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## 6. DISCUSSION

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### 6.1 *The survey's immediate results*

In connection with the survey, numerous exposures were examined. As a result of the survey, a substantial pitchstone sample collection for future research and consultations was formed, and a small number of samples were added to the already extensive pitchstone collections at the Hunterian Museum. Although many large and small pitchstone outcrops were already known at the time of the survey, the investigations on Arran produced four new minor pitchstone locations, namely gazetteer entries 13 (Garbh Allt), 30 (Clauchland Hills), 61 (Monamore Cairn) and 96 (Tormore).

In terms of the sources' potential relevance to prehistoric people (the combination of material homogeneity, outcrop size, degree of exposure and remoteness), the survey confirmed many of the authors' initial thoughts. Vegetation, for example, is clearly a problem, and it was frequently impossible to find, in particular, minor outcrops in areas affected by, for example, the growth of heather. Along watercourses, finding outcrops was hampered by vegetation in general, as well as by algae growth. Shore dykes were frequently obscured by general wear, discolouration and algae growth. During high tides, shore dykes would be covered by water, and in rainy seasons exposures in narrow gullies would become inaccessible due to the occurrence of flash-floods (as experienced in connection with the investigations along the tributaries of the Monamore Burn and in Glen Dubh).

The discovery of loose pitchstone sources behind Tormore shore and in the Clauchland Hills – the latter yielding raw material of exceedingly high quality – suggests that there may in prehistoric times have been more sources available than the outcrops listed in the gazetteer. The obsidian-like pitchstone of the Clauchland Hills site (gazetteer entry no. 30) was discovered on a slope, and it is not unlikely that a potential 'mother-lode' may have been obscured by, for example, soil creep or general erosion. Pitchstone of this quality forms part of larger mainland assemblages, such as those from Luce Bay and Biggar.

However, many of the practical problems experienced by archaeological and geological surveyors could be overcome by prehistoric people living on Arran, people who knew their local environment intimately. Most likely, the inhabitants of Arran would have had procurement strategies which could be adapted to changing circumstances. Obviously, different sources could be exploited at different times of the year, reflecting the changing vegetation, tides, weather, etc., but it is also likely that different

sources would be visited depending on whether raw material was needed for limited domestic usage or bulk exchange. As already mentioned, different outcrops were clearly exploited in the earlier and later parts of the Neolithic period.

No actual pitchstone quarries (that is, worked sills and dykes) were encountered during the survey. It is possible that prehistoric people on Arran mined all their raw material from natural exposures, such as the great sill at Dun Fionn, where huge blocks break off regularly and roll down the slopes, or from the island's shore dykes or natural exposures in cliff faces. However, the question of potential quarrying of pitchstone in prehistoric times is practically impossible to answer, as the rapid weathering of exposed pitchstone sources would have removed obvious signs of this process (as for example the attributes observed and described in connection with the examination of a quartz quarry on the Isle of Lewis; Ballin 2004 (b)). This is probably a combined effect of pitchstone being much softer and much more brittle than, for example, flint (on Moh's exponential scale from 1 to 10, flint has a hardness of 7, whereas pitchstone has a hardness of c 5–5.5).

Basically, the question of how, and from which specific sources, pitchstone was procured by prehistoric people on Arran can only be approached in one way, namely by undertaking a study which compares multiple archaeological samples (from different parts of Arran and from different periods) with geological samples from the various parts of the island, and which includes glass, crystallite and phenocryst characterisation. This will be discussed further in Section 6.2 below.

### 6.2 *The archaeological evidence*

As shown in the gazetteer, approximately 100 pitchstone outcrops are presently known from Arran. The catalogued outcrops differ considerably in terms of the material's flaking properties ('knappability'), as well as in terms of outcrop size, exposure and remoteness. As touched upon in the paper's introduction, the latter three factors may not have excluded a source from exploitation (if symbolic values were in any way involved), whereas poor flaking properties might have. However, 'poor flaking properties' is a relative concept, the definition of which depends on the attributes of the intended end-product: if an industry aimed at manufacturing delicate microblades, large phenocrysts – as well as large spherulites – were to be avoided, whereas an industry aiming at producing more robust, broad blades or flakes would be able to exploit almost any

**Table 1 The raw material distribution of the more substantial assemblages from the Arran Prehistoric Landscape Project (numbers according to [Finlay 1997](#))**

	Quantity				Per cent			
	Flint	Aphyric pitchstone	Porphyritic pitchstone	Total	Flint	Aphyric pitchstone	Porphyritic pitchstone	Total
Kilpatrick Settlement 16/1	82	159	28	269	30	59	11	100
Kilpatrick Cairn 16/2	38	59	30	127	30	46	24	100
Kilpatrick Cairn 16/3	24	25	5	54	44	46	9	99
Kilpatrick 'Fernie Bank' field boundary	24	67	23	114	21	59	20	100
Machrie Moor Cairn 24/1	33	111	4	148	22	75	3	100
TOTAL / AVERAGE	201	421	90	712	28	59	13	100

form of pitchstone, as long as it was not marred by numerous closely spaced planes of weakness, and as long as the raw material was not too devitrified.

Scottish non-Arran assemblages are mostly in aphyric pitchstone, although recent research has shown that, occasionally, porphyritic pitchstone may be present in small numbers. Only the recently discovered assemblage from Blackpark Plantation East on Bute ([Ballin et al forthcoming](#)), and assemblages from adjacent Bute sites (for example, Dunagoil, The Plan and Kingarth Quarry; [Mann 1918](#), 147; [Finlay 2003](#); [Mudie & Richardson 2006](#)), are dominated by porphyritic material.

On Arran, porphyritic pitchstone appears to have been more widely used. The substantial assemblages from *The Arran Prehistoric Landscape Project* ([Barber 1997](#); [Finlay 1997](#)) included on average 13% porphyritic pitchstone, with some assemblages (Kilpatrick Cairn 16/2) having as much as 24% porphyritic pitchstone ([Table 1](#)). If flint is excluded from the equation, the average ratio of aphyric:porphyritic pitchstone is 82:18%, with that of Kilpatrick Cairn 16/2 being 66:34%.

During Haggarty's ([1991](#)) excavation of a number of mainly Neolithic and Early Bronze Age monuments at Machrie Moor, western Arran, 1,696 lithic artefacts were recovered: flint makes up 38%, aphyric pitchstone 33%, porphyritic pitchstone 28%, and artefacts in other lithic raw materials 1%. The ratio of aphyric:porphyritic pitchstone is 54:46%. At Machrie Moor, the individual ratios of aphyric and porphyritic pitchstone forms varied from site to site and from context to context, but the average ratios clearly demonstrate that, on this location, porphyritic pitchstone was used approximately as frequently as aphyric pitchstone.

The report on the lithic material from the Mesolithic site of Auchareoch, southern Arran, only states that aphyric and porphyritic pitchstone were present, but without quantifying the two sub-assemblages ([Affleck et al 1988](#), 46). In total, this site yielded 418 pitchstone artefacts and 3,983 pieces of worked flint. The report on the Monamore chambered cairn and its archaeological finds ([MacKie 1964](#)) does

not characterise the lithic artefacts in detail, as its primary aim was to present and discuss the burial monument. However, it is apparent that more than one form of pitchstone was present at the site.

Although the increasing numbers of Scottish pitchstone artefacts (approximately 5,600 pieces have been examined in connection with the Scottish Archaeological Pitchstone Project) and pitchstone-bearing sites (approximately 350) ([Ballin 2009](#)) have allowed basic conclusions to be made – such as the fact that other sources than the Corriegills outcrops were exploited for use on Arran as well as for exchange – it is presently difficult to indicate how many, and which specific outcrops were exploited. This is mainly due to the fact that, since Williams Thorpe & Thorpe's ([1984](#)) limited attempts at provenancing archaeological pitchstone, almost no pitchstone artefacts have been exposed to geochemical analyses (one noticeable exception being the assemblage from Ballygalley in Northern Ireland; [Preston et al 2002](#)).

However, *explaining* the variation in pitchstone use is even more difficult than *identifying* the probable sources. Analysis of pitchstone artefacts in connection with the Scottish Archaeological Pitchstone Project highlights two main trends, namely 1) a somewhat higher ratio of porphyritic pitchstone on Arran as well as in Argyll & Bute/Southern Hebrides than in the remaining parts of Scotland, and 2) a higher ratio of porphyritic pitchstone in the later Neolithic than in the earlier part of that period ([Ballin 2006](#); [Ballin & Ward 2008](#); [Ballin 2009](#); [forthcoming \(a\)](#); [Ballin et al forthcoming](#)).

The two trends are not mutually exclusive, and a higher than average ratio of porphyritic pitchstone may be regionally as well as chronologically diagnostic. The apparently higher ratio of porphyritic pitchstone in the region immediately north of Arran, and a lower ratio in, for example, the Central Belt and south-west Scotland, may reflect different prehistoric territories and alliances ([Ballin 2006](#), 29). The former area may have been allied with groups in adjacent northern Arran (exploiting sources from the Schoolhouse outcrop

and further north on Arran), whereas the latter area may have been allied with groups in adjacent eastern Arran (exploiting sources in the Corriegills district, Clauchland Hills, the Fairy Glen and the general Lamlash Bay area).

The general increase in the exploitation of porphyritic pitchstone in the later Neolithic period (as demonstrated by the assemblage from Barnhouse on Orkney and Blackpark Plantation East on Bute; [Ballin forthcoming \(a\)](#); [Ballin et al forthcoming](#)), may – at least to a degree – be a function of technological changes, as the later Neolithic production of broad blades did not *exclude* the use of porphyritic pitchstone the way Early Neolithic microblade manufacture did (see above). The various possible explanations will be discussed in more detail in the final report from the Scottish Archaeological Pitchstone Project ([Ballin 2009](#)).

To the Scottish lithics specialist, the provenancing of pitchstone is presently a very (unsatisfactorily) simplistic affair, as it is only possible to distinguish between aphyric and porphyritic pieces. Even this is not straightforward, as it is not always possible, without the use of microscopic analysis, to distinguish unequivocally between the two main forms of pitchstone:

- Although some varieties of pitchstone are clearly aphyric and some clearly porphyritic, pitchstone seems to represent a continuum, ranging from almost obsidian-like forms (Clauchland Hills, catalogue entry no. 30), over lightly porphyritic forms (some Glenashdale outcrops), to coarsely porphyritic forms (for example, [Iorsa Valley](#), [Dippin](#), and [Allt nan Clach](#)).
- Some generally porphyritic outcrops include noticeable bands of almost aphyric material, such as the Schoolhouse outcrop and several sources along Arran’s west-coast (for example, Tormore and Auchagallon).
- It may occasionally be very difficult to distinguish between porphyritic forms, defined by the presence of phenocrysts, and aphyric forms with large and/or irregular spherulites (for example some Lag a’ Bheith varieties, and some of the pitchstone from Tomkeieff’s ‘Magmatic Rolls Quarry’ immediately east of the Fairy Glen).

However, even if it were possible to discriminate macroscopically between aphyric and porphyritic pitchstone, pitchstone provenancing – and thereby analyses of prehistoric territorial structures and exchange networks – would obviously benefit from the development of a standard approach with finer resolution. Several methods for the characterisation of pitchstone sources are presented in Section 4, but the effort should be made to define a generally applicable methodology, which would allow archaeologists to define pitchstone varieties more precisely than simply as being aphyric/porphyritic (in Tyrrell’s terminology: Corriegills Type/non-Corriegills Type) or, in terms of provenance, as deriving from a fairly

small enclave on Arran’s east-coast or from the remainder of Arran.

The pitchstone occurrences on Arran are potentially much more ‘characterisable’ than most lithic materials. They show a remarkable range of mineralogical and textural features (even in small fragments) for such a compositionally restricted suite of rocks. Given a suitable database of well-characterised geological occurrences, there is considerable potential for tightly constraining archaeological sources. Such a database should allow much more rigorous testing of hypotheses about sources and movement of pitchstone artefacts within Arran, as well as more widely in northern Britain. Currently, analytical data for Arran pitchstone crystallites are restricted to three localities ([Preston et al 1998](#)), out of nearly 100 now known on the island. We do not yet know how much intra-locality compositional and mineralogical variation exists, but from the thin-section evidence, it seems likely that considerable discrimination between localities will be achievable.

This methodology should aim to combine research objectives (territoriality, exchange networks, socio-economical organisation) with practical concerns. The latter includes:

- Examining the extent of intra-outcrop mineralogical, textural and compositional variation (at least at selected localities) as well as looking at a broad spread of localities.
- Non-destructiveness: approaches which do not destroy or damage archaeological artefacts (to the degree that this is possible) should be favoured. Modern SEM and EDAX methods, for example, offer the possibility of imaging, and at least semi-quantitative compositional information on untreated artefacts.
- Price: any effort at developing a standard approach for the identification and provenancing of Arran pitchstone forms would probably require a relatively large number of samples to be analysed; the price per analysed sample should therefore be kept as low as possible.
- Logistics: for any approach to become ‘standard’, analysts should have easy access to institutions and individuals capable of carrying out the preferred spectrum of methods (cf list in [Section 4.6](#)).

Although we feel that it would be potentially rewarding to look into the provenance of pitchstone artefacts from Scotland outwith Arran (for example: 1) which outcrops do the small numbers of porphyritic pitchstone derive from?; 2) could proportions of the aphyric pitchstone derive from the Monamore Glen or the Fairy Glen rather than from the Corriegills area *sensu stricto*?; and 3) is it possible that a very small number of local sources could have been exploited in prehistoric time, such as Fiunary in Argyll and Rudh’ an Tangaird on Eigg?), we would recommend first focusing on lithic assemblages from

Arran itself, as these assemblages are expected to include pitchstone from many more sources than, for example, mainland assemblages.

An Arran-based case study should include finds from various parts of the island, as well as from all stone-using periods, and the benefits would be twofold, namely 1) the development of a relevant methodology (discussed above), and 2) answers to specific questions regarding within-island ‘territories’ (within an area as geographically limited as Arran, territorial units would – in post-Mesolithic times – probably be defined more by lineage and clan than by tribe) and procurement/exchange patterns. Although very few assemblages from Arran have yet been published, assemblages have now been recorded from all parts of the island (eg [Donnelly](#)

[& Finlay forthcoming](#)), and including finds from all main prehistoric periods. Once a methodology has been defined – and tested on the interpretation of an archaeological material (assemblages from Arran) – attention can again be turned towards the characterisation, provenancing and interpretation of archaeological pitchstone from mainland Scotland and the islands north of Arran.

We believe that the Arran pitchstones offer the potential to examine the archaeological sources, usage and movement of material, locally and regionally, at an unusual, and perhaps unique level of precision and detail. We hope that this gazetteer might represent the first step in the creation of the detailed database of well-characterised pitchstone sources, which would be needed to support such work.