Reconstruction of past seepage on Vestnesa Ridge off W'Svalbard using methane-derived authigenic carbonate U-Th geochronology

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Gas hydrates within continental margin sediments store signifigant amounts of methane. The stablity of gas hydrates depends on pressure and temperature conditions. Hence gas hydrate deposits are sensitive to environmental changes including hydostatic pressure change and subsurface fluid circulation. Pockmarks, circular depressions on the seabed, form often above gas hydrate bearing sediments along continental margins but their ages remain elusive.

In general, pockmark formation is ascribed to methane seepage from the seabed into the water column resulting from relatively rapid gas hydrate dissociation. The released methane is partly intercepted within the sediment by microbial mediated sulphate-driven anaerobic oxidation of methane (AOM: $CH_4 + SO_4^{2-} \rightarrow HCO_3^- + HS^- + H_2O$). One consequence of AOM is increased carbonate alkalinity in pore waters, inducing formation of methane-derived authigenic carbonate (MDAC) rocks ($2HCO_3^- + Ca^{2+} \rightarrow CaCO_3 + CO_2 + H_2O$). Uranium-thorium geochronology of clear radial-fibrous aragonite cement contained in MDAC rocks thus provides useful means to asess past seepage activity and associated pockmark formation.

Here we will use for the first time U-Th dating results of MDAC rocks sampled from the seabed at ~1200 m water depth and from drill cores up to ~23 m below seabed in order to decipher the longevity of methane seepage on Vestnesa Ridge off W'Svalbard.