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A subglacial meltwater channel system in Marguerite Bay: observations from sediment cores, an underwater ROV and ship-mounted instruments

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On the western Antarctic Peninsula grounded ice is known to have advanced through Marguerite Bay to a position at the shelf edge during the last glacial. Multibeam bathymetry from Marguerite Trough have revealed streamlined subglacial bedforms along the length of the trough and meltwater features (subglacial basins and channels) in the bay and on the inner to middle continental shelf. The channels are inferred to be subglacial in origin based on the fact that they have sections with negative slope gradients and areas of overdeepening along their thalwegs. We investigate the subglacial channel systems on the continental shelf in several ways. First, we investigate channel origin by analysing a series of sediment cores acquired in the channels and in the flat areas immediately in front of them. Interestingly, the cores record a relatively "normal" Late Pleistocene glacial-postglacial stratigraphy of (glacial) diamicts overlain by (post-glacial) hemipelagic muds and do not sample any waterlain sediments (bedded sands, gravels). Physical parameters from the cores allow us to correlate these facies with sediment cores further out on the continental shelf (cf. Kilfeather et al., 2011) suggesting that ice was grounded in the channel system during the last glacial. Secondly, we investigate channel morphometry using high-resolution multibeam data (gridded surfaces have cell sizes c. 0.4 m) and the medium-resolution multibeam data (grid cell sizes of c. 40 m) from ship-mounted systems; the data are complimented by seafloor photographs taken by the Isis ROV. Integration of the these data reveals that the side slopes of the channels are much steeper than originally thought, with some even being undercut, which will affect estimates of potential meltwater flux through the channel system. Given the incredibly large meltwater fluxes that would be required for continuous flow through the channel system, and the evidence for grounded ice during the last glacial, we consider it likely that the channels have been incised to their great size (up to 200 m deep and 1500 m wide) gradually over many glaciations by high-magnitude, low-frequency events (outburst floods).