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Ice-internal and sedimentary structures in the Ekströmisen grounding line region detected with multi-offset seismics

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Ekströmisen is a small catchment area in coastal Dronning Maud Land, Antarctica, terminating in the Ekström ice shelf, which is bounded by a narrow embayment formed by two ice ridges. A seismic survey has been performed along a flow line on Ekströmisen over about 22 km, crossing the grounding line between ice sheet and shelf approximately midway of the profile. The measurements were performed with explosive in shallow firn holes as seismic sources and a 60 channel 1.5 km snow streamer for data recording. The data has been resorted to form a virtual 120 channel 3 km streamer, consisting of 150 shots. The maximum shot-receiver offset is thus about three times larger then the ice thickness, yielding wide angle information for intra-ice and bedrock reflections. Standard seismic data processing yields 862 common depth points in total, with an increment of 25 m. This provides a 20-fold coverage of each common depth point. In addition to yielding the distribution of seismic velocity within the firn, ice and sediment, the data clearly images ice and sedimentary layers. Within the bottom part of the ice, a number of continuous internal layers are visible upstream of the grounding line. Currently, our favorite explanation is abrupt changes in the crystal orientation fabric caused by a combination of laterally compressional flow and vertical shear, as observed with radio-echo sounding at other places in Antarctica. Upstream of and at the grounding line, structures are visible within the bedrock, which we interpret as sedimentary deposits related to glacial activity. The data provide the base for interpretations of the ice-dynamic and sedimentary processes occurring in the basal ice layer and at the ice-bedrock boundary, of relevance for further understanding details of the ice sheet-to-shelf transition area.