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Basal conditions of Kongsvegen at the onset of surge - revealed using seismic vibroseis surveys

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Kongsvegen is a well-studied surge-type glacier in the Kongsfjord area of northwest Svalbard. Long-term monitoring has shown that the ice surface velocity has been increasing since around 2014; presenting a unique opportunity to study the internal ice structure, basal conditions and thermal regime, all of which play a crucial role in initiating glacier surges. In April 2019, three-component seismic vibroseis surveys were conducted at two sites on the glacier, using a small Electrodynamic Vibrator source (ElViS). The first site is in the ablation area and the second near the equilibrium line, where the greatest increase in ice-surface velocity has been observed.

Initial analysis indicates the conditions at the two sites are significantly different. At the ablation area site, the ice is around 220 m thick, and the bed is relatively flat and unvaried, with no clear change in the bed reflection along the profile. The bed appears to comprise a uniform and undisturbed sediment package ~60 m thick, and there are no clear englacial reflections within the ice column. By contrast at the second site, the ice is around 390 m thick, and the internal ice structure is much more complex. Clear internal ice reflections are visible at depths between 150-250 m, and further reflections in the 100 m above the bed indicate there could be shearing or sediment entrainment in this area. Below the bed, cross-cutting layers are clearly visible and the bed reflection itself shows changing reflection polarity – suggesting water or very wet sediment is present in some areas. The contrast between these two sites at the onset of a surge phase allows us to investigate the physical conditions that are conducive to surge initiation, both at the ice-bed interface and within the ice column.

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