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Modern sedimentation in a rapidly warming fjord: Potter Cove, King George Island, Antarctica

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The northern Antarctic Peninsula belongs to the fastest warming regions on earth. The winter-warming trend was strong and stable over the past 70 years. As a result, Potter Cove, a small fjord that opens into Maxwell Bay (King George Island, South Shetland Islands), shows significant environmental change. A former tidewater glacier (Fourcade Glacier) has retreated onto land exposing bedrock such as a small island close to the glacier front. It is suggested that the warming trend triggered excessive discharge of sediment-laden meltwaters in the form of turbid surface waters. The hypothesis for this study is that very fine-grained materials are present in Potter Cove and that meltwater plumes that exit Potter Cove can be traced downstream in the form of fans of fine-grained materials. In this study we investigate the modern sedimentation patterns in Potter Cove using hydroacoustics and seafloor samples to compare that with conditions from the past as recorded in sediment cores.
Surface grain-size distributions reveal a distinct textural pattern in Potter Cove. Cluster analysis suggests 7 classes of sediment types. Four of them are unimodal, three classes show fine-skewed distributions with tendencies to bimodality. The finer sediment classes are found in the central inner part of the cove. The finest class (mode at 16 μm) forms only a small patch in the shelter of a small island. Sediments from close to the glacier front appear to be slightly depleted in fine-grained materials. From the glacier front to the outer fjord the sediments show influence of current sorting, i.e. the coarser mode becomes more significant and sorting increases. A sediment core from the deeper outer basin of Potter Cove reveals only one of the better-sorted, coarser classes that appears to form on the way from the glacier into the basin. There are 5 long sediment cores located less than 10 km off the mouth of Potter Cove in Maxwell Bay. All of which reveal sediments that belong either to the finest sediment class (mode at 16 μm) or to the class that was found in front of the glacier. Age determinations reveal that the finest sediment class occurs predominantely during warmer climate phases such as the Medieval Warm Period (MWP). The fine sediment is significantly reduced during colder climate phases such as the Little Ice Age (LIA). Although the present climate conditions are very similar to those of the MWP, the meltwater that is being discharged in recent summers does not seem to be capable to produce deposits of very fine materials within Potter Cove. At least one of the sediment cores that reveals dominantly the fine sediment class during the warm phases does not show increasing amounts of it since the LIA. Hence, the sediment inventory of the meltwater appears to have changed since the LIA.