

Identifying the chemical and grain size signatures of culturally-modified sediments reveals resilience to explosive volcanic events in the Aleutian Islands, AK

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To what extent have people and ecosystems rebounded resiliently from explosive volcanic eruptions, including the moderate to large eruptions that occur periodically in the Aleutian Islands of Alaska? An international team tested the hypothesis that in prehistory humans were resilient to climate change-related sea level rise, tsunamis generated by tectonic earthquakes, debris flow events, and explosive volcanic eruptions on two of the Islands of Four Mountains, a group of small islands located between the larger eastern and central Aleutian Islands. One aspect of this hypothesis was that the small area of these islands might have magnified the impacts of such events. Exposed by coastal erosion, large sediment fans (>30 m thick) consist of thick paraglacial debris flow deposits at their base, numerous volcanic tephra, and of sediments associated with villages established by at least 3,900 calibrated years BP. Deposits mantling the basal debris flows are primarily volcanic ash falls with a significant pyroclastic sequence occurring circa 1,050 calibrated years BP. Likely originating from Mt. Cleveland volcano, the 1,050-year-old CR-02 tephra clearly caused temporary abandonment of two villages located within 8 km of the summit, however, earlier periods of occupation or abandonment due to volcanic activity are more cryptic. Samples of culturally-modified volcanoclastic and epiclastic deposits reveal P, N, C, and Ca/Ti ratios above background levels, potentially extending the record to times when the evidence of occupation is ephemeral. Grain size analyses of the fine fraction of fan sediments indicate that human modified sediments have distinct spectral characteristics compared to volcanic ash, tephra, and debris flows. For example, in the size range 0.59 to 2,000 microns, culturally modified soils register broader, flatter peaks (lower kurtosis) and spectra may have one unusual concave or convex shoulder. Data from more than 90 samples test whether possible site abandonments circa 2,200 yBP and 3,500 yBP co-occurred with volcanic events. The sedimentary and geochemical records concur in chronicling the high resilience of people to explosive volcanic activity in prehistory.