Permafrost-derived dissolved organic matter character controls microbial community composition in Arctic coastal waters

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Climate warming is accelerating erosion rates along permafrost-dominated Arctic coasts. To study the impact of erosion on marine microbial community composition and growth in the Arctic coastal zone, dissolved organic matter (DOM) from three representative glacial landscapes (fluvial, lacustrine and moraine) along the Yukon coastal plain, are provided as substrate to marine bacteria using a chemostat setup. Our results indicate that chemostat cultures with a flushing rate of approximately a day provide comparable DOM bioavailability estimates to those from bottle experiments lasting weeks to months. DOM composition (inferred from UV-Visible spectroscopy) and biodegradability (inferred from DOC concentration, bacterial production and respiration) significantly differed between the three glacial deposit types. DOM from fluvial and moraine deposit types shows more terrestrial characteristics with lower aromaticity ($S_R$: 0.63 ±0.02, $SUVA_{254}$: 1.65 ±0.06 respectively $S_R$: 0.68 ±0.00, $SUVA_{254}$: 1.17 ±0.06) compared to the lacustrine deposit type ($S_R$: 0.71 ±0.02, $SUVA_{254}$: 2.15 ±0.05). The difference in composition of DOM corresponds with the development of three distinct microbial communities, with a dominance of Alphaproteobacteria for fluvial and lacustrine deposit types (relative abundance 0.67 and 0.87 respectively) and a dominance of Gammaproteobacteria for moraine deposit type (relative abundance 0.88). Bacterial growth efficiency (BGE) is 66% for moraine-derived DOM, while 13% and 28% for fluvial-derived and lacustrine-derived DOM respectively. The three microbial communities therefore differ in their net effect on DOM utilization. The higher BGE value for moraine-derived DOM was found to be due to a larger proportion of labile colourless DOM. The results from this study, therefore indicate a substrate control of marine microbial community composition and activities, suggesting that the effect of permafrost thaw and erosion in the Arctic coastal zone will depend on subtle differences in DOM related to glacial deposit types. These differences further determines the speed and extent of DOM mineralization and thereby carbon channelling into biomass in the microbial food web. We therefore conclude that marine microbes
strongly respond to the input of terrestrial DOM released during coastal erosion of Arctic glacial landscapes.