Candidate Segment Boundary near Cape Blanco Inferred from Great Cascadia Earthquake Chronologies in Southern Coastal Oregon

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Abstract

Detailed Holocene chronologies of Cascadia earthquakes and tsunamis from two estuaries and a lake in southern Oregon imply short (<500 km) rupture lengths for some great (**M**≥8) earthquakes. These short ruptures in the records may correspond to subduction zone segments defined by forearc basins highlighted by offshore gravity lows. Many other events, including the great A.D. 1700 earthquake, involved long (>500 km) ruptures extending most of the length of the megathrust, based on comparisons between records from southern Oregon and regional Cascadia earthquake histories. We examined variations in event timing and recurrence interval at separate sites to assess whether some earthquake ruptures may have stopped at a postulated segment boundary near Cape Blanco. This hypothesis warrants testing because (1) a candidate segment boundary near Cape Blanco separates two offshore gravity lows that have been interpreted to reflect regions of long-term coseismic slip (Wells et al., 2003); and (2) the Cape Blanco anticline is an active transverse upper-plate fold analogous to structural highs that separate segments of the Nankai Trough in southwest Japan (Sugiyama, 1994). For example, geologic evidence of the penultimate Cascadia earthquake (800 to 1200 years ago, Atwater et al., 2004) from southwestern Washington and Coos Bay, Oregon lack a counterpart in records from southern Oregon suggesting that rupture terminated north of Cape Blanco. Evidence for segment ruptures south of Cape Blanco derived from data in southern Oregon corroborate reports of turbidite deposits only found in submarine channels offshore southern Oregon (Goldfinger, personal communication, 2006).

If chronologies derived from the Coquille and Sixes River estuaries capture all great earthquakes, then Bradley Lake, located within 10-20 km of both estuaries, may record tsunamis triggered by ruptures limited to segments north and south of Cape Blanco as well as earthquakes that ruptured the entire length of the plate interface. Age correlations between the Bradley Lake tsunami record and evidence for a series of earthquakes recorded alternately at the two estuaries support this scenario. Ages of 5 Cascadia tsunamis that inundated Bradley Lake 3,700 and 4,700 years ago alternately correlate with individual ages of 3 earthquakes at the Sixes River and 2 earthquakes at the Coquille estuary. The higher average recurrence interval for Cascadia tsunamis in Bradley Lake compared with earthquake recurrence intervals at adjacent estuaries also support a case for short Cascadia segment ruptures in the past. Between 2,000 and 4,700 years ago, tsunamis inundated Bradley Lake on average every 240-280 years. Whereas, over the same time period, earthquakes subsided soils every 350 to 415 years at the Sixes River and every 525 to 650 years at the Coquille estuary.