Lacustrine Paleoseismology in Tyrol and Carinthia: Establishing the first continuous postglacial earthquake records in Austria

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In formerly glaciated intraplate regions with low deformation rates and moderate seismicity, long-term paleoseismic records are essential to determine the probability of strong earthquakes and assess the seismic hazard. Lake sediments provide a continuous and high-resolution paleoseismic archive, which can record seismic shaking as mass transport deposits (MTDs), turbidites and soft sediment deformation structures. Lacustrine paleoseismological studies have been performed on many small and large alpine and piedmont lakes in the French, Italian and Swiss parts of the Alps, leading to some significant improvements in methodological approaches, detecting of periods of enhanced seismicity and discussion of possible paleo-earthquake scenarios. Remarkably, lakes within the Austrian Alps have not been explored yet for sedimentary evidence of past earthquakes, despite being a country with several areas of moderate seismicity and damaging historical earthquakes with epicentral seismic intensity up to IX-X. Here, we present the research strategies and preliminary results of three new projects on Austrian lake paleoseismology:

Tyrol on Shaky Slopes: Former research has shown that large rockslides in the Fernpass and Tschirgant region cluster around 3-4.2 kyrs BP. The triggering factors of these events, however, are still debated. We investigate the sedimentary infill of Piburgersee, Plansee and Heiterwangersee by reflection seismics and sediment cores, in order to assess the probability that these large rockslides were triggered by earthquakes. Together with seismic surveys and coring on Achensee and Hechtsee, these investigations will help to extend the paleoseismological record of Tyrol into the Late Glacial and reveal the recurrence of local and far-field earthquakes.

QUAKE-LAKE Carinthia: Carinthia and the adjacent Friuli region have experienced several well-documented historical earthquakes in a wide intensity range (V-IX; EMS-98) in 1201, 1348, 1690, 1857 and 1976, with the 1348 event considered to be the strongest historical earthquake (moment magnitude of ~7) in the Alps. Understanding the relationships between seismic intensity and the sedimentary fingerprint associated with these earthquakes enables us to use lake sediments as calibrated paleoseismographs. Finely laminated sediments reveal the potential of dating flood- and earthquake-related turbidites on a very high resolution. The 1348 and 1690 events led to ubiquitous landsliding in the large lakes, whereas in the shallow organic-rich lakes, seiche deposits serve as proxies for seismic activity. Extensive slope failures at the Late Glacial/Holocene transition hint at enhanced seismic activity during postglacial-rebound.

ARMONIA: The Interreg V – Italia-Österreich project ARMONIA will implement the results of both QUAKE-LAKE Carinthia and Tyrol on Shaky Slopes in a database of the region’s strong earthquakes. This will help to improve the Environmental Seismic Intensity Scale and lead to a management model to mitigate the seismic hazard in Austria and Italy.