Geophysical Research Abstracts
Vol. 12, EGU2010-11597, 2010
EGU General Assembly 2010

Characterising low molecular weight dissolved organic carbon compounds in subglacial systems; implications for subglacial metabolic activity and potential downstream export

Emily Lawson, Jemma Wadham, Grzegorz Lis, and Jon Telling
Bristol Glaciology Centre, School of Geographical Sciences, Bristol, BS8 1SS (emily.lawson@bristol.ac.uk)

Glaciers and ice sheets represent ∼10% of the contemporary global surface coverage, yet remain one of the least explored sectors of the Earth's biosphere. The basal regions of these ice masses, known as subglacial environments, are capable of harbouring a diverse range of microorganisms that are often metabolically active despite the lack of sunlight, the cold temperatures and nutrient scarcity. Here, we consider the potential for such environments to be active components of the Earth's biogeochemical cycles. Subglacial environments have traditionally been excluded from global carbon budgets because they were assumed to be predominantly abiotic. Organic carbon (OC) reservoirs and transformations were also believed to be limited. However, significant stores of bioavailable carbon are thought to be present in glacially-overridden material, providing a potential substrate for in situ microbial metabolism.

We examine the molecular characteristics of dissolved OC in basal ice and subglacial runoff from two glacier/ice-sheet systems with contrasting organic carbon substrates; Russell/Leverett Glacier, Greenland ice sheet, and Engabreen, Norway, to determine the range of dissolved low molecular weight OC (LMWOC) compounds and their relative bioavailability. Overridden material beneath the Greenland ice sheet is relatively young and organic-rich, contrasting with the older crystalline bedrock/continental shield that was overridden during glaciation at Engabreen.

We first utilise a combination of fluorescence spectroscopy and ion chromatography to identify and quantify volatile fatty acids, carbohydrates and amino acids in basal ice. Volatile fatty acids are key metabolic substrates and their provision is thought to be a primary control on subglacial metabolic activity. We then provide a temporal record of amino acids and carbohydrates in subglacial runoff from Leverett Glacier (June 23rd – August 18th 2009), and compare this with subglacial runoff from Engabreen (2008 melt season). In Leverett subglacial runoff, the carbohydrate signature is dominated by labile metabolic intermediates, namely glucose, fructose and sucrose. Glucose concentrations range from 1-140 μg/L, with export generally highest when discharge is rising. Concentrations of LMWOC compounds in subglacial runoff generally exceed those in basal ice and supraglacial waters by an order of magnitude, indicating that the subglacial environment is an important carbon source and promotes dynamic microbial cycling of OC. This supports the idea that subglacial runoff released at the margins of the Greenland ice sheet is a potential source of bioavailable material for downstream ecosystems. LMWOC compounds in Greenland basal ice and subglacial runoff significantly exceed those at Engabreen. For instance, maximum concentrations of acetate, an important precursor to numerous metabolic pathways (including methanogenesis), reach 160 μg/L in Greenland basal ice, but only 13 μg/L in Engabreen basal ice. This suggests that the age and organic composition of the overridden material strongly influences the OC budget, and thus potential availability to subglacial microbes.