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Variable Late Glacial to Holocene seismicity in the Eastern Alps, Austria? First results from a lacustrine paleoseismic study

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Abstract

Comparison of earthquake frequency in Fennoscandia and Northern Central Europe since the Last Glacial Maximum (LGM) suggests a general seismicity pattern for deglaciated areas, with high seismic activity in the Late Glacial, a rather calm period in the early Holocene and another increase in seismicity during the middle to late Holocene. In these tectonically relatively stable regions, postglacial rebound is believed to be the main contributor to changes in the stress field. However, in formerly glaciated, tectonically active mountain ranges, the role of tectonic stress vs. postglacial rebound on earthquake recurrence is still unclear and further strategically-located paleoseismological studies are needed.

Here, we present preliminary results of a lacustrine paleo-earthquake project in Carinthia, situated at the south-eastern rim of the Eastern Alps, Austria. This region, although located in an intraplate setting, has experienced several historically and instrumentally recorded earthquakes of an M_w up to 7. Eight lakes, all of them remnants of Pleistocene glaciations, were investigated using high-resolution reflection seismics and sediment cores. Our findings show that at least three lakes contain a datable archive of simultaneously-triggered slope failures, for which past seismic activity constitutes the most likely mechanism. By mapping the subaquatic landslides and combining them with analyses on long (~12 - 14 m) sediment cores and bathymetric data, we aim at reconstructing the paleoseismicity and its spatio-temporal distribution in the Carinthian/Friuli area during the last ~14 ky. One of our studied lakes, Klopeiner See, located at the very eastern margin of LGM ice extent, represents an extraordinary archive of deglaciation history. Due to a condensed Holocene section, we can resolve 12 m of Late Glacial history in a sediment core. By geophysical core logging, XRF- & medical CT-scanning as well as detailed core description, we are able to distinguish numerous event deposits from cm- to m-scale and date them accurately using radiocarbon dating, while also gaining insight into landscape evolution during deglaciation.

Our data hints at pulses of enhanced seismicity during the Late Glacial, peaking at the Pleisto- to Holocene transition, with several voluminous landslides covering large parts of all lake basins. Interestingly, the Carinthian lacustrine records show relatively little evidence of seismically triggered landslides in early to mid-Holocene times – a similarity to other paleo-earthquake studies in both the Fennoscandian Peninsula and the Alps. However, other than in the Swiss or French Alps, the tectonic contribution to recent uplift rates in our study area is relatively large. This suggests that seismicity in the Alps was – and maybe still is – rather governed by postglacial rebound than tectonically induced stress.