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PRE-EUROPEAN USE OF DACITE OBSIDIAN IN NORTHERN NEW ZEALAND

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Introduction

Positive identification of the source of stone that has been used for implement manufacture requires the satisfaction of two fundamental criteria. Firstly, it is necessary to demonstrate that an artefact matches the raw material that was available at a potential source. Secondly, and just as importantly, it must be demonstrated that the artefact could not have derived from any other alternative source that would have been available for exploitation.

This is, unfortunately, more easily said than done: the range of raw materials used by pre-European Maori includes comparatively few rock types for which both these criteria can be easily met, at least with our present state of knowledge.

This paper is concerned with the application of these criteria to dacite obsidian, a rock type potentially suitable for flake implement manufacture. Somewhat different in physical appearance and composition from obsidians previously reported from New Zealand, dacite obsidian is found at one of a number of obsidian deposits within the Northland region that have attracted little or no attention from archaeologists. Evidence for the pre-European exploitation of this obsidian for flake implement manufacture is presented below. The potential for attributing artefacts in archaeological assemblages to the only known source is then discussed with reference to the criteria outlined above.

What is Dacite Obsidian?

Dacite obsidian is the glassy equivalent of dacite, a volcanic rock composed of 60-70% silica (Si O_2). The principal minerals in dacites are plagioclase feldspar, quartz, and pyroxene or hornblende.

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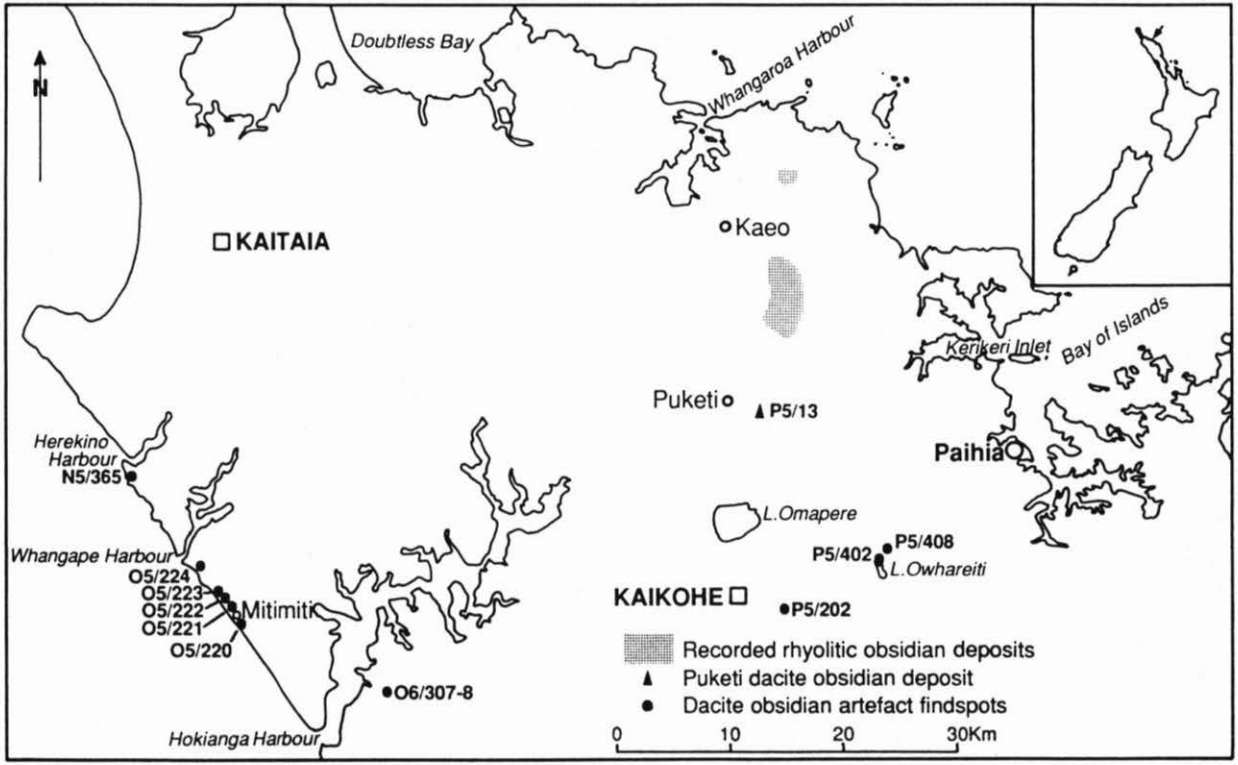

Figure 1. Location map showing the Puketi obsidian deposit and the archaeological sites referred to in the text.

All previously reported New Zealand obsidians, and most obsidians found in other parts of the world, have a higher silica content which corresponds with the composition of rhyolite. Obsidians with chemical compositions matching those of other rock types such as basalt or dacite do occur in some parts of the world and have been used for implement manufacture, but are much less common.

The Puketi Deposit

A small localised deposit of dacite obsidian exists near Puketi, in Northland. The location of the obsidian deposit has been known since 1964, although the rock type that occurs there has not previously been identified.

The deposit is located 3.5 km south-east of Puketi at grid reference P5/ 848 595 (Fig. 1). The obsidian is found on the slopes of a small stream catchment below Waiare Road, within a pine plantation (Fig. 2).

It was initially discovered by a farmer, Tom Wightman, who noticed a scatter of boulders surrounded by flakes whilst clearing farmland. Suspecting that the flaking was the result of past human activity, he contacted the District Forest Ranger, Bob Lawn, who he knew had an interest in archaeology. Lawn inspected the deposit, interpreted it as a utilised stone source, and recorded it as archaeological site N11/33 (now P5/13).

Twenty-one years later, in 1985, I revisited the obsidian deposit as a result of research related to the Pouerua Archaeological Project (Brassey 1985). Samples were taken for analysis and subsequently identified as dacite obsidian.

Geological Setting

The obsidian at Puketi occurs as a 'residual' deposit of boulder-size pieces scattered over the surface of the ground and embedded in the soil horizon. The obsidian boulders typically range in size from 150-300 mm maximum dimension, but larger pieces are occasionally found. Lawn's original record of the site notes the presence of boulders up to 1000 mm across. However there are no longer pieces of that size exposed at the site.

The extent of the deposit is difficult to judge because of the blanket of pine needles and forest understorey. However, it appears from what could be seen when the site was first revisited, that the obsidian occurs over a very limited area, certainly less than one hectare, and probably little more than 50 square

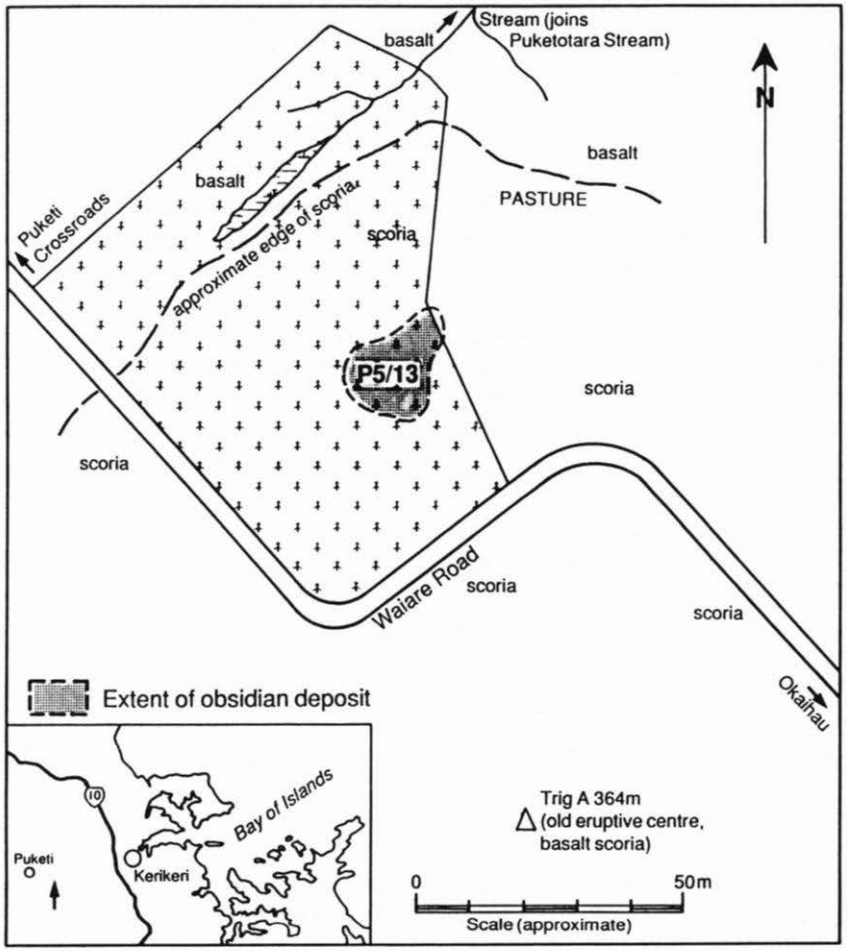

Figure 2. Puketi obsidian deposit.

metres. Since 1985 the forest has been thinned to waste and the obsidian deposit is now almost completely obscured by fallen trees and undergrowth.

The geological relationship of the Puketi obsidian to other geological formations in the vicinity is not readily apparent. The obsidian fragments are embedded in or lying upon friable loam soils derived from weathered

scoriaceous basalt mapped by Kear and Hay (1961) as Horeke Basalt. This scoria is associated with an old volcanic centre (vent) known as Trig A, located just above and to the south of the obsidian deposit (Figure 2). In this respect the Puketi dacite obsidian deposit is similar to some of the rhyolitic obsidian deposits in the vicinity of Kaeo, which also appear to be scattered over the top of the basalt tableland (see Bell and Clarke 1909: 72; Ward 1973: 98). Other deposits near Kaeo occur as localised residual deposits beneath the basalt, and tend to be found around the edge of the basalt tableland where the contact between the basalt and the underlying sedimentary formations is exposed by erosion.

One possible explanation for the two apparently different stratigraphic positions is that the obsidian fragments found on the surface of the basalt tableland represent examples of volcanic erratics: material associated with earlier rhyolitic/dacitic phases of volcanism that has been carried upwards during the periods of eruption which produced the Kerikeri Basalts and subsequently exposed by decomposition of the scoria.

Physical Characteristics

Unbroken pieces of obsidian found at the Puketi deposit are irregularly shaped and exhibit a highly corroded and pitted dull grey to grey-brown outer surface. This corroded appearance, which can also be seen on pieces of obsidian from Pungaere/Waiare and other colluvial deposits, is the result of weathering, and is typical of rocks that have a high glass content.

In hand specimen the rock has a noticeably high specific gravity. Freshly broken surfaces are a dark grey colour (Munsell 2.5Y 3/0) and display a dull- to slightly silky lustre. Unlike most obsidians of rhyolitic composition, which are generally translucent to some degree, the Puketi material appears opaque, even when very thin edges are tested with a strong light source.

Small, colourless glassy crystal inclusions, generally less than 2 mm maximum diameter, occur within the grey coloured groundmass. These are present in all pieces of the dacite obsidian examined, and typically occur with a frequency of 2-3 per cm^2. Spherulites appear to be absent. Flow banding was not observed.

Thin Section Characteristics

Thin section examination reveals the rock to have a base of pale-brown to almost colourless glass. The glass is crowded with innumerable minute rod-

like crystallites, and also contains fairly numerous small phenocrysts of augite (a pyroxene mineral), as well as a few large (up to 1.5 mm across), partially corroded crystals of quartz. Feldspar has not definitely been identified, but is possibly the mineral forming the crystallites.

The refractive index of the glass is consistent with a silica content of about 70% SiO_2.

Chemical Composition

X-ray fluorescence analysis of a grab sample of rock from the Puketi deposit was carried out by Simon Best and Robin Parker at the Geology Department, University of Auckland.

The results of this analysis (Table 1) confirm that the Puketi obsidian has a somewhat lower silica content than is typical of rhyolitic obsidian, and within the range for dacites. They also show the rock to be significantly different in chemical composition from other dacites from the North Auckland Peninsula that have been analysed (Skinner, Smith pers. comm.).

Flaking Characteristics

The obsidian from the Puketi deposit exhibits a moderate conchoidal fracture, but the quality of the flakes is limited by the presence of the crystal inclusions. It is suitable for flake implement manufacture, but does not produce flakes that are as sharp as typical rhyolitic obsidian.

Exploitation of Dacite Obsidian

Potential sources of raw material for implement manufacture can be shown to have been exploited by prehistoric populations either by identifying evidence of quarrying or collection at the source, or by demonstrating that artefacts have been manufactured from the material.

Evidence of exploitation would not normally be expected at a deposit that consisted of cobbles or boulders scattered over the surface. Rather, you would expect pieces to have simply been carried away for use elsewhere. However at the Puketi obsidian deposit, an estimated 90% of the boulders exposed on the surface have flakes missing from them. There are also numerous pieces of flake material scattered on the ground surface and incorporated in the soil profile (Site Record Form). This was interpreted by Lawn in 1964 as evidence that the deposit had been exploited as a source of raw material for implement manufacture.

It is possible that the flaking of boulders at the site is associated with prehistoric exploitation of the deposit. However, it is difficult to imagine why a large number of boulders would have had a few flakes struck from them, and then been left at the site. Furthermore, the flake scars on boulders collected as samples by myself from the site do not exhibit the form that is characteristic of hammerstone percussion.

There are other mechanisms that could conceivably result in the removal of flakes from boulders at the site (vegetation fires, for example), and a more detailed examination of the morphology of the flake scars is required to determine if they have been produced by human action. At the present time the evidence at the site for prehistoric exploitation must be regarded as inconclusive.

Evidence from Artefact Assemblages

Dacite obsidian artefacts have been recovered by archaeological excavation from three archaeological sites in Northland, and surface collected from several others (Table 2). These artefacts are identical in hand specimen to the material found at the deposit near Puketi. Analysis of one of the artefacts recovered from site P5/402 (Table 1) shows it to be indistinguishable, within the limitations of XRF analysis, from material found at the Puketi deposit.

The degree of similarity indicates that the artefact derives from the Puketi location, or at least from some other closely related deposit that has yet to be identified.

No other deposits of dacite of similar composition have been reported from the vicinity, or for that matter from anywhere in Northland (Skinner, Smith pers. comm.). Indeed the volcanic rocks of the inland Bay of Islands area have been studied in some detail by geologists, and it is unlikely that any major deposits remain undiscovered. On the other hand the Puketi obsidian was not found by geologists, so there may still be other small deposits awaiting discovery.

The artefacts of dacite obsidian found in the Northland archaeological sites include flakes, cores, and waste chips. Apart from one artefact from Motutoa which shows evidence of edge damage (Fredericksen 1990: 83), no macroscopic signs of use are visible on any of the flakes examined, and it is assumed that dacite obsidian was used interchangeably with other siliceous materials such as chert to produce flake implements for tasks such as cutting

and scraping.

Extent of Pre-European Exploitation

To determine the extent to which Puketi obsidian has been exploited would require the systematic examination of archaeological assemblages from the North Auckland peninsula by someone familiar with the hand specimen appearance of the material. The only assemblages that have been scrutinised to date are those from the Pouerua and Motutoa sites (Table 2). Most of the other records listed in Table 2 are the result of casual observation of deflated beach midden assemblages.

The fact that the assemblages contain only very small quantities, even though those from the Pouerua sites comprise many thousands of artefacts, suggests that dacite obsidian will not be found in large quantities in other archaeological sites. On the other hand, examination of a small sample of deflated dune sites south of the Whangape Harbour (Fig. 1) revealed the presence of dacite obsidian artefacts in most of the sites inspected (Table 2). This raises the possibility that dacite obsidian might be quite widespread in small quantities in archaeological sites in the northern part of Northland.

Period of Exploitation

It would seem unlikely that a resource of limited geographical extent, located inland from the coast, would have been found by chance during the initial exploration of the Northland region by Polynesian settlers. However, there are a number of factors that might have facilitated the discovery of the Puketi obsidian deposit by Maori.

After the clearance of forest in the inland Bay of Islands, boulders of resistant rock such as obsidian would have stood out on the basalt tableland which is dominated by landforms developed from extensively weathered scoria. The deposit was presumably also somewhat larger and more visible prior to the commencement of exploitation. Furthermore, the Puketi obsidian deposit was located close to one of the main pre-European centres of population in New Zealand, and less than 2 km from the route of what was one of the main tracks between the east and west coasts of the North Auckland peninsula (see Lee 1972). Nearby, at a location known as Te Ngau Areha, was a deposit of kokowai that is said to have supplied the needs of the population over much of the Bay of Islands district (Walsh 1903: 6). The presence of this resource presumably would have resulted in regular visits to the area by Maori, and prompted searches for further sources of raw

materials in the vicinity.

Three of the archaeological sites from which dacite obsidian artefacts have been recovered have been dated. Site O6/307-8 (Motutoa), a pit/terrace complex excavated by Fredericksen in 1989, has produced radiocarbon age estimates encompassing a period from the 15th through to the 19th century (Fredericksen 1990: 69-71).

Site P5/402 at Pouerua, also an undefended settlement, comprised terraces, houses, and storage structures (Sutton *et al* 1990). Excavation revealed two phases of occupation. Three dacite obsidian artefacts were associated with the Area II house, which was occupied during the first phase of occupation and has been dated to the period AD 1435 - 1616 (Sutton 1993: 98).

The other dated site, P5/408, was an undefended settlement at Pouerua which was subsequently fortified as a small pa. A single dacite obsidian artefact was recovered from the Area 1 house. This structure was not radiocarbon dated, but was considered to have been occupied in the late prehistoric period on the basis of dates from other parts of the site, and the absence of any European period artefacts from the assemblage (Sutton & Crosby 1993: 65).

Discussion and Conclusions

Although dacite obsidian does not appear to possess any unique physical properties that would have caused it to be selected ahead of rhyolitic obsidian or even high quality cherts, it clearly has been used for implement manufacture and has been transported around parts of the North Auckland Peninsula. The widespread distribution of what would appear to be a relatively small number of artefacts is unlikely in this case to reflect trade in a valued commodity. It is more likely to be the result of casual collection of material by people travelling past the source location.

If this is the case then dacite obsidian artefacts are unlikely to be found very far beyond the presently identified range in the northern part of the North Auckland Peninsula - except of course if there are naturally occurring deposits elsewhere in the country.

Dacite obsidian artefacts do in fact appear to be present in at least one assemblage from outside the Northland region. Eleven artefacts that have been identified in hand specimen as dacite obsidian were recovered from a small open settlement site (T12/617) near Whangamata on the Coromandel

Peninsula, which was excavated in 1986 (see Furey 1987: 220-2). The most parsimonious explanation for the presence of these is that they are from a source on the Coromandel Peninsula. Dacites occur in a number of places on the Peninsula and this is an area where dacite obsidian deposits and further artefacts are likely to be found. As noted earlier, the possibility that further deposits exist in Northland cannot be discounted either.

In conclusion, dacite obsidian is relatively easily recognised in hand specimen, and it should eventually be possible to develop a more comprehensive picture of where and when it was used by pre-European Maori. However, until potential source deposits have been searched for, identified and recorded, the second of the criteria outlined at the outset cannot be met. Caution is clearly required before attributing dacite obsidian artefacts to the Puketi deposit.

Footnote

Samples of dacite obsidian from Puketi have been placed in the Anthropology Department reference collections at both Auckland and Otago Universities.

Acknowledgements

The XRF analyses were carried out by Simon Best and Robin Parker at the Geology Department, University of Auckland. Thin section identification was arranged by Phil Moore, and undertaken by W. Watters at the NZ Geological Survey, Lower Hutt. Helpful information was provided by Ian Smith of the Geology Department, University of Auckland, David Skinner, formerly of the NZ Geological Survey, Otara, and Roger Evans, Kerikeri.

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Table 1. Results of XRF analyses of a sample from the Puketi deposit and an artefact from site P5/402.

(%)	Waiare Road deposit	Pouerua artefact
SiO_2	66.42	67.21
TiO_2	0.69	0.65
Al_2O_3	14.49	14.30
Fe_2O_3	4.32	4.16
MnO	0.07	0.07
MgO	2.23	2.10
CaO	3.87	3.63
Na_2O	4.15	4.20
K_2O	3.25	3.36
P_2O_5	0.14	0.14
L.O.I	0.02	0.06
Total	99.66	99.87
(PPM)		
Nb	21	22
Zr	179	185
Y	43	42
Sr	134	127
Rb	196	203
Th	30	29
Pb	23	21
Zn	53	54
Cu	19	16
Ni	21	23
Cr	46	39
V	68	62
Ba	78	85
La	34	33

Table 2. Dacite obsidian artefact findspots.

Site	Location	Site type	Description
P5/202	Southeast of Kaikohe	Pa (Parahirahi)	?several pieces
P5/402	Pouerua, on shore of Lake Owhareiti	Undefended settlement	Area 1: 4 flakes, 2 waste flakes Area 2: 2 flakes, 1 waste flake
P5/408	East of Pouerua cone	Pa	Area 1: 1 flake
Near P5/402	Pouerua, north of Lake Owhareiti	Stone structures	1 large core
O6/307-8	Motutoa	Undefended settlement	1 flake, 1 waste flake
O5/220	Mitimiti	Findspot	1 flake
O5/221	North side of Taikarawa Stream	Beach midden/findspot	1 flake, 2 waste flakes
O5/222	Dunes between Taikarawa & Waikare Streams	Findspot	1 flake (further artefacts likely)
O5/223	Bluff north of Waikare Stream	Midden/findspot	1 flake
O5/224	South side of Puapua Stream	Beach midden/burial/ findspot	5 flakes
N5/365	South head, Herekino Harbour	Midden/findspot	1 waste flake