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Ice core measurements of 14CH4 show no evidence of methane release from methane hydrates or old permafrost carbon during a large warming event 11,600 years ago

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Thawing permafrost and marine methane hydrate destabilization in the Arctic and elsewhere have been proposed as large sources of methane to the atmosphere in the future warming world. To evaluate this hypothesis it is useful to ask whether such methane releases happened during past warming events. The two major abrupt warming events of the last deglaciation, Oldest Dryas – Bølling (OD–B, ≈ 14,500 years ago) and Younger Dryas – Preboreal (YD-PB; ≈11,600 years ago), were associated with large (up to 50%) increases in atmospheric methane (CH4) concentrations. The sources of these large warming-driven CH4 increases remain incompletely understood, with possible contributions from tropical and boreal wetlands, thawing permafrost as well as marine CH4 hydrates.
We present new measurements of 14C of paleoatmospheric CH4 over the YD-PB transition from ancient ice outcropping at Taylor Glacier, Antarctica. 14C can unambiguously identify CH4 emissions from "old carbon" sources, such as permafrost and CH4 hydrates. The only prior study of paleoatmospheric 14CH4 (from Greenland ice) suggested that wetlands were the main driver of the YD-PB CH4 increase, but the results were weakened by an unexpected and poorly understood 14CH4 component from in situ cosmogenic production directly in near-surface ice.
In this new study, we have been able to accurately characterize and correct for the cosmogenic 14CH4 component. All samples from before, during and after the abrupt warming and associated CH4 increase yielded 14CH4 values that are consistent with 14C of atmospheric CO_2 at that time, indicating a purely contemporaneous methane source. These new measurements rule out the possibility of large CH4 releases to the atmosphere from methane hydrates or old permafrost carbon in response to the large and rapid YD-PB warming. To the extent that the characteristics of the YD-PB warming are comparable to those of the current anthropogenic warming, our measurements suggest that large future atmospheric methane increases from old carbon sources in the Arctic are unlikely. Instead, our measurements indicate that global wetlands will likely respond to the warming with increased methane emissions.