

## Unexpected observation of emission of subglacial methane to the atmosphere

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During an expedition to the Kangerlussuaq area in West Greenland we measured consistently elevated methane (CH<sub>4</sub>) concentrations in the air expelled with the meltwater at a subglacial discharge point. The CH<sub>4</sub> concentrations in the subglacial air were 3 – 15 times higher than the atmospheric background concentration indicating a substantial emission of subglacial CH<sub>4</sub> to the atmosphere. The release mechanism of the subglacial CH<sub>4</sub> to the atmosphere is currently unknown, but the association with active subglacial meltwater discharge suggests a meltwater driven transport from the subglacial environment.

The subglacial environments below glaciers and continental ice sheets are home to carbon cycling microbial communities which can both produce and consume CH<sub>4</sub>. It has also been suggested that reservoirs of CH<sub>4</sub> clathrates may accumulate under the right combination of subglacial temperature and pressure. Until now direct emission of subglacial emission to the atmosphere has been proved. Our unexpected and striking measurements of direct subglacial CH<sub>4</sub> emission point towards an unknown and unconstrained coupling between subglacial methane-cycling and atmosphere, with possible implications for the atmospheric concentration of CH<sub>4</sub>.

The potential significance of this new discovery is related to a number of critical questions concerning the climatic impact of atmospheric CH<sub>4</sub> in a future changing climate. With documentation of CH<sub>4</sub> cycling below glaciers and ice sheets across the globe, the question is whether the emission of subglacial methane is occurring throughout Earths glaciated regions or isolated to local subglacial carbon hotspots? Also, will the emissions of subglacial CH<sub>4</sub> accelerate in response to with increased surface melt and glacial retreat in a future warmer climate?