Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.34062

The role of microbial dormancy and metabolic strategies in regulating biogeochemical processes in glacial environments.

JAMES A. BRADLEY[1,2], LAURA MOLARES MONCAYO[1,3,4], AMY SOLMAN[4,5], ELOI MARTINEZ-RABERT[3], MARGARET A CRAMM[6], REY MOUROT[3], TESS HUTCHINSON[7], FRANCESCO RICCI[7], RACHAEL LAPPAN[7], HARPREET SINGH[8], TIMOTHY M VOGEL[9], MARCELA HERNÁNDEZ[10], JUAN CARLOS TREJOS-ESPELETA[11], JUAN PABLO MARÍN-JARAMILLO[12], WILLIAM ORSI[13], STEVE SCHMIDT[14], PACIFICA SOMMERS[14], ELIZABETH TREMBATH-REICHERT[15], JACQUELINE GOORDIAL[16], CHRIS GREENING[7], CATHERINE LAROSE[8] AND ANNE JUNGBLUT[17]

[1]Queen Mary University of London
[2]Aix Marseille Univ, Université de Toulon, CNRS, IRD, MIO
[3]Aix-Marseille University, Université de Toulon, CNRS, IRD, MIO
[4]Department of Science, Natural History Museum
[5]School of Geography, Queen Mary University of London
[6]Department of Civil, Environmental, and Geomatic Engineering, University College London
[7]Department of Microbiology, Biomedicine Discovery Institute, Monash University
[8]University Grenoble Alpes, CNRS, INRAE, IRD, Grenoble INP, IGE
[9]Universite Claude Bernard Lyon 1, CNRS, INRAE, VetAgro Sup, UMR Ecologie Microbienne
[10]School of Biological Sciences, Norwich Research Park, University of East Anglia
[11]Ludwig-Maximilians-Universität (LMU)
[12]LMU Munich
[13]GeoBio-Center LMU
[14]University of Colorado
[15]Arizona State University
[16]University of Guelph
[17]Natural History Museum

The cryosphere harbours dynamic microbial ecosystems which operate under low temperatures, energy limitation, strong seasonality, and rapid environmental change. Dormancy, a reversible state of reduced metabolic activity, enables microorganisms to respond to and survive periods of environmental harshness. The various extremes encountered by microbes in the cryosphere make dormancy a central, yet often implicit, regulator of ecosystem dynamics and biogeochemical cycling. Here, we argue that rather than viewing dormancy as a passive survival state, dormancy and transitions of microorganisms between actively growing and maintenance or survival states play consequential roles in regulating carbon and nutrient fluxes across glacial, periglacial, and newly deglaciated environments. On glacier surfaces and within snow and ice, prolonged winter darkness and sub-zero temperatures impose chronic energy stress. We show evidence that the oxidation of atmospheric trace gases may provide a continuous energy supply sufficient to sustain metabolic processes during polar night, enabling long-term cellular integrity and rapid reactivation during transient melting events. Further, as glaciers recede in the face of amplified climate warming, these same aerotrophic physiological strategies shape early community assembly and biogeochemical functioning in forefield soils, while dormancy can buffer populations against episodic disturbance and resource pulses. In these systems, distinguishing between active, inactive and dead microbial fractions is critical for identifying the taxa responsible for driving carbon transformations, stabilization, and soil organic matter formation. By explicitly accounting for microbial state, rather than presence alone, we can better resolve how carbon and nutrient fluxes are sustained throughout winter, initiated during deglaciation, and reorganized as cryospheric landscapes undergo deglaciation in response to ongoing climate change.