# *Stonehenge and its Altar Stone: the significance of distant stone sources*



Parker Pearson, M. ORCID: https://orcid.org/0000-0002-7341-121X, Bevins, R. ORCID: https://orcid.org/0000-0002-7201-0115, Bradley, R., Ixer, R., Pearce, N. and Richards, C. ORCID: https://orcid.org/0000-0002-3151-4915 (2025)
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## Research Article

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Mike Parker Pearson[1,*], Richard Bevins[2], Richard Bradley[3], Rob Ixer[1], Nick Pearce[2] and Colin Richards[4]

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*Correspondence: m.parker-pearson@ucl.ac.uk
[1]UCL Institute of Archaeology, UK
[2]Aberystwyth University, UK
[3]Department of Archaeology, Reading University, and School of Archaeology, Oxford University, UK
[4]University of the Highlands and Islands, UK

# Stonehenge and its Altar Stone: the significance of distant stone sources

*Mike Parker Pearson, Richard Bevins, Richard Bradley, Rob Ixer, Nick Pearce and Colin Richards*

## Abstract

Geological research reveals that Stonehenge's stones come from sources beyond Salisbury Plain, as recently demonstrated by the Altar Stone's origins in northern Scotland more than 700 km away. Even Stonehenge's huge sarsen stones come from 24 km to the north, while the bluestones can be sourced to the region of the Preseli Hills some 225 km away in west Wales. The six-tonne Altar Stone is of Old Red Sandstone from the Orcadian Basin, an area that extends from the Northern Isles of Orkney and Shetland to Inverness and eastwards to Banff, Turriff and Rhynie. Its geochemical composition does not match that of rocks in the Northern Isles, so it can be identified as coming from the Scottish mainland. Its position at Stonehenge as a recumbent stone within the southwest arc of the monument, at the foot of the two tallest uprights of the Great Trilithon, recalls the plans of recumbent stone circles of north-east Scotland. Unusually strong similarities in house floor layouts between Late Neolithic houses in Orkney and the Durrington Walls settlement near Stonehenge also provide evidence of close connections between Salisbury Plain and northern Scotland. Such connections may be best explained through Stonehenge's construction as a monument of island-wide unification, embodied in part through the distant and diverse origins of its stones.

**Keywords:** Neolithic, Early Bronze Age, megaliths, Stonehenge, geological analysis

## Introduction

The megalithic monuments of Neolithic and Chalcolithic Europe required considerable collective effort not only for their erection but also for the movement of their stones from source to monument. In the vast majority of cases, these stones were moved only short distances of less than 10 km or so (Boaventura et al. 2020). Even so, the weights of some megalithic stones such as the almost 150-tonne capstone of the Menga tomb at Antequera in southern Spain (Rodríguez et al. 2023) and the 330-tonne Grand Menhir Brisé in Brittany, France (Le Roux et al. 2007) mean that movement of these huge stones even over relatively short distances of a kilometre or more from their sources was still an extraordinary achievement.

Stonehenge is unique among megalithic stone circles for several reasons: the raising of lintels on top of uprights, the extensive stone-dressing of its surfaces, and – most significantly – the non-local origins of its stones. Yet it was not the first Neolithic monument with raw materials sourced at a distance. Beginning before the end of the fourth millennium cal BC, there is a trend of composite monumentality in which megalithic tombs were built of materials from different sources.

The great passage tombs of Newgrange and Knowth in Brú na Bóinne were constructed with stones brought from at least six source areas as far away as 40 km to the north and south along Ireland's east coast (Cooney 2000, 136, Figure 5.2; Stout 2002, 30–1). The largest of these weigh around half a tonne – the greywacke blocks brought from up to 5 km away (see Figure 1).

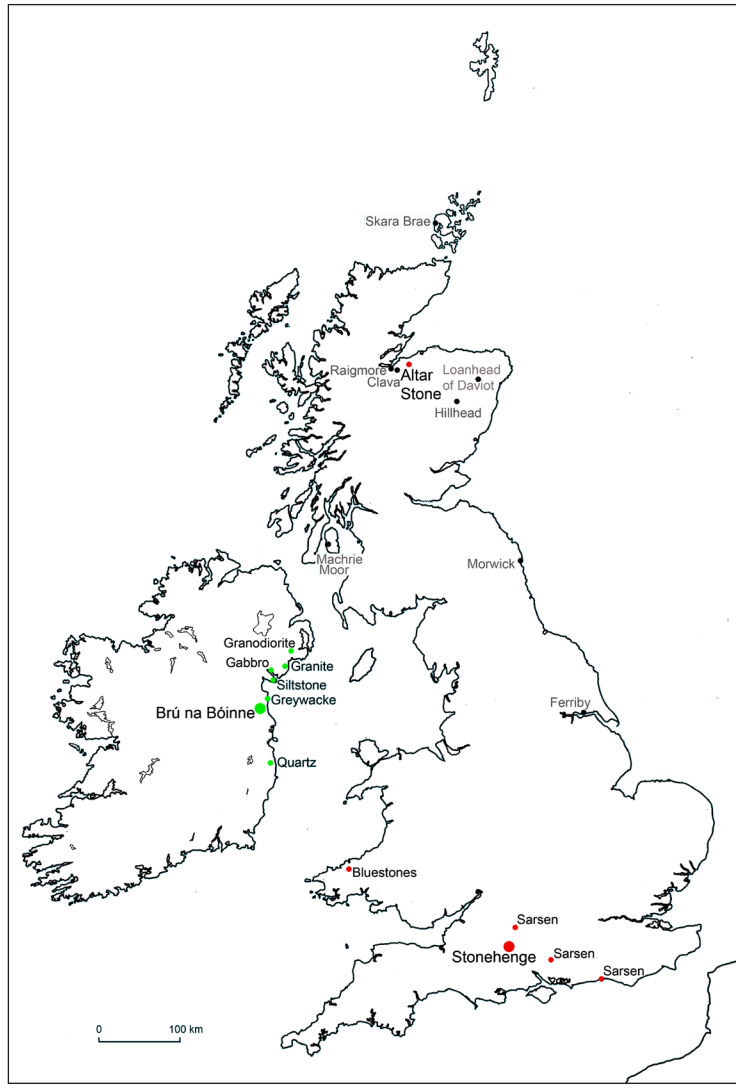


**Figure 1** Locations of stone sources for Stonehenge (red) and Brú na Bóinne passage tombs (green). The location of the source of the Altar Stone is only approximate. Other sites mentioned in the text are in grey

The great passage tomb of La Hougue Bie, Jersey, incorporates different rocks from across the island (Bukach 2003). Apart from passage tombs, stone circles and other monuments at this time were also composed of different types of rock, although the distances travelled were substantially less. The two Orcadian stone circles, the Ring of Brodgar and Stones of Stenness incorporate monoliths derived from up to seven sources, covering distances of more than 13 km (Downes et al. 2013; Richards 2013a). Also, different stone circles among the complex on Machrie Moor, Arran, are constituted of different types of rock: red sandstone and white granite, both derived from different places on the island (Richards and Wright 2013, 50–9).

## Stonehenge's other stones: sarsens and bluestones

Stonehenge's stones are grouped into three based on their lithology: the large uprights and lintels of sarsen (a silcrete or hard sandstone), the 'bluestones' of a variety of igneous and sedimentary rocks originating in the Preseli Hills (Mynydd Preseli) of west Wales and the sandstone Altar Stone. The sarsens form the bulk of Stonehenge, making up the circle of lintelled uprights, the inner horseshoe of five trilithons (pairs of uprights with a lintel) and a number of outer stones consisting of the Heel Stone, the Slaughter Stone and the Station Stones (see Figure 2). All of these may have been erected during Stonehenge's Stage 2, beginning in 2740–2505 cal BC and ending in 2470–2300 cal BC.[1] More precisely, the sarsen circle is dated to 2580–2475 cal BC (Parker Pearson et al. 2022b, 78). A few sarsens may have been erected in Stonehenge's first phase, beginning in 3080–2950 cal BC and ending in 2865–2755 cal BC (Parker Pearson et al. 2020, 301).

It is estimated that there may originally have been as many as 83 sarsens at Stonehenge, although there is uncertainty about whether the sarsen circle was ever completed (Bowden et al. 2015, 43–5; Parker Pearson et al. 2022b, 84).

The bluestones are composed of a variety of rocks of dolerite, rhyolite, andesite, dacite and Lower Palaeozoic sandstone, all of which are sourced to the area of the Fishguard Volcanic Group and its environs (Ixer and Bevins 2017). At Stonehenge these 43 stones form the outer Bluestone Circle and inner Bluestone Horseshoe, having been erected in a series of formations that were rearranged during four stages of construction during *c.* 3000–2000 BC. There may originally have been around 80 of them installed at Stonehenge, with 56 initially occupying the circle of Aubrey Holes close to the monument's perimeter in Stage 1, together with another 25 or so in a small circle (Bluestonehenge), 2 km away beside the River Avon (Parker Pearson et al. 2020, 224–300).

The third type of stone at Stonehenge is the Altar Stone, a 6-tonne monolith of Old Red Sandstone from the Orcadian Basin (Clarke et al. 2024). This lies flat within the south-western part of Stonehenge's centre, pinned in place by the fallen sarsen upright of the Great Trilithon and by its fallen sarsen lintel.

The distant sources of Stonehenge's stones have been inferred for centuries. In the seventeenth century, John Aubrey reckoned that he had found a quarry pit for Stonehenge's sarsen stones 23 km to the north (Scurr 2015, 105). Aubrey also suggested that the sarsens were sourced from the Marlborough Downs slightly further away, around 32 km to the north. Geochemical analysis has recently revealed that 50 of the 52 surviving sarsen

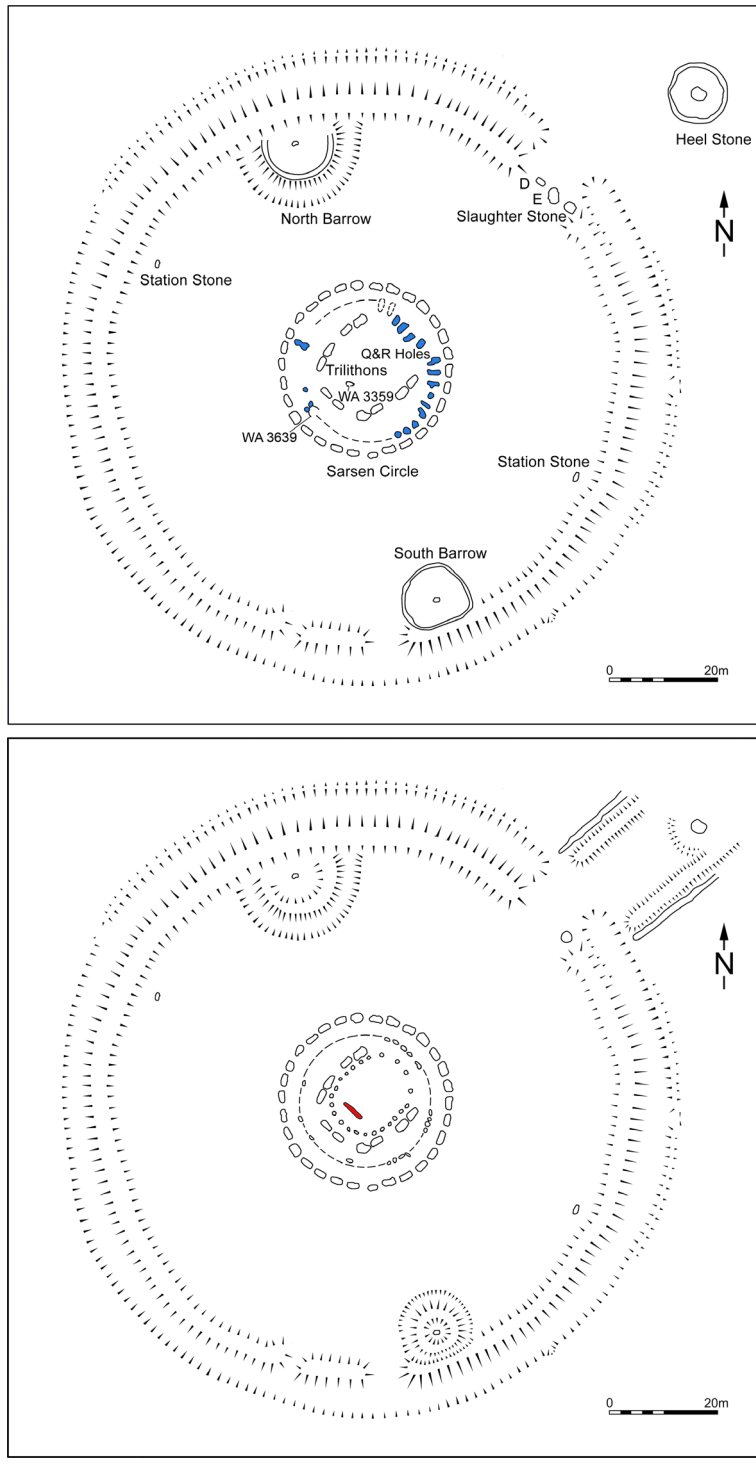


**Figure 2** Bottom: The position of the Altar Stone (in red) at Stonehenge in Stage 4; Top: hypothesised locations (WA stoneholes) of where it may have stood in Stage 2 if it were ever raised as a vertical pillar

uprights and lintels at Stonehenge can be matched with a source in West Woods, 24 km north of Stonehenge (Nash et al. 2020; 2021). Although a re-analysis of the data obtained by Nash's team has suggested that West Woods was just one of several possible sources (Hancock et al. 2024), the original identification of West Woods as the likely single source is upheld (Nash and Ciborowski in press).

The source of the two as-yet unprovenanced sarsens (Stones 26 and 160) is not yet established but analysis of stone debris from Stonehenge reveals that this debris, thought to derive from destroyed sarsen blocks, can be matched with sources around Bramdean and Brighton, 55 km and 200 km to the south-east, as well as with the West Woods area (Ciborowski et al. 2024). This raises the possibility that these fragments derive from monoliths erected earlier than those of Stage 2, not just taken down after Stage 1 but broken up.

The bluestones have been geologically identified as coming from the area of the Preseli Hills ever since Herbert Thomas (1923) identified the most numerous of the Stonehenge bluestones as spotted dolerites that could be matched with outcrops in those hills. Although occasional attempts have been made to explain the bluestones' incorporation in Stonehenge as due to transport by glaciers in a previous Ice Age (John 2024; Judd 1902; Kellaway 1971), there is no evidence that glaciers extended more closely than within 100 km of Salisbury Plain (Clark et al. 2022; also discussed in some detail in Ixer et al. in press). Claims that one or more bluestone fragments from Stonehenge and its environs show evidence of having been transported by glaciers similarly do not stand scrutiny (Bevins et al. 2023a).

Four types of bluestones have been matched geologically with outcrops in the Preseli. The source for most of Stonehenge's spotted dolerites (classed as Group 1) has been identified as Carn Goedog (Bevins et al. 2014). Two sources for unspotted dolerites (Stones 45 and 62; Group 2) are Cerrigmarchogion and Garn Ddu Fach, to the west and east of Carn Goedog (Bevins et al. 2014; 2021; Pearce et al. 2022). Remaining spotted dolerites (Group 3) are thought to derive from an area to the east of Carn Goedog but are not matched to a specific outcrop (Bevins et al. 2014). Of the three types of rhyolite at Stonehenge, Group C is matched to a specific location within the outcrop of Craig Rhos-y-felin, 3 km to the north of the Preseli ridge (Ixer and Bevins 2011). Finally, Stonehenge's two Lower Palaeozoic sandstone monoliths are similar lithologically and, in terms of age, to strata exposed to the north and east of the Preseli Hills (Ixer et al. 2017).

Excavations at the bluestone sources of Carn Goedog and Craig Rhos-y-felin have uncovered evidence of megalith quarrying dating to the centuries before and around 3000 BC, consistent with the date of Stonehenge's first stage. At Craig Rhos-y-felin, that precise part of the outcrop with a match for Rhyolite Group C lies directly adjacent to a niche from which a 2.5-m-long monolith has been removed (Parker Pearson et al. 2015). Quarrying installations include a drystone-revetted, artificial platform at the foot of the outcrop as well as a hollow way or sunken trackway leading from the foot of the platform (Parker Pearson et al. 2019). Quarrying artefacts include three stone wedges still in situ within joints close to the gap left by a removed monolith (Parker Pearson et al. 2022a). Similar evidence of quarrying was found at Carn Goedog, in the form of stone wedges and other stone tools, an artificial platform, niches left by removed pillars and wedge-holes cut into the joints between pillars (Parker Pearson et al. 2019).

## The Altar Stone – what, where and when?

The Altar Stone (Stone 80) is 4.9 m (16ft) long by 1 m (3½ ft) wide by 0.5 m (1¾ ft) thick (Atkinson 1956, 45). Just when the Altar Stone arrived at Stonehenge is unknown. It could have stood during Stage 1 within one of the larger now-empty stoneholes (Parker Pearson et al. 2022b, 112). But now that it can be geographically uncoupled from the bluestones, the idea that the Altar Stone might have been present in Stage 1 has less attraction. Cleal et al. (1995, 188, Figure 86) postulated that it might have stood vertically during Stage 2 (according to the revised chronology) in a large hole (WA 3639) in the south-west sector of the bluestone arc known as the Q & R Holes (Figure 2; Darvill et al. 2012).

Unfortunately, the Altar Stone's only identified stratigraphic relationship is with the collapsed and broken sarsen upright (Stone 55, its two broken halves numbered as 55a and 55b) and lintel (Stone 156) of the Great Trilithon which were erected in Stage 2 and now lie on top of it. Just when they fell is unknown, although this must have occurred before the sixteenth century AD and after the Bluestone Horseshoe was erected in Stage 4 (starting in 2210–2030 BC and ending in 2155–1920 BC).

The top of the Altar Stone now lies level with the grass around it. Numerous excavations, long since filled in, have revealed parts of it at different times. In 1620 the Duke of Buckingham's men dug a large hole at the centre of Stonehenge that may well have exposed part of it. William Stukeley (1740, 30–1) described it as 'squar'd', in other words dressed. William Cunnington dug in front (north-east) of it in 1802, and in 1844 a Mr Brown of Amesbury collected a fragment (Wilts #277; Bevins et al. 2023c) from the underside of the Altar Stone. Finally, Richard Atkinson's (1979, 211–12) 1958 excavation dug around it, revealing that its north-west end had been 'squared off at right angles to the stone' while its south-west end is 'dressed to an oblique bevelled outline', comparable to the bases of some of the sarsen uprights (Figure 3).

**Figure 3** The Altar Stone during excavation in 1958, pinned beneath the Great Trilithon's fallen upright (Stone 55b; centre) and lintel (Stone 156; right), photographed from the north-north-east by Richard Atkinson (Source: © Historic England)

Atkinson (1956, 45) considered that the Altar Stone's bevelled end was evidence that it had once stood vertically at Stonehenge. He could not identify a stonehole for it but thought that it might have stood in a hole that William Cunnington found 'close to the altar'. Underneath the upper half of the fallen upright (Stone 55b) of the Great Trilithon, Atkinson (1979, 212) found what he thought was a large stonehole (WA 3359; see also Cleal et al. 1995, plan 2). Realising that it was not deep enough for the Altar Stone, he tentatively suggested that a stone stood here might have formed a pair with the Altar Stone, potentially forming a midsummer sunrise–midwinter sunset solstice alignment in front of the Great Trilithon (Atkinson 1979, 212).

Putting aside these hypothetical suppositions, the current location of the Altar Stone provides some evidence to work with, although there has been uncertainty about whether it was placed in this location deliberately as a recumbent stone or has fallen from an upright position. It lies neatly in front of the Great Trilithon with its long sides aligned approximately on the midwinter sunrise. As Aubrey Burl (2006, 207–10) noted in his very thorough discussion of the Altar Stone and its position, the probability of this occurring by chance if it were a fallen upright is as low as 1:165 (see also Daw 2015). Thus, the most likely scenario is that the Altar Stone was set here deliberately as a recumbent stone. There is no means of knowing when this might have been done; its location in front of the Great Trilithon would imply that it does not pre-date that structure's erection in Stage 2 but it could date to any point within Stages 2–5.

## The Altar Stone's geological origin in mainland Scotland

On the basis of age dating of detrital zircon, apatite and rutile in the Altar Stone, Clarke et al. (2024) have presented compelling evidence for a derivation of the megalith from the Old Red Sandstone (ORS) Orcadian Basin, in north-east Scotland (see Figure 4). This follows extensive investigations of a possible source in south Wales and the Welsh Borderlands, based on an original west Wales source proposed a century ago by Thomas (1923). This proposal of an origin in Wales was endorsed by K. C. Dunham (former Director of the now British Geological Survey) in a letter to Dr J. F. S. Stone, dated 17 October 1947, in which he stated that rock sample #275, a second type of sandstone found in the Stonehenge landscape, from the Stonehenge Cursus and subsequently described by Stone and Wallis (1951), was from Mill Bay, on the Milford Haven estuary, 0.75 km from Cosheston. This led to the notion of Milford Haven being the exit port for marine transport of the bluestones, as proposed by Stone (1948) and later in popular works by Hawkins (1970) and Atkinson (1979). Ixer and Turner (2006) examined various sandstone samples from Stonehenge and from west Wales and showed the Altar Stone and fragment #275 (now known to be a Lower Palaeozoic Sandstone) to be very different, so concluding that Milford Haven was not the source of the Altar Stone, and that it was probably derived from the Senni Beds elsewhere in south Wales.

More recent investigations (Bevins et al. 2020; 2022; 2023b; 2023c; Ixer et al. 2019; 2020), based on further petrographical studies, combined with analytical investigations using X-ray diffraction (XRD), automated mineralogy (SEM-EDS), portable X-ray fluorescence (pXRF) and Raman spectroscopy, have led to mineralogical and geochemical characterisation of the Altar Stone. Critical in these studies has been the non-invasive

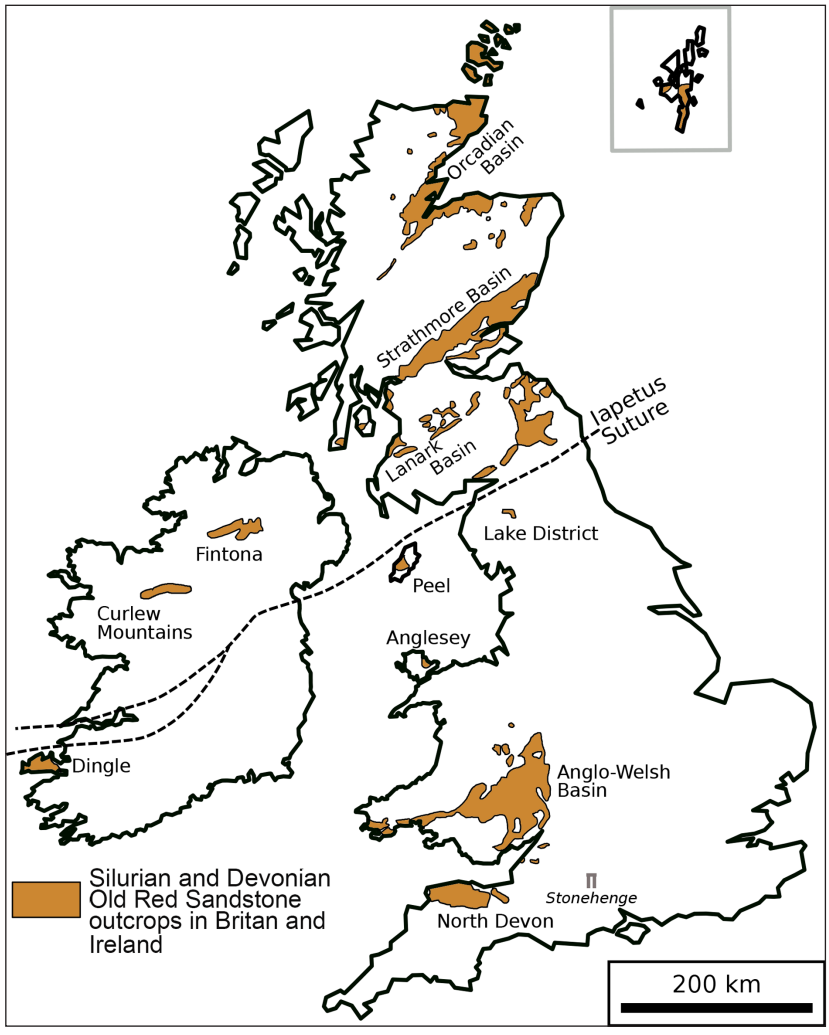


**Figure 4** The geology of Old Red Sandstone deposits in Britain including those within the Orcadian Basin

in-situ analysis of the Altar Stone itself, comparing results with those obtained from a number of debitage samples. Fragments confirmed to be derived from the Altar Stone have then served as proxies for further, more invasive forms of analysis, leading to a greater understanding of the mineralogy and geochemistry of the Altar Stone itself.

The Altar Stone is distinctive in containing the minerals baryte and tosudite (a rare interstratified dioctahedral chlorite/dioctahedral smectite) with a near-total absence of potassium feldspar, while the geochemical analyses of the Altar Stone show high barium (Ba) concentrations, linked to the baryte cement. These investigations led Bevins et al. (2023b) to conclude that the Altar Stone was not, in fact, sourced from south Wales, or indeed from southern Britain, concluding that it was time to 'broaden horizons' and to consider northern England and Scotland as possible source regions. Bevins et al. (2023b) also realised that, given the notable differences between the Altar Stone and the bluestones,

especially in terms of size, weight and position in the monument, and also considering the fact that it is not known when the stone arrived at Stonehenge and whether it was ever erected or was always a recumbent stone, it was time to 'de-classify' the Altar Stone as a bluestone. Including it in the bluestone assemblage had, for a century, strongly restricted thinking about its source.

Following the recognition that the Altar Stone was not sourced from the Anglo-Welsh Basin, a series of criteria were suggested by Bevins et al. (2023b), which potential Altar Stone source sites should meet. These included a terrestrial, 'red-bed' origin for the sediments (encompassing Permian and Silurian/Devonian 'Old Red Sandstone' age deposits), a high Ba concentration (related to the presence of baryte as a cement), as well as the presence in the region of evidence for significant Neolithic settlement/activity. Bevins et al. (2023b) suggested several regions where such criteria were met, with the most obvious being Mainland, Orkney, with its ORS geology, areas with high Ba (British Geological Survey 2024; Everett et al. 2019) and abundant Neolithic remains, as well as the numerous 'cultural' similarities between Orkney and Stonehenge detailed elsewhere in this paper. Even the sizes of the monoliths making up the Ring of Brodgar and the Stones of Stenness are similar to the Altar Stone.

Portable XRF investigations on Orkney were undertaken by Bevins and Pearce in June 2023, analysing various monoliths comprising the Neolithic stone circles of the Ring of Brodgar and the Stones of Stenness, as well as Old Red Sandstone field samples from across Mainland, Orkney. The pXRF results, along with petrological microscopy, XRD, SEM-EDS and heavy mineral (HM) characterisation by Raman spectroscopy on ORS field samples were presented in Bevins et al. (2024), who concluded that there are no realistic comparisons between the geochemistry and mineralogy of the Altar Stone and the analysed Orkney stones and field samples. In particular, there are clear differences between the compositions of the two sample sets in the binary plot of Ba versus Sr and in the triangular plot of Ba-Rb-Sr (see Figures 5 and 6). In addition, distinctive mineralogical and geochemical features of the Altar Stone, described above, are not seen in the Orkney field samples. Although baryte was detected in two Orkney samples, it was linked to base metal mineralisation, which is not the case for baryte in the Altar Stone. Petrography, XRD and HM studies also show marked differences between the two sample sets.

These data lead to the conclusion that the Altar Stone was not sourced from Mainland, Orkney, and that attention needs to be directed to other areas of the ORS Orcadian Basin in mainland northeast Scotland, or, as an extreme, the Shetland Islands (Bevins et al. 2024). Field investigations in these areas are currently underway.

## The cultural context of northern Scotland

Despite the considerable distance between the north of Scotland and southern England, certain styles of material culture were shared between these regions and even more widely throughout Britain and parts of Ireland. The most striking of these is Grooved Ware, a style of decorated pottery with earliest start dates in Orkney at 3160–3045 cal BC (Copper et al. 2021, 82–3) and in use in the Stonehenge landscape by the thirtieth century cal BC (Wessex Archaeology 2020, 102).

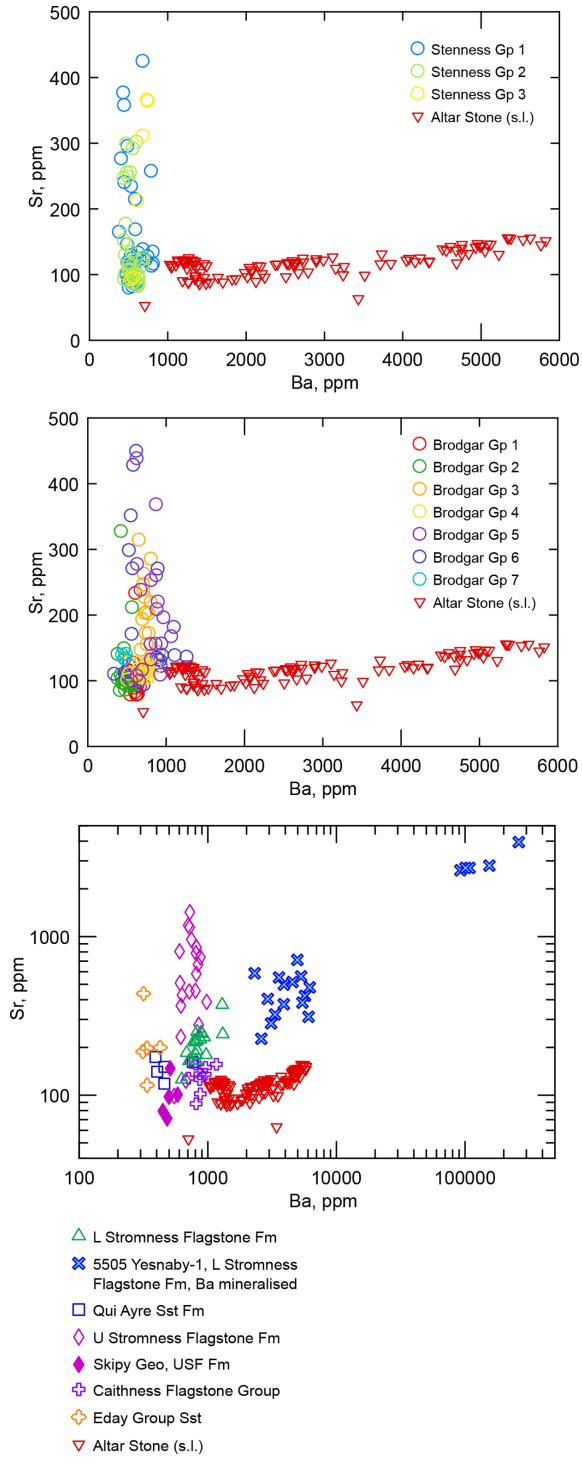


**Figure 5** Ba vs Sr concentrations in the Stones of Stenness, the Ring of Brodgar and a series of lithologies exposed on Mainland, Orkney, compared to data from the Altar Stone at Stonehenge (Source: Data from Bevins et al., 2024)

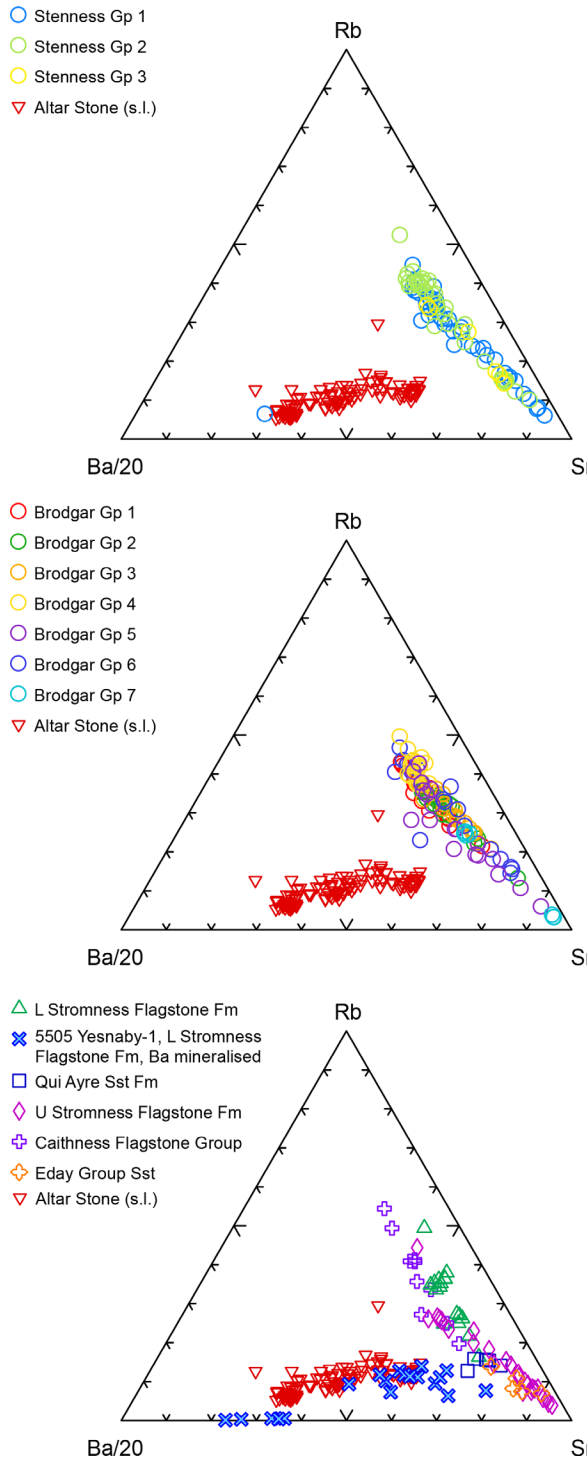


**Figure 6** Triangular diagrams showing the Ba-Rb-Sr compositions of the Stones of Stenness, the Ring of Brodgar and a series of lithologies exposed on Mainland, Orkney, compared to data from the Altar Stone at Stonehenge (Source: Data from Bevins et al., 2024)

The 'circular world' of Late Neolithic Britain, expressed in its timber and stone architecture (Bradley 1998), embraced common architectural principles shared throughout Britain (Bradley 2019; Madgwick et al. 2021; Pollard 2009; Ray and Thomas 2018, 245–6, Figure 5.10). These need not imply some form of homogenised conformity throughout Britain but the numerous similarities between far-flung regions signal a level of shared traditions of practice (Bradley 2024; Cummings 2017, 232; Greaney et al. 2020; Harding 2003, 56–8).

Orkney and northern Scotland shared a number of cultural styles and practices with other, more distant parts of Britain (Parker Pearson 2020). The classic henge (with the bank outside the ditch instead of inside it), found throughout Britain, has its earliest dated example in Orkney at the Stones of Stenness with a modelled date of 3020–2890 cal BC (Schulting et al. 2010, 35–6). Styles of rock art in Orkney are also closely paralleled at Morwick on the Northumbrian coast (Bradley 2024). Even so, there were distinct cultural differences between the Scottish mainland and Orkney. The northern Scottish mainland may have shared in Late Neolithic Britain's dominant funerary rite of cremation (Willis 2021) and differed from the collective inhumation rites of Orkney.

## Domestic architecture

Although there are no Late Neolithic house plans known from the Old Red Sandstone region of Cromarty and Inverness-shire where the Altar Stone may have its origin, the domestic architecture of Orkney is the best known for any part of Neolithic Britain. Intriguingly, there is an unexpected similarity in the shape, size and layout of the houses at Skara Brae in Orkney and the large settlement beneath the henge of Durrington Walls, close to Stonehenge and dating to 2515–2470 cal BC (Madgwick et al. 2021). Contemporary with Stonehenge's Stage 2, this may have been the builders' camp, forming one half of a ceremonial complex at and around Stonehenge.

The best-known group of houses from this period are those forming the village of Skara Brae (Childe 1931). Eight of these date to the village's final phase around or before 2500 BC (Bayliss et al. 2017, Figure 5). Although broadly square in plan, each house's interior is slightly different in size and shape. One house (Hut 7), together with a small ancillary building (Hut 6), is separated from the rest of the houses along its own passageway. The remaining houses (Huts 1–5) were accessed along a main passageway, at the west end of which was an outlying, trapezoidal-plan building (Hut 8).

Nine houses have been excavated at Durrington Walls, seven of them beside its east entrance (Parker Pearson 2007) and two within small, circular ditched enclosures in its centre (Thomas 2007). These are no doubt a small proportion of the possibly hundreds of structures erected at Durrington Walls. Unlike the houses of Late Neolithic Orkney which were built of stone, these were built with walls of wattle and daub. Their chalk plaster floors have impressions of wooden planks, beams and posts where timber box-beds, dressers and other storage units were positioned around a central hearth. The main difference between the two sets of houses is in the use of raw materials: stone in Orkney and wood and plaster at Durrington Walls. In Orkney, flagstone slabs were used to form the edges of the square hearths; at Durrington Walls, the hearths are circular, formed with chalk plaster.

At Durrington Walls those houses beside the henge's east entrance consist of two buildings astride the banks of an avenue leading to the River Avon and a cluster of five north of this avenue. These five consist of a main house (House 851) and an ancillary building (House 848) separated from the others by a timber fence, represented by a line of postholes. The others are two sub-square houses (Houses 547 and 1360) and a trapezoidal-plan structure (House 800).

House 851 bears an unexpectedly close resemblance in its interior floor plan to Hut 7 at Skara Brae (Figure 7). With dimensions of 4.8 m north–south and 5.2 m east–west, it is similar in size to Hut 7, although the two houses do not share the same orientation. The two houses share similar features: the doorway is opposite the dresser, and two beds are set against the side walls, the shorter bed along the left wall (as viewed from the doorway) and the larger along the right. Both houses share the same sub-square plan with rounded corners, including the more fully curved corner immediately left of the doorway. If the two plans are laid on top of each other, they are near-identical. Minor differences include the provision of 'limpet boxes' and a rectangular storage structure (left of the doorway) in Hut 7. The larger bed at Skara Brae is also set closer to the wall with the doorway.

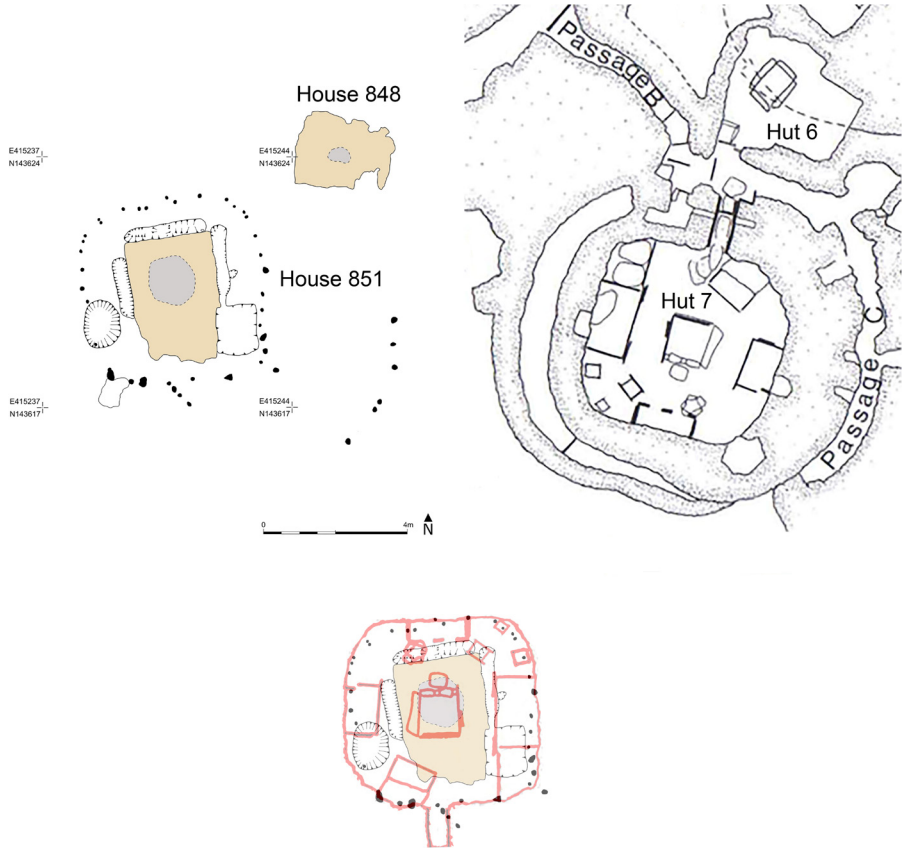


**Figure 7** Comparison of the plans of House 851 and ancillary House 848 at Durrington Walls (near Stonehenge; left) and Huts 7 and 6 at Skara Brae, Orkney (right). Also shown are the plans of the interiors of House 851 and Hut 7 overlaid

The same similarity of shape and size is true for the ancillary structures – House 848 and Hut 6. House 848 (2.6 m long east–west and 1.9 m–2.1 m wide north–south, with its east end 0.2 m narrower than the west) is best characterised from its floor debris and under-used hearth as a small storehouse, and the same may be the case for Hut 6. The two buildings also share a similar close spatial arrangement with their main building (House 851 and Hut 7) although on a different orientation. Although ruinous, a further example of a similarly shaped house of roughly the same proportions comes from Stonehall Farm where House 1 was one of the latest buildings to be occupied on the site (Richards and Jones 2016, 146–51).

Are such parallels in house plan between Skara Brae and Durrington Walls merely coincidental? On first sight, such similarities could be explained if there were a shared blueprint of architectural forms throughout Britain. However, a recent study of 25 other Late Neolithic house structures from England and Wales reveals that none share the same floor plans as those found at Skara Brae and Durrington Walls (Bullmore 2022). Equally, despite Orkney providing the largest number of Late Neolithic house plans anywhere in Britain, none match the plan of Skara Brae's Hut 7 (Bayliss et al. 2017, 1181–5; Richards and Jones 2016). The most plausible explanation would seem to be that there was contact between these geographically very distant communities.

## Recumbent stone circles

Recumbent stone circles are found in north-east Scotland. They are a notable feature of the modern county of Aberdeenshire but have close parallels among the Clava Cairns of Inverness-shire and the inner Moray Firth (Bradley 2019, 193–7; Burl 2000, 215–42).

As their name suggests, their defining feature is a large block or slab placed on the ground as part of a circular stone setting (see Figure 8). It is flanked by the two tallest uprights in the ring, and in a few cases all three components occupy a low platform. There are sites on which the recumbent stone was propped on packing stones so that its upper surface was horizontal. This part of the structure is most impressive when viewed from outside (Welfare 2011).

The monoliths are graded in height, with the lowest towards the north or east and the tallest – the 'flankers' that abut the recumbent stone – towards the south or west (Figure 8). These monuments might have been directed towards the moon (Burl 2000, 226; Welfare 2011, 231–6), but their alignments are restricted to the solar arc at midwinter, and this may provide a simpler explanation of their layout (Bradley 2023, 73–5 and 77–8).

For many years recumbent stone circles were considered freestanding monuments; other structures were erected inside them during subsequent phases. This is not supported by new excavations on four of the sites. They documented a different sequence. Three began as walled enclosures, or as ring cairns bounded by a bank of rubble; the fourth bounded a circular platform (Bradley 2005; Bradley and Nimura 2016, 7–26). In every case the ring of monoliths was a secondary construction and the distinctive arrangement of the recumbent and the flankers resembled a blocked entrance. At Hillhead there is direct evidence that the recumbent closed an earlier gap in the perimeter of the monument (Bradley and Nimura 2016, 16).

The densest distribution of recumbent stone circles is in north-east Scotland where some of them were close to the North Sea. None was constructed in the Highland mountains

**Figure 8** The recumbent stone circle of Loanhead of Daviot in north-east Scotland (Source: © Historic Environment Scotland)

further to the west. Erecting these monuments was a distinctive local practice since the distribution of ring cairns extends beyond the area in which such structures were enclosed by monoliths (Bradley and Nimura 2016, Figure 9.1).

It has not been easy to date recumbent stone circles, but the radiocarbon determinations associated with their construction and use fall between 2500 BC and 2000 BC. Elsewhere in Scotland there are indications that timber circles and early stone settings were graded in height from the Late Neolithic period until at least the Early Bronze Age (Bradley and Nimura 2016, 112–21; Gibson 2010).

The chief characteristics of these monuments were shared with the Clava Cairns of the inner Moray Firth. Like the structures considered so far, most were characterised by ring cairns enclosed by a graded circle of standing stones that increased in height from north-east to south-west (Bradley 2000). The one important difference is that they lacked a recumbent stone. At a small number of Clava Cairns the ring of monoliths enclosed a passage grave (Bradley 2022). Those at the type site, Balnuaran of Clava, were aligned on the midwinter sunset. Again, the stone circles were added to existing monuments. Direct dating evidence is limited but a related monument at Raigmore, Inverness, replaced a timber building associated with Grooved Ware (Bradley 2000, 168–70). Radiocarbon dates suggest that some of these structures were contemporary with recumbent stone circles further to the east, while others were built over a longer period. The distributions of Clava Cairns and recumbent stone circles complement one another (Bradley and Nimura 2016, Figure 1.2).

These architectural traditions shared another feature. In some cases the stones of which the structures were built had been chosen for their distinctive surface appearance (Bradley 2000, 44–5 and 216–17; Bradley 2005, 19–20 and Figures 66 and 84; Welfare 2011, 170–8). These features influenced the stones' positioning at individual sites. It is impossible to establish their sources as most were glacial erratics. In north-east Scotland, the colour of the recumbent stone might contrast with that of the flankers and with other monoliths on the same site.

Certain characteristics of recumbent stone circles and Clava Cairns are reflected in the architecture of Stonehenge. The most striking is the way in which circles of standing stones were graded in height, with the lowest towards the north-east and the tallest to the south-west. This has been treated as a special feature of sites in northern Scotland, but it is evidenced by the sarsen structure at Stonehenge where this arrangement focused on the midwinter sunset. There is similar evidence from the Clava passage graves. It is difficult to discuss the alignments of other features, but the Altar Stone at Stonehenge has a similar orientation to the recumbent stones in Scottish monuments (Welfare 2011, Figure 5.24). The Altar Stone could have been laid recumbent on the ground without ever having been erected vertically, as discussed above.

It is harder to compare the Altar Stone's chronology with that of recumbent stone circles and Clava Cairns. The Altar Stone might belong to one of several stages of construction at Stonehenge and could have been reused, although it seems to have arrived in its present position during the later third millennium BC. That would be consistent with the dates from northeast Scottish stone circles and those for the first Clava Cairns.

Lastly, the Altar Stone was made up of a different material from the other components of Stonehenge. The same applies to some of the recumbent stones at the Scottish sites.

## How was the Altar Stone transported?

Transport of the Altar Stone can only have been achieved in two ways – by land or by water (or a combination of both) – both involving human agency. Clarke et al. (2024) have discussed why theories involving Ice Age glacial transport can be rejected. While ice sheets covered northern Britain in previous glacial periods, glaciers did not move material southwards to Salisbury Plain from northern Scotland; rather, glaciers moved northwards from the Grampian Mountains (Clark et al. 2022; Gibbard and Clark 2011).

A land route in the later third millennium BC would undoubtedly have encountered difficult terrain and dense forests, rather different to the largely deforested conditions on Salisbury Plain for moving Stonehenge's sarsens (French et al. 2012). Yet it might be premature to write off overland transport of the Altar Stone. From ethnographic evidence from living traditions of megalith-building in Madagascar, Indonesia and elsewhere, people prefer to minimise risks, including choosing to avoid moving monoliths by water (Richards 2013b, 7–13). For Stonehenge's bluestones, for example, there is a possible land-based route as well as Atkinson's hypothesised sea route, and even any movement by water along the Bristol Channel and then the Bristol Avon would still have required long stretches of movement overland (Parker Pearson 2012, 279; Pitts 2022, 111–23).

In weighing up the pros and cons of either possibility for the Altar Stone, we should remember that long-distance land routes had been in use from the early fourth millennium

BC onwards, taken by people exchanging axe heads and other materials over hundreds of miles (Bradley and Edmonds 1993; Schauer et al. 2020). The relative fragility of the Altar Stone would make it susceptible to cracking on such a journey, necessitating the use of a suitably robust wooden sledge with vegetation-made shock absorbers, sliding on wooden 'rails' that could be continuously lifted and re-laid.

From the modern-day events of walking from John O'Groats to Land's End, we might calculate that such a journey with a large and heavy sledge could take perhaps four times today's time of under two months for such a distance at walking speeds of about 5 km per hour, needing eight months or so to haul a stone from northern Scotland to Stonehenge.

The sea route, at first glance, might seem more attractive and more easily supportable. Although no boats are known from the Late Neolithic in Britain or Europe, Britain and Ireland's Neolithic farmers and their ancestors had long experience of open-sea travel. Their genetic ancestry can be traced back to early farmers who migrated from Anatolia through the Mediterranean and the Aegean (Brace et al. 2019). By 4000 BC they were capable of moving cattle and other livestock by boat not only across the English Channel but also across the Celtic Sea to southern Ireland (Kinnes 1988; Sheridan 2010).

More locally to northern Britain, the Orkney vole (*Microtus arvalis*) was probably introduced to Orkney by seafarers in 3455–3100 cal BC from somewhere in continental Europe, possibly northern France or Belgium (Bayliss et al. 2017, 1178; Martínková et al. 2013; but see Sheridan and Pétrequin 2014 for a critique). Similarities in Late Neolithic rock-art styles along the North Sea coast from Orkney to Morwick also hint at long-distance connections along that coastline (Bradley 2024).

The earliest known boats in Britain have been found further south along the North Sea coast, in the Humber estuary at Ferriby. The earliest of these Early Bronze Age sewn-plank boats (Ferriby 3) dates to 2030–1780 cal BC (Wright et al. 2001), broadly contemporary with Stonehenge Stage 5. Shallow draft was essential in these paddled boats to ensure less drag and less weight (Roberts 2004, 39). They may have had rocker (arching of their bottom profile), making them more easily manoeuvrable on the sea and increasing their seaworthiness (Roberts 2004, 45).

Even so, the size of a sewn-plank boat sturdy enough to take the 6-tonne weight of a monolith would have to be far greater than the estimated 15 m–16 m length of the Ferriby boats. That may not have been possible with sewn-plank boats because their length would have been limited by the weakness of the withy stitching to withstand flexing from hogging and sagging (when the hull bends upwards and downwards) (Roberts 2004, 45). Other alternatives in the form of logboats or hide-covered curraghs would seem even less feasible, as demonstrated in 2001 by a failed attempt to transport a modern-day bluestone – substantially smaller than the Altar Stone – by curragh (Roberts 2004, 41).

What we know of Early Bronze Age boats, limited though our knowledge is, would suggest that they and their Late Neolithic precursors were unlikely to be sturdy enough to carry a 6-tonne stone in coastal waters. As has been proposed for the transportation of Stonehenge's bluestones, a land route may have been favoured (Parker Pearson 2012, 289–91). Travel by land would have provided much better opportunities for spectacle, pageantry, feasting and celebration that would have drawn people in their thousands to witness and take part in this extraordinary venture (Parker Pearson 2012; Richards 2013b, 7–8). It would also have reaffirmed networks of relationships between distant groups, encouraging collaboration and cooperation on a hitherto unseen scale (Richards 2013b, 7–8; Wunderlich 2019).

## Why was the Altar Stone selected and taken to Stonehenge?

During our research into sourcing the Stonehenge bluestones, one thing that became evident as the work progressed was the extraordinary appearance of the quarries (Parker Pearson et al. 2015; 2022a). At both Craig Rhos-y-felin and Carn Goedog, the outcrops are striking and impressive, with their naturally upright pillars making these places anomalous and remarkable when encountered (Parker Pearson 2019). As yet, the actual outcrop from which the Altar Stone was extracted is unknown, but we might speculate that it similarly derived from a dramatic location. Alternatively, it may have been ripped from its original context by glacial action and have been come upon in another part of northern Scotland, standing out as an extraordinarily shaped monolith of a rock type alien to its surroundings. Whether the Altar Stone was then set up as a standing or recumbent stone near its source, later to be dismantled and taken to Stonehenge, can only be guessed at.

History and myth provide insights into motivation for taking megalithic stones over long distances to Stonehenge. In Geoffrey of Monmouth's pseudo-historical *History of the Kings of Britain*, the wizard Merlin oversees the taking by force of the Giants' Dance, a stone circle in Ireland, to rebuild it as Stonehenge to commemorate a massacre of Britons by Saxons (Parker Pearson 2022; 2023, 117–18; Wright 2007). The Giants' Dance is all the more significant for Merlin because he declares that it has healing properties.

In a historical case, in 1296 Edward I of England captured the Stone of Destiny, the 152-kg Old Red Sandstone block on which the kings of Scotland were crowned, and had it brought from Scone Abbey to Westminster Abbey where it was used to crown English monarchs for the next 500 years (Breeze and Munroe 1997). In both this and the Merlin myth, the motive for transportation is the stone's perceived spiritual properties of bestowing magical or spiritual powers which legitimate authority – whether as a memorial to fallen nobles or as a symbol of sacral kingship. This might be termed cosmological acquisition, the imbuing of Stonehenge with spiritual power deriving in part or in whole from the exotic and distant sources of its stones. One thing is for sure; just as other monuments across Britain and Ireland become material and social microcosms at a more localised level, Stonehenge stands out in being a material and monumental microcosm of the entirety of the British Isles.

An alternative explanation is that the Altar Stone was brought as a contribution or gift by the Neolithic people of northern Scotland, perhaps to cement an alliance or to take part in the extraordinary long-distance collaboration that building Stonehenge represented and embodied. Gordon Childe (1957, 331) wrote of the Preseli bluestones' journey to Stonehenge as illustrating a political unification or a sacred peace. Of course, such unification could have been achieved or at least attempted by force or by consent; either as acquisition through violence of a formerly inalienable symbol or as the giving of a gift within a relationship of reciprocal equality.[2] The latter seems more likely for the Altar Stone, given that its position at Stonehenge seems designed to celebrate the Scottish recumbent circle tradition from which it may have derived.

Why did certain large stones have such significance in Neolithic society? A long-running hypothesis guiding research into Stonehenge is that megaliths can have ancestral significance, representing and even embodying the ancestors that they commemorate, whether as funerary markers, tombs or standing stones (Parker Pearson 2023, 155–7; Parker

Pearson and Ramilisonina 1998). Such symbolic constructions serve to link people with the land – as well as with the heavens – to tie distant places and people into a single cosmological vision of ancestral unity and authority (Parker Pearson 2012, 328–31; 2023, 158–60).

Such a strategy was not invented by the builders of Stonehenge; as discussed at the beginning of this article, it was already mobilised and embodied in the great passage tombs of Brú na Bóinne. On a more local landscape scale, this physical and metaphorical representing in microcosm of the surrounding world by Neolithic monuments has long been recognised (Richards 1996; Tilley 1996, 204–11). The builders of Stonehenge took it to even greater lengths to encompass virtually the entire island of Britain.

The arrival of the Altar Stone at Stonehenge is undated but most likely occurred within Stages 2–4, broadly *c*. 2500–2020 BC. This was a period of substantial population replacement following the arrival from continental Europe of Beaker-using communities with steppe ancestry (Olalde et al. 2018). The Altar Stone's incorporation into Stonehenge as an attempt at unity may have been a response to a legitimation crisis brought on by this influx of new people. Yet, by the end of Stonehenge's five-stage construction sequence (1620–1425 cal BC), Britain's insular Neolithic population appears to have been largely replaced by people with steppe ancestry (Booth et al. 2021). As an attempt at unification, Stonehenge was perhaps ultimately a failure.

Since Childe's day we have learnt so much more about the many distant sources of Stonehenge's stones. Unlike any other stone circle, it is built entirely of stones that are not from its immediate environs. The Altar Stone's origin in Scotland is confirmation of this observation and its distant source further strengthens the unification hypothesis. More detailed geological investigation of Old Red Sandstone sources in northern Scotland may provide a better understanding of the social and cultural context in which the Altar Stone was extracted and initially displayed.

## Conclusion

Sourcing the Altar Stone to the northern Scottish mainland is the latest achievement of a remarkable series of geological projects that have been carried out since the early 2010s. It provides dramatic evidence of Stonehenge's uniqueness among prehistoric stone circles: it was constructed from materials brought from distances of between 24 km and at least 700 km, well in excess of the average distance of up to 7 km noted for megaliths elsewhere in Britain and Europe. Although the date of the Altar Stone's arrival and of its placing in its current position are unknown within the Late Neolithic–Early Bronze Age constructional sequence at Stonehenge, its solstice-aligned axis and strategic positioning in front of the Great Trilithon argue for its deliberate placement as a recumbent stone rather than as an orthostat that has accidentally fallen.

The Altar Stone's northern Scottish origin helps to make better sense of hitherto enigmatic observations. First, its location as a recumbent stone within the south-west arc of Stonehenge resonates with the architecture of recumbent stone circles of north-east Scotland whose distribution extends westwards to the Old Red Sandstone beds of the Orcadian Basin. Second, the unusually strong architectural similarities in ground plans of

Late Neolithic houses at Skara Brae and Stonehall Farm in Orkney and at Durrington Walls near Stonehenge can now be considered in relation to this new indication of connectivity between these distant regions, providing a possible time for the Altar Stone's arrival at Stonehenge in or after Stage 2, *c*. 2500 BC.

Finally, the distant origin of the Altar Stone confirms Stonehenge's unique status as the one stone circle built entirely from non-local stone; a material microcosm projecting at an enormous scale. It is consistent with recent interpretations of Stonehenge as a monument whose builders attempted – ultimately unsuccessfully – to establish some form of political unification and shared identity across much or even all of Britain, bringing together these extraordinary and alien rocks which symbolised and embodied far and distant communities within a complex material and monumental expression of unity between people, land, ancestors and the heavens.

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## Declarations and conflicts of interest

### Research ethics statement

Not applicable to this article.

### Consent for publication statement

Not applicable to this article.

### Conflicts of interest statement

The authors declare no conflicts of interest with this article. All efforts to sufficiently anonymise the authors during peer review of this article have been made. The authors declare no further conflicts with this article.

## Notes

1 All cal BC dates are given at 95.4 per cent probability.

2 'Unification' is a highly charged concept in the modern political history of the UK and Ireland. Some archaeologists, quite rightly concerned by attempts to turn Stonehenge into a symbol of right-wing nationalism, have objected vehemently to the hypothesis that a unification of disparate groups may have been attempted in Britain some 4,500–4,000 years ago. While archaeologists should always be aware

of the dangers of monument-based nationalism and of the use of the past in the present, recent arguments about the meaning and use of Stonehenge in prehistory have fallen into exactly the opposite trap, dragging twenty-first-century politics into our understanding of the past. Reluctance to discuss the possibility of socio-political events spanning the length of Neolithic Britain because such events today would be unpalatable to many in the UK indicates a lack of willingness to face up to difficult aspects of the past.

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