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Three-dimensional maps of a heterogeneous peridotite of the Cima Lunga unit: resolution of lithological limits and geological implication (Central Alps, Switzerland)

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Remote sensing helps to evaluate quantitatively geological processes by increasing the precision of 3D geological maps, especially in areas that are poorly accessible. Here, we investigate the feasibility and the maximum obtainable resolution of digital geological maps of a heterogeneous High-Pressure ultramafic body (length of ca. 300 m) embedded within paragneisses of the Cima Lunga unit (Central Alps, Switzerland). The peridotite contains deformed mafic layers of amphibolite, eclogite, metarodingite or eclogitic metarodingite. Furthermore, calcsilicate layers locally cut the peridotite and are usually interpreted as ophicalcites that formed on the seafloor, prior to Alpine deformation and metamorphism.

Remote sensing data was acquired by an unmanned aircraft system (UAS) and elaborated with the software *Aegisoft Photoscan* for the image mosaic, *Cloud compare* for the Digital Elevation Model and *QGIS* for the visualizations. The model was georeferenced using ground control points, whose exact coordinates were obtained in the field using a GPS (with errors of ± 3 cm). In a first step, we mapped the ultramafic body using the 3D model, the orthoimages and the published geological data. In a second step, we mapped the ultramafic body in the field using our high-precision 3D topographic model (scale 1:1’000). In a last step, we fused the two maps and compared the different approaches in terms of precision of geological boundaries, lithological content and of work efficiency.

The results show that the map interpreted with the digital 3D model yields a high accuracy of the main ultramafic body (<1 m). However, internal small-scale geological features (e.g. mafic dikes <1.5 m) are very hard to distinguish, unless known from prior work. In addition, mapping with UAS images only is not reliable in suboptimal terrain such as loose rocks, grassy ledges, area with large light contrasts, etc.

In comparison, field mapping yielded a much more detailed map with lithological details up to 0.3 m, but the uncertainties of the lithological limits varied from 2.5 to 5 m associated with the precision of the localization in the field. In addition, the field observations helped with the geological interpretation across the partially covered outcrops. However, such an approach was time-consuming.

The fusion of both approaches combined the precision of the 3D model (<1 m) with the resolution of the fieldwork and allowed to resolve features as small as 0.3 m.

Finally, the final 3D map helped to clear up a geological feature: The calcsilicates cannot be considered metamorphosed ophicalcites that formed at the seafloor. Indeed, the map shows that calcsilica-breccias and migmatitic leucogneisses (presumably Alpine in age) together intruded the necking zones of the boudinaged ultramafic body, locally cutting the foliation of the peridotite.