Element Mapping of Ceramic Thin-sections

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The more common use of SEM-EDS (Scanning Electron Microscope combined with a microprobe) on ceramics are detailed analyses of the temper material e.g. to establish the chemical composition of grains that can not be identified by means of microscopy in a polarized microscope and to confirm the presence of different types of temper which may have leached and left only cavities in the ware and only a small imprint on the clay such as e.g. bone-temper. Furthermore it is used for identifying metal and slag inclusions in technical ceramics.

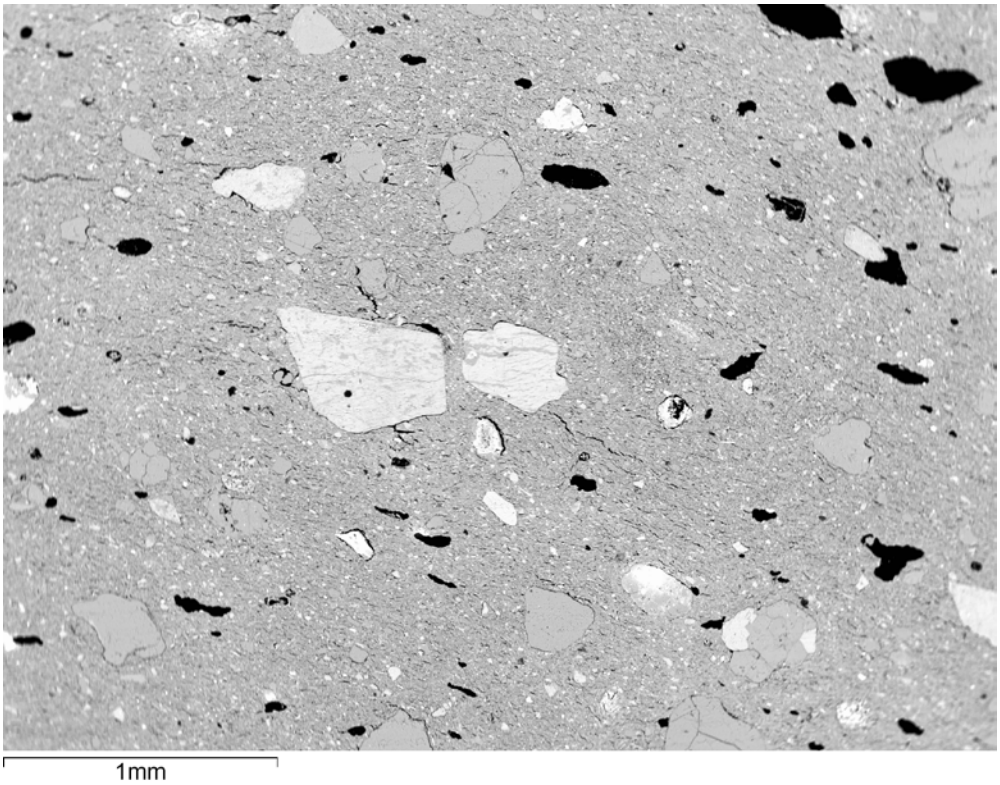

Fig. 1. Black and white image of all elements displayed in the element mapping.

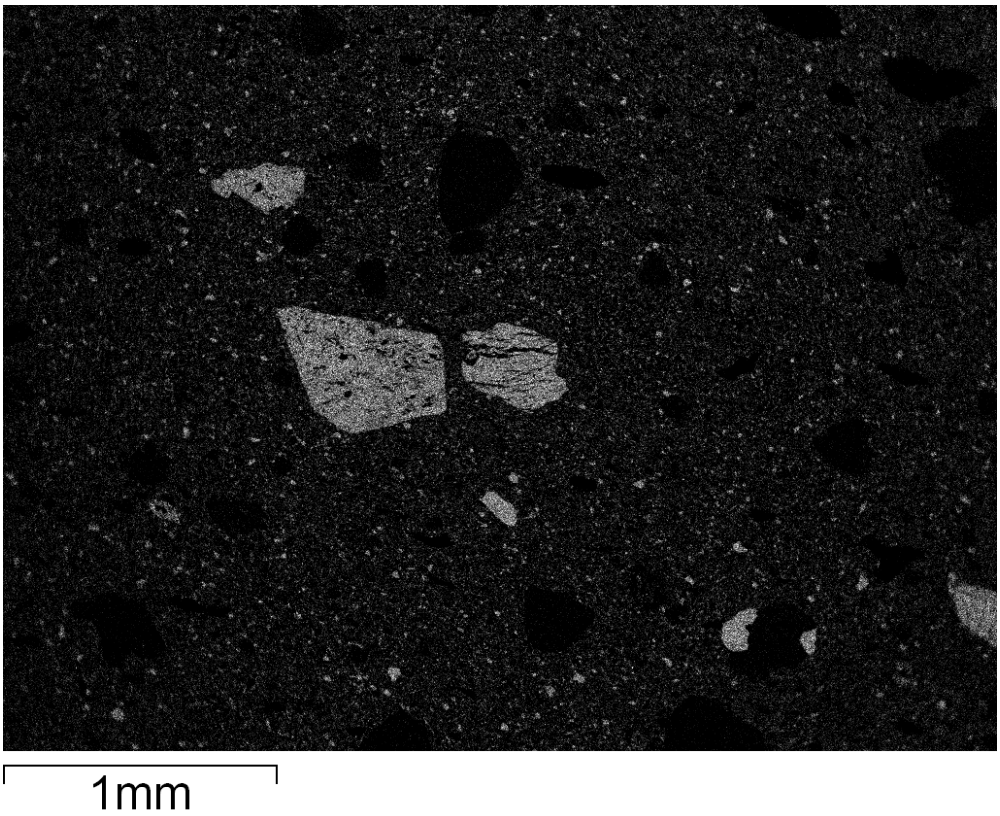

Fig. 2. Black and white image of the element Potassium (K).

In this project, however, I am investigating a larger part of the thin section in order to get an image of the chemical composition of all the grains of the silt fraction within this given area. The vast majority of the grains in the silt fraction are natural components of the clay i.e. they have not been added to the clay by the potter. Due to variations in the amount of e.g. quartz grains and different types of feldspar this type of image could be used to identify different clay sources.

The scan should be performed at the lowest possible magnification and still maintain a sharp image of the entire mapping area. Using the SEM-EDS Hitachi S3400N with the Oxford Inca EDS at the department of Geology in Lund the maximum mapping area of the thin-section is 3.5x2.5 mm. All elements in the periodic system with an atomic number of fluorine and higher are identified in the element mapping. The element mapping will only give a qualitative image of the distribution of elements of the sample.

The mapping is initially presented in an image of the combined elements (Fig. 1). The limitation of a SEM-EDS image is that it is always in a grey-scale which makes it difficult to differentiate between the different minerals just by

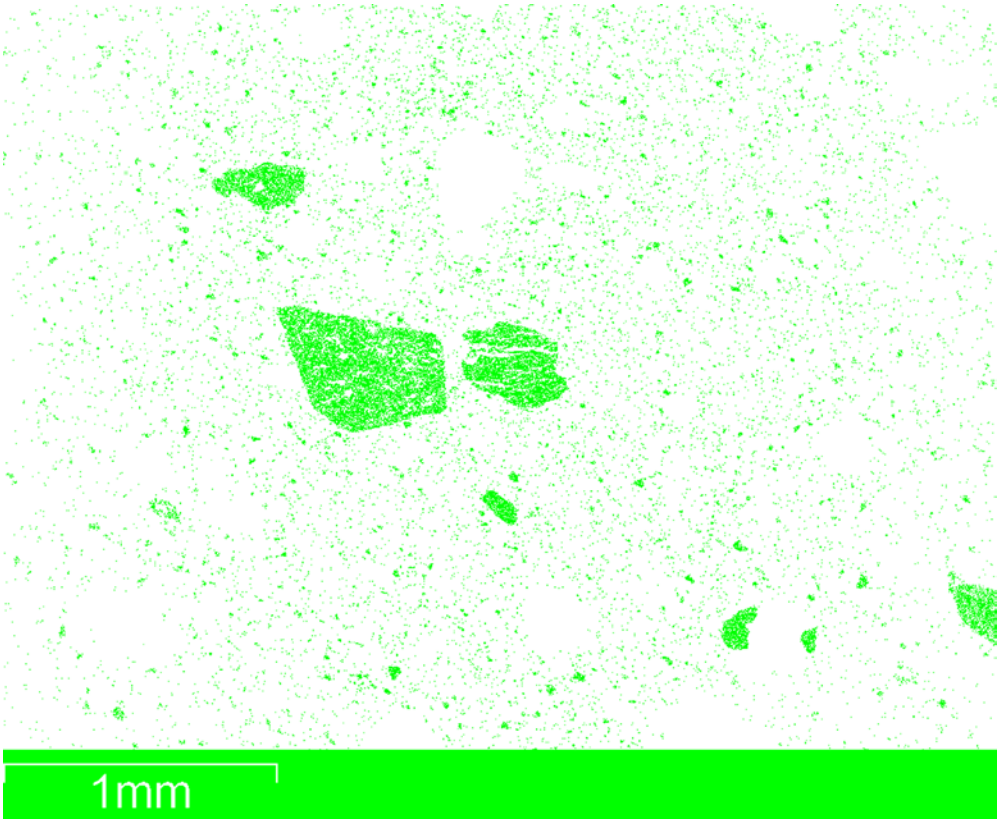

Fig. 3. Colour image of the element Potassium (K). The colouring has been made in Adobe Photoshop.

looking at the element mapping-image. One objective of this project is to display the elements in a colour-image an by doing so increase the possibility distinguish the different minerals.
A number of steps have to be taken to arrive at this colour-image.

First it has to be decided which elements are relevant to describe the mineral composition of the ceramic ware. A graph of the element spectra display the different elements found in the mapping and this information serves as a guideline to make mapping images of selected elements. The most common elements used to describe the mineral composition of the fine-silt fraction are Al, Fe, Ca, K, Si, Mg, Na, Ti, Zi. The black and white images of the single element mappings (Fig. 2) are imported to Adobe Photoshop where each element is given a unique colour (Fig.3). Thereafter the different colour images are combined into one image. Finally this combined colour-image is pasted over the original black and white image of the element mapping (Fig. 4). It is now possible to e.g. differentiate between potassium rich and sodium rich feldspars, feldspars and quartz etc. Furthermore grains of iron-rich clay pellets and grains of grog-temper are easily distinguishable.

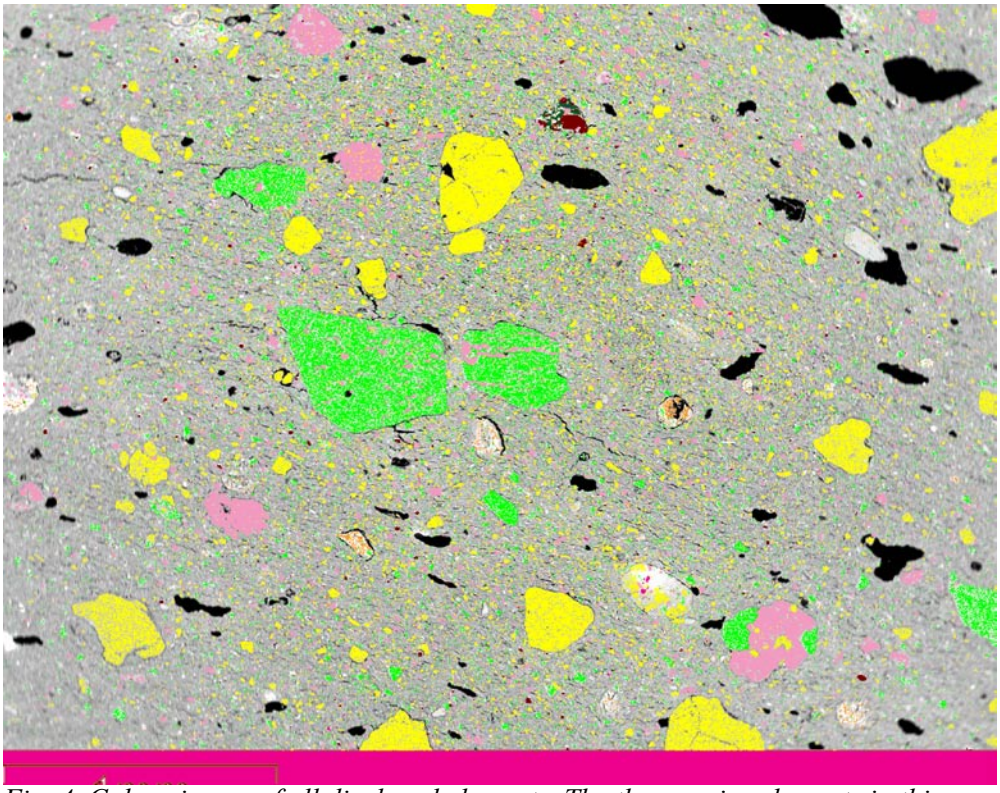

Fig. 4. Colour image of all displayed elements. The three major elements in this image are Potassium, Silica and Sodium where Green = Potassium (K), Yellow = Silica (Si), Pink = Sodium (Na).

A further use of the colour images is quantitative analyses of minerals using an image analysing system such as Kontron KS300 (Zeiss) or the more modern and enhanced system NIS-Elements BR (Nikon).

Ceramic materials from two different work-shops of post-medieval dating in Jönköping will be used to test the method. According to written sources at least two clay quarries were in use at the time. The results of the petrographic microscopy indicate that it is possible that the raw material originate from two different sources.