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– ARTICLE –

Cultural Distribution of Obsidian along the Waikato - King Country Coastline, North Island, New Zealand

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ABSTRACT

Analysis of obsidian artefact assemblages from fifteen 'early' (pre-AD 1500) Maori sites along an almost 150 kilometre long stretch of the Waikato-King Country coastline in the western North Island shows that while most are dominated by material from Mayor Island, they also contain a significant proportion of 'grey' obsidian (grey in transmitted light) from two main source areas – Taupo, and Cooks Beach-Hahei on Coromandel Peninsula. The presence of obsidian from these two source areas in a relatively large number of 'early' sites is suggestive of a well-developed exchange network, involving a continuing connection with the same sources over a considerable period of time, perhaps 50–100 years. Possible transportation routes for the obsidian are discussed.

Keywords: Obsidian, Waikato, King Country, cultural distribution

INTRODUCTION

The potential for obsidian artefacts to provide information on connections between people and places, transportation routes, and trade/exchange networks has long been recognised in New Zealand, and this has remained the ultimate goal of many of the sourcing studies undertaken in the past 40–50 years (Green 1962, Leach 1978). To date, however, much of the research effort has been concerned with developing suitable methods of analysis and documenting the nature of the sources, and detailed analyses of obsidian assemblages have been largely restricted to those from single excavated sites, or groups of sites within a small area, which have generally resulted in only limited indications of cultural connections (e.g. Leach & Anderson 1978, Neve *et al*. 1994, Moore 2004). But increasing knowledge about the main obsidian sources, and particularly the visual characteristics and chemical composition of the source material (leading to greater reliability of sourcing results), has provided an opportunity to examine the cultural distribution of obsidian on a regional basis (e.g. Moore 2005), and to identify possible cultural/political boundaries and transportation routes at different times in the past.

The Waikato-King Country coastline contains a large number of recorded archaeological sites, many of them believed to be 'early', though very few have been excavated or dated. Even fewer artefact assemblages have been described in any detail, but recently small surface collections of obsidian and other artefacts from three sites in the Waikorea area between Port Waikato and Raglan were analysed (Ritchie *et al*. 2009), yielding some important insights into the origin and use of various lithic materials on this part of the Waikato coast.

This paper reports on the analysis of obsidian artefact assemblages from 15 mostly 'early' (pre-AD 1500) archaeological sites along the Waikato-King Country coastline between the Waikato River mouth in the north and Awakino in the south – a distance of approximately 150 kilometres (Figure 1). All except one of the assemblages are from surface collections, and may not be fully representative of the lithic content of individual sites. Collectively, however, the data are considered to provide a reasonable indication of the cultural distribution and use of obsidian in this part of the North Island.

SITES AND ASSEMBLAGES

The Waikato-King Country coastline consists of a combination of long sandy beaches backed by large areas of deflating dunes and steep, rocky cliffs and headlands, and includes three major harbours – Raglan, Aotea and Kawhia (Figure 1). Many 'early' (or Archaic) sites, probably dating to the 14th and 15th centuries, have been recorded along this coastline. Wilkes (1994, 1995) identified up to 24 such sites between Kawhia Harbour and Awakino, all situated on destabilised dunes and mainly near stream or river mouths. Some covered a hectare or more in area. The location of these sites, along with 16 or 17 others around the Aotea and Kawhia harbours, is shown on a map recently published by McFadgen (2007: 158). Ritchie *et al*. (2009) also listed about 24 presumed early sites just north of the

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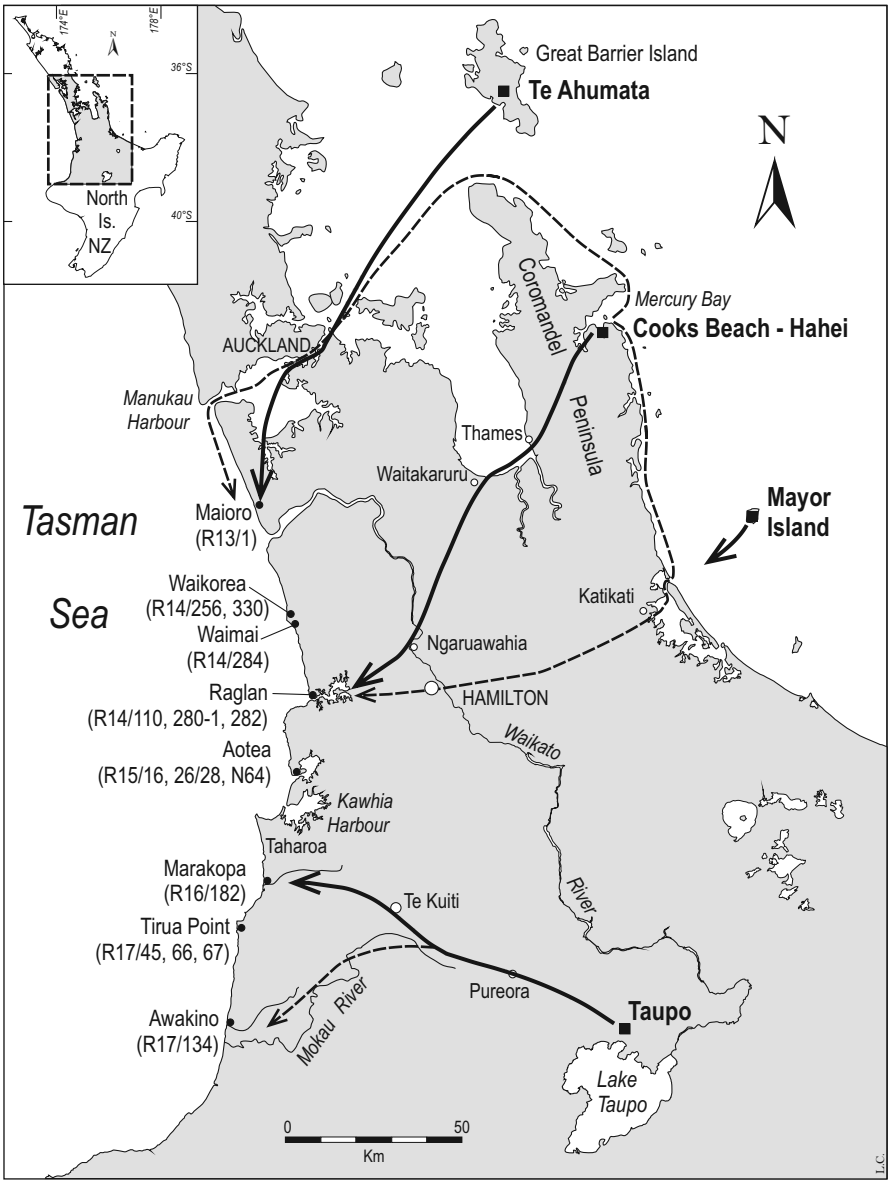

Figure 1. Location of study sites along the Waikato-King Country coastline, and possible transportation routes of obsidian from sources (solid lines = direct routes, dashed lines = indirect routes)

Raglan harbour mouth. In total, therefore, as many as 60 early sites have been recognised along the Waikato-King Country coastline.

Apart from the recent analysis by Ritchie *et al.* (2009), there have been only two other published studies on obsidian collections from the Waikato coast. The first was on an excavated assemblage from the Maioro site R13/1 (N51/5) north of the Waikato River mouth, initially analysed by B. McFadgen (Fox 1982, Fox & Green 1982), and subsequently by Seelenfreund & Bollong (1989) using non-destructive energy-dispersive XRF. As part of their large scale nationwide study on obsidian artefact assemblages Seelenfreund & Bollong (1989) also analysed collections from two sites at Raglan (R14/55 (N64/16) and R14/57 (N64/18)) and one at Aotea North Head (R15/10, N64/25) [Imperial site numbers are given in brackets where these are used in the original references]. Of the 16 flakes recovered from site R14/55, only four were analysed. Three were assigned to Mayor Island and one to an unspecified Northland source.

The other Raglan site, R14/57, is a late site. All 81 pieces of obsidian were analysed by Seelenfreund & Bollong (1989), and of those 48 were assigned to Mayor Island, two to Northland, 18 to Northland or Mayor Island, two to Fanal Island, and another two to Fanal, Huruiki, Great Barrier, Coromandel, or 'Inland' (i.e. Rotorua–Taupo region). Nine could not be allocated to any source. From this it is likely that up to 68 pieces (84 per cent) were from Mayor Island and at least four, and probably up to 13 (16 per cent),

were from other sources. For the Aotea site R15/10, which is dated to the early 16th century (Fox & Cassels 1983), all 26 pieces (of 43) analysed were attributed to Mayor Island. The collections from these three sites were not re-examined as part of the present study.

Maioro (R13/1)

The Maioro site is situated approximately 6 kilometres north of the Waikato River mouth and one kilometre from the coast, on a prominent ridge about 100 metres above sea level (Figure 1). Excavated during the period December 1965 – January 1966, it revealed four phases of occupation, initially as an undefended settlement (Phase 1) and subsequently as a defended site (Phases 2–4; Fox & Green 1982). Radiocarbon dates indicated the site was occupied between the 13th and 16th centuries (Green 1983).

About 960 pieces of obsidian were recovered during the excavation, most of which were associated with the early occupation phase (Fox & Green 1982:7). The analysis of this assemblage by B. McFadgen, by visual examination only, attributed 387 pieces (40 per cent) to Mayor Island and 487 (51 per cent) to Great Barrier (presumably the Te Ahumata source). The remaining 87 (9 per cent) of pieces could not be assigned to any source. In the EDXRF analysis by Seelenfreund & Bollong (1989) the obsidian assemblage was split into separate collections from phases 1 and 2 of the occupation sequence. Of the 795 pieces from the earlier Phase 1 sequence, 336 (42 per cent) were considered to be from Mayor Island and 459 (58 per cent) from Northland (Huruiki), Fanal Island, Great Barrier Island, Coromandel or 'Inland'. Two were assigned specifically to Northland. Of the 116 pieces from Phase 2, 60 (52 per cent) were assigned to Mayor Island and 56 (48 per cent) were considered to be from Huruiki, Fanal or Great Barrier. For the total assemblage Seelenfreund & Bollong's (1989) results – 43 per cent from Mayor Island and 56 per cent from other sources – are obviously very similar to those obtained by McFadgen.

Waikorea area (R14/256, 330, 284)

Surface collections of artefacts were made from eroding dunes in the lower Waikoria valley between 1987 and 1989, from four different areas. Three of these areas were regarded as separate parts of a large site complex, R14/256, and labelled A, B and C. The other site, R14/330, was situated on the south side of Waikorea Stream. A single radiocarbon date of 560 ± 40 BP (calibrated to 1400 to 1440 AD at 68 per cent probability) was obtained for charcoal from the exposed occupation surface at R14/256A (Ritchie *et al.* 2009).

Altogether about 550 flakes, cores and pieces of obsidian were collected from the Waikorea sites, most from R14/256A. Mayor Island obsidian constituted about 95 per cent of the total, while 'grey' material (grey in transmitted light) formed only 5 per cent (Ritchie *et al.* 2009). Four flakes of red-brown obsidian were also recovered from R14/256A. The 'grey' obsidian was divided into three groups based on physical characteristics, and samples from each group were analysed by conventional wavelength-dispersive XRF. This indicated that one group originated from the Taupo source, and that obsidian in the other two groups came from the Hahei source on Coromandel Peninsula. The red-brown obsidian is almost certainly from Taupo.

A small quantity of obsidian (17 flakes) collected from site R14/284 at Waimai Stream, about two kilometres to the south, was also examined. This assemblage included only two pieces of 'grey' obsidian, both of which were probably derived from the Taupo source.

Data from the Waikorea and Waimai sites, previously published by Ritchie *et al.* (2009), have been included in the present study and are provided in Table 1.

Raglan

The group of apparently early sites recorded on the dunes just north of the Raglan Harbour mouth contain a range of lithic materials (Ritchie *et al.* 2009, appendix 1; pers. obs.). Many of the sites have been completely destroyed by deflation of the dunes, leaving only dispersed surface scatters of artefacts and oven stones behind. Only one site (R14/56) has been excavated (Bonica n.d.), and none dated, although the range of artefacts recovered and presence of moa, other bird and sea mammal bone at some sites suggests that most are probably 'early' (pre-1500 AD).

Small collections of obsidian were made by Richard Cassels (then of Auckland University) in 1970 from some of the numerous middens recorded on the southern part of the dunes, although only that from R14/110 (35 flakes) is large enough to include in this study. Collections from two other sites (R14/108 – 6 flakes and R14/118 – 7 flakes) consisted of Mayor Island obsidian only. More significant collections of obsidian have subsequently been made from surface scatters in the vicinity of sites R14/280, 281 and 282. The first two sites (middens) are only about 50 metres apart, and because of the uncertainty over which site the obsidian came from, the collection is treated as a combined one. Site R14/282 is situated about 100 metres north of R14/281.

Aotea Harbour

Over 100 individual middens on the dunes at Aotea North Head were recorded, sampled and analysed by Richard Cassels in the early 1970s, and some of the results of this work were presented in a paper in 1973 (Cassels 1973). Although the details remain unpublished, his original data sheets are incorporated in the NZAA Site Record files and show that very few of the middens contained obsidian flakes or other artefacts. Of the collections still held by

Table 1. *Proportions of Mayor Island and 'grey' obsidian in assemblages from sites along the Waikato-King Country coastline. Some data for Maioro from Fox (1982); data for Waikorea and Waimai from Ritchie* et al. *(2009).*

SITE NO.	MAYOR ISLAND				GREY				RED	TOTALS	
	No.	%	Weight (g)	Wt %	No.	%	Weight (g)	Wt %	No.	Total No.	Total Wt (g)
Maioro	>387	>40			461	48				961	727?
Waikorea											
R14/256A	454	96	925	91	17	4	80	3.6	4	475	1016
R14/256B	43	96	145	98	2	4	3	2		45	193
R14/330	30	88	60	86	4	12	10	14		34	70
Waimai											
R14/284	15	88	55	86	2	12	9	14		17	64
Raglan											
R14/110	26	74	43.4	75	9	26	14.7	25		35	58
R14/280–281	100	71	210	71	40	28	85	29	1	140	295
R14/282	122	81	186	73	28	19	70	27		150	256
Aotea											
R15/26 or 28	17	85	47.5	83	3	15	9.8	17		20	115
N64	71	91	29	94	5	6	1	3	2	78	31
R15/16	11	65	30	59	6	35	21	41		17	51
Marakopa											
R16/182	5	63	23	64	3	37	13	36		8	36
Tirua Point											
R17/66	100	59	605	68	70	41	285	32		170	884
R17/67	8	50	44	38	8	50	72	62		16	116
R17/45	55	68	72	64	26	32	41	36		81	113
Awakino											
R17/134	41	85	90	84	7	15	17	16		48	107

the Anthropology Department, University of Auckland, three (R15/16, R15/26 or 28, N64 Aotea) contain sufficient amounts of obsidian for inclusion in this study. Small collections from two other sites (R15/10, R15/13) consist of Mayor Island obsidian only.

Taharoa

Initial surveys of the large expanse of dunes at Taharoa were undertaken by the Historic Places Trust in 1970 and 1972, and 14 'principal sites' were recorded over that period (McKinlay n.d.). At least three of those (R16/11, R16/12, R16/279) were reported as containing obsidian, chert and other stone flakes. A more extensive survey was carried out in 1978, resulting in a further 129 sites being recorded (Bulmer n.d.), of which at least six contained obsidian. All were classed as either middens or habitation areas. Owen Wilkes' analysis of the site records indicates that over 40 sites in the Taharoa area contained obsidian, a remarkably high percentage of the total number of sites known.

One site – a pit complex with midden (R16/10) was excavated by the Historic Places Trust in 1970–1972 (McKinlay n.d.). McKinlay records that there were 'significant numbers of obsidian and chert flakes' (n.d: 10), along with fragments of other artefacts, scattered over the site, although none were apparently associated with the main structural features (pits and house sites). A single radiocarbon date of 450 ± 60 BP was obtained for the site (Wilkes 1994: 36, Pain 1979).

According to a list contained in the NZAA Site Record files for Waikato a significant collection of artefacts was made from the Taharoa area, including a total of 294 obsidian flakes from 23 sites. Most of these (171) were from site R16/10. The current location of this collection is unknown.

Southern coast (Marakopa to Awakino)

Very few of the sites along the King Country coastline south of Taharoa are reported as containing obsidian, although some small collections were made by Owen Wilkes during his intrepid field surveys in 1992–1994. These were from R16/182 (pebble scatter/midden) at Marakopa, three sites near Tirua Point (R17/45, R17/66 and R17/67), and a pebble scatter/midden/working floor (R17/134) at Awakino (Figure 1). All of these were regarded as Archaic sites by Wilkes. In addition, Wilkes noted that another site, R17/65, had 'numerous well-shaped obsidian knives/scrapers' (1994: 37). A Duff type 1B adze was also found at this site.

ANALYSIS

Two methods were employed in the analysis of the obsidian assemblages: visual examination of physical characteristics, resulting in a separation into different groups, followed by chemical analysis of selected pieces by energy-dispersive X-ray fluorescence (EDXRF). In total about 1800 flakes, pieces and cores were studied, with a combined weight of >3.5 kg (Table 1). The visual examination provides some constraints on potential sources of the obsidian (Moore 1988). The reliability of sourcing on the basis of physical characteristics has been demonstrated in many studies (mostly unpublished) carried out by the author and other workers over the past 20 years (e.g. Neve *et al.* 1994, Furey 2002, Moore 2004).

Visual characteristics

All assemblages were examined under a binocular microscope, in both transmitted and reflected light, and in most cases the obsidian was initially divided into two groups: those pieces with an olive green colour in transmitted light, and those that were 'grey'. This practice has been widely employed in the analysis of obsidian assemblages since the 1960s, mainly to establish the approximate percentages of Mayor Island and 'other' material (e.g. Green 1964, Leach & Anderson 1978, Neve *et al.* 1994, Furey 2002, Moore 2004). Where limited chemical analysis has been used to confirm the identification of Mayor Island obsidian, this has indicated a reliability of the original assignment (based on visual features) of ≥ 90 percent, and in one case 100 per cent (Neve *et al.* 1994). In the present study it is considered that at least 99 per cent of the 'green' obsidian originated from Mayor Island.

The 'grey' or non-Mayor Island obsidian was examined more closely in order to establish possible sources for this material, using the procedure outlined by Moore (1988). This method involves sorting the obsidian into different groups based on one or a combination of visual characteristics, which are then compared to the known characteristics of potential sources. For instance, high quality obsidian with good translucency and few, if any, phenocrysts (crystal inclusions) is largely confined to the Te Ahumata (Great Barrier Island), Maratoto (Coromandel) and Taupo (central North Island) sources, and a distinction can be made between these on other factors such as the presence or absence of spherulites (Te Ahumata–rare, Maratoto–absent, Taupo-sparse to abundant) and type of cortex. Although obsidian with poor translucency is found in many sources, it is typical of Huruiki in Northland and Hahei, Tairua and Waihi on Coromandel Peninsula. This process will not necessarily result in the identification of a specific source, and is mainly aimed at reducing the options. An example of the methodology is provided by Moore (2004). For the assemblages in this study, groups were distinguished mainly on the basis of degree of translucency, flow banding, and type of cortex. A few flakes were then selected from these groups for chemical analysis by EDXRF, to back up the tentative source allocations indicated from the visual examination. Flakes containing relatively flat and less sand-blasted surfaces were selected where possible.

Maioro

The Maioro obsidian was re-studied by the author in May 2009. It was treated as a single assemblage (cf. Seelenfreund & Bollong 1989), and involved separation of all the 'green' obsidian followed by detailed examination of the 'grey' material. In total, 461 'grey' flakes and pieces (constituting about 48 per cent of the original collection) were identified. Many of these are small, and generally only the larger flakes were examined closely. Most are characterised by good translucency and weak or no flow banding, and a number contain light grey spherulites. A significant proportion (at least ten per cent) has remnants of rough, pitted cortex which, in some cases, is slightly water-worn. A few pieces also have white clay or highly weathered rhyolite or tuff adhering to the surface. From the degree of curvature of the cortex it is evident that many of the flakes and pieces were derived from pebble to small cobble sized nodules, and the roughness of the cortex suggests these were obtained from a colluvial or small stream deposit. The physical characteristics of the obsidian flakes in this group indicated they most likely originated from the Te Ahumata source on Great Barrier Island.

A small number of the 'grey' flakes and pieces (about 17, or four per cent) have moderate or poor translucency, and it was considered that these were probably derived from a different source. Some contain grey spherulites and have a distinct brown colour in transmitted light. Indications were that the obsidian in this group may have come from the Cooks Beach or Hahei sources on Coromandel Peninsula.

Raglan

The obsidian assemblage from sites R14/280 and R14/281 (both middens) at Raglan is a surface collection from an area of deflating dunes between them, and probably represents a mixture of material from both sites. However the middens are likely to be contemporary. A total of 40 flakes and pieces of 'grey' obsidian was analysed. All pieces are sand-blasted, making the accurate identification of some physical characteristics (colour, translucency) more difficult, but despite this the assemblage was able to be divided into five distinct groups. Samples analysed by EDXRF are given in square brackets.

Group 1 (twenty four pieces) – characterised by moderate to poor translucency. Many of the pieces had remnants of rough, pitted and striated or smooth but finely pitted

cortex. The cortex was not obviously water worn. Some pieces also contained grey spherulites and crystal inclusions (phenocrysts) of feldspar. The characteristics of this group suggested a likely source was Hahei, on Coromandel Peninsula. [R14/280 – 1/1A, 1B, 1C]

Group 2 (thirteen flakes) – good translucency (with a smoky tinge) and weak flow banding. Most contained spherulites and a few feldspar crystals. There were three flakes with remnants of rough but water-worn cortex, and one was definitely derived from a rounded water-worn pebble or cobble. It was considered the obsidian in this group probably came from the Taupo source [R14/280–1/2].

Group 3 (three pieces) – moderate translucency, weak to moderate flow banding, and grey spherulites, but no cortex [R14/280–1/3]. The source of these pieces was uncertain.

Group 4 (one flake) – very poor translucency and no spherulites or crystals. These characteristics suggested it could be from Cooks Beach-Hahei.

Group 5 (one flake) – dark reddish brown (2.5YR 2.5/4) obsidian with black flecks. It almost certainly came from the Taupo source.

The same groupings were applied to the assemblage of 28 'grey' flakes and pieces from site R14/282.

Group 1 – nine flakes and pieces, six of them with rough, pitted cortex. As for R14/280–1, it was considered a Hahei or Cooks Beach source was likely [R14/282/1A, 1B].

Group 2 – eleven flakes with good translucency and weak or no flow banding, many containing grey spherulites and/or crystals. Four had remnants of cortex, in one case smooth (water worn) and in another pitted and striated, similar to that in Group 1. Most of the obsidian in this group is likely to have come from Taupo.

Group 3 – eight flakes with similar characteristics to those in Group 2, but with moderate to strong flow banding. Most contained light grey spherulites and/or crystals [R14/282/2B].

Group 4 – one flake with very poor translucency and grey spherulites.

For the remaining collections (Table 1), most of the 'grey' obsidian was able to be placed into two main groups – one characterised by moderate to poor translucency, the other with good to moderate translucency (commonly with a smoky tinge), which are essentially equivalent to Groups 1 and 2 respectively that were established for the assemblages from sites R14/280–1 and R14/282 at Raglan. Many of the flakes, pieces and cores in Group 1 contain spherulites and show moderate to strong flow banding, and a few have remnants of rough cortex. None possess water-worn cortex. Those in Group 2 generally show weak or no flow banding, and some have portions of rough or smooth, water-worn cortex. The bulk of the obsidian in Group 1 was considered to be either from Cooks Beach or Hahei, and that in Group 2 to originate from the Taupo source.

Chemical analysis

Thirty pieces were analysed by EDXRF using the new portable Innov-X spectrometer (PXRF) at the Anthropology Department, University of Auckland. The specifications of this machine, and general analytical procedure, are outlined by Sheppard *et al.* (2010). All samples were run for six minutes, and data were automatically downloaded onto an iPAQ PDA. A standard (NIST 2709) was run at the start of each session and after every 8–10 samples. The results are presented in Table 2.

The Innov-X routinely measures the concentrations of 25 elements, but that does not include the lighter elements of Si, Al, Na and Mg. Detection limits for most elements are 10–100 ppm, and 250–2500 ppm for K and Ca, and precision errors are typically <5 per cent. However measurements of some elements have considerably larger errors and hence they have been excluded from consideration, along with those below detection limits. The elements of greatest value in sourcing the obsidian are Rb, Sr and Zr, which have errors of only about 1–3 per cent.

Many of the samples selected for analysis were those with moderate to poor translucency (i.e. Group 1) which, based on previous XRF results from Waikorea (Ritchie *et al.* 2009), were considered likely to be from either Cooks Beach or Hahei. Others were chosen from groups with more certain assignment to Taupo and Te Ahumata based on physical characteristics.

Scatter plots of Rb-Sr and Zr-Rb are presented in Figures 2 and 3. These include unpublished analytical data for more likely sources (based on visual characteristics), which were obtained by conventional wavelength-dispersive XRF. Although element concentrations produced by EDXRF and WDXRF analysis are not perfectly comparable, they are sufficiently close for the purposes of sourcing archaeological material (see below). Data are also included for the two closest Coromandel sources (Whangamata, Tairua) with physical characteristics similar to those of Cooks Beach-Hahei material. The nearest sources, Maratoto and Waihi, were excluded because of their very different visual characteristics and chemistry. Comparisons with the 9 or 10 remaining sources of flake quality 'grey' obsidian in New Zealand (out of the 24 listed by Sheppard 2004, fig. 7.1) produced no matches, and these were excluded from the scatter plots for the sake of clarity.

Table 2. *Energy-dispersive XRF analyses (Rb, Sr and Zr) of obsidian artefacts, and source allocations.*

SITE / SAMPLE	Rb	Sr	Zr	Rb/Sr	Zr/Rb	Source	Group*
Maioro							
AQ1	200	23	120	8.7	0.6	Te Ahumata	n/a
AQ27	203	32	125	6.34	0.62	Te Ahumata	n/a
AQ222	141	96	137	1.47	0.97	Hahei	n/a
AP462	143	96	143	1.49	1	Hahei	n/a
AP734	204	25	121	8.16	0.59	Te Ahumata	n/a
AP873	206	34	133	6.06	0.65	Te Ahumata	n/a
AP937	194	35	123	5.54	0.63	Te Ahumata	n/a
AP990	191	23	115	8.3	0.6	Te Ahumata	n/a
Raglan							
R14/110/1	131	74	136	1.77	1.04	Cooks Beach	1
R14/110/2	121	78	128	1.55	1.06	Cooks Beach	1
R14/279/1	133	95	139	1.4	1.05	Hahei	1
R14/280–1/1A	125	71	134	1.76	1.07	Cooks Beach	1
R14/280–1/1B	139	99	143	1.4	1.03	Hahei	1
R14/280–1/1C	129	72	136	1.79	1.05	Cooks Beach	1
R14/280–1/2	125	95	159	1.32	1.27	Taupo	2
R14/280–1/3	134	91	129	1.47	0.96	Hahei	3
R14/282/1A	142	95	142	1.49	1	Hahei	1
R14/282/1B	134	100	143	1.34	1.07	Hahei	1
R14/282/2B	122	70	131	1.74	1.07	Cooks Beach	3
Aotea							
R15/16 (A11)	131	94	160	1.39	1.22	Taupo?	1
Marakopa							
R156/182/1	124	72	135	1.72	1.09	Cooks Beach	2
South coast							
R17/66/1	117	88	147	1.33	1.26	Taupo	2
R17/66/2	121	88	152	1.38	1.26	Taupo	2 or 3
R17/66/3	125	90	152	1.39	1.22	Taupo	2 or 3
R17/45/1	154	121	191	1.27	1.24	unknown	1?
R17/45/2	132	97	160	1.36	1.21	Taupo	2
R17/45/3	133	92	136	1.45	1.02	Hahei	1
Awakino							
R17/134/1	125	92	156	1.36	1.25	Taupo	2 or 3
R17/134/2	115	90	143	1.28	1.24	Taupo	2
R17/134/3	126	93	158	1.35	1.25	Taupo	2

* Based on visual characteristics (see text)

The Waikato-King Country artefacts fall into two distinct groups, one clearly associated with Te Ahumata, the other with Cooks Beach-Hahei-Taupo, and one outlier (R17/45/1). Although there is some overlap between the main group and Whangamata source samples on the Zr-Rb plot (Figure 3), there is good separation with Rb-Sr (Figure 2). None of the archaeological samples appear to be from Tairua, and the outlier sample does not match any known source.

All of the artefacts which plot in the Te Ahumata field have physical characteristics consistent with derivation from that source, and are from the Maioro site only. While there appears to be no clear differentiation of the larger group, which consists of flakes with moderate to good and moderate to poor translucency, enlargement of the plots does show broad clustering around the source samples, particularly with Rb-Sr. A distinction between Taupo, Cooks Beach and Hahei can also be made on the basis of Rb/Sr and Zr/Rb ratios (Table 2).

RESULTS

There are two main areas of potential error in the results: the inability of visual characteristics to clearly distinguish obsidian from different sources; and comparison of the EDXRF results with source data obtained by XRF analysis. Both of these factors could have resulted in some incorrect source allocations.

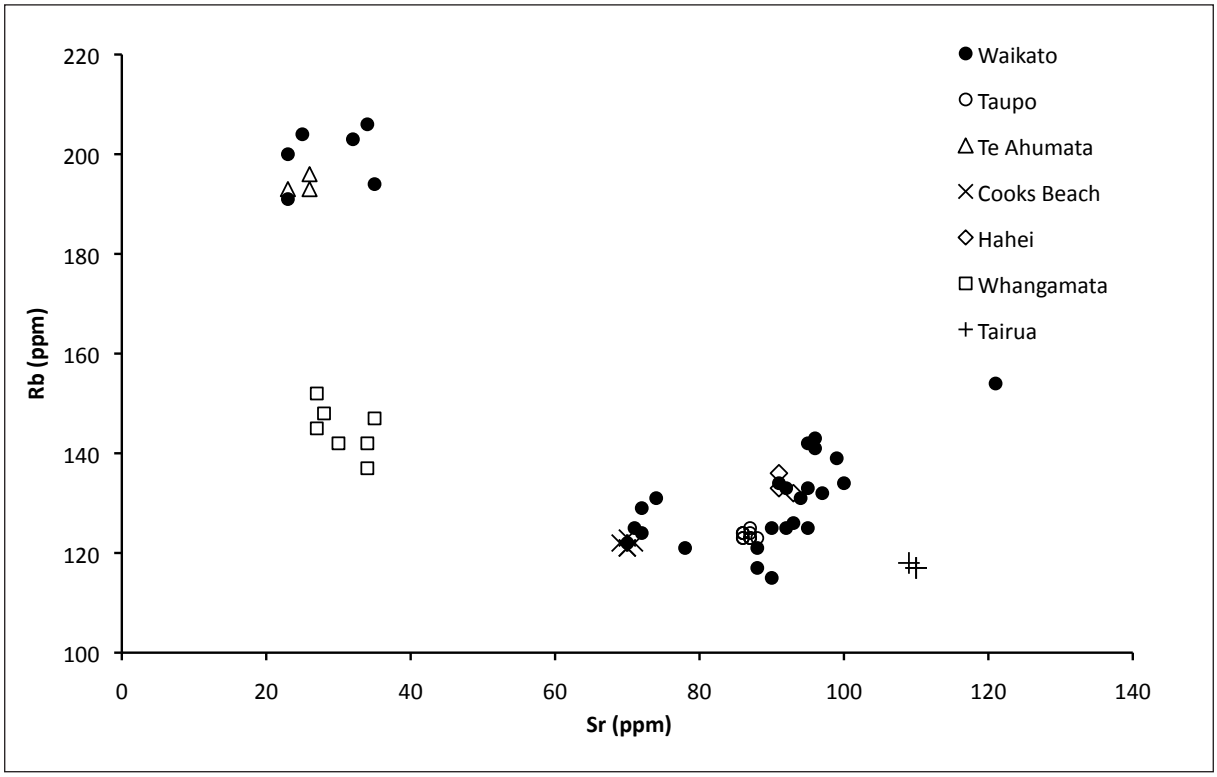

Figure 2. Rb-Sr plot for archaeological (black dots) and source samples (open symbols)

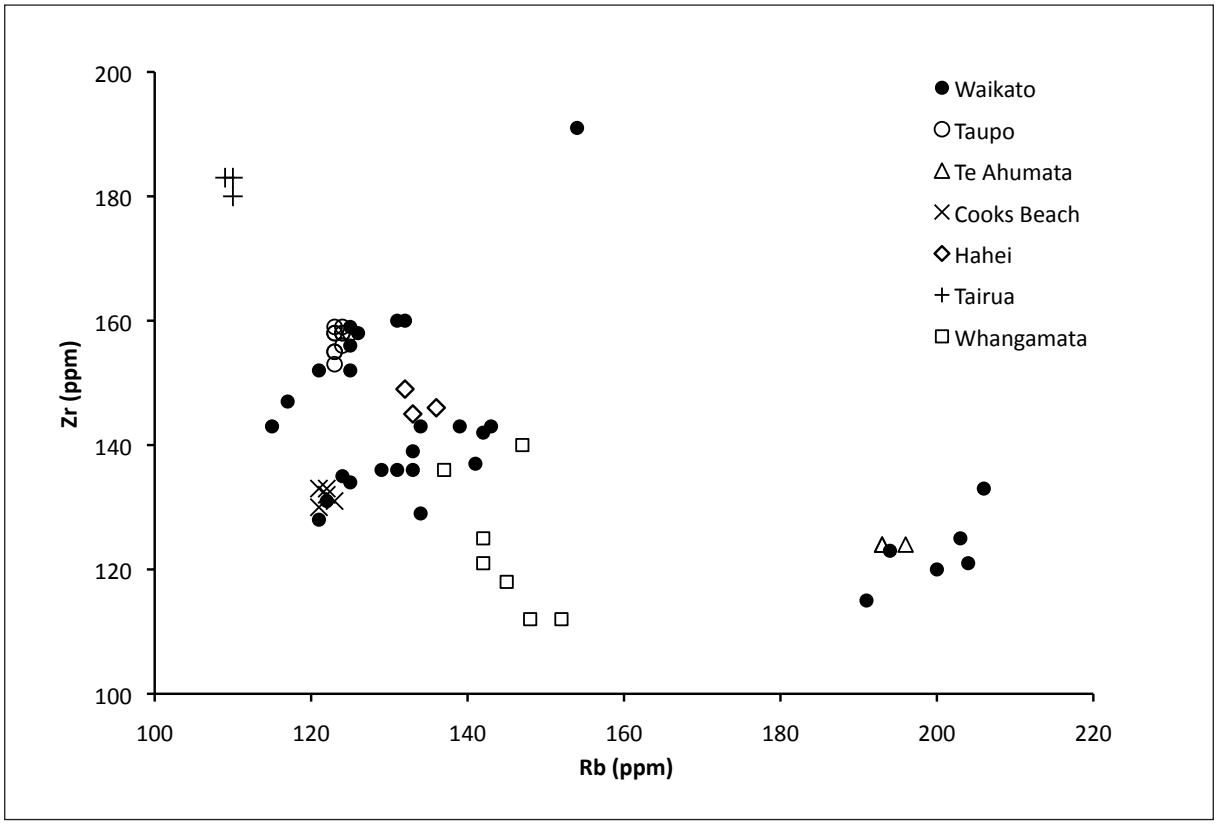

Figure 3. Zr-Rb plot for archaeological and source samples

The EDXRF analyses indicate that all except two of the 11 artefacts (R15/16/A11, R17/45/1) selected from the Group 1 assemblages did originate from Cooks Beach-Hahei, and that the majority of those placed in Group 2 (5 out of 6) are in fact from Taupo (Table 2). Those placed in Group 3, which have less diagnostic physical characteristics, are shown by EDXRF analysis to be largely from Cooks Beach-Hahei. Altogether only three (15 per cent) of the 22 artefacts analysed from sites other than Maioro had been incorrectly assigned to sources in the visual examination. Given the small size of some collections, and that many of the pieces were badly sand-blasted, this is considered to be an acceptable error. The only way to significantly reduce this error would be to subject all 'grey' flakes to EDXRF analysis.

The possible errors resulting from comparison of EDXRF data with values for source samples obtained by XRF analysis are difficult to assess. However, Rb, Sr and Zr concentrations determined by both methods for a small number (10) of source and archaeological samples from other areas (unpublished data) indicate that EDXRF results should be within 10% of the XRF values. These analyses showed a very close correspondence in Zr/Rb ratios.

Overall, the EDXRF analyses largely confirm the tentative source allocations for the 'grey' obsidian based on physical characteristics. This allows the relative proportions of obsidian derived from different sources, at each of the study sites, to be calculated with a reasonable degree of confidence (Figure 4, see also Table 1). Although most assemblages include some cores which can somewhat distort the proportions, particularly in small collections, many of the cores are small and do not unduly affect the results. Determination of percentages by weight shows no significant differences in the relative proportions.

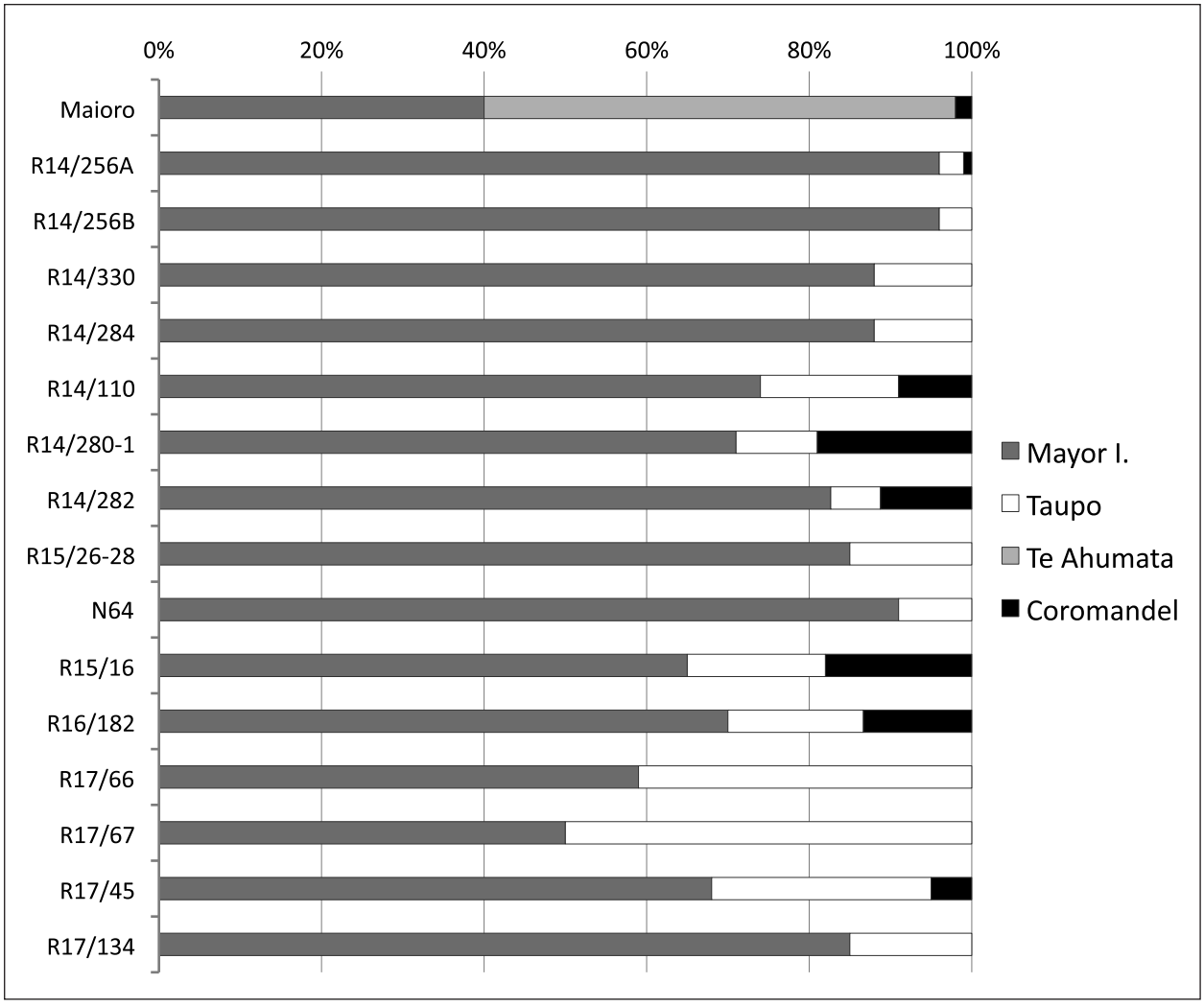

Figure 4. Relative proportions (numerical) of obsidian from different sources in sites along the Waikato-King Country coastline. Sites are ordered from north to south. 'Coromandel' = Cooks Beach + Hahei. See Table 1 for details.

CULTURAL DISTRIBUTION

It is evident from Figure 4 that all except two of the assemblages are dominated by Mayor Island obsidian. Excluding Maioro, there is also an overall decrease in the proportion of Mayor Island obsidian from north to south, from >90 per cent at Waikorea to 50–60 per cent at sites in the Tirua Point area, and a corresponding increase in 'grey' obsidian. While there is clearly some variation in this trend, notably at Aotea, which could be due to non-representative collections or differences in age, what is significant is that many of the 'early' coastal sites contain >10 per cent 'grey' obsidian.

The available data indicate that the bulk of the 'grey' obsidian found in early sites along the Waikato-King Country coast, south of the Waikato River mouth, originated from the Taupo source in the central North Island. Smaller quantities – between 1 and 20 per cent of some assemblages – were obtained from Coromandel Peninsula, entirely from the Cooks Beach and Hahei sources in the Mercury Bay area (Figure 1). There is no clear trend in the distribution of Coromandel obsidian, but it is relatively common at Raglan, at Marakopa, and possibly one site at Aotea, and appears to be absent or occur only in very small quantities elsewhere. The assemblage from Maioro is obviously very different and dominated by 'grey' obsidian from the Te Ahumata source on Great Barrier Island. It includes a small amount of obsidian (< 2 per cent) from Hahei, but apparently none from Taupo.

The presence of both Taupo and Coromandel obsidian in the lithic assemblages of many of the 'early' sites (excluding Maioro) along an almost 150 kilometre long stretch of very exposed coastline suggests there was a well-established exchange network operating over a considerable period of time, perhaps 50–100 years, involving continuity of access to the same obsidian sources. It implies some relationship between the former occupants of those sites, possibly members of a single group of people migrating, periodically or seasonally, up and down the coast. Of course this is mere conjecture, but the alternative, that different groups obtained small quantities of 'grey' obsidian from the two source areas quite independently of those inhabiting nearby sites, seems untenable. Although Ritchie *et al*. (2009:106) suggested that the presence of Coromandel (Hahei) obsidian at Waikorea may have been due to a 'one-off event', that is clearly not the case.

The fall-off in the proportion of Taupo obsidian from south to north (Figure 4) would seem to indicate down-the-line transfer of raw material northwards along the coast, rather than via the Waikato River to the sea and then southwards along the coast as perhaps might be expected, although the river may have served as a transportation route for at least part of its length. Such a fall-off trend is suggestive of a more direct route from Lake Taupo overland through the Pureora Forest to the west coast via the Mokau or Awakino rivers, or via Te Kuiti and the Marakopa River (Figure 1). The latter is possibly favoured by the higher proportion of Taupo obsidian in the Marakopa and Tirua Point sites. Movement of other lithic materials from the south is indicated by the artefact assemblages from Waikorea (Ritchie *et al*. 2009).

We can only speculate on what the transportation routes might have been for obsidian from the Hahei and Cooks Beach sources. The shortest and most direct route from Mercury Bay to say Raglan would be via the Whitianga estuary and over the Coromandel Range to Thames or Waitakaruru, then across to Ngaruawahia and possibly up the Waipa River before crossing the hills to the coast (Figure 1). A slightly longer, indirect route, by canoe down the Coromandel-Bay of Plenty coast to about Katikati and across the Kaimai Range to Hamilton is also possible, particularly if Mayor Island obsidian was also carried overland. Transportation by sea to Auckland, then southwards along the coast from the Manukau Harbour, cannot be ruled out.

In the case of the Maioro site, the replacement of Taupo by Great Barrier as the main source of 'grey' obsidian may reflect the existence of a cultural/political boundary at the Waikato River mouth, resulting in very different cultural connections between the Auckland and Waikato regions, although the distribution of Hahei obsidian indicates the link with that particular source remained common to both areas over a considerable period of time.

There is obviously a lot more we need to know about how obsidian was being accessed and distributed, and why certain sources were exploited in preference to others. Further information is certainly required from the Auckland area, as well as the Taranaki coastline to the south, in order to test some of the ideas discussed here.

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