

Diet, geography and drinking water in Polynesia: microfossil research from
archaeological human dental calculus, Rapa Nui (Easter Island)

John V. Dudgeon* and Monica Tromp

Department of Anthropology and Center for Archaeology, Materials and Applied Spectroscopy
(CAMAS), Idaho State University, 921 South 8th Avenue, Pocatello, ID 83209, USA

Abstract

This paper uses microfossil analysis of human dental calculus to address questions of human and human-environment interactions using 114 teeth from an archaeological population on Rapa Nui (Easter Island), dated between the late 16th to early 18th century. We recovered 16,377 total biogenic silica microfossils: 4,733 phytoliths and 11,644 diatoms. The majority of phytoliths correspond with the *Arecaceae* or palm family (n = 4,456) and the minority corresponds to the *Poaceae* or grass family (n = 277). Because of the relatively large sample size we were able to test hypothesis related to age cohort, sex, food resources and geographic region. There was not a significant difference in phytolith or diatom recovery based on age cohort or sex. However, the high frequency of phytoliths found in calculus extracted from the anterior dentition argues for the consumption of soft or cooked foods and the high frequency of diatoms recovered from the southern part of the Island argues for different sources of drinking water.

Key words: microfossils, phytoliths, diatoms, dental calculus, Easter Island, Rapa Nui, Polynesia

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* Correspondence to: Department of Anthropology, Idaho State University, 921 S. 8th Avenue,
Stop 8005, Pocatello, ID 83209, USA
e-mail: dudgeon@isu.edu

Ecological, and especially human-ecological and human-induced environmental change on Rapa Nui (Easter Island) has been a subject of recent debate within the scholarly literature (e.g., Bahn and Flenley, 2003; Hunt and Lipo, 2007, 2011; Mieth and Bork, 2010). Much effort has gone into establishing a chronological record of this change through microfossil floral evidence, specifically pollen and phytolith data from lake and terrestrial sediments, from as early as 37,000 years ago (Azizi and Flenley, 2008; Butler and Flenley, 2001; Flenley, 1979) to the more recent evidence of human-environment interaction after Polynesian colonization (Cummings, 1998; Horrocks and Wozniack, 2008; Vrydaghs et al., 2004). Although much of this literature is devoted to understanding broader aspects of biodiversity evolution on isolated Pacific Islands, a recurrent theme centers on establishing timelines for human colonization and the impact of subsistence strategies and demographic change on Rapa Nui's limited flora. While sedimentary data may provide an overview and timeline of vegetation composition and change, often as a result of human activity, it does not allow for interpretations of specific impacts to human populations.

In 2009, we hypothesized that embedded microfossils in human dental calculus provide a more direct link to dietary subsistence practices, as it reflects incorporation of residues of food and water consumption. Here, we evaluate the utility of microfossils recovered from dental calculus in describing and quantifying the nature of human-plant interactions among the archaeological population on Rapa Nui. We believe that analysis of these residual materials in calculus recovered from archaeological skeletal material is one key piece of evidence for reconstructing individual and group-level subsistence strategies, and holds the promise of creating dietary classes that can be used to test alternative hypotheses of social structure and geography.

Phytolith and diatom microstructures are the skeletons or "hard parts" of plants and marine and terrestrial phytoplanktons, respectively. These biogenic silica structures are dominantly composed of SiO₂ (Conley, 2002), which is extremely resistant to alteration through abrasion in masticatory activities or from biologic acids or enzymes found in oral saliva. The silica-rich matrix may provide stem and leaf support or predation protection for many plants and is the main component of the exoskeletal frustules of diatoms. Because these structures are so resilient to salivary digestion they can become incorporated in subgingival calculus, creating thick (2.1 – 3.9 mm) bands encircling the cervical neck of the tooth, approximating the position of the alveolus during the time of formation (Figure 1).

Calculus forms from the deposition of salivary calcium phosphate salts on adhering surface bacteria and food debris (Jepsen, 2011). The roughened surfaces of superficial calculus produce ideal crystallization sites for further calculus development, often leading to destruction of connecting ligament and surrounding alveolus, terminating in tooth loss (Lieverse, 1999; White, 1997). Since calculus is produced by deposition of dissolved calcium phosphate mineral salts in salivary secretions, it forms only during the lifetime of the individual. As a compact mineralized structure, it is highly resistant to diagenetic alteration after death and can record in some detail the dietary or masticatory evidence associated with its formation. For this reason, microfossils incorporated within dental calculus are a prime analytical target for

archaeologists interested in what people put into their mouths (e.g., Henry et al., 2011; Wesolowski et al., 2010).

To frame preliminary hypotheses about the constellation of potential Polynesian subsistence cultigens, we consulted written texts of European voyages to Rapa Nui beginning in AD 1722. These ethnohistoric accounts list a variety of cultivated foods representing the significant and enduring Polynesian horticultural base. During the first documented European contact with Rapa Nui, Dutch explorer Jacob Roggeveen remarked on the foods that the inhabitants held in great esteem: “for in a little while they brought a great abundance of sugar-cane, fowls, yams, and bananas; (Ruiz-Tagle, 2005:27).” In his ethnological study of the early 20th century culture of Easter Island, Métraux (1940:151-159) summarizes the early European documentary evidence for cultivation practices on the island, remarking on the widespread distribution of agricultural plots growing sweet potato (*Ipomoea batatas*), taro (*Colocasia esculenta*), yam (*Discorea spp.*), sugar cane (*Saccharum officinarum*), banana (*Musa sapientum*) and gourd (*Lagenaria vulgaris*). Only three of these taxa (sugar cane, banana and gourd) are known to produce diagnostic phytoliths in the edible portion of their flesh, leaves or skin (Piperno, 2006). We hypothesize that if these and other microfossil-producing foods were regularly consumed as part of the diet, then their frequency in dental calculus (mediated by the frequency of their occurrence in the foods themselves) will correlate with dietary habits, food preference and possibly regional availability. For these reasons we selected a large number of individual, geographically-diverse teeth to construct a generalized picture of dietary subsistence components and document the different classes and diagnostic morphotypes of microfossils trapped in dental calculus.

Material

We selected teeth from 104 individuals (114 total samples) with macroscopically evident supragingival and subgingival calculus to perform microfossil extraction and analysis. These teeth provide a geographically-representative sample of recovery locations (Table 1) adjacent to the large, ceremonial statue platform features (*ahu*) that ring the coastline of Rapa Nui (Figure 2), allowing us to test hypotheses about diet related to possible ecological availability or demographic variables like sex or associated internment site. Subsets of skeletons from each *ahu* site were sampled from collections housed at the Museo Antropológico Padre Sebastián Englert (MAPSE) on the island. The total sample represents individuals from 13 *ahu* locations, with 50 male, 25 female and 29 unsexed individuals comprising seven out of nine age cohorts (Table 1). Five samples from salvage excavations with unknown provenience were included (3 males, 1 female, 1 unknown), but were not used in the geographic analysis.

Based on obsidian hydration dates of artifacts basal to the skeleton (Stevenson, 1984), most of the material in this sample is believed to date from between the late 16th to early 18th century. Because Rapa Nui is marked by thin, rocky soils, most skeletons were interred in stone-lined crypt structures proximate to or within the edifice of the *ahu* platforms, or in shallow caves adjacent to these structures (Stevenson, 1984). Preservation of skeletal material is therefore generally good due to limited postdepositional

alteration from UV photo-oxidation, wind and rain (Dudgeon, 2008). As a consequence, the recovered teeth were generally free from contact with sediments and sedimentary microorganisms, groundwater or adhering soils, significantly lessening the likelihood that areas of sampled calculus were contaminated with soil or groundwater-derived microfossils.

In all cases, tooth samples were removed directly from mandibular or maxillary association by gentle extraction from the surrounding alveolus. Due to the extent of subgingival calculus present on most specimens, alveolar resorption was pronounced, and the sampled teeth were removed without damage to the skeleton. All teeth were recorded using the ASU dental morphology scoring system (Turner et al., 1991), photographed in four planes and the extent of calculus was described using the protocol established by Dobney and Brothwell (1987).

Methods

Calculus removal and demineralization

All calculus removal, demineralization and microfossil extraction was performed in the Bioarchaeology Laboratory in the Department of Anthropology at Idaho State University. All recovery operations were performed in a laminar flow, Class 100 positive pressure hood to minimize contamination from exogenous or airborne microfossils. Prior to calculus removal, each tooth was cleaned with a dry endocervical brush to remove any debris or adhering sediment that was not incorporated within the calculus. Adhering calculus was removed using dental picks that had been abraded, acid cleaned, sonicated and autoclaved before use. Calculus was gently scraped into 1 cm² aluminum foil pans and weighed to 0.001 mg on a microbalance, with extracted weights ranging from 0.028 to 13.370 mg (see Supplementary Data). Calculus was transferred to sterile 2.0 ml microcentrifuge tubes for the demineralization step. For the 30 samples that had weights over 3 mg, we divided the calculus into two separate 2.0 ml tubes to retain a portion for future analyses.

Before final calculus demineralization, several published methods (e.g. Boyadjian et al., 2007; Fox et al., 1996; Henry and Piperno, 2008; Middleton, 1994) were evaluated using modern calculus obtained from a local dentist and small subsamples of the Rapa Nui calculus. Our final calculus demineralization protocol is a modified version of the method of Henry and Piperno (2008). To deflocculate the calculus, we added 1.25 ml of 10% sodium hexametaphosphate to each microcentrifuge tube, and the tubes were vortexed and placed on a nutating tray. After 24 hours, samples were vortexed and centrifuged at 16,000 xg for four minutes and the supernatant pipetted off. Samples were washed twice with 18 MΩ water to rinse the sample, vortexed and centrifuged. Finally, 1 ml of 6 N HCl was added to each tube, vortexed and placed on a nutating tray for 48 hours. The samples were washed twice, using the steps above and stored in 1.25 ml of 18 MΩ water.

Scanning Electron Microscopy (SEM)

The majority of biogenic silica research employs oil immersion optical microscopy to visualize

morphotypes because of the ubiquity and low cost of high-quality binocular microscopes. Even though this is the most common method for microfossil studies we decided to use SEM for its many benefits over optical microscopy. The primary advantage of imaging with SEM is the ability to visualize discrete morphology and topographic detail at higher magnification than is possible using optical microscopy. This is due to the inherent magnification limitations of visible light and light transmission errors in the lenses of the optical path from the sample to the eye, or imaging device. In the case of the SEM, electron-specimen interactions produce adequate surface resolution for objects four to five orders of magnitude smaller than under optical microscopy. Increased resolution in this case yields increased useful magnification and visualization/imaging of finer-scale diagnostic morphology (Figure 3a and 3b). Second, because of the longer focal path of electron beam, SEM has a higher depth of field than optical microscopy, meaning that most or all of the characteristic morphology is in the focal plane at the same time, reducing the amount of time and refocusing required for making a positive morphotype assignment. Third, biogenic silica microfossils are opaque under SEM imaging, which increases the topographic fine detail of microfossil surfaces and eliminates chromatic aberration caused by light refracting through the silicate matrix (see Figures 3a, b and 4 – 6). Finally, the SEM used in this study has an attached energy dispersive x-ray spectrometer (EDS), a chemistry tool that identifies the elements present in the microfossils during imaging (Figure 3c). This makes it possible to preclassify SiO₂ (biogenic silica) particles for further evaluation and to sort out geological minerals and organic detritus, improving identification and recording efficiency.

SEM analysis was performed on a FEI Quanta 200 FEG with a Bruker Quantax 200 SDD-EDS x-ray detector at the Applied Microscopy Laboratory, Center for Archaeology, Materials and Applied Spectroscopy (CAMAS), at Idaho State University. Samples were prepared for SEM imaging by partitioning a 5 x 5 cm borosilicate glass microscope slide into 25 10 x 10 mm counting partitions using high-visibility, colloidal silver conductive paint (Figure 3d). Glass slides are not ideal for SEM work due to their low conductivity and the associated charge effects from electron buildup on their surface. However, we found that the high surface tension of the borosilicate glass slides prevented the sample drops from spreading out to the edges of the wells, and provided a very flat and smooth surface that resulted in a high contrast background from the imaged microfossils. Sputter coating the samples mounted on the glass slides with a 150 – 450 Å (angstrom, about 15 – 45 nm) layer of carbon greatly reduces electron charge buildup and produces excellent, high-contrast images with superior morphological detail.

We optimized the aliquot volume in the 10 x 10 mm partitions through experimentation in order to create an evenly distributed monolayer of microfossils in each partition without clumping, starting with a 70 µl drop size and decreasing the volume to 35 µl, producing a uniform distribution in the counting well with good separation of individual microfossils. The smaller aliquot volume did not affect the average number of microfossils counted (70 µl drops had an average of 547 microfossils and 35 µl drops had an average of 688 microfossils), but it did significantly decrease the spacing between microfossils and consequently the analysis time required for each sample. We used the SEM image montage feature to create a map of each 10x10 mm sample well to aid in the systematic analysis of the sample. For the first 44

samples the whole drop was analyzed at a horizontal field width of 75 μm per image frame, in order to identify rare classes of microfossils. For all remaining samples half of the drop was analyzed by viewing every other 75 μm image frame. All microfossils were counted using images that were taken during the scanning of each sample, separating them first into plant or animal types and then by morphotype. For the samples where the entire drop was counted, 50% of the microfossil images were resampled using random numbers to make the results comparable to the other samples.

Results

A total of 16,377 biogenic silica microfossils were recovered, identified and counted from the dental calculus of the 114 tooth specimens (phytolith $n = 4,733$; diatom $n = 11,644$). Only three teeth produced no microfossils in the calculus samples (see Supplementary Data). Phytolith classes are dominated by the globular echinate morphotype ($n = 4,456$; 94.15% of total phytoliths) (Figure 4), with significantly smaller quantities of bilobate ($n = 139$; 2.94% of total), polylobate ($n = 9$; 0.19% of total) and trapeziform morphotypes ($n = 129$; 2.73% of total) (Figure 5). The diatoms we identified in this analysis represent terrestrial classes typically found in ponded standing water and soils and were comprised of centric and pennate forms ($n = 8,760$; 75.23% and $n = 2,884$; 24.77%, respectively) (Figure 6). Diatoms also occurred in large clusters where it was not possible to accurately quantify the number of individuals or their morphotypes (Figure 7). In these cases we remarked on the total number of diatom clusters we observed in each sample (Table 1).

Globular echinate morphotypes are consistent with phytoliths from the family *Arecaceae*, which includes several species of palm. In Rapa Nui, these phytoliths are associated with the extinct palm *Paschalococos disperta*, believed to be related to the giant Chilean wine palm *Jubea chilensis* (Grau, 2000; Zizka, 1989). Previous research suggests that much of the island was covered with this palm prehistorically, but today no specimens remain (Dransfield et al., 1984; Mieth and Bork, 2010). Minor classes of phytoliths are generally consistent with *Panicoideae* and *Chloridoideae* grasses (bilobate, polylobate and trapeziform morphotypes) (Runge, 1999; Strömberg, 2003). Sugarcane is an edible *Panicoideae* grass and a traditional Polynesian cultigen, although research suggests that subtropical Rapa Nui, marked by thin, nutrient poor soils and frequent water stress present poor growing conditions for its cultivation (Louwagie et al., 2006).

Previous research on Rapa Nui has documented a variety of freshwater diatom taxa (Cocquyt, 1991) and we identified specimens representative of these diatoms, in addition to other cosmopolitan, or ubiquitous freshwater classes (Cocquyt, personal communication). There are no permanent streams on Rapa Nui, and drinking water is limited to several stagnant water impoundments in craters and cinder cones, collapsed lava tubes and rainwater collection basins carved into exposed bedrock (called *taheta*). It is likely that the recovery of freshwater diatoms from the dental calculus sampled here reflects the incorporation of microfossils through consumption of some or all of these surface drinking water sources. In an attempt to discern possible differences between the occurrence of microfossils in dental calculus from

the Rapa Nui skeletal sample, we plotted the phytolith and diatom averages by dental element, age cohort, sex and regional site location (Figure 8).

Microfossils by dental element

Dental elements were grouped by anterior-posterior orientation (incisors, canines, premolars, molars) without reference to maxillary or mandibular position (Figure 8a). Globular echinate phytolith frequency decreases on average in an anterior – posterior orientation (see Figure 7a). From a biomechanical perspective, this suggests that a soft or cooked food, such as heart of palm was being consumed, as this would only require the anterior teeth (incisors and canines) to bite off a portion and the tongue to quickly form a bolus that could easily be swallowed without much involvement of the posterior teeth (Lucas, 2004:171). We also recovered small numbers ($n = 277$) of Panicoid phytoliths (likely sugar cane) occurring exclusively on the posterior teeth (premolars and molars). Sugar cane, being tough and fibrous, would require crushing and pulverizing to release the sugar solution, a task well-suited to the posterior tooth crown morphology (Lucas, 2004: 99-110). Calculus-incorporated terrestrial diatoms also increase in frequency from anterior to posterior teeth (Figure 7a), but at present we do not have a clear hypothesis for their differential occurrence.

Microfossils by age cohort

Samples grouped by age cohort suffer from small sample sizes in the sub-adult classes: cohorts 1 and 3 have no representatives, cohorts 2 and 4 have one representative and cohort 5 has two representatives (Figure 8b). Cohorts 6, 7, 8 and 9 had four, seven, 22 and 25 samples, respectively and show an average increase in phytoliths of 25% ($sd = 4.5\%$) in each succeeding age cohort. This may represent the incorporation of new phytoliths through successive accretion of subgingival calculus deposits through time, although we found no positive association between calculus band size and age cohort in this study ($p = 0.242$). Because our sample is dominated by later age individuals (cohorts 8 and 9, 75.8% of specimens with age assignments) or individuals without age assignment (40.4% of the total sample), it is not possible to generalize about any specific dietary life-history strategies.

Microfossils by sex

When the samples were grouped by sex ($n = 75$; M/F = 50/25), males and females had nearly the same average number of total microfossils present in calculus (mean = 167.60; $sd = 1.27$), but the distribution of phytoliths to diatoms was uneven between the sexes. Diatoms made up an average of 77% of male microfossils and 62% of female microfossils (phytoliths were 23% and 38%, respectively), although the differences were not significant (two-sample t-test, diatoms: $t = -0.556$, $df = 61.343$, $p = 0.581$, phytoliths: $t = 0.924$, $df = 27.513$, $p = 0.364$) (figure 8c).

Microfossils by geographic region

Samples grouped by geographic region of recovery exhibited significant differences in number of diatoms incorporated in calculus (ANOVA, $p = 0.001$), but not for phytoliths (ANOVA, $p = 0.678$). Calculus from tooth samples recovered from the Southeast ($n = 18$) and South ($n = 34$) coasts of the island produced on average five times the number of diatoms found from the West ($n = 20$) and North coast ($n = 23$) samples and over two and half times the number from the Northeast coast ($n = 14$) samples (Figure 8d).

Discussion

Our results suggest that although there appears to be little variation in phytolith distribution within the Rapa Nui skeletal collection, there is regional geographic variability in the occurrence of calculus-embedded diatoms. This variability may be explained by differential reliance on permanent versus transient drinking water sources, which represents an enduring research question not only on Rapa Nui (Cocquyt, 1991; Hunt and Lipo, 2011:181-182; Shepardson, 2006), but for other Pacific island societies as well (Kirch, 2000). In addition, we present evidence for utilization of one of Polynesia's staple foodstuffs, the *Panicoideae* grass sugarcane, though the frequency of these phytoliths was very low (5.85%), compared to the large numbers of palm phytoliths.

Phytoliths

Soil and lake core pollen and phytolith studies on Rapa Nui have noted the predominance of globular echinate or palm phytoliths (Cummings, 1998; Delhon and Orliac, 2010; Horrocks and Wozniak, 2008; Mann et al., 2008; Vrydaghs et al., 2004). However, the overwhelming frequency of palm phytoliths recovered from calculus is a puzzling result since the small, golf ball-sized nut produced by the Rapa Nui palm (a relative of the Chilean Wine Palm, *Jubea chilensis*) is entirely devoid of phytoliths (Delhon and Orliac, 2010; author's own unpublished work). Previous examination of dental macro- and microwear patterns showed no evidence of non-dietary masticatory processing (Dudgeon, 2008), such as occurs with chewing fibers for pulping or leaf stripping for making cordage (Larsen, 1985; Minozzi et al., 2003). We reassessed the state of dental wear using standard criteria (Hillson, 1996) during calculus extraction under both optical and scanning electron microscopy and found no patterns of linear striations or grooving consistent with fiber processing activities. Alternate routes of palm phytolith incorporation into dental calculus may derive from other dietary components of the palm itself. For example, palm flour is made from the spongy center of the Buri palm (*Corypha elata*) in the Philippines (Foreman, 1899) and heart of palm is produced from several species of coconut trees worldwide (Haynes and McLaughlin, 2000). The biggest obstacle to this explanation is that most evidence suggests that the island's native species of palm was substantially, if not totally, removed prior to the late prehistoric period from which the skeletons of this study are dated. Obsidian hydration dates from artifacts basal to the recovered skeletons suggests that nearly all of this skeletal material, recovered during the 1980-81 National Geographic expedition, date from the late-prehistoric and protohistoric period, between A.D.1650 and A.D.1860 (Stevenson, 1984).

Accounts from European sailors from the latter half of this time period report on the generally denuded character of the Rapa Nui landscape, although some observations describe the presence of remnant stands of palm-like trees in several locations (Ruiz-Tagle, 2005). We argue that the sheer numbers of palm phytoliths recovered from dental calculus in this study are inconsistent with a precipitously declining or remnant population of surviving trees and for this reason an alternative explanation for their occurrence in dental calculus is warranted. The observation of large numbers of palm phytoliths in the dental calculus of the skeletal collection suggests that either 1) the dating of the obsidian recovered underneath the skeletons is far too recent, 2) that the palm that once covered large parts of the island persisted until significantly later than historical accounts suggest, or 3) there are additional mechanisms of phytolith incorporation into dental calculus that need to be assessed. Corollary to the first two of these alternate hypotheses is that the prehistoric Rapanui incorporated large amounts of palm starches into their diet, supplementing the taro and sweet potato subsistence base found elsewhere in marginal Polynesia (Kirch, 2000; Yen, 1973).

Diatoms

The recovery of large numbers of terrestrial diatoms from the dental calculus demonstrates the importance of understanding consumption of potable water in the archaeological record. Terrestrial (as opposed to marine) diatoms can grow in any hydrated environment with sunlight exposure, such as ponds, streams, moist soil and even on rock surfaces if they are perennially wet (Johansen, 2010). The distribution of diatoms from our dental calculus samples indicate a greater reliance on standing ponded water for drinking water on the South and Southeast coasts, occurring at least two and half times more frequently in these areas than on the Northeast, North or West coasts of the island. Since diatoms “bloom” maximally in sunlit, standing surface waters (Furnas, 1990), higher frequencies in dental calculus may reflect more available ponded surface water exposures on the South and Southeast coasts. This hypothesis is not supported by our current data on the existing ponded water sources on the island, however (Cocquyt, 1991; Figure 2). It is possible that many of the surface ponded water sources on the island remain undiscovered (cryptic sources), or that landscape modification after European contact (Hunt and Lipo, 2011: 170) altered the exposure of these potable water sources.

Conversely, the differential geographic observation of higher frequencies of ephemeral rainwater collection vessels (*taheta*) on the North and West coasts of the island (Morrison, personal communication) does fit within our explanatory framework. These rainwater collection vessels are shallow depressions pecked into many of the island’s horizontally exposed bedrock outcrops, and pedestrian surveys indicate that they occur predominantly at increasing elevations on the slopes of the large volcanic cone on the Northwest portion of the island (Shepardson, 2006). Ephemeral rainwater collection vessels should not contain large quantities or “blooms” of diatoms seen in permanent, standing water sources, because periodic drying from drinking or evaporation limits their reproductive capacity (Johansen, 2010). This suggests that individuals residing on the North and West coasts of Rapa Nui demonstrate and increased reliance on ephemeral rainwater sources of drinking water and that a more diversified—but as yet

cryptic—drinking water collection strategy persisted along the island’s South coast. We argue that the frequency differences seen in Northeast, North and West coast dental samples compared to the South and Southeast coasts reflects not only differences in access to consistent potable surface water, but also to broader demographic implications of settlement strategy and geographic mobility.

Conclusion

The recovery and high-resolution SEM-based analysis of microfossils from prehistoric dental calculus holds great promise for describing features of dietary subsistence from the archaeological skeleton. While high frequency archaeological sampling is rare (see Wesolowski et al., 2010 for one other example), we argue that our large-scale sampling approach produces data which can be evaluated under multiple working hypotheses. These include hypotheses on life history strategies between sexes or across age cohort classes, as well as geographic or ecological hypotheses that suggest the viability of particular agricultural practices across space or through time. Inclusion of non-dietary microfossil classes such as freshwater diatoms provides a key data point for describing prehistoric utilization of what some believe is a key limiting resource on Polynesian Pacific Islands—potable drinking water (Finney, 1979; Kirch, 2000; Métraux, 1940).

In contrast to previous research on dental calculus from archaeological skeletal collections, we recovered a high frequency of biogenic silicate microfossils (e.g., Henry and Piperno, 2008; Hardy et al., 2009). Our SEM-EDS-based approach improves identification and quantification of biogenic silicate microfossils when compared to optical microscopy because it permits higher magnification and increased resolution of characteristic morphology in partial or damaged specimens and allows chemistry confirmation (Figure 3). However, the extreme disparity of palm phytolith counts compared to all other phytolith morphotypes (94.15% to 5.85%) suggests that SEM-based identification methods, while representing an improvement in contrast and resolution over optical microscopy, are insufficient to account for the high frequency of palm phytoliths in these calculus samples. More research will be necessary to determine the process of incorporation of palm morphotypes in dental calculus.

Due to the postmortem aboveground interment practiced in stone crypts or shallow caves we believe that our microfossil assemblage is derived from dietary plant and surface water consumption and reflects the calculus formation process during life. We are less certain of the mechanism of incorporation, especially since the early ethnohistoric accounts of food production make no mention of the utilization of palm for dietary subsistence (Métraux, 1940). In fact, most of these accounts note the absence of Pacific varieties of palm tree and the generally denuded, treeless character of the landscape (Ruiz-Tagle, 2005). If these skeletons are truly temporally associated with the immediate pre- and post-contact period, additional data will be required to explain the presence of these microfossils in dental calculus.

Presently, we are conducting biogenic silicate extractions on modern Polynesian cultigens described in the ethnohistoric accounts (Métraux, 1940), botanical studies (Zizka, 1991) and modern ecological observations (Flenley, 1993), as well as sediments recovered from archeological garden plots

and enclosures to document the full complement of foods grown and eaten by the prehistoric and protohistoric people of Rapa Nui. We will compare this data to the microfossils documented in the dental calculus samples to identify possible ambiguities in morphotype assignments and whether other types of plants are present.

While we have found no evidence of geographic or life history variability in the recovered phytolith data, our results indicate a significant and geographically-patterned difference in frequencies of terrestrial aquatic diatoms. This observation highlights the need for a more complete inventory of permanent and ephemeral drinking water sources on Rapa Nui. Surprisingly, our study revealed proportionally little evidence of the consumption of sugar cane, a dominant Polynesian food source. These results conflict with the early historic accounts (Ruiz-Tagle, 2005), but are more consistent with the estimation of Rapa Nui as nearly marginal for growing sugar cane (Louwagie et al., 2006). Additional classes of calculus microfossil data, from pollens, starches and other plant microfossil structures will undoubtedly increase the potential for resolving spatial variation in agricultural practices corresponding to ecological and demographic features (or simply dietary preference).

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Table 1. Summary of samples by site.

| Site of Recovery | Region | <i>n</i> ¹ | Dental Element ² | | | | Sex ³ | | | Age Cohort ⁴ | | | | | | | | Phytoliths ⁵ | | Diatoms ⁶ | | |
|-------------------|-----------|-----------------------|-----------------------------|----------|-----------|-----------|------------------|-----------|-----------|-------------------------|----------|----------|----------|----------|-----------|-----------|-----------|-------------------------|------------|----------------------|-------------|-------------|
| | | | I | C | P | M | M | F | U | 2 | 4 | 5 | 6 | 7 | 8 | 9 | ? | <i>a</i> | <i>b</i> | <i>c</i> | <i>d</i> | <i>e</i> |
| Nau Nau | North | 21 | 1 | 1 | 11 | 8 | 8 | 5 | 8 | – | – | – | – | 2 | 3 | 5 | 11 | 860 | 10 | 432 | 117 | 381 |
| North Coast | North | 2 | – | – | 1 | 1 | 2 | – | – | – | – | – | – | – | – | – | 2 | 135 | 5 | 184 | 32 | 28 |
| Mahatua | Northeast | 14 | – | 1 | 6 | 7 | 4 | 6 | 1 | – | – | – | 1 | 2 | 2 | 5 | 4 | 505 | 65 | 824 | 36 | 214 |
| Akahanga | South | 10 | – | – | 5 | 5 | 5 | 3 | 2 | – | – | – | 1 | – | 3 | 2 | 4 | 812 | 30 | 1284 | 70 | 348 |
| Mahiha | South | 2 | 1 | – | – | 1 | 1 | – | 1 | – | – | 1 | – | – | – | – | 1 | 13 | – | 2 | 5 | – |
| Onero | South | 14 | – | – | 4 | 10 | 6 | 4 | 4 | 1 | – | – | 1 | 1 | 1 | 2 | 8 | 696 | 40 | 1067 | 1208 | 234 |
| Oroi | South | 8 | 1 | 1 | 2 | 4 | 6 | 2 | – | – | – | 1 | 1 | – | 2 | 3 | 1 | 40 | 13 | 905 | 482 | 256 |
| Koe Hoko | Southeast | 9 | 1 | – | 6 | 2 | 6 | 2 | 1 | – | 1 | – | – | 2 | 2 | 3 | 1 | 109 | 7 | 2159 | 696 | 572 |
| One Makihi | Southeast | 4 | – | – | 3 | 1 | 2 | – | 2 | – | – | – | – | – | 1 | 1 | 2 | 143 | 9 | 174 | 87 | 4 |
| Tongariki | Southeast | 5 | – | – | 2 | 3 | – | – | 5 | – | – | – | – | – | – | – | 5 | 88 | 5 | 1204 | 1 | 295 |
| Kihi Kihi Rau Mea | West | 14 | – | 3 | 5 | 6 | 3 | 1 | 3 | – | – | – | – | – | 7 | – | 7 | 629 | 74 | 263 | 107 | 40 |
| Kote Riku | West | 3 | – | – | 1 | 2 | 1 | 1 | 1 | – | – | – | – | – | 1 | 1 | 1 | 84 | 1 | 84 | 17 | 98 |
| Tautira | West | 3 | – | – | 3 | – | 3 | – | – | – | – | – | – | – | – | 1 | 2 | 227 | 1 | 177 | 2 | 67 |
| Unknown | – | 5 | – | – | 2 | 3 | 3 | 1 | 1 | – | – | – | – | – | – | 2 | 3 | 115 | 17 | 1 | 24 | – |
| Totals | | 114 | 4 | 6 | 51 | 53 | 50 | 25 | 29 | 1 | 1 | 2 | 4 | 7 | 22 | 25 | 52 | 4456 | 277 | 8760 | 2884 | 2537 |

¹ *n* = total number of samples per site

² I = incisor; C = canine; P = premolar; M = molar

³ M = male; F = female; U = unknown

⁴ 2 = infant; 4 = 6 – 12; 5 = 12 – 18; 6 = 18 – 25; 7 = 25 – 30; 8 = 30 – 40; 9 = > 40; ? = unassigned (1 = neonate and 3 = 3 - 6 not represented)

⁵ *a* = globular echinate; *b* = all other morphotypes

⁶ *c* = centric; *d* = pennate; *e* = clusters

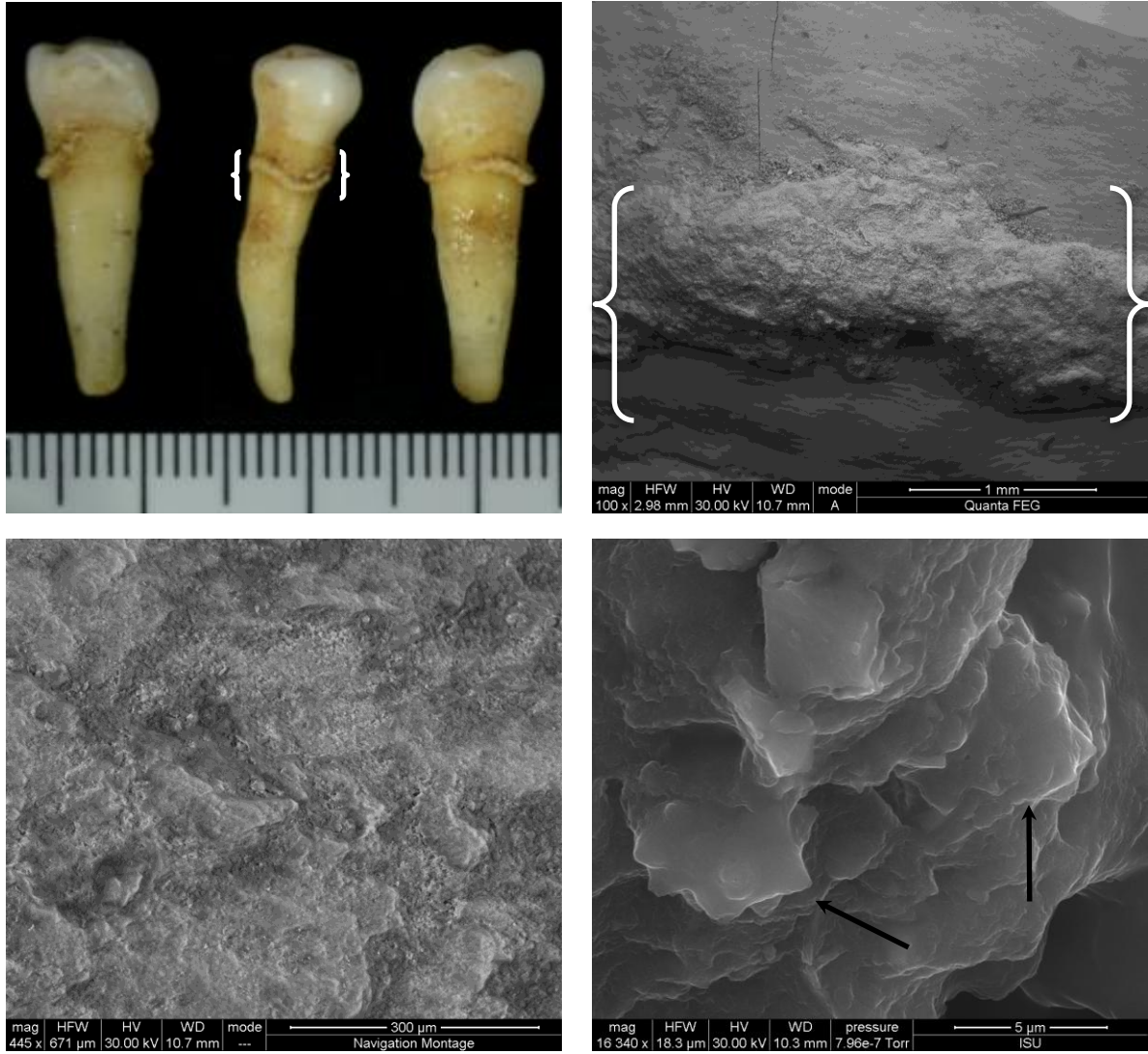


Figure 1. Tooth from Ahu Mahatua showing a band of calculus encircling the cervical neck of the tooth (band shown between white brackets, top left); SEM image of calculus band on a tooth from Togariki (shown between white brackets, top right); close-up of calculus in-situ (bottom left); and globular echinate phytoliths embedded in calculus (see black arrows, bottom right).

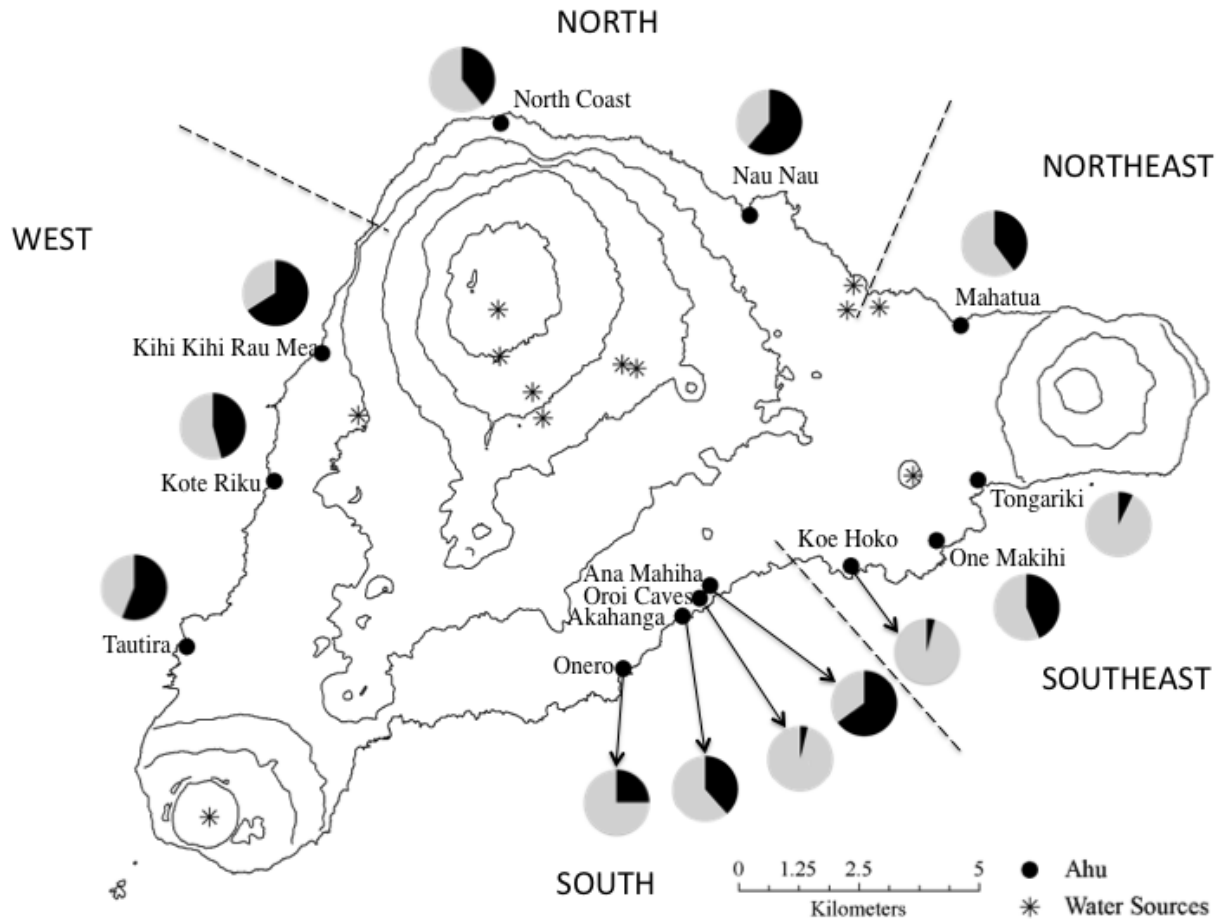


Figure 2. Map of Rapa Nui (Easter Island) showing sampling sites, regions (indicated by dashed lines), frequencies of phytoliths (black area in pie charts) and diatoms (grey area in pie charts) at each site and published water sources (Cocquyt, 1991).

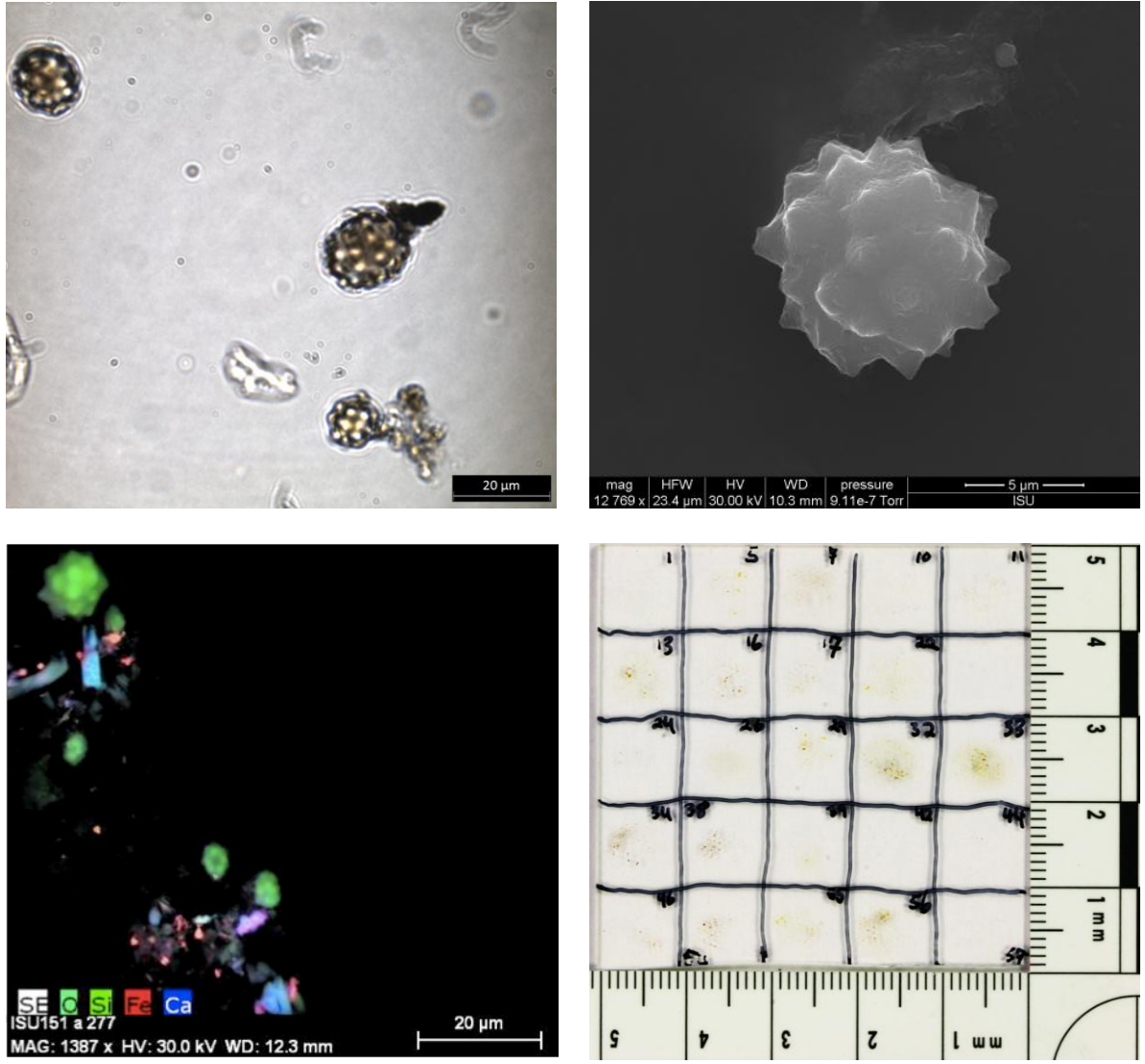


Figure 3. (a) Light microscope image of modern *Arecaceae* phytoliths (top left); (b) SEM image of archaeological *Palmae* phytolith; (c) EDS element map of archaeological *Palmae* phytoliths and other microfossils extracted from calculus; (d) Glass slide with 35 µl drops of sample prior to carbon coating.

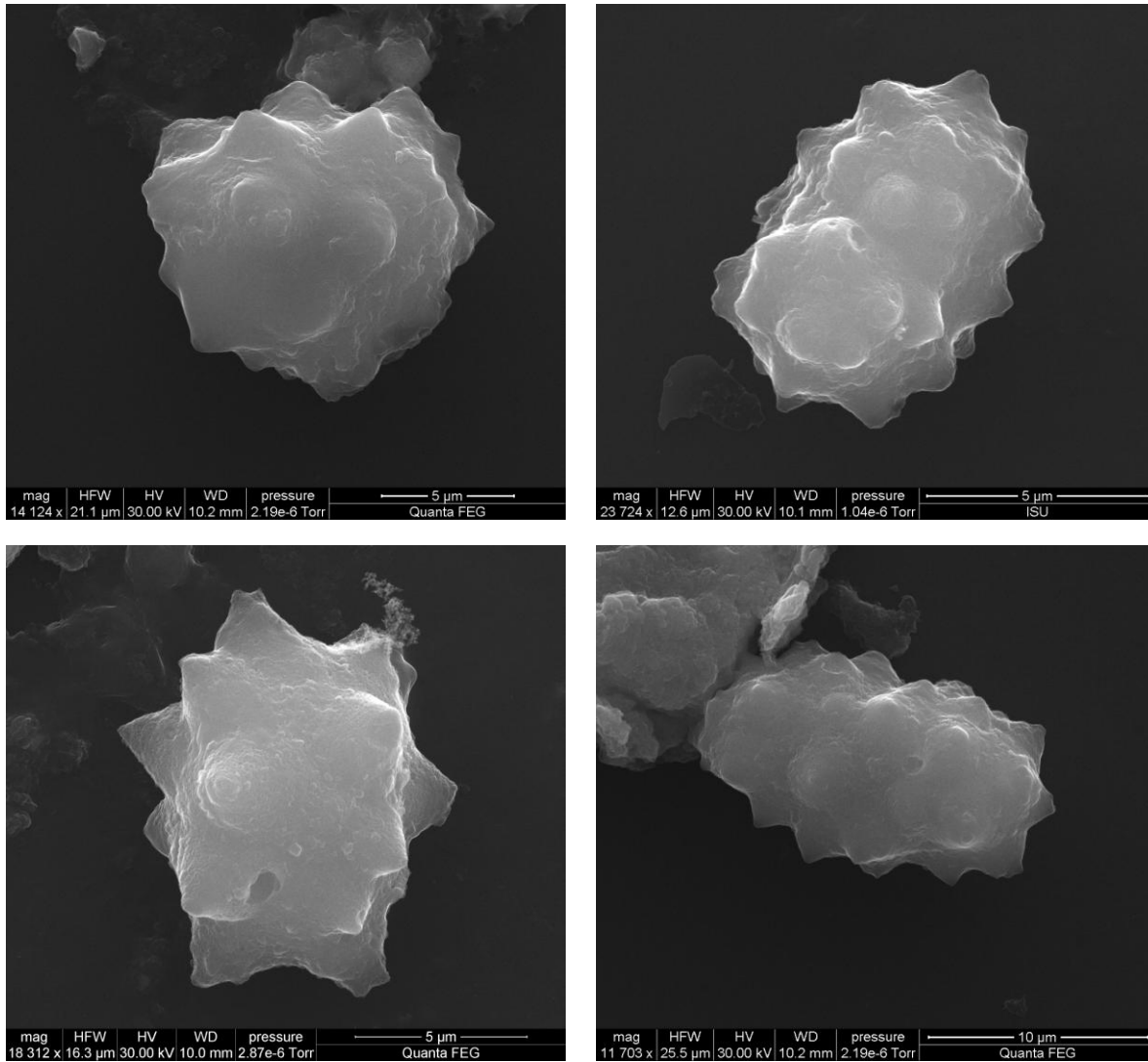


Figure 4. Examples of globular echinate *Palmae* phytoliths.

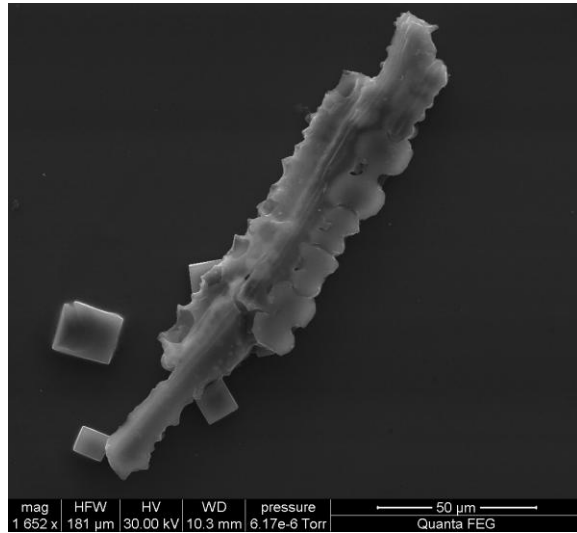
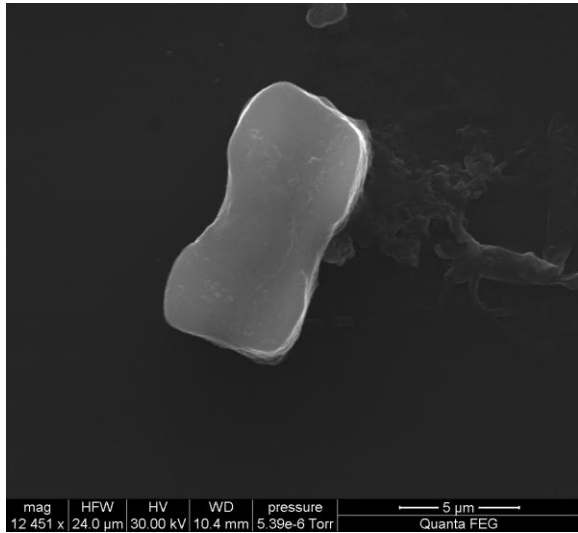
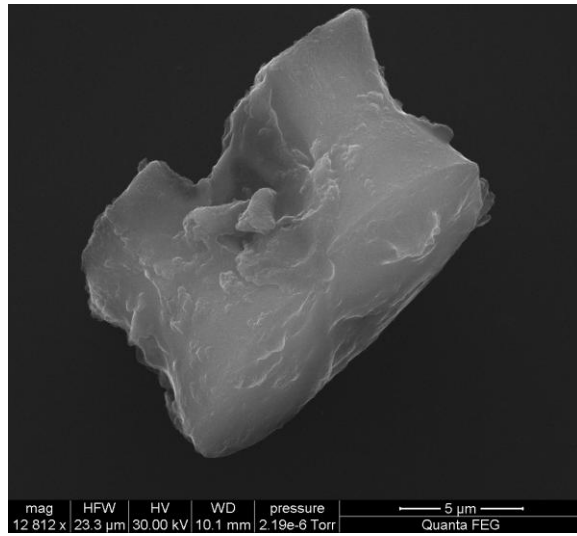
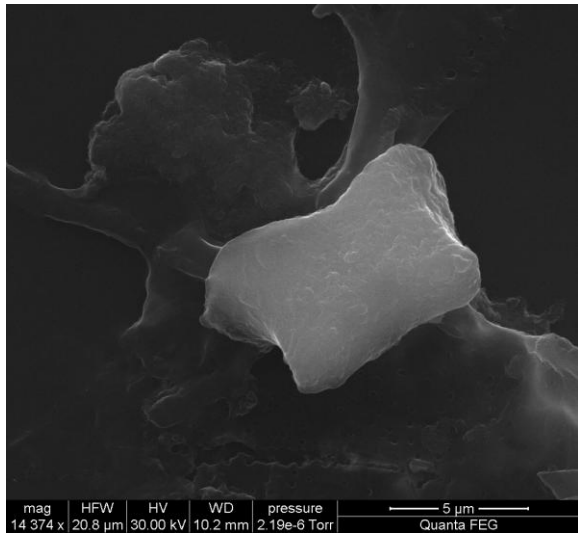


Figure 5. Examples of bilobate (bottom), trapeziform (top) phytoliths. Articulated bilobate and polylobate *Poaceae* phytoliths (bottom right).

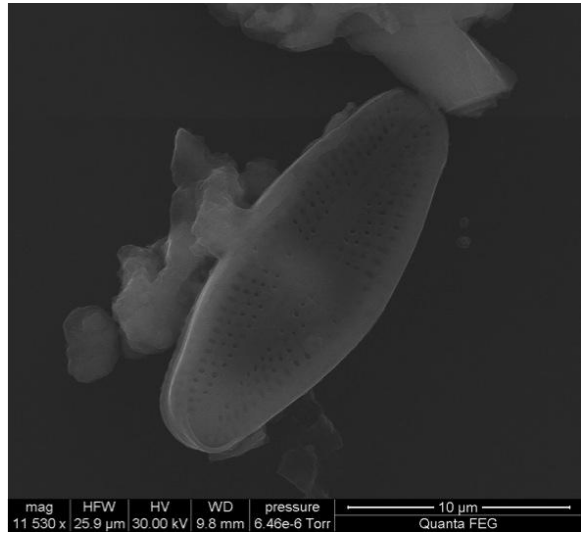
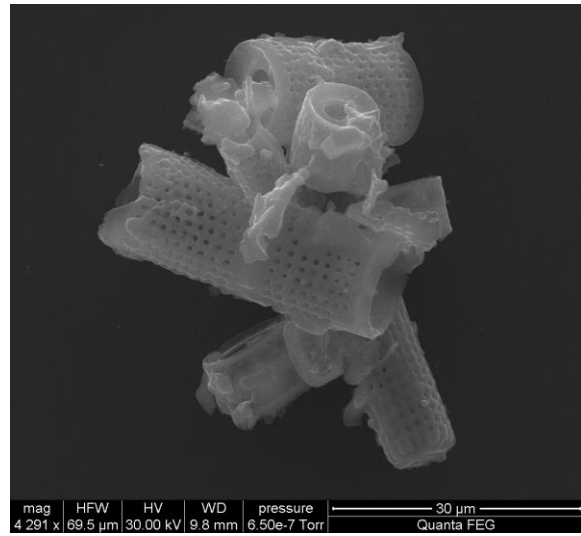
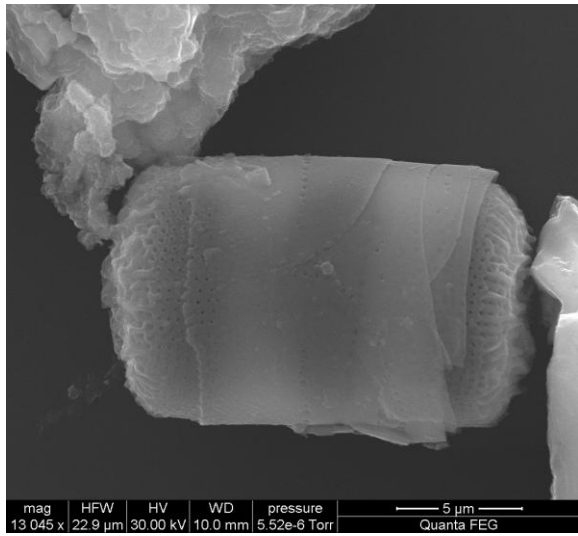


Figure 6. Examples of centric (top) and pennate (bottom) diatoms: *Orthoseira spp.* (top left); *Aulacoseira spp.* (top right); *Diadesmis spp.* (bottom left); *Luticola spp.* (bottom right).

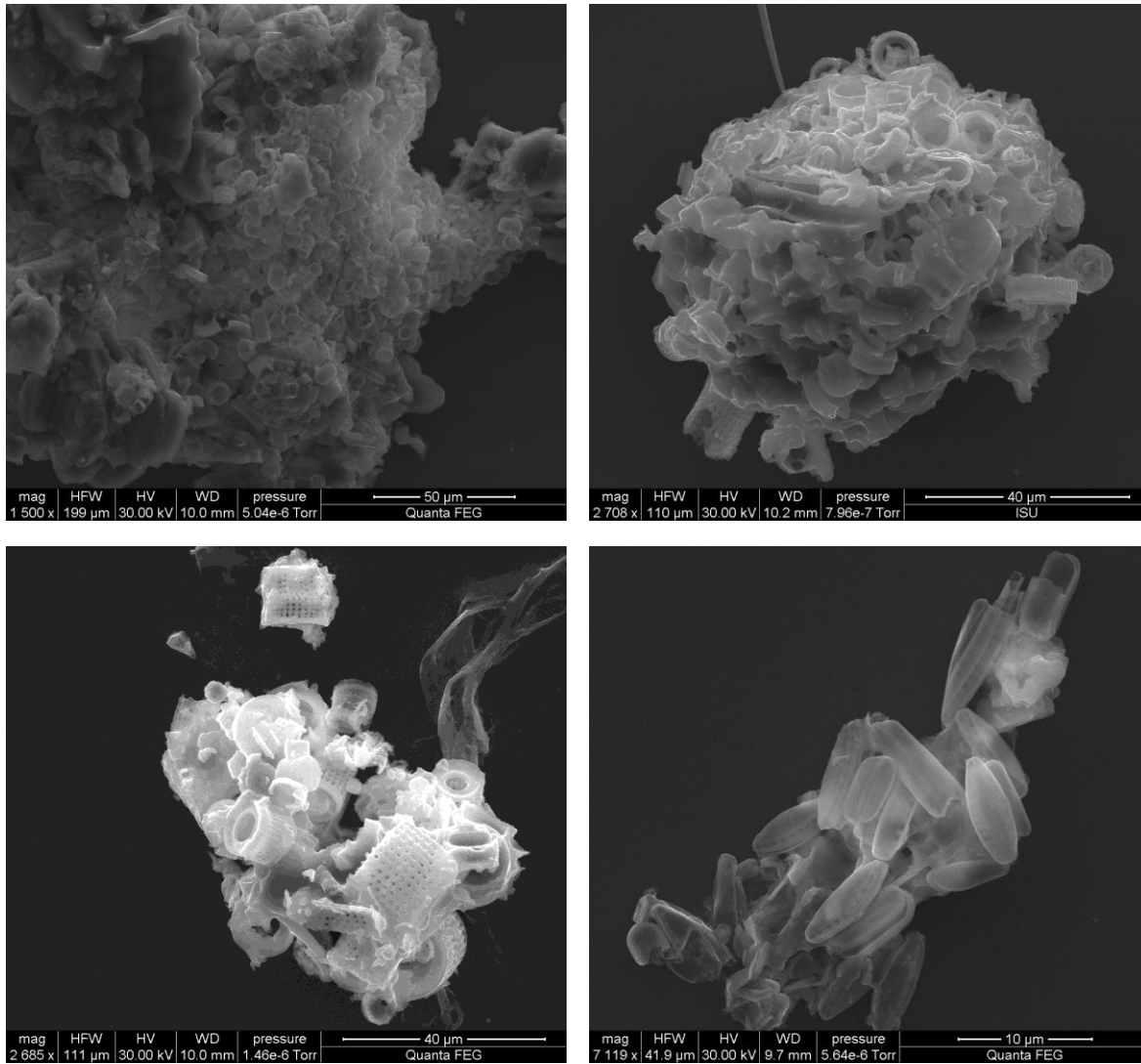


Figure 7. Large clusters of diatoms attached to strands of filamentous algae.

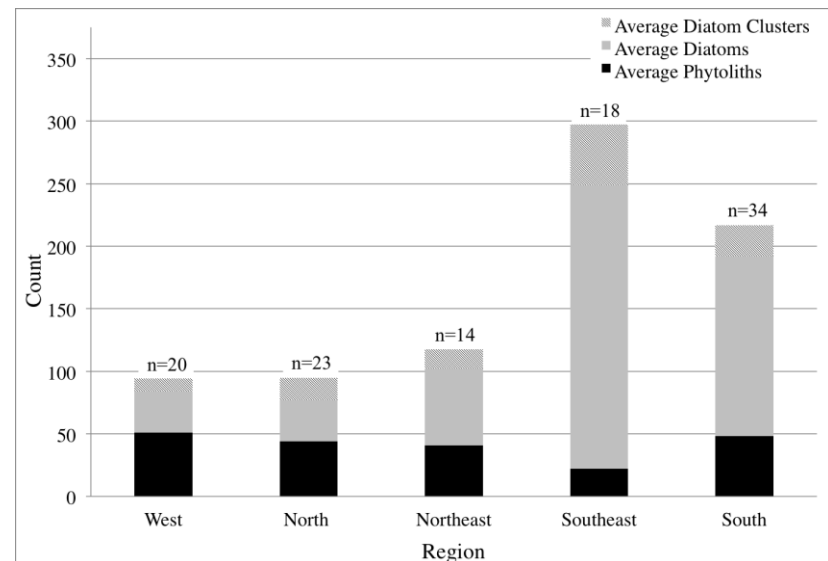
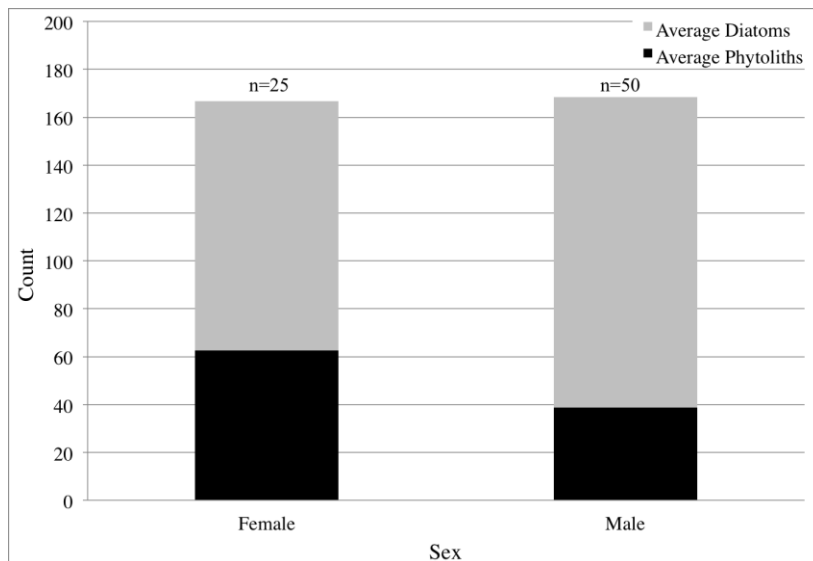
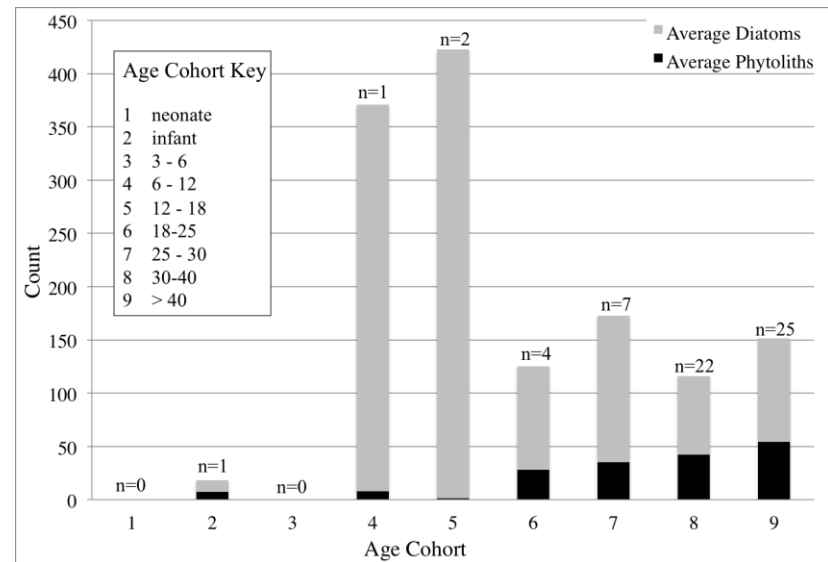
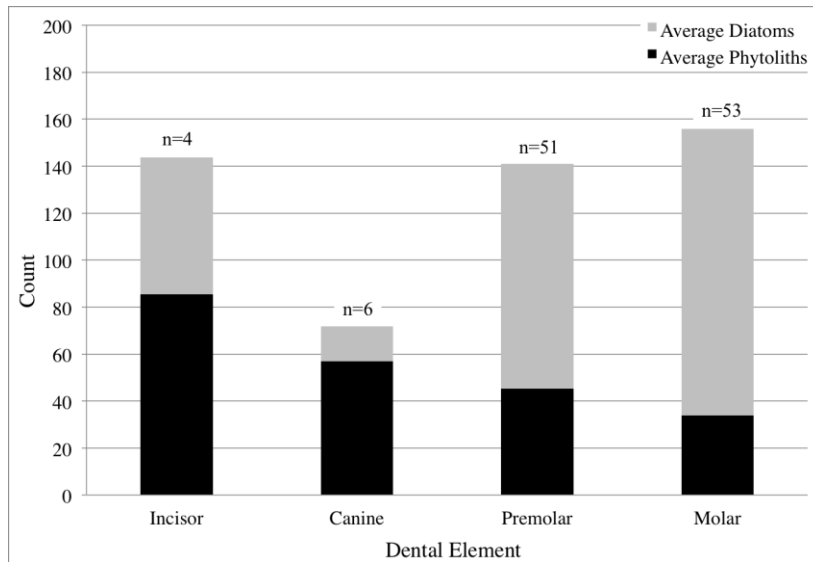


Figure 8. Average counts of diatoms and phytoliths by: (a) dental element (upper left); (b) age cohort (upper right); (c) sex (lower left); (d) geographic region (lower right). In all graphs, *n* equals the number of individual teeth used in the calculation.

Supplementary Data

| ISU Sample # | RH # | Inventory # | State of Preservation | Dental Element | Site | Sex | Age Cohort | Sample Weight (mg) | Total Microfossils | Total Phytoliths | Total Individual Diatoms | Phytoliths | | | | Diatoms | | | Cluster |
|--------------|----------------|-------------|-----------------------|----------------|---------------------------|---------|------------|--------------------|--------------------|------------------|--------------------------|-------------------|----------|------------|-------------|---------|---------|-----|---------|
| | | | | | | | | | | | | Globular Echinate | Bilobate | Polylobate | Trapeziform | Centric | Pennate | | |
| 1 | RH0289 | 17.06.0717 | Average | LRP2 | Ahu One Makihiki | Male | >40 | 2.942 | 289 | 43 | 246 | 42 | -- | 1 | -- | 164 | 82 | 4 | |
| 2 | RH0296 | 17.06.0718 | Good | LLP2 | Ahu Tautira | Male | >40 | 3.166 | 271 | 93 | 178 | 93 | -- | -- | -- | 177 | 1 | 66 | |
| 3 | RH0298 | 17.06.0720 | Bad | UP | Ahu Tautira | Male | AEI | 1.292 | 47 | 47 | -- | 47 | -- | -- | -- | -- | -- | -- | |
| 4 | RH0283 | 17.06.0724 | Good | LLM1 | Oroi Caves | Male | 12 - 18 | 2.871 | 845 | 3 | 842 | 1 | 1 | -- | 1 | 472 | 370 | 126 | |
| 5 | RH0353 | 17.06.0760 | Good | URP2 | Unknown | Male | 30 - 40 | 0.898 | 6 | -- | 6 | -- | -- | -- | -- | 1 | 5 | -- | |
| 6 | RH0285 | 17.06.0736 | Good | LRP2 | Oroi Caves | Male | >40 | 0.950 | 21 | 15 | 6 | 15 | -- | -- | -- | 5 | 1 | 1 | |
| 7 | RH0350 | 17.06.0789 | Good | ULM1 | Unknown | Male | 30 - 40 | 2.840 | 73 | 63 | 10 | 52 | 1 | -- | 10 | -- | 10 | -- | |
| 8 | RH0318 | 17.06.0791 | Average | LM | Ahu Nau Nau | Male | >40 | 1.947 | 51 | 50 | 1 | 49 | 1 | -- | -- | -- | 1 | -- | |
| 9 | RH0319B | 17.06.0795 | Average | I | Ahu Nau Nau | Female | AEI | 1.600 | 324 | 324 | -- | 320 | 3 | -- | 1 | -- | -- | -- | |
| 10 | RH0320 | 17.06.0803 | Average | P | Ahu Nau Nau | Male | AEI | 4.116 | 15 | 15 | -- | 13 | 1 | -- | 1 | -- | -- | -- | |
| 11 | B1 | 17.06.0689 | --- | Mb | Ahu Kihiki Kihiki Rau Mea | Unknown | AEI | no wt. | 36 | 18 | 18 | 17 | 1 | -- | -- | 6 | 12 | -- | |
| 12 | RH0271 | 17.06.0693 | Good | URP2 | Ana Akahanga | Female | 18 - 25 | 0.810 | 21 | 2 | 19 | 2 | -- | -- | -- | 19 | -- | 8 | |
| 13 | RH0249B-D-A-RB | 17.06.0700 | Good | LRP1 | Ahu Kihiki Kihiki Rau Mea | Male | 30 - 40 | 2.728 | 123 | 51 | 72 | 31 | 20 | -- | -- | 64 | 8 | 12 | |
| 14 | B#1 | 17.06.0703 | --- | C | Ahu Kihiki Kihiki Rau Mea | Unknown | 30 - 40 | 1.836 | 63 | 59 | 4 | 58 | 1 | -- | -- | 3 | 1 | -- | |
| 15 | B#1 | 17.06.0703 | --- | Pb | Ahu Kihiki Kihiki Rau Mea | Unknown | 30 - 40 | 13.019 | 49 | 47 | 2 | 46 | -- | -- | 1 | 2 | -- | -- | |
| 16 | B#1 | 17.06.0703 | --- | Ma | Ahu Kihiki Kihiki Rau Mea | Unknown | 30 - 40 | 1.218 | 52 | 48 | 4 | 46 | 1 | -- | 1 | 4 | -- | -- | |
| 17 | B#1 | 17.06.0703 | --- | Mb | Ahu Kihiki Kihiki Rau Mea | Unknown | 30 - 40 | 2.028 | 184 | 84 | 100 | 82 | 1 | -- | 1 | 84 | 16 | 26 | |
| 18 | B#1 | 17.06.0703 | --- | Pa | Ahu Kihiki Kihiki Rau Mea | Unknown | 30 - 40 | 0.796 | 151 | 65 | 86 | 50 | 11 | -- | 4 | 65 | 21 | -- | |
| 19 | RH0273 | 17.06.0715 | Average | URP2 | Ana Akahanga | Female | >40 | 2.650 | 975 | 559 | 416 | 554 | 1 | 1 | 3 | 375 | 41 | 138 | |
| 20 | B#1 | 17.06.0646 | --- | UM | Ahu Mahatua | Unknown | AEI | 10.607 | 55 | 51 | 4 | 47 | 2 | -- | 2 | 3 | 1 | -- | |
| 21 | B#1 | 17.06.0646 | --- | C | Ahu Mahatua | Unknown | AEI | 1.618 | 9 | 5 | 4 | 5 | -- | -- | -- | -- | 4 | -- | |
| 22 | B#1 | 17.06.0646 | --- | Pb | Ahu Mahatua | Unknown | AEI | 2.019 | 2 | 2 | -- | 2 | -- | -- | -- | -- | -- | -- | |
| 23 | RH0235 | 17.06.0661 | Good | LRM2 | Mahatua Poe Poe | Female | >40 | 0.944 | 163 | 33 | 130 | 33 | -- | -- | -- | 128 | 2 | 41 | |
| 24 | RH0236 | 17.06.0670 | Good | LLM1 | Ahu Kihiki Kihiki Rau Mea | Male | 30 - 40 | 0.927 | 9 | 4 | 5 | 4 | -- | -- | -- | 5 | -- | 1 | |
| 25 | RH0230 | 17.06.0672 | Good | LRM1 | Mahatua Avanga | Female | >40 | 1.114 | 545 | 132 | 413 | 98 | -- | 1 | 33 | 396 | 17 | 124 | |
| 26 | RH0254 | 17.06.0681 | Average | M | Ahu Kihiki Kihiki Rau Mea | Male | AEI | 3.530 | 107 | 107 | -- | 104 | 3 | -- | -- | -- | -- | -- | |
| 27 | RH0270 | 17.06.0683 | Good | UPR2 | Ana Akahanga | Male | 30 - 40 | 1.938 | 104 | 40 | 64 | 35 | 5 | -- | -- | 62 | 2 | 17 | |
| 28 | RH0266 | 17.06.0684 | Average | LRP2 | Ahu Kihiki Kihiki Rau Mea | Female | AEI | 2.654 | 7 | 4 | 3 | 4 | -- | -- | -- | 3 | -- | 1 | |
| 29 | B1 | 17.06.0689 | --- | C | Ahu Kihiki Kihiki Rau Mea | Unknown | AEI | 0.808 | 10 | 10 | -- | 9 | -- | -- | 1 | -- | -- | -- | |
| 30 | RH0216 | 17.06.0617 | Good | LRP2 | Ahu Mahatua | Female | >40 | 2.164 | 25 | 10 | 15 | 8 | 1 | -- | 1 | 9 | 6 | 2 | |
| 31 | RH0204 | 17.06.0622 | Bad | LRP1 | Ana Koe Hoko | Male | AEI | 1.085 | 458 | 9 | 449 | 9 | -- | -- | -- | 322 | 127 | 65 | |
| 32 | RH0626 | 17.06.0626 | Good | ULP1 | Ahu Mahatua | Male | >40 | 2.930 | 133 | 128 | 5 | 121 | 2 | -- | 5 | 4 | 1 | -- | |
| 33 | RH0212 | 17.06.0627 | Good | LLP2 | Ahu Mahatua | Male | 30 - 40 | 4.123 | 63 | 51 | 12 | 42 | 5 | -- | 4 | 12 | -- | 3 | |
| 34 | RH0207 | 17.06.0629 | Bad | LLP2 | Ana Koe Hoko | Male | 30 - 40 | 0.607 | 417 | 16 | 401 | 16 | -- | -- | -- | 359 | 42 | 67 | |
| 35 | RH0221 | 17.06.0633 | Average | LRM1 | Ahu Mahatua | Female | 25 - 30 | 0.864 | 140 | 48 | 92 | 42 | -- | -- | 6 | 92 | -- | 25 | |
| 36 | RH0214 | 17.06.0637 | Good | LLM1 | Ahu Mahatua | Male | 25 - 30 | 3.189 | 13 | 11 | 2 | 11 | -- | -- | -- | -- | 2 | -- | |
| 37 | RH0224 | 17.06.0639 | Average | LLP2 | Mahatua Cave | Male | >40 | 1.342 | 71 | 16 | 55 | 15 | 1 | -- | -- | 53 | 2 | 12 | |
| 38 | RH0209 | 17.06.0643 | Bad | DM1 | Ana Koe Hoko | Unknown | 6 - 12 | 0.738 | 371 | 8 | 363 | 8 | -- | -- | -- | 341 | 22 | 60 | |
| 39 | B#1 | 17.06.0646 | --- | M | Ahu Mahatua | Unknown | AEI | 1.940 | 17 | 17 | -- | 16 | 1 | -- | -- | -- | -- | -- | |
| 40 | RH0174 | 17.06.0597 | Good | URM2 | Ahu Kote Riku | Male | 30 - 40 | 4.493 | 124 | 43 | 81 | 43 | -- | -- | -- | 79 | 2 | 96 | |

| ISU Sample # | RH # | Inventory # | State of Preservation | Dental Element | Site | Sex | Age Cohort | Sample Weight (mg) | Total Microfossils | Total Phytoliths | Total Individual Diatoms | Phytoliths | | | | Diatoms | | |
|--------------|------------|-------------|-----------------------|----------------|-----------------|---------|------------|--------------------|--------------------|------------------|--------------------------|-------------------|----------|------------|-------------|---------|---------|---------|
| | | | | | | | | | | | | Globular Echinate | Bilobate | Polylobate | Trapeziform | Centric | Pennate | Cluster |
| 41 | RH0181/992 | 17.06.0599 | — | LRM2 | Unknown | Female | AEI | 0.671 | 7 | 7 | -- | 6 | 1 | -- | -- | -- | -- | -- |
| 42 | RH0182/993 | 17.06.0600 | — | LLP2 | Unknown | Male | AEI | 0.028 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 43 | RH0167 | 17.06.0603 | Average | LLM1 | Ahu Onero | Female | 18 - 25 | 0.667 | 104 | 55 | 49 | 48 | 5 | -- | 2 | 17 | 32 | 1 |
| 44 | RH0192 | 17.06.0607 | Average | UR1 | Ana Koe Hoko | Male | >40 | 0.060 | 8 | 2 | 6 | -- | 2 | -- | -- | 4 | 2 | -- |
| 45 | RH0191 | 17.06.0609 | Good | LRM3 | Ana Koe Hoko | Female | >40 | 0.866 | 318 | 13 | 305 | 11 | 2 | -- | -- | 296 | 9 | 104 |
| 46 | RH0190 | 17.06.0610 | Average | URP2 | Ana Koe Hoko | Male | >40 | 0.528 | 84 | 8 | 76 | 8 | -- | -- | -- | 60 | 16 | 20 |
| 47 | RH0169 | 17.06.0612 | Average | ULM | Ahu Onero | Female | >40 | 0.212 | 4 | 4 | -- | -- | 4 | -- | -- | -- | -- | -- |
| 48 | RH0222 | 17.06.0615 | Good | LRP1 | Ahu Mahatua | Female | 30 - 40 | 2.209 | 29 | 11 | 18 | 11 | -- | -- | -- | 18 | -- | 7 |
| 49 | RH0217 | 17.06.0616 | Average | LLM1 | Ahu Mahatua | Female | 18 - 25 | 1.903 | 165 | 55 | 110 | 54 | -- | -- | 1 | 109 | 1 | -- |
| 50 | RH0140 | 17.06.0554 | Good | URP1 | Akahanga Karava | Male | 30 - 40 | 6.258 | 116 | 105 | 11 | 102 | -- | -- | 3 | 9 | 2 | -- |
| 51 | RH0188 | 17.06.0579 | — | LLP1 | North Coast | Male | AEI | 1.114 | 145 | 122 | 23 | 117 | 3 | -- | 2 | 23 | -- | -- |
| 52 | RH0186 | 17.06.0580 | — | LRM1 | North Coast | Male | AEI | 2.898 | 211 | 18 | 193 | 18 | -- | -- | -- | 161 | 32 | 28 |
| 53 | RH0164 | 17.06.0584 | Bad | P | Ahu Onero | Female | >40 | 0.299 | 49 | -- | 49 | -- | -- | -- | -- | 5 | 44 | 1 |
| 54 | B#6 | 17.06.0585 | — | M | Ahu Onero | Unknown | AEI | 0.242 | 375 | 35 | 340 | 35 | -- | -- | -- | 143 | 197 | 47 |
| 55 | RH0165 | 17.06.0586 | — | M | Ahu Onero | Unknown | AEI | 2.578 | 108 | 15 | 93 | 13 | -- | 1 | 1 | 29 | 64 | -- |
| 56 | RH0166 | 17.06.0589 | Bad | LRP2 | Ahu Onero | Male | 25 - 30 | 1.188 | 134 | 113 | 21 | 103 | 8 | 1 | 1 | 5 | 16 | -- |
| 57 | B#5 | 17.06.0590 | — | M | Ahu Onero | Unknown | AEI | 0.204 | 1 | 1 | -- | 1 | -- | -- | -- | -- | -- | -- |
| 58 | RH0200 | 17.06.0592 | Average | ULP1 | Ana Koe Hoko | Male | 25 - 30 | 4.015 | 224 | 27 | 197 | 25 | -- | -- | 2 | 125 | 72 | 47 |
| 59 | RH0196 | 17.06.0593 | Bad | ULP2 | Ana Koe Hoko | Female | 25 - 30 | 1.105 | 672 | 18 | 654 | 17 | 1 | -- | -- | 625 | 29 | 206 |
| 60 | RH0145 | 17.06.0489 | — | M | Ahu Onero | Unknown | infant | 0.053 | 18 | 7 | 11 | 7 | -- | -- | -- | 6 | 5 | -- |
| 61 | RH0160 | 17.06.0501 | — | LRP2 | Ahu Onero | Male | AEI | 1.610 | 912 | 221 | 691 | 213 | 5 | -- | 3 | 334 | 357 | 92 |
| 62 | RH0135a | 17.06.0505 | — | M | Akahanga Avanga | Unknown | AEI | 2.426 | 133 | 64 | 69 | 59 | 3 | -- | 2 | 48 | 21 | 2 |
| 63 | RH0134a | 17.06.0507 | — | UM | Akahanga Avanga | Unknown | AEI | 2.749 | 43 | 29 | 14 | 19 | -- | -- | 10 | 10 | 4 | -- |
| 64 | RH0162 | 17.06.0509 | Bad | LRM1 | Ahu Onero | Female | AEI | 1.861 | 255 | 150 | 105 | 145 | 3 | -- | 2 | 73 | 32 | -- |
| 65 | RH0157 | 17.06.0521 | Bad | ULP1 | Ahu Onero | Male | 30 - 40 | 2.696 | 117 | 66 | 51 | 65 | -- | -- | 1 | 26 | 25 | 6 |
| 66 | RH0163 | 17.06.0523 | Average | M | Ahu Onero | Male | AEI | 3.082 | 55 | 33 | 22 | 30 | 1 | -- | 2 | 18 | 4 | 2 |
| 67 | RH0136 | 17.06.0524 | Bad | LRM1 | Akahanga Avanga | Male | AEI | 0.035 | 752 | 2 | 750 | 2 | -- | -- | -- | 750 | -- | 181 |
| 68 | RH0138 | 17.06.0527 | Good | LRM1 | Akahanga Karava | Male | >40 | 0.732 | 21 | 10 | 11 | 10 | -- | -- | -- | 11 | -- | 2 |
| 69 | RH0159 | 17.06.0529 | Average | M | Ahu Onero | Male | AEI | 3.244 | 29 | 24 | 5 | 24 | -- | -- | -- | 2 | 3 | -- |
| 70 | SIN N° | 17.06.0410 | — | M | Ahu Nau Nau | Unknown | AEI | 11.535 | 14 | 14 | -- | 14 | -- | -- | -- | -- | -- | -- |
| 71 | RH0166 | 17.06.0445 | Good | LLP1 | Oroi Caves | Male | 30 - 40 | 0.477 | 38 | 1 | 37 | -- | 1 | -- | -- | 18 | 19 | 8 |
| 72 | RH0115 | 17.06.0446 | Good | URC | Oroi Caves | Male | >40 | 0.886 | 30 | 10 | 20 | 9 | -- | -- | 1 | 9 | 11 | 6 |
| 73 | RH0118 | 17.06.0458 | Average | URM1 | Oroi Caves | Female | 18 - 25 | 0.167 | 211 | -- | 211 | -- | -- | -- | -- | 143 | 68 | 72 |
| 74 | RH0109B3 | 17.06.0464 | Good | URM2 | Ana Mahiha | Male | 12 - 18 | 0.093 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 75 | RH0132 | 17.06.0466 | Bad | LM | Oroi Caves | Female | AEI | 1.132 | 5 | 1 | 4 | 1 | -- | -- | -- | 2 | 2 | -- |
| 76 | RH0127B6 | 17.06.0467 | Good | UR2 | Oroi Caves | Male | >40 | 0.964 | 223 | 3 | 220 | 3 | -- | -- | -- | 220 | -- | 38 |
| 77 | RH0133 | 17.06.0481 | Bad | ULM1 | Oroi Caves | Male | 30 - 40 | 3.257 | 67 | 20 | 47 | 11 | 8 | -- | 1 | 36 | 11 | 5 |
| 78 | SIN N° | 17.06.0482 | — | I | Ana Mahiha | Unknown | AEI | 0.428 | 20 | 13 | 7 | 13 | -- | -- | -- | 2 | 5 | -- |
| 79 | RH0152 | 17.06.0483 | Bad | LLM1 | Ahu Onero | Male | AEI | 1.653 | 850 | 12 | 838 | 12 | -- | -- | -- | 409 | 429 | 85 |
| 80 | SIN N° | 17.06.0260 | — | P | Ahu Nau Nau | Unknown | AEI | 2.055 | 14 | 14 | -- | 14 | -- | -- | -- | -- | -- | -- |
| 81 | SIN N° | 17.06.0299 | — | UM | Ahu Nau Nau | Unknown | AEI | 11.045 | 123 | 123 | -- | 123 | -- | -- | -- | -- | -- | -- |

| ISU Sample # | RH # | Inventory # | State of Preservation | Dental Element | Site | Sex | Age Cohort | Sample Weight (mg) | Total Microfossils | Total Phytoliths | Total Individual Diatoms | Phytoliths | | | | Diatoms | | |
|--------------|-----------------|-----------------|-----------------------|----------------|---------------------------|---------|------------|--------------------|--------------------|------------------|--------------------------|-------------------|----------|------------|-------------|---------|---------|---------|
| | | | | | | | | | | | | Globular Echinate | Bilobate | Polylobate | Trapeziform | Centric | Pennate | Cluster |
| 82 | RH0104B4 | 17.06.0302 | Average | UM | Ahu Akahanga | Male | AEI | 0.521 | 1 | 1 | -- | 1 | -- | -- | -- | -- | -- | |
| 83 | SIN N° | 17.06.0304 | --- | UM3 | Ahu Nau Nau | Unknown | 25 - 30 | 0.396 | 4 | 4 | -- | 4 | -- | -- | -- | -- | -- | |
| 84 | SIN N° | 17.06.0314 | --- | URP1 | Ahu Nau Nau | Female | AEI | 0.587 | 1 | 1 | -- | 1 | -- | -- | -- | -- | -- | |
| 85 | RH0100bB3 | 17.06.0325 | Average | ULP2 | Ahu Akahanga | Female | 30 - 40 | 2.972 | 30 | 30 | -- | 28 | 1 | -- | 1 | -- | -- | |
| 86 | | #1 TR-14-548 F4 | --- | P | Tongariki | Unknown | AEI | 0.036 | 47 | 4 | 43 | 4 | -- | -- | -- | 43 | -- | 12 |
| 87 | | #1 TR-14-548-03 | --- | P | Tongariki | Unknown | AEI | 0.282 | 155 | 6 | 149 | 6 | -- | -- | -- | 149 | -- | 41 |
| 88 | SIN N° | 17.06.0380 | --- | P | Ahu Nau Nau | Unknown | AEI | 0.122 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 89 | SIN N° | 17.06.0399 | --- | M | Ahu Nau Nau | Unknown | AEI | 1.233 | 144 | 22 | 122 | 21 | -- | 1 | -- | 8 | 114 | 289 |
| 90 | RH003 | 17.06.0014 | Good | ULP1 | Ahu Nau Nau | Male | 30 - 40 | 2.100 | 74 | 1 | 73 | 1 | -- | -- | -- | 73 | -- | 21 |
| 91 | RH0039 | 17.06.0071 | Average | URM | Ahu Nau Nau | Male | 25 - 30 | 13.370 | 23 | 23 | -- | 23 | -- | -- | -- | -- | -- | -- |
| 92 | RH0070 | 17.06.0115 | Average | LRP1 | Ahu Nau Nau | Female | AEI | 0.729 | 3 | 1 | 2 | 1 | -- | -- | -- | 2 | -- | -- |
| 93 | RH0061 | 17.06.0119 | Good | ULM1 | Ahu Nau Nau | Male | >40 | 7.975 | 80 | 9 | 71 | 9 | -- | -- | -- | 71 | -- | -- |
| 94 | RH0083 | 17.06.0149 | Average | ULP1 | Ahu Nau Nau | Male | >40 | 4.508 | 4 | 4 | -- | 4 | -- | -- | -- | -- | -- | -- |
| 95 | RH065 | 17.06.0159 | Good | ULP2 | Ahu Nau Nau | Male | 30 - 40 | 3.813 | 283 | 3 | 280 | 3 | -- | -- | -- | 278 | 2 | 71 |
| 96 | SIN N° | 17.06.0179 | --- | LRM3 | Ahu Nau Nau | Unknown | AEI | 0.340 | 8 | 8 | -- | 8 | -- | -- | -- | -- | -- | -- |
| 97 | SIN N° | 17.06.0214 | Average | URC | Ahu Nau Nau | Male | 30 - 40 | 6.169 | 156 | 156 | -- | 154 | 2 | -- | -- | -- | -- | -- |
| 98 | RH0195 | 17.06.0217 | Average | LP? | Ana Koe Hoko | Male | 30 - 40 | 2.678 | 419 | 15 | 404 | 15 | -- | -- | -- | 27 | 377 | 3 |
| 99 | RH0173 | 17.06.0254 | Good | URM1 | Ahu Kote Riku | Female | >40 | 1.778 | 22 | 16 | 6 | 16 | -- | -- | -- | 1 | 5 | -- |
| 100 | TOMB A BURIAL 1 | 17.06.0859 | --- | Pa | Ahu Kihiki Kihiki Rau Mea | Unknown | AEI | 0.729 | 17 | 13 | 4 | 12 | -- | -- | 1 | 1 | 3 | -- |
| 101 | TOMB A BURIAL 1 | 17.06.0859 | --- | C | Ahu Kihiki Kihiki Rau Mea | Unknown | AEI | 0.841 | 163 | 101 | 62 | 98 | 1 | -- | 2 | 23 | 39 | -- |
| 102 | | #2 TR-14-548 F4 | --- | UM | Tongariki | Unknown | AEI | 1.386 | 81 | 45 | 36 | 40 | 2 | -- | 3 | 36 | -- | 3 |
| 103 | | #2 TR-14-548-03 | --- | LRM1 | Tongariki | Unknown | AEI | 1.506 | 476 | 5 | 471 | 5 | -- | -- | -- | 470 | 1 | 93 |
| 104 | | #3 TR-1458-01 | --- | LRM2 | Tongariki | Unknown | AEI | no wt. | 539 | 33 | 506 | 33 | -- | -- | -- | 506 | -- | 146 |
| 105 | RH0321 | 17.06.0804 | Average | P/C? | Ahu Nau Nau | Female | >40 | 1.724 | 91 | 91 | -- | 91 | -- | -- | -- | -- | -- | -- |
| 106 | RH0314 | 17.06.0824 | Good | LLP1 | Ahu Nau Nau | Female | >40 | 0.044 | 1 | 1 | -- | 1 | -- | -- | -- | -- | -- | -- |
| 107 | RH0308 | 17.06.0827 | --- | LRP2 | Ahu Nau Nau | Unknown | AEI | 0.259 | 6 | 6 | -- | 6 | -- | -- | -- | -- | -- | -- |
| 108 | RH0287 | 17.06.0835 | Good | LRP2 | One Makihiki Crevice | Male | 30 - 40 | 1.932 | 39 | 28 | 11 | 26 | 2 | -- | -- | 7 | 4 | -- |
| 109 | SIN N° | 17.06.0837 | --- | LLP1 | Ahu Kote Riku | Unknown | AEI | no wt | 40 | 26 | 14 | 25 | 1 | -- | -- | 4 | 10 | 2 |
| 110 | SIN N° | 17.06.0838 | --- | UM | Unknown | Unknown | AEI | 2.157 | 71 | 62 | 9 | 57 | 3 | -- | 2 | -- | 9 | -- |
| 111 | RH0297 | 17.06.0846 | Bad | URP2 | Ahu Tautira | Male | AEI | 0.590 | 89 | 88 | 1 | 87 | -- | -- | 1 | -- | 1 | 1 |
| 112 | SIN N° | 17.06.0852 | --- | P | Ahu One Makihiki | Unknown | AEI | 2.860 | 25 | 25 | -- | 24 | -- | -- | 1 | -- | -- | -- |
| 113 | SIN N° | 17.06.0852 | --- | Mb | Ahu One Makihiki | Unknown | AEI | 3.531 | 60 | 56 | 4 | 51 | 1 | -- | 4 | 3 | 1 | -- |
| 114 | TOMB A BURIAL 1 | 17.06.0859 | --- | M | Ahu Kihiki Kihiki Rau Mea | Unknown | AEI | 2.138 | 102 | 92 | 10 | 68 | 16 | 3 | 5 | 3 | 7 | -- |