Constraints on the size of submarine landslides triggered by the M9.2 1964 earthquake at Seward, Alaska, from high-resolution seismic reflection data

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Abstract

Submarine-landslide generated tsunamis caused the greatest loss of life and property in the 1964 M9.2 Alaska earthquake. As a result of this megathrust earthquake, 90% of lives lost are attributed to tsunamis, with about 80% of those deaths caused by submarine landslide generated tsunamis. Here we discuss high-resolution seismic reflection data from Resurrection Bay, near Seward, Alaska to better describe the submarine mass flow deposits, assess their volume, sources, and timing of deposition.

Previous work in Resurrection Bay showed large failures occurred on major alluvial fans or deltas entering northern Resurrection Bay. The mass flows coalesced and were deposited in a deep, flat part of the fjord, which we refer to as the bathtub. Reflection data clearly image the 1964 mass-flow deposit as an acoustically transparent unit approximately 8-12 m thick. Pre-1964 sediments are locally truncated by the acoustically transparent unit, indicating the mass flows were erosive.

Pre-1964 mass flows are also evident in the reflection profiles. Off of Fourth of July Creek, a sequence of parallel reflectors overlies a deformed sequence above an angular unconformity. A small bathymetric high coincides with the downslope extent of the deformed sequence, which we interpret as a mass-flow deposit. As there was no change in depth in this region in 1964, this mass flow occurred prior to the 1964 earthquake. There are one or two thin acoustically transparent sequences beneath the 1964 deposit in the bathtub. None of the older mass flows are as thick and extensive as the 1964 deposit. The paleoseismic record of the southern Alaska megathrust indicates the largest time span between events was between the penultimate earthquake and the 1964 earthquake. Thus, perhaps an unusually large volume of sediment had accumulated along the margins of Resurrection Bay before the 1964 earthquake, resulting in larger submarine landslides.