

Fold-structure analysis of paleozoic rocks in the Variscan Harz Mountains (Lautenthal, Central Germany) based on laserscanning and 3D modelling

Bianca Wagner (1), Bernd Leiss (2), Ralf Stöpler (1), and Fabian Zahnnow (1)

(1) University of Göttingen, Geoscience Center, Applied Geology, Germany (bwagner1@gwdg.de), (2) University of Göttingen, Geoscience Center, Structural Geology, Germany

Folded paleozoic sedimentary rocks of Upper Devonian to Lower Carboniferous age are very well exposed in the abandoned chert quarry of Lautenthal in the western Harz Mountains. The outcrop represents typical structures of the Rhenohercynian thrust and fold belt of the Variscan orogen and therefore allows quantitative studies for the understanding of e.g. fold mechanisms and the amount of shortening.

The sequence is composed of alternating beds of cherts, shales and tuffites, which show varying thicknesses, undulating and thinning out of certain layers. Irregularly occurring lenses of greywackes are interpreted as sedimentary intrusions. The compressive deformation style is expressed by different similar and parallel fold structures at varying scales as well as small-scale reverse faults and triangle structures.

An accurate mapping of the outcrop in the classical way is very challenging due to distant and unconnected outcrop parts with differing elevations and orientations. Furthermore, the visibility is limited because of nearby trees, diffuse vegetation cover and no available total view.

Therefore, we used a FARO 120 3D laserscanner and Trimble GNSS device to generate a referenced and drawn to scale point cloud of the complete quarry. Based on the point cloud a geometric 3D model of prominent horizons and structural features of various sizes was constructed. Thereafter, we analyzed the structures in matters of orientation and deformation mechanisms. Finally, we applied a retrodeformation algorithm on the model to restore the original sedimentary sequence and to calculate shortening including the amount of pressure solution.

Only digital mapping allows such a time-saving, accurate and especially complete 3D survey of this excellent study object. We demonstrated that such 3D-models enable spatial correlations with other complex structures cropping out in the area. Moreover, we confirmed that a structural upscaling to the 100 to 1000 m scale is much easier and much more instructive than it could have been done in the classical way.