

# Archaeological Approaches for Understanding the Marquesan Stone Pounder *ke'a tuki popoi*

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*Stone pounders known as ke'a tuki popoi, ke'a tu'i kioe, or k'ea tuki kóna, were and are still used on certain Polynesian Islands to mash food, usually fruit, especially breadfruit, to make a paste known as poi, and some were used to produce medicine and pigments. They were the second most frequently collected stone objects in Polynesia after adzes in the colonial period and are numerous in global museum collections. Yet, pounders have not received as much archaeological attention. Stone pounders provide a way of studying the colonial period and the impacts of colonialism on the production and circulation of traditional Polynesian objects by comparing them with adzes from earlier and more recent (pre-Contact to early colonial) periods. This study combines an object itineraries and portable X-ray fluorescence (pXRF) geochemical study to an assemblage of Marquesan pounders in museum collections to (1) identify stylistic change through time, (2) identify volcanic rock type and match geological sources used to make these artifacts, and (3) consider the impacts of Western colonialism on Marquesan cultural practices. The results of these analyses identified that the distinct Tiki-headed ke'a tuki popoi were produced from a localized region in the Marquesas and that pounders were not produced from the same basalt quarries as adzes. The patterns of stone pounder production and distribution identified in this geochemical study contrast somewhat with the historical accounts from the 19th and 20th centuries and therefore provide a new perspective into Marquesan stone carving practices just prior to and during the early Western colonial period.*

**Keywords:** museum archaeology, stone pounders, Marquesas, portable X-ray fluorescence (pXRF) spectroscopy

## Introduction

Stone pounders are considered by archaeologists to be a later Polynesian invention (c. AD 1400) (e.g., [Linton 1923](#); [Buck 1944](#); [Emory 1988](#)). They were used for food, medicine, and pigment processing and their distinctive forms, especially those from the Society Islands and Marquesas, are easily recognized ([Sinoto 1970](#)). The main Marquesan forms have been referred to as Opu, Phallic, Salt, Children/Infant, and

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Modern pounders (Linton 1923). The geochemical results presented in this paper investigate whether the Tiki-headed *ke'a tuki popoi* from the Marquesas were produced from localized basalt sources. There is also potential to investigate if the production of Marquesan pounders changed during the historical period. Establishing the distribution patterns of these iconic stone pounders in this later period, however, is complicated by Western interactions.

Emory (1988) included the restricted distribution of some stone poulder forms, most notably the complete absence of pounders on some islands, in his archaeological model of Polynesian migrations (see also Linton 1923; Buck 1944). Emory (1988) interpreted the presence of the knob poulder in Hawai'i as a link to the Marquesan phallic poulder and the lack of any Tahitian forms as evidence for an initial Marquesan migration to Hawai'i. Additionally, the absence of stone pounders in New Zealand, on Pitcairn Island, and on Rapa Nui suggested to Emory that the stone poulder was a later development: occurring after people had left for New Zealand and Rapa Nui and after Pitcairn Island was no longer favored for long-term permanent occupation.

Identifying the geographical origins of stone pounders is key to testing the hypothesis that some poulder forms were specially curated through social networks, perhaps to function as exchange valuables. This is significant for understanding social mechanisms in the period directly prior to and after Western Contact. Stone adze exchanges are at the center of geo-archaeological research because those interactions are considered to have occurred during the pre-Contact period. Yet, almost no attention has been given to examining the exchanges of Polynesian stone artifacts invented later on, including pounders. Despite there being ethnographic accounts about the use of stone pounders in ritual food preparation and their manufacture, there is comparatively little recorded about the location of stone sources and almost nothing about the early colonial (i.e., pre-1920) interactions and exchanges required to obtain the finely crafted poulder forms. This stone provenance analysis provides an opportunity to better understand the nature of Polynesian-Polynesian and Polynesian-Western cross-cultural interactions in which pounders were exchanged during the initial Western contact period.

## Marquesan Pounders: A Brief History

Stone pounders, known as *ke'a tuki popoi*, *ke'a tu'i kioe*, or *k'ea tuki kóna* in the Marquesas, were and are still used on certain Polynesian Islands to mash food, usually fruit, especially breadfruit, to make a paste known as *poi*. They are also used to produce medicine and pigments. Breadfruit, known as *mei*, became the Marquesans' primary food because it was easily cultivated and was the main storable food resource during long drought periods (Handy 1923; Kjellgren 2005:6; Crook 2007 [1799]). The preparation of *poi* was observed and recorded in the early accounts of James Cook (Beaglehole 1969, I:122), Joseph Banks (1896:140f.), Sydney Parkinson (1773:17, 45), and George Forster (1989, I:236, 326f. cited in Hauser-Schaublin 1998) from the 1760s and 1770s.

Most of the information about poulder form distributions comes from ethnographic and archaeological accounts. Early twentieth-century accounts reported that carved stone pounders were commonly found in Polynesia, except in Sāmoa, Tonga, Rapa Nui, or the Chatham Islands (Linton 1923:83). Handy's (1923) written accounts of the Marquesan pounding of *popoi* rite *koina ha'ame 'ie i'ima* and specialist carvers *tuhuka ke'a tuki popoi* have been commonly referenced (e.g., Ivory 2005; Kjellgren 2014). His accounts focused on the social role and rituals involving stone pounders in the preparation of food for the

family. “[S]oon after the birth, a purgative was given to the child. This was made by pounding shrimps with a stone pounder and mixing them with coconut milk” (Handy 1923:74). Then at the age of 10, all children had to “consecrate the[ir] hands so that an individual could make *popoi* for himself or herself, or others, the *ko’ina ha’ame’ie i’ima* (*ha’a*, to make; *me’ie*, clear; *ima*, hand) rite removed the tapu from the child” (Handy 1923:91). All the immediate family took part in the occasion followed by a feast. The importance of stone pounders in the Marquesas meant that the specialist carvers “who possessed exceptional intellectual, physical, or artistic talent were acknowledged and honoured as experts or *tuhuka*, and their services were highly sought after” (Handy 1923:143, cited in Kjellgren 2005:4).

E.S.C. Handy described the everyday preparation of *popoi* as follows: “There was always a large, thick and slightly hollowed, board (*hoana*) on which the breadfruit was pounded. The pounding was done with stone pounders (*ke’a tuki popoi*)” (Handy 1923:64–65). He noted the difference in the names on Hiva Oa (*koumu*) and Nuku Hiva (*vahima*) for the oven-baked *ma* (fermented breadfruit) which was “placed on the kneading trough and pounded into a smooth paste with the stone *popoi* pounder (*kea tuki popoi*)” (Handy 1923:190). There were also sacred aspects to the use of stone pounders. Gell (1993:177, 215) wrote that one of the sacred reasons women and girls were tattooed on their right hand was to enable them to handle the stone pounder to prepare *popoi* and serve it from a bowl. Willowdean Handy even recorded the string figures related to stone pounders, “some for objects used by the natives, but without resemblance to them in form, such as . . . a stone pounder” (W. Handy 1925:304). She occasionally wrote about the use of stone pounders in her field notes, where she also recorded numerous recipes (W. Handy 1925; also see Handy 1923).

E.S.C. Handy also referred to his colleague Linton (1923), who:

“ . . . distinguishes four types of pounders: salt pounders, children’s pounders, those used for the breadfruit paste, and those for infant food. A full account of these and of different types of bowls and containers used by the native will be found in Mr Linton’s study of material culture” (Handy 1923:64–65).

Handy did not collect any pounders for the Bernice Pauahi Bishop Museum collections; rather, Linton was responsible for the pounders collected on the Bayard Dominick Expedition. These pounders are currently held in the collections at the Bernice Pauahi Bishop Museum in Honolulu, Hawai‘i.

Since pounders are largely found in surface contexts and rarely found in archaeological excavations, a reliable chronological sequence has not been developed throughout East Polynesia (although for the Marquesas, see Suggs 1961:99; Sinoto 1970; see also Garanger 1967; Lavondès 1974 for examples of morphometric terminology). Several recent findings of pounders in archaeological contexts, however, show that pounders were present in contexts that likely date to the sixteenth to eighteenth centuries (Conte & Molle 2011, cf. Sinoto 1970). Also, pounders have been observed to remain in domestic use for a very long time, often as inter-generational heirlooms (Emory 1988; McKinney 2012). Some pounders were restricted to ceremonial *tapu* use, for instance, at the Ua Huka *me’ae* and in Tahitian *marae* where they were found cached with adzes (Conte & Molle 2011). Further, there are few pounders in museum collections that originated in the eighteenth or nineteenth centuries; the majority were collected in the twentieth century. Subsequently, because stone pounders have been considered a more “recent artifact class” they have received much less

archaeological attention than adzes, even though they are common domestic objects. [Linton \(1923:77\)](#) observed that apart from adzes, pounders were the most common stone artifacts in the Marquesas.

Interestingly, historical reports document mass production of Marquesan stone pounders by a “German trading company” on Ua Huka, “which sold them in their stores throughout the group and even in Tahiti” ([Linton 1923:77](#)). This company may have been the Société Commerciale de l’Océanie, owned by Hamburger Godeffroys, which operated exclusively in Eastern Polynesia between 1876 and 1914 ([Gossler 2006](#)). There is the potential to detect a change in poulder production geochemically, for example, to determine if the German trading company copied Society Island poulder forms and mass produced them on Ua Huka with Marquesan stone. It might also be possible to trace the influence of foreign designs incorporated into pounders that were mass produced for commercial and “curio” markets ([Bouge 1931](#)). This would certainly constitute a different type of cross-cultural exchange between Polynesians and Westerners than was previously observed in adze exchanges. In such “commercial” exchanges, Westerners would have commissioned or instigated the production of stone pounders rather than Polynesians, although the craftsmen were still Polynesian.

## An Assemblage Across Collections

Rather than studying objects in isolation, an assemblage-based approach (e.g., [Flexner 2016a, 2016b](#)) and an *object itineraries* approach ([Joyce 2015](#); [Joyce & Gillespie 2015](#)) has been chosen for the analysis of Marquesan pounders in eighteenth to twentieth-century museum collections from central Polynesia, with a particular focus on the British Museum and Pitt Rivers Museum collections. A survey of pounders in early museum collections is required to make comparisons with more recent collections and potentially to distinguish “ancient” and “modern” poulder forms. Marquesan pounders are not common in early collections. Some of the earliest examples of pounders that were collected by British explorers include pounders from Tahiti in the Pitt Rivers Museum and pounders collected during Cook’s voyages, which are in the British Museum (see [Richards 2021](#) for detailed descriptions). The earliest Marquesan poulder identified in these collections is likely the double tiki-head, *ke’a tuki popoi* at the Pitt Rivers Museum (PRM 1884.128.78) ([Coote 2015](#)). The assemblage of Tiki pounders in museum collections is presented in [Table 1](#) (see also [Tables 3](#) and [4](#) for images).

## Marquesan Tiki-Headed Pounders

A Marquesan poulder with a distinct double tiki-head, *ke’a tuki popoi*, was part of the Pitt Rivers Museum founding collection (PRM 1884.128.78), but the object’s documentation and collection history is unclear. An object itineraries approach is applied here to suggest the most likely collection history. Jeremy [Coote \(2015\)](#), former curator and Joint Head of Collections at the Pitt Rivers Museum, found evidence that Lane-Fox (later Pitt-Rivers) displayed a “West Indies” muller [1217] and two “Tahitian” mullers [1215 and 1216] in 1870 at an Ordinary Meeting of the Ethnological Society in London (Bonwick 1870:121 cited in [Coote 2015](#)). The objects were recorded in Pitt-Rivers’ “blue book.” Objects [1217] (PRM 1884.128.78) “Stone pestle ornamented with human head. Central America or W. Indies,” and [1216] (PRM 1884.128.77) are still at the Pitt Rivers Museum, but the second Tahitian muller [1215] is no longer in the collection ([Coote 2015:307](#)). This 1870 display

Table 1. An assemblage of Tiki-head pounders in museum collections c. 1869–1955.

| Collector        | Collected/accessioned           | Institution                       | Museum no.      | Type                          | Museum notes            | Find spot |
|------------------|---------------------------------|-----------------------------------|-----------------|-------------------------------|-------------------------|-----------|
| Unknown          | By 1870                         | Pitt Rivers Museum                | PRM 1884.128.78 | Double Tiki                   | Marquesas (?)           | Ua Huka   |
| C. D. Voy        | 1869/1891                       | University of Pennsylvania<br>MAA | PENN 18011      | Double Tiki<br>(smaller eyes) | Marquesas Islands       | Marquesas |
| C. D. Voy        | 1869/1891                       | UPMAA                             | PENN 18012      | Double Tiki<br>(smaller eyes) | Marquesas Islands       | Marquesas |
| F.W. Christian   | 1895–1896                       | British Museum                    | BM Oc1899-161   | Double Tiki                   | Huahuna (Washington Is) | Ua Huka   |
| Unknown          | 1910                            | B.P. Bishop Museum                | BPBM 8044       | Double Tiki<br>(smaller eyes) | Taipi Valley, Nukuhiva  | Nuku Hiva |
| A. M. McBryde    | 1911                            | B.P. Bishop Museum                | BPBM 10.780     | Double Tiki<br>(smaller eyes) | Marquesas               | Ua Huka   |
| R. Linton        | 1921                            | B.P. Bishop Museum                | BPBM B.3050     | Double Tiki                   | Marquesas (?)           | Ua Huka   |
| R. Linton        | 1921                            | B.P. Bishop Museum                | BPBM B.3040     | Double Tiki                   | Marquesas               | Ua Huka   |
| R. Linton        | 1921                            | B.P. Bishop Museum                | BPBM B.3037     | Double Tiki                   | Marquesas               | Ua Huka   |
| G. Spitz         | 1926–1956<br>(Accession Book C) | B.P. Bishop Museum                | BPBM C.476a     | Double Tiki                   | Nuku Hiva, Marquesas    | Nuku Hiva |
| G. P. Wilder     | 1926–1956<br>(Accession Book C) | B.P. Bishop Museum                | BPBM C.506      | Double Tiki                   | Marquesas               | Ua Huka   |
| K. P. Emory      | 1931                            | B.P. Bishop Museum                | BPBM C.4049     | Double Tiki                   | Marquesas               | Ua Huka   |
| K. P. Emory      | 1931                            | B.P. Bishop Museum                | BPBM C.4050     | Double Tiki                   | Marquesas               | Ua Huka   |
| K. P. Emory      | 1931                            | B.P. Bishop Museum                | BPBM C.4045     | Double Tiki                   | Marquesas               | Ua Huka   |
| K. P. Emory      | 1931                            | B.P. Bishop Museum                | BPBM C.2361     | Double Tiki                   | Marquesas               | Ua Huka   |
| Unknown          | 1931                            | Musée de Papeete                  | MTI 55 (124)    | Double Tiki<br>(smaller eyes) | Marquesas               | Ua Huka   |
| Musée de Papeete | 1939                            | Musée de Papeete                  | MTI 123         | Double Tiki<br>(smaller eyes) | Marquesas               | Ua Huka   |
| Musée de Papeete | 1939                            | Musée de Papeete                  | MTI 217         | Double Tiki                   | Marquesas Is. (?)       | Ua Huka   |
| T. Heyerdahl     | 1955                            | Kon Tiki Museum                   | K-T 2635        | Double Tiki                   | Marquesas               | Nuku Hiva |
| T. Heyerdahl     | 1955                            | Kon Tiki Museum                   | K-T 2633        | Double Tiki                   | Nukuhiva, Marquesas     | Nuku Hiva |

led [Coote \(2015\)](#) to suggest these pounders might have been collected during the HMS *Topaze* voyage through the Pacific in 1868–69 that included a visit to the Marquesas. However, [Coote \(2015:308\)](#) questions this c. 1869 date of collection by Charles D. Voy (1842–1895), naturalist and explorer, because “it would be surprising for its Marquesan provenance to have been forgotten so quickly.”

The University of Pennsylvania Museum of Archaeology and Anthropology (UPMAA) holds three pounders collected by Voy, two double Tiki-headed and one phallic (PENN 18011, 18012, and 18013). These Tiki-headed pounders do not have the same large goggle eyes as the Pitt Rivers example, which [Linton \(1923\)](#) refers to as an “ancient type.” They were a gift to the museum from William Pepper (1843–1898) in 1891. Pepper had purchased the pounders from palaeontologist Edward Drinker Cope (1840–1897) who had acquired the objects from Voy. The two Tiki-headed pounders (PENN 18011 and 18012) have smaller eyes and more elaborate ear decoration and this style was thought by [Linton \(1923\)](#) to be a “more recent tiki type.” [Linton \(1925:322\)](#) noted that during the post-Contact period, the carving of Polynesian anthropomorphic “figures were modified to conform to the general scheme of design or were simplified to increase the speed of production.” He observed further that “the reduced or degenerated human figure in Marquesan carving simplified the head,” which was considered the most important part, to “a pair of eyes, or to one eye with its attached ear-scroll.” Linton considered this modern form with more expediently carved facial features as a contrast to the more finely carved but larger features of the ancient forms.

In 1899, the British Museum purchased Marquesan stone pounders from English explorer and philologist Frederick William Christian (1867–1934) with funds left by Henry Christy (1810–1865), the ethnologist, banker, and collector ([McKinney 2012](#)). The three pounders in the British Museum are a stone double Tiki-headed poulder (BM Oc. 1889.161) with small eyes, a stone phallic poulder (BM Oc. 1889.162), and a coral phallic poulder (BM Oc. 1889.163), all collected on Ua Huka in 1896. Christian gives the pounders a brief and complimentary mention at the end of his stay on Ua Huka, remarking: “I carefully packed my curios, amongst them some fine specimens of basalt pestles used for mashing bread-fruit, and early one calm morning we set forth” ([Christian 1910:176](#)).

Marquesan pounders were also collected by Karl von den Steinen (1855–1929) during his visit to the islands in 1897. While in the Marquesas, he focused on collecting objects, oral traditions, recording imagery, and documenting the significance of the art forms, which he had been studying for many years from his home in Germany. Nearly all of the pounders collected by [von den Steinen \(1928:29, Fig. 8\)](#) appear to be the modern double Tiki-headed form and to have good collection provenance (i.e., find spot location). This form was described as the simpler small eye type by [Linton \(1923\)](#), who also said they were made for the German commercial trading company on Ua Huka, with the exception perhaps being the less embellished forms 8c, 8e, and 8f. There are two unique pounders, 8b and 8d. Poulder 8b is odd because it was found on Ua Pou but is identified as Ua Huka stone.

It is hard to know how von den Steinen could have been sure of this; perhaps he was informed by a Marquesan. In addition, the head on poulder 8b has a human face that looks upwards; [Bouge \(1931\)](#) suggests this form was an introduced foreign style. Likewise, poulder 8d is an odd form. The presence of a mid-ring and the unusual flare at the base is reminiscent of the anthropomorphic poulder from the Caribbean (Taino) (BM Oc. 5321) donated by W.J. Bernhard Smith to the British Museum. However, these two styles (8b and 8d) may be unique to the southern Marquesas where less information about pounders has been documented. Additionally, it is not clear if the pounders pictured by von den Steinen

were collected during his 1897 trip to the Marquesas or if these pounders were acquired for his own personal collection in Germany as part of his studies prior to this expedition.

Linton (1923:340) described “Tiki” pounders as the “highest development of Marquesan stone working.” He considered that the large goggle-eyed tiki, “the rarer type (A) are pre-European, probably had special ceremonial significance, but the local school of carving became extinct” (Linton 1923:340). However, Linton did not associate the Tiki type with a specific island. Likewise, while he spent some time describing the functions of the “infant” and “children’s” poulder types, he did not ascribe them to an island (Linton 1923:341). The “phallic” type was also observed throughout the Marquesas, while the associated “Opu” type was said to be particular to Hiva Oa (Linton 1923:339). Linton (1923:337) was informed that the “modern” pounders were made on Ua Huka and reported that they were mass-produced for a “German trading company.” The Tiki-headed pounders collected by Linton are currently held in the Bernice Pauahi Bishop Museum collections.

Archaeologist Robert Suggs (1961, Table 10) reported excavating 11 pounders on Nuku Hiva in 1957 but noted that they “are rarely found in excavations. The quantity recovered was inadequate for the construction of a completely reliable sequence.” He did separate Linton’s (1923) Tiki-headed type from the phallic type based on “grounds of chronological significance”; the Tiki-headed type was ascribed to the more recent “Historical Period (1790 A.D. on)” and the Phallic form to the preceding “Classic Period (1400–1790 A.D.)” (Suggs 1961:101–102). Suggs (1961:181–187) also questioned Linton’s “Opu” type because his informants had never “heard it used so specifically,” but he decided to continue using the “Opu” type terminology for convenience and considered this the earliest poulder type from the Expansion Period (AD 1100–1400). In fact, Suggs (1961) maintained the terminology of all of Linton’s (1923) poulder types including the eclectic “conical” type category, which he also designated to the Expansion Period. He found eight conical pounders, two with interesting heads: one with a face looking upward and one with a transverse bar marked with medial and terminal ridges (Suggs 1961:102, Fig. 30).

Suggs (1961) did not reference Bouge (1931) or Silverthorne (1936) in relation to the upward face poulder, which they consider an introduced foreign type. Nor did Suggs (1961:102) consider the transverse bar to be from the Cook Islands, despite referencing Buck’s (1927) work and noting similarities in the types. He did, however, consider that the transverse bar poulder resembled Tahitian pounders and therefore agreed with Buck’s theory that this “may indicate some sporadic contact with Tahiti” (Buck 1927:247).

Thor Heyerdahl reported on pounders in a chapter titled “Surface Artifacts” (Heyerdahl 1961). Heyerdahl and Skjölsvold (1965) subsequently wrote about stone pounders from different islands in “Artifacts collected on Certain Islands in Eastern Polynesia” (1965). They described pounders found in the Gambier Islands on Mangareva Island, Rapa Iti, and Raivavae; Austral Islands on Tubuai; Society Islands on Tahiti; Marquesas on Hiva Oa and Nuku Hiva. They collected a variety of pounders, including the common conical, Maupiti, phallic, and Tiki-headed forms. The pounders reported by Heyerdahl (1961) and Heyerdahl and Skjölsvold (1965) are currently incorporated into the Kon Tiki Museum collection in Oslo.

This assemblage of Tiki-headed pounders collected in the eighteenth to twentieth centuries may be examined for change over time. In particular, an important early historical period (eighteenth to nineteenth centuries) assemblage includes the Tiki-headed poulder at the Pitt Rivers Museum (PRM 1884.128.78) that was in the United Kingdom by 1870 (Coote 2015), Voy’s c. 1868 collection at the UPMAA, the one collected in 1896 by F.W. Christian at the British Museum (BM Oc. 1899-161), those collected in 1897 by von den

Steinen (1928), now in the Ethnological Museum in Berlin (Staatliche Museen zu Berlin), and the few found in late-context excavations on Nuku Hiva by Suggs (1961). A 20th century assemblage includes those collected by Linton (1923) now at the Bernice Pauahi Bishop Museum, Honolulu and those collected by Heyerdahl and Skjölsvold (1965), now at the Kon Tiki Museum, Oslo. The pounders in the Pitt Rivers Museum, British Museum, Kon Tiki Museum, and Bishop Museum collections were analyzed with pXRF for this study (Table 2). Other Marquesan poulder forms in early museum collections have been considered further in Richards (2021).

### Object Itineraries for Tiki-Headed *ke'a tuki popoi* (PRM 1884.128.78)

The early colonial exchanges (collector to museum) have been relatively easily identified for the early collection of pounders. Likewise, it may be easily inferred that cross-cultural exchanges (Polynesian to Western collector) occurred *terminus ante quem*, before the museum acquisition; however, more research is required to define the precise nature of those exchanges. Reliable and accurate provenience for an object find spot from a collector is crucial for conducting further research into earlier exchanges. If a museum object has lost its provenience information, additional research may assist to reconstruct it, but this approach is fraught with the problem of provenience equifinality.

Pounders collected in the early colonial period are important for understanding the distributions of a variety of forms at that point in time. Studying pounders with secure provenience best enhances our knowledge of poulder distributions and exchanges. The Tiki-headed *ke'a tuki popoi* (PRM 1884.128.78) in the Pitt Rivers Museum is an exemplar of a form from the early colonial period but has unfortunately lost its provenience information and clearly demonstrates the provenience equifinality problem. Taking an assemblage-based and object itineraries approach contributes some useful information that can help clarify who the likely collectors of this object might have been. This method requires considering the whole class of objects, that is, all pounders collected before 1870, rather than attempting to construct a single “biography” for the Tiki-headed poulder (PRM 1884.128.78). The next section demonstrates the effectiveness of this approach by proposing that W.J. Bernhard Smith (c. 1810–1884), biologist and collector, most likely exchanged the Tiki-headed poulder with Pitt-Rivers in 1869 (Western exchange). This section also explores the possibility that this Tiki-headed poulder may have been collected from Polynesia earlier than the 1860s (Polynesian—Western exchange).

Prominent collector W.J. Bernhard Smith donated 28 objects from India, Africa, the Caribbean, and the Pacific to the British Museum in 1869. This included a Tahitian Maupiti poulder (BM Oc. 5321) and a Caribbean [British West Indies] anthropomorphic poulder (BM Am. 5269).<sup>1</sup> The museum accession card for BM Am. 5269 describes it as a “Stone implement probably for pounding maize found at Petit Trow Is. Of St. Domingo.” The material is identified as “heavy green stone,” and it appears coarse-grained and unpolished. The top of this poulder is phallic-shaped with a human face carved on one side looking slightly upward; the neck of the poulder is thicker and straighter than the flared Polynesian pounders with a ring above the base. Bernhard Smith acquired this poulder from zoologist John Hearne Esq. It is certainly plausible that Bernhard Smith had made a similar exchange with Lane-Fox (later Pitt-Rivers) in 1869 in time for the objects to be on display at the Ethnological Society of London on 25 January 1870. Lane-Fox and Bernhard Smith are often listed as exhibiting objects at the same monthly meetings of local societies, for example, the Anthropological Institute (later Royal), whose reports featured in the



Table 2. Summary of DFA 2 matching Tiki-headed pounders to basalt sources in Marquesas.

| Collector           | Collected/<br>accessioned          | Institution        | Museum no.      | Museum notes               | Find spot | Source<br>match | SqDist<br>(Actual) | Prob<br>(Actual) | -Log<br>(Prob) | Predicted | Prob<br>(Pred) | Others                  |
|---------------------|------------------------------------|--------------------|-----------------|----------------------------|-----------|-----------------|--------------------|------------------|----------------|-----------|----------------|-------------------------|
| Unknown             | By 1870                            | Pitt Rivers Museum | PRM 1884.128.78 | Marquesas (?)              | Ua Huka   | <b>Hiva Oa</b>  | 32.12              | 0.000            | 9.2            | Hiva Oa   | 1.00           |                         |
| F.W. Christian      | 1895–1896                          | British Museum     | BM Oc 1899-161  | Huahuna<br>(Washington Is) | Ua Huka   | <b>Hiva Oa</b>  | 19.21              | 0.005            | 5.3            | Hiva Oa   | 0.76           | North Nuku<br>Hiva 0.23 |
| Unknown             | 1910                               | B.P. Bishop Museum | BPBM 8044       | Taipei Valley,<br>Nukuhiva | Nuku Hiva | <b>Tahuata</b>  | 48.62              | 0.000            | 5.2            | Tahuata   | 0.60           | Hiva Oa 0.36            |
| A. M. McBryde       | 1911                               | B.P. Bishop Museum | BPBM 10.780     | Marquesas                  | Ua Huka   | <b>Tahuata</b>  | 41.21              | 0.005            | 5.3            | Tahuata   | 0.99           |                         |
| R. Linton           | 1921                               | B.P. Bishop Museum | BPBM B.3050     | Marquesas (?)              | Ua Huka   | <b>Hiva Oa</b>  | 13.22              | 0.016            | 4.1            | Hiva Oa   | 0.98           |                         |
| R. Linton           | 1921                               | B.P. Bishop Museum | BPBM B.3040     | Marquesas                  | Ua Huka   | <b>Hiva Oa</b>  | 45.92              | 0.000            | 9.8            | Hiva Oa   | 1.00           |                         |
| R. Linton           | 1921                               | B.P. Bishop Museum | BPBM B.3037     | Marquesas                  | Ua Huka   | <b>Tahuata</b>  | 135.37             | 0.000            | 11.4           | Tahuata   | 1.00           |                         |
| G. Spitz            | 1926–1956<br>(Accession<br>Book C) | B.P. Bishop Museum | BPBM C.476a     | Nuku Hiva,<br>Marquesas    | Nuku Hiva | <b>Hiva Oa</b>  | 56.72              | 0.001            | 7.0            | Hiva Oa   | 0.97           |                         |
| G. P. Wilder        | 1926–1956<br>(Accession<br>Book C) | B.P. Bishop Museum | BPBM C.506      | Marquesas                  | Ua Huka   | <b>Hiva Oa</b>  | 31.00              | 0.137            | 2.0            | Hiva Oa   | 0.51           | Tahuata 0.36            |
| K. P. Emory         | 1931                               | B.P. Bishop Museum | BPBM C.4049     | Marquesas                  | Ua Huka   | <b>Hiva Oa</b>  | 35.94              | 0.002            | 6.2            | Hiva Oa   | 0.98           |                         |
| K. P. Emory         | 1931                               | B.P. Bishop Museum | BPBM C.4050     | Marquesas                  | Ua Huka   | <b>Hiva Oa</b>  | 87.11              | 0.005            | 5.2            | Hiva Oa   | 0.97           |                         |
| K. P. Emory         | 1931                               | B.P. Bishop Museum | BPBM C.4045     | Marquesas                  | Ua Huka   | <b>Hiva Oa</b>  | 44.90              | 0.001            | 7.4            | Hiva Oa   | 0.99           |                         |
| K. P. Emory         | 1931                               | B.P. Bishop Museum | BPBM C.2361     | Marquesas                  | Ua Huka   | <b>Hiva Oa</b>  | 53.51              | 0.001            | 6.7            | Hiva Oa   | 0.98           |                         |
| Unknown             | 1931                               | Musée de Papeete   | MTI 55 (124)    | Marquesas                  | Ua Huka   | <b>Tahuata</b>  | 116.32             | 0.000            | 10.0           | Tahuata   | 1.00           |                         |
| Musée de<br>Papeete | 1939                               | Musée de Papeete   | MTI 123         | Marquesas                  | Ua Huka   | <b>Tahuata</b>  | 96.75              | 0.001            | 7.3            | Tahuata   | 1.00           |                         |
| Musée de<br>Papeete | 1939                               | Musée de Papeete   | MTI 217         | Marquesas Is. (?)          | Ua Huka   | <b>Hiva Oa</b>  | 20.45              | 0.033            | 3.4            | Hiva Oa   | 0.94           |                         |
| T. Heyerdahl        | 1955                               | Kon Tiki Museum    | K-T 2635        | Marquesas                  | Nuku Hiva | <b>Tahuata</b>  | 1041.89            | 0.000            | 276.8          | Tahuata   | 1.00           |                         |
| T. Heyerdahl        | 1955                               | Kon Tiki Museum    | K-T 2633        | Nukuhiva,<br>Marquesas     | Nuku Hiva | <b>Tahuata</b>  | 614.80             | 0.000            | 299.2          | Tahuata   | 0.69           | Hiva Oa 0.26            |

Archaeological Journal (e.g., 1854; 1855; 1863), and the Proceedings of the Society of Antiquaries of London (e.g., 1867). Later, in 1884, Pitt-Rivers acquired 55 lots at a Sotheby's auction, mostly arms and armor, from Bernhard Smith's estate for the founding collections of the Pitt Rivers Museum (Rivière 2011).

Bernhard Smith may have attributed the Tiki-headed pounder (PRM 1884.128.78) to the West Indies, perhaps confusing it with the pounder he donated to the British Museum. Another plausible alternative is that the person from whom he had previously exchanged these objects made the attribution mistakes. There are occasional instances in the British Museum collections where objects have strange or confused histories. Jill Hasell (2004), curator of the Oceanic collections at the British Museum, identified interesting correspondence from F. Godsell, a descendant of T. Godsell, second mate on the Duff. This letter stated that the wooden *rongorongo* tablet (Oc1903,-.150) from Rapa Nui was found "near the ruins of Pompei[i] and Mount Vesuvius." Yet the tablet was certainly from Rapa Nui as subsequent studies of the table identified the *rongorongo* script and the wood is Oceanic rosewood, *Thespesia populnea* (Fischer 1997; Parkinson 1999; Orliac 2005).

Identifying Bernhard Smith as the likely source of the Tiki-headed pounder in 1869 (PRM 1884.128.78), however, does not provide any new information about its original field collection from Polynesia. Importantly, the assumption that the Tiki-headed pounder (PRM 1884.128.78) was collected directly from the Marquesas, brought straight to England then purchased by Bernhard Smith is limiting. First, this assumption ignores the prospect of local Polynesian exchanges between the Marquesas and Society Islands. Second, this assumption neglects the exchanges of traditional objects occurring between the European (e.g., French and Spanish) exploration and merchant ships that were trading various commodities, including ethnographic objects, in the region. Twelve European ships had visited the Marquesas by 1800; by 1820 there had been 75 ships, which had increased in 1840 to 259 ships and by the end of 1842, 320 ships in total had visited the Marquesas (Denning 1980:296–300). If the possibility that the Tiki-headed pounder could have been collected in Tahiti is also considered, the number of potential ships increases almost exponentially because Tahiti was a popular merchant ship harbor from the 1760s onwards.

The Tiki-headed pounder (PRM 1884.128.78) is a useful example to explore the historical context in which ethnographic collections were made as part of European colonial processes that began at the end of the eighteenth century. To achieve this, possibilities around the original collection of this Tiki-headed pounder are considered in scenarios related to three notable early voyages by Cook (*Resolution* 1774), Captain George Vancouver (1757–1798) (*Discovery* 1791), and Captain William Bligh (1754–1817) (*Bounty* 1789 and *Providence* 1791). Evidence that these individuals or their crew may have collected the Tiki-headed pounder was located in the collection publications and in museum collection accession notes. Finding evidence of this early collection would push the suspected acquisition date from 1869 back by almost a century to somewhere between 1774 and 1791.

Cook made his first voyage to the Marquesas in 1774 aboard the *Resolution*. It is possible one of the ship's company collected the Tiki-headed pounder during this voyage. This is especially plausible as Cook had given his crew permission to individually barter for goods ashore while anchored at Vaitahu Bay, Santa Christina (Tahuata) (8–11 April 1774) (Beaglehole 1969:373–375; Thomas 1991:28). There are 25 Marquesan objects collected by the Forsters from the *Resolution* in the Pitt Rivers Museum, including the Tahitian pounders described above. However, as Coote (2015), Thomas et al. (2017), Kaeppler (1972, 1976), and Whitehead (1969) have explored, correctly identifying and locating the

objects from Cook's voyages is not a straightforward task. Over a dozen Marquesan objects in the Pitt Rivers Museum were accessioned at around the same time but are missing information about how and where they were collected; this includes the Tiki-headed poulder (PRM 1884.128.78).

George Humphrey (1739–1826), naturalist, auctioneer, art and ethnographic dealer, and brother-in-law of George Forster, emerges as someone who may have acquired the Tiki-headed poulder from the *Resolution*. Humphrey was an avid shell collector (conchologist) and dealer in natural history (Whitehead 1969). He was known to have bought the bulk of shells from the *Resolution* when it docked after the second voyage, where “curiosities” were also sold to the highest bidders and consequently may have also amassed a large stock of Cook voyage objects (Whitehead 1969:172). In 1779, Humphrey's creditors forced him to sell his personal Museum Humfredianum collection and afterwards he became a dealer (Kaeppler 1972:199; Patterson 1779). Private collector Sir Ashton Lever (1729–1788) is another notable suspect, having acquired a larger collection of Cook voyage objects than the British Museum. Like Humphrey, Lever was also unable to support his Leverian Museum financially. By 1785 James Parkinson had acquired the Leverian collection but in turn was forced to sell it by auction in 1806. In both cases, this resulted in the wide dispersal of the Cook voyage objects. Many of the objects were initially placed in a later museum started in c. 1795 by collector William Bullock (c. 1773–1849), but he decided to sell his collection in 1819. W.J. Bernhard Smith, or Pitt-Rivers for that matter, could have purchased the Tiki-headed poulder at any one of the subsequent auctions of these objects, but unfortunately, because many of the ethnographic objects were inadequately described or documented, it is difficult to trace any such transaction.

The next scenario examines the possibility that the Tiki-headed poulder (PRM 1884.128.78) was collected in association with the voyage of Vancouver aboard the HMS *Discovery* (1791–1795). Vancouver was well known for his ethnological collections, although much of the associated documentation from the *Discovery* was regrettably lost (King 1994). Also lost were the details for the collections made by his crew members Joseph Barker, Edward Bell, William Broughton, Thomas Manby, Peter Puget, and Joseph Whidbey (King 1994:35). Surgeons Archibald Menzies (1754–1842) and George Goodman Hewett (1765–1834) were also collectors aboard the HMS *Discovery* with Vancouver. Hewett and Menzies collected many objects that are now in the British Museum, although not all can be identified; Hewett notably collected a Maupiti poulder from Tahiti (BM Oc,VAN.356). Further, Vancouver had sailed with Cook on his second voyage on the *Discovery* that stopped at the Marquesas, but unfortunately all details of Vancouver's personal collection have been lost.

In 1891, A.W. Franks (1826–1897) was able to purchase part of Hewett's collection from his daughter-in-law, including part of Hewett's written inventory (King 1994; Hasell 2004). Although incomplete, Hewett's inventory contained four entries for items from the Marquesas (King 1994:50–51): a head ornament (BM Oc,VAN.399), a neck decoration (BM. Oc,1983,Q.15), an ear decoration (BM Oc,VAN.400), and a fish hook (unidentified in the BM, McKinney 2012). Importantly, this shows that Vancouver, Hewett, and Menzies acquired a few Marquesan objects through various exchanges with those with whom they had congenial relationships in the region, including the Spanish. McKinney (2012:55) identified that because neither the *Discovery* nor its companion ship Chatham ever called at the Marquesas, the Marquesan objects were most likely acquired through a transaction with the crew from the *Daedalus* that had visited Nuku Hiva and Tahuata in 1792. The *Daedalus*

was captured by Richard Hergest (1754–1792) who also sailed on Cook’s *Resolution* and *Discovery* voyages with Vancouver.

The third and final scenario considers the possibility that the Tiki-headed pounder’s (PRM 1884.128.78) West Indies attribution might be explained by William Bligh’s breadfruit voyages aboard the HMS *Bounty* (1789) or HMS *Providence* (1791). Bligh, who had sailed with Cook on his third voyage to the Pacific, could have been the collector of the Tiki-headed pounder, or it could have been collected by someone travelling with him on one of his breadfruit voyages. Importantly, Bligh’s association with the pounder could also explain the West Indies misattribution. Prior to his breadfruit voyages, Bligh had resided in the West Indies with the merchant Duncan Campbell (1726–1803). Bligh’s connection to Campbell was significant; in 1781 Bligh married Campbell’s niece Elisabeth Betham and from 1784 Bligh regularly sailed on Campbell’s ships to Jamaica. Further, Campbell sold the ship *Bethia* to the Royal Navy in 1784; it was refitted and became the *Bounty*.

The breadfruit voyages had the objective of bringing the breadfruit plant to the British West Indies to cultivate in the colonies as a staple food crop and cheaply feed the slaves working on the sugar cane plantations. Bligh’s first breadfruit voyage famously failed with the mutiny aboard the *Bounty*, led by Fletcher Christian (1764–1793) and fuelled by many of the crew who had developed relationships with Tahitian women during their four-month stay on Tahiti (Henderson 1983). After setting Bligh and his loyalists adrift on boats, Christian and the 18 mutineers returned to Tahiti in March 1789. Later in September 1789, a smaller group of eight crew and some Tahitians set sail with Christian and eventually arrived on uninhabited Pitcairn Island. However, Pitcairn had not always been uninhabited and was noted for the quantity of “adzes, pounders and other implements dug from the [Pitcairn] plateau” since the time of settlement by the mutineers of the *Bounty* (Emory 1928:125; also see Molle & Hermann 2018).

The British Museum has a pounder (BM Oc1903,1116.12)<sup>2</sup> collected from Pitcairn Island that is associated with the *Bounty* mutineers. It is a typical Marquesan phallic pounder. As the *Bounty* never travelled to the Marquesas, this pounder likely represents evidence of local Polynesian exchanges between the Marquesas and Society Islands during the historic period. The pounder probably belonged to one of the Tahitian women who ran away with the mutineers and would have continued to be used to process food during the time the mutineers lived on Pitcairn. An old museum label affixed to the object identifies that the pounder was used for “corn mulling.” Francis Brent Esq. (1816–1903), marine zoologist, collector, and Fellow of the Society of Antiquaries, bequeathed this pounder to the museum, along with another 200-odd objects from his global collection, but it is not clear where the pounder had been between 1800 and 1903. There are another 10 objects in the British Museum associated with the *Bounty* mutineers from various collectors: a brass candlestick (said to have been used as a pounder) (BM Oc1981,Q.1643), half a dozen barkcloths made by the mutineers on Pitcairn (e.g., BM Oc1855,1220.173 a-b), a barkcloth beater (BM Oc1931,1010.1), and two stone axes (BM Oc1904,0701.3 and Oc1904,0701.2). No objects listed in the Pitt Rivers Museum online catalog specify that they are associated with the *Bounty* mutineers.

In 1791, Bligh resumed his breadfruit voyages aboard the *Providence*, and the *Pandora* was dispatched to capture and return the *Bounty* mutineers. Bligh was escorted by the Assistant under Captain Nathaniel Portlock (c. 1748–1817), a maritime fur trader and author who had also sailed with Cook. In contrast to his first voyage, Bligh’s second breadfruit voyage was a success. He managed to cultivate breadfruit plants and bring them to the West Indies. Salmond (2011) detailed the daily cultural exchanges Bligh and his crew

undertook with the Tahitian people, including numerous gift exchanges. Importantly, Cook and Bligh were received fondly and these negotiated cross-cultural engagements likely served Tahitian chiefly aggrandizing goals as much as they fulfilled Bligh's objectives. However, these interactions also had impacts and changed the local chiefly social structures and thus had lasting implications in the lead up to French colonization (Danielsson 1988).

The *Pandora* was dispatched with a clear objective to capture the *Bounty* mutineers and return them home for trial and punishment. They managed to capture 10 mutineers in Tahiti. However, the *Pandora* failed to locate the *Bounty* hidden at Pitcairn Island and on her return journey ran aground on the Great Barrier Reef 140km east of Cape York, Australia, and sank. Although 89 of the 91 crew and the 10 captured mutineers survived, the majority of objects aboard the ship could not be salvaged and it is therefore unlikely that the Tiki-headed pounder (PRM 1884.128.78) was saved during this event. Although collecting was not a stated objective of the *Pandora*'s voyage, Polynesian objects were excavated from the wreck (Gesner 2000; Illidge 2002:70); they are now at the Museum of Tropical Queensland, Australia.

By taking an object itineraries approach to contextualize the historical trends associated with the exchanges and collection of stone pounders from Polynesia, it becomes possible to consider the wider possibilities that the Tiki-headed pounder (PRM 1884.128.78) might have been collected very early on, in the 1790s. It also illustrates that pounders could be confused and mistaken in exchanges between European collectors, as were many objects, and this was likely also the case for stone adzes collected at this time. This case study further demonstrates the difficulty in investigating the agent group that includes middlemen, brokers, and auction houses (Byrne et al. 2011). Examining these early collections of pounders is important because it shows that Englishmen did not only acquire these objects as "fashionable curios" of the time, but that Tahitians also chose to engage in these cross-cultural exchanges to fulfill their own purposes (Richards & Günther 2019). However, early collections are still significant for identifying that not all classes of traditional Polynesian objects were exchanged, but rather some were withheld. Notably, there are no pounders in the Russian Krusenstern collection from 1804 despite the many cross-cultural interactions (Govor 2010; Govor & Thomas 2019). Yet later, in the early twentieth century, as a result of Western trade demands, pounders increased in production and entered museum collections as European colonies were established in the Pacific. This poses an important question to be addressed in a pXRF geochemical analysis: do pounders collected between 1769 and 1850 compare typologically and geochemically with pounders collected after 1850? Identifying changes in stone pounder production over time can help to characterize the nature of cross-cultural interactions between Polynesians and Westerners during the historical period. This may be especially useful for understanding how Polynesian people maintained or persisted with certain traditional practices, or not, after European colonization (e.g., Silliman 2009).

## Discussion of Historical Sources

The sources for much of Linton's (1923:377) and E.S.C. Handy's (1923) information on pounders came from "local informants," especially in relation to the manufacture and daily use of these objects. However, these informants were not always local Marquesan people, but often Westerners who had been living in the Marquesas. Linton (1923:270) acknowledged and thanked "many European residents in the Marquesas" who had hosted him and likely acted as interpreters. However, Linton has been faulted for not keeping

detailed field notes and relying on “informal ethnographic observations” (Denning 1980:280; Ivory 1993:66). In fact, there are no field notes from Linton held in the Bernice Pauahi Bishop Museum archives, only his expedition photographs, which he acknowledged having “received from various sources” (Linton 1923:270). Still, in relation to pounder stone sources, Linton (1923:337) provided the most information,

[i]n ancient times [pounders] appear to have been manufactured to some extent in all the valleys but even in prehistoric days the superiority of the stone found in Ua Pou and Ua Huka had led to a localization of the industry. The finished implements were traded from these islands to the rest of the group.

Linton also included a quote from an informant about where pounder stone was obtained:

For the pounders three varieties of stone were formerly used, all of which appear to have been rather soft, even grained magmatic rocks. The best grade was called *ovao*, a grey rock fine grained, strong and light. The second best was called *puhite'a*, and the third best *patako*. All these varieties are said to have been obtained from the high part of the island laying to the east of the valley of *Hokatu*, but as bowlders [sic] in two other valleys were pointed out as good pounder stone, it is probable that the deposits were rather wide spread. The stone does not appear to have been regularly quarried, but was obtained from rock slides and stream beds. (Linton 1923:337)

It could also be expected that both von den Steinen and Linton would have consulted the published eighteenth to nineteenth century European accounts from the Marquesas, including those of Edward Robarts, William Pascoe Crook, Joseph Kabris, Adam Johann von Krusenstern, and Georg von Langsdorff (Terrell 1982). Handy and Linton’s accounts have also been criticized for describing Marquesan culture as virtually unchanging and therefore still maintaining many “ancient” traits, despite the fact that, as described below, there had been profound changes since Western contact (e.g., Ivory 1993; 2011).

Ivory (1993:66) emphasized that by the time the Bayard Dominick Expedition visited the Marquesas in 1920, over a century had passed since first European contact. There had been “decades of sandalwood trade, whalers, military expeditions and disease,” plus the enactment of French colonial laws “forbidding . . . tattooing, funeral rituals, dancing, feasting and other ceremonial activities”; consequently, “even the oldest of his informants could not have witnessed Marquesan culture unadulterated by extensive Western contact.” The specific historical context complicates how the negotiated cross-cultural exchange of pounders between the Marquesan people and Linton took place. Next to many of the pounder entries in the Bishop Museum Accession Book B, it is recorded that, “This was supposedly collected on the Dominick Expedition (1920–21) but the letter from S.E. Ball mentions it being purchased by Linton from E. Bloch.” E. Bloch Mercantile Co. were importers and exporters with a store known as “The House of Novelties” at 241–243 Market Street, San Francisco.

It appears very likely that both von den Steinen and Linton obtained pounders from the Western “curio” market for their personal studies prior to, or perhaps even after, visiting the Marquesas. The reliance on accounts from European and “modern day” informants, plus the relative ease of purchasing Polynesian objects from the twentieth century “curio” market, thus brings into question the accuracy of historical accounts relating to the pounders collected by von den Steinen, Handy, and Linton for understanding the

geographic distribution (production) of Marquesan pounder forms. It would therefore be more productive to investigate what types of exchanges (i.e., Western—Western) are visible in their pounder collections. A geochemical study to match the pounder basalts to their geological sources may shed light on the origin of the stone and help to verify these historical accounts. Geochemical sourcing can provide more information about the pounder production and distribution networks in the Marquesas (i.e., stone source to find spot) and what relationships exist between pounder forms and stone sources.

## pXRF Method

This geochemical study analyzed 18 Tiki-headed pounders collected from the Marquesas with a Bruker Tracer III-SD portable EDXRF (pXRF) analyzer (see [Richards 2021](#)). Each pounder was analyzed three times on different surface areas, and the results were averaged. The reference data (training data) are from the GEOROC database and previous archaeological studies in the Marquesas (pXRF and WDXRF) ([McAlister & Allen 2017](#)) (Table S1). Recent studies have shown that pXRF can achieve a similar measurement precision as EDXRF and WDXRF, for the elements calcium to niobium, when the instruments are cross-checked and calibrated with standard reference materials (SRM) (see [McAlister & Allen 2017](#); [Reith et al. 2013](#); [Steiner et al. 2017](#)). The Bruker Tracer III-SD used in this study was calibrated with 30 SRM and six in-house reference materials (see [Richards 2021](#)).

Care was taken to analyze the pounders on flat, clean surfaces that appeared not to have been affected by surface weathering. Surface weathering often alters archaeological basalts, especially by the build-up of surface carbonates, which can affect the accuracy of light element measurements for nondestructive analyses ([Lundblad et al. 2008](#)). Surface carbonates may be removed by washing with a hydrochloric acid (HCl) solution (e.g., [Charleux et al. 2014](#)), however, this was not possible in the museum collections for the pounders included in this study. However, the Pearce W-F diagram chosen for the first step of this analysis, to identify and group the rock types, uses immobile elements (i.e., those not affected by weathering) zirconium, titanium, yttrium, and niobium ([Pearce 1996](#); [Winchester & Floyd 1977](#); [Richards 2019a](#)).

For the second stage of the geochemical study, discriminant function analysis (DFA) in JMP<sup>®</sup> was chosen to analyze the calibrated pXRF data with the geological source datasets (training data). DFA predicts a classification (island group) variable (basalt elemental concentration) based on known continuous responses (training data). DFA has successfully matched archaeological basalts from the Marquesas ([McAlister & Allen 2017](#)), Tonga and Samoa ([Clark et al. 2014](#)), Pitcairn, Gambier Islands and Marquesas ([Richards 2019b](#)), and Papua New Guinea ([Pengilley et al. 2019](#)) to geological sources using calibrated pXRF data.

## pXRF Results

The Marquesan pounders plot between the alkali basalt to foidite range on the Pearce W-F diagram ([Figure 1](#)). Of the 134 pounders examined by [Richards \(2021\)](#) and the 18 Tiki-headed pounders included in this study, the majority of pounders are made of alkali basalts ( $n = 122$ ), 10 are foidite, one is subalkaline basalt, and one is basaltic andesite. This result contrasts to the Marquesan adzes examined in [Richards \(2021\)](#), which clustered together in two groups in the alkali basalt range on the diagram. This result suggests that the pounders

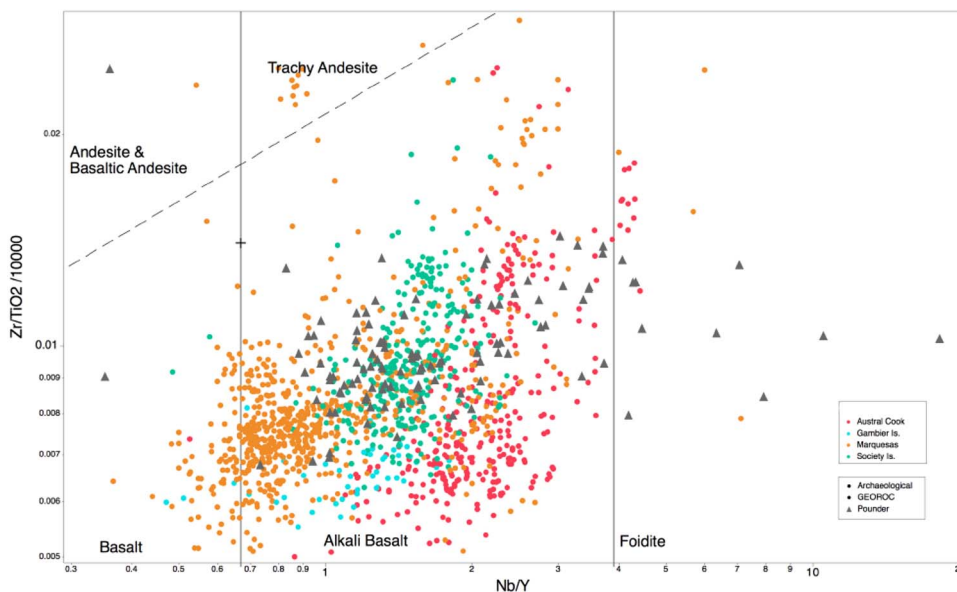


Figure 1. All the Marquesan pounders (grey triangles) analyzed in this study on the Pearce W-F diagram with the GEOROC and archaeological reference data (colored circles) from the Austral Islands, Cook Islands, Gambier Islands, Marquesas, and Society Islands (GEOROC database; [Sinton & Sinoto 1997](#); [Kahn et al. 2013](#); [Rolett et al. 2015](#); [McAlister & Allen 2017](#)).

were made of basaltic rock that was more opportunistically obtained from the landscape, rather than from quarry sources like the adzes. Fine-grained basalt is required for adzes, while a pounder may be made from a suitably large piece of rock, which may even be vesicular (porous). When all the pounders are plotted by type on the Pearce W-F diagram ([Figure 1](#)) there is no clear overall pattern observed. There appears to be a slight separation of the alkali basalt group at  $Nb/Y = 2$ , however, all the pounder types are present in both groups (less than 2 and greater than 2) ([Figure 1](#)).

## Tiki-Headed Pounders

The distinctive Marquesan Tiki-headed pounders are examined further with DFA to match them to islands within the Marquesas group. DFA 1 shows that all the Tiki-headed pounders match the Marquesas reference samples ([Figure 2](#)). Further analyses are required to (1) differentiate the basalts from islands within the Marquesas, (2) compare the poulder basalt source locations for those pounders that were accessioned into museum collections prior to or during the 20th century, and (3) determine if pounders were mass-produced on Ua Huka (from local basalt) for Western traders. Compared to the Society Islands basalt sources, there is much greater potential to explore and discriminate the Marquesan basalt sources. This is due to the fact that the Marquesan sources have been archaeologically surveyed on Eiao and Nuku Hiva (e.g., [Rolett et al. 1997](#); [McAlister 2011](#); [Charleux et al. 2014](#); [McAlister & Allen 2017](#)) and there are more samples and elemental values from the other Marquesan islands available in the GEOROC database.





Figure 2. DFA 1 canonical plot showing the separation of the Austral-Cook Islands, Gambier Islands, Marquesas, and Society Islands reference data and the identification of the Tiki-headed pounders as matching the Marquesas group.

Figure S1 shows the Tiki-headed pounders on the biplot of Sr/Nb with the geological data from [McAlister and Allen's \(2017\)](#) study. Notably, the pounders do not plot with the Eiao Group I, Henua Ataha, or Northeast Nuku Hiva samples, all of which were collected from adze quarries. Figure S2 shows the Tiki-headed pounders with the GEOROC samples from the other Marquesas islands included on the Sr/Nb biplot. The pounders group with both northern and southern Marquesan islands in the Sr/Nb biplot. There is a slight separation of the northern Marquesan islands and the southern islands observable on the Sr/Nb biplot shown in Figure S3. However, this separation is slightly improved on the Pearce W-F diagram where the northern island samples tend to be <1.2 Nb/Y less alkaline (Figure 3 and Figure 4). There is still overlap in the Pearce W-F diagram southern island samples that also plot <1.2 Nb/Y. Figure 3 shows that the Tiki-headed pounders are all ≥1.2 Nb/Y compared to the other types of Marquesan pounders, suggesting that they were not made from basalts from Eiao or Nuku Hiva. Similarly, Figure 3 also suggests that

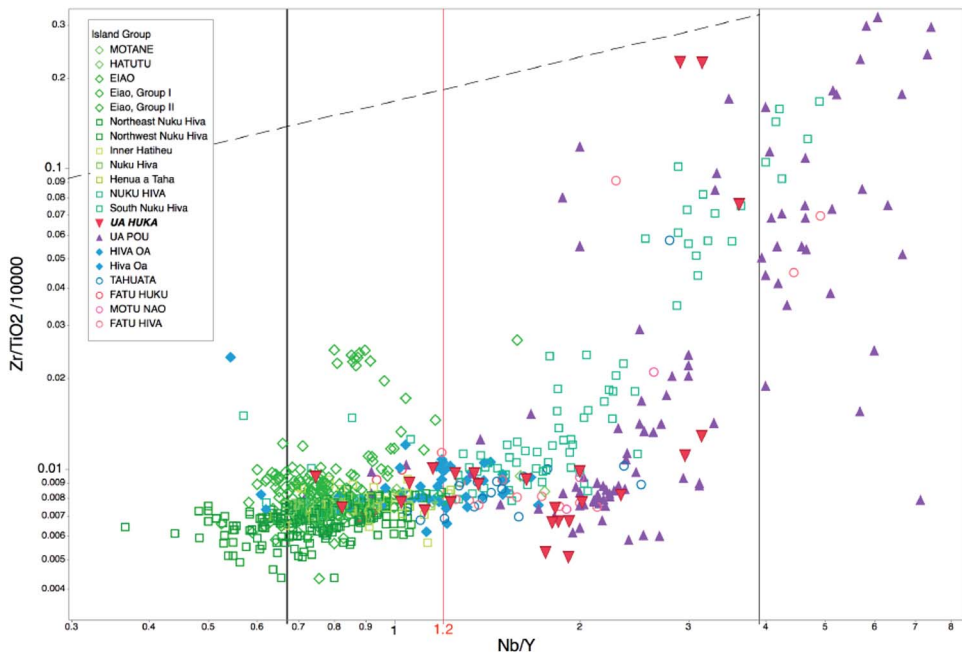


Figure 3. Pearce W-F diagram showing the archaeological GEOROC data with Ua Huka, Ua Pou, and Hiva Oa emphasized (solid red, purple, and blue shapes). There is improved clustering of the Ua Huka, Ua Pou, and Hiva Oa samples compared to Sr/Nb biplot (Figure S3). The Nuka Hiva samples do not plot above Nb/Y > 1.2 (see Figure 4).

only a few pounder types may be made of northern Nuku Hiva basalts, such as those identified by [Linton \(1923\)](#): the Opu, Phallic, and Salt types.

DFA 2 was run with [McAlister and Allen's \(2017\)](#) reference data and additional GEOROC data from the southern islands: Ua Pou, Ua Huka, Hiva Oa, and Tahuata. The elements available for this DFA were CaO, TiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3T</sub>, MnO<sub>2</sub>, Zn, Rb, Sr, Zr, Nb, and Y. [Figure 5](#) shows that there was a misclassification of 13% of the training data and a R<sup>2</sup> of 0.52. However, it does also show a separation of the northern Marquesan islands and the southern islands; Hiva Oa is the only southern island to show an overlap with the northern islands. All of the Tiki-headed pounders were matched to southern Marquesan islands, specifically Tahuata and Hiva Oa ([Figure 5](#); [Table 3](#) and [Table 4](#)). Interestingly, these results do not corroborate the historical accounts recorded by [Linton \(1923:377\)](#) that claimed “superior” pounder stone was obtained from Ua Pou and Ua Huka.

## Other Marquesan Pounder Forms

Other Marquesan pounder forms (Opu, Phallic, Salt, Children/Infant, Modern, blanks, and others) were also examined by [Richards \(2021\)](#) and did not support the hypothesis that Ua Huka basalts were used to mass produce pounders (Table S1). Overall, the majority of other pounder forms matched the basalts from Hiva Oa ( $n = 33$ ) and Tahuata ( $n = 21$ ), but in contrast to the Tiki-headed pounders, several other islands also were represented, including Ua Pou ( $n = 18$ ), North Nuku Hiva ( $n = 17$ ), South Nuku Hiva ( $n = 6$ ), and Eiao ( $n = 1$ ). Notably, no Modern pounder forms were matched to Ua Huka, Tahuata, or South Nuku



Figure 4. Map of the Marquesas islands with a red dotted line indicating the 1.2 Nb/Y value on the Pearce W-F diagram (see Figure 3) (base map from McAlister 2011).

Hiva. These preliminary results indicate that the Ua Huka basalts were not favored for producing any of the poulder forms and identified that the poulder blanks found on Ua Huka were imported. Further geochemical characterization of archaeological basalts on Ua Huka is important for confirming this result in future research.

## Discussion: Marquesan Poulder Exchange

The pounders examined here are from the late pre-Contact and early post-Contact period (1869–1955), as opposed to excavated from earlier contexts. Therefore, these results could support ideas about Western traders altering traditional distribution networks. Significantly, the results identified that Tiki-headed pounders were only made from Hiva Oa and Tahuata basalts, which suggests the highly skilled and specialized carving of Tiki-headed pounders may have been a localized activity or at least restricted to these specific basalts. Notably, matching the Tiki-headed pounders to the Hiva Oa and Tahuata basalts does not confirm the historical accounts given by Linton (1923) about the “superior” poulder stone from Ua Pou and Ua Huka. While only 18 Tiki-headed pounders have been studied here (see Tables 3 and 4) the results show that the smaller eye Tiki-headed pounders ( $n = 4$ ) are only made with the Tahuata basalt while the big goggle-eyes ( $n = 14$ ) are more frequently made with Hiva Oa basalt ( $n = 11$ ) than from Tahuata basalt ( $n = 3$ ). These results indicate the

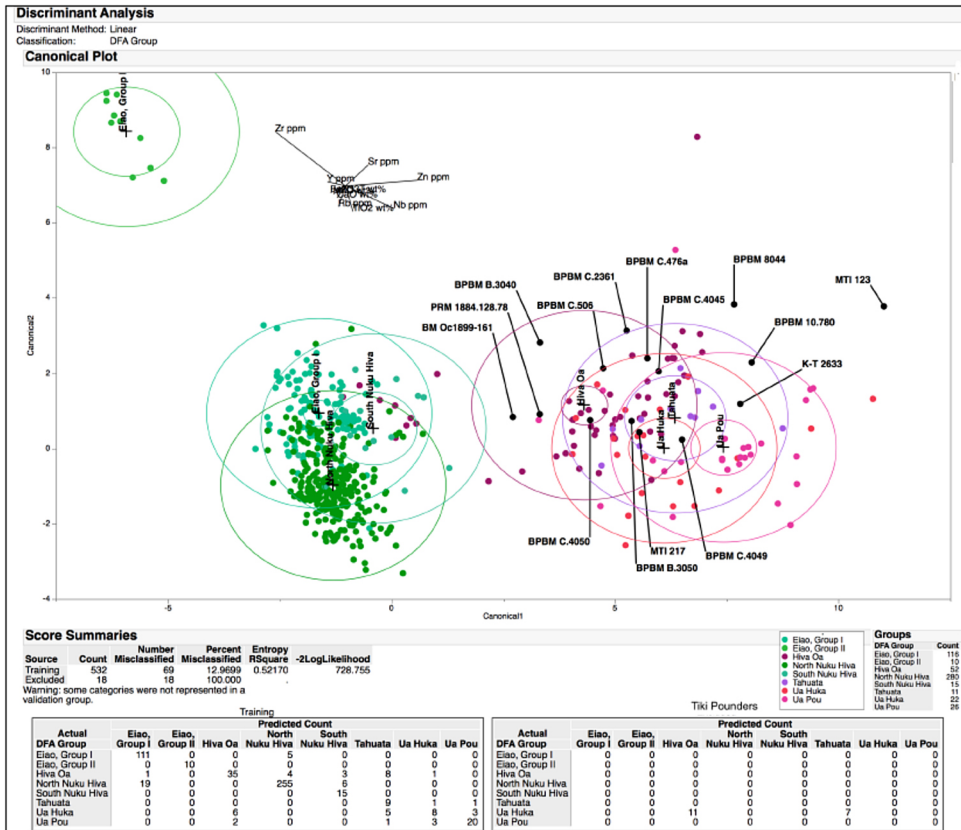


Figure 5. DFA 2 Tiki pounders matched to Marquesan islands basalt sources (see Table 1).




Tahuata basalt source is where the smaller eye style emerged within the localized production of Tiki-headed pounders. Interestingly, if Linton’s assertion that the goggle-eye form is indeed ancient and the smaller-eye form is modern, this might suggest Hiva Oa was the original basalt source for Tiki-headed pounder production, but this requires further archaeological investigation.

Further, these results do not show a marked change in production of Tiki-headed pounders from late pre-Contact to early post-Contact times. Tiki-headed pounders collected between 1769 and 1850 and those collected from 1850 to 1950 are all made of Hiva Oa and Tahuata basalts. Interestingly, there is no evidence for a change to the use of Ua Huka basalt for mass production of this style of pounder. In fact, these results did not identify any pounder forms made of Ua Huka basalts (Figures 3 and 4). These results therefore suggest that if pounders were being made on Ua Huka, this was done with basalts that were being imported to the island from Hiva Oa, Tahuata, Ua Pou, and Nuku Hiva.

### Tiki-Headed Pounder PRM 1884.128.78

Given that the Pitt Rivers Museum holds such a large collection from the *Resolution* voyage, it does seem most likely that the Tiki-headed pounder PRM 1884.128.78 was one

Table 3. Tiki-headed Pounders matched to Hiva Oa in DFA (BM = British Museum; PRM = Pitt Rivers Museum; BPBM = Bishop Museum; MTI = Musée de Tahiti et des Îles).

|  |   |   |  |  |   |
|--|---|---|--|--|---|
| <br>Museum No: <b>BM Oc1899-161</b><br>Collector: F.W. Christian<br>Date: 1895-96<br>Find Spot: Ua Huka<br>DFA Match: Hiva Oa | <br>Museum No: <b>PRM 1884.128.78</b><br>Collector: Unknown<br>Date: By 1870<br>Find Spot: Marquesas<br>DFA Match: Hiva Oa | <br>Museum No: <b>BPBM C.476a</b><br>Collector: George Spitz<br>Date: C Book (1926-1950)<br>Find Spot: Marquesas<br>DFA Match: Hiva Oa | <br>Museum No: <b>BPBM C.506</b><br>Collector: Geritt P. Wilder<br>Date: C Book (1926-1950)<br>Find Spot: Marquesas<br>DFA Match: Hiva Oa | <br>Museum No: <b>BPBM C.4049</b><br>Collector: K. P. Emory<br>Date: 1931<br>Find Spot: Marquesas<br>DFA Match: Hiva Oa | <br>Museum No: <b>BPBM C.4050</b><br>Collector: K. P. Emory<br>Date: 1931<br>Find Spot: Marquesas<br>DFA Match: Hiva Oa |
| <br>Museum No: <b>BPBM C.4045</b><br>Collector: K.P. Emory<br>Date: 1931<br>Find Spot: Marquesas<br>DFA Match: Hiva Oa        | <br>Museum No: <b>BPBM C.2361</b><br>Collector: K.P. Emory<br>Date: 1931<br>Find Spot: Marquesas<br>DFA Match: Hiva Oa     | <br>Museum No: <b>MTI 217</b><br>Collector: Unknown<br>Date: 1939<br>Find Spot: Marquesas<br>DFA Match: Hiva Oa                        | <br>Museum No: <b>BPBM B.3050</b><br>Collector: R. Linton<br>Date: 1921<br>Find Spot: Marquesas<br>DFA Match: Hiva Oa                     | <br>Museum No: <b>BPBM B.3040</b><br>Collector: R. Linton<br>Date: 1921<br>Find Spot: Marquesas<br>DFA Match: Hiva Oa   |   |

of the examples of fine carving acquired during the brief Western–Polynesian cross-cultural exchanges at Tahuata between 10 and 11 April 1774. Sourcing the Tiki-headed pounder PRM 1884.128.78 to Hiva Oa may support the hypothesis that this pounder was collected during the *Resolution* voyage while anchored at the neighboring island of Tahuata for three days. Cook wrote in his journal about how the crew had made exchanges for many Marquesan souvenirs, including examples of fine carvings, the best he had observed in Polynesia, before all exchanges were stopped after some highly prized red feathers from Tonga were exchanged for a pig (Beaglehole 1969:369). However, these results also provide evidence that Tiki-headed pounders were exchanged to other Marquesan islands. For instance, Tiki-headed pounder BM Oc1899-161 and Phallic pounder BM Oc1899-162, both of which were source matched to Hiva Oa, were recorded by F.W. Christian among his belongings on Ua Huka in 1896 (Christian 1910:176; Richards 2017). The British Museum accession book and object labels also cite “Huahuna (Washington Is.)” [Ua Huka] as the place of collection. It should also be noted that Christian traveled to Tahuata and Hiva Oa before he visited Ua Huka and had received passage aboard local canoes between some of the Marquesas Islands when the *La Corse* was not available (Christian 1910:175).

## Conclusion

Potential source locations in the southern Marquesas Islands have been identified for the Marquesan pounders examined in this study. These results also reveal Marquesan intra-archipelago exchanges as well as provide insights into Marquesan-Western exchanges beginning in the early post-Contact period. This sourcing study could not conclusively detect the inter-archipelago exchanges of pounders. However, the possibility that

Table 4. Tiki-headed Pounders matched to Tahuata (BPBM = Bishop Museum; MTI = Musée de Tahiti et des Îles; K-T = Kon Tiki Museum).

|   |  |  |  |
|---|--|--|--|
|    |   |   |    |
| <p>Museum No: <b>BPBM 10780</b><br/> Collector: Alexander McBryde<br/> Date: 1911<br/> Find Spot: Marquesas<br/> DFA Match: Tahuata</p> | <p>Museum No: <b>MTI 123</b><br/> Collector: Unknown<br/> Date: 1939<br/> Find Spot: Marquesas<br/> DFA Match: Tahuata</p>   | <p>Museum No: <b>BPBM B.3037</b><br/> Collector: R. Linton<br/> Date: 1921<br/> Find Spot: Marquesas<br/> DFA Match: Tahuata</p> | <p>Museum No: <b>K-T 2635</b><br/> Collector: T. Heyerdahl<br/> Date: 1955<br/> Find Spot: Nuku Hiva<br/> DFA Match: Tahuata</p> |
|   |    |    |  |
| <p>Museum No: <b>K-T 2633</b><br/> Collector: T. Heyerdahl<br/> Date: 1955<br/> Find Spot: Nuku Hiva<br/> DFA Match: Tahuata</p>        | <p>Museum No: <b>BPBM 8044</b><br/> Collector: Unknown<br/> Date: 1910<br/> Find Spot: Marquesas<br/> DFA Match: Tahuata</p> | <p>Museum No: <b>MTI 55 (124)</b><br/> Collector: Unknown<br/> Date: 1931<br/> Find Spot: Marquesas<br/> DFA Match: Tahuata</p>  |  |

Marquesan basalt was imported to the Society Islands as blanks is worth exploring in future research. This study has indicated that Marquesan pounders were not crafted from quarried basalts, which contrasts with recent adze sourcing results (Richards 2021). Lastly, although historical and archival research was conducted, identifying some poulder exchanges has been restricted because the find-spot and collection provenience information remains limited for many of these pounders. Overall, the stone poulder industries in the Marquesas and Society Islands saw the movement of basalt between islands at a local scale and were active during the late pre-Contact period and persisted through the early post-Contact period after Western colonization. There is still great potential to investigate the impacts of colonialism in the region by understanding the Polynesian and Western exchanges of pounders, especially when the proveniences are known.

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## Notes

1. [https://www.britishmuseum.org/collection/object/E\\_Am-5269](https://www.britishmuseum.org/collection/object/E_Am-5269)
2. [https://www.britishmuseum.org/collection/object/E\\_Oc1903-1116-12](https://www.britishmuseum.org/collection/object/E_Oc1903-1116-12)

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