Benthic trace element cycling controlled by glacial activity in Arctic fjords (Spitsbergen, Svalbard)

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Glacial meltwater is rich in trace elements that are derived from biotic and abiotic processes in the sub- and pro-glacial environments. Following delivery of meltwater to the ocean, glacially derived trace elements undergo biogeochemical processing in marine sediments and may be sequestered in the solid phase or recycled back to the water column in aqueous or nanoparticulate phases. The geochemical composition and reactivity of the material delivered to the seabed influences the fate of redox-sensitive trace elements and may differ between meltwater stream and tidewater glacier inputs. In order to investigate the effects of differing glacial sources on trace element processing in sediments, we collected sediment cores in head-to-mouth transects from several fjords fed primarily by either meltwater streams or tidewater glaciers on Svalbard, Norway. We analysed sulphate reduction rates and aqueous and solid phase trace element geochemistry (Fe, Mn, As, Co, Cu, Mo, Ni, and U). In stream-dominated fjords, we found evidence of stronger cycling of Fe, Mn, and associated trace elements (As, Co, and Ni) close to the glacial input, and higher sulphate reduction rates and corresponding entrapment of sulphide-sensitive elements (Cu, U, and Mo) in the outer fjord. We suggest that biotic and abiotic processing during stream transport produces sediment enriched in reactive trace element phases, which are more rapidly mobilized across the head-to-mouth fjord axis relative to the less-reactive material delivered by tidewater glaciers. Thus, current widespread glacial melting may lead to changes in sequestration or transport of trace elements in and through fjords influenced by retreating glaciers.