Smectite in ancient pottery from Hallstatt – a contradiction?

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250 million years ago the area around Hallstatt was covered by a large ocean. Even at that time climate change was a fact: Due to global warming water evaporated and huge amounts of salt crystallized. 7000 years ago people discovered these salt deposits, settled in Hallstatt and started salt mining. Pottery was used in everyday life and also as grave goods. During the last 200 years archeologists excavated various ceramic products and many potsherds from Bronze Age, Iron Age and Roman times.

For this study about 30 different shards and samples from some clay pits in the surrounding of Hallstatt were selected and analyzed. Bulk and clay mineral composition of shards and potential raw materials were determined by X-Ray Diffraction (XRD) and Simultaneous Thermal Analysis (STA). Cation exchange capacity of all samples and grain size distribution and consistency limits of the raw materials were measured. Trace elements were analyzed by ICP-MS to obtain information about the provenance of the raw material for the pottery.

Against expectation the trace element composition of the clay samples and the pottery did not match. This proves that the pottery was not produced in Hallstatt, but imported in exchange for the salt.

The mineral content of pottery depends on raw material, possible additives and firing temperature. Clay minerals from the raw materials are transformed into new silicate minerals during the firing process. Especially smectites and vermiculites are very sensitive to temperatures above 550 °C. At this temperature an irreversible dehydroxilation occurs.

Surprisingly considerable amounts of smectite were detected in some of the analyzed shards. It seems implausible that the firing temperature did not exceed 550 °C, because such pottery would not be durable and it is well known that the kilns allowed much higher temperatures.

The most probable explanation is that during thousands of years of burial in the soil of Hallstatt smectite did recrystallize. The further investigation of pottery from different areas and different times produced under different conditions should help to understand this clay mineralogical contradiction.