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Subglacial Water and Sediment Transport across the Grounding Zone of Whillans Ice Stream, West Antarctica

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Much of the threshold behavior of marine ice sheets is thought to result from processes occurring at the grounding zone, where the ice sheet transitions into the ice shelf. At short time scales (decades to centuries) grounding zone behavior is likely to be influenced by processes not included in the current generation of ice sheet models. Here we report on two such processes: the flow of subglacial water from beneath the ice sheet, and the associated transport, and deposition, of sediment. We present a ground-based geophysical study across the grounding zone of a major West Antarctic Ice Stream (Whillans Ice Stream). Using a combination of active-source seismology and radio-echo sounding (RES) data, we image the outlet of a large subglacial drainage system. This drainage system deposits sediment, the lithology of which we determine with seismic amplitude analysis, into a thin (< 15 m) ocean water column. RES reflectivity indicates that subglacial deformation, subglacial water flow, and this ocean water column likely transport sediment along the base of the ice sheet and eventually the ice shelf. These findings have implications for the evolution of grounding zones and the basal melt of ice shelves; knowledge of both of which is required if well-informed models are to provide accurate estimates of future sea level rise.