Towards a paleoseismic record of intraslab earthquakes in the Alaskan subduction zone

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Paleoseismic records of Alaskan subduction zone earthquakes currently rely on coastal marsh records. While these are extremely valuable for reconstructing megathrust earthquake recurrence, they do not provide direct information on shaking and therefore cannot record intraslab earthquakes, which do not cause land deformation. In contrast, sedimentary records preserved in lakes above subduction zones may – apart from megathrust earthquakes – also register evidence of intraslab earthquakes in the form of shaking-triggered turbidite or landslide deposits, when Modified Mercalli Intensities (MMI) reached values of ≥V½. Consistent with this hypothesis, we identify turbidites related to the recent M_w 7.1 2016 Iniskin and 2018 Anchorage earthquakes in the lakes studied here. We present a 2.3 kyr landslide- and turbidite-based paleoseismic record of two proglacial lakes: Skilak and Eklutna Lake, located in the zones of strong ground motion in 2016 and 2018, respectively. High-resolution varve-based age models link several lacustrine slope failure deposits to the known megathrust earthquakes that left coastal evidence in the Prince William Sound, Kenai, and Kodiak sections of the megathrust. To validate these correlations, we calculated the paleo-MMI for each of these earthquakes by means of intensity prediction equations (IPEs). Similarly, we used IPEs to identify which crustal earthquakes – independently known from fault trenching – caused an MMI of ≥V½ and are thus potentially recorded in the lakes by means of turbidites or landslides. We therefore postulate that the majority of the remaining earthquake-triggered turbidites are the result of intraslab earthquakes that caused shaking at the lakes similar to, or more intense than, that resulting from the 2016 and 2018 earthquakes. These new records thus provide paleoseismic records of intraslab earthquakes, which are not identified in the coastal marsh records and provide insight into their recurrence.