Pseudomoroh after ikaite – called Glendonite is it a geological thermometer in cold sediments or geological oddity as it occurs close to PETM in the Fur formation



2009 IOP Conf. Ser.: Earth Environ. Sci. 6 072059

(http://iopscience.iop.org/1755-1315/6/7/072059)

**P07.47**

**Pseudomoroh after ikaite – called Glendonite is it a geological thermometer in cold sediments or geological oddity as it occurs close to PETM in the Fur formation**

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he pseudomorph “Glendonite” can be assumed to be found after the metastable mineral Ikaite (CaCO3•6H2O). Ikaite is namely thought a low temperature mineral forming mostly in sediments. Therefore the Glendonite has been given the role of a geological thermometer. My studies however show that the truth is more complex than just the temperature as outcrops occur where temperature is higher than 5-7 ° C which has been assumed the maximum temperature at which Ikaite can grow and remain stable. The normal theory places Ikaite (CaCO3•6H2O) in cold water conditions associated with periglacial or thawing permafrozen environments. A very broad collection of all known modern outcrops of Ikaite and its assumed fossil record named Glendonite however shows a more complex picture. If the Ikaite - Glendonite assumption holds it hints that Ikaite is rather the product of a biological influenced chemistry environment with many ions from volcanic material. The biological influence means that the Laboratory thermodynamics is no longer the ground principal for understanding the geological record as bacteria has held its influence. This means that Glendonite is not automatically an indicator of low temperature. The outcrops in the Eocene Fur Formation right next to the PETM and the outcrops in Bay of Fundy from 960 AD. are good examples of this. Outcrops in NSW Carbo-permian sediments holding drop stones however fit the original description nicely along with Kempers Cretaceous Valanginian stage glaciations publicized in Klima der Kreide (Kemper 1987). Normal proof of a pseudomorphs parent mineral rests on crystallographic recognition. This can however not be applied here as the recrystallisation of Ikaite to Calcite has warped the morphology. So the proof rest on the fact that three modern pseudomorph after established Ikaite hold some very distinct features and isotopic characteristics. These can not be found in other calcite build pseudomorphs other than the ones called Glendonite assumed to be after Ikaite. Fur Formation and PETM: The Fur Formation is roughly 60 meters thick and divided into two members. The lower member is named the Knudeklint Member and is some 40 m thick consisting of 18 m black clay followed by two 30 cm thick silicified shale horizons that is very poor in fossil material. The upper member is called the Silstrup Member and is some 25 m thick comprise the positive ash layer from +1 to + 140. The member includes several horizons of calcareousconcretions and abundance of large pseudomorphs after ikaite. Under the Fur Formation is a roughly 14 m thick deposit of olive black silty clay named the Stolleklint Clay. The International Subcommission on Paleogene Stratigraphy, however, has defined the Paleocene/Eocene boundary to be at the base of the CIE (Carbon Isotope Excursia). This definition of the P/E boundary implies a boundary position in Denmark probably at the base of the Stolleklint Clay. (Beyer, Heilmann-Clausen, Abrahamsen, 2001). Ikaite (CaCO3•6H2O): The mineral Ikaite is known for its spectacular outcrop in the Ikka fjord of SE Greenland. The mineral Ikaite is calcium carbonate hexahydrate (CaCO3•6H2O). A metastable mineral synthesized first by the French chemist Pelouze in 1831. Pelouze identified it as a phase of calcium carbonate which was subsequently found to be stable at room temperatures only under high pressures (>5Kb) (Marland, 1975). Mineral outcrops are linked to very specific geological settings are not that uncommon in present natural environments, ranging from a few cold springs to some deep-sea sediment along with Sibiran river deltas and than the Ikka fjord. Ikka fjord columns where first in 1963 where brought to the attention of science and analysed to be Ikaite by Hans Pauly. The Ikka Project (Buchardt et.al 1997) carried out mainly by Bjørn Buchardt, Poul Seamann and Douglas Shearman and other has show how the mixing of meteoric water from an ancient Carbonotite leaking into the Ikka fjord bottom. This together with bacteria promotes the growth of Ikaite in an Marin environment. The bacteria film covering the mineral columns explain why the Ikaite is not instantly dissolved into the seawater as it should be. The history of Glendonite and link to Ikaite: First known as pseudogaylussite (Freiesleben, 1827) later as Glendonite (Dana, 1849) these odd shaped pseudomorfs showed are to be calcite after ikaite generated in special sedimentary environments. The size range from a few millimetres to one meter and they weigh up to twenty kilos. The morphology is composed of monoclinic type prismatic and pyramid crystal faces. These crystal faces are superimposed by the calcite morphology during the pseudomorfication process. Furthermore the pseudo-morfication of ikaite involves a reduction in volume by 5 - 30 % resulting in morphology, which deviates from the monoclinic symmetry. However the morphological appearance and especially a very distinct petrologic fabric link the pseudomorfs to ikaite with zonated calcite filling out the mould. The zonation generated when (CaCO3•6H2O) goes to

 

(CaCO3•H2O) ant to (CaCO3). Along this the δC13 in the zonated calcite is often around minus 15 – 25. The zonated calcite's carbon origions direct of the original Ikaite. The discoveries of sediment grown ikaite in The Bransfield Strait by Erwin Suess (Suess 1982) and in The Ocromsk Sea by Jens Greinert (Greinert 2004) has show that Ikaite forms as the shapes of the pseudomorphs mould.

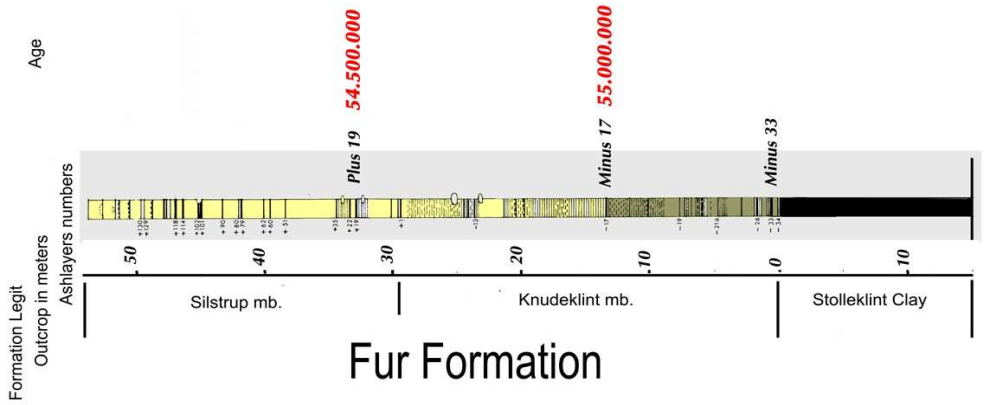


Figure 1. The Fur Formation

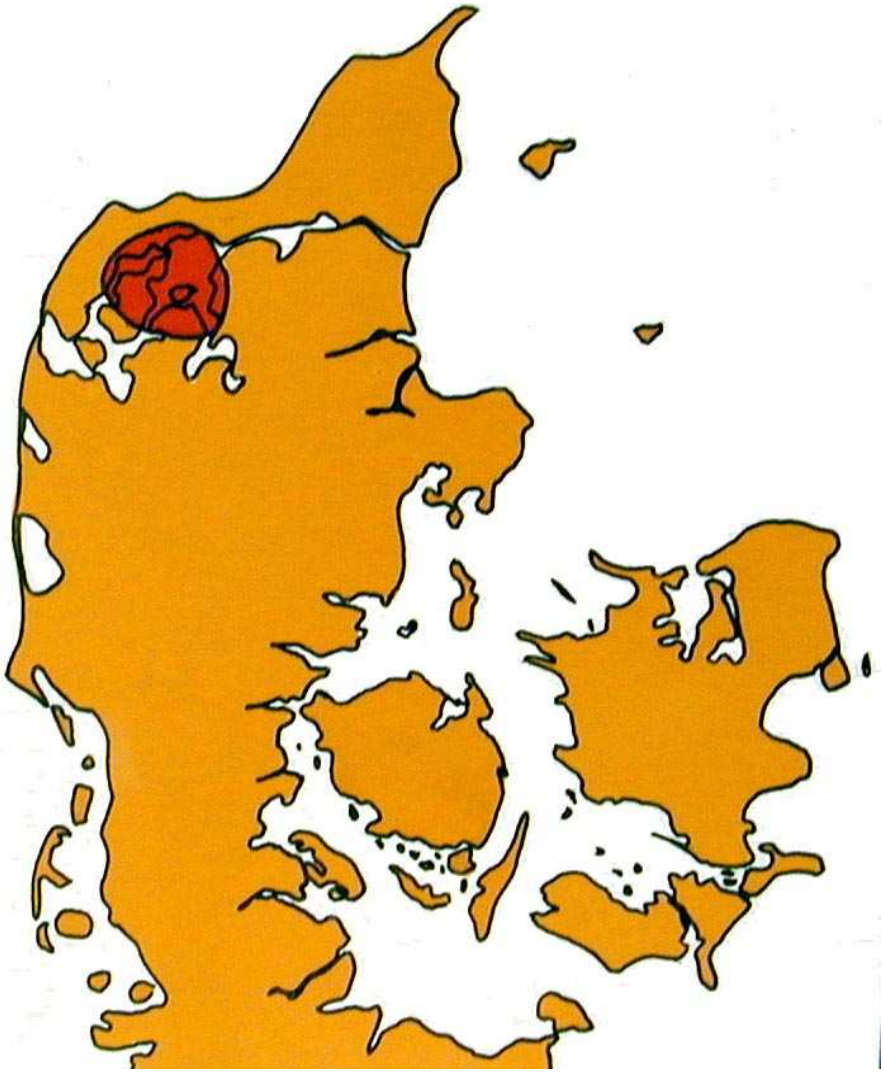

Figure 2. The Fur Formation Outcrop

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