HOLOCENE INTERSEISMIC DEFORMATION AND STRATIGRAPHIC MODELING OF THE EARTHQUAKE CYCLE, KODIAK ISLANDS, ALASKA

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ABSTRACT

PALEOSEISMICITY AND COASTAL TECTONICS OF THE KODIAK ISLANDS ALASKA

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The Kodiak Islands are composed of Mesozoic and Tertiary subduction complex rocks of the eastern Aleutian arc. These islands offer a rare opportunity to study a subaerial subduction complex subject to cyclic earthquake deformation. The 1964 great Alaska earthquake rupture zone included the Kodiak Islands at its southwest extent which caused up to 1.8 m subsidence of the islands. We occupied an array of 19 tidal benchmarks, encompassing an area of ~19,000 km^2, uniquely distributed over the down-dip edge of the coseismic rupture. Average 1993-1964 postseismic uplift of 0.46 m formed a broad arch with its crest slightly arcward of the coseismic axis of subsidence.

Paleo-earthquakes are identified in the intertidal marshes of the islands as multiple stratigraphic events recorded as abrupt changes in marsh surface elevation and vegetation. The event horizons are frequently characterized by sand or fine gravel tsunami generated deposits. The cluster of radiocarbon ages associated with two of these events correspond to paleoseismicity identified in the eastern part of the 1964 rupture zone. We have

identified a later event with ages clustering in the ~500 yBP range. The spacial distribution of the sample sites suggests that a maximum of two earthquakes, each of a minimum magnitude of 8, was necessary to preserve the ~500 yBP cluster of event horizon ages in the marsh stratigraphy.

A Holocene northwest tectonic tilt was inferred from geomorphic and archeological data. A roughly contemporaneous uplifted paleo-lagoon and submerged paleo- habitation deposits define a ~4000 yBP tilt surface recording a minimum tilt rate of 0.01 μrad/yr. Remarkably steady Mesozoic and Tertiary exhumation of 12 km since 73 Ma was accompanied by accretion of a 36 km thick package of material. Simple mass balance calculations invoking underplating as the primary cause of the uplift results in the present mean elevation of the islands (0.2km) in approximately 1 Ma, and strongly suggests that the Holocene deformation records an increment of the long term accretionary processes that have lead to the growth of the prism and uplift of the islands.