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Detecting and characterising an englacial conduit network within a temperate Swiss glacier using active seismic and ground penetrating radar

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The englacial hydrological system is an integral driver of glacier dynamics however it is often difficult to observe englacial conduits on temperate glaciers as a result of their short lived nature.

We have monitored and characterised englacial conduit conditions within an overdeepening using active surface seismic data from the Rhone Glacier, Switzerland in 2012 and 2017. The high resolution (maximum frequency 1500 Hz) seismic imaging provided evidence that an englacial conduit system formed between the survey years and was well developed in 2017. Seismic imaging with Kirchhoff pre-stack time migration and reverse time migration complemented one another and assisted in the englacial conduit interpretation. Amplitude-versus-angle (AVA) analysis on the 2017 seismic data suggested the englacial feature is water filled and between 0.5 and 4 m thick.

During the 2018 melt season the englacial conduit network persisted and a grid of GPR profiles imaged the network's extent, covering approximately 14,000 m^2. In late summer 2018, several boreholes were drilled into the englacial conduit network and a borehole camera provided imaging of a fast flowing englacial conduit transporting sediment.

From the geophysical findings and observations, we have inferred the englacial conduit network is fed by surface melt water and streams flowing along the glacier's margin. These surface streams enter the glacier's base through a system of subglacial channels flowing along the glacier's flank. The subglacial channels subsequently flows into highly efficient englacial conduits traversing the upglacier section of the overdeepening before connecting with the subglacial drainage system.