Recurring LP-events within a tidewater greenlandic glacier

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Long-period (LP) events, with dominant frequencies below 5 Hz, have puzzled seismologists, volcanologists and glaciologists since their first detection more than 4 decades ago. Ever since, these seismic events have regularly resurfaced in the literature. Although a relationship between LP events and fluid presence in glaciers and volcanoes is often proposed, the debate surrounding the underlying source mechanism is ongoing. On the one hand, LP events are often explained as a fluid-filled cavity resonance excited by fracture-opening or rapid flow of water into a newly opened space. On the other hand, volcanologists have proposed an alternative interpretation in terms of a slow rupture combined with propagating effects through a layered material. As LP events on glaciated volcanoes demand seismologists to distinguish between ice-related signals and telltale eruption precursors, a better understanding of source mechanisms is also needed for volcanic hazard research.

In July 2015 and July 2016, we conducted two passive seismic experiments at Bowdoin Glacier, an iceberg calving glacier in northwest Greenland. Using 5 - 8 station networks installed directly on ice or rock near the glacier, we observed thousands of LP events occurring every 10 minutes or less. With 20-30-s-long, low-frequency (< 2 Hz) monochromatic coda tails, and broadband, high-frequency (up to 20 Hz) onsets.

To understand source mechanisms of LP events at Bowdoin Glacier, we detect them by pattern matching and locate them with frequency-wavenumber analysis performed at two seismic arrays. This yields source locations near the calving front of the glacier near an active subglacial discharge channel. We report LP-events features, present temporal variations, and compare them to other available time-series (GPS, borehole water pressure, AWS measurements, and time-lapse photography), which, at this point, suggest fluid-filled cracking as the most likely source mechanism.

Keywords: glacier, seismicity, Long-Period event

