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– ARTICLE –

# Evidence of a Well-developed Obsidian Distribution Network in the Far North of New Zealand: New Data from the Aupouri Peninsula

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ABSTRACT

New analyses of obsidian artefact assemblages from 53 archaeological sites located on sand dunes of the western Aupouri Peninsula indicate that a well-developed distribution network operated in this area from the late 15th to 18th century. During the 16th–early 17th century this network included several key 'high activity' sites, containing large numbers of obsidian and other artefacts, which are considered to have acted as re-distribution centres. These formed part of at least four separate site clusters, apparently representing relatively long-term settlements. Most of the obsidian was procured, probably by a combination of direct access and exchange, from the Pungaere and Mayor Island sources, with lesser amounts from Coromandel Peninsula, Great Barrier Island, and Huruiki.

*Keywords*: Aupouri Peninsula, Ninety Mile Beach, obsidian, site clusters, distribution network

## INTRODUCTION

There have been numerous studies of pre-European obsidian artefact collections in New Zealand, many of them concerned primarily with identifying the original geological source of the material recovered from individual sites (e.g. Sheppard *et al.* 2011, see also Sheppard 2004). While this has provided invaluable information on the range of sources exploited, few reports have given much consideration to *how* the obsidian was procured, or to the geographic extent and temporal span of distribution (exchange) networks during the prehistoric period. However, it is evident from some New Zealand-wide studies (e.g. Seelenfreund & Bollong 1989, Walter *et al.* 2010), and analyses of assemblages from groups of sites within particular areas, such as at Palliser Bay (Leach & Anderson 1978, Prickett 1979) and along the Waikato-King Country coastline (Moore 2011), that far-reaching distribution networks were established shortly after initial settlement.

In this paper we report on the analysis of obsidian assemblages from 53 archaeological sites located on sand dunes inland from Ninety Mile Beach (Te Oneroa a Tohe), in the Far North of New Zealand (Figure 1). These sites were recorded as part of the Aupouri Sand Dunes Archaeological Study over a 10 year period from 1976 to 1986 (Coster 1983, 1989). Of some 400 pre-European sites recorded within the study area over 150 were systematically sampled, mapped, excavated or otherwise studied in detail. In the process some 7500 pieces (approximately 27 kg in total) of worked stone, mostly flakes and cores, were

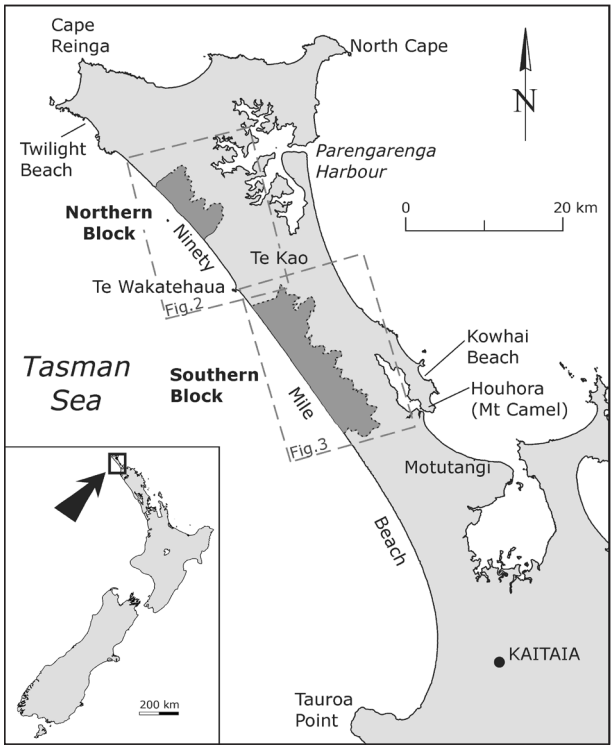


Figure 1. Location of the study area (darker shading), and other places mentioned in the text.

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collected, of which about 70 percent were obsidian. These collections, which include items of chert, quartz, quartzite, sandstone, nephrite, metasomatised argillite and iron oxide (ochre), are now held by Auckland Museum.

The obsidian assemblages were analysed in 2010–11, using a combination of visual attributes and energy-dispersive XRF (EDXRF) to establish the proportions of obsidian derived from different sources, and provide some insights into how this lithic material was procured and distributed in what is a relatively remote part of New Zealand. Other sites in the Far North where obsidian assemblages have been analysed, with varying degrees of reliability, include those at Twilight Beach near Cape Reinga (Taylor 1984), North Cape (Moore 1988) and Houhora (Seelenfreund & Bollong 1989, Furey 2002; Figure 1). Some data on the obsidian from these sites are presented elsewhere (Moore 2012a).

## SETTING

The Aupouri Peninsula is a large tombolo some 85 km long and up to 15 km wide (Figure 1). It is composed of Pleistocene to Holocene dune and beach sands with outliers of much older volcanic and sedimentary rocks forming the higher land between Cape Reinga and North Cape, around the Parengarenga Harbour, and at Mt. Camel (Houhora), which represent former islands (Isaac 1996). Along the western side of the peninsula at Ninety Mile Beach, deflated dunes extend up to a kilometre behind central and southern parts of the beach while transverse dunes, now stabilised by pine trees, extend up to 5 km inland. The dunes are bordered by a zone of wetlands and podzolised 'gum-land' soils along central and eastern parts of the peninsula. Soils exhibit varying degrees of weathering and consolidation, and within the formerly mobile west coast dune belt podzolised Pleistocene sands and loosely-consolidated Holocene Pinaki sands form isolated exposures among the younger transverse dunes (Sutherland *et al.* 1979). It is on these exposures of once-stable soils that most archaeological sites are located.

Evidence that the peninsula once supported extensive coastal lowland forest is provided by sub-fossil wood, charcoal and land snails found on the dunes (Coster 1983), and by small forest remnants near Mt Camel and Te Kao (Conning & Holland 2003: 28). If the small number of defensive pa on the central part of the tombolo may be taken as an indicator of population density, much of the area was relatively sparsely settled in the later prehistoric period. This may reflect the limited availability of arable soils, although extensive pre-European garden areas, characterised by wetland drains, occur at Onepu adjoining the study area, and also further south at Motutangi (Carpenter 2012, Furey 2006, Horrocks & Barber 2005; Figures 1, 3). In spite of the small number of pa, however, other sites of Maori occupation, consisting of shell middens, artefacts and oven stones are widespread on the west coast sand dunes.

## THE STUDY AREA

The Aupouri Sand Dunes Study was confined to two separate areas of mobile sand dunes at Ninety Mile Beach, separated by 11 km of previously-planted pine forest (Figure 1). The northern block (30 km²) extends for 9 km between the Waikoropupunoa and Waikanae Streams, and lies 5 km from the Parengarenga Harbour on the east coast (Figure 2). Here the dunes rise to around 120 m above sea level and are bounded to the east by impoverished podzolised Pleistocene sands. Remnants of these sands also form extensive exposures among the mobile dunes. The southern block (90 km²) extends for 21 km along the central part of the beach and is situated northwest of the Houhora Harbour, which is 5 km distant at its closest point (Figure 3). The dunes in this block, by contrast, are lower, rising to between 50 and 90 m, the eastern edge formed largely by Holocene and recent sands. The two blocks extend through the contemporary *rohe* (territory) of Ngati Kuri, Te Aupouri and Ngai Takoto.

Since 1986, archaeological surveys (Johnson 1990, Maingay 1993) have also been carried out in the area separating the two blocks, between the Waikanae Stream and Te Arai. Some 80 sites, comprising middens, stone scatters

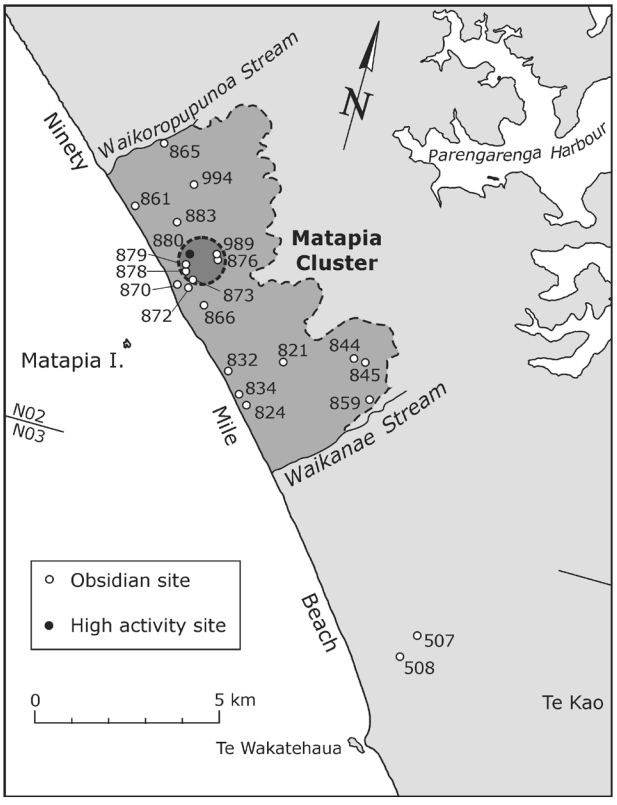


Figure 2. Map of the northern block showing locations of sites with analysed obsidian assemblages, and Matapia cluster (circled area). All site numbers prefixed N02, except those near Te Wakatehaua.

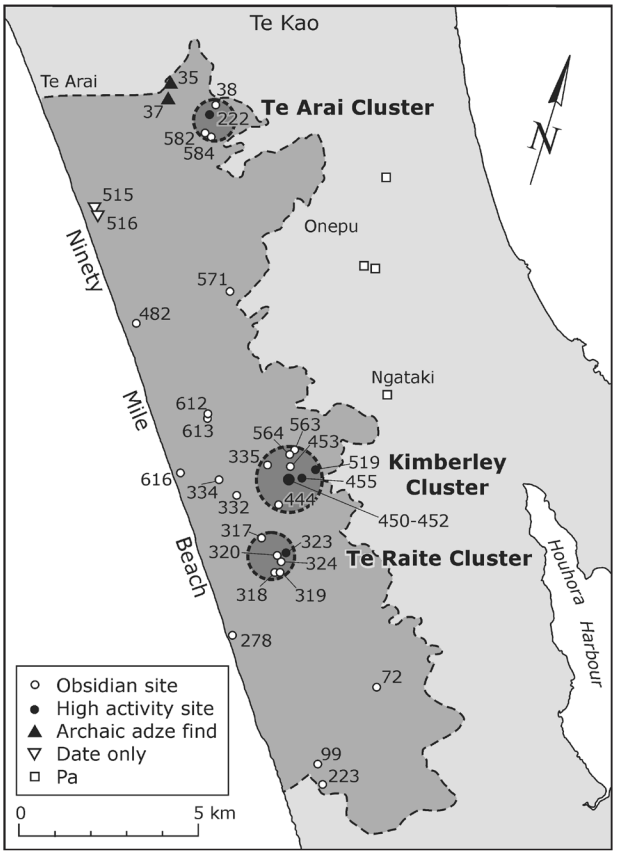


Figure 3. Map of the southern block showing locations of sites and site clusters (circled areas in darker shading). All site numbers prefixed N03.

and artefact finds (including numerous obsidian flakes) were recorded. This area was planted in pines between 1972 and 1976, prior to systematic archaeological assessment of the Aupouri dunes and is not included in the present study, apart from two sites (N03/507, 508) from which obsidian had been collected (Figure 2). The surveys of this central area were not exhaustive and it is probable that the density of sites is substantially higher than recorded, and comparable to that of the northern and southern blocks.

## DISTRIBUTION AND NATURE OF SITES

Sites recorded during the Aupouri study do not necessarily represent spatially or temporally discrete occupation features. Some extensive occupation areas were, for reasons of convenience, recorded as more than one individually numbered 'site' under the New Zealand Archaeological Association (NZAA) site recording scheme, while in other cases, particularly along the coast, areas which could have included more than one event in the past were recorded together as a single site. In virtually all cases site extent was partially obscured by sand drifts or coastal vegetation. Stratigraphy was generally simple (or non-existent), making it difficult to estimate the length of occupation of individual sites. Sites were originally recorded under the imperial system, based upon 1:63360 scale topographic maps, but have since been allocated metric numbers.

Coster (1983, 1989: 54–57) described the archaeological site distribution behind Ninety Mile Beach in terms of 'coastal' and 'inland' zones. About 60 per cent were classified as inland sites and 40 per cent as coastal. Coastal sites are located on unweathered dune sand, generally between 50 and 350 m from high tide mark. They consist mainly of extensive midden complexes of concentrated shell, often burned and crushed, with oven stones but very few artefacts. These sites are interpreted as the products of large-scale shellfish processing. In contrast, inland sites, particularly in the southern block, are commonly underlain by Holocene paleosols (possibly arable at the time of occupation) and many contain a variety of artefacts along with oven stones and debitage, representing a range of activities from fishing to woodworking. Some include shellfish from east coast harbours and rocky shores, as well as from the open sandy west coast beach. A few of these inland sites (or site complexes) are extensive, up to four hectares in area, and are likely to represent former *kainga* (villages or hamlets). The distinction between coastal and inland sites is less clear in the northern block where a broad deflation zone, with scattered archaeological remains, forms a transition between the two.

Artefacts were found at 62 percent of inland sites but only 25 percent of the coastal sites. The number of artefacts recorded per site was generally fewer than 100, but five 'high activity' inland sites in the southern block (N03/222, 323, 450–452, 455, 519, Figure 3) stand out in terms of their artefact content. Each yielded between 400 and 1700 artefacts, which in total represent 60 percent of the artefacts collected overall and 59 percent of the obsidian. These sites contrast markedly with all others, though in the northern block N02/821 and N02/880, with 200 and 150 items respectively, are comparable.

Of the 'high activity' sites N03/450–452 is a large occupation complex covering some four hectares in area (Figure 4). It included 100 individual ovens, 70 midden deposits and a probable house site (indicated by post-holes associated with a major artefact concentration), and yielded 1700 artefacts. It probably represents one or more occupations. Nearby N03/455 is 1800 m² in area with *in situ* middens, ovens and 400 artefacts including stone files, hammer stones, obsidian and quartzite. Site N03/323, covering an area of at least 700 m², with 1100 artefacts including stone files, hammer stones and adzes, and a large successively re-used hangi, suggests, like N03/455, at least a seasonal household. Similarly N03/519, covering an area of around 4000 m², contained an intact midden, evidence of intense fires and 500 artefacts, including flakes, files and red ochre. Site N03/222, some 2000 m² in area, included around 1000 artefacts (73 percent of them obsidian) and a large number of water-rolled pebbles, six of which showed evidence of use as hammer stones. It contained

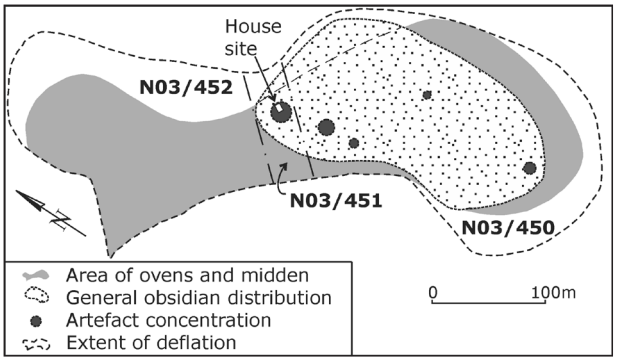


Figure 4. Plan of the large site complex N03/450–452 (recorded as three sites), in the Kimberley cluster, showing the general distribution of obsidian artefacts. Extent of site N03/451 delineated by parallel lines.

little other evidence of occupation such as shell midden or oven stones, though the stone material is indicative of intensive activity.

These, together with N02/880 in the northern block, form the cores of four separate *clusters* (Figures 2, 3), which are groups of sites containing higher than usual numbers of artefacts and evidence of multiple activities such as cooking and tool manufacture. The 'Matapia cluster' (labelled 'M' on tables) in the northern block is an exception in that its principal site N02/880 yielded only 150 artefacts. This cluster is situated between 200 and 1700 m from the coast. The three clusters in the southern block are located further inland (Figure 3). The northern 'Te Arai cluster' (TA) lies between 3 and 5 km inland and its principal site is N03/222. The 'Kimberley cluster' (K), previously identified by Coster (1989:57), incorporates the major sites N03/450–452, 455 and 519 and extends over some 2 km. It lies within 3–6 km of pa and extensive gardens at Ngataki and Onepu, which are assumed to have been a focus of activity in the pre-European past. The nearby 'Te Raite cluster' (TR), possibly a southern extension of the Kimberley group, is about one kilometre across, 1.5–2.5 km from the sea, and centred on N03/323. Notably, both clusters are situated close to the upper reaches of Houhora Harbour. It seems that these two southern site clusters in particular represent groupings of longer term, multiple-use sites, which served as a base for a range of activities, including fishing, shell-fishing, gardening and tool manufacture. Such clusters were perhaps strategically positioned on overland routes between the west coast and eastern harbours to enable access to a wider variety of resources.

## AGE

Twenty radiocarbon dates have been previously obtained for sites in the study area (Coster 1989, McFadgen 2007), all from intact deposits, and calibrated ages for 16 of these are presented in Table 1. Shell dates were re-calibrated using the Marine13 curve and a local marine reservoir correction (Delta R) of $-7 \pm 45$ (F. Petchey pers. comm.). The one charcoal sample (NZ6581), from an oven at site N03/323, included *Beilschmiedia taraire* (taraire) and *Kunzea ericoides* (kanuka) and could have an inbuilt age of 50 years or more. Of the four dates excluded, three are from sites containing little or no obsidian, and one (NZ6608, from N03/455) was on charcoal which may have had a significant inbuilt age. Three dates (from N03/515 and 516, Figure 3) were included to increase the representation of coastal sites.

The majority of inland sites seem to have been occupied during some part of the 16th to early 17th century, though some of those in the Kimberley cluster may have ranged into the late 17th century. None definitely date to before 1450 AD. The oldest reliable date (late 15th – early 16th century) is for a site within the Matapia cluster of the northern block (N02/876, NZ7068). Thus it would appear that occupation of the inland dunes probably spanned a period of about 200 years, from the late 15th to late 17th century. It is believed that inland sites had largely been abandoned by around 1650 AD due to dune migration and environmental degradation (Coster 1989). The dates for coastal sites indicate that while some may be contemporary with those further inland (N03/482), others (N02/870, N03/515, 516) are undoubtedly later and probably date to around the mid to late 18th century. According to local residents, seasonal occupation along the coast continued into the 20th century.

Prior to afforestation of the central block a number of adzes of early (Archaic) form had been collected by employees of the NZ Forest Service, particularly in the area around Te Arai and Te Wakatehaua (see Coster & Johnston 1977). These included two side-hafted (Type 5) adzes of Tahanga basalt (Moore *et al.* 1979), at least one 'hogback' adze from N03/35, and an argillite adze from N03/37 (Figure 3). They point to occupation of this area somewhat earlier than indicated for other sites in the study area, perhaps in the 14th century. It has been suggested that a tsunami in the late 15th century may have been responsible for destabilisation of the dunes along Ninety Mile Beach (McFadgen 2007:162–163), which could account for the absence of Archaic sites close to the coast.

## COLLECTION OF OBSIDIAN ASSEMBLAGES

Archaeological sites exposed on the Aupouri dunes have been subjected over a long period to disturbance by wind deflation, sand migration, water erosion, stock trampling, vehicle movement and casual artefact collecting. Although many sites have been exposed by deflation, others must have been hidden by sand accumulation. This study therefore relies on an incomplete sample of the obsidian transported to the Ninety Mile Beach area during its occupation by pre-European Maori. We would argue, however, that the size of the total assemblage, and large area covered, validate the results obtained.

Table 1. *Radiocarbon dates for Aupouri sites. Dates calibrated using Oxcal 4.2.3, Marine13 curve, and IntCal13 atmospheric curve.*

| Site no. (1) | Lab no. | CRA (2) | Calibrated date (cal AD) | | Context (3) |
|---|---|---|---|---|---|
| | | | 68% prob. | 95% prob. | |
| **Inland** | | | | | |
| N02/821 (N) | NZ7066 | 766 ± 36 | 1470–1620 | 1450–1660 | Midden |
| N02/876 (TA) | NZ7068 | 818 ± 49 | 1430–1560 | 1400–1650 | Midden |
| N03/582 (TA) | NZ7097 | 775 ± 36 | 1460–1590 | 1440–1660 | Midden |
| N03/519 (K) | NZ7069 | 713 ± 48 | 1520–1660 | 1460–1700 | Midden |
| N03/450 (K) | NZ6228 | 685 ± 44 | 1540–1670 | 1460–1800 | Midden |
| N03/450 (K) | NZ6303 | 679 ± 55 | 1530–1680 | 1470–1810 | Pit fill |
| N03/450 (K) | NZ7105 | 729 ± 59 | 1500–1650 | 1440–1700 | Midden |
| N03/455 (K) | NZ6229 | 698 ± 55 | 1520–1670 | 1450–1800 | Midden |
| N03/323 (TR) | NZ6581 | 430 ± 32 | 1430–1480 | 1420–1620 | Oven (base) |
| **Coastal** | | | | | |
| N02/870 (N) | NZ7067 | 524 ± 27 | 1690–1850 | 1680–1950 | Midden |
| N03/515 | NZ6301 | 528 ± 54 | 1690–1870 | 1660–1950 | Midden |
| N03/515 | NZ6302 | 597 ± 45 | 1640–1820 | 1540–1900 | Midden |
| N03/516 | NZ6299 | 583 ± 55 | 1640–1830 | 1550–1950 | Midden |
| N03/482 | NZ6226 | 574 ± 54 | 1650–1830 | 1590–1950 | Midden |
| N03/482 | NZ6281 | 675 ± 45 | 1540–1680 | 1470–1810 | Midden |
| N03/482 | NZ6282 | 656 ± 55 | 1540–1700 | 1480–1820 | Midden |

1 Letters in brackets: N = Northern Block, TA = Te Arai cluster; K = Kimberley cluster; TR = Te Raite cluster
2 All dates on shell (*Paphies ventricosa, P. subtriangulata*) except NZ6581 (charcoal)
3 All samples from sealed *in situ* deposits

The methodology employed in the collection of artefacts varied from taking only a proportion of exposed material (typically 20–50 percent), collecting all that visible on a site at a particular time, to systematic collection over a period of months, involving gridding, scraping down, excavation and sieving of material from specific sites. In general, collecting from sites recorded earlier (N02/821–866, N03/35–335; 1976–79) was less complete than from those recorded later (N02/870–994, N03/444–616; 1980–1983). While spatial control over sampling was relatively good, with each site or sample being located by the use of aerial photographs to within 50–100 m, temporal control is lacking since few artefacts were recovered from *in situ* or directly dated contexts. Altogether, collections of obsidian were made from 169 sites, representing 42 percent of the 400 recorded.

## ANALYSIS

Obsidian assemblages from a total of 90 sites were actually examined, but for practical reasons data for only a selection of these (53 sites)–20 in the northern block, 31 in the southern block, and two in between – are used in the analyses presented here (Table 2). The locations of the sites are shown on Figures 2 and 3. These sites were selected, mainly on the basis of collection size, in order to achieve a reasonable geographic coverage and balance between inland and coastal sites (including most of those dated), while still providing a representative sample of the obsidian utilised in the area. All except two of the collections from excluded sites consisted of <20 pieces.

The assemblages consist of flakes, shatter (irregularly-shaped pieces) and small cores, most of which have been sand-blasted. Many of the flakes and shatter collected from some sites are very small (<1 cm long) and clearly constitute waste material. These were not generally included in the analysis as they are too difficult to source reliably. Altogether data are provided for 3534 pieces, which represents 65 percent of the total obsidian collected. Although the obsidian was not weighed separately, based on an estimated average per piece of 3–4 g the total weight involved is probably in the order of 10–14 kg.

Two different methods were employed in the analysis of the obsidian assemblages: visual examination of physical attributes, followed by chemical analysis of selected pieces by energy-dispersive X-ray fluorescence (EDXRF). The visual examination resulted in sorting of the assemblages into different types and groups and provided some preliminary source allocations, as well as information on cortex (Table 3). EDXRF analysis was used to identify more precisely the original source of some of the obsidian within those groups (Table 4).

Table 2. *Numbers of analysed artefacts in 53 Aupouri sites according to different obsidian types, arranged from north (top) to south. Those analysed by* EDXRF *shown in brackets. Letter codes adjacent to site numbers refer to clusters (M = Matapia, TA = Te Arai, K = Kimberley, TR = Te Raite). Dated sites indicated by*. See Figures 6, 7 for graphic representations of data.*

| Site no. | Location | Mayor I. | Pungaere | Grey | Total |
|---|---|---|---|---|---|
| **NORTHERN BLOCK** | | | | | |
| N02/865 | Inland | 25 | 2 | 0 | 27 |
| N02/861 | Coastal | 41 | 0 | 1 | 42 |
| N02/994 | Inland | 0 | 0 | 1 (1) | 1 |
| N02/883 | Inland | 11 | 3 | 3 (1) | 17 |
| N02/880 (M) | Inland | 32 | 2 | 0 | 34 |
| N02/879 (M) | Inland | 19 | 1 | 2 (1) | 22 |
| N02/878 (M) | Inland | 48 | 1 | 1 | 50 |
| N02/989 (M) | Inland | 27 | 12 | 0 | 39 |
| N02/876 (M) * | Inland | 4 | 5 | 0 | 9 |
| N02/870 * | Coastal | 3 | 7 | 0 | 10 |
| N02/873 | Inland | 11 | 0 | 1 (1) | 12 |
| N02/872 | Inland | 16 | 0 | 0 | 16 |
| N02/866 | Inland | 14 | 2 | 9 | 25 |
| N02/832 | Coastal | 8 | 10 | 0 | 18 |
| N02/821 * | Inland | 12 | 109 | 0 | 121 |
| N02/834 | Coastal | 27 | 6 | 1 | 34 |
| N02/824 | Coastal | 18 | 6 | 5 | 29 |
| N02/844 | Inland | 7 | 17 | 2 (1) | 26 |
| N02/845 | Inland | 6 | 17 | 10 | 33 |
| N02/859 | Inland | 12 | 30 (1) | 16 (5) | 58 |
| **CENTRAL AREA** | | | | | |
| N03/507 | Inland | 3 | 16 | 0 | 19 |
| N03/508 | Inland | 30 | 73 | 1 | 104 |
| **SOUTHERN BLOCK** | | | | | |
| N03/37 | Inland | 1 | 20 | 1 | 22 |
| N03/38 (TA) | Inland | 4 | 9 | 5 | 18 |
| N03/222 (TA) | Inland | 29 | 334 | 280 (13) | 643 |
| N03/582 (TA) * | Inland | 2 | 8 | 11 (2) | 21 |
| N03/584 (TA) | Inland | 72 (1) | 0 | 0 | 72 |
| N03/571 | Inland | 0 | 4 | 1 (1) | 5 |
| N03/482 * | Coastal | 1 | 17 | 1 (1) | 19 |
| N03/612 | Inland | 0 | 28 | 0 | 28 |
| N03/613 | Inland | 0 | 37 | 0 | 37 |
| N03/616 | Coastal | 31 | 0 | 0 | 31 |
| N03/334 | Inland | 2 | 7 (1) | 1 | 10 |
| N03/332 | Inland | 1 | 24 | 0 | 25 |
| N03/335 (K) | Inland | 7 | 20 | 0 | 27 |
| N03/453 (K) | Inland | 10 | 39 | 1 | 50 |
| N03/563 (K) | Inland | 0 | 3 | 3 (1) | 6 |
| N03/564 (K) | Inland | 1 | 7 | 40 (2) | 48 |
| N03/519 (K) * | Inland | 15 | 162 | 1 | 178 |
| N03/450 (K) * | Inland | 57 | 238 | 4 (2) | 299 |
| N03/451 (K) | Inland | 6 | 200 | 2 (1) | 208 |
| N03/455 (K) * | Inland | 53 | 150 | 0 | 203 |
| N03/444 (K) | Inland | 3 | 26 | 0 | 29 |
| N03/317 (TR) | Inland | 7 | 1 | 12 | 20 |
| N03/320 (TR) | Inland | 3 | 7 | 1 (1) | 11 |
| N03/323 (TR) * | Inland | 112 | 261 | 100 (5) | 473 |

Table 2 *continued*

| Site no. | Location | Mayor I. | Pungaere | Grey | Total |
|---|---|---|---|---|---|
| N03/324 (TR) | Inland | 21 | 34 | 18 (2) | 73 |
| N03/318 (TR) | Inland | 21 | 55 | 3 (2) | 79 |
| N03/319 (TR) | Inland | 7 | 15 | 6 (1) | 28 |
| N03/278 | Coastal | 0 | 4 | 1 (1) | 5 |
| N03/72 | Inland | 2 | 45 | 0 | 47 |
| N03/99 | Inland | 2 | 23 | 0 | 25 |
| N03/223 | Inland | 20 | 26 | 2 (1) | 48 |
| **TOTALS** | | **864** | **2123** | **547** | **3534** |

Table 3. *Proportion of artefacts with cortex from selected sites. Letters in brackets refer to site clusters.*

| Type | Pungaere | | | | Grey | | | |
|---|---|---|---|---|---|---|---|---|
| Site no. | N | % of total no. | No. with cortex | Cortex % | N | % of total no. | No. with cortex | Cortex % |
| N02/821 | 109 | 89 | 16 | 15 | | | | |
| N02/859 | 30 | 52 | 5 | 17 | 16 | 28 | 3 | 19 |
| N03/222 (TA) | 334 | 52 | 14 | 4 | 280 | 44 | 40 | 14 |
| N03/482 | 17 | 89 | 4 | 24 | | | | |
| N03/508 | 73 | 70 | 17 | 23 | | | | |
| N03/450 (K) | 238 | 80 | 47 | 20 | | | | |
| N03/451 (K) | 200 | 96 | 75 | 37 | | | | |
| N03/453 (K) | 39 | 78 | 13 | 33 | | | | |
| N03/455 (K) | 150 | 74 | 22 | 15 | | | | |
| N03/519 (K) | 162 | 91 | 24 | 15 | | | | |
| N03/564 (K) | | | | | 40 | 83 | c.10 | 25 |
| N03/317 (TR) | | | | | 12 | 60 | 2 | 17 |
| N03/318 (TR) | 55 | 70 | 10 | 18 | | | | |
| N03/323 (TR) | 261 | 55 | 63 | 24 | 100 | 21 | 16 | 16 |
| N03/324 (TR) | 34 | 46 | 4 | 12 | 18 | 25 | 3 | 17 |
| **Total/mean** | **1702** | | **314** | **18** | **466** | | **74** | **16** |

## VISUAL ATTRIBUTES

The obsidian artefacts were initially sorted into three different *types* on the basis of colour in transmitted light (olive green, green-grey and grey), using a fluorescent light box, binocular microscope and cold light source. In most cases the grey obsidian could be readily distinguished from all other material, but some difficulty was experienced in separating the green and green-grey pieces, mainly because of the extent of sand-blasting which significantly reduces the translucency. A distinction was therefore generally made on a combination of colour, texture and cortex.

All of the obsidian which is olive green in colour (in transmitted light) is considered to be from Mayor Island, in the Bay of Plenty (see Figure 10). It is usually more translucent than the green-grey material, occasionally flow-banded, and also more vitreous. Cortex is rarely preserved, but where present is invariably water-worn. In contrast, the green-grey obsidian has a speckled texture, duller lustre, and is rarely flow-banded, features which are typical of material from the Pungaere source near Kaeo (Moore 2012b). A proportion of the flakes and shatter of this type have remnants of rough pitted cortex (partly smoothed by sand-blasting), and a few have slightly water-worn cortex, indicating that some of the original material came from a fluvial context. The presence of rough cortex proved to be a useful criterion in distinguishing Pungaere from Mayor Island obsidian.

The grey obsidian was examined more closely in order to establish potential sources for this material, using the procedure outlined by Moore (1988, 2011). Four main groups were recognised on the basis of similarities in visual attributes. The dominant group (Group A) is characterised by obsidian with moderate to poor translucency, weak to strong flow banding, and a relatively high proportion of flakes and shatter with grey spherulites. Though the

Table 4. *Chemical (EDXRF) analyses of Aupouri obsidian artefacts. Element concentrations in ppm.*

| Site no. | Sample | Rb | Sr | Zr | Rb/Sr | Zr/Rb | Group | Source |
|---|---|---|---|---|---|---|---|---|
| **NORTHERN BLOCK** | | | | | | | | |
| N02/844 | Z3184/14 | 119 | 70 | 128 | 1.70 | 1.08 | A | Cooks Beach |
| N02/859 | Z3568/1 | 140 | 93 | 139 | 1.50 | 0.99 | A | Hahei |
| N02/859 | Z3568/13 | 115 | 64 | 119 | 1.80 | 1.03 | A | Cooks Beach |
| N02/859 | Z3568/21 | 119 | 66 | 126 | 1.80 | 1.06 | A | Cooks Beach |
| N02/859 | Z3568/22 | 125 | 71 | 134 | 1.76 | 1.07 | A | Cooks Beach |
| N02/859 | Z3568/23 | 638 | 0 | 1961 | – | 3.07 | n/a | Pungaere |
| N02/859 | Z3389/2 | 184 | 35 | 226 | 5.26 | 1.23 | A1 | Poor Knights |
| N02/873 (M) | Z3190/3 | 141 | 38 | 150 | 3.71 | 1.06 | A | Huruiki |
| N02/879 (M) | Z3196/10 | 135 | 90 | 146 | 1.50 | 1.08 | A | Hahei |
| N02/883 | Z3200/8 | 122 | 69 | 125 | 1.77 | 1.02 | A | Cooks Beach |
| N02/994 | Z3449 | 116 | 64 | 122 | 1.81 | 1.05 | A | Cooks Beach |
| **SOUTHERN BLOCK** | | | | | | | | |
| N03/222 (TA) | Z3422/7 | 207 | 26 | 129 | 7.96 | 0.62 | C | Te Ahumata |
| N03/222 (TA) | Z3422/53 | 121 | 66 | 126 | 1.83 | 1.04 | B | Cooks Beach |
| N03/222 (TA) | Z3422/93 | 114 | 64 | 119 | 1.78 | 1.04 | A | Cooks Beach |
| N03/222 (TA) | Z3422/213 | 115 | 66 | 122 | 1.74 | 1.06 | A | Cooks Beach |
| N03/222 (TA) | Z3422/358 | 118 | 69 | 122 | 1.71 | 1.03 | A | Cooks Beach |
| N03/222 (TA) | Z3422/437 | 121 | 69 | 126 | 1.75 | 1.04 | A | Cooks Beach |
| N03/222 (TA) | Z3422/532 | 130 | 73 | 136 | 1.78 | 1.05 | B | Cooks Beach |
| N03/222 (TA) | Z3422/600 | 211 | 27 | 127 | 7.81 | 0.60 | C | Te Ahumata |
| N03/222 (TA) | Z3422/616 | 136 | 93 | 129 | 1.46 | 0.95 | A | Hahei |
| N03/222 (TA) | Z32422/704 | 117 | 68 | 126 | 1.72 | 1.08 | A | Cooks Beach |
| N03/222 (TA) | Z3422/709 | 181 | 21 | 113 | 8.62 | 0.62 | B | Te Ahumata |
| N03/222 (TA) | Z3422/895 | 135 | 91 | 137 | 1.48 | 1.01 | A | Hahei |
| N03/222 (TA) | Z3422/948 | 187 | 22 | 112 | 8.50 | 0.60 | C | Te Ahumata |
| N03/582 (TA) | Z3431/19 | 119 | 68 | 127 | 1.75 | 1.07 | A | Cooks Beach |
| N03/582 (TA) | Z3431/20 | 136 | 95 | 156 | 1.43 | 1.15 | A | Hahei |
| N03/584 (TA) | Z3432/50 | 129 | 0 | 974 | | 7.34 | n/a | Mayor I |
| N03/482 | Z3396/11 | 132 | 92 | 126 | 1.43 | 0.95 | A | Hahei |
| N03/450 (K) | Z3031/170 | 118 | 66 | 122 | 1.79 | 1.03 | A | Cooks Beach |
| N03/450 (K) | Z3031/301 | 119 | 68 | 125 | 1.75 | 1.05 | A | Cooks Beach |
| N03/451 (K) | Z3530/481 | 114 | 67 | 122 | 1.70 | 1.07 | B | Cooks Beach |
| N03/563 (K) | Z3573/1 | 118 | 69 | 125 | 1.71 | 1.06 | A | Cooks Beach |
| N03/564 (K) | Z3416/56 | 124 | 71 | 130 | 1.75 | 1.05 | A | Cooks Beach |
| N03/564 (K) | Z3416/61 | 113 | 67 | 122 | 1.69 | 1.08 | A | Cooks Beach |
| N03/571 | Z3428/1 | 179 | 34 | 213 | 5.26 | 1.19 | A1 | Poor Knights |
| N03/223 | AR6753/4 | 204 | 49 | 141 | 4.16 | 0.69 | D | Fanal |
| N03/278 | Z3402/2 | 196 | 48 | 145 | 4.08 | 0.74 | D | Fanal |
| N03/318 (TR) | Z3541 | 128 | 38 | 133 | 3.37 | 1.04 | A | Huruiki |
| N03/318 (TR) | AR6774/3 | 182 | 34 | 217 | 5.35 | 1.19 | A1 | Poor Knights |
| N03/319 (TR) | AR6775/4 | 124 | 89 | 131 | 1.39 | 1.06 | A | Hahei |
| N03/320 (TR) | AR6776/2 | 185 | 34 | 217 | 5.44 | 1.17 | A1 | Poor Knights |
| N03/323 (TR) | Z3030/44 | 209 | 40 | 259 | 5.23 | 1.24 | A1 | Poor Knights |
| N03/323 (TR) | Z3030/89 | 188 | 36 | 226 | 5.22 | 1.20 | A1 | Poor Knights |
| N03/323 (TR) | Z3030/346 | 137 | 39 | 142 | 3.50 | 1.04 | A | Huruiki |
| N03/323 (TR) | Z3030/625 | 121 | 67 | 129 | 1.80 | 1.07 | B | Cooks Beach |
| N03/323 (TR) | Z3030/734 | 185 | 36 | 229 | 5.14 | 1.24 | A1 | Poor Knights |
| N03/324 (TR) | Z3543/1 | 183 | 33 | 219 | 5.54 | 1.20 | A1 | Poor Knights |
| N03/324 (TR) | Z3543/44 | 188 | 35 | 231 | 5.37 | 1.23 | A1 | Poor Knights |
| N03/334 | AR6789/2 | 669 | 0 | 2058 | – | 3.08 | n/a | Pungaere |

bulk of the obsidian in this group is quite similar, some pieces contain sparse to common yellowish glassy globules (about 1–2 mm diameter), are medium to dark grey in colour, brownish in transmitted light, or have very poor translucency. Those with globules are sufficiently different (and numerous) to be classified as a separate sub-group (A1), and almost certainly came from a different source. The remainder appeared to be derived from perhaps only one or two sources, most likely Cooks Beach and/or Hahei, on Coromandel Peninsula (Moore 2012a, 2013). These sources are only about 1–2 km apart.

Group B consists of pieces with moderate to good translucency, usually weak or wispy flow banding, few if any spherulites, and generally rare globules. The main source for the obsidian in this group was considered to be Cooks Beach, with some possibly from Te Ahumata (i.e. those without globules). Group C comprises a small number of flakes and shatter with good translucency, weak flow banding and no globules. The most likely source for these is Te Ahumata, although Taupo (central North Island) cannot be excluded. Group D consists of a few flakes of relatively poor quality obsidian with moderate to good translucency, abundant phenocrysts, sparse to common globules and no spherulites. These characteristics are typical of the material from Fanal Island (Moore 2013). None of the artefacts appear to be from the nearest source of grey obsidian, Otoroa, which is of poor quality (Moore 2012b).

The reliability of sourcing on the basis of visual attributes has not been properly assessed. However a recent review of some New Zealand studies suggests that identifications of Mayor Island obsidian (based primarily on its green colour in transmitted light) are likely to be >90 percent correct, and in some cases 100 percent (Moore 2012c). Similar figures are probably attainable for Pungaere obsidian. The reliability of source attribution of grey obsidian is more variable because of the overlap in characteristics, and depends on the particular mix of sources represented, the condition of the material, and experience of the analyst, but in many cases errors (incorrect attributions) of around 10–15 percent can be expected.

## CORTEX

The recording of cortex was intended to identify any significant differences in the nature of the raw material being utilised, and possibly something about the place or means of procurement. The proportion of flakes, shatter and cores of Pungaere and grey obsidian with remnants of cortex at selected sites is indicated in Table 3, and the cortex percentage relative to the proportion of Pungaere and grey obsidian is plotted in Figure 5. For Pungaere obsidian the proportion of artefacts with cortex is generally in the order of 15–25 percent, but varies from 4 percent to 37 percent. The unusually low figure (4 percent) for N03/222, in the Te Arai cluster, suggests the Pungaere obsidian being used at

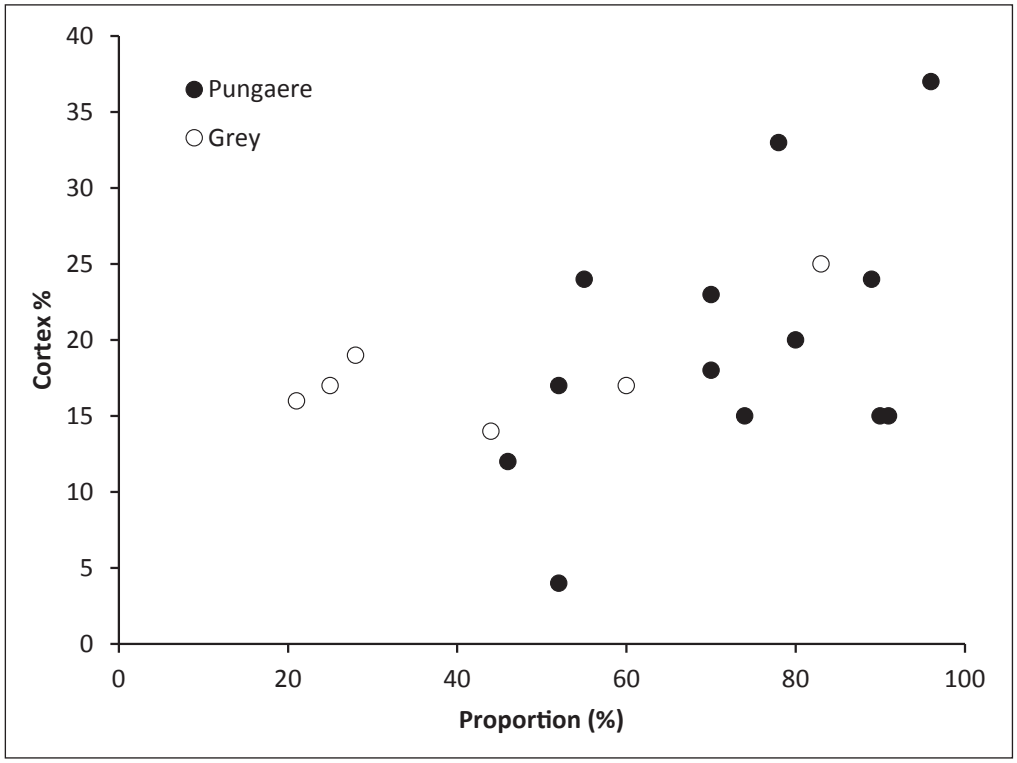


Figure 5. Plot of cortex % versus the proportion of Pungaere and grey obsidian in assemblages. Data from Table 3.

this site may have been in the form of pre-prepared cores rather than unworked cobbles. In contrast, the high cortex percentage at sites N03/451 and 453, which constitute part of the Kimberley cluster, indicates that material was probably being imported into these sites in a raw state, direct from source. Since the cortex preserved on Pungaere obsidian is mostly rough and pitted, not water worn, the bulk of the material was presumably obtained from colluvial rather than stream deposits.

The available figures for grey obsidian are reasonably similar, suggesting that the size and nature of the raw material being worked might not have been too different, though the percentage of grey obsidian with cortex at site N03/222 is considerably higher than that for the Pungaere material (Table 3). The very similar proportions of cortex at sites N03/323 and 324, which form part of the Te Raite cluster, could reflect a close connection between these two sites. At site N03/564 (Kimberley cluster), the relatively high percentage of cortex combined with the unusually high proportion of grey obsidian may indicate that much of this material was procured by direct access to the source. Overall there is a suggestion of a slight increase in cortex with increasing proportions, for both Pungaere and grey obsidian (Figure 5).

## CHEMICAL ANALYSES

Forty nine pieces of obsidian (46 grey, 2 green-grey, 1 olive green) were analysed by EDXRF using an INNOV-X Alpha series spectrometer at the Anthropology Department, University of Auckland. The specifications of this machine, and general analytical procedure, are outlined by Sheppard *et al*. (2011). 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 10 samples. The samples were selected mainly in order to provide a broad indication of the sources of grey obsidian rather than to identify the origin of every piece (which was considered both impractical and unnecessary), and to reveal any significant differences between the main site clusters. Thus many of the pieces chosen were those with more unusual visual characteristics. Selection was also constrained to some extent by size (i.e. not <1 cm), the need for relatively smooth flat surfaces, and avoidance of reference numbers painted on the artefacts.

EDXRF analyses of Rb, Sr and Zr for obsidian artefacts from 23 of the Aupouri sites are provided in Table 4, along with classifications according to the groups (A–D) identified from visual attributes. Sources were established by comparison with element ratios determined from conventional wavelength-dispersive XRF analyses of geological source samples (Moore 2012b, 2013). Scatter plots of Rb-Sr and Zr-Rb for geological and EDXRF samples were used to identify the sources of grey obsidian, based on the proximity of data points. The Rb-Sr diagram showed good clustering of samples attributed to Cooks Beach, Hahei and Huruiki, while those considered to have originated from Te Ahumata and Fanal formed a broad cluster with the pieces from Group A1. However those pieces in Group A1 were readily distinguished from Te Ahumata and Fanal obsidian on the Zr-Rb plot. Chemically, the Group A1 obsidian does not match that from any of the previously recognised sources in New Zealand (Moore 2012a).

All eight of the pieces from Group A1 that were analysed contain sparse to abundant globules, a feature which combined with the moderate to poor translucency would suggest they originated from the Huruiki source. However the EDXRF results show that they have much higher Rb and Zr values and Rb/Sr ratio than Huruiki obsidian, and therefore did not come from that source. They also have a considerably higher Zr concentration than Te Ahumata obsidian, besides which Te Ahumata material does not usually contain globules (Moore 2013). Comparison with analyses of obsidian artefacts from the Poor Knights Islands off the eastern Northland coast (Moore, unpublished data) provided a good match. This represents the first recorded occurrence of Poor Knights obsidian on the mainland.

Table 4 shows that for the most part there is good agreement between the tentative source assignments based on visual attributes and those indicated from chemical analyses. However, although Group A obsidian was largely derived from Cooks Beach-Hahei, three of the 27 samples analysed from this group (excluding A1) were from Huruiki, a source which has very similar visual characteristics to Hahei material (Moore 2012b). All of the pieces in this group which contained globules (Group A1) can be assigned to the Poor Knights. Artefacts with moderate to good translucency and few or no spherulites (Group B) originated from Cooks Beach and Te Ahumata, while those with good translucency (Group C) would appear to be entirely from Te Ahumata. As expected, the few flakes of poorer quality obsidian characterised by abundant phenocrysts and presence of globules (Group D), came from Fanal Island.

From a combination of visual attributes and the limited EDXRF analyses we have estimated the approximate proportions of grey obsidian from different sources for the two sites (N03/222 and 323) containing the largest quantities of this material (Table 5). These are the principal sites of the Te Arai and Te Raite clusters respectively. For N03/222 about 98 percent of the artefacts have moderate to poor translucency (Group A), and the EDXRF results suggest that most originated from Cooks Beach-Hahei. Two of the three of those in Group B were also from Cooks Beach. Only three have good translucency (Group C) and all of these are from Te Ahumata. There is a possibility that a few pieces in Group A are from Huruiki, but none appear to be from the Poor Knights (Group A1). Thus >95 percent of the grey obsidian at this site came from the Cooks Beach-Hahei sources.

Table 5. *Approximate proportions of grey obsidian from different sources at sites N03/222 (Te Arai cluster) and N03/323 (Te Raite cluster)*

| SITE | N03/222 (Te Arai cluster) | | N03/323 (Te Raite cluster) | |
|---|---|---|---|---|
| **Grey obsidian group** | **Visual ID (N=280)** | **EDXRF analyses (sources)** | **Visual ID (N=100)** | **EDXRF analyses (sources)** |
| Group A | *c.*274 | 7 (Cooks Beach, Hahei) | *c.*30 | 1 (Huruiki) |
| Group A1 | 0 | 0 | *c.*32 | 3 (Poor Knights) |
| Group B | 3 | 3 (Cooks, Te Ahumata) | *c.*38 | 1 (Cooks Beach) |
| Group C | 3 | 3 (Te Ahumata) | 0 | 0 |
| Group D | 0 | 0 | 0 | 0 |

These figures contrast with those for site N03/323 (Table 5), where only about 60 percent of the pieces are characterised by moderate to poor translucency (Group A + A1). Many of those in this group lacking spherulites may be from Huruiki, while the pieces containing globules (about 30) are probably mainly from the Poor Knights source. Approximately 38 percent have moderate to good translucency (Group B), and it is likely that the majority of these are from Cooks Beach. At least two other sites (N03/318, 324) in the Te Raite cluster also contained obsidian from the Poor Knights (Table 4), suggestive of a particular connection with these islands.

### SPATIAL VARIATION

The relative proportions of Mayor, Pungaere and grey obsidian in assemblages from 36 inland sites, determined from visual examination, are shown in Figure 6. Numbers of pieces in these assemblages range from 18 (N03/48) to 643 (N03/222), and most consist of 20–50. The sites are arranged from north to south in relation to the coastline, not map grid, and are distributed over a distance of about 40 km. A separate chart for coastal sites is presented in Figure 7.

It is evident from Figure 6 that most inland assemblages are dominated by Pungaere obsidian, except in the northern block where Mayor Island obsidian is predominant in half of the sites sampled. Few assemblages consist of obsidian from a single source. Grey obsidian is irregularly distributed throughout the area, and only a small number of sites contain a high proportion of grey material. Overall the inland sites account for 95 percent of the obsidian analysed (N = 3346), of which about 21 percent is from Mayor Island, 62 percent from Pungaere and 17 percent from various other sources.

For coastal sites most collections are very small (Table 2), and sufficient data are available for only seven of these (N = 10–42, Figure 7). Most of those in the northern block contain a relatively high proportion of Mayor Island obsidian (>40 percent). There are insufficient data to reach any useful conclusions about coastal sites in the southern block, although N03/616 (N = 31) appears to contain only Mayor Island obsidian. Compared to inland sites, coastal sites contribute only 5 percent of the total analysed (N = 188) but 69 percent of this is from Mayor Island, 26 percent from Pungaere and around 5 percent is grey. Hence in addition to differences between the northern and southern blocks (Figure 6), there are also notable differences between coastal and inland sites in terms of obsidian proportions.

### Site clusters

All four site clusters recognised in the study area include one or more 'high activity' sites, which together yielded over half of the obsidian and other lithics collected. The northernmost (Matapia) cluster is distinguished by a predominance of Mayor Island obsidian and presence of only minor grey material (Figure 6). However sites south of Matapia Island differ from those in this cluster by containing higher proportions of grey obsidian, and in this regard more closely resemble site clusters in the southern block. This may indicate the existence of a socio-political boundary within the northern block.

In the southern block, sites in the Te Arai cluster contain a relatively high proportion of grey obsidian, mainly from the Cooks Beach and Hahei sources. Site N03/584 is clearly atypical, and despite being situated close to N03/582 may not constitute part of this cluster. Assemblages from sites in the Kimberley cluster are fairly consistent, with the exception of N03/564 which contains an extremely high percentage of grey obsidian. However the collection from this site is small (N = 48). The Te Raite cluster is distinguished by very similar proportions of Mayor Island obsidian and relatively common grey material. Though the proportion of grey obsidian at N03/317 is unusually high, the collection from this site is very small (N = 20) and represents only about a quarter of the total pieces recorded. While the assemblages in the Te Arai and Te Raite clusters appear quite similar, site N03/222 (Te Arai cluster) is the only one where obsidian from the Te Ahumata source has been identified. In contrast, the Te Raite cluster contains both Poor Knights and Huruiki material (Tables 4, 5).

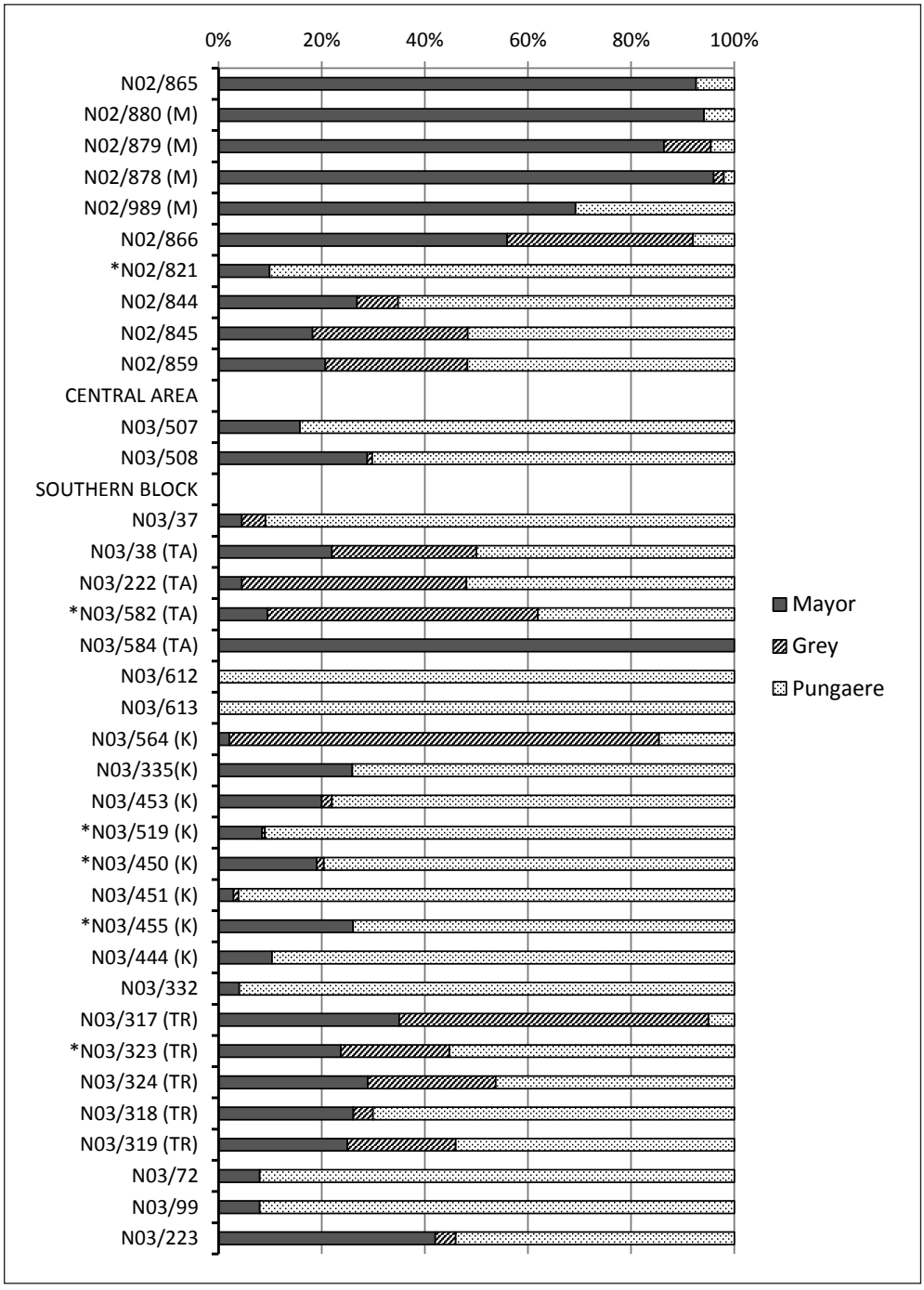


Figure 6 – Relative proportions of obsidian types at 36 inland sites, ordered from north (top) to south, based on data from Table 2. Site clusters are Matapia (M), Te Arai (TA), Kimberley (K) and Te Raite (TR). Dated sites indicated by *.

**Intra-site variation**

Separate collections were made from different parts of the larger sites within the Te Arai and Kimberley clusters and reveal the extent of spatial variation within them. A plot of some of the individual samples (N = 10 to 111) from site N03/222 (Figure 8) shows relatively similar proportions over an area of 50 m by 50 m, divided into 10 m squares. Mayor Island obsidian was apparently not present in all squares, and there appears to have been greater use of grey obsidian in area H. Most of the Te Ahumata obsidian was found in the south-eastern part in squares G, H and I. At the much larger site complex N03/450–452 (Figure 4), samples (N = 17 to 208) collected from 50 m grid squares over a distance of some 400 m showed considerable variation in proportions, with Mayor Island obsidian consti-

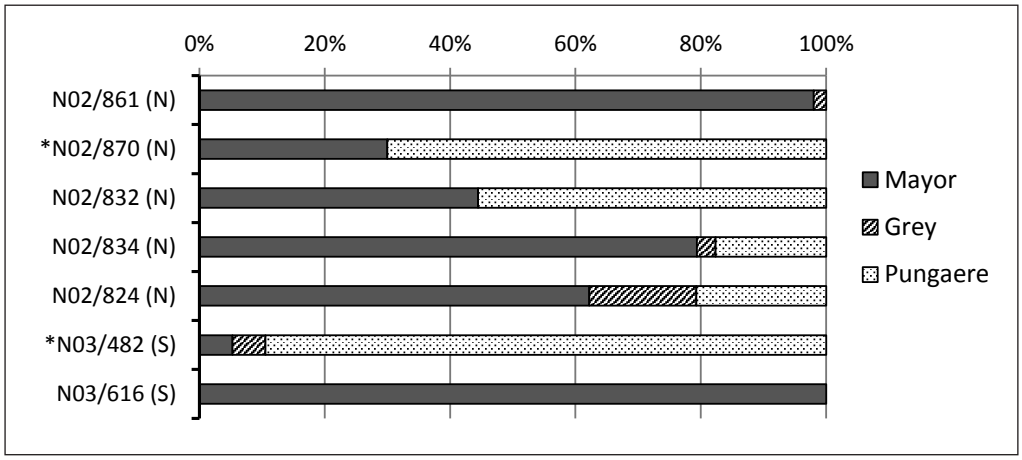


Figure 7. Relative proportions of obsidian at seven coastal sites, arranged from north (top) to south. (N) = Northern Block, (S) = Southern Block.

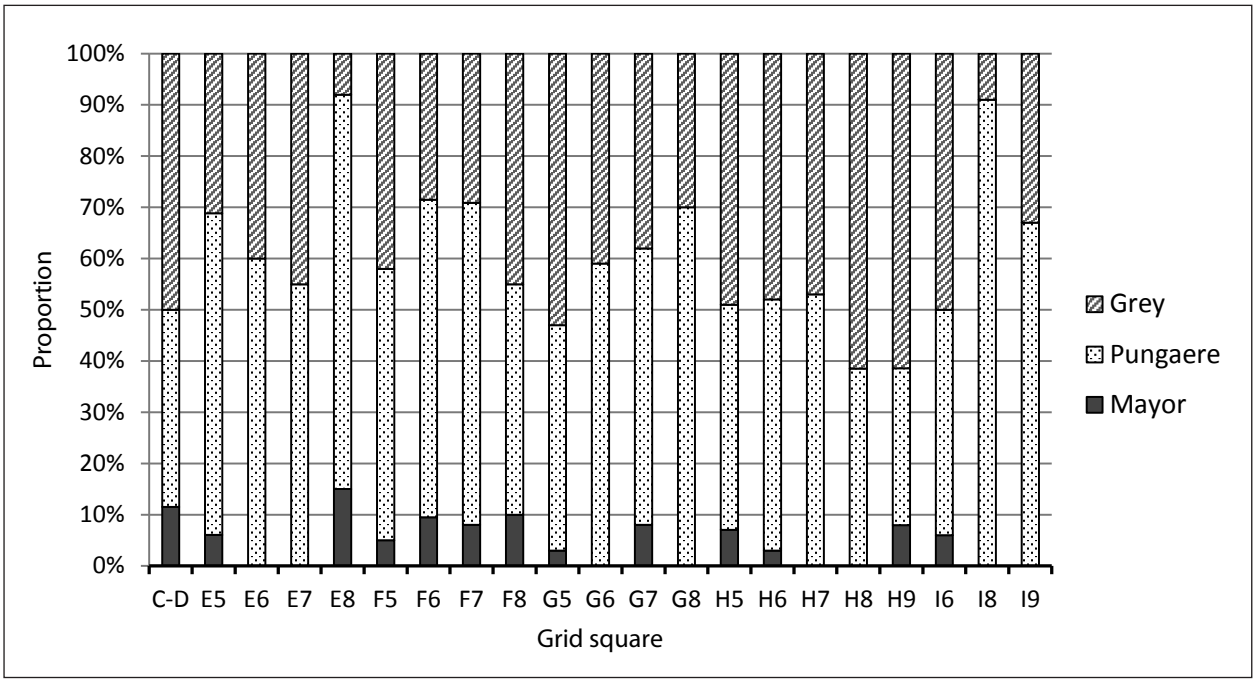


Figure 8. Intra-site variation in the proportions of obsidian at site N03/222 (Te Arai cluster), over an area of 50m x 70m.

tuting up to 50 percent in one square. Most of the grey obsidian was found in the eastern part of N03/450. Such internal variations in obsidian distributions may be indicative of multiple use of a site, over a number of seasons.

## TEMPORAL CHANGES

An approximate chronological sequence of dated sites with analysed assemblages is shown in Figure 9, based on the radiocarbon dates from Table 1. Excluding the coastal site N02/870, which is the only one from the northern block, this sequence spans the late 15th to 18th centuries. The order among what appear to be the three earlier sites (N02/821; N03/582, 323) is not necessarily correct, but site N02/870 is probably the latest (18th – early 19th century, NZ7067). It should also be noted that the relative proportions for some sites (N02/870; N03/482, 582) are based upon very small numbers of artefacts (N = 10–20), and may not be entirely reliable. No obsidian was recovered from the coastal sites N03/515 and 516, and there was insufficient material from N02/876 to provide reliable proportions.

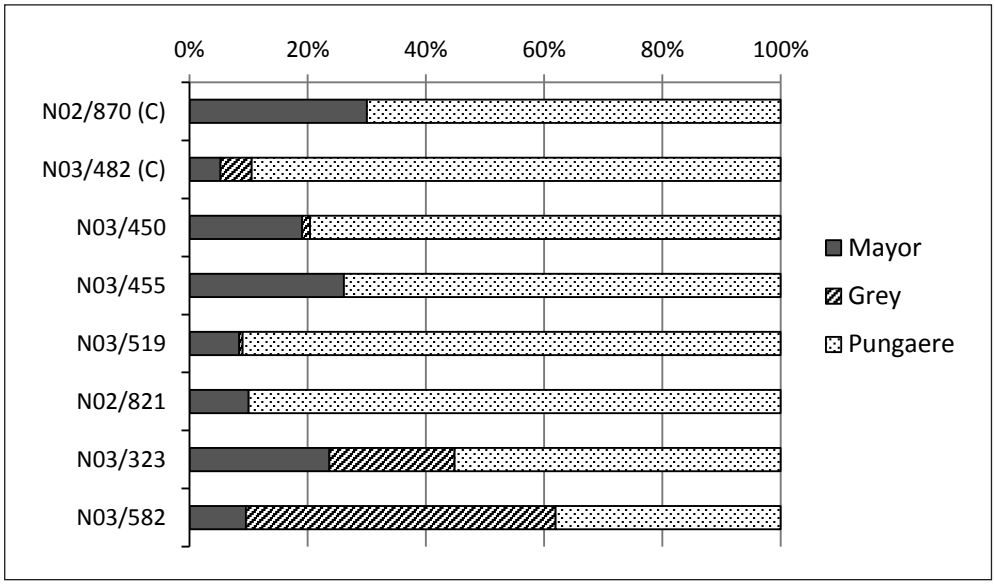


Figure 9. Approximate chronological sequence of Aupouri sites, from youngest (top) to oldest.

The quantities of Mayor Island obsidian used in the area appear to have remained fairly similar throughout, but there is an indication of a slight increase in the proportion of Pungaere obsidian and a corresponding decline in the use of grey material. If this trend is applicable to the majority of sites in the study area then it is possible that those with a very high percentage of grey obsidian (e.g. N03/222, 317, 564, Figure 6) are among the earliest. On this basis sites in the Te Arai and Te Raite clusters might be slightly older than most sites in the Kimberley cluster, which is consistent with the available radiocarbon dates, though it would require further dating to confirm this. The finds of Archaic adzes at sites N03/35 and N03/37 in the vicinity of the Te Arai cluster (Figure 3) also support such a possibility. Notably the coastal sites, which are generally younger, contain few if any pieces of grey obsidian (Figure 7). The percentage of Pungaere obsidian with cortex remained much the same over the entire period, at 15–24 percent (Table 3, Figure 5), suggesting there was no marked change in the nature of material obtained from this source.

## PROCUREMENT AND DISTRIBUTION

From our study it is estimated that about 40 percent (numerically) of the obsidian utilised on the western Aupouri Peninsula came from >150 km away, and the bulk of this – all of the Mayor Island and most of the grey material – had to be transported over 350 km. We can only speculate on how that was achieved, but the most obvious means was by lengthy sea voyages along the north-eastern coast of the North Island, perhaps on occasions by 'island-hopping'. Figure 10 shows a fairly direct route from Mayor Island to the Far North which passes close to all of the sources exploited. There is also a possibility that some obsidian was transported by *waka* (canoe) up the west coast of Northland, but considering the generally rougher sea conditions and limited shelter, it seems less likely. The third option is via well-established inland routes, involving procurement directly from the source or by exchange with other communities.

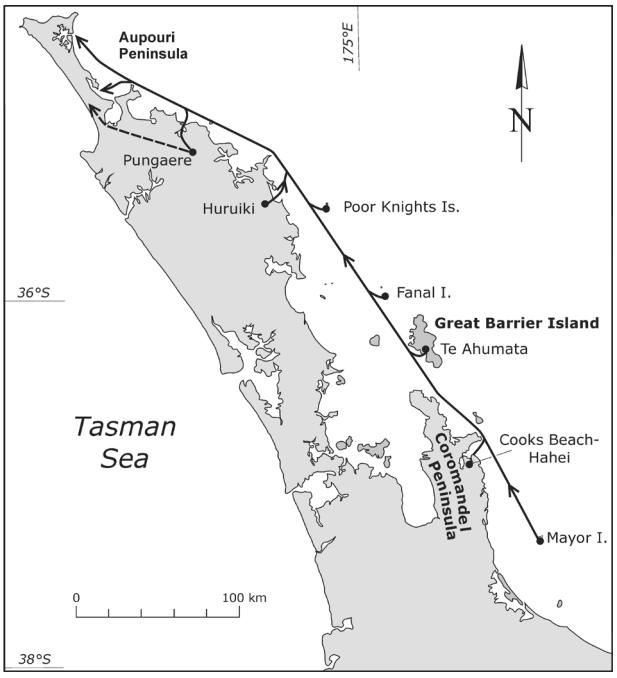


Figure 10. Possible transportation routes from obsidian sources exploited at Aupouri sites.

The people occupying the Aupouri Peninsula probably had no need to procure obsidian from anywhere other than the Pungaere source 80–100 km to the southeast, which we assume they could have accessed more-or-less directly. Therefore a significant proportion of the material from more distant sources was presumably acquired through some form of exchange. While such interactions could have occurred almost anywhere along the eastern coast, considering the sources of grey obsidian represented in the Aupouri sites we suggest that two of the more suitable places were Mercury Bay on Coromandel Peninsula (for Cooks Beach, Hahei and possibly Mayor Island obsidian) and perhaps Whangaruru Harbour in Northland (for Huruiki and possibly Poor Knights obsidian). Given its relatively poor quality, the obsidian from Fanal Island is not likely to have been obtained through gifting.

How the obsidian was dispersed once it reached the Aupouri Peninsula is clearly a critical question, and there are several points to consider: (1) in the southern block, the proportion of Pungaere to Mayor Island obsidian is fairly similar throughout the inland area, and almost all sites contain obsidian from both of these sources; (2) in contrast, grey obsidian is mainly associated with site clusters; and (3) overall, there is no obvious fall-off trend for any of the three main types of obsidian that would indicate down-the-line exchange from the south, though there may have been some transfer of Mayor Island obsidian from the north (Figure 6).

We propose that the principal ('high activity') sites within the main clusters in the southern block played a key role as re-distribution centres in which a proportion of the obsidian imported onto these sites would be subsequently distributed to other sites within the clusters either by direct transfer or exchange of material, as indicated by the reasonably similar proportions (Figure 6), cortex percentages (Table 3) and occurrence of grey obsidian from the same sources. This is particularly well illustrated by sites N03/323 and 324 in the Te Raite cluster, both of which contain Poor Knights obsidian. The Te Arai and Te Raite clusters could have acted as the main distribution centres for grey obsidian, whereas the principal sites within the Kimberley cluster seem more likely to have been involved in the importation and distribution of Pungaere obsidian, with the possible exception of N03/564. Notably, two of the Kimberley sites (N03/451, 453) contain an unusually high percentage of Pungaere obsidian with cortex (33–37 percent, Table 3). There is no clear indication of how the obsidian found at sites beyond the main clusters was acquired, and while we suggest it was mainly through outward diffusion from the clusters (i.e. more permanent settlements) there is a possibility that some was imported directly from outside the area.

Although we consider this model best fits the available data, there are other options. For example it could be argued that the site clusters represent repeated (seasonal) occupation of the same area by a single group who had a more permanent settlement elsewhere, possibly on the eastern coast. Each season, obsidian (still in a raw state) would need to be brought from their home base, which had been procured from the same sources. In this scenario the principal sites were re-occupied more often but played no role in the re-distribution of obsidian to other sites in the vicinity. However this requires the existence of a main settlement beyond the inland Aupouri dunes which itself acted as a re-distribution centre. So far, no such site has been identified.

Sites in the northern block with much higher proportions of Mayor Island obsidian (Figure 6) may have formed part of the same distribution network or an entirely separate one. In either case the Matapia cluster could have acted as a re-distribution centre, but the scarcity of 'high activity' sites in this block might indicate that some obsidian was obtained from other centres beyond the surveyed area, perhaps to the north or east. Certainly if the inland dune area was abandoned during the 17th century then the later coastal sites could not have been directly supplied with obsidian from the inland sites. Although none of the coastal sites contain large quantities of obsidian it would appear the sources utilised remained basically the same (i.e. Mayor Island, Pungaere, Huruiki, Cooks Beach, Hahei), suggesting that the distribution network continued to operate well into the 18th century.

## DISCUSSION

The new data from sites on the western Aupouri Peninsula indicates there was a well-developed obsidian distribution network operating in this area during the 16th–early 17th century. Such a network is unlikely to have existed only in this particular area, and probably extended over much of the Far North. Some support for this idea is provided by the fact that all three types of obsidian (Pungaere, Mayor Island, grey) have also been recorded elsewhere on the Peninsula (Moore 2012a). At the 14th century site of Houhora, about 30 percent of a selection of 870 flakes from the lower cultural layers were attributed to Pungaere and 65 percent to Mayor Island; only three percent were grey (Furey 2002). In the North Cape area, analyses of assemblages from seven undated but probably relatively early sites indicated that between 30 and 70 percent of the obsidian was from Pungaere and 30–50 percent from Mayor Island; up to 15 percent was grey and came from the Cooks Beach, Hahei and Huruiki sources (Moore 1988, unpublished data). Small collections examined as part of the present study from five sites at Kowhai Beach just north of Houhora all contained Pungaere obsidian, with the largest (N = 68) comprising 75 percent Mayor Island and 25 percent Pungaere material.

These observations suggest that a distribution network for obsidian (and presumably other lithics) had already been established on the Aupouri Peninsula by about the mid 14th century and, based on the available dates from

the study area, probably existed at least into the 18th century. The only apparent change indicated from our data, which covers the late 15th to 18th century, is a possible reduction in the quantities of grey obsidian procured. On the other hand the supply of Mayor Island obsidian seems to have remained fairly constant, in marked contrast to the situation elsewhere in Northland where there is evidence of a significant decline in the use of material from this source during the late prehistoric period (Moore 2012a).

Similar distribution networks may well have existed elsewhere in New Zealand. At Palliser Bay, for instance, one early site yielded almost 11,000 stone items (from an area of only 70 $m^2$), about ten times more than any of the other 24 excavated sites in the area (Prickett 1979). This site also contained a considerable quantity of obsidian, mainly from Mayor Island but including some from Cooks Beach, Huruiki and the central North Island (Leach & Anderson 1978). Thus it could have fulfilled the same role as the principal sites at Aupouri. A well-developed network also appears to have existed along the Waikato coast where there is an indication of down-the-line exchange in obsidian (Moore 2011), possibly involving similar 'high activity' sites.

## CONCLUSIONS

Analysis of obsidian artefact assemblages from archaeological sites on the western part of the Aupouri Peninsula, using a combination of visual attributes and energy-dispersive XRF, has revealed that the bulk of the material (about 60 percent overall) was procured from the Pungaere source near Kaeo, 80–100 km to the southeast, with smaller quantities (24 percent) from Mayor Island. The relatively large proportion of grey obsidian (16 percent overall) came from six different sources, mainly Cooks Beach and Hahei on the eastern Coromandel Peninsula about 360–380 km to the south. Small amounts were also procured from the Te Ahumata source on Great Barrier Island, Fanal Island, and Huruiki in southern Northland. A few pieces of obsidian have almost identical visual attributes and chemical composition to that found on the Poor Knights Islands off eastern Northland, suggestive of occasional contact with those islands. Most obsidian was probably transported by sea along the north-eastern coast.

Our study has indicated that an obsidian distribution network operated on the Aupouri dunes from the late 15th to 18th century. In the 16th–early 17th century this was focused on four separate site clusters, each of which included at least one principal or 'high activity' site containing large numbers of obsidian and other artefacts. These sites are thought to have functioned as re-distribution centres for obsidian (and probably other lithic materials) until abandonment of the inland dune settlements about the mid 17th century. In the northern part of the dune belt the predominance of Mayor Island obsidian suggests there may have been a separate distribution network, relating to the existence of a different community.

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