

Large earthquakes in historical and pre-historical times in Switzerland: An overview of earthquake induced effects

Donat Fäh (1), Gabriela Gassner-Stamm (1), Michael Strasser (2), Remo Grolimund (1), and Stephanie Wirth (3)
(1) ETH Zürich, Swiss Seismological Service, Zürich, Switzerland (faeh@sed.ethz.ch), (2) Geological Institute, University of Innsbruck, 6020 Innsbruck, Austria, (3) Centre for Hydrogeology and Geothermics, Université de Neuchâtel, Neuchâtel, Switzerland

The building inventory in the Alpine area increased over the last century, increasing exposure to potential earthquake impacts. This is particularly critical in relation to earthquake-triggered mass movements, tsunamis in lakes and liquefaction. In Switzerland, it is possible to assess the spatial extent and impact of such secondary earthquake effects from historical and paleo-seismological analysis of past damaging earthquakes. Paleo-seismological information can also be used to estimate the size of the largest events in the last 20'000 years, which is an important input to constrain the maximum magnitude of earthquakes in the Alpine area.

The Earthquake Catalogue of Switzerland (ECOS-09) covers the period from 250 to 2009 AD, including the assessment of earthquake-induced effects related the larger damaging events. For the time before 1100 AD the catalogue is, however, only scarcely populated with events. For this period, we do not have reliable data or even completely lack historical sources. Access to earthquake information is then provided by paleo-seismology, with a considerable number of studies in Switzerland during the last decades, indicating possible evidence for large pre-historical earthquakes. The goal of our study was to gather all existing raw data from the different research fields (Sedimentology, Archaeology, Speleology, Geomorphology and Historical research), in order to homogenize it in a single common database, and to link the observations to possible events. The observations are mainly related to earthquake-related traces left in sediments and the environment by secondary earthquake-induced effects such as liquefaction, landslides and rock falls, mass movements in lakes and related tsunamis, fault scarps and broken stalagmites and stalactites. By analyzing this database for the last 20'000 calibrated years before present (cal yr BP), 16 periods with an increased number of paleo-seismological evidence attract attention. For the youngest incidents, highly reliable historical records are available, and paleo-seismological observations can be assigned to known historical earthquakes. For the older period, at least three incidents can be identified with paleo-seismological evidence distributed over a wider area, indicating a possible strong earthquake or a period of overall increased seismicity throughout Switzerland. The most prominent incident occurred in the period 2100-2300 cal yr BP. If assumed to be one single earthquake, it would be a candidate for being the strongest earthquake in the last 5'000 years in Switzerland, an event which would significantly exceed the magnitude of the Basel earthquake of 1356 (Mw of 6.6). The systematic collection and interpretation of paleo-seismological observations proved to be a valuable approach for detecting possible large pre-historical earthquakes and helps set priorities for future research. The collection and mapping of earthquake-induced effects can be used to calibrate seismic risk models which also include the impact of landslides, liquefaction and tsunamis on the built environment.