Geophysical Research Abstracts
Vol. 18, EGU2016-7429, 2016
EGU General Assembly 2016

First evidence for a late LGM subglacial lake in Pine Island Bay, Antarctica

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Subglacial lakes are widespread beneath the Antarctic Ice Sheet and as a source for subglacial meltwater they are assumed to modulate ice stream velocity. Further, the evacuation of subglacial meltwater at the ice sheet margin influences ocean circulation and geochemical cycles. However, despite their importance,, subglacial lakes are one of the least explored environments on our planet. As a consequence, their importance for ice sheet dynamics and their ability to harbour life remain poorly characterised.

We present the first direct evidence for a palaeo-subglacial lake on the Antarctic continental shelf, documenting that subglacial meltwater was stored during the last glacial period and evacuated during the subsequent deglaciation. A distinct sediment facies observed in a core recovered from a small bedrock basin in Pine Island Bay, Amundsen Sea, is indicative of deposition within a low-energy subglacial lake setting. Diffusive modelling demonstrates that low chloride concentrations in the pore water of this characteristic sediment facies can only be explained by original deposition in a freshwater setting. We also show that the location of the subglacial lake within a basin on the inner shelf is consistent with the predicted distribution of subglacial lakes based on bathymetric data. This finding will enable future modelling studies to investigate how the geometry and capacity of subglacial lake systems can influence ice dynamics when the substrate and profile of the ice sheet is known – especially in the highly sensitive area known as the "weak underbelly" of the WAIS.

With the exception of a direct lake water access at Subglacial Lake Vostok, and some centimetres of sediment retrieval from Subglacial Lake Whillans, the subglacial hydrological system in Antarctica has hitherto mostly been explored using remote sensing and numerical models that suggest the number of potential lake sites to more than 12.000.

Our study not only provides first empirical evidence for a palaeo-subglacial lake but also delivers a framework for investigating and refining exploration of these unique subglacial lake environments and their sediments beneath thick contemporary ice sheets. Our approach, however, is easier and cheaper to conduct by using ship borne coring equipment on the seasonal ice-free continental shelf.