



Paleoseismic data from deformed speleothems at the Salzach-Ennstal Fault System: Indications for Quaternary lateral extrusion of the central Eastern Alps

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Deformed cave sediments (seismothems, Delaby, 2002) exposed at a branch of the sinistral SEMP (Salzachtal-Ennstal-Mariazell-Puchberg) Fault System prove Late Pleistocene seismic slip along one of the major fault systems related to the eastward lateral extrusion of the Eastern Alps. The faulted cave (“Hirschgrubenhöhle”) is located 6 km south of the main fault of the SEMP in the Hoschwab karst massif. The deformed cave gallery is located 200 m below the surface. It is controlled by preferred karstification of several ENE-striking sinistral faults paralleling the SEMP, which are associated with cohesive and non-cohesive cataclasite suggesting progressive deformation during exhumation. Seismothems consist of sheared stalagmites, flowstone showing fault striations, and faulted flowstone. Striations and offsets of at least 20 cm prove sinistral strike-slip movement. Detailed speleological mapping excludes deep-seated mass movements and ice flow inside the cave as deformational mechanisms. Fault striae and faulted flowstone are overgrown by younger undeformed layers of flowstone. Age data from both the pre- and post-event flowstone (13 U/Th ages) prove that faulting occurred between 11 and 86 ka (i.e., Late Pleistocene). The observed structures and displacements suggest seismic faulting associated with surface rupture. Late Pleistocene glacial overprint, however, has eroded surface fault scarps, which might have formed during the event. The described Pleistocene seismothems are the first paleoseismological evidence for sinistral faulting along the SEMP. Our data is corroborated by fault plane solutions from two moderate earthquakes ($M = 4.1$ and 4.4), which occurred at the fault system (Reinecker & Lenhardt, 1999). Significant

neotectonic displacement along the fault is further indicated by an up to 480 m deep Quaternary basin associated with a releasing fault bend of the SEMP some 50 km west of the deformed cave (Schmid et al., 2005). The combined data suggest that the SEMP Fault System accommodates active lateral extrusion of the central Eastern Alps with kinematics similar to the Oligocene and Miocene ones.