

The Grays Hills silcrete source, inland South Canterbury

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The Grays Hills quarry, in the Mackenzie Basin, appears to have been one of the more significant sources of silcrete (or orthoquartzite) utilised by South Island Māori for the manufacture of cutting implements. This paper provides a brief description of the quarry, and a nearby source site, along with an account of previous work, visual attributes of the silcrete and some of the artefacts recovered from the area.

Keywords: artefacts, Grays Hills, Mackenzie Basin, quarry site, silcrete, South Canterbury

Introduction

Silcrete or orthoquartzite was one of the more important stone materials utilised by early Māori settlers in the southern half of the South Island, and was procured from a number of sources mainly in North and Central Otago (Hamel 2001; Anderson 2003). The Grays Hills quarry in the Mackenzie Basin, South Canterbury, was re-discovered in 1930. Limited excavations were undertaken in 1938 (Irvine 1943) and 1970 (Trotter 1970), but the site has not been previously described in any detail, and the large number of artefacts collected remain unstudied.

Brief visits were made to the area in March 2017 and 2018, and two separate silcrete sources are described in this paper: the Grays Hills quarry (site I38/1 of the New Zealand Archaeological Association Site Recording Scheme, www.archsite.org.nz) and a smaller working area located about 4 km to the south,

which is referred to here as the Stony River site I39/1 (Fig. 1). The paper also includes a review of existing records, new information on the nature of the silcrete, and a description of some of the artefacts held by Canterbury Museum. It is intended to provide a basis for further research, such as additional field investigations and an analysis of existing artefact collections.

Previous work

The earliest published account of the Grays Hills silcrete quarry appears to be that by Irvine (1943), who reported on a brief visit to the site with H S McCully and B Beck in April 1938, following its discovery by McCully in 1930 (Simmons and Wright 1967: 73). In addition to recording three main pits, Irvine and his colleagues also investigated a circular hollow, which was 8–9 feet (2.4–2.7 metres)

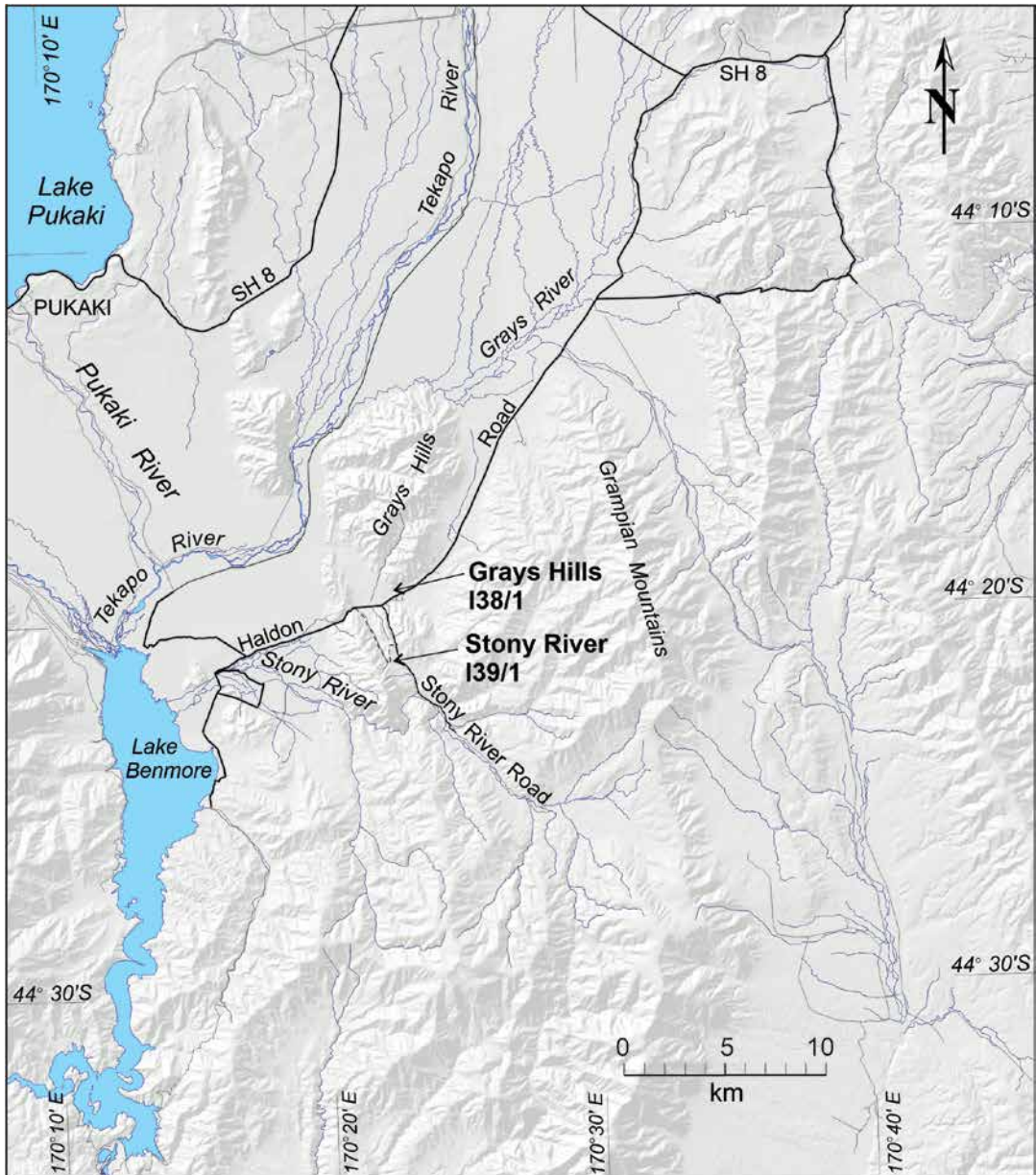


Figure 1. Location of the Grays Hills and Stony River silcrete sources

in diameter and about 1 foot 6 inches (45 cm) in depth. In the centre of this was a fireplace, and excavation of the remainder of the feature revealed “finished tools stacked around the outer margin” along with a “complete set of rough chipping tools made of black stone foreign to the locality” (Irvine 1943: 90). The

circular hollow was interpreted as a hut site (see also Anderson 1986).

The quarry was revisited on 29 January 1970 by Michael Trotter and several members of the Canterbury Museum Archaeological Society (CMAS), at which time a plan was made of the entire site and seven test squares were excavated

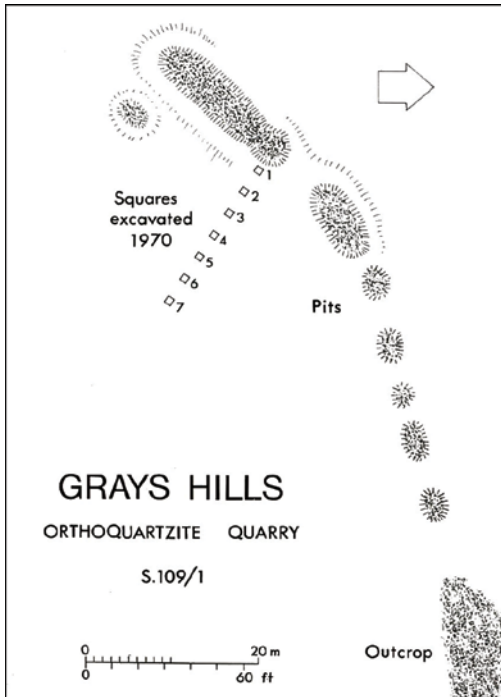


Figure 2. Plan of the Grays Hills quarry site showing the location of quarry pits and squares excavated in 1970 (plan drawn in 1970)

(Trotter 1970; details provided in field book number 9; pp 117–118). These ‘squares’ were approximately 3 feet by 2 feet (90 cm by 60 cm) and up to 9 inches (23 cm) deep, and extended in a single row southeast of the largest pit (Fig. 2). Thousands of flakes were uncovered (see Trotter 1970), though only a few hundred items, mainly from squares 6 and 7, were retained (now held by Canterbury Museum).

The Stony River site was briefly described by McCully (1953: 410), where he reported seeing “white quartzite flakes strewn over 2–3 acres (0.8–1.2 hectares)”, as well as many beneath the surface. The site was revisited and surface collected by CMAS in 1970 (Trotter 1970).

Geological context

Grays Hills is located on the southern margin of the Mackenzie Basin, near Lake Benmore (Fig. 1). This area has not been mapped in any detail geologically and the silcrete occurrence is not

depicted on the latest 1:250,000 scale geological map (Forsyth 2001). However, the silcrete probably represents a minor outlier either of the Miocene Manuherikia Group or Eocene Eyre Group, which has been preserved by down-faulting into the much older surrounding Permian-Triassic greywacke (which is exposed in a modern quarry only about 100 metres to the north). The nearest recorded occurrence of Manuherikia sediments is on the western side of Lake Benmore near Shepherds Creek, approximately 20 km to the southwest (Forsyth 2001). Eyre Group strata outcrop along the eastern side of the Grampian Mountains in the upper Hakataramea River valley and Snow River, about 15 km to the east (Cox and Barrell 2007). The silcrete at Stony River, which occurs on an alluvial fan, appears to be derived from a buried outlier, possibly also down-faulted.

Description of sites

Grays Hills (site I38/1)

The quarry site is located directly opposite the Grays Hills homestead, within a gently sloping paddock about 250 metres west of the Haldon Road at approximately 470 metres above sea level (Fig. 1). It is clearly identified by two large willow trees (Fig. 3). The site was originally known as the No. 1 quarry (McCully 1953).

The site extends over a distance of about 130 metres and covers a total area of approximately 1,670 m² (based on GPS readings). It consists of a line of pits and row of boulders trending northeast to east-northeast (Fig. 2). The main part of the site comprises two large pits (c.f. Irvine 1943), the first one (from the southwest) being about 20 metres long with a deep, round pit at its northeastern end (Fig. 4). The second large pit is more oval-shaped. Both pits have raised rims. Beyond these there is a series of five or six smaller, shallower pits on a slightly different trend, ranging from 3 to 4 metres in length. To the northeast, these line up with a group of boulders composed not of silcrete but limonite. These boulders were previously referred to as the “outcrop” (Irvine 1943), but



Figure 3. View southwest of the Grays Hills quarry site. Willow trees mark the position of the two large pits. Limonite boulders in foreground. Photograph by Phil Moore, March 2017

none appear to be in situ and in fact silcrete does not form a solid outcrop anywhere on the site. About 5 metres east of the first pit there is a shallow, almost circular, depression, and this is likely to be the feature excavated by Irvine et al. in 1938.

Michael Trotter's field notes on the seven test squares excavated by CMAS in 1970 provide some indication of the sub-surface stratigraphy (Fig. 5). In squares 1 and 2, nearest the largest pit, he recorded that there were "many large immovable pieces [of silcrete] at a depth of only 6–9 inches", but in squares 3–7 a "clay floor" was encountered at a depth of between 5 and 9 inches (12–23 cm). This suggests that the sub-surface silcrete 'seam' may extend at least 5–6 metres east of the pit, but beyond that is either absent or concealed beneath a clay layer (alluvial silt or loess). It was not recorded whether any of

the "immovable pieces" had been worked.

Irvine (1943: 90) estimated that approximately 100 tons (102 tonnes) of "material" had been excavated from the three main pits that he recorded, each of which was said to be 16 feet (4.8 metres) long by 8–9 feet (2.4–2.7 metres) wide and about 6 feet (1.8 metres) deep. Whether "material" meant silcrete plus clay and soil or just silcrete is not clear (but the latter was assumed by Challis 1995: 32). However, based on Irvine's measurements, and using the formula for the volume of a half barrel (sectioned lengthwise), we calculated a total volume of about 48 m³. The density of quartz is 2.7 g/cm³, giving a maximum weight of silcrete of 130 tonne. But since the silcrete body might only consist of about 70% solid rock (otherwise quarrying would have been extremely difficult), Irvine's



Figure 4. Largest of the quarry pits, Grays Hills. Photograph by Phil Moore, March 2017

figure of 100 tons seems quite reasonable, if it referred to silcrete only.

A calculation for the largest pit only, using our estimated measurements (about 20 metres long by 3–4 metres wide and 2 metres deep) and the same formula, produced a volume of 45 m³ and quantity of approximately 85 tonne of silcrete (at 70% solid rock). If we include the amount quarried from the other pits, allow for some subsequent infilling and accept that the silcrete must have been exposed above ground level originally, then 100 tonne is probably a minimum figure for the amount of silcrete removed from the pits.

Stony River (site I39/1)

The Stony River site was originally referred to as the No. 2 quarry (McCully 1953). It was described in 1970 as consisting of “quantities

of white flakes of orthoquartzite on the surface” with “odd scattered flakes elsewhere on the hillside” (Site Record Form¹), though there was no indication of the total area concerned. Trotter (1970) reported there were “thousands of large flakes of better quality white orthoquartzite” there (Fig. 6).

This site was relocated in March 2018 in a shallow depression on the alluvial fan, adjacent to a fence line, at GPS position 44.35839°S 170.37584°E (NZTM E1390880 N5084970), which is approximately 350 metres east-southeast of the originally recorded location. It lies at an altitude of approximately 650 metres above sea level. The site consists of scattered flakes, cores and a few worked and unmodified boulders of white to grey silcrete, spread over an area of about 90 metres by 60 metres. Some of the boulders are up to 70 cm



Figure 5. Silcrete artefacts in square 6, Grays Hills quarry. Photograph by Michael Trotter, 1970

across, and flakes up to 20 cm long. In 2017, one isolated boulder of silcrete (26 cm across) and a sparse scatter of flakes were found, at different locations, approximately 200 metres north-northwest of the main site (the flakes are at GPS position 44.35658°S 170.37530°E, NZTM E1390830 N5085170).

The original (geological) source of the silcrete is uncertain. Based on the presence of boulders within the alluvial fan, at one time it must have been exposed further upslope, but our search of the higher part of the fan and steep, rocky hillside revealed no outcrop of silcrete. McCully, though, stated that he followed a “reef outcrop” for a distance of roughly 30 metres “at a little below ground level” (McCully 1953: 410). If so, this outcrop must have been subsequently buried by further deposition of gravel on the alluvial fan.

Petrography

Ten silcrete samples, all waste pieces, were surface collected (with appropriate permission) from various parts of the Grays Hills quarry site in order to provide a reasonably representative selection of material for petrographic study, and these were examined both macroscopically and under a binocular microscope. Most pieces, in natural light, are light brownish grey (2.5Y 7/1–7/2) to grey (2.5Y 6/1), and some have a white weathered surface (colour codes are those of the Munsell Soil Color Chart 2000). Fresh surfaces typically have a waxy lustre. Some silcrete is composed of fine grained, well-sorted, silica-cemented sandstone made up predominantly of angular to rounded quartz grains, with a few larger clasts up to 2 mm across, and rare black and red mineral grains. A number of samples, however, consist of scattered quartz grains in a milky, clayey matrix, and these have a distinctly cherty appearance. A few include small white spherical structures about 0.5 mm in



Figure 6. The Stony River site. Photograph by Michael Trotter, 1970

diameter and other possible organic remains.

Artefacts previously collected from the quarry were also examined (see below) and the colour was recorded for 21 of these. The majority are light grey (N7 to 5Y 7/1), but some are white, very light grey, grey (5Y 6/1) and variably grey and pale yellow.

Only two samples were collected from the Stony River site. These are white to light grey (2.5Y 8/1–7/1) with a yellowish weathering rind and have a sugary to waxy lustre. Both samples are composed of very pure silcrete consisting of very well-sorted fine sandstone with scattered black and red mineral grains. Neither have a milky matrix, as seen in many samples from the Grays Hills quarry.

In a pioneering petrographic study of silcretes from selected South Island sources and archaeological sites, Simmons and Wright (1967) examined four samples from “Gray’s Hills Quarry”, although their description of the site

as consisting of “small boulders of quartzite and much working debris in a dish-shaped hollow” could just as easily refer to the occurrence at Stony River (Simmons and Wright 1967: 73). Three of the samples consisted of angular to sub-rounded quartz grains in a matrix of stained, secondary quartz. The other was grey and flinty with narrow, darker grey sub-parallel bands (1–2 mm thick) of chalcedony, and a matrix of chalcedony and finely granular quartz. Minor mineral grains identified in these samples included zircon, magnetite, and rare tourmaline and hornblende.

Artefacts

A significant number of artefacts have been previously collected from both the Grays Hills quarry and Stony River site, which are held by Canterbury Museum. There are also some in the South Canterbury Museum (not examined) and Otago Museum (Simmons



Figure 7. Mid-section of a broken serrated-edged 'knife', Grays Hills quarry. Canterbury Museum 2008.1157.13

1973). No detailed study of the hundreds of flakes and cores recovered during the 1970 excavations at the Grays Hills quarry has yet been undertaken, but about 30 items were examined to provide some indication of the range of artefact types produced, and material used. They included unmodified flakes, cores and a few retouched flakes and blades, along with pieces of waste rock. Some of these are illustrated in Figures 7 and 8.

Flakes vary considerably in size and form, from what may be termed spalls to large, elongate blades (roughly defined as having a length:width ratio >2 , Leach and Leach 2019: 248). Most can be classified as waste flakes, but some show evidence of secondary retouch (fine flaking) along the edges. This includes a small broken blade which is serrated along both sides and presumably intended for use as a knife (Fig. 7). There is also an unusual tool which has been retouched to produce a distinct waist. (Fig. 8). It is somewhat similar to a tanged blade from the Shag River Mouth site, illustrated by Anderson (2003: fig. 12.10). Of the cores, a number have elongate flake scars. These artefacts were made from both high quality white to light grey silcrete and poorer quality, distinctly cherty material with a milky matrix, as also seen among the 10 petrographic samples collected by us.

A single spall of greywacke was recovered in 1970 from Square 7, which had clearly been struck off a well-rounded cobble and indicates



Figure 8. Unusual silcrete tool (100 mm length) showing secondary flaking to produce a central 'waist', Grays Hills quarry. Canterbury Museum 2008.1157.50

that such cobbles were likely used as hammer stones. A greywacke cobble was also found by us at the first pit. Additionally, McCully (1953: 410) reported there was a greywacke "anvil", apparently the same one observed by Irvine et al. in 1938, set in the ground near the line of limonite boulders. It was not seen in 2017.

The range of artefact material at the Stony River site is similar to that seen at the Grays Hills quarry. It consists mainly of flakes, with some cores and worked boulders. Some of the flakes show secondary retouch (Fig. 9). No hammer stones were found in 2018, but one rounded greywacke cobble (Canterbury Museum 2008.1157.42) was collected in 1970, which had probably been used for that purpose.

Discussion

There is no direct evidence for the age of the Grays Hills quarry, though Duff (1956: 272) considered "it must also have been first worked in Mōa-hunter times", based on the finding of an unfinished serpentine reel on the adjacent "Streamlands" station at an altitude of 1,700 feet (about 520 metres) above sea level, close to the base of the hills in this area. Anderson (2003: fig. 12.1) also recorded a slate knife or ulu from Grays Hills. Both artefacts are certainly indicative of an early Māori presence in the area.

In 1848, a sketch map of the Waitaki River and its tributaries was drawn by Te Ware Korari



Figure 9. Two large flakes (141 mm and 147 mm in length) of white silcrete with secondary retouch along edges, Stony River site. Canterbury Museum 2008.1157.51 (left) and 2008.1157.52

for W Mantell showing the Māori names for many rivers, streams and important cultural sites along the river catchment (Andersen 1916: 39). This included what was labelled an “Ancient Settlement” named Rauru, located close to the confluence of the Tekapo and Pukaki rivers, somewhere near the head of present day Lake Benmore. In 1953, McCully (1953) attempted to relocate this settlement, which he considered should be found on Grays Hills station, but failed to do so. Nevertheless, it is tempting to speculate that Rauru may have been associated with the Grays Hills quarry.

Exactly how the Grays Hills source was originally discovered is somewhat puzzling, given that there is no outcrop or scatter of silcrete boulders there today. However, some exposure of the rock must have been evident on the surface, which it can be reasonably

assumed was subsequently quarried away. We have no way of knowing how much silcrete was actually removed off-site, but even 5% of the estimated minimum of 100 tonne quarried (i.e. 2 m³ or 5.4 tonne) constitutes a substantial amount, and to that we can probably add at least 100 kilograms from the Stony River site. But since it is evident from Irvine’s (1943) account and the Canterbury Museum collections that finished tools were actually being produced at Grays Hills, the quantity of raw material transported to early settlements along the Canterbury (and perhaps Otago) coast need not have been that great.

There is clearly a need for further work at the Grays Hills quarry, particularly the preparation of a more detailed plan of the site and perhaps additional excavations. A proper analysis of material from the 1970 investigations is also

required to determine the range of artefact types produced and processing technology used, and to facilitate comparisons with some of the well-studied silcrete quarries in Otago (e.g. Leach and Leach 2019).

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Endnote

- 1 Site record form for site I39/1. New Zealand Archaeological Association Archaeological Site Recording Scheme. www.archsite.org.nz

References

- Andersen JC. 1916. *Jubilee History of South Canterbury*. Christchurch: Whitcombe & Tombs Ltd.
- Anderson A. 1986. "Makeshift structures of little importance": a reconsideration of Maori round huts. *Journal of the Polynesian Society* 95 (1): 91–114.
- Anderson A. 2003. *Prodigious Birds. Moas and moa-hunting in prehistoric New Zealand*. Cambridge: Cambridge University Press.
- Cox SC, Barrell DJA. 2007. Geology of the Aoraki area. Institute of Geological & Nuclear Sciences 1:250,000 geological map 15.
- Challis AJ. 1995. *Ka Pakihi Whakatekateka o Waitaha: the archaeology of Canterbury in Maori times*. Science and Research series no. 89. Wellington: Department of Conservation.
- Duff R. 1956. The moa-hunter period of Maori culture. *Canterbury Museum Bulletin* 1: 1–400.
- Forsyth PJ. 2001. Geology of the Waitaki area. Institute of Geological & Nuclear Sciences 1:250,000 geological map 19.
- Hamel J. 2001. *The Archaeology of Otago*. Wellington: Department of Conservation.
- Irvine R. 1943. Quartzite quarry at Grays Hills, Mackenzie country. *Journal of the Polynesian Society* 52 (2): 90.
- Leach BF, Leach HM. 2019. Excavation of a twelfth-century prepared-core prismatic-blade workshop at Oturehua, Central Otago, New Zealand. *Tuhinga* 30: 209–255.
- McCully HS. 1953. In quest of Rauru. *Journal of the Polynesian Society* 62 (4): 410–411.
- Simmons DR, Wright JB. 1967. Use of the polarising microscope for classifying quartzite artefacts from South Island sites. *Transactions of the Royal Society of New Zealand* 2 (4): 71–78.
- Simmons DR. 1973. Suggested periods in South Island prehistory. *Records of the Auckland Institute and Museum* 10: 1–58.
- Trotter M. 1970. Lake Tekapo survey. Canterbury Museum Archaeological Society Newsletter 21, March 1970.