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# Control of a Calcite inhibitor (phosphate) and Temperature on Ikaite precipitation in Ikka Fjord, Southwest Greenland

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Ikaite, Ikka Fjord, seawater, orthophosphate, calcite inhibitors, precipitation

## Abstract

Ikaite ($CaCO_3 \cdot 6H_2O$) forms submarine tufa columns in Ikka Fjord, SW Greenland. This unique occurrence is thought to relate to aqueous phosphate concentration and low water temperatures (< 6 °C). Phosphate ions are well-known inhibitors of calcite precipitation and Ikka Fjord has a naturally high-phosphate groundwater system that when mixing with seawater leads to the precipitation of ikaite. In the study presented here, experiments simulating conditions of Ikka Fjord show that a) the formation of ikaite is unrelated to the aqueous phosphate concentration (0–263 μmol/kg $PO_4^{3-}$) in 0.1 M $NaHCO_3$/0.1 M $Na_2CO_3$ solutions mixing with seawater at 5 °C and pH 9.6–10.6, and b) ikaite forms at temperatures up to 15 °C without phosphate and in open beakers exposed to air. Instead, supersaturation of ikaite and the seawater composition are the likely factors causing ikaite to precipitate in Ikka Fjord. This study shows that adding $Mg^{2+}$ to a $NaHCO_3$/$Na_2CO_3$ – $CaCl_2$ mixed solution leads to the formation of ikaite along with hydrated Mg carbonates, which points to the high $Mg^{2+}$ concentration of seawater, another known inhibitor of calcite, as a key factor promoting ikaite formation. In experiments at 10 and 15 °C, increasing amounts of either nesquehonite ($Mg(HCO_3)(OH) \cdot 2H_2O$) or an amorphous phase co-precipitate with ikaite. At 20 °C, only the amorphous phase is formed. In warming Arctic seawater, this suggests Mg carbonate precipitation could become dominant over ikaite