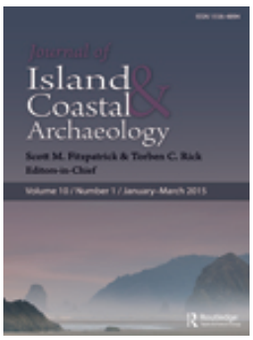

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The Geographic Range of Interaction Spheres During the Colonization of New Zealand (Aotearoa): New Evidence for Obsidian Circulation in Southern New Zealand

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ABSTRACT

During the colonization of remote Pacific Islands, founding communities forged novel interaction spheres within newly settled archipelagos. We report on new research on the geographic range of interaction spheres in the first centuries of occupation of New Zealand based on geochemical source identifications from obsidian assemblages found along the coast of the Otago region in the southern South Island. Results suggest that while there is evidence for interaction spanning the entire archipelago, logistical limitations on long-distance mobility along the long north-south axis of New Zealand appear to have developed early on and may be important in understanding the development of territories later in Māori culture history.

Keywords island colonization, mobility, transient villages, obsidian, New Zealand

Nearly 20 years ago, Anderson and Smith (1996) described the coast of Southern New Zealand as having been home to transient villages during the first centuries after settlement. These villages would have occupied sections of the coast briefly and repeatedly soon after settlement around AD 1250 until local food resources—moa and seals—became unreliable after AD 1500 due to extinctions and extirpations (Davidson 1984). More recently, isotopic analysis of human remains has confirmed a high degree of mobility and diverse diet at this stage in Māori culture history (Kinaston et al. 2013). In addition to moving short distances within a home range, early villages were also part of geographically extensive interaction spheres. Obsidian circulation remains

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the strongest material indictor of travel beyond the village with Mayor Island (Tūhua) obsidian having been reported as the predominant source used by the ancestors of Māori across all of New Zealand. Mayor Island obsidian commonly accounts for nearly all obsidian present at Early Period sites (Scott 2008; Seelenfreund and Bollong 1989), including the Wairau Bar site (Knox 2011). Recently, Lawrence et al. (2014) reported the first case of a South Island site where Mayor Island was not the preferred obsidian used. This community, who made their home at the inlet to Otago Harbour (Figure 1), was part of an interaction sphere dominated by obsidian from the central North Island near Lake Taupo (52%) and Rotorua (28%) with few examples of Bay of Plenty sources at the site (Mayor Island, 11%; and the Coromandel Peninsula, 9%).

While obsidian circulation has proven ideal as a clear metric indicating interaction between villages in the first generations after settlement, it has been less useful in defining persistent spatial patterns within those movements. Travel between village locations likely reflected tradition and notions of property rights through usage (Jackson and Smith 2013), rather than a series of random events. Unfortunately, much of what continues to be published on New Zealand obsidians does not make it possible to examine such patterns as it has relied heavily on visual matching of artifacts to sources (e.g., Moore and Coster 2015), and often focuses on a single source (e.g., Walter et al. 2010). This is in contrast to studies where artifacts are definitively matched to a range of sources by geochemistry (McCoy and Carpenter 2014; McCoy et al. 2010, 2014; Mosley and McCoy 2010; Sheppard et al. 2011), building on decades of prior investigations on the geochemistry of New Zealand's obsidians (see Sheppard 2004 for a recent summary).

We returned to collections of obsidian in the Otago Museum from the coast of Southern New Zealand to ask what does the distribution of sources present tell us about interaction spheres within New Zealand during its colonization? We report on the geochemically determined source of obsidian artifacts ($n = 383$) from six sites, which together with two other sites previously studied, more than doubles the total number of sourced artifacts in the study area ($n = 606$). Our findings suggest that the geographic range of travel beyond villages along this portion of the coast indicate a surprising amount of interaction between the study area and the southern North Island. People certainly had the logistical capacity to travel the length of the country; however, it may have been that from even the earliest period in New Zealand's culture history there were regional patterns beginning to emerge along archipelago's long north-south axis.

MATERIAL AND METHODS

For this study we chose obsidian artifacts in the collections of the Otago Museum from Early Period sites in Southern New Zealand (Figure 2). These sites have long histories of collecting (see Davidson 1984), with several having been the center of multi-season excavation projects aimed at better understanding the colonization period (e.g., Smith 1998). Artifacts were catalogued, measured, weighed, and examined for standard metrics in a lithic technology study (Andrefsky 2005; e.g., presence of cortex, edge damage from use; see Supplemental Data). Two Bruker-AXS™ portable XRF were brought in to the collections laboratory at the museum so geochemical assays could be conducted on site. Two filter settings were applied using established laboratory protocols (McCoy and Carpenter 2014). Geochemical data and details on how artifacts were matched to source are described in our Supplementary Data. In brief, all artifacts in the study were shot using the optimal settings for 'mid-z' trace elements that include Rb, Sr, Y, Zr, and Nb (40 kv and 8 microamps at a 300-second live time and with a filter, 12milAl + 1milTi + 6milCu, or what the manufacture calls the green filter). This allowed us to identify unambiguously obsidian from the Mayor Island and Kaeo sources, and local pitchstones. For other obsidians a second setting was then used in the examination of lighter elements

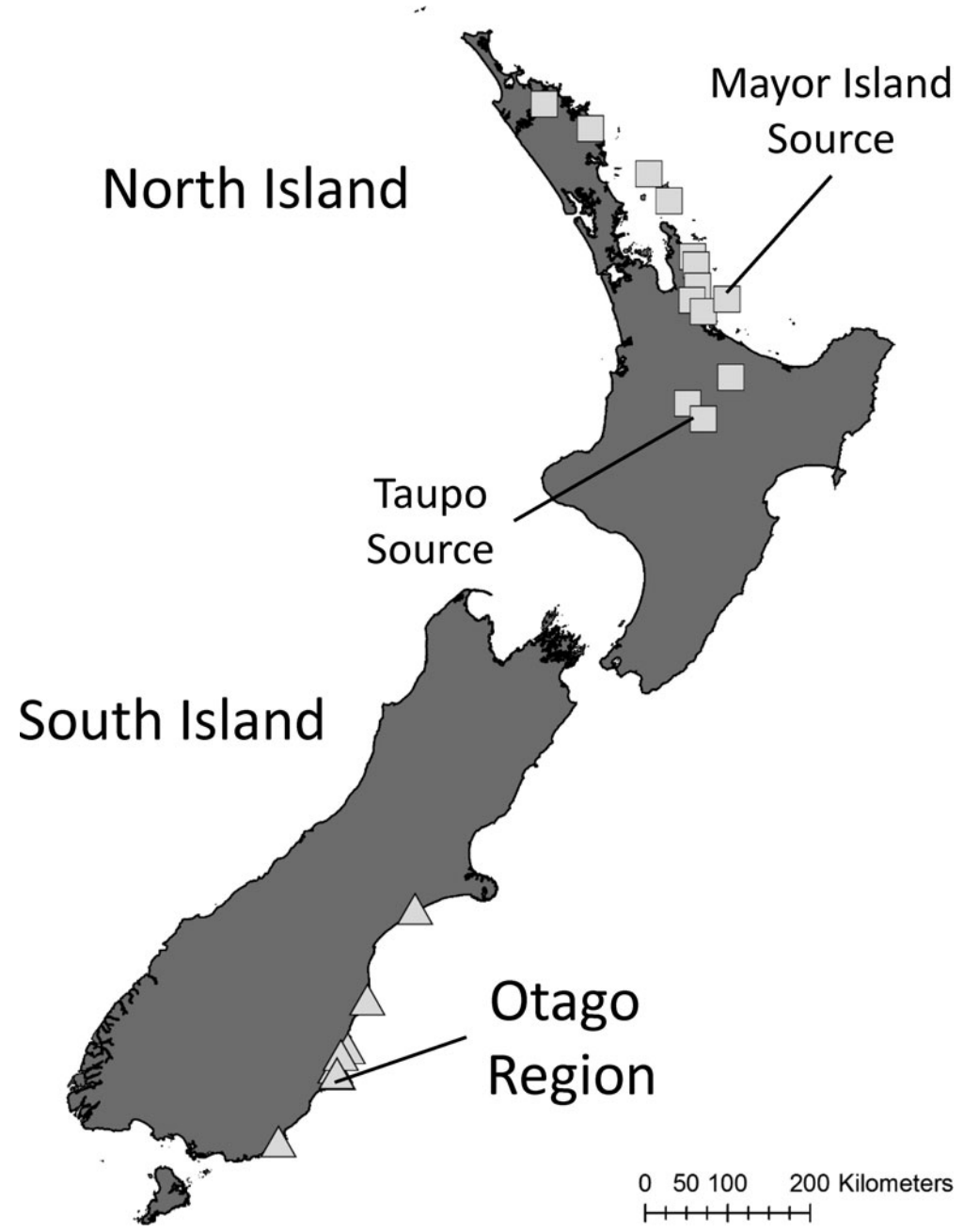

Figure 1. *Location of Early Period sites in the Otago Region (South Island) and obsidian sources (North Island) in New Zealand.*

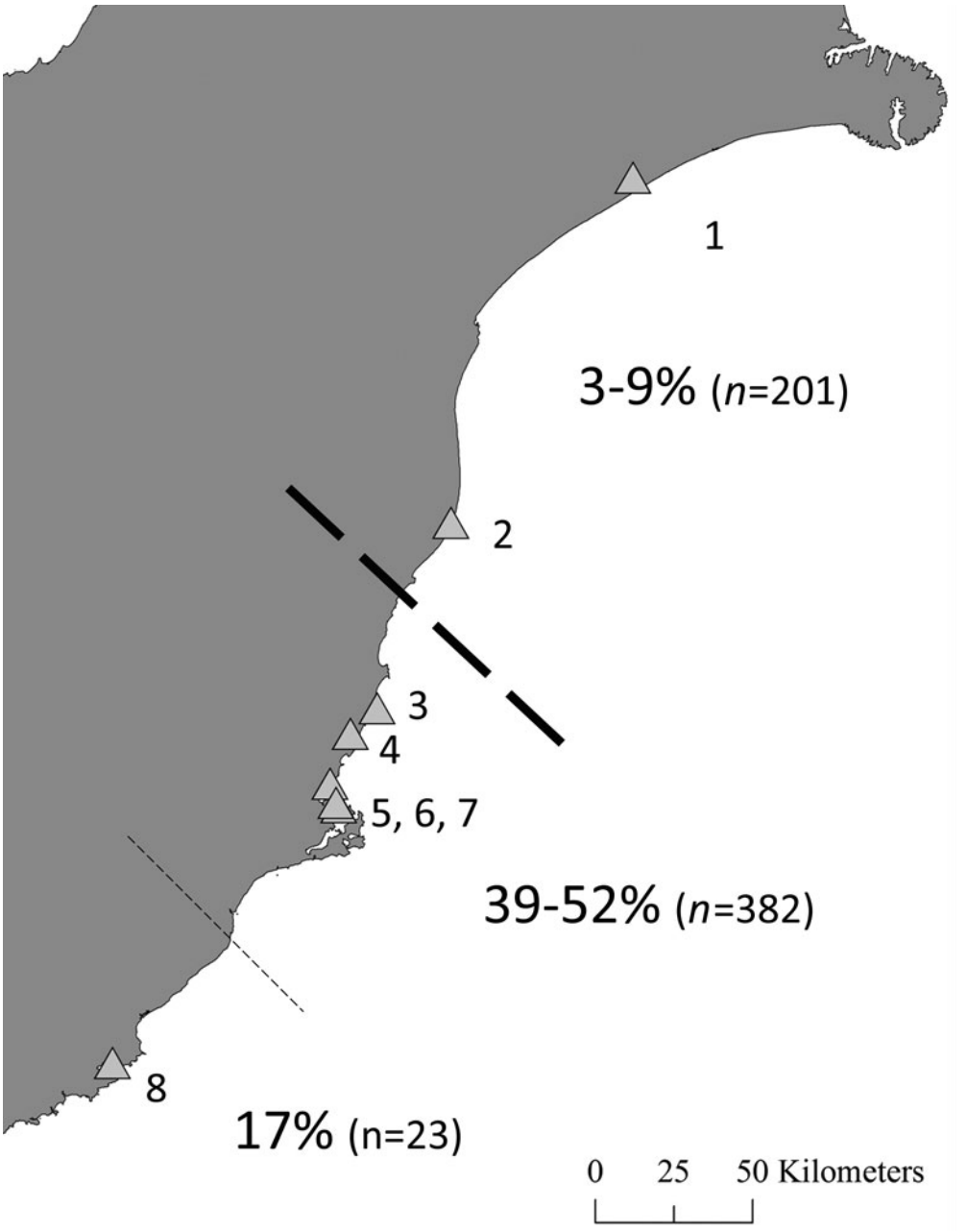

Figure 2. *Frequency of Taupo obsidian at Early Period sites with geochemically sourced obsidian collections. Sites include: 1. Wakanui, 2. Waitaki River Mouth, 3. Shag River Mouth, 4. Pleasant River Mouth, 5. Little Papanui, 6. Pūrākaunui, 7. Long Beach, and 8. Pounawea.*

Table 1. **Results of geochemical sourcing obsidian artifacts, Otago Museum Collections.**

	Shag River Mouth	Waitaki River Mouth	Pleasant River Mouth	Little Papanui	Long Beach	Pounawea	Total
Kaeo	0	3	0	0	1	0	4
Coromandel Peninsula (Tairua)	0	1	0	1	0	0	2
Mayor Island	11	111	10	44	48	19	243
Rotorua	0	0	0	5	0	0	5
Taupo	7	11	11	49	47	4	129
Total	18	126	21	99	96	23	383

Total number of artifacts sourced, $n = 383$.

that include Si, Ti, Al, Fe, Mn, Mg, Ca, Na, and K. This protocol used the Bruker pXRF's vacuum, 15 kv and 45 microamps without the use of a filter, for 300 seconds. Some artifacts proved too small to definitively match to source (see also Lawrence et al. 2014 for a discussion of artifact size and sourcing). The second shot allowed us to match artifacts to sources in Taupo, Rotorua, and Coromandel Peninsula (Tairua).

RESULTS

The two most common sources of obsidian at the six sites examined were Mayor Island ($n = 243$, 63%) and Taupo ($n = 129$, 34%) with rare occurrences of Rotorua ($n = 5$, 1.3%), Coromandel Peninsula (Tairua) ($n = 2$, 0.5%), and Kaeo ($n = 4$, 1%) obsidians (Table 1). We found that comparing the two most common sources was especially revealing. Both have high ubiquity, having been found at all sites examined as well as two other sites with previously published datasets (Table 2; Lawrence et al. 2014; Mosley and McCoy 2010).

To determine if these sources were circulating differently from one another, we compared the ratio of one to the other in terms of count and weight. At a site level, the results allow us to classify assemblages into three groups:

- *Mayor Island > Taupo:* Three sites where Taupo obsidian is rare compared to Mayor Island obsidian, and is on average either the same size or smaller,

Table 2. **Previous geochemical sourced obsidian collections.**

	Wakanui	Pūrākaunui	Total
Kaeo	2	0	2
Coromandel Peninsula (Cooks Bay)	6	14	20
Mayor Island	65	16	81
Rotorua	0	41	41
Taupo	2	77	79
Total	75	148	223

Total number of artifacts sourced, $n = 223$.
Sources: Lawrence et al. (2014); Mosley and McCoy (2010).

Table 3. **Comparison of two common obsidian sources: Mayor Island (MIO) and Taupo (TO).**

	Mayor Island frequency (n)	Frequency (%)	Average weight (g)	Taupo frequency (n)	Frequency (%)	Average weight (g)	Total sourced	Source comparison
Wakanui	65	87%	1.73	2	3%	1.7	75	MIO > TO
Waitaki River Mouth	111	88%	7.48	11	9%	3.43	126	MIO > TO
Shag River Mouth	11	61%	5.72	7	39%	5.35	18	MIO = TO*
Pleasant River Mouth	10	48%	1.26	11	53%	1.99	21	MIO = TO*
Little Papanui	44	44%	3.62	49	50%	3.95	99	MIO = TO
Pūrākaunui	16	11%	1.32	77	52%	0.61	148	TO < MIO
Long Beach	48	50%	3.44	47	49%	2.84	96	MIO = TO
Pounawea	19	83%	4.86	4	17%	2.21	23	MIO > TO*

Note that at four out of eight sites these two sources are indistinguishable from one another in terms of frequency and size (MIO = TO), three sites are dominated by MIO, and one by TO. Sites are listed from north to south.

*Based on small sample size.

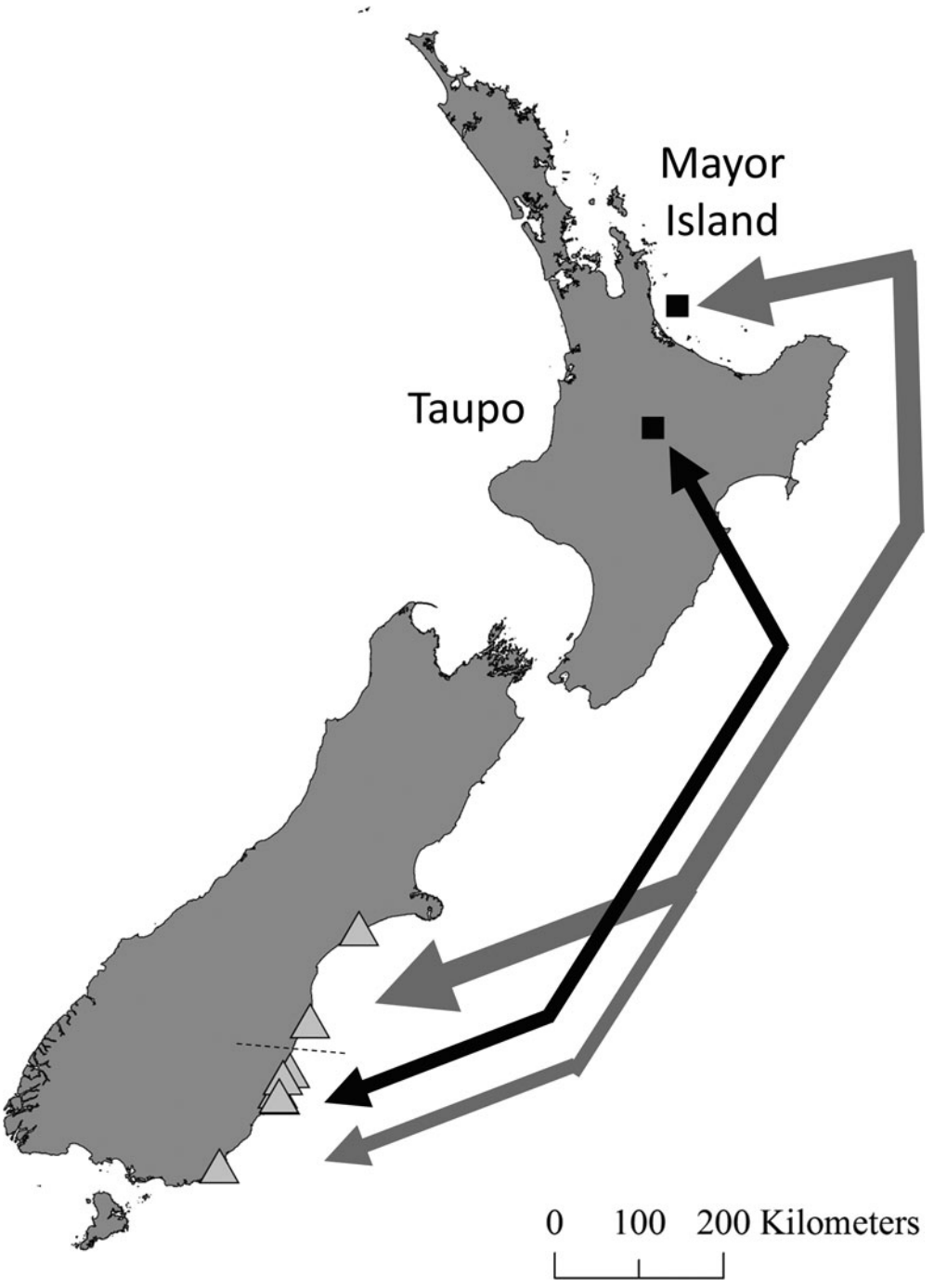

Figure 3. *This schematic map illustrates how villages in and around the Otago Harbour may have interacted with southern North Island communities more than other South Island villages slightly further north.*

including Wakanui, Waitaki River Mouth, and Pounawea;
- *Mayor Island = Taupo:* Four sites where the two sources are indistinguishable from one another in frequency or size, including Shag River Mouth, Pleasant River Mouth, Little Papanui, and Long Beach; and
- *Mayor Island < Taupo*; One site where Taupo obsidian was more frequent than Mayor Island obsidian, Pūrākaunui.

We note that some of these collections have geochemically sourced sample sizes that are too small for meaningful summary statistics (Table 3).

In the assemblages that have been sourced and studied in detail there is a clear spatial pattern along the coast. Taupo is common at sites in and around Otago Harbour (39–52%, $n = 382$ sourced artifacts) and rare north of the Otago Harbour (3–9%, $n = 201$ sourced artifacts) (Figure 2). It is also less common in the small number of artifacts examined at the southernmost site in this study (19%, $n = 23$ sourced artifacts). We interpret this as evidence that villages north of the Otago Harbour had long-distance interaction spheres that included communities on the northern half of the North Island but rarely included the southern half of the North Island (Figure 3). The communities living at Otago Harbour however appear to have had a long-distance interaction sphere divided roughly equally between the northern and southern halves of the North Island.

CONCLUSIONS

We present evidence that the first generations of people who settled the islands of New Zealand moved in circuits of travel beyond their coastal transient villages that were more logistically limited than we would expect based on previous studies of New Zealand obsidians (Walter et al. 2010). Figure 3 illustrates how the Otago region, at the far southern end of New Zealand interacted more frequently with groups in the southern North Island than neighboring communities who evidently rarely interacted with southern North Island region. If this is representative of mobility across the country, then there may have been regional social networks forming along a north-south axis from the initial settlement of New Zealand. Future research on mobility and exchange among founding groups in the colonization of Pacific Islands would do well to consider not just the degree but also the specific geographic ranges of groups as critical data on how early social networks may have had consequences for later culture history.

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SUPPLEMENTAL

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