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# Late Pleistocene coastal loess deposits of the central west coast of North America: Terrestrial facies indicators for marine low-stand intervals

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ABSTRACT

Coastal loess deposits measured in sea cliffs, bay cliffs, road cuts and boreholes (62 sites) are compiled for the states of Washington, Oregon, and California in the central west coast of North America (1700 km in length). The loess-enriched deposits are recognized by (1) substantial abundances of silt (30–90% by weight) and (2) depositional settings in uplifted marine terraces or dune fields that are situated well above alluvial floodplains at the coast. Total loess thickness above the MIS5a marine terrace, or 80 ± 20 ka basal TL age, ranges from 0.1 to 8.0 m in 46 dated sites. Loess deposits reach maximum thickness (5–8 m) in the vicinities of glacial outwash plains in the highest latitudes. Loess thickness in the middle and lower latitudes increases with proximity to 1) large river mouths (>3 × $10^6$ mt $yr^{-1}$ modern suspended sediment discharge) and 2) broad shelf widths (>10 km distance from 0 to −100 m depth). Coastal loess deposits dated by TL or radiocarbon (37 samples) range from ~250 to 11 ka in age, but generally fall into the MIS4-2 marine low-stand intervals (32 dates between 77–15 ka). The coastal loess facies represent marine low-stand intervals in coastal Quaternary sequences from the central west coast of North America.



## 1. Introduction

Loess deposits are widespread along the central west coast of North America (Fig. 1) though they are largely unrecognized or misidentified. Coastal loess deposits, that were derived from emerged continental shelf sources, have been reported elsewhere from the southeast coast of the South Island, New Zealand (Raeside, 1964), the Bohai and Yellow Seas areas in China (Peiying et al., 1992) and the North Sea areas in Europe (Eden, 1980) among others. In the central west coast of North America the coastal loess deposits were (1) misidentified as volcanic ash layers or (2) unrecognized as loess in dunal ponds and wetland deposits (Cooper, 1958, 1967; Reckendorf, 1975) where the highly-mobile silts can locally accumulate (Peterson and Hofgren, 2003). Patching (1984) speculated that forest silt-loam topsoil in the coastal foothills of Oregon could reflect loess enrichment. In this paper we present the first regional compilation of coastal loess deposits from 62 localities in the central west coast of North America (about 1700 km in length north–south). This regional compilation is needed to establish the latitudinal extent, depositional environments, and timing of coastal loess accumulation, relative to emergence of the continental shelf during late Pleistocene marine low-stands.

In the higher latitudes of northwest Washington (Fig. 1) the coastal loess deposits are interbedded with glacial outwash sand and gravel (Florer, 1972; Rau, 1973; Heusser, 1977; Thackray, 1998, 2001). It is not known how the glacial outwash loess deposits compare in thickness or age to coastal loess deposits in lower latitudes that did not experience glacial climates. In the lower latitudes of southwest California the Simonton soil is identified as a thin loess layer in the dune sands of the semi-arid San Miguel Island (SANM) (Johnson, 1972). It is not known why additional loess layers due not occur above the Simonton Soil in thick Holocene dune deposits that accumulated on the north side of the small San Miguel Island.

In middle latitudes of Oregon and northwest California (Fig. 1) the coastal loess deposits are interbedded with Pleistocene coastal dune strata, where they locally influence coastal soil development, groundwater infiltration and slope stability (Fig. 2) (Peterson et al., 2006). The loess deposits also serve as regional stratigraphic

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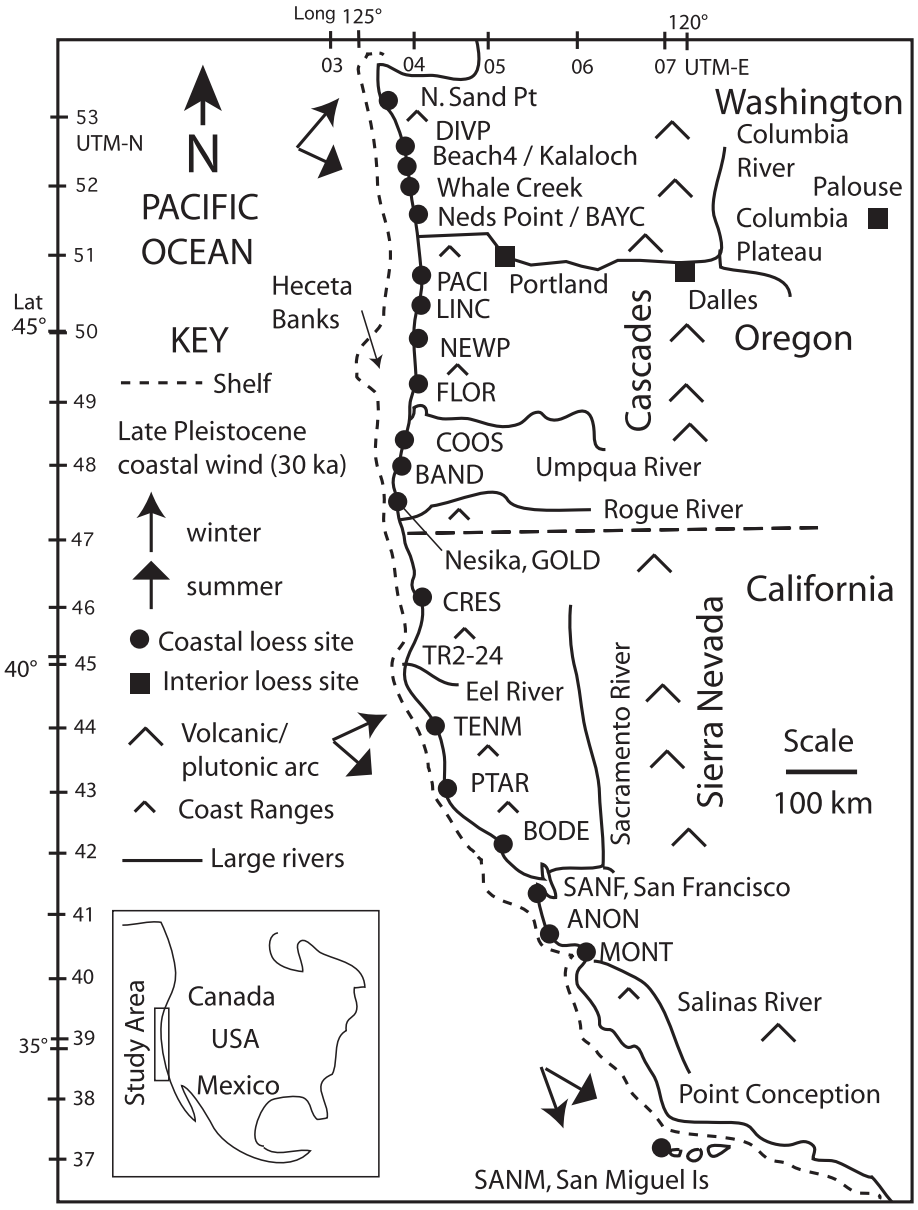


**Fig. 1.** Representative coastal loess localities (solid circles) in hosting coastal terraces and dune fields (named) are shown in the central west coast of North America. The approximate width of the exposed continental shelf (dashed line) is shown for late Pleistocene marine low-stands (~100 m bathymetric contour). Onshore wind directions (arrows) are shown for winter and summer conditions, as modeled for the late Pleistocene at 30 ka (Peterson et al., 2007). Major rivers (bold lines) are named.

marker beds that discriminate between late Pleistocene dune strata and overlying Holocene dune strata that do not contain the loess layers (Peterson et al., 2007). The youngest loess layers, which span the latest pre-Holocene intervals, could potentially host archeological materials from the early peopling of the west coast of North America (Rob Bonnicsen, pers. comm., 2000).

In this paper we document the regional distributions and ages of the late Pleistocene coastal loess deposits in the central west coast of North America (Fig. 1). The loess deposits are dated both by radiocarbon dating of organics in the loess layers and by luminescence dating of the loess itself or of the hosting dune sand strata. Several loess deposits in southwest Washington and western Oregon are characterized here for the first time by grain size distribution and mineralogy. Regional variability in loess deposit thickness is related to the proximity of river silt sources and to adjacent continental shelf widths. Coastal loess deposits should be of interest to earth scientists working in coastal systems where the coastal loess deposits can serve as marine low-stand indicator facies.

## 2. Background and methods

Field reconnaissance surveys of coastal dune sheets and interbedded loess deposits were completed in Oregon and California (Fig. 1) between 1995 and 2005 (Peterson et al., 2006) following the pioneering dune field work of Cooper (1958, 1967). The objectives of those recent surveys were to date the coastal dune deposits and relate the origins of the dune sheets to changing sea levels, onshore wind and wave directions, and resulting alongshore sources of littoral sand supply (Peterson et al., 2007, 2009). The interbedding of loess layers with coastal dune sand strata indicated that (1) both the coastal dune sand and loess were transported landward by onshore winds (Fig. 3) and (2) both the Pleistocene dune sand and the loess were supplied from the continental shelf when it was emerged during marine low-stands (Fig. 4).

The loess deposits associated with the dune strata were dated by (1) radiocarbon dating of organics that were preserved in the low redox conditions of the thicker silt layers and (2)