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3D structural modelling of an outcrop-scale fold train using photogrammetry and GPS mapping

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Upper-Cretaceous marls and limestones of the Gosau Group, exposed in a quarry SE of Vienna, Austria, show folds of unknown origin. In order to distinguish between a tectonic (early Tertiary Alpine nappe stacking) or gravitational cause for this deformation, we created a 3D model of a representative part of the outcrop.

From more than 500 photographs we generated a point cloud using the software Photosynth™. This freeware is available on www.photosynth.net and requires nothing but a series of overlapping pictures showing the same scenery from different perspectives, and preferably various distances. The pictures need to be loaded onto a web server, where they are arranged in 3D by pattern recognition and a coloured point cloud is generated. The xyz- and RGB values of this point cloud can be downloaded and imported into GoCAD® (Paradigm). From this dataset, we constructed the quarry walls as triangulated surfaces and mapped the folded sedimentary layers. Using a differential GPS handheld-PC (Trimble), we additionally mapped several prominent bedding planes and were able to georeference the whole setting.

In combination with structural measurements of sedimentary layering, fold axes and axial planes, and fault planes, the constructed 3D structural model clearly indicates that the exposed fold train was formed by gravitational slumping, and is not related to later nappe stacking and folding.
The workflow to generate 3D geological datasets from a series of photographs may be a useful addition or alternative to more sophisticated and cost-intensive tools like laser scanners or total stations.