# The procurement and exchange of lithic raw materials on Skye during the Mesolithic period

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**Abstract** – In contrast to regions like southern Britain and Denmark, where early prehistoric lithic assemblages are dominated heavily or entirely by flint, assemblages from Scotland tend to be more diverse, with assemblages from the Isle of Skye in the Inner Hebrides being the most diverse by far. The variety of raw materials creates some difficulties for lithics specialists, as well as archaeologists in general. However, it also opens up possibilities to discuss areas of interest that are almost impossible to discuss on the basis of flint-only assemblages, such as procurement and exchange of lithic raw materials, as well as social territories. The early prehistoric assemblages from Skye tend to be dominated by flint from the beaches on Skye, bloodstone from the island of Rum immediately south of Skye, Durness chert from Ord in SW Skye, Staffin baked mudstone from northern Skye and quartz, supplemented by minority materials like dolerite and tuff. Due to difficulties in terms of identifying weathered varieties of these raw materials, new categories were invented, such as 'chalcedonic silica' and 'flint-like cherts', which made it almost impossible to discuss the topics listed above. However, one of the authors (TBB) suggested a way of distinguishing safely between the most important of these raw materials. In the present paper, procurement, exchange and territorial structures on Skye are discussed on the basis of raw materials with limited but geographically well-known outcrops, such as Rum bloodstone, Durness chert, Staffin baked mudstone and massive lapilli tuffs from the extinct Kilchrist caldera in southern Skye. Four Mesolithic assemblages from Skye are classified according to the new understanding of their raw materials, namely Staffin, South Cuidrach, Camas Daraich 2 and Rubh an Dunain. It has been possible to divide Skye into a northern and a southern half due to the different raw material preferences from the excavated sites, and to conclude that their main lithic raw materials were procured within an area with a radius of up to c. 25km from the settlements. It was also possible to infer that the distribution of Rum bloodstone (which was clearly considered a 'precious' raw material and exchanged more widely) is stepped, including an inner ring (sites with distances to Rum of up to 80km) and an outer ring (sites with distances to Rum of up to 150km). The core area (up to 25km from the outcrop) is defined by large numbers of bloodstone artefacts per site, whereas the sites in the inner and outer rings are all characterised by few pieces per site. Instead, the main difference between the inner and outer ring is the number of sites with bloodstone – in the inner ring most sites have at least one or two pieces of bloodstone, whereas in the outer ring most sites have none but some rare pieces do occur. An interpretation of the observed patterns is offered, but this interpretation is clearly in need of corroboration from more Mesolithic assemblages, classified, characterised and analysed following the principles defined in this paper.

**Key words** – archaeology; Late Mesolithic, lithic raw material procurement; exchange networks; Isle of Skye; Inner Hebrides

**Titel** – Die Beschaffung und der Austausch von Steinrohmaterialien auf Skye (Innere Hebriden) während des Mesolithikums

**Zusammenfassung** – Im Gegensatz zu Regionen wie dem südlichen Großbritannien oder Dänemark, wo urgeschichtliche Steinartefaktinventare weitgehend oder vollständig von Feuerstein dominiert werden, sind Inventare aus Schottland tendenziell diverser, wobei Inventare von der Isle of Skye in den Inneren Hebriden die bei weitem vielfältigsten sind. Die Vielfalt an Rohmaterialien stellt Spezialisten für Steinartefakte und Archäologen im Allgemeinen vor Herausforderungen. Sie ermöglicht es jedoch auch, Fragestellungen zu erörtern, die auf der Grundlage von reinen Feuersteininventaren kaum diskutiert werden können, wie z.B. die Versorgung mit und der Austausch von lithischen Rohmaterialien sowie soziale Territorien. Die urgeschichtlichen Inventare von Skye werden tendenziell durch Feuerstein von den Stränden Skyes, Heliotrop (Blutjaspis) von der Insel Rum unmittelbar südlich von Skye, Durness-Hornstein aus Ord im Südwesten Skyes, Staffin-Tonstein (baked mudstone) aus dem Norden Skyes und Quarz dominiert, ergänzt durch seltenere Materialien wie Dolerit und Tuff. Aufgrund von Schwierigkeiten bei der Bestimmung verwitterter Varietäten dieser Rohmaterialien wurden neue Kategorien erfunden, wie zum Beispiel 'chalcedonic silica' und 'feuersteinartige Hornsteine', die es fast unmöglich machten, die oben aufgeführten Themen zu diskutieren. Allerdings schlug einer der Autoren (TBB) einen Weg vor, um sicher zwischen den wichtigsten dieser Rohmaterialien zu unterscheiden. Im vorliegenden Aufsatz werden Versorgung, Austausch und Territorialstrukturen auf der Grundlage von Rohmaterialien mit begrenzten, aber geographisch bekannten Aufschlüssen diskutiert, wie Heliotrop von Rum, Durness-Hornstein, Staffin-Tonstein und massive Lapillituffe aus der erloschenen Kilchrist-Caldera im südlichen Skye. Vier mesolithische Inventare von Skye werden entsprechend des neuen Verständnisses ihrer Rohmaterialien unterteilt, und zwar Staffin, South Cuidrach, Camas Daraich 2 und Rubh an Dunain. Aufgrund der unterschiedlichen Rohmaterialpräferenzen auf den ausgegrabenen Fundplätzen war es möglich, Skye in eine nördliche und eine südliche Hälfte zu unterteilen und den Schluss zu ziehen, dass die wichtigsten lithischen Rohmaterialien innerhalb eines Gebietes mit einem Radius von bis zu ca. 25 km Entfernung von den Lagerplätzen beschafft wurden. Es war ebenfalls möglich zu folgern, dass die Verbreitung des Heliotrops von Rum (der eindeutig als 'kostbares' Rohmaterial angesehen und großräumiger getauscht wurde) abgestuft ist und einen inneren Ring (Fundstellen mit Entfernungen von Rum von bis zu 80 km) sowie einen äußeren Ring (Fundstellen mit Entfernungen von Rum von bis zu 150 km) umfasst. Das Kerngebiet (bis zu 25 km vom Aufschluss) wird durch große Anzahlen von Heliotrop-Artefakten pro Fundstelle definiert, wohingegen die Plätze im inneren und äußeren Ring alle durch wenige Stücke pro Platz gekennzeichnet sind. Stattdessen besteht der Hauptunterschied zwischen dem inneren und dem äußeren Ring in der Zahl an Fundplätzen mit Heliotrop – im inneren Ring enthalten die meisten Fundstellen mindestens ein oder zwei Stücke aus Heliotrop, während im äußeren Ring die meisten Plätze keine aufweisen, aber einige seltene Stücke doch vorkommen. Eine Interpretation der beobachteten Muster wird vorgeschlagen, aber diese Interpretation bedarf eindeutig einer Untermauerung durch mehr mesolithische Inventare, die anhand der in diesem Aufsatz definierten Prinzipien klassifiziert, beschrieben und analysiert werden.

Schlüsselwörter – Archäologie; Mesolithikum; Spätmesolithikum; Beschaffung lithischer Rohmaterialien; Austauschnetzwerke; Isle of Skye; Innere Hebriden; Schottland

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**Introduction**

Over the last century, Mesolithic sites from the northern part of the Inner Hebrides (the Isle of Skye and surroundings) have been investigated, either through surface collections or through actual excavations (for overview, see the HIARF regional SCARF report, Kruse & Noble, 2021). However, where the southern part of the Inner Hebrides is characterised by relatively plentiful supplies of good-quality flint (e.g., Mercer, 1968; 1970; 1971; Mithen, 2000; Marshall, 2000a; 2000b), the northern part is characterised by relatively scarce flint supplies, and the available flint is generally of poorer quality (e.g., Ballin, 2014). For this reason, Mesolithic people on Skye had to supplement their insufficient flint resources with other lithic raw materials (see raw material section in Saville & Wickham-Jones, 2012; Ballin, 2013b), some of which are available on the island or on neighbouring islands. These raw materials include Rum bloodstone (Wickham-Jones, 1990; Ballin, 2018), Durness chert from Ord in southwest Skye (Hardy & Ballin, 2024), baked mudstone from Staffin Bay in the north (e.g., Saville et al., 2012), quartz and dolerite from a number of occurrences throughout the island, and a recently identified lithic raw material from an archaeological site at Staffin (massive lapilli tuff, below abbreviated to mLT) which outcrops in the periphery of the Kilchrist Caldera in southern Skye (Ballin, 2024; Drake, 2015; Drake et al., 2022).

Processing the lithic assemblages from sites on and around Skye turned out to be challenging, as it can be difficult to distinguish between the local flint, chert and bloodstone, particularly when the artefacts have weathered through contact with air, soil or sea-water. The weathering might alter not only the colour of the raw material, but it may also mask the patterning and lustre, and affect the cortex. This led specialists to 'invent' new broader lithic raw material categories, such as 'chalcedonic silica' which includes, in some cases, flint, Rum bloodstone and Durness chert (e.g., Wickham-Jones, 1990, Table 2), and in others, flint and Durness chert (e.g., Wickham-Jones & Hardy, 2004, Table 4; Hardy & Wickham-Jones, 2009, Table 104) with Rum bloodstone dealt with as a separate and more easily identifiable entity. Unfortunately, the general consequence of this was that it made it very difficult to discuss matters such as raw material procurement, exchange networks and territorial structures. The fourth main raw material used on Skye during the Mesolithic period, Staffin baked mudstone, is easily identifiable and can not be confused with any of the other three main raw materials in **Table 1** (however, see the discussion below of confusion between Staffin baked mudstone and Western Isles mylonite).

In some of his publications, the analyst applied the term 'flint-like cherts' to describe the generally poor-quality flints from the northern part of the Inner Hebrides, but recent research suggests that this raw material is indeed flint which simply differs in appearance and flaking properties from the much better-quality flint from the southern part of the Inner Hebrides (see flint section below).

However, after having processed numerous assemblages from Skye, neighbouring islands and the adjacent parts of west-mainland Scotland, the analyst now feels confident that there are sufficient visual differences between the region's main lithic raw materials to safely distinguish between them – where these materials used to be considered in some cases indistinguishable, individual classification of them should now have a very low error ratio, possibly in the order of a few per cent. As shown in **Table 1**, a small number of attributes allows safe classification of the three raw materials formerly included in the category 'chalcedonic silica'.

| | Lustre | Globules | Fossils |
|---|---|---|---|
| Local flint | Dull | | x |
| Rum bloodstone | Greasy | x | |
| Durness chert from Ord | Greasy | | |

**Tab. 1** Raw material distinction.

Over the last few years, the analyst has examined, classified, catalogued and reported on four sites on Skye applying the classification principles in **Table 1** (in addition to the primary colours of the raw materials), and it appears that assemblages in northern Skye are dominated by one set of raw materials and sites in southern Skye by another set of raw materials, but with flint, Rum bloodstone, Durness chert, Staffin baked mudstone, quartz and dolerite being present on all, although in different proportions. So far, forms of mLT have only been found at Staffin.

In this paper, the main lithic raw materials found on, and exchanged between, these Mesolithic sites on Skye will therefore be presented and char-

acterised, and it will be attempted to discuss and interpret the raw materials' distribution patterns in terms of procurement strategy, exchange networks and territorial structures. It is hoped in the future to add new sites and assemblages to this discussion, as the identification of raw materials from most 'old' excavations of Mesolithic sites in the region are biased by the use of petrological misnomers (i.e., 'chalcedonic silica' and 'flint-like cherts').

## Location of recently excavated settlements and lithic outcrops

*Settlements*

As mentioned above, four sites on Skye, and their lithic assemblages, have been analysed in recent years, following the raw material schema presented as **Table 1**. They are: Staffin on the eastern side of the island's northern tip; South Cuidrach on the north-western side of the island; Rubh an Dunain Cave on the south-western side of the island; and Camas Daraich on the southern coast of Skye (**Fig. 1**). The raw material composition of these assemblages is shown in **Table 1**).

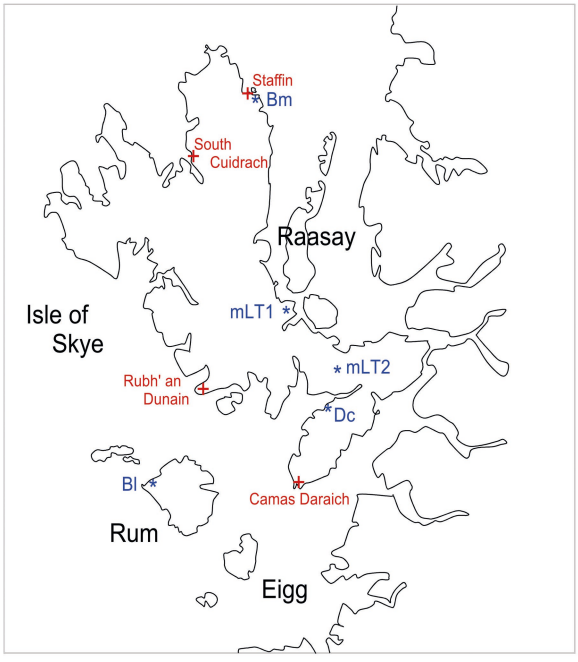


**Fig. 1** Settlements and lithic outcrops. Red crosses mark settlements, blue stars lithic outcrops. Bm = Staffin baked mudstone; Bl = Rhum bloodstone; Durness chert (Ord); mLT 1-2 = Kilchrist massive lapilli tuffs. North is up; Skye measures c. 80 km north-south and c. 40km east-west.

*Staffin:* This site (or conglomerate of sites) is located along c. 600m of the southern shore of Staffin Bay (centred on NGR: NG 49042 68568), not far from the Early Mesolithic site of An Corran and with all parts of the site being less than one km from the island's main baked mudstone outcrop (Saville et al., 2012). The location was excavated by AOC Archaeology in 2022. Analysis of the site's blades, cores and tools suggests that all parts of the assemblage are datable to pre-Neolithic times, with narrow blades and narrow microliths indicating that most of the finds were deposited during the Late Mesolithic. A small number of broad blades are probably indicators of brief visits to the site during the Early Mesolithic (Ballin, forthcoming b).

*South Cuidrach:* This site (or conglomerate of sites) is located along a 200m long raised beach along the shore of north-western Skye (centred on NGR: NG 38352 57729), and during 2018-24 a number of test pits were excavated. Due to its nature, the raised beach yielded redeposited lithic artefacts from a number of pre-Neolithic material cultures, and based on analysis of diagnostic blades, cores and tools, it was possible to relate the finds to the following general stages: 1) the Late Upper Palaeolithic; 2) the Late Upper Palaeolithic/Early Mesolithic transition; 3) the Early Mesolithic; and 4) the Late Mesolithic (Hardy & Ballin, 2024).

*Rubh an Dunain Cave:* This cave is located on the Rubh an Dunain peninsula, c. 500 metres from Loch na Airde at around 31m above OD (NGR: NG 3995 1625). The most notable excavations took place in the 1930's when Scott investigated the Hebridean type chambered tomb (Scott, 1932; 1934a) as well as the cave (Scott, 1934b). As the lithics, according to Scott, included no diagnostic pieces, and as he discovered sherds of Beaker pottery, he suggested that the lithic assemblage of flint, Rum bloodstone, baked mudstone and chert represented a 'knapper's workshop' of Neolithic or Early Bronze Age date. Scott also found evidence for the later use of the cave in the form of a well-built smelting hearth and associated iron slag deposits which he suggested might date to the Iron Age. However, test pit excavation at the site in 2002 by Birch (2020; Birch & Ballin, forthcoming) led to the recovery of c. 1,500 lithic artefacts, and analysis of the finds suggested that the main visit to the site happened in the Late Mesolithic period, with some broad blades, a leaf-shaped arrowhead and one piece of Arran pitchstone (Ballin, 2015) indicating one or more brief visits to the site during the Early Neolithic. It should be considered whether the lithics recovered by Scott are

actually contemporary with his Beaker sherds or whether they form part of the mainly Late Mesolithic assemblage recovered by Birch.

*Camas Daraich:* In 2000, an excavation was carried out at Camas Daraich on the southern shores of Skye (NGR: NG 567 000), but as the classification of the site's lithics included the category 'chalcedonic silica' (see above), this material is not suitable for the purposes of this paper (Wickham-Jones & Hardy, 2004). However, in 2010 and 2012 a team from Universitat Autònoma de Barcelona, led by Karen Hardy, carried out an exploratory excavation at another site at Camas Daraich which resulted in the recovery of c. 12,500 lithic artefacts which were classified, catalogued and reported on by the analyst (Ballin, forthcoming a) following the raw material definitions of this paper (**Table 1**). Diagnostic blades, cores and tools suggest that the assemblage was accumulated in connection with a small number of visits to the site during a relatively brief period within the Late Mesolithic. Below, this site and its assemblage will be referred to as Camas Daraich 2, to distinguish it from the neighbouring site dealt with in Wickham-Jones & Hardy (2004).


**Fig. 2** Natural flint from Kilmartin River, Skye, donated by Stephen Birch, West Coast Archaeological Services (photo: Beverley Ballin Smith, GUARD Archaeology Ltd.).

## Skye raw materials and the associated raw material terminology

This chapter focuses on Skye's dominating lithic raw materials flint, Staffin baked mudstone, Rum bloodstone and Durness chert from the Ord outcrop. The locations of these raw materials are shown in **Fig. 1**.

*Flint*

As mentioned in Ballin (2014), it appears that the Inner Hebrides archipelago is subdivided into two areas, namely the southern part (Islay and Jura with surrounding islands and adjacent parts of the Scottish mainland) and the northern part (Skye and surrounding areas and islands). The flint from the southern part of the Inner Hebrides is generally a fairly good raw material (in terms of knapping properties), whereas that from the north is of slightly lower quality, with some of the differences being nodule size, grain size, and nature of the cortex, as well as the absence/presence of impurities.

The flint from the southern part of the Inner Hebrides (Islay and Jura; e.g., McCullagh, 1989; Marshall, 2000a; 2000b; Saville 2005) occurs as relatively large nodules of fine-grained material, whereas that from the northern part (the Skye and Loch Torridon area) is available in the form of smaller nodules and it is not as abundant as at some locations further south. Although most of the flint from the north is fine-grained, some of it tends to be coarser, and the cortex of some nodules in the northern part of the archipelago is occasionally centimetre-thick compared to the much thinner cortex characterising the southern flint. The flint from the north also commonly contains impurities such as fossils, sheets of crystals and chalk balls.

Combined, these attributes make the flint from the north a somewhat less attractive material in terms of availability and knapping properties, which (from a functional point of view) may explain the wide-spread use in the north of non-flint lithic materials, whereas, further south, flint and quartz dominate the Hebridean assemblages more prominently. According to Wickham-Jones & Collins (1978), there is a white calcareous sandstone containing flints west of Clack Alasdair at the western end of Laig Bay on Eigg, and Karen Hardy, University of Glasgow (pers. comm.), has found small flint pebbles in the area around An Corran at the northern tip of Skye. Marshall (2000b) also reported rolled flint from Staffin Bay, but it is uncertain from his report whether these pieces are natural flint or rolled artefacts. Based on the nature of the artefacts from AOC's site at Staffin, many of which are rolled, the analyst is uncertain as to whether there is actually natural flint in the Staffin area or whether those pieces are rolled artefacts.

Research by Harding et al. (2004) indicates that most of the flint in the general Islay area (including the adjacent parts of the Scottish mainland) may be of the same age (Upper Cretaceous) as the so-called Antrim flint, and that it eroded out of chalk cliffs then extending from Northern Ireland to Scotland. There are still deposits of Upper Cretaceous chalk in Mull (Gribun) and Morvern (Beinn Iadain), as well as in other parts of the southern parts of the Inner Hebrides (Mortimore et al., 2001, Ch. 6; Hopson, 2005, 39). Antrim flint is generally associated with the Ulster White Limestone Formation, and flint occurs in strata dated to the late Santonian to the early Maastrichtian (c. 85-70 million years BP; Mitchell, 2004, 155), that is, the late part of the Upper Cretaceous period.

As mentioned above, the analyst suggested in a paper (Ballin, 2014) that the poor-quality flint from the northern parts of the Inner Hebrides might be a form of flint-like chert (for description, see above). However, in 2016 the analyst sent a collection of artefacts based on a similar form of flint from Barabhas on Lewis to geologist Dr Alan Owen, School of Geographical and Earth Sciences, University of Glasgow, for analysis of the flint's micro-fossils. His verdict was that: 'I don't think it is possible to be any more precise about the age of the fossils in the flints other than *"Upper Cretaceous"*'. These fossils included parts of sea urchins, various forms of bryozoans, molluscs and starfish. It is possible that this type of flint dates to an earlier part of the Upper Cretaceous than the flint from the southern part of the Inner Hebrides, but more research is needed to determine the specific geological date of the flint from the northern part of the Inner Hebrides and the Western Isles.

*Staffin baked mudstone*

Baked mudstone occurs in a number of locations throughout Scotland (e.g., Davidson et al., 1949), in the Outer Hebridean area (e.g., the Shiants northwest of Skye; Foster & Hooper, 2005), as well as on Skye, but in the Inner Hebrides it is only present as a notable and easily accessible outcrop of flakable raw material at An Corran, Staffin Bay, northern Skye. In the Staffin Bay area, it occurs within the local igneous rocks as rafted sediments, which were altered by contact metamorphism (Saville et al., 2012, 19). It is a fine-grained, black (monochrome), flint-like lithic raw material with excellent flaking properties, its only major flaw being natural fault planes running through this finely foliated (although rarely visibly banded) type of rock.

When weathered, its outer surfaces disintegrate and become powdery to slightly 'soapy', and its original colour changes to grey, light olive-grey or fawn, and it is generally opaque. This raw material has been referred to in the literature as 'banded mudstone', but it is neither banded nor a mudstone, which prior to being 'baked' is not hard enough to be exploited as a lithic raw material. Although baked mudstone pebbles from Staffin Bay was clearly used in prehistory (ibid.), most baked mudstone used by prehistoric people in the Hebridean area during the Late Upper Palaeolithic (South Cuidrach; Hardy & Ballin, 2024) and Mesolithic periods (Saville et al., 2012) was probably quarried from the outcrop behind the mainly Early Mesolithic site of An Corran (ibid.), with larger nodules or blocks used for broad blades. However, baked mudstone was also used on Skye in later periods, as indicated by for example scale-flaked knives and small scrapers with acute pressure-flaked edge-angles of this material in a Neolithic/Early Bronze Age assemblage from Home Farm, Portree, on the east-coast of Skye (Ballin, 2013).

Occasionally, it has been claimed that the raw material on the western Isles referred to by Lacaille as mylonite (Lacaille, 1937, following analysis by geologist Dr A. J. Macgregor, Geological Museum and Survey, South Kensington) is baked mudstone from Staffin on Skye (e.g., Professor Emrys Phillips, British Geological Survey, Edinburgh; Phillips, 2006). However, in 2000, the analyst asked geologist Dr Alan Hall, Archaeological Department, University of Glasgow to examine and comment on a number of possible

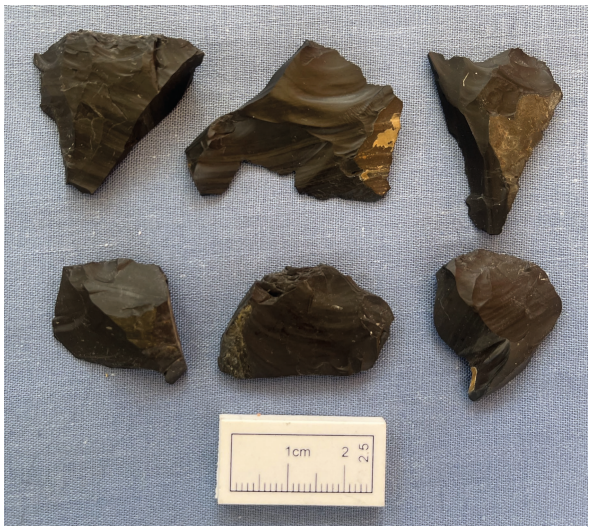


**Fig. 3** Fresh, unweathered flakes in baked mudstone from An Corran, Staffin; knapped by Steven Birch (photo: Beverley Ballin Smith, GUARD Archaeology Ltd).

mylonite artefacts from the Calanais stone circle on Lewis, and his determination was as follows: some samples could only be identified as either 'fine-grained sedimentary rock, hornfels or mylonite', but one sample (Sample 4) was classified as a typical mylonite, possibly a 'tectonised amphibole'. In short, this raw material has been determined by some as baked mudstone and by others as mylonite, and all determinations are based on examination by geologists.

**Fig. 4** Weathered LUP or EM blades in baked mudstone from An Corran, Staffin; recovered from South Cuidrach by Karen Hardy (HARDY & BALLIN, 2024) (photo: Beverley Ballin Smith, GUARD Archaeology Ltd).

However, the simplest test is visual inspection, and by simply looking at baked mudstone from Staffin on Skye and comparing it with the fine-grained toolstone from the Western isles, it is immediately obvious that they are two different raw materials, and that the raw material from the Western Isles is not Staffin baked mudstone. As shown in **Figs 3-4**, the material from Staffin is generally monochrome and only very rarely banded, and that from the Western Isles is generally notably 'tiger-striped' (**Figs 5-8**; BALLIN, 2018a). This analyst therefore suggests that, on balance, the banded lithic raw material from the Western Isles is more likely to be mylonite than baked mudstone from Staffin.

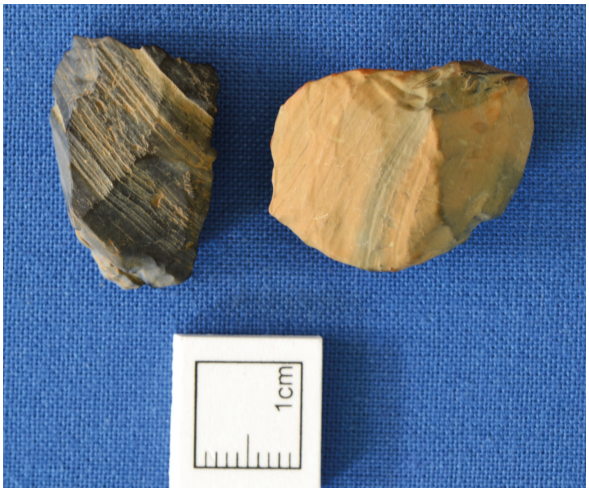


**Fig. 5** Barabhas, Lewis (Elliott Collection): Bipolar cores in mylonite (photo: Beverley Ballin Smith, GUARD Archaeology Ltd).

*Rum bloodstone*

Bloodstone is a member of the chalcedony family, and according to Přichystal (2010) it is not a chert, as it does not have an organic origin. However, in contrast to macro-crystalline quartzes, which occasionally form hexagonal crystals, chalcedony was formed by the solidification of silica-rich hydrothermal fluids in cavities in lavas, and it does not form visible crystals. Instead, it commonly occurs as botryoidal masses, and it may form geodes which are either hollow or filled with quartz crystals (PELLANT, 1992, 88).


**Fig. 6** Barabhas, Lewis (Elliott Collection): Barbed and tanged arrowheads in flint, mylonite (nos 2 and 3) and pseudetachylite (photo: Beverley Ballin Smith, GUARD Archaeology Ltd).


**Fig. 7** Barabhas, Lewis (Elliott Collection): Thumbnail-scrapers in flint, mylonite (nos 7 to 10) and quartz (photo: Beverley Ballin Smith, GUARD Archaeology Ltd).

The chalcedony family may be subdivided into a number of different sub-categories on the basis of colours and patterns, such as chalcedony proper (grey or bluish-grey), jasper (usually red), carnelian (brown), agate (characterised by concentric banding), and bloodstone (a mostly green jasper). The coloured forms of chalcedony are frequently shot through with veins of either quartz or plain chalcedony.

Bloodstone is also called heliotrope, and heliotrope and plasma are frequently found in the same geological environments (Hall, 2000, 93), such as for example around the extinct volcanoes on the Isle of Rum in the Scottish Inner Hebrides (Bloodstone Hill). Substantial amounts of good quality (knappable) bloodstone have not been found elsewhere in Scotland. Heddle (1901, 57) defines plasma as: 'Chalcedony stained bright green by the uniform admixture with Delesite or Celedonite. Lustre, greasy to horny'. He (ibid.) defines heliotrope in the following fashion: 'Chalcedony stained various shades of green, dark to leek-green, by admixtures with Celedonite, and, when sprinkled with red spots, becomes Bloodstone; when these from confluence become blotches, it is Heliotrope' (**Fig. 9**).

In their discussion of bloodstone from Rum (in Wickham-Jones, 1990), Durant et al. (1990) states that '… there is little agreement as to terminology in the geological literature, but technically the term bloodstone should be reserved for

**Fig. 8** Barabhas, Lewis (Elliott Collection): 'Other' scrapers in flint, mylonite (nos 3 and 6) and quartz (photo: Beverley Ballin Smith, GUARD Archaeology Ltd).

**Fig. 9** Flake of gem-quality bloodstone showing the characteristic red spots and filaments. Purchased by the analyst in a jewellery shop in Stirling, Scotland (photo: the author).

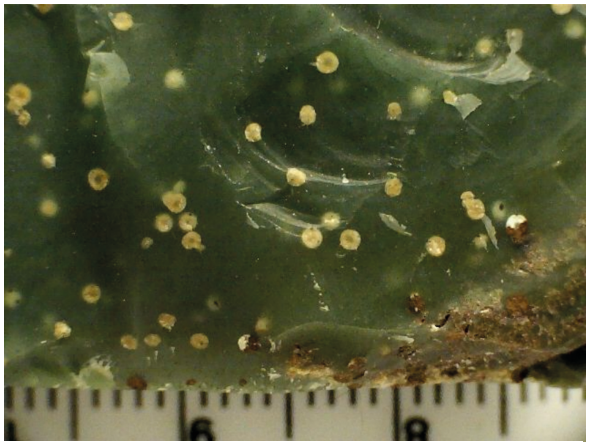

**Fig. 10** Fresh inner surface showing white, unweathered globules.

the fine-textured dark green nodules that are shot through with red'. However, they also conclude that: '… prehistoric people apparently made no distinction between the formal varieties (i.e., plasma or heliotrope)'. Furthermore, in terms of characterising pieces of worked plasma/heliotrope in archaeological assemblages, it would be entirely unrealistic to attempt to distinguish between these two forms of green stone as: 1) frequently, worked pieces of plasma/heliotrope are very small, and it is in most cases impossible to say whether the original nodules had any red filaments or not, and 2) many pieces of plasma/heliotrope from archaeological sites in Scotland have weathered and become discoloured, and they are now as white as weathered flint, only recognizable as plasma/heliotrope due to their chalcedonic lustre and the presence of small characteristic globules (**Figs 5-6**). To the lithics specialist it is necessary to combine these two raw materials, and it is suggested to follow the going practice and refer to both (in an archaeological context) as bloodstone.

The globules just mentioned (not to confuse with the above-mentioned red spots and filaments) are an important attribute of Rum bloodstone, but it has not been possible for the present analyst to find explanations of this phenomenon in the geological literature. These globules may correspond to the spherulites encountered in some Arran pitchstones, which in Ballin & Faithfull (2009, 5) were defined as: 'Finely crystalline, usually radiating intergrowths of quartz and feldspar, indicating devitrification […]'. When the stone is fresh, these globules are usually pale, when weathered reddish-brown, and they are the most important identifier of discoloured archaeological bloodstone (**Figs 5-6**). When globules (also occasionally called 'orbs') grow so large and/or numerous that they dominate the appearance of a jasper (and bloodstone is a jasper), this piece may be referred to as orbicular or ocean jasper (Strekeisen, 2020).

Examination of bloodstone-bearing assemblages in National Museums Scotland, as well as bloodstone-bearing assemblages processed by the analyst (e.g., Camas Daraich 2 on Skye, as well as Guirdil Glen, Raonapoll and the Deer Larder Site

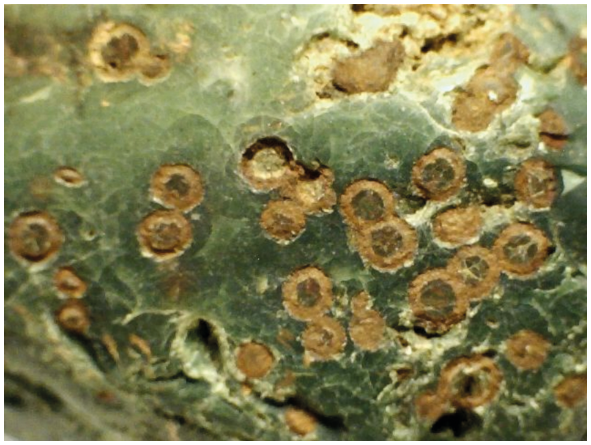

**Fig. 11** Weathered outer surface showing discoloured, rust-brown globules; several globules in this group have fallen out – the semi-spherical cavities left by detached globules are as geologically diagnostic as the globules themselves. Both pieces of bloodstone were collected in Guirdil Bay, Rum, by Steven Birch, West Coast Archaeological Services, and donated to the author's bloodstone research (photo: Beverley Ballin Smith, GUARD Archaeology Ltd).

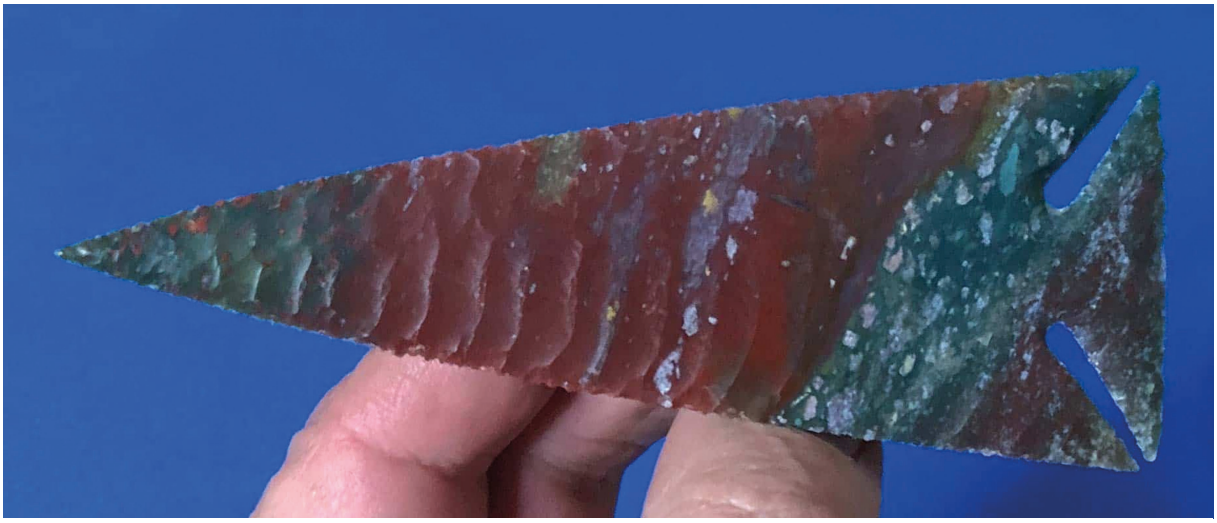

**Fig. 12** Corner-notched, ripple-flaked arrowhead produced by American master-knapper Mike Cook (https://www.artofishi.com). The piece has bands of red and green jasper as well as an area at the tip with red filaments (photo: Mike Cook, Art of Ishi).

on Skye; Ballin, 2020a; 2020b; 2022; forthcoming a), showed that these collections included pieces with 'bloodstone globules', and that several of these pieces had other colours, such as white, milky-green, green, dark-green, brown, purple, and black, and it is highly likely that the bloodstone family may be more varied than generally thought, as the definitions were to a large extent defined by lapidarists searching for gem-quality stones with red blotches (till this day, the analyst has never in a lithic assemblage seen a single piece of 'bloodstone sensu stricto' with the red spots and filaments desired by lapidarists). However, widening of the bloodstone definition would require more research to be carried out to build up a more statistically secure database of bloodstone finds and varieties, and altering the name of this mineral category (the name is basically a misnomer) could cause significant confusion.

Although it has not been possible to satisfactorily explain the development of the bloodstone globules/orbs, the red filaments in the material favoured by lapidarists are probably simply small areas of red jasper in a matrix of green jasper. This is clearly shown in **Fig. 12**, which presents a jasper arrowhead produced by American master knapper Mike Cook. The piece has bands of red and green jasper, and at the tip an area of green jasper has filaments of red jasper, like in the form of Rum bloodstone favoured by lapidarists.

It has been suggested that most bloodstone from assemblages on and outwith Rum may derive from the secondary sources at Guirdil Bay or from the talus on Bloodstone Hill itself (Durant et al., 1990, 52). However, the Camas Daraich bloodstone's high ratio of vein cortex (in addition to some specimens with abraded pebble cortex) indicates that most of this assemblage may in fact have been procured from primary sources.

*Durness chert*

The chert from Mesolithic sites on Skye is grey Durness chert from the Durness limestone (Raine, 2009). The Durness limestone stretches from Durness, near Cape Wrath, to Loch Torridon and across the southern parts of Skye, just south of the island's volcanic centre. The nearest sources of unaltered chert is found near Ord, c. 16 km north of


**Fig. 13** Durness chert from Ord, Skye (photo: Beverley Ballin Smith, GUARD Archaeology Ltd).

| Assemblage | Approximate distance | Dominating quartz variety |
|---|---|---|
| Barvas 2 | | Fine-grained and milky quartz, pebble source |
| | 14.5 km | |
| Dalmore | | Coarse-grained quartz, pebble source |
| | 10.0 km | |
| Olcote | | Fine-grained and milky quartz, vein and pebble sources |
| | 2.0 km | |
| Calanais | | Milky quartz, vein source |
| | 3.5 km | |
| Cnoc Dubh | | Milky quartz, vein (quarry) |
| | 16.0 km | |
| Berie Sands | | Fine-grained quartz, vein source |

**Tab. 2** A number of Neolithic and Bronze Age settlement and ritual sites along the Lewisian west coast, their individual distances, and dominating quartz types.

Camas Daraich 2, on the southern shores of Loch Eishort (Bell & Harris, 1986, 25). Some of the Ord outcrops are on or near the beach, and Karen Hardy has found worked chert there (Ballin, forthcoming a), which is identical to the chert recovered at Camas Daraich 2 (Ballin, ibid.), South Cuidrach in north-west Skye (Hardy & Ballin, 2024), Staffin in the north (Ballin, forthcoming [in Peteranna]), and Rubh an Dunain Cave in south-west Skye (Birch & Ballin, forthcoming). Baked Durness chert may be found on the southern periphery of the volcanic centre, a few kilometres inland from Broadford (Hoersch, 1981); it is uncertain how useful this resource would have been to prehistoric people, and availability and flaking properties need to be assessed. Although many variants of Durness chert from sources in north-western Scotland (Raine, 2009) contain fossils, none has been discovered in the chert from Skye.

**Fig. 14** Milky quartz. Scraper from Kilmelfort Cave, Argyll (photo: Beverley Ballin Smith, GUARD Archaeology Ltd).

**Fig. 15** Fine-grained quartz. Core from Scord of Brouster, Shetland (photo: Beverley Ballin Smith, GUARD Archaeology Ltd).

*Quartz*

Quartz is available from igneous, sedimentary as well as metamorphic rock formations (Ballin, 2008). Some vein quartz may be from sandstone and is likely to derive from the Torridonian sandstone on Skye (Bell & Harris, 1986, 11). Pebble quartz was probably collected along the island's beaches or from watercourses. Quartz is unlikely to have been exchanged and, being so ubiquitous, it was probably procured from sources near the various sites. Examination of quartz from sites on Lewis showed that each site tended to be dominated by a particular type of quartz (**Table 2**), suggesting that this raw material was of low value and procured from so-called primary or secondary 'back-yard' outcrops.

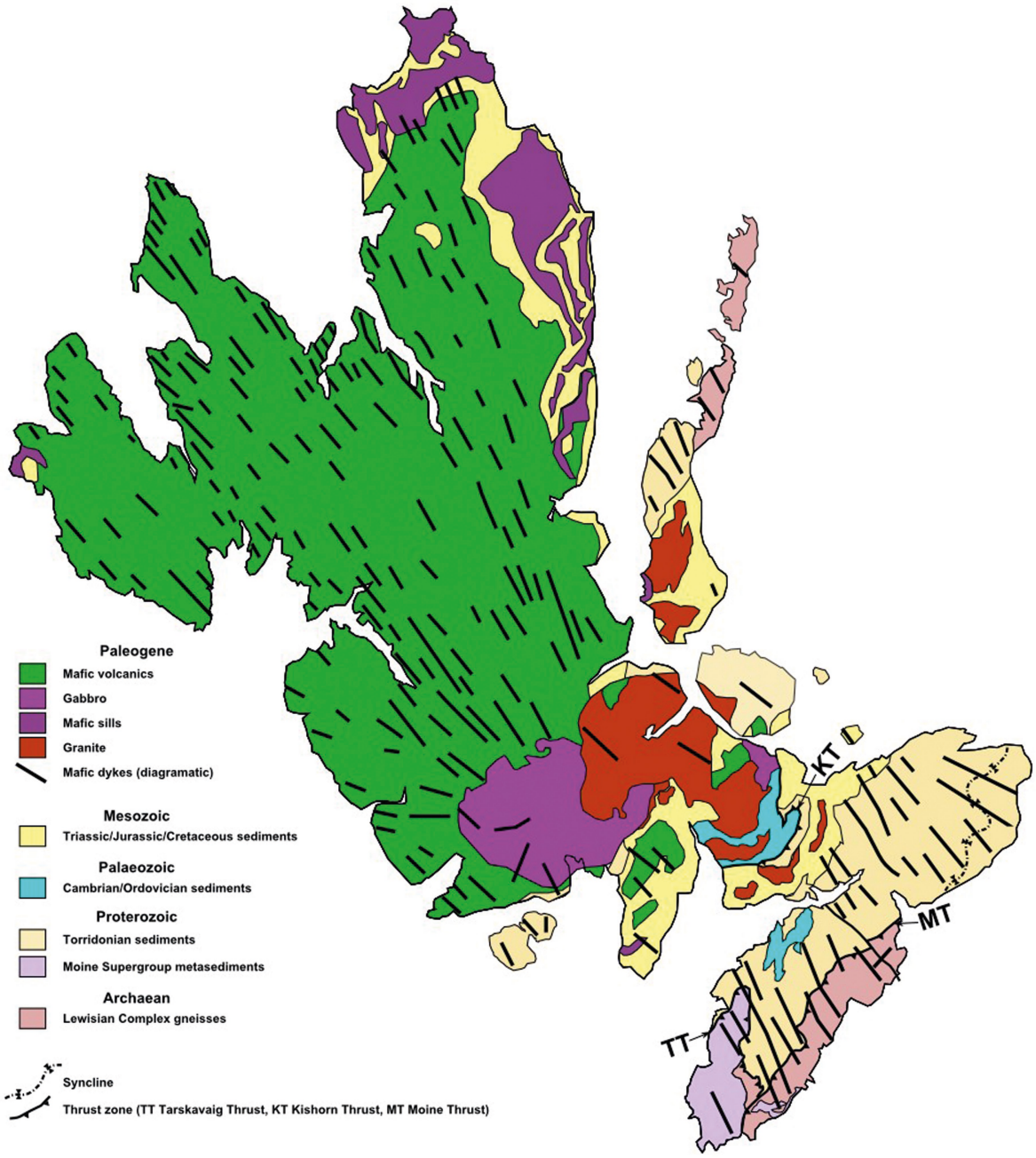


**Fig. 16** Mafic dykes (dolerite) on Skye. Downloaded from Wikipedia and created by Mike Norton (2013).

*Dolerite*

Like quartz, dolerite is present throughout the island (**Fig. 16**). It can be extremely difficult to distinguish dolerite from baked mudstone when these raw materials are weathered or rolled. Dolerite, a lava, tends to be dark-grey/brownish-grey to black and with coarser grains than baked mudstone, and it is occasionally recognisable by small cavities left by gas-bubbles. In reports on assemblages from earlier excavations in the general Skye area (e.g., Clachan Harbour on Raasay; Ballin et al., 2011), some related pieces were identified as possibly tuff, which is solidified volcanic ash, but it is now the analyst's conviction that the 'tuff' from these sites, may be baked mudstone as indicated by freshly chipped edges where it is possible to assess the original colour and structure of the material.

Due to the ubiquitousness of the Skye dolerite, it is unlikely that this raw material was exchanged between sites in the Mesolithic period.

*Massive lapilli tuffs*

Six pieces from Staffin form a distinctive and separate group of artefacts (CAT 132, 133, 151, 271, 456, 470). They are in a dense crystalline type of rock with a fine-grained matrix, and it contains numerous shiny phenocrysts which give it a somewhat spectacular appearance. Some pieces have a white matrix, whereas that of others is either dark-grey (**Fig. 17**) or pink (**Figs 18-20**). Although this does not appear to be a toolstone with good flaking properties, it was clearly workable, as the small group of six pieces includes two flakes, one blade, one indeterminate piece, one bipolar core and one expedient side-scraper.


**Fig. 17** Typical dolerite from Waterswallows Quarry, Buxton, Derbyshire (photo: Beverley Ballin Smith, GUARD Archaeology Ltd).

The phenocrysts include many small crystals and sharp-edged fragments with GDs between 0.5-2.0 mm scattered throughout the main matrix of the rock. Some of these bits are clearly quartz (crystals with hexagonal cross-sections), whereas others are pink forms of feldspar, but it is uncertain whether the darker bits are smoky quartz or volcanic glass. Mica is present but rare. Dr Simon Drake (Birkbeck, University of London, Department of Earth and Planetary Sciences), who is a specialist on the geology of the volcanic centre on Skye, identified these pieces as belonging to two types of so-called 'massive lapilli tuffs (mLT)' formed in connection with pyroclastic flows. These types of rock occur in a number of places on the periphery of the Kilchrist Caldera in Skye's central complex (Drake, 2015; Drake et al., 2022). A lapilli tuff (without the prefix 'massive') implies deposition from ash falling through an eruption cloud which these types of rock were not deposited by. Its a completely different process. Both types (the grey mLT 1 and the pink mLT 2) are rhyolitic in chemistry and they are marginal caldera facies.

Type mLT 1 can be found north-west of Loch Ainort at Moll, around the summit area and flanks of Mheall a Mhaoil (NGR NG 553 307), and Type mLT 2 outcrops on the Heaste Road around NGR NG 660190 – NG 660 200 as well as in the surrounding area.

*Other raw materials*

A number of other raw materials were also used during Skye's Mesolithic period, although to a lesser extent. In addition to bloodstone, which is a green jasper, other members of the chalcedony family were also exploited (chalcedony proper, red jasper, agate and carnelian), as were a number of medium- to coarse-grained rock (e.g., Torridonian sandstone, which is particularly common around Camas Daraich, quartzite, mica-schist, granite and amphibolite).

## Assemblage raw material composition and discussion of skye's mesolithic raw material exchange network

As explained above, it was only possible to include four Mesolithic sites in the present analysis and discussion (Staffin, South Cuidrach, Camas Daraich 2 and Rubh an Dunain), as it was necessary to first dispose of a number of raw material misnomers (chalcedonic silica, flint-like chert) and misidentifications (the suggestion that

**Figs. 18-20** One flake (CAT 271), one blade (CAT 151) and one bipolar core (CAT 456) in massive lapilli tuff (Fig. 18 mLT 1; Figs 19-20 mLT 2) (photo: Beverley Ballin Smith, GUARD Archaeology Ltd).

Lacaille's Western Isles mylonite is Staffin baked mudstone), develop acceptable definitions of Skye's main lithic raw materials, and define principles for the distinction between those (**Table 1**). Only these four sites and lithic assemblages have been analysed, applying the latest and more detailed definitions of Skye's main lithic raw materials. **Table 3** shows the specific location of these four sites and the relevant raw material outcrops.

As also explained above, the assemblage from Staffin dates mainly to the Late Mesolithic, with a proportion of the finds probably being datable to the Early Mesolithic; the artefacts from South Cuidrach probably include finds from the Late Upper Palaeolithic, the Early Mesolithic and the Late Mesolithic; the finds from Camas Daraich 2 are generally datable to the Late Mesolithic; and the assemblage from Rubh an Dunain is dominated by Late Mesolithic lithics, supplemented by some mostly Early Neolithic intrusive finds. The locations of the sites and raw material sources discussed in this paper are shown in **Fig. 1**.

| Settlements | Raw material | NGR (NG) |
|---|---|---|
| Staffin | | 4904 6857 |
| South Cuidrach | | 3835 5773 |
| Camas Daraich 2 | | 5670 0007 |
| Rubh an Dunain Cave | | 3995 1625 |
| Outcrops | | |
| An Corran | Baked mudstone | 4915 6848 |
| Bloodstone Hill | Bloodstone | 3145 0065 |
| Beinn an Dubhaich (Ord) | Durness chert | 60001816 |
| Mheall a Mhaoil | mLT 1 | 553 307 |
| Heaste Road | mLT 2 | 660 200 |

**Tab. 3** The specific location (NGR) of the settlements and outcrops discussed in this paper.

**Table 4** gives an overview of the procurement and exchange of lithic raw materials across Mesolithic Skye.[1] Three of the most commonly used raw materials – flint, quartz and dolerite – were probably available from numerous locations across the island and along the island's shores, and provide little information of relevance to the present discussion. The other raw materials – Staffin baked mudstone, Rum bloodstone, Durness chert from Ord and mLTs from the Kilchrist Caldera – appear in a notably restricted number of locations and inform us of how lithic raw materials were moved from one end of the island to the other. The focus of this paper's discussion is the latter four raw materials.

Based on the raw material composition of the four sites (**Table 4**) it is clearly possible to divide Skye into a northern (Staffin and South Cuidrach) and a southern part (Camas Daraich 2 and Rubh an Dunain). In northern Skye, baked mudstone makes up between 28 % and 76 % of the assemblages,

| | Staffin, N Skye | S Cuid, N Skye | Camas 2, S Skye | Rubh an Dun, S Skye |
|---|---|---|---|---|
| Staffin baked mudstone | 28 | 76 | 1 | 4 |
| Rum bloodstone | 1 | 1 | 37 | 42 |
| Durness chert | trace | trace | 14 | 5 |
| Massive lapilli tuffs (mLT) | 1 | | | |
| Flint | 63 | 21 | 28 | 43 |
| Quartz | 2 | trace | 17 | 5 |
| Dolerite | 3 | 2 | | 1 |
| Others | 2 | trace | 3 | trace |
| **TOTAL** | **100** | **100** | **100** | **100** |

**Tab. 4** The raw material composition of the four selected settlements in per cent.

supplemented by trace amounts (up to 1 %) of the other three raw materials. In contrast, the assemblages from sites in southern Skye include large amounts of bloodstone (37-42 %) and Durness chert (5-14 %), with baked mudstone only making up between 1 % and 4 %. Overall, flint is the most common material used on Skye, varying between 63 % and 21 % of the assemblages. At the moment, mLTs have only been recovered from Staffin, but it is quite possible that som pieces in this unusual raw material may have been defined as 'indeterminate' in other assemblages. However, this raw material is important in the present context as it was clearly procured from a restricted number of sources and exchanged over some distance.

**Table 3** was produced to allow the distances to be calculated between the settlements and the main lithic outcrops. This table shows the specific locations (national grid references) of the settlements and outcrops. The information in this table was then used to calculate the distances between the settlements and the outcrops of lithic raw materials discovered at those sites.[2]

**Table 5** shows these distances, and the sites' main lithic raw materials were clearly procured within an area with a radius of up to c. 25 km, whereas the 'minority raw materials' were procured from outcrops located between c. 40-70 km from the settlements.

When discussing the interpretation of the data in **Table 5**, it should be borne in mind that the calculated distances represent distances 'as the crow flies'. As shown by the presence of lithic raw materials far from the sources, the Mesolithic people of Skye were clearly sea-faring people, and the procurement of the raw materials was probably carried out mainly by boat – the baked mudstone, bloodstone and Durness chert sources are all on or near the shore, and only the mLT sources are inland outcrops. On the mainland, relatively large amounts of baked mudstone has been identified at, inter alia, Redpoint and Sand on the eastern side of the Inner Sound. Redpoint (NG 7275 6855) is located 23 km from the baked mudstone outcrop at An Corran, and Sand (NG 6837 4936) 27 km from this outcrop (Gray, 1960;

| Outcrops | Raw material | Settlements | | | |
|---|---|---|---|---|---|
| | | Staffin | South Cuidrach | Camas Daraich 2 | Rubh an Dunain |
| An Corran | Baked mudstone | 0.14 | 15.24 | 68.83 | 53.03 |
| Bloodstone Hill | Bloodstone | 70.16 | 57.50 | 25.26 | 17.77 |
| Beinn an Dubhaich (Ord) | Durness chert | 51.59 | 45.11 | 18.39 | 20.14 |
| Mheall a Mhaoil | mLT 1 | 38.38 | NA | NA | NA |
| Heaste Road | mLT 2 | 51.45 | NA | NA | NA |

**Tab. 5** Distances (km) between the four Mesolithic settlements and Skye's most important raw material outcrops (bar flint which could probably be collected in a number of different locations). The individual settlement's dominant raw material(s) are highlighted (compare with **Table 4**).

Hardy & Wickham-Jones, 2009), corresponding to the settlement-outcrop distances indicated above (c. 25 km) for the sites' main lithic raw materials.

Inspection of the distribution patterns of many probably 'precious' lithic raw materials in Scotland (i.e., either visibly pleasing or associated with good flaking properties) shows that the fall-off curves (Renfrew, 1977) tend to be stepped. The best documented example is undoubtedly Arran pitchstone ('Scottish obsidian'; Ballin, 2009, Table 9), where the distribution appears to include three main zones defined by different numbers of pitchstone artefacts per pitchstone-bearing site (Zone I: >200 pieces; Zone II: c. 15-30 pieces; and Zones III/IV: c. 2-4 pieces). In Ballin (2009), it was suggested that these zones may represent different perceptions of the raw material with increased distance, and possibly different forms of relations between 'gift-giver' and receiver (different territorial/kinship levels; Service, 1971; Sahlins, 1974; Hyde, 2006; Earle & Ericson, 1977).[3]

In his paper on Rum bloodstone, the author (Ballin, 2018) divided bloodstone-bearing sites into two groups, namely those located within an inner ring (sites with distances to Bloodstone Hill of up to 80 km), and those located within an outer ring (sites with distances to Bloodstone Hill of up to 150 km). The inner ring includes Skye, surrounding Inner Hebridean islands and adjacent parts of the Scottish mainland, and the outer ring the Western Isles, the Black Isle (Ballin & Grant, 2020) and possibly Jura (Finlayson pers comm in Clarke & Griffiths, 1990). The evidence presented in the present paper suggests that the distribution of Rum bloodstone (as well as baked mudstone and Durness chert) includes a third level of up to 25 km from the raw material sources. This core area is defined by large numbers of bloodstone artefacts per site, whereas the sites in the inner and outer ring are all characterised by quite few pieces per site. Instead, the main difference between the inner and outer ring is the number of sites with bloodstone – in the inner ring most sites have at least one or two pieces of bloodstone, whereas in the outer ring most sites have none.

Interpreting this form of stepped distribution is difficult. The core areas – in terms of pitchstone, Arran itself, and in terms of, inter alia, bloodstone, a 25 km zone around the main outcrops – may be defined by logistical concerns (large amounts of easily accessible raw material), although it can not be ruled out that emblematic style (Wiessner, 1983; 1984) was also a factor, that is, the raw material, its colour or some other attribute of the raw material may have been used to identify the group (band/tribe) in control of the outcrop. It is slightly easier to interpret the distribution outside the core area, as the simple possession of one or two pieces of a raw material either per person, village or territory may have given the person, village or band/tribe possessing a precious piece a feeling of belonging to a larger social group. As put in Ballin (2009):

The commodities circulated in a tribal exchange system may be functional (consumables, such as raw materials and everyday objects) as well as symbolic items. Symbolic items may be either particularly well-executed/over-sized artefacts, or they may be functional pieces, or raw materials, which gained in symbolic value due to the distances they travelled, or both. As stated by Beck & Shennan (1991, 138), '... the spatially distant, because of its strangeness, has great power'. On occasion, exotic objects may be fairly inconspicuous artefacts, but by travelling far, an exchange object is automatically transformed from being mundane to being special (Gould, 1980, 142). Most exotic objects (for example raw materials) would be easily recognisable as such, due to their 'strange' aesthetically pleasing appearance, and frequently these items (in particular raw materials) had ancestral resonance (e.g., Topping, 2005, Appendix 1).

Due to the fact that exchanged symbolic/exotic items gave the recipient more status than exchanged consumables, the different types of goods tended to be exchanged in different ways. Consumables were mostly exchanged in relatively informal ways, whereas objects of higher symbolic (and thus status-giving) value might be exchanged in a more ceremonial and cyclic manner. At these events, kinship relations would be 'confirmed' and alliances forged, thus re-affirming or expanding the involved [leader's] local and regional positions. Stewart (1994, 90) suggests that the exchange in exotics and other symbolically laden objects kept the archaeologically invisible necessities moving through the system, and Earle & Ericson (1977, 10) claim that the ceremonial cycles, where status-giving objects were exchanged and, on occasion, sacrificed/consumed, were the social mechanism which regularised and stabilised regional exchange and thus underpinned social renewal and stability.

However, this interpretation of the distribution of lithic raw materials across the region is clearly in need of corroboration from more Mesolithic sites, classifying, characterising and analysing the lithic assemblages following the principles defined above (**Table 1**).

**Acknowledgements**

We would like to thank Mara Weber (Museum für Archäologie, Schloss Gottorf, Schleswig) for the translation of the paper's abstract.

## Notes

[1] Exchange is here defined as in Renfrew (1977, 72), that is '... in the case of some distributions it is not established that the goods changed hands at all; [exchange] in this case implies procurement of materials from a distance, by whatever mechanism'.

[2] The distances were calculated by the application of online software produced for this purpose, available at https://www.movable-type.co.uk/scripts/os-grid-dist.html.

[3] Firstly, a commodity (for example a raw material) must be appreciated for its functionality, its striking appearance, and/or its association with parts of tribal mythology; and secondly, distance – more or less automatically – adds a premium to the value as a consequence of the time/labour invested in acquiring it, combined with a less measurable extra value determined by rarity in itself (an added 'mysterious' aspect; Beck & Shennan, 1991, 138).

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