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Trace elements and cathodoluminescence of detrital quartz in Arctic marine sediments – A new ice-rafted debris provenance proxy

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The records of ice-rafted debris (IRD) provenance in the North Atlantic – Barents Sea allow the reconstruction of the spatial and temporal changes of ice-flow drainage patterns during glacial and deglacial periods. In this study a new approach to characterisation of the provenance of detrital quartz grains in the fraction >500 μm of marine sediments offshore of Spitsbergen is introduced, utilizing scanning electron microscope backscattered electron and cathodoluminescence (SEM-CL) imaging, combined with laser ablation inductively-coupled plasma mass spectrometry (LA-ICP-MS). We have studied 9 core-top (0-1 cm) samples randomly distributed along the western and southern coast of Spitsbergen and compared the quartz properties in the >500 μm fraction with 18 onshore samples from potential source areas in central, west, south and southeast Spitsbergen.
Based on their micro-inclusions, SEM-CL and trace element characteristics the investigated IRD grains can be classified into five distinct populations. The classification was developed by means of the observed, most significant features of the investigated offshore grains and, thus, the classification application is restricted to the offshore sample area of this study. The distinguishing features were chosen in that way that each offshore grain could assigned to one group only. Three of the five populations are indicative of potential IRD provenance provinces in the Storfjord area including Barentsøya and Egdeøya. The results imply that under modern (interglacial) conditions IRD deposition along the western Spitsbergen margin is mainly governed by the East Spitsbergen Current controlling the ice-drift pattern and, thus, long-distance transport by sea ice is the dominant transport mechanism for the quartz grains. The presence of detrital quartz from local provinces, however, indicates that variations in IRD supply from western Spitsbergen may be quantified as well.
In this pilot study it is demonstrated that this new approach applied on Arctic continental margin sediments, bears a considerable potential for the definition of the sources of IRD and thus of spatial/temporal changes in ice-flow drainage patterns during glacial/interglacial cycles.