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Biogeochemical contributions to supraglacial meltwater chemistry and discharge during summer in coastal Antarctica

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Fjords in coastal Antarctica that receive considerable glacial meltwater discharge from the surrounding glaciers during summer are likely impacted by the nutrient inputs. We present chemical changes in supraglacial meltwater (Figure 1) over 30 days of austral summer, along a 1.2 km transect, starting from the ice cap margin in Larsemann Hills and traversing through a melt pool (Figure 2) and cryoconite holes before discharging into the fjord. Cryoconite holes in Larsemann Hills are hydrologically connected ($\Delta t < 1$) and contribute to the meltwater discharge in the region. Dissolved organic matter (DOM) was predominantly humic-like in the cryoconite holes and the melt pool with the intensity of humic-like DOM increasing in the melt pool through the melt season. In the supraglacial stream, there was a gradual shift in DOM composition from high molecular weight and protein-like DOM to low molecular weight and more humic-like DOM as the summer progressed. Photochemical degradation resulted in a less aromatic DOM towards the end of the season. Higher Al (19 times) and ssFe (25 times) concentrations were observed in the cryoconite holes compared to the supraglacial stream owing to sediment dissolution. The interaction between meltwater and dust also contributed to enhanced concentrations of Ca^{2+} and K^{+}. Thus, the cryoconite hole ecosystem is a significant contributor to the supraglacial discharge of nutrients. Overall, glacier discharge transports significant amounts of dissolved Fe (3.9 kg km^{-2} a^{-1}) and potentially labile organic matter (53.2 kg km^{-2} a^{-1}) to the coastal Antarctic fjords. This, together with fast-changing hydrological regimes through the melt season could have important biogeochemical implications for adjacent fjords.


Figure 1

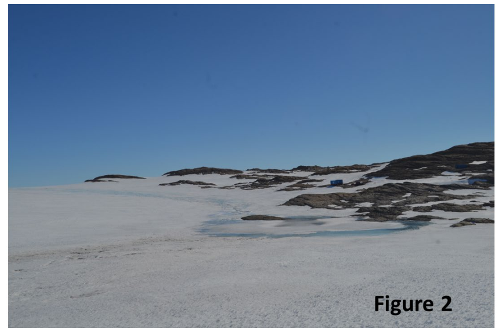
Figure 2