6 Microwear analysis of a sample of flaked stone tools *by K Hardy*

6.1 Introduction

The microwear analysis of a lithic assemblage comprises the study of lithic artefacts under a range of magnifications in order to identify minute physical changes that have taken place as a result of the stresses to which artefacts are put during episodes of use or movement. It is something that has rarely been carried out in Scottish Mesolithic studies. When it has, there has been a tendency to concentrate on retouched artefacts, in particular microliths (Finlayson 1989, 1990; Finlayson & Mithen 2000). Based on ethnographic work, however (eg White 1968; White & Thomas 1972; Hayden 1979; Sillitoe & Hardy 2003), it is clear that modern conceptions of what may be deemed a useful edge or artefact rarely correlate with the perceptions of the manufacturer/users. This is supported by microwear evidence on archaeological specimens elsewhere (Knuttsson 1988a, 1988b, 1990; Fullager 1993; Hardy 1993a).

Microwear analysis is often regarded as a slow and expensive process, requiring extensive experimental work followed by detailed high power microscopic comparative work and analyses. This is not necessarily the case, and it can provide a wealth of information that contributes greatly to the general interpretation of a site. Microscopic analysis can shed light on elements such as: the use and aims of artefact modification (were artefacts broken or modified for use in specific ways?); the knapping process in general (which unretouched pieces are waste products and which are not?); and post-depositional processes of artefact movement. Microscopic examination of unretouched artefacts as well as retouched material is helpful in understanding much about the 'background noise' of a site, including why lithics are scattered the way they are, what concentrations of lithics may mean and how the lithic assemblage may have related to other artefacts, often not preserved.

The aims of microwear analysis have always been set high, attempting to determine how rather than whether pieces were used, the direction of movement and ultimately the materials on which they were used (wood, bone etc; eg Keeley 1980; Dumont 1985; Grace 1989; Finlayson & Mithen 2000). All of this is, however, difficult without experimental comparison and it does not address more subtle questions such as multifunctionality or complex patterns of discard. A particular problem in Scotland is that the wide range of different raw materials means that a detailed experimental programme is required for each individual raw material, as each may respond differently to pressure and movement. This is usually prohibitive. Nevertheless, similar raw materials respond to stress in similar ways. Fine-grained, silicious materials such as chert, flint and bloodstone tend to produce comparable wear patterns. These comprise microfractures, edge abrasion, particularly on thin edges, edge-rounding and polish, and much can be deciphered from their observation. It is the interaction between them and the buildup of polish that is impossible to interpret without experimental comparison thus preventing more precise results. Even so, lines of polish all lying in one direction point to the dominant direction of use, for example if they all lie perpendicular to an edge they indicate use in an up/down direction, rather than longitudinally. Polish that extends deep into an edge is likely to have been used on a pliable material, such as hide, and polish that is restricted to the limits of an edge is likely to have been used on a hard or brittle material, such as bone. Step fractures are more likely to be the result of a percussive motion while snap and flake fractures are more likely to result from cutting, whittling, or scraping.

Microscopic edge fractures are dependent on numerous factors other than use, including the nature of the raw material, the thinness of the edge and stress, which may range from being carried around in a pocket or pouch by the user, trampling, soil, or even post-excavation abrasion, for example bagging with other artefacts. However, if an artefact shows a concentration of fractures, often combined with unnatural straightening on one edge, or part of an edge, then it is likely to be due to use. By contrast, if an artefact, particularly a thin one, has inconsistent or random fractures around all or most of its edges, then it is more likely to be related to something other than use. Like edge fracture, polish may be due to many different factors. Spots of polish, or polish that occurs at random across a surface, are unlikely to have been caused by use. A consistent pattern of polish along an edge is more likely to have been caused by repeated motion, which usually signifies use.

Based on the criteria discussed above, and without an experimental programme, 62 lithic artefacts from Camas Daraich were examined microscopically to determine whether any traces of use wear or evidence of post-depositional movement were apparent. This work had several aims including an examination of the potential of the various raw materials for the formation of microwear, an examination of the selection of pieces for use and of the range of tasks involved, the recovery of information on retouched versus unretouched tools and any spatial variation in the assemblage. In addition, information on post-depositional stresses was also considered.

Table 18 Camas Daraich, microwear analysis: assemblage studied

Artefact type	Number of pieces
Blade	21
Flake	31
Chunk	3
Core	1
Microlith	6
Total	62

Table 19 Microwear analysis: raw materials

Raw material	Number of pieces
Rùm bloodstone	23
Chalcedonic silica	34
Baked mudstone	4
Quartz	1

Table 20 Microwear analysis: locations and contexts of studied artefacts

Square	Quadrant	Context	No of artefacts
B1	NE	13	6
B1	NW	1	1
B1	NW	5	1
B1	SE	3	1
B1	SE	10	4
B3	NE	8	16
B3	NW	8	8
B3	SE	8	9
B3	SW	8	7
C2	NE	8	4
C2	SE	8	2
TPX		2	3

6.2 Methods

Artefacts were washed by soaking in detergent. Where necessary, edges and surfaces were cleaned with alcohol. An Olympus BHM microscope was used. Magnifications employed ranged from ×50 to ×200. An initial scan of the artefact's surface and edges was carried out at 50 magnifications followed, where necessary, by a more detailed examination at 100 and 200 magnifications. If microscopic features were identified, the edge was then looked at in profile to determine whether any rounding or flattening had occurred. This is particularly useful in very thin edges where a small amount of use can result in rapid blunting, something which also leads to a detectable area of unnatural straightness and can be equated with use.

The microscopic features recorded include: micro-fractures, edge-rounding, breakage and polish development. Examination of all these features together has resulted in a well established method for undertaking microwear analysis which is followed here (Keeley & Newcomer 1977; Newcomer *et al* 1986; Unrath *et al* 1986; Grace *et al* 1985, 1988; Bamforth 1987; Grace 1989). This report is not a conclusive attempt to identify movement and interpret the use of artefacts, rather it provides a record of the presence or absence of microscopic features. From this it can offer a general interpretation of patterns of use and movement, including the characteristics that made an artefact more likely to be selected for use.

A range of artefacts was studied, including both retouched and unretouched pieces, pieces that looked 'likely' and those that appeared unlikely, incorporating pieces from secure Mesolithic contexts as well as some from the ploughsoil (particularly useful in identifying the effect and processes of soil movement). The majority of artefacts are made of fine-grained siliceous materials and have more readily identifiable traces. Some artefacts of baked mudstone were included to see whether similar traces might survive.

6.3 Results

The full results are set out in Section 19 and presented schematicall for selected pieces in Illus 37. Details of the pieces studied are presented in Tables 18 and 19. The contexts of the artefacts are presented below (Table 20). The variation in quantity of artefacts from different contexts reflects the contents of the contexts (Section 5).

6.4 Interpretation of use

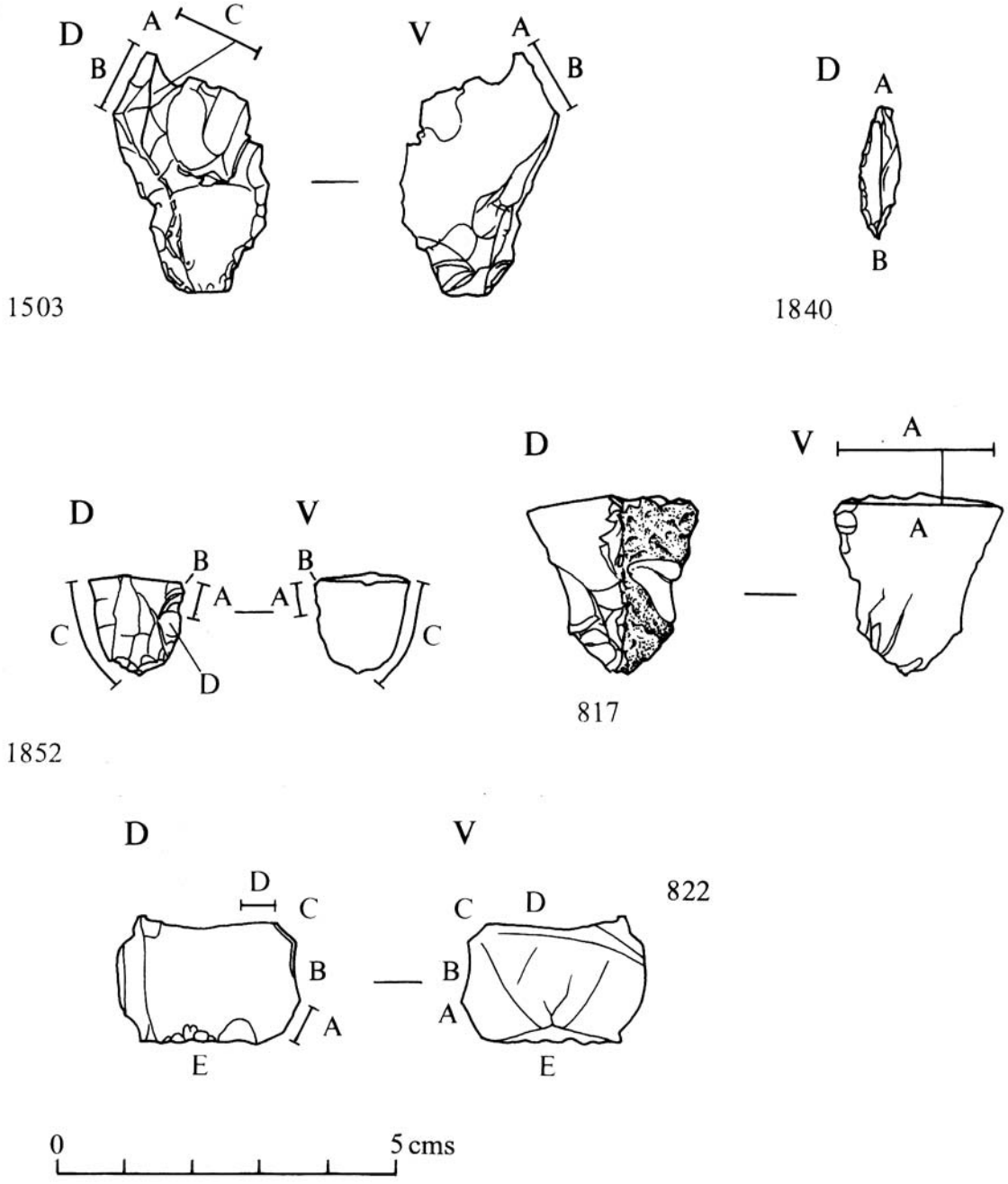
Of the 62 artefacts, 26 have traces suggesting use and 36 do not (Section 19).

6.5 Raw material

With regard to raw material and selection for use (Table 21), it is interesting that over half of the bloodstone pieces have visible traces of use while these were identified on just under one third of the pieces of chalcedonic silica. While this may mean that traces are more easily formed, or recorded, on bloodstone, it may reflect some selection on the part of the inhabitants of Camas Daraich and is worthy of further exploration. Mudstone did not figure as a large proportion of the study, but the presence of visible wear on one artefact suggests that it should be included in any future experimental work.

6.6 Selection by size

In an attempt to try to understand the factors that make an artefact more likely to be selected for use,



Illus 37 The lithic assemblage: sample of artefacts with microwear (NB: numbers refer to the catalogue numbers). Bloodstone flake: 1503; Chalcedonic silica, microlith – fine point: 1840; Chalcedonic silica, blade (one half of a refit): 1852; Quartz blade: 1817; Bloodstone flake: 822

Table 21 Microwear analysis: raw material and use

Raw material	Microwear present	Microwear absent
Rùm bloodstone	12	11
Baked mudstone	1	3
Quartz	1	0
Chalcedonic silica	12	22

the measurements of the longest dimension, thickness and edge angle were all compared to the presence of microwear (Table 22; Table 23; Table 24). In this way it is also possible to see whether different specific blank types stand out.

With regard to size, the initial results from Table 22 are unclear. Over one third of the 25 artefacts with microwear are less than 20 mm long. While

Table 22 Artefacts with microwear: the largest dimension

Largest dimension (mm)	Microwear present	Microwear absent
< 20	10	17
20–25	4	12
26–30	9	2
31–39	3	5

Table 23 Artefacts with microwear: thickness

Thickness (mm)	Microwear present	Microwear absent
2–3	4	13
4–5	10	10
6–7	4	5
8–10	5	5
> 10	3	3

Table 24 Artefacts with microwear: edge angle. NB: Not all edge angles were measured, notably those on broken microliths

Edge angle	Microwear present	Microwear absent
21–30	2	11
31–40	7	11
41–50	4	5
51–60	8	2
> 60	4	2

certain small tools, such as the microliths, undoubtedly fall into this group, it is also possible that this proportion is inflated by those pieces that snapped during, or after, use as five of the artefacts with microwear are broken. The presence of some artefacts with microwear in each of the categories indicates that there was no clear size template in use at Camas Daraich, though it is possible that the broken artefacts were originally larger when selected which would alter the proportions in favour of larger pieces.

With regard to thickness the same picture prevails. While over a third of the artefacts fall into the 4–5 mm range, there are both thinner artefacts and thicker artefacts, all with wear traces.

Edge angle measurements again demonstrate a range of sizes, perhaps with some preference for more obtuse edge angles.

While there is no apparent optimum usable size, this is in itself an interesting point. The fact that all size groups contain artefacts with wear traces suggests that the assemblage has resulted from a wide range of different needs and different uses by the people of Camas Daraich. Given the small size of the sample it is perhaps not surprising that specific groups of characteristics could not be isolated.

Table 25 Microwear on unretouched blades and flakes (Illus 37)

Blades/flakes	Microwear present	Microwear absent
Flakes/chunks	17	16
Blades	5	16
Total	22	32

6.7 Presence of microwear on unretouched pieces

A number of unretouched blades and flakes were examined for traces of use (Table 25).

Interestingly, many of the unretouched artefacts examined did bear microscopic damage. It is also interesting that more flakes and chunks than blades have microwear traces. Flakes were clearly as important, if not more so, as blades at Camas Daraich, and unretouched pieces were as important as retouched for use as tools.

6.7.1 Microwear on unretouched blades

Of the five blades, one (cat:1505) had a light concentration of snap and flake fractures on a small area on the left side, though no polish was detected. The microwear suggests very light longitudinal use. Two blades refit (cat:1850, cat:1852; Illus 37) and may only represent one working tool (see below). These and artefact cat:1854 had no visible use-related polish, though all had heavy fractures along their edges, suggesting heavier or more abrasive use, again in a longitudinal direction. Artefact cat:1365 had lightly fractured edges which were slightly rounded, again suggesting longitudinal use. It is interesting that no use-related polish was detected on any blades, this suggests that pieces were not used for long enough to build up polish. That four blades had heavy fracturing yet no polish suggests they might have been used on a harder material, such as wood, and the fact that one piece may have broken (cat:1850 and cat:1852) during use strengthens this interpretation. Artefact cat:1365, with lighter fractures and edge-rounding, may have been used on a less abrasive material such as hide. It is interesting, in the light of such tenuous wear traces, to note that Lewenstein (Lewenstein 1993) undertook a series of experiments to determine how long it took for identifiable wear to form on obsidian and chert artefacts while whittling wood. Only after intensive working for 30 minutes was the edge sufficiently altered, both with fractures and polish, to suggest use. Examination of tools after 10 minutes working showed light fracturing. This suggests that the expedient use of tools might not always be detected by microwear analysis though Hardy (Hardy 1993b) found that snap-fracturing did occur on flint flakes after only five minutes cutting root vegetables.

Table 26 Microwear on retouched artefacts

Type	Wear present	Wear absent	Broken
Microliths			
Obliquely blunted points (2)		2	No (2)
Rod (1)		1	Yes
Fine point (1)	(1) Fractured tip		No
Backed bladelets (2)	(2) Scratches and polish on edges about halfway up, one had polish and fractures on unretouched edge		Yes (2)
Scrapers (3)	(1) Rounded tip, thin line of polish along scraper edge	2	
Scraper resharpening (1)	(1) Fractures along old scraping edge, likely related to former use as part of scraping edge		No

6.7.2 Microwear on unretouched flakes and chunks

Of the 16 flakes and chunks, five had visible microwear only on sides and 11 on tips. Of these, five had microwear on tips and adjacent edges and six on tips. This suggests that flakes may have been predominantly selected for their usable tips or corners. Of the five flakes with microwear along their edges, one piece (cat:1823) had been used in a percussive motion along its distal edge, three pieces (cat:1250, cat:1352, cat:1607) had fractures along their sides, cat:1607 also had polishing on the fractured side, cat:1352 also had edge-rounding and cat:1250 had heavy fracturing though no polish. Their microwear suggests a longitudinal use such as cutting or grooving. Artefact cat:817 had a build up of polish and parallel lines of polish along its inner platform edge. This edge is too thick for cutting, and the thin line of polish suggests smoothing.

6.8 Presence of microwear on retouched pieces

Table 26 presents the retouched pieces examined for microwear.

Of the six microliths examined, neither the obliquely blunted points (cat:1849, cat:1855) nor the rod (cat:1841) had any microwear traces that could be related to use, though the rod was broken. The fine point (cat:1840, Illus 37) had no apparent wear traces except for a small snap-fracture at its distal end, while the two backed bladelets (cat:1845, cat:1846) were both broken and had similar scratches and areas of polish midway up their sides. This could be evidence for hafting. It is, of course, possible that cat:1841, cat:1845 and cat:1846 were all broken during or before use, or while being hafted, so that the breakage may, in itself, be a form of usewear. If they were used as projectiles this, together with no detectable microwear, might be likely. The work of Fischer *et al* (Fischer *et al* 1984) is important here as it suggested that projectile use rarely takes place over enough time for usewear to build up.

Alternatively, the microliths at Camas Daraich may not, or not all, have been intended for use as projectiles, and cat:1845 does have polish and fractures along its unretouched side. This would be supported by Finlayson & Mithen (Finlayson & Mithen 2000; Mithen & Finlayson 2000) who suggested that microliths had many other uses.

Of the two scrapers examined, only one (cat:1434) had any microwear. This occurred on the right distal tip, which is fractured and smoothed (Section 6.9). The use of this tip seems unrelated to a light line of polish that occurs along the scraping edge. It appears that this tool was used in two different ways, along the scraping edge and on the tip.

6.9 Points and tips

Twelve flakes, one scraper and one microlith have points, tips or corners with traces of use. Of these, eight were bloodstone, four were chalcedonic silica and one quartz. This does not correspond either with the proportions of raw material in the assemblage as a whole or with those pieces examined for microwear and suggests that pieces with microwear on corners or tips were, apparently, more likely to be made of bloodstone. These 'working tips' almost always occured on distal corners and edges – only two artefacts had tips on their proximal corners. This diversity suggests that the selection of artefacts was based on a known task and the presence of a suitable 'tip', rather than on a formal, preconceived, tool shape.

Of these artefacts, four (cat:1246, cat:1252, cat:1257, cat:1347) had tips which had snapped off and it is unclear what their movement directions might have been. One artefact (cat:1243) had many step fractures, suggesting a percussive or stabbing motion; two (cat:1361, cat:1434) were smoothed and blunted and contained many flake and snap-fractures, suggesting a boring motion; while one (cat:1503) had polish and fractures extending along the tip edges and up a ridge on the tip. The snap-fractures on the ridge suggests that it was used in a rotational direction and the buildup of polish may have occurred due to its use on a non-abrasive material such as hide. One piece (cat:868) had a

Table 27 Microwear analysis: distribution of points, tips, corners

Square	Quadrant	Context	Raw material	Type	Microwear
B1	NW	01	Bloodstone	Scraper	Tip
B1	NE	13	Ch. Silica	Microlith	Tip
B1	NE	13	Bloodstone	Flake	Tip and edge
B3	NE	08	Bloodstone	Flake	Tip
B3	NE	08	Bloodstone	Flake	Tip and edge
B3	NE	08	Quartz	Flake	Tip
B3	NE	08	Bloodstone	Flake	Tip and edge
B3	SE	08	Bloodstone	Flake	Tip and edge
B3	NW	08	Ch. Silica	Flake	Tip
B3	NW	08	Bloodstone	Flake	Tip
B3	NW	08	Ch. Silica	Flake	Tip
B3	NW	08	Ch. silica	Chunk	Tip
C2	NE	08	Bloodstone	Flake	Tip and edge
C2	NE	08	Ch. Silica	Flake	Tip

polished tip. Four pieces (cat:822, cat:1358, cat:1359, cat:1859) had tips or corners associated with used adjacent edges. These pieces are likely to have been used in a cutting or grooving motion. The last piece (cat:1840) is a microlith (fine point). A small fracture at its distal end suggests projectile use.

It is interesting that so many artefacts had well used corners or tips, but this is a logical and likely way for artefacts to have been used for many tasks including cutting and it is comparable to the way knives are sometimes used today. It is clearly possible to suggest many possible Mesolithic tasks that would require a sharply pointed edge.

Some flakes, no doubt, had naturally sharp corners, but in at least two cases the shaping of corners was enhanced with retouch. The lack of blades with this wear type suggests that they were made for a different purpose. This is supported by the microwear.

The location of these artefacts suggests a concentration in B3 context 08 where nine of the 14 pieces occur (Table 27).

6.10 Refits and usewear

Artefacts cat:1850 and cat:1852 refit. This is interesting in that both are blades with clear and comparable traces of use (see above Section 6.7.1). The microwear on cat:1852 suggests it may have broken either during or after use. Their location, in the same square and quadrant, means that both are possible.

6.11 Artefact distribution and usewear

Using context 08, artefact location was examined to determine whether any deposition patterns could be detected (Table 28). Context 08 was selected because it is a secure Mesolithic context with some spatial variation and contained 46 of the 62 pieces studied.

Obviously the numbers are too small to draw hard and fast conclusions, but it is interesting that less than one third of the artefacts from square B3 had visible traces of use, while all but one (a microlith) from square C2 showed traces of use. Nine artefacts had clearly polished edges and five of these were in C2.

Pieces with wear in C2 suggested a range of use – two suggested longitudinal motion using the sides, two had used tips and one piece had both a used tip and adjacent edge. In B3, in contrast, 10 of the 11 pieces with wear showed signs of the specific use of a corner or tip. Whatever led to the deposition of the material in B3 it would seem to have included some, possibly specialized, task that required a very specific type of tool.

6.12 Traces of movement

With regard to post-depositional movement, the results are more difficult to interpret. The main problem is that surface scratches and polish, while easily identifiable, could have resulted from a wide range of different causes, pre-deposition, post-deposition or post-excavation. In order to examine whether the microwear might be post-depositional, the distribution of artefacts with non-use-related surface damage was examined. Very few artefacts in trench 1 had any evidence for movement but two of the three artefacts from test pit TPX had indeterminate polish across their surfaces. This suggests that some movement may have taken place here.

6.13 Summary

This study has provided a wide range of information to show how, even without an experimental pro-

Table 28 Microwear analysis: location of used artefacts in context 08

Square, quadrant	Microwear present	Microwear absent
B3 NE	6	10
B3 NW	2	6
B3 SE	2	7
B3 SW	1	6
C2 NE	3	1
C2 SE	2	0

gramme, microwear analysis can make a major contribution to the interpretation of a site. Aspects covered include the types of artefacts selected for use (both with and without retouch), suggestions of how pieces were used and information on their distribution.

With regard to the raw materials, most of the artefacts studied were of fine-grained siliceous materials. The microwear was easily recognizable even without experimental comparison. The presence of wear traces on at least one artefact of baked mudstone is exciting and provides an indicator for future work. Raw material selection may have occurred for certain types of tasks and certain microwear traces appear to be more intensively present on bloodstone artefacts. This may suggest that bloodstone was preferred for certain tasks, such as those involving the use of flakes with a strong tip or corner.

Further work on the relationship between artefact thickness, edge angles and wear traces may assist in predicting those artefacts selected for use, thus providing a new dimension to the interpretation of the formation and technological variation within a lithic assemblage. The use of unretouched artefacts has been highlighted many times in the past (eg White 1967; White & Thomas 1972; Hayden 1979; Knuttsson 1988, 1990; Hardy & Sillitoe 2003) and it is not surprising that this analysis should confirm that they were important to the people of Camas Daraich.

What light is thrown on the actual tasks that were carried out at Camas Daraich? The lack of any clear proforma for use suggests that a range of tasks was undertaken and this is confirmed by the variability of the microwear traces. One of the patterns to emerge is the number of artefacts with points and corners showing microwear, all of which occurred on flakes or chunks. Some suggested cutting or grooving actions, while others suggested a rotational or stabbing action. The use of points for cutting gives some indication of the way in which many unretouched flakes may have been held and used and compares with the way some knives are used today. It is also interesting that so few blades showed evidence of heavy use, though all those with microwear had similar evidence of longitudinal cutting type motion. It would seem that blades, if used at all, were used lightly. Another group comprised two artefacts with microwear traces on the inner platform edges, suggesting a longitudinal edge smoothing motion. This suggests a second level of tool-working in that it suggests tool refinement rather than primary shaping. Of the retouched pieces, two microliths (both backed bladelets) have traces that suggest hafting, and one of these had fractures and polish along its unretouched side as well. The two obliquely blunted points and a rod had no evidence of usewear, and the fine point had a fractured tip. In all, the lack of use-related traces on five of the microliths studied might suggest they were used as projectiles. The fact that three were broken may in itself be a wear trace, but it is also possible that the microliths were, like many other artefacts, either so lightly used as to leave no trace, or unused.

It will be clear that a study such as this can rarely suggest precise tasks or worked materials. In this respect it is worth remembering that many studies, both of microwear on archaeological assemblages and of ethnographic material, have emphasized the role of lithic artefacts in the manufacture and maintenance of other tools (Hayden 1987; Clarke 1998; Hardy & Sillitoe 2003). It is generally accepted that the importance of stone tools is exaggerated because of their survival. Any prehistoric tool kit will no doubt have incorporated artefacts of many different materials of which stone was but a part (and possibly a minor one; Sillitoe & Hardy 2003).

One of the most exciting points to arise from the microscopic study is the fact that, even within the small area excavated at Camas Daraich, and within the confines of this small sample, some spatial differences have been observed. Square C2 contained a high proportion of artefacts with microwear showing a variety of use. Square B3, on the other hand, though with far more pieces, had an apparently much more specialized assemblage in which fewer than one third of the potential pieces had signs of use though those that did comprised most of the unretouched pieces with points or corners and little else. Square B1, in contrast, had far fewer pieces with microwear, and these comprised mainly retouched pieces with two microliths and one scraper. These suggestions of spatial diversity both alter and add considerably to the refinement of interpretation of the site (Section 12.3).

Taken across the site as a whole the information on tasks is interesting because it suggests that, over

time, Camas Daraich was not a specialized site. Whatever went on, it involved a range of tools in a range of activities, some of which took place (or were discarded) in different locations. This is useful information in the light of current interpretations of the Mesolithic which tend to see smaller sites in terms of specialized activity sites, even in the absence of microwear analysis (Wickham Jones & Dalland 1998). Perhaps Camas Daraich is an example of a different kind of site, perhaps it is much larger than the work in 2000 could suggest. Only further fieldwork can tell, but the potential is clearly there.