Hyperspectral imaging of drill cores from Heggdal (E39, Møre-Romsdal, Norway) for mineral chracterisation and mapping of expansive clays.

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Drill cores providing essential information for planning of infrastructure projects and innovative methods are desired for efficient analysis of these core materials. Mineral composition controlling geotechnical properties should be carefully evaluated during the planning stage in infrastructure projects. Specific clay minerals, in particularly smectites, which can also occur with chlorite as mixed-layered clay, can expand due to water absorption, and generate significant swelling pressure. Extra measures might be required for tunnel constructions and should be addressed during planning when expansive clays with critical swelling pressure occur. It is therefore crucial to analyse the presence of expansive mineral composition in the planning stage of infrastructure projects.

Hyperspectral imaging is a non-destructive, non-contact method to identify and map mineralogical composition utilising the reflectance properties of minerals within the visible and the infrared spectral range of light and is increasingly used in rock laboratories for drill core analysis. Many minerals, among others, different clay types can be differentiated by reflectance spectrometry and can be therefore mapped with hyperspectral imaging.

In this study, the potential of hyperspectral imaging is evaluated to detect, map, and quantify expansive clays in the Heggdal cores, drilled for the infrastructure project E39 Vik–Julbøen (Vestnes, Møre og Romsdal, Norway), which is aiming to cross the Romsdalsfjord with a 14.5 km long underwater tunnel from Vik to Nautneset and a 2 km long suspension bridge from Nautneset to Julbøen. The project is a part of the infrastructure program led by the state highways authority intending a ferry-free coastal highway in Southern Norway.

A selection of core boxes from the Heggdal core have been scanned with the core hyperspectral imaging system at NGU using a SisuRock scanning system equipped with two hyperspectral image cameras measuring within the visible near-infrared (VNIR, 400-1000nm) and short-wave infrared (SWIR, 1000-2500nm) spectral range. The evaluation of the hyperspectral image data shows that image spectra with smectite and chlorite signatures have been found. The spectra and spectral maps indicate that the clay composition in these cores is dominated by smectite and chlorite and both minerals are found in all analysed core boxes. The spectral mapping results can guide in-depth sampling, and swelling pressure should be tested at locations with high smectite and chlorite concentrations.

XRD analysis confirms that spectra interpreted to be representative for smectite and chlorite in these data showing highest concentrations of this minerals and that the clay composition in these cores are dominated by smectite and chlorite. The XRD analysis also indicates that the spectral maps provide representative mineral distribution and mineral concentration maps. This study confirms the potential of core hyperspectral imaging for mineral characterisation and to map minerals of particular interest such as swelling clays or other hazardous material over the entire core lengths. Further work is required for more comprehensive validation studies, to determine limitations and to adjust the method for the need in infrastructure projects.

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