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Environmental change in the European Arctic inferred from fjord sediments: a sediment-provenance study of glacio-marine sediments in Kongsfjorden, Svalbard

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Ice sheets and oceans are key elements of the climate system. Understanding the links between these is central to our understanding of the mechanisms of (Arctic) climate change. Sedimentary archives of fjord systems - characterised by exceptionally high sedimentation rates - provide the potential for studying those links and reconstructing palaeo-environmental changes on multidecadal to centennial time scales.

Here we focus on the Krossfjorden and Kongsfjorden region in NW Svalbard – a region where sedimentation processes are strongly influenced by the presence of tide-water glaciers – where we conducted a sediment-provenance study of modern and late Holocene sediments. Sediment obtained from drifting icebergs, surface sediment samples from the fjords and adjacent shelf area, and late Holocene sediments from Krossfjorden (gravity core NP05-11-17GC) have been investigated for various sediment properties including major elemental composition (XRF scanning), grain-size distribution (wide-range laser-diffraction particle sizer) and IRD (ice-rafted detritus) content and composition. Decomposition of the geochemical and grain-size datasets has been accomplished with the end-member modelling algorithm EMMA. The modelled (geochemical / grain size) end members will be compared to sediments of known origin (provenance / mode of transport) which allows for an independent assessment of the validity of the obtained mixing models. We envisage that the unmixing of the compositional data sets provides an important step forward in the development of a source-specific sediment flux model for the Kongsfjorden region.

Our sediment-fingerprinting results indicate that the modern sediments supplied into the fjord systems by the various glaciers clearly reflect the bed rock composition in the hinterland. The bedrock around Krossfjorden and along the northern coast of Kongsfjorden – drained by Lilliehöök-, Conway- and Blomstrandbreen – consist of medium-grade metamorphic rocks of most probably Middle Proterozoic age. In contrast, the region east of Kongsfjorden – which is drained by Kronebreen and Kongsvegen – is dominated by sedimentary rocks of Devonian and Carboniferous-Permian age. The land mass south of Kongsfjorden, at present not drained by any tide-water glaciers, consists of sedimentary rocks of Late Palaeozoic and Tertiary age, although some metamorphic rocks occur. The distribution pattern of the ‘metamorphic’ and ‘sedimentary’ end member compositions clearly suggest that such data can be used to reconstruct mass balances of sediment transfer from glacial drainage basins to the adjacent fjord basins.