

Geological Evidence for Great Earthquakes on the West Coast of Canada

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Large earthquakes at the Cascadia subduction zone have left a distinct geologic signature in estuaries and low-elevation lakes on the west coast of Canada. Geologic evidence includes a record of episodic land subsidence, tsunami inundation and intertidal sedimentation. Accumulated strain between the Juan de Fuca and North American plates is periodically released in great ($>M_w8$) earthquakes which produce a predictable pattern of coseismic subsidence on the Pacific coast. The magnitude of coseismic subsidence decreases from a maximum of 2 m on the outermost coast to zero some 100 km to the east. The earthquakes trigger tsunamis that inundate low-lying coastal areas to heights < 20 m in certain locations.

The tsunamis leave distinct sheets of sand and gravel in the silt and peat sequences of coastal marshes and lakes; deposits thin and fine landward, and contain marine fossils. At tidal marshes within the zone of coseismic subsidence, the tsunami deposits abruptly overlie former marsh surfaces and are overlain by intertidal mud that grades upward into peat. This stratigraphic succession is indicative of nearly coincident coseismic subsidence and tsunami deposition, followed by gradual sediment accretion which reestablishes the marsh. Tsunami sediments in lakes are interbedded with freshwater silt, peat and gyttja. Great earthquakes at the Cascadia subduction zone have a recurrence interval of approximately 500 years; the last event occurred in AD 1700. The physical evidence provides a basis for predicting the effects of future subduction earthquakes and their tsunamis, for example, tsunami run-up, and areas and amount of coseismic subsidence.