

Early diagenesis of volcanic ash and associated carbonate mineral formation in seafloor sediments

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Glendonites are calcium carbonate pseudomorphs after ikaite, a metastable, hydrated form of calcium carbonate that only precipitates under unusual chemical conditions and (generally) at near-freezing temperatures. The discovery of glendonites in the glendonites in sediments deposited during the greenhouse climate of the early Paleogene is therefore rather surprising, and it is notable that they occur in close association with ash horizons from the nearby North Atlantic large igneous province [1]. Volcanic ash deposited directly into marine settings is known to rapidly release various elements during ash–water interactions, including phosphorus and magnesium [2,3], which are believed to promote ikaite precipitation over the more stable polymorphs. In sufficiently high concentrations, Mg may even stabilise ikaite formation at warm (> 10 °C) temperatures [4]. In order to investigate the possible role of ash diagenesis in authigenic CaCO₃ precipitation, we undertook experiments to discover if and how ash leaching may create the chemical conditions required to stabilise ikaite precipitation over the more stable carbonate polymorphs. This was done by leaching pristine ashes collected from the Eyjafjallajökull 2010 and Grímsvötn 2013 eruptions (Iceland) in artificial seawater under different temperatures, and measuring chemical variables such as alkalinity that have been directly linked to ikaite stabilisation. Ultimately, we attempt to force ikaite to precipitate in artificial seawater under conditions simulating extensive ash leaching in order to test the link between volcanism and ikaite, and (re)assess the temperature range under which Paleogene ikaite may have grown.

[1] Vickers, Lengger, Thibault, Bernasconi, Schultz, Fernandez, Ullmann, Rasmussen, Bjerrum, Hougaard and Korte (2020). *Nature Communications* 11, 4713.

[2] Jones and Gislason, S. R. (2008). *Geochimica et Cosmochimica Acta* 72, 3661-3680.

[3] Olsson, Stipp, Dalby and Gislason (2013). *Geochimica et Cosmochimica Acta* 123, 134-149.

[4] Tollefsen, Balic-Zunic, Mörth, Brüchert, Lee and Skelton (2020). *Scientific Reports* 10, 8141.