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Water at the bed of Pine Island Glacier

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Pine Island Glacier is a fast flowing ice stream in West Antarctica. In recent years it has undergone increasing acceleration and associated thinning. We have conducted nearly 60 km of seismic reflection profiling and used this to calculate the acoustic impedance of the ice stream bed between 100 and 200 km from the grounding line. Broadly the acoustic impedance can be used to distinguish between areas of solid bedrock, non-deforming sediments, deforming sediments and water. The results reveal a mixed bed with areas of water, deforming sediment and harder non-deforming sediment or possibly consolidated rock. The significant areas of free water we have detected by this technique contrast with similar experiments which have been conducted extensively on the Rutford Ice Stream and have so far detected no significant areas of free water at the base.
Around 170 km from the grounding line, the basal roughness at wavelengths less than the ice stream thickness (approximately 2 km) appears to be controlled by a change in the geology. A sub-basal reflector shows a transition in the geology which may be a geological fault. This interpretation is reinforced by airborne gravity and magnetic surveys which suggest that this transition is from hard rock to softer rock or unconsolidated sediments. These sediments are up to several hundred metres thick. The acoustic impedance characteristics do not change across this boundary and free water and deforming sediments can be found on either side. However, the basal roughness at wavelengths of 10s to 100s of metres is greater over the harder geology. This may have a local influence on the flow of the ice stream, with the fastest flow located over the smoother bed.