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Seismic characterisation of subglacial media around a supraglacial meltwater lake, Russell Glacier, West Greenland

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The delivery of supraglacial meltwater into the subglacial system has a significant impact on glacier dynamics, on a range of temporal scales. However, the ability of water to influence glacier dynamics is strongly controlled by the composition of the media immediately underlying the ice – for example, can those media be eroded, and what is their porosity and permeability? Predictive models of glacier dynamics should therefore include subglacial hydrological processes, but there are few direct, in situ, measurements of subglacial material properties. Such properties can be interpreted, however, from seismic datasets using amplitude-versus-offset (AVO) analyses.

AVO is a powerful means of constraining the material properties of media either side of an interface, using the amplitudes of seismic wavelets recorded at a range of source-receiver offsets (typically exceeding the depth of the target interface by a factor of 2). A series of AVO experiments was conducted on Russell Glacier, West Greenland, around a recently-drained supraglacial meltwater lake. Assuming that basal water is routed preferentially in the down-stream direction, different AVO responses may be expected up- and down-stream of the lake. At this location, Russell Glacier flows to the south-west, hence AVO experiments were performed at two sites, to the north and the south-west of the drainage site (along two orthogonal lines, in the latter case). Seismic energy, emitted from explosive charges, was recorded along a 48-channel geophone array (470 m spread length, 10 m station interval) with a maximum source-receiver offset approaching 2.5 km. Profiles of stacked seismic data show the glacier to be $\sim$1.2 km thick, but with 100 m of topographic variation on the glacier bed.

We compare AVO observations up- and down-glacier of the supraglacial lake site, and highlight differences in the AVO curves observed for each.