Evidence of the 1812 Tsunami and Holocene Subsidence in Carpinteria Marsh

Abstract

The Santa Barbara coast is at risk for tsunamis generated from tectonic movement as well as from submarine landslide movement in the Santa Barbara Channel. Historical documents and other records indicate Santa Barbara has experienced approximately sixteen historical tsunamis, the largest of which may have occurred on Dec 21, 1812, following a magnitude ~7.1 earthquake. We propose that an anomalous sand deposit, Sand Facies One (SF1), which is found within the first meter of sediment throughout Carpinteria Marsh in Carpinteria, CA, may represent deposition related to this event. We have collected over 30 vibracores, up to 4.1 m depth, and five Geoprobe cores to ~15.2 m depth in Carpinteria Marsh in order to characterize the sedimentological evolution of the marsh. SF1 occurs in 21 of the vibracores and exhibits sedimentological characteristics associated with a tsunami genesis such as: fining upward grain size, sharp or erosional basal contact, and thinning of the deposit landward. We show that an improved age chronology, which includes exotic pollen stratigraphy and radiocarbon data, indicates an age range appropriate for the 1812 event but does not exclude regional flooding events documented in the 1860s. Over 25 radiocarbon ages indicate average sedimentation rates of ~1.9m/kyr prior between 3900 and 6700 cal. yrs BP, and 1m/kyr between 1000 and 1500 cal yrs. BP. These prehistoric sedimentation rates are higher than estimated sedimentation rates for other estuaries in southern and central California (Mudie and Byrne, 1980), and indicate at least 1m/kyr of subsidence of the marsh when corrected for sea level variations and uplift. We use the characteristics of SF1 to determine if similar layers occur at other depths. Preliminary core descriptions indicate that there are at least two sand layers that fine upward and occurs over peat or mud: at 4m depth in CS12-20, and at ~8m depth in CS13-01 and CS13-02. We conclude (1) that tsunami deposition related to the 1812 event is a possible explanation for SF1, but additional analyses are needed to rule out other flooding events, and (2) Carpinteria Marsh has subsided throughout the Holocene and may preserve sedimentological records of abrupt subsidence and/or inundation events.