PROCEEDINGS OF THE TWENTY-EIGHTH ANNUAL KECK RESEARCH SYMPOSIUM IN GEOLOGY

April 2015
Union College, Schenectady, NY

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ISSN# 1528-7491

The Consortium Colleges The National Science Foundation ExxonMobil Corporation

KECK GEOLOGY CONSORTIUM
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ARCHAEOLOGICAL SITE STRATIGRAPHY AS A RECORD OF HUMAN RESILIENCE IN THE ISLANDS OF FOUR MOUNTAINS, ALASKA
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Funding Provided by:
Keck Geology Consortium Member Institutions
The National Science Foundation Grant NSF-REU 1358987
ExxonMobil Corporation

KECK Geology Consortium

Learning Science Through Research

Published by Keck Geology Consortium

Short Contributions
28th Annual Symposium Volume
25th April, 2015
ISBN: 1528-7491

ARCHAEOLOGICAL SITE STRATIGRAPHY AS A RECORD OF HUMAN RESILIENCE IN THE ISLANDS OF FOUR MOUNTAINS, ALASKA

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Research Advisors: Kirsten Nicolaysen, Whitman College; Virginia Hatfield, University of Kansas

INTRODUCTION

The Islands of Four Mountains (IFM) lie in the central Aleutians, a volcanically active region that has hosted native Unangan (Aleut) populations from as early as 9000 BP in the east and ~3300 BP in the west (McCartney, 1984; Corbett et al., 2001; Dumond, 2001; Davis and Knecht, 2010; Lefevre et al., 2001; West et al., 2012). Holocene volcanic activity produced extensive lahars and tephra on at least three islands of the IFM; however, geologic influences on Unangan populations remain unstudied. Fitzhugh (2010), studying Kuril Ainu resilience to geologic hazards concluded that tephra deposits did not significantly displace Native populations. Alternatively, Davis and Knecht (2010) concluded that pyroclastic flow deposits overlying two archeological sites on Hog Island, near Unalaska Island and Makushin Volcano, would have impacted humans present at ~9,000 cal. BP.

In July – August 2014, an interdisciplinary team of geologists, archaeologists, and paleoecologists undertook fieldwork to establish the Holocene history of IFM volcanoes and investigate contemporaneous human habitation. Bishop Veniaminov remarked that the IFM volcanoes only smoked in Aleut memory (Hrdlicka, 1945). Conversely, Mount Cleveland erupted throughout the Holocene (Pekar et al., 2005; Neal et al., 2015). Microstratigraphy of lahars, tephras, soils, and cultural strata at two archeological sites reveals the geologic events preceding, during, and subsequent to Unangan habitation. Coupled with radiocarbon dating, stratigraphic information may provide answers to such questions as how volcanic activity affected the Unangax, their choice of village locations, and their environmental adaptations.

This study examines the stratigraphy of two naturally exposed profiles at near-shore archeological sites: the West Ravine Profile at CG02, Chuginadak Island and the South Profile at CR02, Carlisle Island. Grain size analysis, loss on ignition (LOI), and micromorphology of strata from both sites help identify soil types, organic carbon contents, and nature of strata to determine their stratigraphic history. These results, combined with ^{14}C dates and archeological evidence, clarify the geologic and human history of the area.

METHODS

In the field, I collected 28 samples, one from each layer of CG02 (Fig. 1) along with 28 samples from CR02 (Fig. 2). For each profile, I took photographs, drew, and described stratigraphic columns. I sieved each sample into separate aliquots of >1mm and <1mm. Mastersizer measurements provided grain size percent volume for a split of the <1mm aliquots. To further compare grain sizes, I measured the mass percent of both aliquots. Subsequently, I extracted a 3g split from each <1mm aliquot for loss-on-ignition (LOI) based on the methodology of Konen (2002).

Two samples were collected in the field for micromorphology: strata 16-20 at CG02-West Ravine Profile and strata 6-11 at CR02-South Profile. I examined polished thin sections of these micromorphology samples under a petrographic microscope to identify soil horizon boundaries and grain lithologies. I used a Scanning Electron Microscope (SEM) to image charcoal and lithic fragments and identify the composition of pumice, lithic fragments, and individual crystals in tephra layers and soils.

RESULTS

Chuginadak

The semi-subterranean houses at CG02 were excavated into a large debris flow rising 30m directly from the cobble beach. CG02 consists of ~67 features, 21 of which represent ancient dwellings (O'Leary, 1993). The West Ravine Profile is located on a wall naturally cut by an ephemeral stream channel along the western edge of the site, intersecting a house pit (V.Hatfield, pers. comm.).

Grain size analysis yielded a range from clay to coarse sand (Fig. 3). For each stratum, sand content ranged from 90-39 vol% (average 65 vol%). The LOI

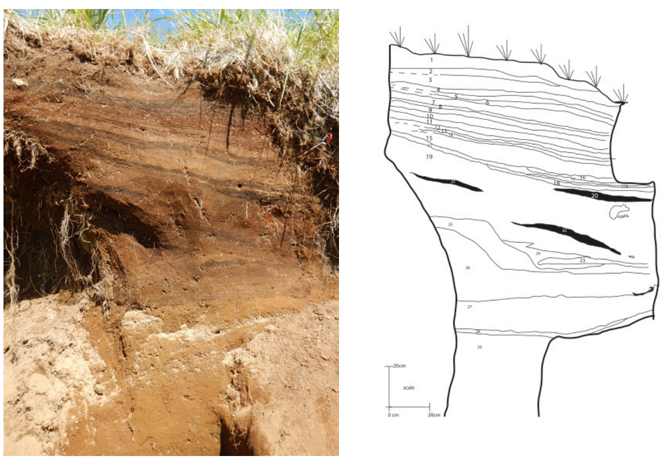

Figure 1. CG02 – West Ravine Profile. (1a) Photograph of the profile. The bottom two layers are from a debris flow or alluvial fan environment with visible cross-bedding in stratum 27. All layers were sampled and described by the author. (1b) Profile of CG02 with labeled strata by V. Hatfield and L. Loopesko.

measurements yielded relatively high wt% organic carbon content for many strata of the CG02 (2–35 wt%) and averaged 14 wt% and, in some cases, high combustible carbon correlated with visible charcoal, such as in layer 20 (Figs. 4, 5).

The thin section, CG02-12, encompasses strata 16-20 (Fig. 4a) and field-inferred cultural layer-tephra transitions (Fig. 5). Stratum 17 contains a lithic fragment with a dark organic deposit on one edge, characteristic of burned griddlestones elsewhere in the Aleutians. Stratum 20 is particularly high in charcoal with a higher wt% organic carbon and finer grain size. Stratum 18 and 19 show high volcanic ash concentrations with low carbon values. The ash is identified by its concave and sickle-shaped fragments of glass, remains of shattered bubble walls common in pumiceous tephras. Charcoal is opaque in thin section having a distinctive weave with pores that are either equal or flattened and may represent plant structures.

Carlisle

The CR02 – South Profile is exposed in a cliff of unconsolidated sediment above a rocky beach on Carlisle Island. Erosion exposed a house pit in profile. The South Profile lies above a debris flow 40m high but slumping obscured much of the nature of this flow. CR02 consists of 93 house pits (Cooper, 1991). The South Profile contains 31 strata, only 28 of which were sampled. The stratigraphic section (Fig. 2) includes the adjacent section of the profile where strata 26 & 27 continue laterally to an adjacent profile for deeper stratigraphic analysis on strata 26-48. No samples were taken from the adjacent profile.

Grain size analysis of CR02 yielded similar values to those of CG02. The sand values averaged 59 vol% with values ranging from 37-88 vol%. (Fig. 3). The

Figure 2. Annotated photographs of the composite CR02 South Profile and its adjacent section extending deeper into older deposits. (2a) The South Profile from which all sediment and micromorphological samples were taken. (2b) The adjacent profile which contained the 5mm obsidian flake found in stratum 30.

LOI measurements for CR02 yielded much lower organic carbon values than the CG02. The average wt% carbon values plotted at 5 wt% with values ranging from 9 to 2 wt% (Fig. 5).

The South Profile, CR02-34 thin section includes strata 6-11 (Fig. 4b). Though there is no clear

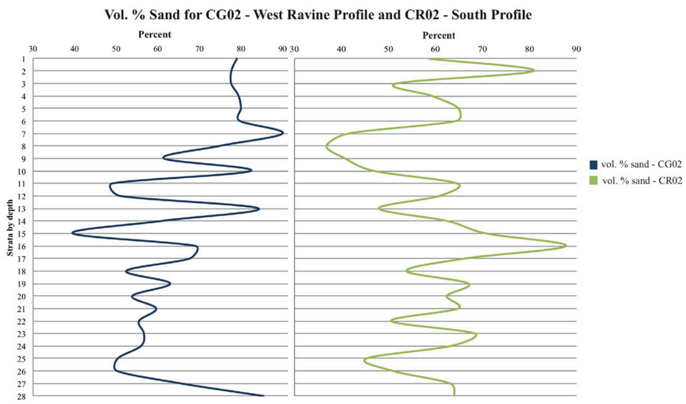

Figure 3. Sand (wt%) content for CG02 and CR02. Sand fraction is measured to describe each stratum and support inferences of origin as cultural deposit, lahar, or tephra. For example, the extremely low sand, 40 vol%, of stratum 15 (CG02) tephra is distinctive. Though presented side-by-side, graphs do not imply correlation.

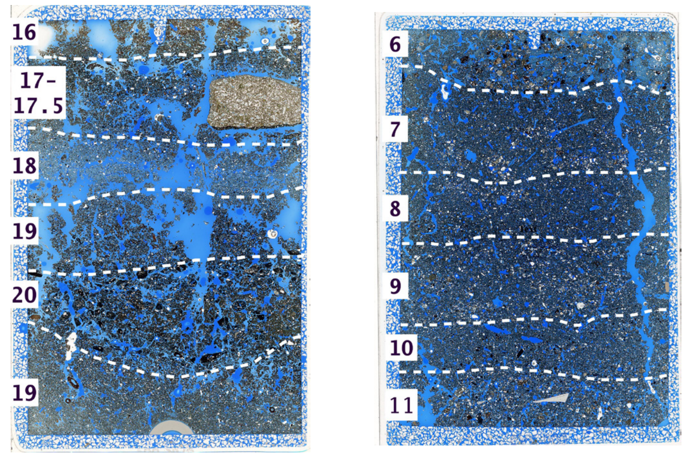

Figure 4. Micromorphology thin sections from each profile. (4a) Thin section of CG02 strata 15-17 with evident soil horizons annotated. A 7mm width lithic fragment appears with dark, organic rich coating on one side in stratum 17-17.5 along with copious charcoal in stratum 18. (4b) An annotated photograph of the thin section of CR02 strata 6-11. Though strata 7-10 are not clearly defined, stratum 6 has significantly larger lithic fragments and more glass. An obsidian flake appears at the bottom, correlated with stratum 11.

delineation between strata 7-11, stratum 6 clearly shows large quantities of lithic and pumice fragments. SEM analysis of the sharp fragment in stratum 11 yields high silica indicating that it may be an obsidian flake from human activity.

DISCUSSION

Cultural activity is difficult to determine purely on grain size and organic carbon data. What field observations indicate as charcoal lenses (CG02 - strata 20-23) have lower carbon values in the finest fraction than other strata interpreted as soils in the field (Fig 5). Cultural layers do not have a characteristic grain size, but most are sandy loams. The abundant charcoal and remains of anthropogenically-derived lithics, such as the obsidian flake and burnt lithic, are indicative of cultural layers. Some of these characteristics are seen only in thin section and not evident in the field, suggesting a cultural significance that is difficult to detect for stratum 17 of CG02.

In the field, I interpreted tephras from large amounts of sand size pumice or silt size particles interpreted to be volcanic ash. In the lab, tephras are identified from grain size, high abundances of angular mineral fragments and glass shards, and low carbon content. At CG02, tephras range in grain size, due to distance from the volcanic vent and dispersal direction of the eruptive plume, but have consistently low organic carbon levels. However, at CR02, neither grain size nor carbon levels are indicative of tephras. Under a microscope, both CR02 and CG02 tephras have larger concentrations of pumice and glass with larger lithics than in other strata. Thin sections may prove useful to identifying cultural layers, offering a closer look at the physical make-up of layers, and SEM measurements can be used to analyze the chemical composition of fragments and volcanically-derived minerals.

Carbon dates from charcoal in both sites range from 2905-2000 yBP for CG02 and 2990-1045 for CR02. The cultural habitation represented in CG02 coincides with the cultural occupation of CR02 strata 1-13 (Fig. 5). Thus, the entirety of the stratigraphy for CR02 above stratum 12 may be concurrent with the stratigraphy above CG02 stratum 9.

The stratigraphic history of CG02 consists of debris flow deposits into which several layers of cultural fill have been subsequently buried by interbedded layers of tephra and soils (Fig. 5). CR02 is also built on debris flow deposits and consists of several layers of soils below stratum 30, which I identified as a

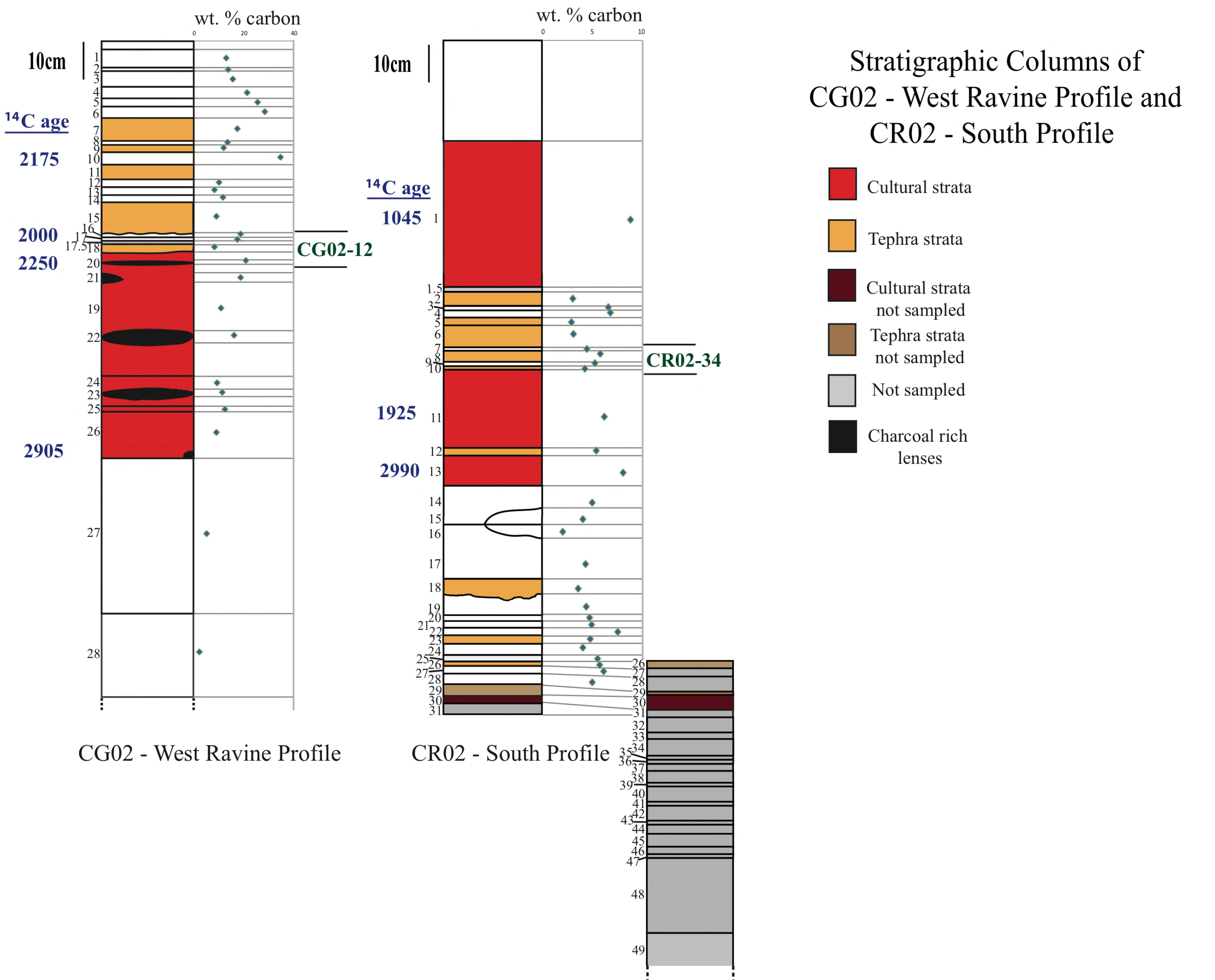

Figure 5. Stratigraphic columns summarizing both CR02 and CG02 including ^{14}C ages, wt% organic carbon for each stratum, and the location of micromorphological samples. Uncalibrated ^{14}C ages are written next to their corresponding location. Micromorphological samples, CG02-12 and CR02-34, are written left of their stratigraphic location. All cultural and tephra classifications are based on field observations. CG02 stratum 11 was analyzed for grain size but not for LOI.

cultural layer in the field based on a single obsidian flake. The significance of stratum 30 requires further field investigation and sampling. Above stratum 30, soils and debris flow deposits underlie two cultural layers interrupted by a tephra deposit. Further tephra deposits separate these cultural layers from the most recent cultural layer at the top of the profile. The location of cultural deposits above and below tephra layers, particularly at CR02 (Fig. 5), suggests volcanic activity occurred during Unangax habitation of these sites.

According to Fitzhugh's (2011) study on the Kuril Islands, volcanic eruptions had little effect on local populations between 3000 and 1000 years ago. However, on Hog Island in the eastern Aleutians Davis and Knecht (2010) found evidence of habitation sites capped by a ~8200 calBP pyroclastic flow, though the site was never reoccupied. Okuno et al. (2012) found that on Adak Island a site was occupied almost immediately after an eruption ~7200 yBP. In CG02, the occupation of the village at 2250 yBP may have ended because of volcanic eruption as 12cm thick tephra layers (strata 18 and 15) immediately overlie cultural stratum 19 dated ~2250 calBP. Elsewhere the site shows signs of occupation approximately 400 years later (D.L.West, V. Hatfield, pers.comm). At CR02, cultural strata 11 and 13, dated 1925 and 2990 yBP respectively, are separated by the thin tephra stratum 12, and capped by the tephra stratum 10. It is possible that unlike either the Hog Island or Kuril sites, multiple smaller eruptions represented by thin tephra deposits may have caused temporary abandonment of villages.

ACKNOWLEDGEMENTS

This is an interdisciplinary project under the co-direction of the research advisers and Dixie West benefitting from discussion with project participants Kale Bruner, Breanyn MacInnes, Tina Neal, Mitsuru Okuno, and Arkady Savinetsky. I thank Captain George Rains, Pilot Dan Leary, and crew of the *R/V Maritime Maid*. Nick Bader assisted with understanding micromorphological and LOI data. This material is supported by the National Science Foundation under Grants NSF-REU #1358987 and NSF-PLR #1301925 in collaboration with the US Geological Survey and the Alaska Volcano Observatory.

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