

The transformation of ikaite into less hydrated CaCO₃ minerals controlled by fluids and temperature

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Recent years' research on the tufa columns in Ikka Fjord, SW Greenland have shown a change in mineralogy from almost pure ikaite (CaCO₃•6H₂O) into less hydrated calcium carbonate minerals of monohydrocalcite (MHC), aragonite, and calcite (Stockmann et al. 2022). These dehydration reactions are interpreted as a response to an increase in seawater temperature supported by *in-situ* observations of summer 2019 of temperatures ranging from 6 – 9 °C in the submarine column area. An upper stability threshold of 6 °C was previously suggested for the ikaite columns based on past *in-situ* temperature recordings from Ikka Fjord. In recent laboratory experiments, small pieces of ikaite columns were heated incrementally while submerged in natural seawater from Arsuk Fjord, SW Greenland. They were mounted in a special-designed thermal cooling stage at the University of Gothenburg that allows for contemporaneous Raman analysis. The aim of the experiments was to discern the role of fluids for the transformation of ikaite with respect to temperature and alteration mineralogy. In one series of experiments, a sample of pure ikaite was submerged in seawater throughout the experiment conducted at 2.5 – 23.0 ± 0.1 °C for 2.5 months. This caused a mineral transformation into MHC initially at 10 – 11 °C. With increasing temperature, ikaite disappeared completely by altering into MHC. A further transformation of MHC into aragonite and minor calcite occurred at 22.0 °C. In a second series of experiment, the ikaite column sample was dried out at 6 °C, which caused a complete and instant alteration into aragonite. For comparison, a piece of ikaite column was taken straight from the freezer and left to dry at a laboratory temperature of ~22 °C for four days. The alteration product was almost pure calcite. Thus, we conclude that fluids and incremental heating are paramount for a prolonged stability of ikaite and has consequential effect on its mineral alteration assemblage.

References

Stockmann, G.J., Seaman, P., Balic-Zunic, T., Peternell, M., Sturkell, E., Liljebladh, B. & Gyllencreutz, R., 2022: Mineral Changes to the Tufa Columns of Ikka Fjord, SW Greenland. *Minerals* 12(11), 1430, <https://doi.org/10.3390/min12111430>.