

Great Earthquakes and Tsunamis on the West Coast of Canada

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Estuaries and low-elevation freshwater lakes on the west coast of Vancouver Island, British Columbia, provide a record of episodic land subsidence, tsunami inundation, and intertidal sedimentation resulting from large earthquakes at the Cascadia subduction zone. Geophysical data and modeling indicate that parts of the Juan de Fuca and North American plates are locked along their bounding thrust fault and that strain is gradually accumulating. Accumulated strain is periodically released in great ($>M_w8$) earthquakes which produce a predictable pattern of coseismic subsidence along part or all of the Pacific coast from central Vancouver Island to northern California. The magnitude of coseismic subsidence decreases from a maximum of about 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 of up to 20 m. The tsunamis leave distinct sheets of sand and gravel in the silt and peat sequences of coastal marshes and lakes. Tsunami deposits thin and fine landward, contain marine fossils, and may comprise two or more graded beds deposited by successive waves in the tsunami wave train. 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. In contrast, tsunamis sediments in lakes are interbedded with freshwater silt, peat and gyttja. Tsunami deposits attributable to great earthquakes at the Cascadia subduction zone and other subduction zones in the North Pacific Ocean have been identified at many marshes and lakes on Vancouver Island. Great earthquakes at the Cascadia subduction zone have a recurrence interval of approximately 500 years; the last event occurred in AD 1700. The most recent large tsunami to strike the British Columbia coast, however, was triggered by the great Alaska earthquake in 1964. 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. This information is useful in formulating emergency preparedness plans and managing development on the Pacific coast.