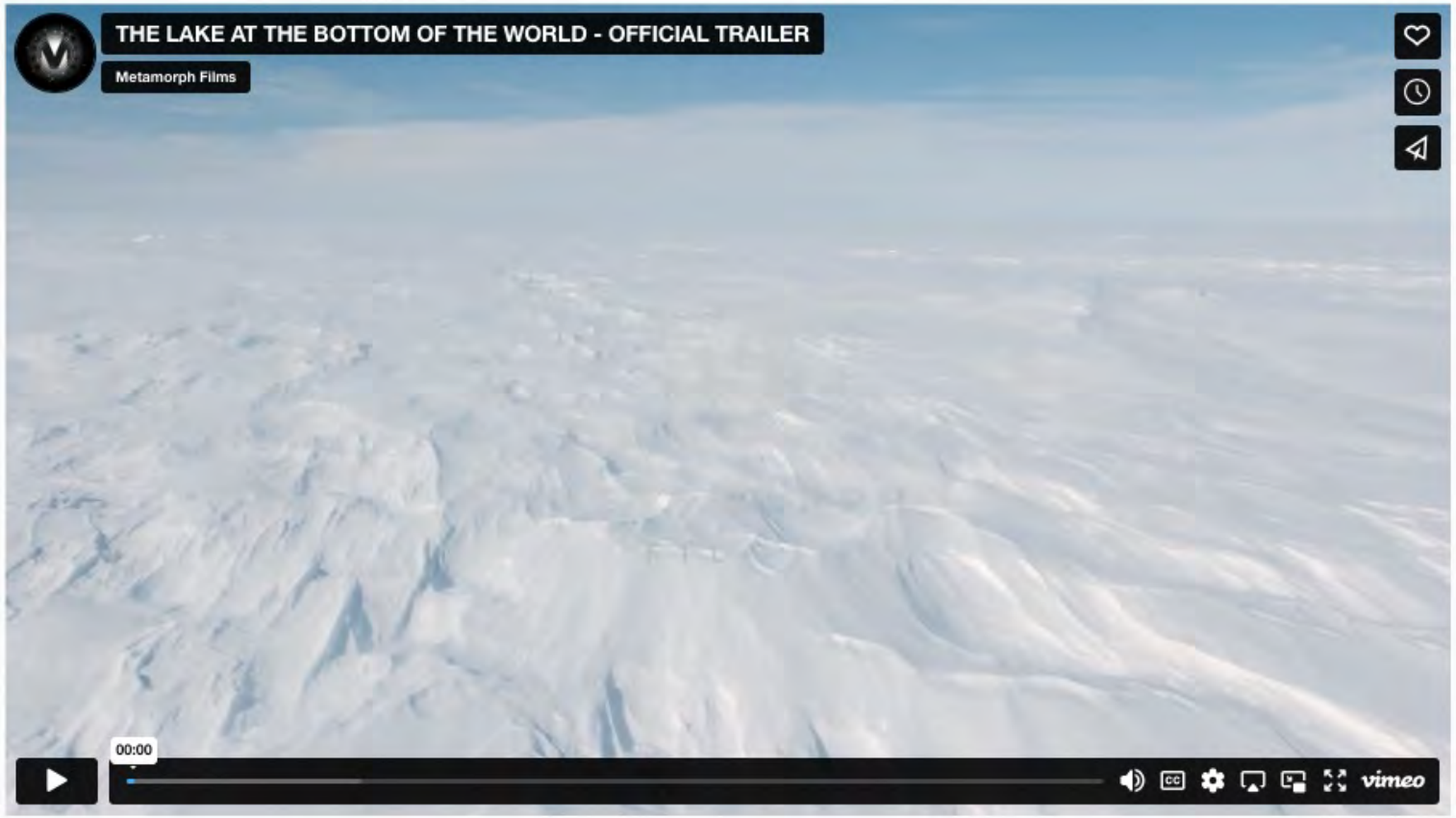

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