

Chemical fingerprints of earthquake event deposits in the Japan Trench

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The Japan Trench subduction zone has repeatedly been affected by large earthquakes, as most recently in 2011 by the giant magnitude 9 Tohoku-oki earthquake. The depression of the deep Japan Trench floor (>7500 m water depth) acts as sediment trap, where seismically triggered submarine mass flows are deposited and preserved in the geological record. Sedimentary records, collected east of the Tohoku-oki epicenter in a 60 km north-south transect along the Japan Trench floor axis and from a small basin on the slope, comprise several event deposits, which we test for seismic origin to investigating the earthquake history in this region. Porewater geochemistry and tephrochronological analyses on intercalated ash layers provide an age control and reveal that the records cover the recent 2011 event deposits, historical events, and prehistoric evidence up to ~62ka ago. Detailed analyses of these records, by using their sedimentological and lithological characteristics, their physical properties as well as their elemental composition (X-ray Fluorescence, XRF) allow to characterize and to identify individual turbidite units.

Three prominent seismo-turbidite sequences, related to the 2011 Tohoku-oki, the AD 869 Jogan and an earlier prehistoric earthquake, are widespread and exhibit in all records the same lithology as well as specific, unique elemental characteristics. In combination with reported rupture areas and incorporated calcareous nanno fossils, the deposited turbidity currents seem to originate from slope areas shallower than ~4500 m water depth. Further two chemical correlative seismo-turbidites have been deposited solely in an isolated basin in the deep trench and might be related to an historical earthquakes in AD 1454 (or AD 1611) and a prehistoric event ~2400 years BP. Other turbidite units do not reveal similarities in the elemental characteristics, but may also be the result of seismic triggered slope failures, deposited at locally restricted sites. It is observed that the frequency of turbidite deposition in the deep Japan Trench is higher during the past 1500 years, than during the period from ~15 ka to 2 ka, and might provide hints on the paleoseismic activity along the Japan Trench off Tohoku.

Keywords: Paleoseismology, Japan Trench, event-stratigraphy