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A Comparison of Disturbance Events in Cascadia Lakes to Marine Seismogenic Turbidites

Details

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Abstract

Lacustrine sedimentary sequences have been successfully used to develop earthquake chronologies and seismic hazard assessments in a variety of settings, however most of these lakes are large (> 10 km2), deep, and in close proximity to an active fault. The recent discovery of disturbance in small (0.04 - 1.20 km2) southern Cascadia inland lakes with similar characteristics and timing as compared to marine seismogenic turbidites prompted us to investigate the nature of these deposits and compare to the marine record. For this study we investigated lacustrine records from four lakes: Sanger and Bolan Lakes (both predominantly spring-fed, cirque lakes) and Upper Squaw Lake (a stream-fed, landslide-dammed lake), are from the Klamath Mountains of northern California and southern Oregon 24-100 km from the coast. Triangle Lake (a stream-fed, landslide dammed lake), is from the central Oregon Coast Range 43 km from the coast. Lacustrine disturbance event characteristics differ as a result of the type and availability of sediment, size of lake, drainage area, terrain near the lake shore, location of core with respect to lake bathymetry, and distance from the coast. The disturbance events are typically coarser-grained, fining-upward deposits higher in mineral content as compared to background sedimentation. Physical property (magnetic susceptibility, gamma and CT density) and particle size data through these disturbance events show similarities to contemporaneous deposits in the marine turbidite record, except where the concentration of organic matter attenuates the signal. Even with these differences in composition between lake and marine settings, these disturbance events can be correlated spatially using deposit and sequence characteristics, and associated radiocarbon ages. Geochemical analyses through one disturbance event (dated at 1520(1280-1830) BP) from the Upper Squaw Lake core revealed evidence of a manganese oxide profile which suggests instantaneous deposition (days to weeks), whereas the lack of an oxidation profile through a deposit of the same thickness would suggest the introduction of sediment more slowly through time from the watershed. A comparison of the gamma and CT density from this deposit to a marine turbidite deposit (dated at 1480(1310-1620) BP) from Smith Apron core M9907-33TC show remarkable similarities. The great distance and multiple depositional environments over which these events correlate suggests these are earthquake-generated deposits and supports the hypothesis that gravity-driven seismogenic deposits may record a crude primary signal of shaking we call a "paleoseismogram". Simple limit equilibrium calculations of slope stability (pseudostatic) suggest expected PGA for these inland sites is likely sufficient to trigger sediment failures within the lakes from subduction earthquakes with Mw as low as 8.0.

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