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Millennial scale marine incursion into an isolated environment fuels a contemporary subglacial microbial community beneath the West Antarctic Ice Sheet

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Clean access into Mercer Subglacial Lake (SLM), West Antarctica, in 2018-2019 allowed sampling and measurement of geobiological properties in the sediment and water column from this cryptic environment. Sediments contained the largest reservoir of organic carbon in the lake despite only consisting of 0.15% TOC. The marine stable isotope signature (-30 ‰ - -24 ‰ PDB) and age (as recently as 6.2 ky) of the sedimentary organic carbon reservoir illustrates the potential for marine incursion to fuel the contemporary microbial communities observed in the sediment and water column. We found evidence that this relatively young carbon pool metabolized from the sedimentary organic reservoir into the dissolved inorganic carbon pool, but rates calculated from natural level radiocarbon signatures were greater than directly observed radioactive label uptake rates measured in the field. Coupled with evidence that the lake, which is only about 180 years old in its current formation, fills and drains on 6-year cycles, we conclude that a contemporary microbial community in an upstream area much larger than SLM is also supported by marine incursion and metabolism of relatively young carbon. Thus, marine incursions into an otherwise isolated environment may be necessary to supply microbial communities sourced from more isolated areas of the West Antarctic Ice Sheet. The emerging picture of genetically isolated communities fueled by organic matter derived from marine incursions is supported by the diversity of microbes and viruses isolated from SLM samples and creates upstream targets for delineating the boundaries of past marine incursions and isolating upstream communities that may seed areas of WAIS that are prone to marine incursion. Given the timescales involved, from cellular doubling time (~200 days) to marine incursion (thousands of years), our observations of SLM during one of its dynamic equilibria illustrate the diverse processes shaping and sustaining a microbial community in an extreme environment.