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Initiation and evolution of a major fault-controlled valley: the Enns valley, Eastern Alps

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Many of major orogen-parallel valleys of Eastern Alps follow strike-slip faults initiated during Oligocene-Neogene lateral extrusion (e.g., Ratschbacher et al., 1991, Tectonics 10, 257-271). However, the succession of tectonic processes, erosion, and sediment infill has not been described in detail up to now, and new insights can get when doing so. Here we present new data from the ca. E-trending Enns valley, which represents one of the most significant fault-controlled valley comprising the northern confining sinistral strike-slip fault (Salzach-Enns fault) of the extruding wedge. New data result from a current mapping programme at its western end, associated work of fault rocks, and palaeostress assessment of fault-and striae data, and we discuss these data in the framework of existing data sets.

The ca. E-trending Enns valley developd along the eastern part of the Salzach-Enns fault. The Salzach-Enns fault basically controls the Early Miocene to Recent exhumation and surface uplift of the Hohe Tauern-Niedere Tauern corridor along the southern side and its iuxtaposition to the Graywacke zone/Northern Calcareous Alps on its northern strand, implying a minimum vertical, transtensional offset of ca. 3 – 4 km in the westernmost Enns valley. There, the northern strand shows a large rollover structure. The Salzach-Enns fault merges with the ENE-trending Mandling fault, and the intersection includes the Mandling wedge, which is interpreted here as a dextral strike-slip duplex with a minimum dextral offset of 25 km. The Salzach-Enns fault is running mostly along the southern side of the Enns valley beneath the Holocene valley fill, beside its intersection with the western Mandling fault. There, the fault is well exposed ca. 1 – 2 km S of the valley, comprise in general a small damage zone in the south, well-exposed m- to ca. 15 m thick black fault gouge, and a wide zone cataclasites along the northern side, the later mainly in fully cemented dolomite breccia

within Middle-Upper Triassic rocks of the Mandling wedge. Palaeostress data along the E-trending Salzach-Enns fault indicate sinisitral strike-slip tensors superposed by dextral reactivation, ca. NW–SE to N–S extension.

Based on sedimentary infill, the following steps of evolution can be recognized: (1) The Mandling fault initially developed during Early Miocene in a sinistral transtensive strike-slip regime, and the Wagrain basin with its ca. 250 m thick, fully consolidated fill formed close to the northeastern edge of exhuming Tauern window. The basin developed as halfgraben filled with detritus from Austroalpine medium-grade metamorphic sources now exposed ca. 40 to 60 km further east, implying a minimum sinistral offset of ca. 40 km along the Salzach-Enns fault. (2) Locally preserved, coarse block gravels in a silty-muddy matrix occur in elevations of ca. 1100–1300 meter a.s.l. have been reconized for the first time during our study. These are tentatively interpreted to represent a Pliocene valley fill and a subsequent surface uplift has to be assumed. (3) Pleistocene fluvial conglomerates are widespread along the northern margin of the Enns valley, and in part in elevation ca. 360 m above the present-day sea level (Schladming-Ramsau). Their dominant clastic source is still the Niedere Tauern corridor. (4) Well sorted, unconsolidated fluvial gravels have been found at elevations ca. 100 m above the present valley floor along the Salzach-Enns fault, and these rocks are still affected by faulting. (5) The effects of latest glaciations are widespread, and mainly represent the effects of the last glacial maximum. (6) The thickness of Pleistocene and Holocene valley fills is seemingly increasing from west to east as few scattered drill holes and a seismic survey (Schmid et al., 2005, Jb. Geol. Bundesanst.) in the east suggest. This indicates strong glacial erosion resulting in over-deepening of the valley, and, in conjunction with levels of preserved Pleistocene fluviatile sediments, continuing surface uplift. The fault still displays some seismic activity and youngest palaeostress indicators are in line with NE-SW compression and WNW-ESE extension similar to fault plane solutions.