



Historical and stratigraphic evidence for two ruptures of the Alaska-Aleutian megathrust in 1788

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Ruptures of the Alaska-Aleutian subduction-zone megathrust produced $M > 8$ earthquakes in 1938, 1946, 1957, 1964, and 1965, yet we know little about megathrust ruptures prior to the 20th century west of Kodiak Island. Incomplete written Russian accounts suggest that the area between east central Kodiak Island in the east and Sanak Island in the west (700 km apart) ruptured, likely during two earthquakes in the summer of 1788. The first earthquake on July 21st resulted in coastal subsidence (~ 1 m) and tsunami inundation ($\sim 6-8$ m) at the first Russian settlement in Alaska at Three Saints Bay 105 km SW of the present city of Kodiak. Greater uncertainty, however, surrounds the second earthquake on August 6th, presumably the source of a 1788 tsunami that Russian church records from Unimak Island (800 km SW of Kodiak) suggest inundated the Shumagin and Sanak islands (570 and 730 km SW of Kodiak) up to 10–50 m. Here we synthesize field evidence of coseismic land-level changes and tsunami inundation in 1788 from our investigations in the eastern Aleutians (2010–2016) with historical, archeological, and other published coastal findings from Kodiak Island.

Stratigraphic records of coastal subsidence and tsunami deposits on Kodiak Island corroborate Russian accounts of a great earthquake in 1788. Evidence for coseismic uplift at Sitkinak Island (160 km SW of Kodiak), and tsunami deposits at Chirikof Island (290 km SW of Kodiak), suggest that the megathrust ruptured well beyond the western boundary of the Kodiak rupture segment. New field evidence from Sitkalidak Island (80 km SW of Kodiak) and nearby Old Harbor are consistent with our analyses of archaeological findings and historical records of land subsidence and tsunami inundation at Three Saints Bay (15 km SW of Old Harbor) and, when combined with results of earlier studies, suggest a minimum rupture length of 300 km. In contrast, there is an absence of evidence for land-level changes or tsunami inundation in 1788 at Sanak, Simeonof, or Unga islands, where brief, second-and-third-hand Russian accounts report the highest tsunami waves. Tsunami deposits as high as 6 m that extend >800 m inland at Sanak Island either date to 1946 or pre-date the 1788 earthquake by >2000 years. Here we present alternative hypotheses that may explain the absence of stratigraphic evidence in the Shumagin and Sanak islands for a western rupture in August of 1788.