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The ikaite to calcite transformation: A key to understanding the palaeoclimatic significance of glendonites?

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Marine sedimentary ikaite is the parent mineral to glendonites, stellate pseudomorphs found throughout the geological record. Glendonites are a controversy in palaeoclimatic studies as there is an ongoing debate as to whether their presence in sedimentary successions may be used as cold-climate indicators. Glendonites are typically found associated with glacial sediments, and for a long time ikaite was believed to only nucleate and grow at temperatures < 7 °C. However, with the successful laboratory synthesis of ikaite at higher temperatures, the climatic significance of glendonites was brought into question. This study uses a combination of physical and inorganic chemistry techniques to demonstrate the variable stability of natural marine sedimentary ikaites over short (minutes to hours) and longer (weeks to months) timescales, both between ikaite samples, and in a given ikaite. We examine the nucleation of calcite from the destabilized ikaite, observing that this process is much more complex than previous studies suggest. We demonstrate that over much longer (e.g. months or more) timescales, natural marine sedimentary ikaites are not stable above 5 °C, and thus glendonite presence in sedimentary successions may be considered cold climate indicators.