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Does Carneiro's circumscription theory help us understand Maori history? An analysis of the obsidian assemblage from Pouerua Pa, New Zealand (Aotearoa)

Mark D. McCoy [a,*], Thegn N. Ladefoged [b], Maria Codlin [a], Douglas G. Sutton [b]

[a] University of Otago, Department of Anthropology & Archaeology, P.O. Box 56, Dunedin 9054, New Zealand
[b] University of Auckland, New Zealand

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ABSTRACT

Circumscription theory, originally proposed to explain the rise of state society, is appealing in that it gives us an elegant, straightforward way to account for warfare among farming communities in the transition to complex societies. It predicts that as populations increase, groups will come in to conflict over limited prime land, and thus explain why we see a spatial correlation between good farmland and fortifications; as has been noted in New Zealand (Aotearoa). But, to date we do not have strong data to support the notion that conflict between Maori was primarily about access to farmland, and counter to circumscription theory, ethnography suggests exclusive ownership was discouraged. Here we test the efficacy of circumscription for understanding Maori history using obsidian artefact data from Pouerua Pa, a fortification in the heart of Ngā Puhi's tribal territory. New geochemical sourcing clears up ambiguities in source assignments and shows shifts in access to local sources and long distance exchange. We interpret these changes as being consistent with circumscription having been a factor in the earliest stage of fortification construction, and easing over time as the area was largely confederated under a single tribal identity in the early post-contact period.

1. Introduction

The study of warfare and its role in social evolution is a fundamental part of anthropological archaeology (e.g., Arkush and Allen, 2008). Since it was first proposed over forty years ago, Carneiro's (1970, 1986) *circumscription theory* has been especially influential in how archaeologists interpret evidence of conflict. It predicts that a concentration of resources will draw people together and lead to a cycle of conflict as neighbouring groups restrict each other's growth. Carneiro (1970: 736) saw this as the key to understanding the rise of state societies with greater hierarchical controls created as:

> "… individuals, who owed their improved social position to their exploits in war, became, along with the ruler and his kinsmen, the nucleus of an upper class. A lower class in turn emerged from the prisoners taken in war and employed as servants and slaves by their captors. In this manner did war contribute to the rise of social classes."

Archaeologists and other social scientists have not limited the application of circumscription theory to pre-modern states. In New Zealand (Aotearoa) for example, it has been posited to explain why we find the highest density of earthwork fortifications (*pa*) in areas with the best natural conditions for growing the staple crop sweet potato (*Ipomoea batatas*) (Kirch, 1988; Leathwick, 2000). While this is consistent with some views of Maori history (e.g., Vayda, 1961), simply identifying a spatial correlation between fortifications and prime agricultural lands does not on its own demonstrate that people's social networks and ability to access natural resources were in fact shaped by increasing conflict over land.

While circumscription theory is elegant, it is founded on the logic of exclusive ownership. However, traditional Maori property rights create an institutional framework that discourages exclusivity (Kawharu 1977). As 'people of the land' (*tangata whenua*), land was not owned in the strict Western sense of the word, rather Maori defined group-level and personal identity with reference to specific places on the landscape. Land was held in common, and one asserted one's rights with regard to a specific place through genealogy (*whakapapa*, or genealogical layering), or by marriage. Land could be taken by force, but members of defeated groups that

* Corresponding author.
E-mail address: mark.mccoy@otago.ac.nz (M.D. McCoy).

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remained in some instances retained rights, even if they were enslaved. Further, while rights to land were derived from inheritance and continuity of use, they also came with a practical and spiritual obligation to manage resources through customary guardianship (*kaitiakitanga*) (Kawharu, 2000). Exchanging food with neighbours would have been no less layered with cultural meaning since gifts implied an obligation to reciprocate to achieve the cultural ideal of balance (*utu*). Failure to reciprocate in kind put one in mortal spiritual danger (Mauss, 1990 [1950]).

If the fact that some emic cultural values do not follow the logic of circumscription theory is not reason enough to give us pause regarding the appropriateness of Carneiro's hypothesis, archaeological research to date is at best ambiguous regarding the link between Maori warfare and gardening. For example, while many fortifications had store houses within their palisades – a strong indicator food required protection from raiding – there are many examples of fortifications without storage, as well as store houses located outside defences. Obsidian studies too have fallen short of definitively identifying a link between warfare and control over land. For example, obsidian from Mayor Island (Tūhua) is found with high frequency in Early Period (1250–1500 AD) deposits across the country. In the Late Period (1500–1769 AD), it becomes restricted to the North Island and there appears to be a trend toward increased regionalisation in access to obsidians (Brassey, 1985; Seelenfreund and Bollong, 1989). However, with a few important exceptions from recent studies, this general pattern is derived from a period when chemical characterisation was in a pioneering phase (e.g., Leach, 1977), and when visual source matching was the norm (e.g., Moore, 1988).

The rise of the Ngā Puhi tribe (*iwi*) offers anthropological archaeology the opportunity to test the efficacy of circumscription theory in practice. In brief, small independent groups from the inland region of the Bay of Islands, a location with a good horticultural climate and one of the country's greatest concentration of rich volcanic soils, formed alliances and then conquered tribes located at the coast beginning around 1700 A.D. (Sissons et al., 2008). This processes continued through the early contact era in the late 18th century and early 19th century, leading to the present day confederation of sub-tribes (*hapū*) that make Ngā Puhi the single largest tribe in New Zealand. In the 1980s, excavations aimed at reconstructing Maori social organisation were undertaken at Pouerua pa, a fortification in the centre of an agricultural field system, which features prominently in Ngā Puhi traditions (Sutton 1990, 1993; Sutton et al., 2003).

We report on new geochemical sourcing and lithic technology studies on obsidian artefacts from Pouerua excavations. Our goal is to determine if the strategies that people employed to supply themselves with obsidian in the Late Period and Early Post-contact Period were impacted by circumscription. Circumscription theory predicts that when people began to build fortifications, we should see an increasing concern for exclusive control of land reflected in a decrease in the geographic scope of obsidian collecting, and shrinking social networks evident in exchanges. After the region was confederated under the larger Ngā Puhi tribal identity, we should see the opposite effect; an increase in the area open for local obsidian collection and larger social networks. Or, alternatively, if social circumscription was not a factor, we should see people maintaining access to natural obsidian sources through social institutions that discouraged exclusive use and encouraged fluid group dynamics (Ballara 1998). This second scenario does not deny the dangers associated with conflict, but rather questions if conflict and control over land was sustained enough to shape the degree to which people cooperated with one another over the region.

2. Background

2.1. Obsidian studies in New Zealand archaeology

The ancestors of Maori likely came from Central East Polynesia (e.g., Cook Islands) to settle New Zealand sometime after 1250 A.D. Within a century of settlement, we find midden deposits across the entire country containing fish and shellfish remains, but more importantly, now extinct taxa of flightless birds and lithic assemblages that suggest people had discovered all major sources of raw material (for recent summaries, see Walter et al., 2006, 2010). These lithic assemblages include New Zealand's most naturally abundant source of obsidian on Mayor Island, a small off-shore island located in the Bay of Plenty (Fig. 1). Mayor Island obsidian has been discovered in high frequency in Early Period deposits, but after 1500 A.D., when we see the first earthwork fortifications constructed, direct access to the source would appear to have become restricted. In the Late Period, North Island tribes took advantage of local sources of obsidian and there is no longer strong evidence for its transport to South Island tribes.

This broad pattern of unfettered access to Mayor Island obsidian followed by regionalisation became established in the archaeological literature thanks to decades of research aimed at determining the source of obsidian artefacts (see Sheppard, 2004 for a

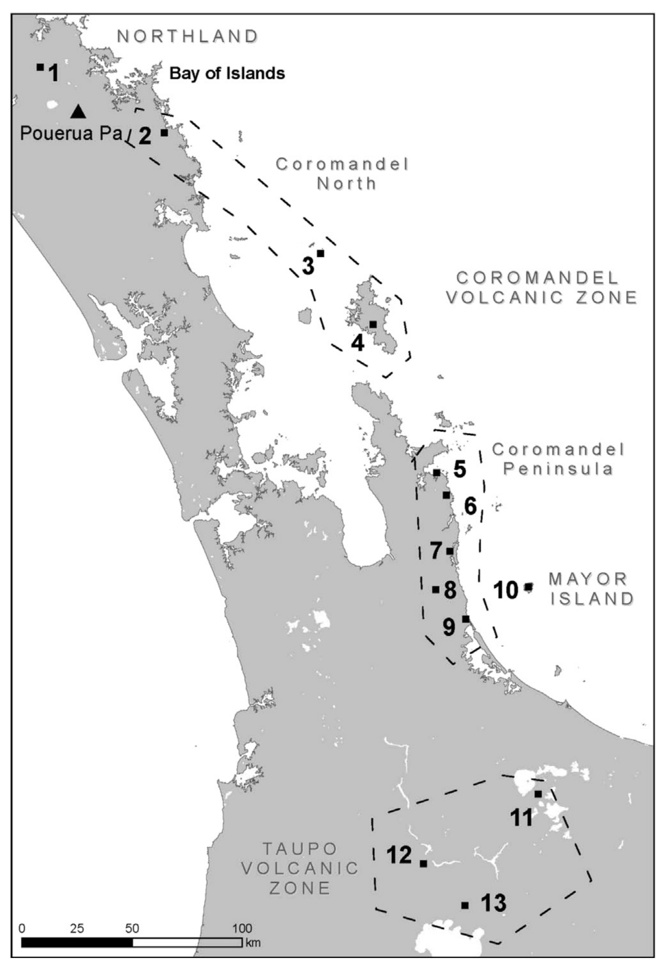

Fig. 1. Locations of Sources of Obsidian, North Island, New Zealand. In this study we report on collections of obsidian that have been geochemically matched to Kaeo [1] and Huruiki [2], off-shore islands including Fanal Island [3], Great Barrier Island [4], and Mayor Island [10], and the central North Island source Taupo [13]. See Table 1 for full list of names of sources.

recent review). It was Roger Green who recognised the potential of obsidian for the fledgling field of New Zealand archaeology over fifty years ago (Green, 1962). Foss Leach at the University of Otago began the push to document the range of natural sources of obsidian in the country and match collections coming out of excavations using XRF, NNA, and other geochemical methods (Duerden et al., 1984; Leach and de Souza, 1979; Leach and Fankhauser, 1978; Leach et al., 1978; Leach, 1996; Leach and Warren, 1981; Ward, 1972).

At the University of Auckland, Peter Sheppard has continued these efforts using PIXIE-PIGME (Neve et al., 1994), and more recently with the application of laboratory based portable XRF (pXRF) (Sheppard et al., 2011). We have also employed pXRF to try and estimate the expected range of the area people might have regularly visited to obtain obsidians by direct access (McCoy et al., 2010), and to identify the use of low quality pitchstones along with imported obsidians in the Early Period South Island (Mosley and McCoy, 2010). We have also made the case for the importance of combined sourcing and technology studies to investigate the strategies Maori used to obtain obsidian (McCoy and Carpenter, in press).

Even with this long history of previous study, we continue to refine our baseline knowledge of the geology and geochemistry of sources. For example, Cruickshank's (2011) recent work on Great Barrier Island (Aotea) not only helped clarify the geochemical variation in obsidians there, but suggests that the 'Awana' source was probably too low quality to have been used in the past. The same can be said for the low quality 'Weta' source that has yet to be found in archaeological assemblages. In addition, Phil Moore, the sole remaining advocate for the use of visual identification of New Zealand obsidians, has nonetheless published a great deal on the physical and chemical qualities of important source areas (Moore, 2012, 2013).

Fig. 1 is a map of 13 obsidian source areas and four regions, modified from Sheppard et al. (2011) with a focus on sources that regularly show up in archaeological assemblages. Theses geographic regions are: Northland, the Coromandel Volcanic Zone, Mayor Island, and the Taupo Volcanic Zone. The Coromandel Volcanic Zone can be divided in to a northern sub-region that includes Huruiki, Fanal Island, and Great Barrier Island sources; and a southern sub-region that includes five sources on the Coromandel Peninsula itself (Cooks Beach/Hahei, Tairua, Onemana/Whangamata, Maratoto, and Waihi). We note that Cooks Beach and Hahei is grouped here as single source area with two chemically distinct sub-sources. The Taupo Volcanic Zone is broken in to three source areas, Rotorua, Ongaroto/Maraetai, and Taupo. Northland and Mayor Island are each 'regions' corresponding to a single source. In this study we apply a method of geochemical sourcing, again building upon Sheppard et al. (2011), where artefacts can be matched to one of these thirteen sources (see also McCoy and Carpenter, in press).

2.2. The archaeology of Pouerua Pa

The Pouerua Archaeological Project was conducted over several seasons in the 1980s to investigate common features recorded on surveys in New Zealand (Fig. 2). This included open villages (*kaianga*) (Sutton 1990), small defended settlements ('peripheral' pa) (Sutton 1993), and a large pa situated on the area's main volcanic cone (P05/195) (Sutton et al., 2003). The stratigraphy of features and radiocarbon dates from around the site indicate three stages: an undefended period (1400–1600 A.D.), a defended period (1600–1769 A.D.), a post-contact defended period (1769–1840 A.D.). Bracketing these periods turns on identifying two historical processes in the archaeological record: the construction of defencive features, and early European contact. While the presence of foreign artefacts made of manufactured glass and metal are obvious markers of post-contact deposits, there are several chronological models one could choose to use in identifying the onset of the construction of fortifications from radiocarbon dates. These models yield results from 1517 to 1683 A.D. (Sutton et al. 2003: 196), with a median date of 1600 A.D. that is useful as a rough estimate. The early contact period here is defined by the first landing of

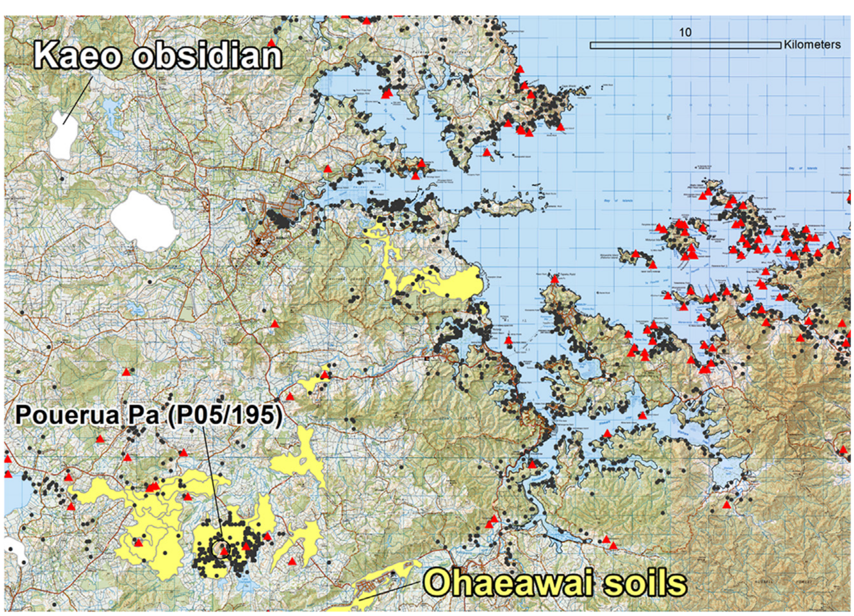

Fig. 2. The Bay of Islands, Northland, New Zealand. The recorded distribution of archaeological sites (circles) and well-known fortifications (triangles) are shown to illustrate the high density of occupation in the study area. Also shown are Ohaeawai series volcanic soils (yellow) which are a rich, silt loam that, unlike many other places in New Zealand, would not have required additions of sand, gravel, and shell for gardening (for more on modified soils, see Barber, 2010; Furey, 2006: 46). Locations of 'rhyolite domes and local obsidians' (white) indicate areas where Kaeo obsidian may have been collected. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Europeans in 1769 A.D. and the formal establishment of a British colony with the signing of the Treaty of Waitangi in 1840 A.D.

The first attempt by the Pouerua Archaeological Project to match obsidian artefacts to their source using geochemistry unfortunately ended with limited and problematic results. This study focused on 123 artefacts from excavations early on in the project at six undefended sites (P05/383, 384, 402, 859, 857, 858). Four out of the seven source assignment groups were ambiguous ($n = 18$ artefacts). Other groups included the local Kaeo source ($n = 72$), Mayor Island ($n = 24$), and Fanal Island ($n = 10$). In addition to the ambiguities in source assignments, there is some question as to the degree of mis-assignment in early XRF studies (Brassey, 1985). Until the study presented here, there has been no attempt to geochemically source obsidian from the main site of Pouerua Pa (P05/195), or to evaluate obsidian lithic technology specific to source and time period.

3. Methods

Our methodology is described below in terms of the artefact collections chosen for study, individual lithic analysis, and geochemical matching of obsidians to their likely natural source.

3.1. Collections

We examined 574 obsidian artefacts from three time periods. The earliest deposits with obsidian belong to undefended settlements ($n = 54$, P05/857 and $n = 223$, P05/195's Area II). These are followed by obsidian found in deposits that yielded pre- and post-defence radiocarbon dates ($n = 55$, P05/195's Area III), but likely post-date defence. We group these together with deposits that only yielded post-date defence dates ($n = 104$, P05/195's Area I). Finally, the presence of foreign material, including manufactured bottle glass utilised as tools, puts the last use of obsidian after European contact ($n = 134$, P05/195's Area IV). A small number of obsidian artefacts were matched to source but could not be definitively linked to a time period having come from surface collections or lacking provenience information ($n = 17$). We also note that although sourcing of obsidian from P05/857 has been published previously (Seelenfreund and Bollong, 1989), due to a lack of information on which pieces were previously examined the present study is only generally comparable with the earlier one.

3.2. Lithic technology

We began our study of lithic technology by recording individual artefact attributes for all material identified in the field as obsidian. This included standard quantitative and qualitative data (Andrefsky, 2005), specifically: weight (g), length (mm), width (mm), thickness (mm), artefact type (e.g., flake, core), presence of cortex (e.g., weather natural surface of raw material), number of flake scars, and presence of macroscopic evidence of edge damage from use.

To interpret the results of individual analyses on an assemblage scale we use three expected patterns derived from direct access, down-the-line exchanges, and long distance trade. These are based on our recent study of similar collections from sites in New Zealand (McCoy and Carpenter, in press), and we recognise that these are simply abstract models of on what should be present if there is a preponderance of one activity. With direct access for example, because it is associated with regularized trips made to quarry or collect material from the natural source area, we would expect a significant number of artefacts with cortex. A recent study of thousands of artefacts from a single volcanic glass source in the Hawaiian Islands suggests direct access should leave behind cortex on 25–50% of artefacts in directly accessed assemblages (McCoy et al., 2011). As a corollary, we would expect all stages of reduction to be present with recent research suggesting that primary reduction assemblages in New Zealand will have an average weight of around 2 g (McCoy and Carpenter, in press).

Trade and exchange, either as informal down-the-line or formal long-distance movement, should leave different patterns. Material left behind from informal exchanges should show low frequency of cortex and decreased average size as it was reduced with each new owner. In contrast, formal trade and exchange should rarely leave behind cortex since quarrying reduction will occur at the time of collection to avoid the extra weight of unusable cortex. Clearly, raw material could be taken unaltered, but that would mean carrying, paddling, or sailing more weight than was necessary. Average size should be closer to direct accessed material. We would expect this to be true even if imported material entered in to a local informal trade and exchange network after it was imported.

3.3. Chemical characterization

In this study we used a BrukerAXS™ pXRF in the archaeology laboratories of the University of Otago to evaluate artefacts and geological samples (Table 1). All samples were shot using optimal settings for 'mid-z' trace elements (Rb, Sr, Y, Zr, and Nb), specifically 40 kv and 8 microamps at a 300 s live time and with a filter (12 mil Al + 1 mil Ti + 6 mil Cu, or what the manufacture refers to as the 'green' filter). To examine lighter elements, a second protocol was used that engaged the Bruker pXRF's vacuum, with the beam set to 15 kv and 15 microamps, with no filter. For both settings, laboratory

Table 1
Geological samples used in matching obsidian to source.

Map key	Volcanic zones	Source name	Geological samples
1	Northland	Kaeo	$n = 2$; GS464, GS560
2	Coromandel North (CVZ-N)	Huruiki	$n = 10$; GS167, GS171, GS195, GS234, GS237_8, GS238_3, GS257, GS361, GS364, GS518
3		Fanal Island	$n = 1$; GW255
4		Te Ahumata	$n = 4$, GS140, GS146, GS148, GS148_1
5	Coromandel Peninsula (CVZ-CP)	Cooks Bay	$n = 5$; GS546, GS591, GS601, GS610, GT844
		Hahei	$n = 3$; GT466_1, L21, UL1
6		Tairua	$n = 4$; GS629, GS631, GS632, GS639
7		Onemana	$n = 1$, Onemana-1
8		Maratoto	$n = 1$, GT847
9		Waihi	$n = 2$; GT841, GT843
10	Bay of Plenty	Mayor Island	$n = 12$; GS716, GS717, GS741, GS797, GS808, GS859, GS898, GT619, GT643, GT699, GT732, GT751
11	Taupo (TVZ)	Rotorua	$n = 10$; GS958, GS980, GS983, GT126, GT148, GT18, GT229, GT476, GT50, GT91
12		Maraetai	$n = 4$; GT279, GT282, GT288, GT304, GT793
		Ongaroto	$n = 4$; GT346, GT354, GT355, GT363
13		Taupo	$n = 7$; GT397, GT500, GT542, GT549, GT560, GT578, GT585

specific quantification protocols were created and applied. Linear regressions were based on nine pelletized international standards each shot three times for each of the two setting. Green filter linear regressions were improved by applying Speakman's (2012) OB40 calibration to raw counts before the lab specific linear regression. A USGS basalt standard (BHVO-2) was run alongside samples as a quality check (see Supporting material 1). Since our goal was to determine the source of the full range of artefacts present, the collection was not sub-sorted by size to eliminate small artefacts that might not yield readings that can be translated to valid quantitative results. All objects were larger than the pXRF's 3.5 mm diameter beam.

We also looked closely at the assemblages and eliminated non-obsidians initially labelled in the field as obsidian (Fig. 3). While in other collections these most commonly included dark coloured chert used by Maori in a similar fashion as obsidian, as well as unaltered dark coloured stones initially mistaken for artefacts, there appears to be a special class of non-obsidians present at Pouerua. Unexpected elemental peaks in the spectra of 13 artefacts led us to compare these with the chemistry of an intact natural piece of black tourmaline found at Pouerua. Given our limited study of these materials, our best guess is these are examples of flaked tourmaline; a material that will produce obsidian-like conchoidal fracture when worked. It would be premature to match it to source, but we note that its chemical similarity to obsidians may be due to the crystal having grown out of volcanic context, such as New Zealand's best known source of black tourmaline on Cuvier Island in the Bay of Plenty. There is circumstantial evidence to support Cuvier Island as a source since the relative frequency of artefacts made of tourmaline are correlated with the presence of Mayor Island obsidian, also located in the Bay of Plenty. We note that South Island pitchstones, sometimes found among assemblages of 'obsidian' (Mosley and McCoy, 2010), were not found at these sites.

We used a stepwise method to assign artefacts to source (see McCoy and Carpenter, in press). In the first stage, we used a bivariate plot of elements of rubidium (Rb) and zirconium (Zr) ratioed to strontium (Sr) to distinguish between Mayor Island, Kaeo, and all other obsidians (Fig. 4). In the second step, this same plot was used to distinguish between the three major CVZ sources located north of the Auckland region (CVZ-N, e.g., Great Barrier Island, Fanal Island, and Huruiki) (Fig. 5). For the last step, we turned to quantitative data from the vacuum setting, specifically the ratio of iron (Fe, ppm) to calcium (Ca, ppm) to distinguish between Coromandel Peninsula and Taupo Volcanic Zone obsidians (Fig. 6). Because ratios are not used, we would eliminate any small artefacts yielding readings that fall below a certain total count as not having sufficient data, but in this case this was not necessary.

4. Results

4.1. Historical patterns in obsidian procurement

Table 2 lists the results of source assignments, with 502 artefacts assigned to the Kaeo source, 53 to Huruiki, 12 to Mayor Island, five to Fanal Island, one to Great Barrier Island, and one to the Taupo source. Unfortunately, the large Taupo obsidian artefact was a surface collection and cannot be assigned to a time period. Broadly speaking, there is consistency across all deposits in that the closest local source accounts for 74–93% of artefacts, however there are key differences that suggest there were significant shifts in people's decisions regarding how they supplied themselves with obsidian (Fig. 7).

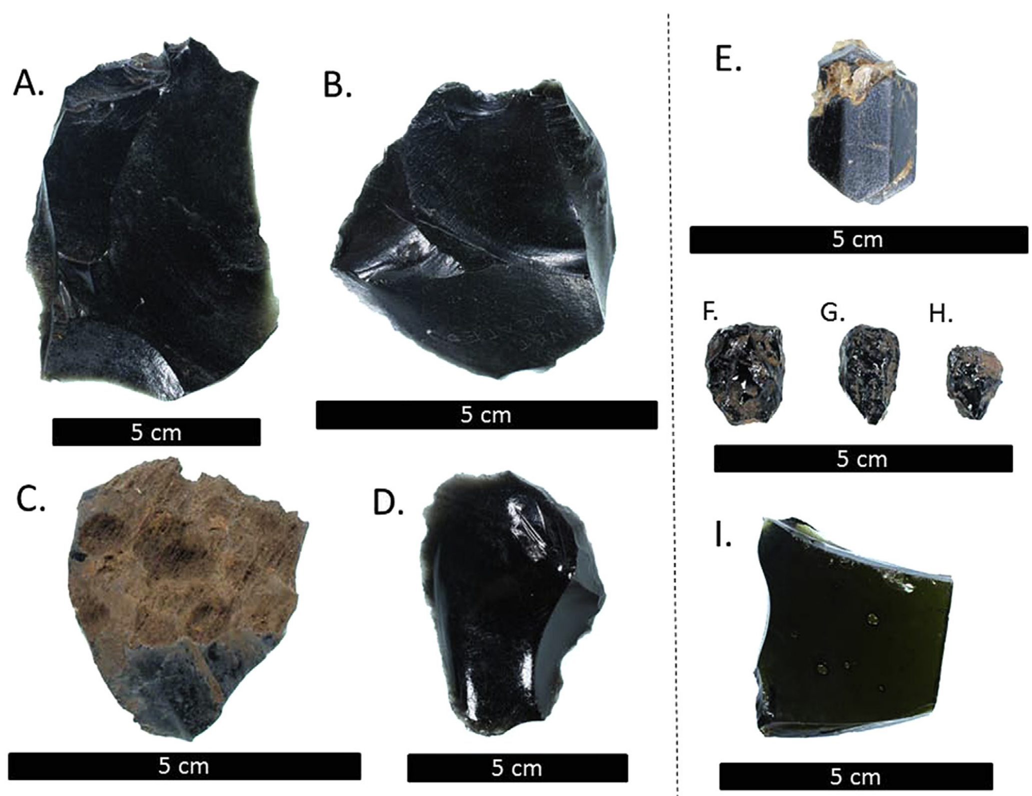

Fig. 3. Examples of Flaked Artefact Assemblage, Pouerua Pa, New Zealand. Pictured here are the three materials relevant to this study: obsidian (A to D), black tourmaline (E to H), and foreign historic era manufactured glass (I). Obsidian shown is sourced to Kaeo (A and B), Huruiki (C; dorsal side cortex shown), and the Taupo (D) sources.

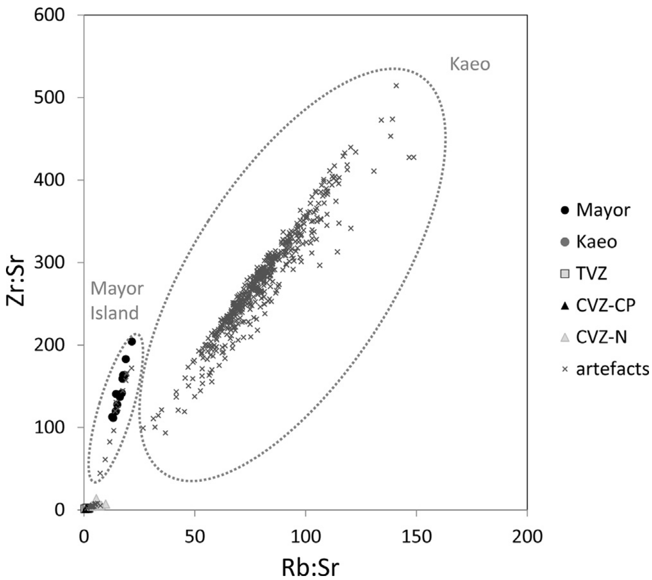

Fig. 4. Geochemistry of Artefacts Matched to the Mayor Island and Kaeo sources.

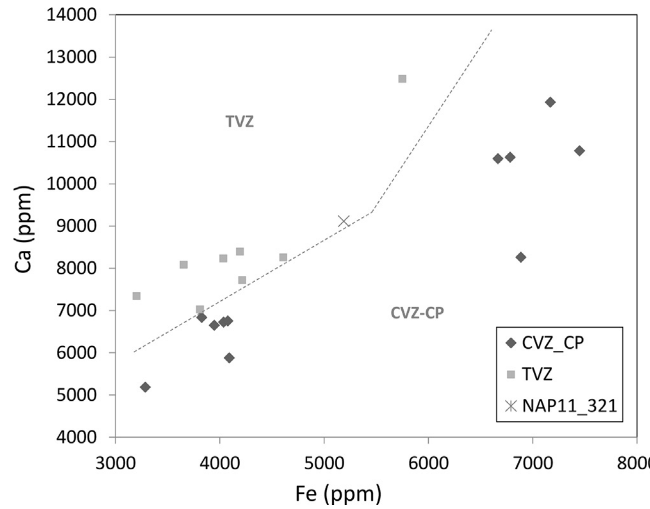

Fig. 6. Geochemistry of Artefact Matched to the Taupo Source.

4.1.1. Pre-contact undefended period (1400–1600 A.D.)

The earliest deposits at Pouerua indicate that obsidian from the closest local source, Kaeo, reached the site through a mix of direct access and informal down-the-line exchange. An assemblage reflecting purely direct access we would expect to see an average weight around 2 g and cortex on 25–50% of artefacts (McCoy and Carpenter, in press). At this stage, average weight ranges from 2.3 g to 1.2 g and cortex is found ca. 23% of Kaeo obsidian artefacts (Figs. 8 and 9; Tables 3–5). The next two closest sources, Huruiki and Fanal Island, are more common than any other period, together accounting for 26-14% of all obsidian. Moreover, average weights and the frequency of cortex are both similar to Kaeo, suggesting that all three sources were accessed in a similar fashion. While there appears to be relatively unrestricted access to local obsidian, non-local material is rare and limited to Mayor Island obsidian (MIO). This is consistent with other Late Period deposits that post-date the decline from Early Period access to MIO.

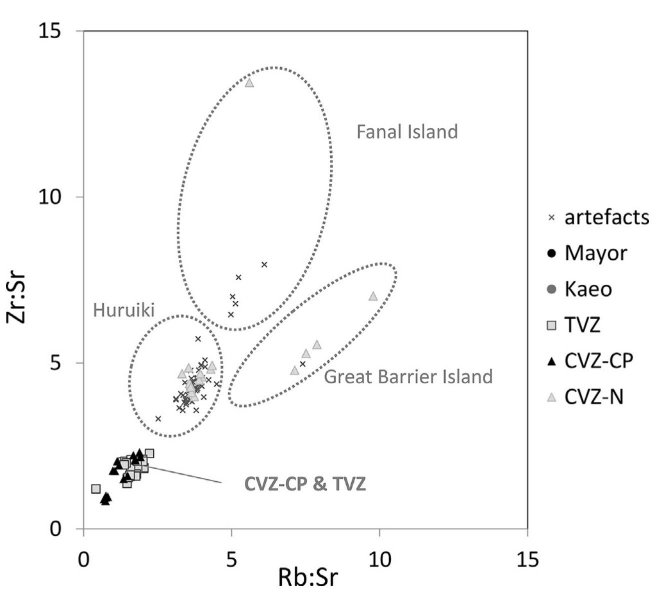

Fig. 5. Geochemistry of Artefacts Matched to the Coromandel Volcanic Zone North: Huruiki, Fanal Island, and Great Barrier Island.

4.1.2. Pre-contact defended period (1600–1769 A.D.)

All evidence points to an extreme restriction in people's access to local obsidian coinciding with the first defences constructed. At this stage, Kaeo obsidian accounts for 93–95% of artefacts, and while average size is similar to the previous period (2.3–0.9 g), the frequency of cortex drops dramatically, found on only 6%–11% of Kaeo obsidians. Obsidian from Fanal Island is no longer found and the rare occurrences of Huruiki obsidian are small and lack cortex. We interpret this as a sharp increase in obtaining local Kaeo obsidian through informal exchange, rather than through direct access, with direct access to other local sources nearly abandoned.

In contrast to local obsidians, non-local obsidian shows signs of increasingly formal long distance trade and exchange. Although they account for a small fraction of total assemblages, the average size of MIO is remarkably large (average: 5.2–10.5 g) and we have our only example of Great Barrier Island obsidian bracketed to this period. The larger average size of MIO is not only due to an increase in the maximum end of the size range (i.e., max. wt. is 7.8 g in Area II, 14.5 g in Area III, and 20.1 g in Area I), but also an increase in the smallest sized artefacts (i.e., min. wt. is 0.5 g in Area II; 1.2 g in Area III, and 4.3 g in Area I). If this were the result of informal down-the-line exchanges, we would expect the average size of material from this great of a distance would be quite small. Indeed, given the presence of cortex it is possible these reflect direct access. But, we believe the unexpected increase in the size is indicative of large blocks of MIO having been traded in to the area.

Table 2
Obsidian source assignments by site and excavation area.

	P05/857	P05/195 Area II	P05/195 Area III	P05/195 Area I	P05/195 Area IV	No site identification	
Kaeo	40	180	50	96	123	13	502
Huruiki	11	28	2		11	1	53
Fanal Island	3	2					5
Mayor Island		4	2	4		2	12
Great Barrier Island				1			1
Taupo						1	1
	54	214	54	101	134	17	574

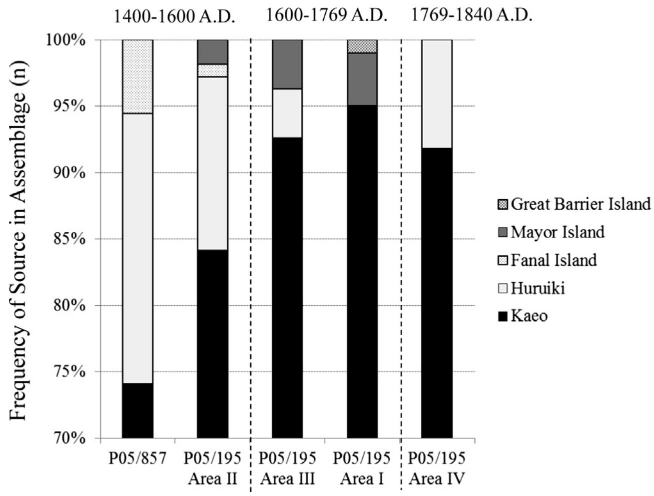

Fig. 7. Frequency of Obsidian Sources in Time Series. Local Kaeo obsidian increases in frequency over time as other local sources (Huruiki, Fanal Island) become less abundant in collections. A single artefact from the Taupo source was discovered, but is not included here since it was a surface collection.

4.1.3. Post-contact defended period (1769–1840 A.D.)

In the post-contact period we see a return to direct access to local material but no evidence of long distance trade and exchange in obsidian. In terms of local obsidians, there is not just a return to direct access, but more open access than in previous periods. Kaeo obsidian, which accounts for 92% of artefacts, is larger and has a greater frequency of cortex than in any other period (average size of 4.4 g; cortex at 35%). Huruiki obsidian, which accounts for the remaining 8%, is significantly larger than previous periods and cortex is found at a similar frequency to the rest of the assemblage (average size: 3.4 g, cortex: 27%). No non-local obsidians were found within these deposits, but given that we do find bottle glass fragments with use ware (Fig. 3), perhaps at this stage long-distance exchange of obsidians had been replaced by trade in foreign goods that included manufactured glass with the same properties as obsidians. Certainly these imported materials had yet to replace obsidians entirely at this early stage, nonetheless, they may be the preferred choice over non-local obsidian in exchanges.

5. Discussion

The results here are consistent with circumscription having been a factor shaping the history of Maori society. Evidence of

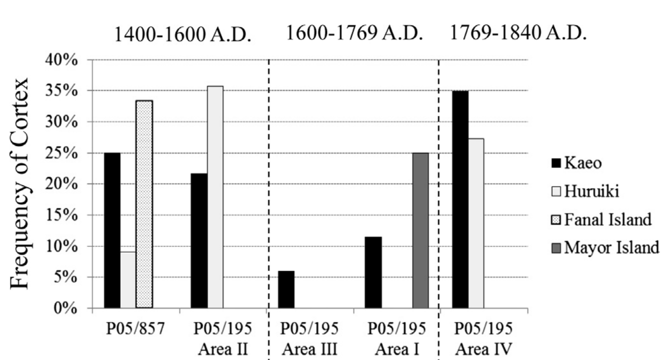

Fig. 8. Cortex Found on Obsidian Artefacts in Time Series. Cortex is common in early assemblages, but becomes rare, and then increase in frequency in the post-contact period. This is perhaps our clearest indication of a restriction in direct access to obsidian sources, as predicted by circumscription theory.

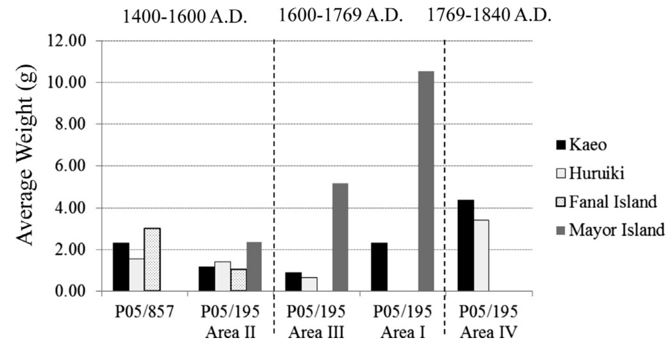

Fig. 9. Average Weight (g) of Obsidian Artefacts in Time Series. Note the unexpected increase in non-local (Mayor Island) obsidians over time until the post-contact era when it is no longer present.

direct access to local obsidian sources is not constant. Rather, there is shift to a remarkably high level of restriction in access coinciding with the addition of fortifications at Pouerua around 1600 A.D. This is especially evident in a marked decline in obsidian from the Huruiki source and an end to access to Fanal Island's obsidian. There are likely many social mechanisms at play here, one of which could be that the traditional guardians of the areas placed an explicit ban on collection (*rahui*). The practical effect of these kinds of bans would be that they simultaneously established the authority (*mana*) of the residential group to conserve or use the land as they saw fit, and at the same time demonstrate their willingness to protect their property. There is good evidence in the early post-contact period for how restrictions on land and resources were respected, and their transgression met with aggression. Perhaps the best example of this in the Bay of Islands is the visit of Commander Marion du Frense, a French explorer who, ignoring the advice of the tribe that hosted his crew for a month, one day in 1772 insisted on fishing in a location where it had been prohibited. Not long after, du Frense was killed in retribution; an act that caused his crew to turn on their host tribe and sack the main fortification on Motorua Island.

Our discovery of an increase in trade and exchange at exactly the time when circumscription is most apparent is surprising until viewed from the perspective of those grappling with new restrictions on land. Indeed, it follows that people will choose to exchange and trade with their neighbours for raw material to meet their needs when direct access is too risky. The importation of blocks of raw material from Mayor Island, while a small part of the assemblage, may also reflect this shift in how people view obsidian. McCoy and Carpenter (in press) argue that while the terms 'local' and 'non-local' are subjective, that MIO would be recognisable as non-local not only due to its distinctive green colour but the fact that its potential maximum size is a great deal larger than any other natural source in New Zealand. This may have been especially important in gifting because (McCoy and Carpenter, in press):

> "…a block of grey obsidian, even one that was from a great distance away, would look identical to local obsidian, including a source that the recipient had inherited rights to. Even with… caveats regarding Maori concepts of ownership, you can't 'give' someone something they already 'own', and even the appearance of doing so might insult to the recipient's authority (*mana*)…[Mayor Island] green obsidian that is clearly from outside… may have been a practical solution to fit to the larger traditional framework of Maori values."

Future studies should take care to show how direct access and exchange changed in locations where circumscription would appear to have been a factor shaping social history. Further, it

Table 3
Comparison Of Black Tourmaline and Mayor Island Obsidian Found. We note that there is general correlation between these two materials, perhaps indicating that they both reflect goods imported from the Bay of Plenty.

	P05/857	P05/195 Area II	P05/195 Area III	P05/195 Area I	P05/195 Area IV	No site identification
Black tourmaline	–	9	1	3	–	–
Mayor Island	–	4	2	4	–	2

Table 5
Average weight (g) of obsidian artefacts.

	P05/857	P05/195 Area II	P05/195 Area III	P05/195 Area I	P05/195 Area IV
Kaeo	2.29	1.15	0.89	2.29	4.36
Huruiki	1.55	1.39	0.65		3.40
Mayor Island		2.34	5.18	10.52	
Fanal Island	3.00	1.05			

would be valuable to expand analyses of Late Period lithic collections in New Zealand and consider a range of material classes to examine the possibility that people chose to adapt lithic technology to suit the availability of different materials.

Finally, it is particularly interesting that alliances of sub-tribes came with more direct access to local obsidians and an apparent replacement of imported obsidian by imported manufactured glass used as a raw material. We cannot comment on what exactly broke the cycle conflict, however D'Arcy (2000) gives us some insight in to the process. He suggests that Ngā Puhi leader Hongi Hika's success in unifying factions within the region was tied to his ability to amass a large number of warriors keen to have access to new weapons (i.e., muskets), and his overarching goal not to place himself at the head of a large polity, but to exact revenge on Tāmaki tribes to the south who had raided the Bay of Islands. These two themes – an attraction to novel foreign goods and the settling of a rivalry with tribes outside the region – may have encouraged Bay of Islands tribes to give far less attention to conflicts between neighbours, and focus more immediately on their relationships with the world outside the region. We would also add that Sissons et al. (2008: 152) point to the possibility that the,

> "extension of the name 'Ngā Puhi' to designate a larger political whole had its basis in some prior conception of genealogical unity. However, it is also possible that the formation… coincided with greater emphasis being placed on common decent from [the well-known leader] Rāhiri and his two sons… Such shifts in relative emphasis legitimate claims to greater mana by politically powerful hapū… denying such claims to others."

This is an important reminder that social circumscription, although centred on conflict over a basic need to feed a growing population, is sensitive to scale, identity, and worldview.

6. Conclusions

Our analysis of the obsidian assemblage from excavations at Poeurua Pa clarifies ambiguities in original sourcing studies and documents several stages in people's ability to access local obsidians and engage in trade for non-local material. During the first phase (1400–1600 A.D.) there was unfettered direct access to local sources as far away as Fanal Island. In the second stage (1600–1769 A.D.) there was restriction of direct access across the board. This is likely the most intense period of conflict in the region. Somewhat counter-intuitively, this is also a period with evidence for people engaging in long-distance trades. The final stage (1769–1840 A.D.) shows renewed direct access, a collapse of trade with southern tribes, and new trade with European ships and settler communities. This coincides with the advent of Ngā Puhi tribal identity in its current form, which likely eased local access to sources. Trade beyond the region appears to have shifted away from exchanges of non-local obsidians with the introduction of foreign goods.

Table 4
Frequency of cortex found on artefacts.

	P05/857	P05/195 Area II	P05/195 Area III	P05/195 Area I	P05/195 Area IV
Kaeo	25%	22%	6%	11%	35%
Huruiki	9%	36%	0%		27%
Mayor Island		0%	0%	25%	
Fanal Island	33%	0%			
Great Barrier Island				0%	

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jas.2013.11.034.

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