NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

ARCHAEOLOGY IN NEW ZEALAND

Exquisite Harmony in Material, Form and Function: Concretions as Fishing Sinkers

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Introduction

Among Māori artefacts in the Booth Whanau Collection (housed at Te Kōngahu Museum of Waitangi) are eight made-items of particularly dense - concretionary - stone. All are (presumably) fishing sinkers, most (six) having come from sand-dune surfaces along 20 km of Northland's west-coast centred on Mitimiti, 13 km north of the Hokianga Harbour Heads (Figure 1), with another two from elsewhere in Northland. Four of the Mitimiti sinkers stand out in their harmonious combination of aesthetically-pleasing form, craftsmanship, and – because there was probably no more-dense stone available - unmatched merging of material with function. There are also seven additional pieces of 'raw' (including partly-worked) concretionary-stone from Mitimiti. The deflated-dune and beach-surface find-locations of these artefacts are several kilometres distant from known sources of concretionary material, pointing to focused selection, collection and transport of rock to living/working sites by previous peoples.

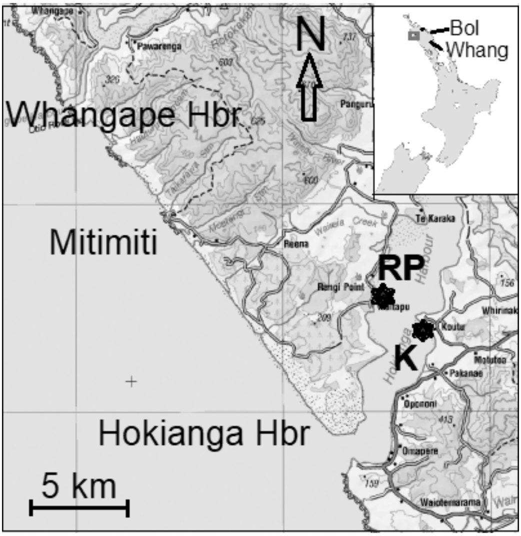

Figure 1. Mitimiti lies between Whangape and Hokianga harbours (inset shows location on the North Island, New Zealand; BoI, Bay of Islands; Whang, Whangarei). Stars show known-sources of barium-rich concretions (RP, Rangi Point; K, Koutu).

Context of collection

The Booth Whanau Collection is composed of ~3000 archaeological objects collected mainly in Northland during the late-1950s to early-1970s, the 15 items here being those immediately-suggestive - through their high-density and form - of being concretionary.

The 13 concretionary-stone items (both made and raw-material, combined) from Mitimiti comprise 7% of nearly 200 objects from there listed in the collection catalogue (also available at the Museum). The Mitimiti material, in its entirety, varies considerably in age and form. The oldest items include moa- and marine mammal-bone artefacts and an argillite hog-backed adze that together suggest early occupation/stopover; the most recent are broken clay-pipe stems, weathered flakes of glass, and a lead musket ball (~15 mm diameter). Almost 80% of the items are stone (mainly broken adzes and stone-working tools, but there are also three sinkers of less-dense stone than those dealt with here); most of the rest of the items are of bone and shell. Overall, the Mitimiti artefact assemblage is geologically-rich - more so than any other site represented in the Booth Whanau Collection, with objects of – among others (as identified by RR) - pounamu, Tahanga basalt, (presumably) local basalt, argillite, Mayor Island and Kaeo obsidian, Puhipuhi sinter, pumice, flint, chert, jasper, chalcedony, sandstone – and, here, barite. Because few of these rocks are native to the dune-areas, widespread trade, exploration and/or gathering is indicated. Ten percent of all worked items are fishing-related, reflective of nearby presence of a coastline still known today for its snapper, kahawai, trevally and grey mullet in particular; and also the sheltered waters of Hokianga Harbour, with a wide diversity of estuarine fishes.

The other two concretionary-stone items are almost certainly fishing sinkers (complete or in-the-making), found on the south shore of Kerikeri Inlet in the Bay of Islands, and at a further, unknown Northland location.

Our concretionary material

Concretionary material in the Booth Whanau Collection is listed in Table 1. Specific gravity (SG) of the objects (determined by hydrostatic weighing near sea-level and at ~20°C by suspending the object in water by fine cotton thread to estimate the weight of the water displaced) of the Mitimiti material averaged 4.06 (SD 0.13) and is probably among the most-dense lithic available to Māori. (This SG is high compared with, for example, basalt [2.84], but lead [11.34] and grandad's filling [~19, gold] are far more dense.) The similarity in SGs among the Mitimiti objects points to (but does not categorically mean) the same or similar geology and source. The other two items are similarly dense (Table 1), but form no further part of this paper.

Table 1. Concretionary material from Mitimiti (and two other Northland localities). W=Weight, SG=Specific gravity.

Cat. No.	Characteristics	W(g)	SG	Cat. No.	Characteristics	W(g)	SG
Mitimiti sinkers				**Mitimiti 'raw-material' items**			
24M14	Small; fusiform; deep lashing incision	36	4.00	24M145	Large 'sectional' form; shaped	592	3.95
24M15	Small; fusiform; deep lashing incision	34	4.25	24M113	Large 'sectional' form;	557	4.04
24M160	Small; fusiform; deep lashing incision	14	4.00	24M185	Large flattened oval	449	3.84
24M16	Small; spherical; medium-depth lashing incision	14	4.29	24M168	Roughly spherical	183	3.98
24M12	Large, sectional; lashing nicks	346	4.02	24M146	Small 'sectional form'; probably faced	107	4.12
24M159	Medium-size; pear-shaped; wide and shallow lashing incision	232	4.07	24M176	Spherical	56	4.00
				24M177	Spherical	34	4.25
Other items							
51S10 (Bay of Islands)	Sinker in making	192	3.49				
51U (Unknown)	Sinker	217	4.00				

The six Mitimiti sinkers are illustrated in Figure 2, four being fusiform to spherical in shape, small (25-40 mm in greatest dimension, and up to 36 g in weight) and dense (SG 4.00-4.29); the other two are much larger but similarly dense (up to 75 mm and 346 g; SG 4.02-4.07), one (24M12) appearing to be a cross-section of a larger parent item (*see* Figure 4). There are three distinct styles of line-attachment: 'sawn' (with collateral longitudinal striae on each side of the groove; 24M160) or filed (24M14, 24M15 and 24M16) grooves lengthwise around the sinker; simple and narrow notches on each corner (24M12); and a wide, lengthwise pecked trough (24M159).

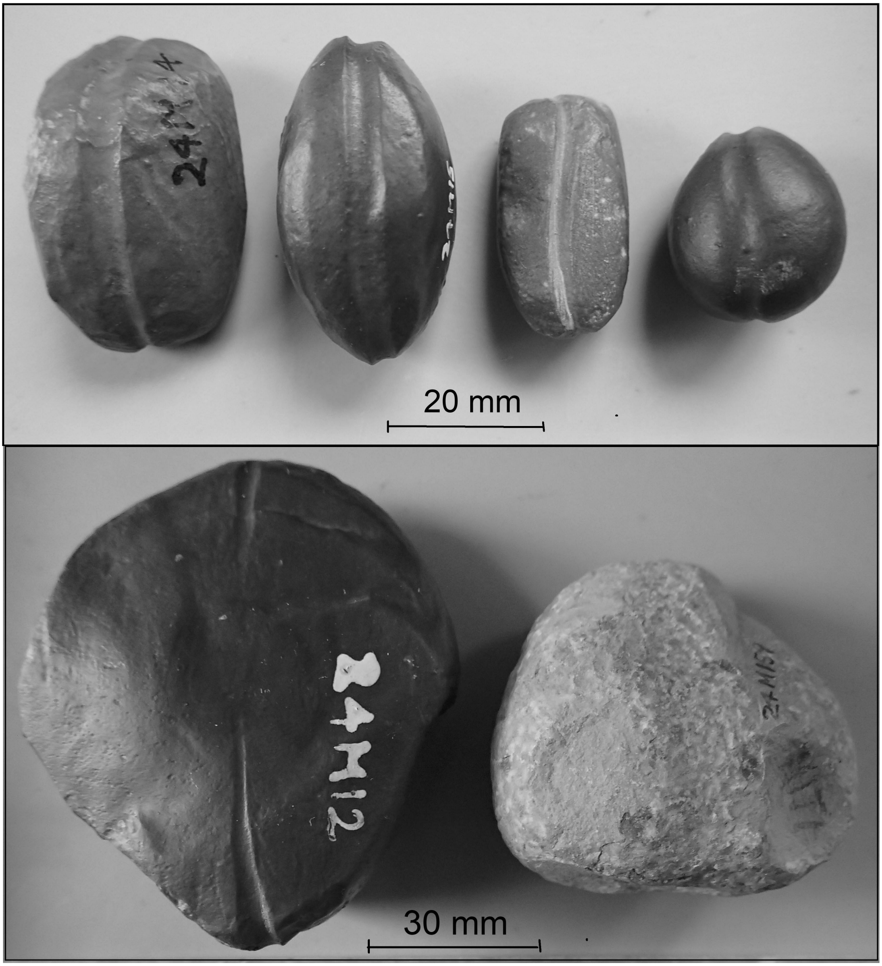

Figure 2. Mitimiti fishing sinkers made from concretions (from top left: 24M14, 24M15, 24M160, 24M16, 24M12, 24M159). The light-colour of 24M159 comes about mainly through fine-pecking of the artefact surface.

The items of ‘raw’ concretionary material from Mitimiti (Figure 3) consist of mainly-spherical concretionary stones, some showing working such as splitting from a parent block, flaking and pecking.

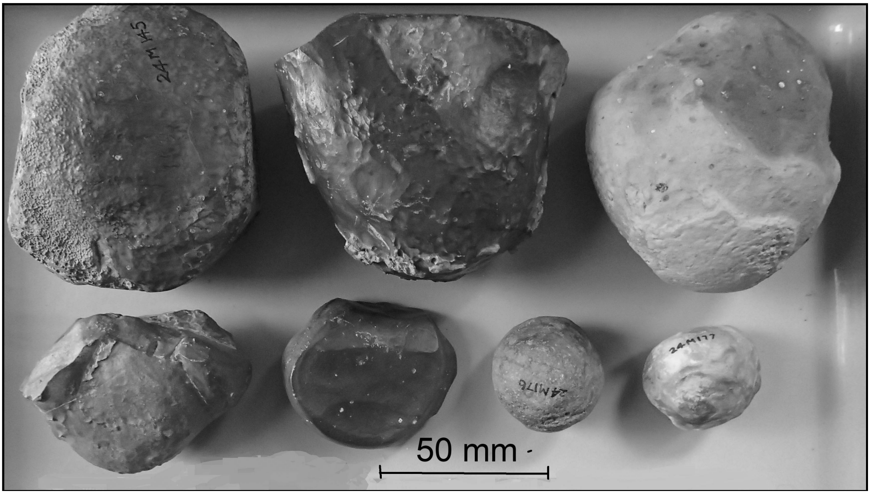

Figure 3. Mitimiti 'raw' concretionary material (from top left: 24M145, 24M113, 24M185 24M168, 24M146, 24M176, 24M177).

Age, fashioning and function

The sand-blasted nature of most of the Mitimiti items suggests they had lain for decades (possibly centuries) atop the deflated dunes. We presume the made-objects are all fishing sinkers (although secured weights were also used, for example, in stone-drilling). Sinkers tend to be far-less-well represented in localised artefact collections than fishhooks or other fishing componentry in both early sites (eg, Davidson 1984: 71; Furey 2002), and some (eg, Booth et al. 2018) - but not all (eg, Davidson 1984: 71; Prickett 1987; Furey 1996) - later ones, likely reflecting wide use of unmodified or contained stones.

In our review of the literature concerning fishing sinkers from northern New Zealand, we did not find reference to use of the same or similar material to ours (although by no means was our enquiry comprehensive, and, apparently, sinkers of concretionary material are held in Auckland War Memorial Museum [Louise Furey, pers. comm. 2019] but they are inaccessible at present).

The style and form of the four small sinkers illustrated in Figure 2 might appear to go beyond the purely functional, having been purposefully and fusiformly shaped in small form, with the lashing incision lengthwise rather than round-the-waist of the objects - but they are probably of the form apparently used quite widely for handlines, as illustrated in Figure 7 of Best (1929).

Geological context

The density and often-spherical form of our objects suggest concretionary material, with several exhibiting concentric growth (*https://www.geocaching.com/geocache/GC21VP5_koutu-boulders-northland?guid=186163b5-4303-4d0f-9e12-44a28d20c08f*) (eg, Figure 4). The typically-waxy luster suggests commonality with Kaipara Harbour (120 km south of Hokianga Harbour) barite concretions (Hodgson 1968: 1255). Indeed, a small fragment of the 'raw' material item 24M168 (RD 3.98), examined as five subsamples by one of us (RR) using polished-section electron microscopy (Appendix), contained barite ($BaSO_4$) with minor intergrowths of silica (SiO_2; Table 2).

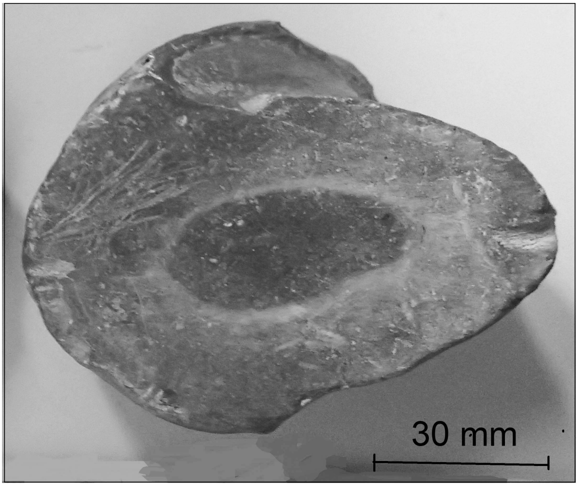

Figure 4. Concentric accretion of minerals visible on the reverse side of 24M12.

A well-known, more-local, site for barite concretions and crystals is Koutu, on the south side of Hokianga Harbour and only a few kilometres from the Mitimiti find-spots (Figure 1; Hayward 2014; Rust 2014; *http://roundtherocks.blogspot.com/;https://www.geocaching.com/geocache/GC21VP5_koutu-boulders-northland?guid=186163b5-4303-4d0f-9e12-44a28d20c08f*). (Apparently, there are also barite concretions at Rangi Point, opposite Koutu; Seabourne Rust, pers. comm., 2019.) Barite crystals from Koutu had SGs of 4.3-4.7, and small concretions (presumably barite) were up to SG 4.2, values similar to our Mitimiti material.

*Table 2. Weight % analyses of concretion 24M168. For operating conditions see Appendix (*t = trace amount).

Subsample	Ba_1	Ba_2	Ba_3	Ba_4	Ba_5
Si as SiO_2	t	3	100	3	13
S as SO_2	32	33	x	32	28
Ba as BaO	67	65	x	65	58

We suggest our barite concretions have likely weathered out of the Cretaceous Punakitere Formation, about 90-75 million years old and part of the Northland Allochthon (Hayward 2014). In the Hokianga area the sedimentary sequence of Late Cretaceous and Palaeocene quartzose sandstone and siliceous mudstone (included in the Mangakahia Complex) overlies Cretaceous Tangihua Complex rocks of the Waima Range (Rust 2014). Other sites in Northland with Cretaceous spherical concretions from the Punakitere Sandstone are scattered as far south as Silverdale (Hayward 2014), including at Parua Bay in Whangarei Harbour (RR).

Barite is highly insoluble and occurs world-wide, having been deposited through several processes including biogenic, hydrothermal and evaporation (Hanor 2000). Its SG is 4.5, and it is brittle and not particularly hard (Mohs hardness 3-3.5). Seawater is undersaturated with respect to it, the barite apparently most often being produced in the water column in association with decaying organic matter (eg, Paytan and Griffith 2007), although the organisms concerned are unclear (Gonzalez-Muñoz et al. 2012).

Conclusions

We have demonstrated use of barite concretions in the production of fishing sinkers found mainly on sand-dunes near Mitimiti on the west coast of Northland 50 years ago; the known presence of barite concretions at Koutu and Rangi Point means it is likely that the Hokianga was the source of this material, although other origins cannot be discounted. The weathering of the objects suggests considerable age. The four smallest sinkers represent a remarkable confluence of material and function with aesthetically-pleasing form.

Acknowledgments

Thanks Seabourne Rust and Diane Yanakopulos for guiding us to - and at - Koutu, and for providing stimulating korero and delicious scones.

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Appendix. *Sample preparation and analysis undertaken at Otago Micro and Nanoscale Imaging, University of Otago (RR)*

Samples of concretion 24M168 were mounted in a block and polished. The block was subsequently coated with a film of amorphous carbon (<3 nm) to prevent a build-up of charge during analysis. Quantitative chemical analyses were performed using a JEOL 840A scanning electron microscope equipped with an Oxford Instruments ATW X-ray Energy Dispersive Spectrometer. The microscope was operated at a high-tension of 40 kV, the probe current was set at 6 Na and the working distance at 39 mm. The resolution of the energy-dispersive detector was 147 Ev at 5.9 keV. Typically, the live time was 100 seconds. All spectra were acquired using a focused (~1 μm diameter) probe. Bulk compositions were determined by raster analyses of single fields using the maximum available area. All quantitative analyses involved applying the ZAF matrix correction procedure to the measured intensities of the Na-Kα, Mg-Kα, Al-Kα, Si-Kα, P-Kα, S-Kα, K-Kα, Ca-Kα, Ti-Kα, Fe-Kα and Pb-Lα characteristic x-ray peaks. Oxygen content was calculated by difference based on the assumed stoichiometry of the oxides. The internal standards and references used in this investigation included apatite (Ca, P), anhydrite (S), plagioclase An 65 (Al, Si), tugtupite (Na), sanidine (K), iron (Fe), lead (Pb), magnesium (Mg) and titanium (Ti). The presence of trace quantities of other elements was confirmed by inspecting spectra by eye. Due to peak overlap, it was not possible to confirm visually for (a) sulphur when lead was present and (b) sodium when remote fluorescence from the copper sample holder gave rise to a Cu-L peak. In most instances results are regarded as +/- 5%, however in some cases, where the amount of powder was very small, this degree of precision would decrease.