Dating the response of methane hydrate systems in the Barents and Norwegian Seas to collapse of the Scandinavian Ice Sheet

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CH_4-derived authigenic carbonate (MDAC) crusts exhibiting characteristic ^{13}C-depleted isotopic signatures were collected from five seepage sites of the Norwegian and Barents Sea, areas that were characterised by thick (>1km) grounded ice during the last glacial maximum. Modelling of the gas hydrate stability zone in grounded ice margin indicate the potential for significant CH_4 hydrate accumulations during glacial maximum. U-Th dating of MDAC has been attempted on early generation carbonate phases that cement sandy and gravelly sediments as well as late generation phases occurring as botryoidal laminae that fill cavities within carbonate cemented sediments. U-Th dates indicate that the formation of the early generation carbonate cements in studied crust samples was coincident with the deglaciation of the area and collapse of the Scandinavian Ice Sheet (ca. 17 ka). The CH_4 flux for the carbonate crust formation was likely provided by the dissociation of CH_4 hydrates that formed in underlying sediments during the last glacial period due to ice sheet loading, but became unstable due to pressure release associated with ice sheet retreat and collapse. The main episode of CH_4 seepage and carbonate crust formation that was initiated by the ice sheet collapse continued for 7-10 kyr after deglaciation as the gas hydrate stability zone continued to thin in response to sea-level change, isostatic rebound and bottom water warming. These data provide constrain in the timescale of CH_4 efflux in basins which were ice grounded during glacial maximum but underwent rapid ice sheet collapse.