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On-ice vibroseis: What lies beneath Ekström Ice Shelf, East Antarctica?

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Between 2010-2018 an extensive grid of seismic reflection data were collected across the grounding line and on the Ekström ice-shelf, using an on-ice vibroseis source and snowstreamer. Here they are used to investigate current ice dynamics and reconstruct the glaciological history of this region.
These data show the ice-shelf thickness ranges from 170 m, near the ice-shelf front, to ∼600 m near the grounding line. Relic crevasses are seen at the ice base, in the Western part of the ice shelf, which can be tracked back to a current crevasse field at the grounding line. There is also evidence of an ice-shelf basal channel, with a corresponding surface depression. Beneath the sea floor the outcrop and sub-ice extent of the volcanic Explora Wedge (generated through Jurassic rifting and seafloor spreading) is clearly imaged. The wedge is overlain by a sequence of truncated, dipping marine-sediment layers. The sediment layers were likely truncated by former ice advance and subsequent retreat; which has also left evidence in the form topographic over-deepening and glacial debris deposits at the sea floor. The debris deposits range from elongated bedforms in a topographic trough (indicating probable former ice-stream flow) to layered sediment wedges at the current iceshelf front (indicating the likely former extent of grounded ice).
The vibroseis method is fast and effective allowing for a high volume of data collection. For example, in the 2016/17 season ∼280 km of multi-fold seismic reflection data were collected over a 25-day period. Future integration of these results with numerical models will provide a better understanding of past and present interactions between the ice sheet and the solid Earth in Dronning Maud Land, which will in turn improve understanding of future contributions of this region to sea-level rise.