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Coastal Environmental Change During Sea-Level Highstands: A Global Synthesis with implications for management of future coastal change

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Archaeological Data as Sea Level Proxies: Purported Early to Middle Holocene (7-4 kya) High Stands in Alaska and Chukotka.

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Abstract

Archaeological data can offer precision and extensive stratigraphic profiles, albeit restricted to discrete areas, subject to the stratigraphic modifications of human agents, e.g., construction, trash disposal, geochemical additions (Schiffer 1987, Harris 1989, Stein 1990). Site-specific data from archaeological sites must be filtered through a regional prism to confirm and amplify trends. At various localities in Chukotka and Alaska, geologists working with archaeologists have proposed a higher eustatic sea level from 7000 to 4000 ¹⁴C yrs BP (Black, 1980; Crowell and Mann 1996; Mason, 2002). The quality of data varies considerably between regions, but a consideration the complexities of the isostatic, seismotectonic and storm regimes leads to the dismissal of most, if not all the claims for an early to middle Holocene.

Alaskan and Chukotkan coasts respond to a variety of sea level parameters, including coseismic elevational changes reflecting the Aleutian subduction zone (Plafker, 1969), isostasy (Mann and Poteet 1995), and eustasy (Gilpin, 1995; Jordan and Mason, 1999; Mason and Jordan, 2002; Mason, 2002). Transient elevational changes, e.g., storms (Mason and Jordan, 1993) and tsunami (Bryant, 2001) can modify coastlines; while tsunami effects are locally important (Waythomas and Neal, 1998), storm ridges are widespread and establish that near modern eustatic sea levels have prevailed with only modest coseismic or isostatic effects. In diverse locations, on the Aleutians, and along the south coast of the Alaska Peninsula, the formation of extensive shore platforms, suggests comparative stasis in sea level position over the last 7000 years, if as process models indicate, these form in the lower-middle tidal range (Bradley and Griggs, 1976; Trenhaile, 1987; Sunamura, 1992).

Carver and Gilpin (1994) record three episodes of coseismic subsidence on adjacent Kodiak Island. Several meters (>5m) of uplift across the megathrust hinge line is substantiated by the stranding of a lagoon associated with the 6000 year old Rice Ridge on Kodiak Isl. (Carver and Gilpin, 1993). Diatom evidence from marshes bordering Kodiak Island indicates that sea level fluctuated within a prism of 1 to 2 m, over the last 7500 years (Gilpin, 1995).

The effects of isostasy on coastal evolution on Alaska Peninsula remain undocumented (cf. Jordan, 2001) despite the reconstruction by Mann and Peteet (1995) that the Alaska Peninsula was subject to considerable isostatic depression as a result of the LGM ice cap, between 65-135 m. Crowell and Mann (1996) minimize coseismic effects and produce an eustatic regional sea level curve Crowell and Mann's (1996) sea level curve for the Katmai coast includes only limited data points, relying on only eight ¹⁴C assays, mostly <3000 yrs old, derived from marsh peats and three ages on storm berms up to 2 m above "mean" sea level. Unfortunately, Crowell and Mann (1996) define mean sea level \as "mean high tide" in a region with a tidal range of 4-7 m.

A mean value of 5.5 m lies below the highest storm waves capable of producing 1.5-2 m high storm berms. In addition, the data used in this sea level curve are limited; only a single point constrains the curve before 7000 BP. The ages on the storm berms serve as upper limiting ages on archaeological occupations and may reflect intense storms between 4000-3000 BP associated with the Neoglacial expansion, as in northwest Alaska (Mason and Jordan, 1993). The seven inter-tidal peat ages obtained by Crowell and Mann (1998) indicate relatively minor sea level change on the Katmai coast, within 50 cm of "mean sea level" from 4000 BP to the present.

Numerous archaeological sites along Shelikof Strait were occupied between 7000-4000 ¹⁴C yrs BP and contain basal components that are only 1.5 m above present mean high high water; several of these lie on eroding bluffs adjacent to the modern coast.

The stratigraphy of these sites alternates between airfall tephras, and colluvium emplaced under subaerial condition, as expressed in detail from the Mink Island archaeological site, excavated by the U.S. National Park Service from 1996 to 2001. In the Aleutians, a variety of locales record extensive beach ridge emplacement at elevations close to modern sea level.



Figure 1. Localities discussed in the Study. Shelf contours offshore in 50 m intervals.

On Chukotka, most high stand locales are either undated or may reflect very local transformative agencies (e.g., coseismicity) (Mason, 2002). These data contrast strongly with submarine evidence in adjacent northwest Alaska continental shelves of contemporaneous eustatic sea levels that were several meters lower. The Chukotkan data also differ from a 5000 yr sea level eustatic record, constructed from both marsh peat and archaeological proxies (Jordan and Mason, 1999; Mason and Jordan, 2002).

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