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Earthquake-triggered remobilization of surficial sediments in the lacustrine and ocean realm.

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As subaquatic paleoseismology is based on turbidity records produced by earthquake-induced reworking of slope sediments it is of key importance to understand the erosional processes taking place during seismic shaking. It is commonly assumed that sediment remobilization by earthquakes happens only through subaqueous slope failure mechanisms such as subaquatic landslides, delta or canyon head collapses. A certain amount of sediment needs to be accumulated before a slope is again susceptible to failure. This would have implications on continuity of earthquake records and sensitivity of the method. Recent study on the composition of turbidite deposits in several Chilean lakes found that these turbidites were rather produced by earthquake-triggered mobilization of the upper few centimeters of sediment and not by subaquatic landslides. Recent research showed evidence for the same surficial erosion process for deposits from the Japan Trench and Nankai Trough. Both studies focused on basin sediments, though to better understand the process it is necessary to also study the slope.

Using multi-method analyses we investigated slope sequences of the Japan Trench and Chilean lakes. We compared results from i) stratigraphic correlations, ii) geochemical proxies (short-lived radionuclides, pore water geochemistry, high-resolution geochemical analyses by XRF core scanner), and iii) sediment-physical proxies (CT-scans, shear strength) to pinpoint gaps in the stratigraphy linked to surficial erosion. The sediment of the Chilean lakes is nicely laminated making it ideal for stratigraphic correlation by image analyses and high-resolution geochemical profiles. Sediment of the Japan Trench is optically homogenous and often disturbed by bioturbation making geochemical analyses more suitable to study this area.

Preliminary results of both Japan Trench and Chile show promising results. Pb-210 concentrations from a slope core taken on the trench-ward lower slope of the northern Japan Trench show a surficial erosion related gap in the stratigraphy possibly linked to the AD1968 Mw 8.3 Tokachi earthquake. Also, stratigraphic correlation of Chilean slope and basin sequences show an unconformity of a few centimeters caused by earthquake-triggered surficial remobilization. An additional 32 cores were taken on the slope of two Chilean lakes to constrain the effect of slope gradient and orientation on surficial erosion processes. Both the Japan Trench and Chilean lakes support diatom-rich sediments intercalated with tephra layers, making their geotechnical characteristics comparable. Lakes serve as an ideal natural laboratory where data acquisition is cost-effective and boundary conditions are well known, whereas the ocean setting is much more complicated, though allows an insight into the large-scale implications of seismically-triggered sediment transfer to the deep ocean.

For remobilization of surficial sediment virtually no recharge of sediment is needed between earthquakes to facilitate production of turbidity currents, in contrast to the production of subaquatic landslides. This would mean that, through the process of surficial erosion, turbidite paleoseismic records from closed basins (i.e. not affected by large subaquatic landslides or canyon-derived turbidites) can be continuous and of high sensitivity. As the mechanism has been found at both lake and ocean margins, this remobilization process might be of worldwide significance.