Micro-scale clues to transport-scale questions: How LA-ICP-MS trace-element composition maps can reveal steatite's hidden secrets

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Steatite is an easily carved, talc-rich, metamorphic rock with a high heat capacity, which made it especially popular in Viking Age Scandinavia for crafting household objects, especially cooking pots. Such pots have been found even in settlement locations with no local sources of steatite. Archaeologists and geologists have tried a variety of approaches over the past 50 years to characterise steatite quarries sufficiently to demonstrate the sources for steatite artefacts (e.g. Allen et al. 1975; Bray 1994; Jones et al. 2007; Keulen et al. 2022); each of these studies have furthered our understanding of the complexities of steatite and the challenges inherent in such provenance studies.

These challenges stem from the hot, fluid driven, metamorphic processes, which typically results in heterogenous steatite outcrops showing substantial variations in the concentrations of the major minerals. This can result in different bulk rock chemistry for each sample from the same outcrop and can affect even the Rare Earth Element (REE) distribution patterns.

However, while this style of metamorphism comes with such built-in challenges, each outcrop forms under a unique set of conditions (temperature, pressure, and the composition of precursor rock and fluid flow), which results in certain trace elements being favoured, or rejected, during the growth of the various accessory minerals included in the steatite, as dictated by those conditions. Therefore, this study focuses on these accessory minerals, particularly the opaque sulphide and oxide minerals, which are the phases most likely to contain many of the sample's trace elements.

Laser-ablation ICP-MS trace-element composition maps of accessory minerals (and their surrounding matrix minerals) have been made for samples collected from a variety of Swedish and Norwegian steatite outcrops to illustrate the ways in which these minerals are, or are not, zoned with respect to their major and trace elements, and to investigate the differences in these patterns from one location to another, with the goal to develop a more reliable method to quickly determine if a given steatite artefact could have come from an analysed quarry.

This contribution presents LA-ICP-MS trace element maps of iron oxide and pyrite crystals from two steatite artefacts from Haithabu and compares and contrasts them with one another, and with maps of iron oxide and pyrite crystals from several steatite quarries in Sweden and Norway.

References

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