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# Potential of 3D hyperspectral data for mineral exploration: an example from the Paleoproterozoic Mârmorilik Pb-Zn- deposit (Central-West Greenland)

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Due to modern society's high demand for raw materials and the gradual depletion of low-cost mineral ores, mineral exploration campaigns and geological mapping increasingly require the development of sustainable, cost-efficient and easily applicable methods. Sustainability is a critical issue especially for exploration in Arctic regions with their unique and sensitive ecosystems. This study validates the potential of a newly developed multi-source and multi-scale remote sensing approach and will showcase how spectral imaging supports less invasive geological exploration work. Our workflow brings traditional 2D hyperspectral data into the third dimension with the help of SfM-MVS (Structure from Motion-Multi View Stereo) derived pointclouds, which provide a basis for evaluation of material properties and geological structures in a geometrically accurate virtual environment. This approach can be used to guide the geologist in the field and thus decreases the geologist's personal risk in the field, is less invasive than traditional mapping and may even reduce the number of required boreholes. The case study area is located in Central West Greenland and hosts the Black Angel Pb-Zn deposit. Central West Greenland is characterized by Arctic climate conditions and alpine terrain, which prevents the growth of vegetation, but makes access for field campaigns extremely difficult. Thus, a ground-based hyperspectral imaging system was employed to highlight small mineralogical differences in rocks that cannot be recognised in traditional RGB images and associated photogeological models. Based on well-defined absorption features of the carbonates within the Shortwave-Infrared (SWIR; 970–2500 nm), the marbles of the Paleoproterozoic Mârmorilik Formation can be divided into calcite- and dolomite-rich units. As a result, previously unknown deformation structures (faults and folds) and lithological boundaries within the apparently homogeneous marbles are clearly revealed. Additional mineral mapping procedures such as Spectral Feature Fitting highlight gypsum occurrences related to deformation and ore emplacement. The lithological boundaries and tectonic structures extracted from the hyperspectral 3D surface model are then extrapolated into the subsurface using existing well data. The proposed workflow is fast, efficient, and fully validated and should be considered as a viable alternative to traditional techniques in exploration mapping.