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High-resolution mapping of fault drag and displacement gradients from terrestrial laser scanner data (SE Vienna Basin, Austria)

H. Pretsch (1), U. Exner (1), B. Grasemann (1) and A. Haring (2)

(1) Department of Geodynamics and Sedimentology, University of Vienna, Austria (herbert.pretsch@gmx.at), (2) Christian Doppler Laboratory for "Spatial Data from Laser Scanning and Remote Sensing", Vienna University of Technology, Austria

Normal faults in unconsolidated sediments are exceptionally well-exposed in a gravel pit south of St. Margarethen (Burgenland, Austria). The Sarmatian/Pannonian sediments represent a succession of deltaic gravels with intercalations of shallow marine calcareous sands, which have been deposited in the Neogene Eisenstadt-Sopron Basin, a subbasin of the Vienna Basin. NW-SE dipping extensional high-angle faults initially localized within in meter-thick layers of well-rounded conglomerates and record a marked displacement gradient along their dip. Faults with larger displacements cross-cut the succession of fine to coarse grained sedimentary layers, which document fault drag in the vicinity of the normal faults.

In order to precisely map the fault drag and the displacement gradients along the faults we use a terrestrial laser scanner system (*RIEGL* LMS-Z420i) consisting of a high performance long-range 3D laser scanner and a calibrated high-resolution digital camera mounted onto the scanner head. The resulting virtual outcrop is analyzed using the 3D visualization software Gocad that allows the user to directly map faults and displaced/distorted marker horizons. Simultaneously, spatial orientations fracture connectivity, branch-line geometry, relationship between corrugations and fault splays, detailed fault throw profiles, and the spatial correlation between fracture density and fold curvature can be measured quantitatively.

Detailed mapping reveals that in the gravel pit south of St. Margarethen dip angles

of the normal faults are directly related to the magnitude of offset. Isolated normal faults record reverse drag. Closely spaced normal faults reveal domino-type block rotation. Therefore we suggest that these faults originated at higher dip-angles and were subsequently rotated towards lower dip-angles.