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Surveying a fossil oyster reef using terrestrial laser scanning

A. Haring (1), U. Exner (2), and M. Harzhauser (3)

(1) Christian Doppler Laboratory at the Institute of Photogrammetry and Remote Sensing, Vienna University of Technology, Austria (ah@ipf.tuwien.ac.at), (2) Department of Geodynamics and Sedimentology, University of Vienna, Austria (ulrike.exner@univie.ac.at), (3) Department of Geology and Paleontology, Natural History Museum Vienna, Austria (mathias.harzhauser@nhm-wien.ac.at)

The Korneuburg Basin, situated north-west of Vienna, is well known to contain a rich variety of fossils from the Early Miocene (16.5 ma) and therefore has been investigated extensively by scientists in the past decades. An exceptional discovery was made in 2005: a large fossil oyster reef has been excavated and documented carefully during the last years. Aside from the giant-sized oyster *(Crassostrea gryphoides)*, the excavation site contains numerous species of molluscs along with teeth of sharks and rays and even isolated bones of sea cows.

The oysters, having lengths of up to 80 cm, are protruding from the ground surface, which is more or less a tilted plane (25°) with a size of about 300 m^2. The entire site is crosscut by a network of geological faults, often also offsetting individual oyster shells. Displacements along the normal faults do not exceed $\sim$ 15 cm. The faulted fossils offer a unique opportunity to measure displacement distribution along the faults in great detail and provide insight in deformation mechanisms in porous, barely lithified sediments.

In order to get a precise 3D model of the oyster reef, the terrestrial laser scanner system Leica HDS 6000 is used. It is a phase-based laser scanner, i.e. the distance measurement is performed using the phase-shift principle. Compared to the time-of-flight principle, this method is generally more appropriate to projects like this one, where the distances to be measured are relatively small ($<$ 35 m) and where a high point density (point spacing of about 1 cm) and precision (some mm) is required for capturing the oysters adequately. However, due to fact that they occlude each other, one single scan is not sufficient to get all sides of their surface. Therefore, scans from different positions had to be acquired. These scans have to be merged, which involves the problem of sensor orientation as well as sampling of the entire 3D point cloud. Furthermore, a representation of the surface data is required that is suitable for answering certain questions of paleontologists and geologists. Finally, structural measurements may be performed in a geological software application, without treading on the fragile surface. On the other hand, paleontologists are interested in knowing if the oyster axes are aligned randomly or if they show a systematic alignment, in order to draw conclusions on the ocean currents at that time.

For data processing, we use the 3D modeling software Geomagic Studio and the DTM (Digital Terrain Model) software SCOP++. The entire site has also been systematically documented by a large number of digital photographs. The obtained texture information allows a visual interpretation of the underlying surface.

We discuss in how far such a 3D model derived from terrestrial laser scanner data may be useful to support the research work of geoscientists.