7. THE BEAKER

7.1 Report on the Beaker

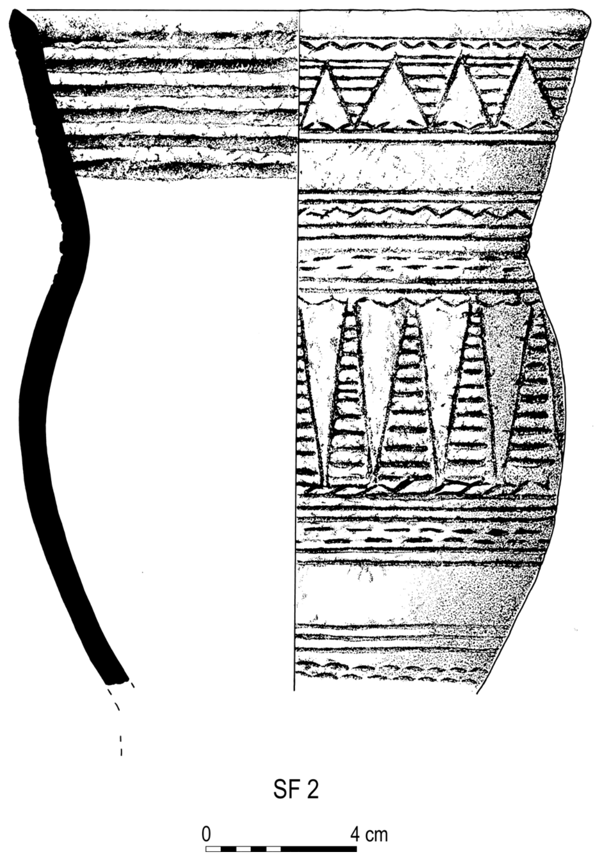
Neil Wilkin

The Beaker (SF002, Illus 12) was analysed according to the *Guidelines of the Prehistoric Ceramics Research Group* (PCRG 1997), with full details recorded in the archived report (held at the National Record of the Historic Environment maintained by Historic Environment Scotland). A catalogue of the sherds is also included with the project archive. The vessel is approximately 80–85% complete, including *c* 90% of the neck and rim and >90% of the upper body. These sherds are in relatively fresh condition. However, the lower body (*c* 3cm above base) is complete and abraded to only *c* 20–25%. The base is also incomplete, abraded and complete to only *c* 50%. The dimensions of the vessel are as follows: height *c* 190–200mm; rim diameter *c* 155mm; base diameter *c* 95mm; wall thickness *c* 7mm.

7.1.1 Detailed vessel description

The colour of the exterior surface is brown to dark brown (Munsell 5YR 5/6) while the interior is a yellow-buff to brown. Quartzatic inclusions are frequently distributed, with maximum size of 3–4mm, and with some showing on the surface of the vessel. Also evident on the surface are black mica platelets. Both inclusions of quartzatic grits and mica platelets are a common feature of Beakers from the north-east of Scotland, occurring in a high proportion of funerary vessels in the collection of the Marischal Museum, University of Aberdeen (author's personal dataset). Indeed, of the 11 Beakers excavated to modern standards (that is, from *c* 1970/80), and for which data are available, at least five have quartzatic grits.

The fabric has a cross-section comprising an oxidised exterior; a black, unoxidised core, and an oxidised interior, indicative of the open-air firing and incomplete burning of the carbonaceous matter



Illus 12 The Beaker. © Northlight Heritage

at the core of the wall. A number of sherds show evidence of residues, most notably the basal sherds, that may relate to the original use of the Beaker (see 7.2 'Organic residue analysis of the Beaker' below). There is evidence of burnishing to the undecorated areas of the exterior surface, with the unfilled isosceles triangles of the chevron patterns bearing an especially high sheen. A slip was applied to the exterior of the vessel prior to decoration and burnish. Further elaboration is represented by possible traces of a decorative white infill or inlay to a section of the neck. This feature occurs on a significant proportion of Beakers in north-east Scotland (*c* 57%) and has been identified on some as calcium hydroxyapatite (the major inorganic constituent of bone), derived from burnt, ground bone that was mixed with liquid to a soft paste and rubbed into the incised decoration (Curtis et al 2010). The low visibility of the white inlay on the Knappach Toll Beaker is perhaps understandable given the poor preservation of human remains within the short cist.

The vessel has a gently curving ovoid body with a relatively sharp angle between the neck and the body (Illus 12). The neck flares outwards at a uniform angle, terminating at an unusual rim that has been bevelled to the interior and exterior. Although the lower body of the vessel is not complete, an approximate height of 190–200mm can be proposed based upon the estimated base diameter of 95mm. This places the vessel among the upper size range of north-east Scottish Beakers of 120–220mm (cf Shepherd 1986: 29–32). The internal base of the vessel rises to a low omphalos. A neat, thin cordon (*c* 3–4mm wide) encircles the vessel at the base of the neck, just above the waist.

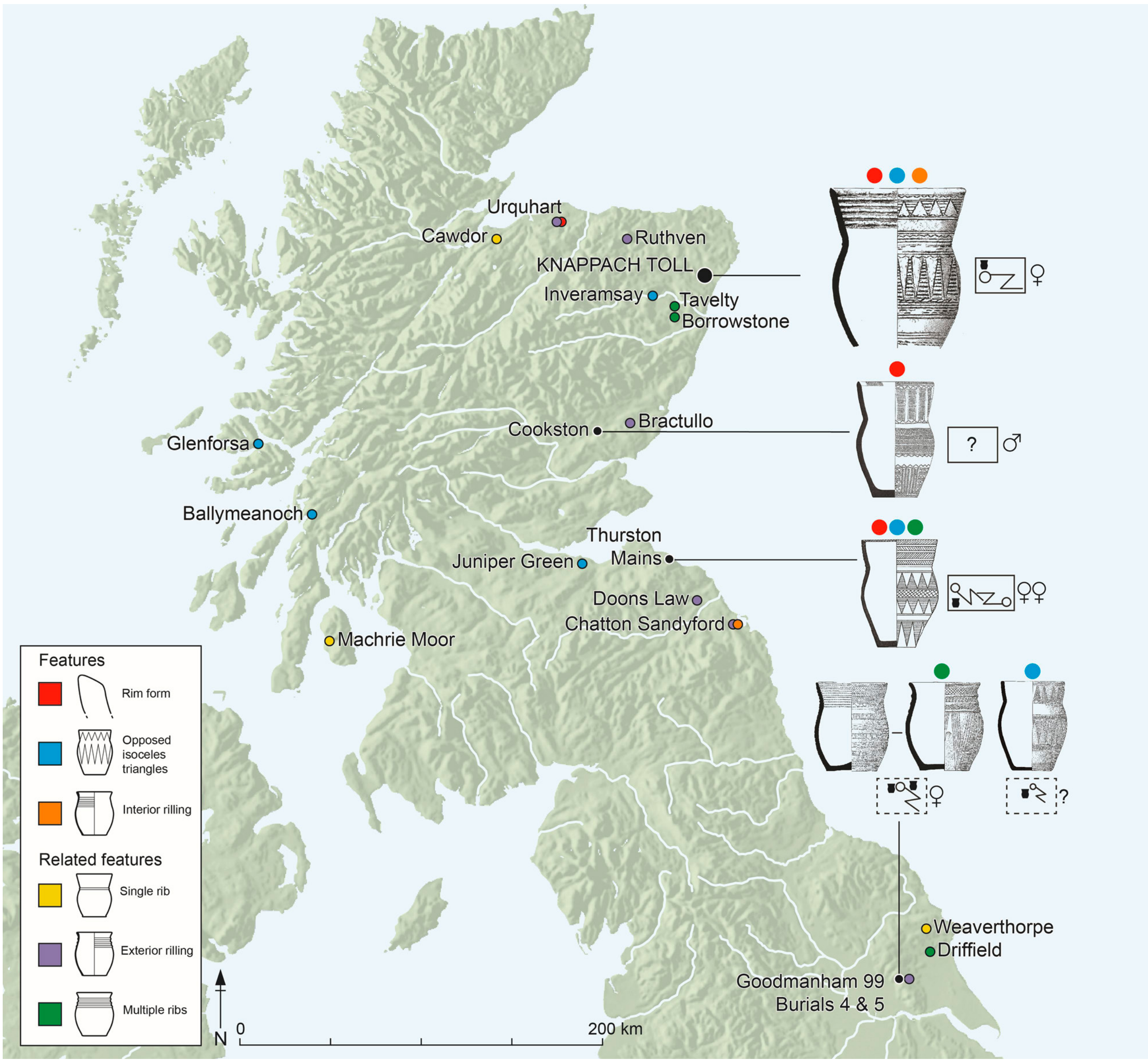
There are five zones of decoration: four on the exterior surface (two on the neck and two on the body) and one on the interior of the neck. The decorative zones on the exterior include Clarke's (1970) Southern British Motif Group 4, No. 29 (also forming No. 30); Primary Northern British/Dutch Motif Group 2, Nos. 16 and 17, and Late Northern Motif Group 3, No. 21. The decoration consists of a row of isosceles triangles to the neck and body respectively, both with encircling lines (including dashes and fringing/horizontal herringbone) to either side. The exterior decorated and undecorated bands thus nest around isosceles triangles on both the upper neck and body, creating a mirror image that is broken by the difference in the scale of the opposed isosceles triangles. The overall design is therefore centred upon opposed, filled and unfilled triangles – a relatively popular Beaker scheme (see 7.1.2 'The Beaker: traits and comparanda' below).

The decoration was executed using three techniques. The main technique was comb impression, with at least two combs utilised, one with teeth of 0.7mm diameter (for example, for the upper chevrons) and the other with teeth of 1–2mm diameter (for example, for the encircling lines). The fringes, dashes and the fill of the lower chevron pattern have been incised, possibly using the edge of a comb. Finally, the encircling lines on the inside of the neck were grooved using a blunt instrument (*c* 4–5mm) with irregular edges.

7.1.2 The Beaker: traits and comparanda

The Knappach Toll vessel sits comfortably within the overall decorative and morphological palette of Beaker pottery in Deeside and north-east Scotland, but also presents some unique features and evidence for inter-regional connections (see Illus 13). The closest parallels for the overall decorative design and form are the angular-necked vessels from Cookston, Angus (Coutts 1971: 48, fig 82a); Thurston Mains, East Lothian (Clarke 1970: no. 1648, fig 648: 'Skateraw'), and Goodmanham 99, Burial 5, East Yorkshire (Clarke 1970: no. 1309, fig 675). However, several individual features are rare and require further attention in relation to privileged connections within the wider Beaker network of eastern Britain. For instance, the double-bevelled rim, shaped to a blunt point, is a modest but relatively rare feature, although internal bevels alone are more common. Limited parallels include the vessel from Cookston, Angus (Coutts 1971: 48, fig 82a) and the unusual squat bowl from Urquhart, Moray (Clarke 1970: no. 1721, fig 723).

Opposed filled isosceles triangles (frequently associated with horizontal herringbone/fringing) are a recurrent decorative feature of funerary Beakers in north-east Scotland, frequently globular vessels from the Buchan region (Shepherd 1986: illus 20; Shepherd 2012: illus 17.6). However, the Beaker from Knappach Toll belongs to a more dispersed group with longer, angular necks and more ovoid bodies that stretch the opposed



Illus 13 Map showing connections between the key and related decorative and morphological features of the Knappach Toll Beaker and similar vessels from Northern Britain. The Beakers that share most in common with the Knappach Toll vessel (from Cookston, Thurston Mains, and Goodmanham 99) are shown as line drawings (vessels not to scale). Illustration by Craig Williams. © Northlight Heritage

isosceles motif across neck and body. This is also true of the vessels from Juniper Green, Midlothian (Clarke 1970: no. 1710, fig 710); Inveramsay, Aberdeenshire (Clarke 1970: no. 1457, fig 682); Ballymeanoch henge, Argyll and Bute (Clarke 1970: no. 1530, fig 711), and Glenforsa, Mull, Argyll & Bute (Clarke 1970: no. 1531, fig 676). Most closely comparable, however, is the design of the vessel from Goodmanham 99, Burial 5, East Yorkshire (Clarke 1970: no. 1309, fig 675; Kinnes & Longworth 1985: 85).

The single cordon or 'rib' positioned at the base of the neck of the Knappach Toll Beaker relates to the practice of placing up to six cordons on the neck of angular-necked Beakers. It is likely to be related to (or have its origins in) the single or double cordons placed immediately below the rim of non-funerary and typologically early Beakers (for example, Clarke's Northern British/North Rhine grouping, 1970, vol 1: 36–7). Shepherd (1986: 145) associated this feature with 'high-status' burials associated with 'archery' equipment, for instance at Tavelty, Aberdeenshire

(Ralston 1996: 143–5); Borrowstone, Cists 5 and 6, Aberdeenshire (Shepherd 1986: 13–15, illus 12), and Kellythorpe, Driffield, Yorkshire (Clarke et al 1985: 261–2). It is also a feature of some Continental European Beakers, including from the Netherlands (E Drenth, pers comm; for example, Clarke 1970: fig 455). A further notable parallel is Thurston Mains, East Lothian (Clarke 1970: no. 1648, fig 648: 'Skateraw'), which features five cordons to the neck, an internally bevelled rim and opposed isosceles triangles on the body of the vessel (Clarke 1970: no. 1648, fig 648). Furthermore, the globular, Short-Necked vessel from Machrie North, Cairn 24/7C, Isle of Arran, has a single cordon at the inflection between neck and body and filled chevron decoration on the lower body (Barber 1997: 88–91). The vessel from Inchnacoarach, Cawdor, Moray, also features only one cordon to the neck, also placed at the base of the neck, with the others applied to the body (Clarke 1970: no. 1730, fig 663). A small number of Beakers from England also feature a single cordon, also positioned at the base of angular necks (eg Clarke 1970: figs 526, 639–40).

The use of rilling on the inside of the neck is an unusual technique that is difficult to parallel on British funerary Beakers. Rilling is quite frequently applied to the exterior of the neck (eg Bractullo, Angus (Coutts 1971: 44, no 77a), Ruthven, Aberdeenshire (Clarke 1970: no. 1491, fig 277), and Doons Law, Berwickshire (Clarke & Hamilton 1999)), often on vessels that lack a clear separation between neck and body (eg 'S'-profiled vessels) (Case 2001: 369). The vessel from Urquhart, Moray (Clarke 1970: no. 1721, fig 723), despite its bowl-like profile, features rilling to an angularly set neck, double-bevelled rim, and (non-comb applied) herringbone and 'dash' decorative elements – all similar to the Knappach Toll repertoire (Clarke's Primary Northern British/Dutch, Motif Group 2, nos 16 and 17).

One of the few British funerary Beakers to feature internal grooving is from Chatton Sandyford, Burial 1, Northumberland (Jobey 1968; Clarke 1970: no. 647.2, fig 300). Notably, this Beaker (associated with two V-perforated jet or cannel coal buttons) was from a burial close to a second (Burial 2) with a very similarly decorated Beaker, with four ribs/cordons on its neck (Clarke 1970: no. 647.1, fig 299). Internal rilling occurs slightly more often on non-funerary Beakers, although it is still rare (eg Gibson 1982 vol 1: 119, 142; 2006: fig 3.6.3; MacGregor & Stuart 2008: 88–91).

Humphrey Case connected the use of internal rilling to the Late Neolithic Grooved Ware tradition (2001: 369; cf Manby 1999: 61, table 6.2; Brindley 1999), a claim that is noteworthy given the chronological overlap between Grooved Ware and Beaker deposition (Garwood 1999), and the socio-cultural relationships between communities using these respective ceramic traditions (eg Needham 2007). Thus internal rilling is more easily paralleled among the non-funerary Beaker assemblage, a claim that also applies to the use of external cordons and, indeed, Grooved Ware pottery. In typological terms, the Beaker can be assigned to Clarke's (1970) Late Northern (N3) grouping due to its decorative motifs (Motif Group 3, no. 21 and Motif Group 4, no. 29–30) and shape (Variation IV). Clarke observed that bevelled rims were more common in this group than any other (ibid: vol 1, 176), although the inner and outer bevel of the Knappach Toll vessel is rare. Within Shepherd's scheme for north-east Scotland (Shepherd 1986; following Lanting & Van der Waals 1972), the vessel belongs to Step 4 due to the relatively sharp angle between neck and body and the emphasis placed upon the neck by the use of internal rilling and cordon. In Needham's most recent, national Beaker scheme (Needham 2005), the vessel belongs to the wide-ranging Short-Necked group (ibid: 191–5), due to the presence of a neck depth of less than 35% of the overall height. However, the Knappach Toll vessel may not satisfy this requirement by very much, with its neck depth of *c* 33–34% based on the assumed total height of *c* 190–200mm. In Curtis & Wilkin's (2019) north-east Scottish scheme, it belongs to the Tall Short-Necked group.

Previous radiocarbon dates have suggested an overall currency of *c* 2350–1900 cal BC for Beakers from short-cist burials in north-east Scotland (Curtis et al 2008; Wilkin 2010). A notable number of Beakers with features (decoration, rim form, cordon and profile) similar to Knappach Toll are associated with relatively early dates (ie with ranges extending earlier than *c* 2200 cal BC at 95.4% probability). Indeed, the radiocarbon date obtained from the human remains, of 2330–2040 cal BC (95.4% probability; SUERC-30852; 3775±35 BP), is consistent with this view and spans both sides of the critical interface between the Chalcolithic and Early Bronze Age in our chronologies (cf Needham's (2005) 'fission' horizon at *c* 2200 cal BC and the adoption of both tin-bronze and the more widespread adoption of Beakers after this date). This date is consistent with other Tall Short-Necked vessels from north-east Scotland (Curtis & Wilkin 2019).

7.2 Organic residue analysis of the Beaker

Lucija Šoberl & Richard P Evershed

Lipid residues of cooking and the processing of other organic commodities have been found to survive in archaeological pottery vessels for several thousand years as components of surface and absorbed residues. The components of the lipid extracts of such residues can be identified and quantified through solvent extraction and using a combination of analytical techniques capable of achieving molecular level resolution, such as high-temperature gas chromatography (HTGC), GC/mass spectrometry (GC/MS; Evershed et al 1990) and GC-combustion-isotope ratio MS (GC-C-IRMS; Evershed et al 1994). Characterising lipid extracts to commodity type is only possible through detailed knowledge of diagnostic compounds and their associated degradation products formed during vessel use or burial. For example, triacylglycerols (TAGs) are found in abundance in fresh animal fats; however, they are degraded to diacylglycerols (DAGs), monoacylglycerols (MAGs) and free fatty acids during vessel use and burial, such that in archaeological pottery the free fatty acids tend to predominate. This has been observed in numerous pottery vessels (Evershed et al 2002) and verified through laboratory degradation experiments (eg Charters et al 1997; Dudd & Evershed 1998; Evershed 2008a; Evershed 2008b). An increasing range of commodities is being detected in pottery vessels, including animal products (for example, Evershed et al 1992; Copley et al 2003), leafy vegetables (Evershed et al 1991; Evershed et al 1994), specific plant oils (Copley et al 2005a) and beeswax (Evershed et al 1997b).

Animal fats are by far the most common class of residue identified from archaeological pottery, with compound-specific stable carbon isotope analysis allowing detailed characterisation of their source. GC-C-IRMS allows the carbon stable isotope ($\delta^{13}C$) values of individual compounds to be determined within a mixture. The $\delta^{13}C$ values for the principal fatty acids ($C_{16:0}$ and $C_{18:0}$) can be used to distinguish between different animal fats, such as ruminant and non-ruminant adipose fats and dairy fats (Evershed et al 1997a; Dudd & Evershed 1998), as well as to identify the mixing of commodities (Evershed et al 1999; Copley et al 2001). Research has demonstrated that dairy products were important commodities in prehistoric Britain, as illustrated through the persistence of dairy fats in prehistoric pottery (Copley et al 2003; 2005b). For an overview of the use of compound-specific stable isotopes in archaeology, see Evershed et al (1999) and Evershed (2008b).

7.2.1 Methods

A single sherd, weighing 1.680g, from the body of the Knappach Toll Beaker was received for lipid analysis. Lipid analyses were performed using established protocols which are described in detail elsewhere (Evershed et al 1990; Charters et al 1993). The identification of individual compounds was based upon eluting order, comparison of retention times to standards and comparison of mass spectra with known fragmentation patterns and the NIST spectra library. A detailed description of the methods is included in the archive report.

7.2.2 Results

Table 5 lists the concentration of lipids detected in the Knappach Toll sherd together with the analysed visible residue, and the assignments of the broad commodity group based on the molecular data retrieved.

The Knappach Toll Beaker displayed a very good preservation with high lipid concentration of 276.5μg g^{-1} sherd. The preservation of lipids in pottery is heavily influenced by degradative alterations that may occur during vessel use or due to post-burial conditions in the soil (Evershed et al 1999).

Illus 14 shows a partial gas chromatogram for the total lipid extract (TLE) of the absorbed residue, indicating the compounds detected, namely free

Table 5 Summary of the results of the organic residue analyses (FA refers to free fatty acids; MAG to monoacylglycerols; DAG to diacylglycerols; TAG to triacylglycerols)

Bristol sherd number	Lipid concentration ($\mu g\ g^{-1}$)	Lipids detected	$\delta^{13}C_{16:0} \pm 0.3$ (‰)	$\delta^{13}C_{18:0} \pm 0.3$ (‰)	Predominant commodity type
SCO 32	276.52	FA, MAGs, DAGs, TAGs	-27.75	-34.25	ruminant adipose/ ruminant dairy

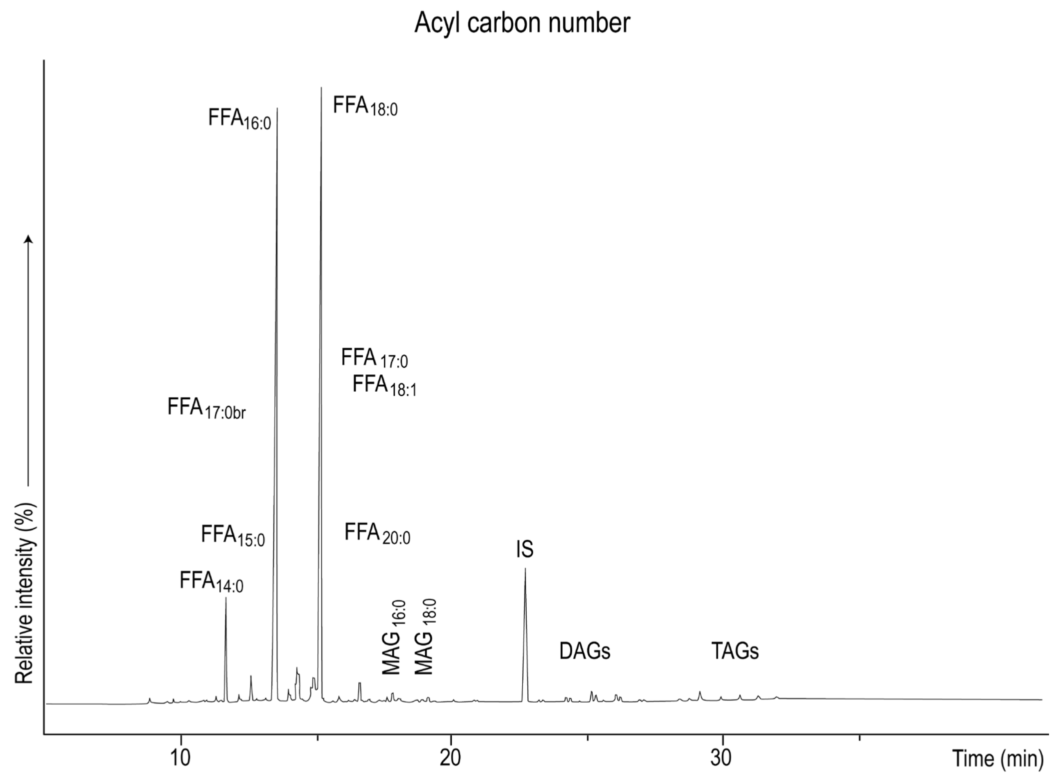
fatty acids, with high abundances of saturated $C_{16:0}$ and $C_{18:0}$ components. The presence of mono-, di- and triacylglycerols indicates a relatively good level of preservation, most likely due to the favourable post-burial conditions in the soil.

The Knappach Toll Beaker extract yielded an appreciable amount of lipids and was further submitted for stable carbon isotope ratio measurements. $\delta^{13}C$ values obtained for the $C_{16:0}$ and $C_{18:0}$ components are plotted in Illus 15. The values of modern reference fats are represented by confidence ellipses (1 standard deviation). All $\delta^{13}C$ values obtained for modern reference animal fats have been adjusted by the addition of 1.2‰ for the post-Industrial Revolution effects of fossil fuel burning (known as the Suess Effect; Tans et al 1979). Lines connecting the ellipses represent theoretical $\delta^{13}C$ values obtained through the mixing of these fats. The $C_{16:0}$ and $C_{18:0}$ $\delta^{13}C$ values of the Knappach Toll Beaker extract plot adjacent to the ruminant dairy fat reference confidence ellipse, thus indicating the likely lipid origin.

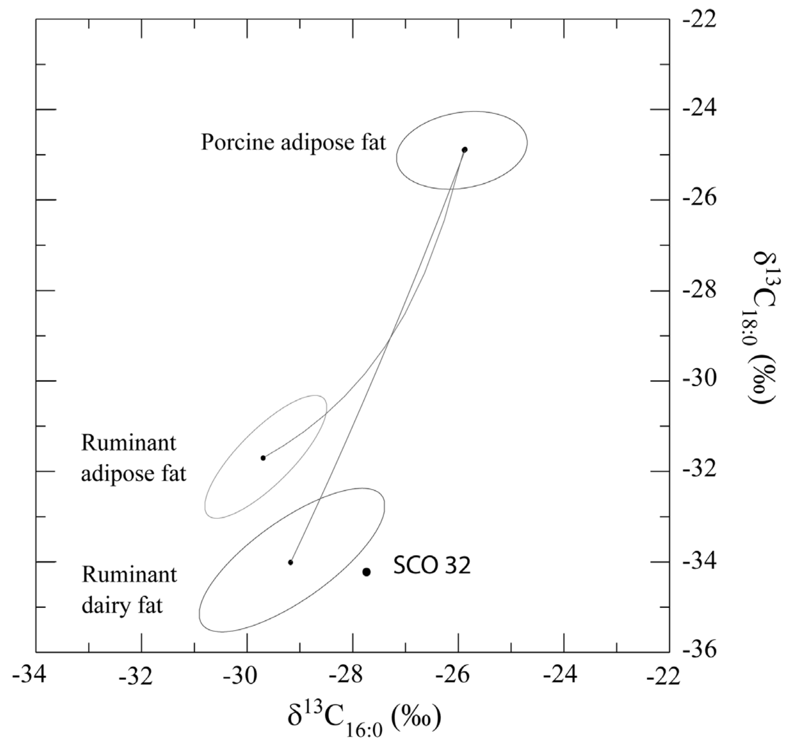
The animals that supplied the modern fats used to construct the reference isotope plot were reared on strict C_3 diets of forages/fodders and cereals. The slight displacement of $\delta^{13}C$ isotopic values for the Knappach Toll Beaker outside the ruminant dairy confidence ellipse may be due to the fact that the animals in prehistory were reared on diets which varied in $\delta^{13}C$ values compared to today's values. The $\delta^{13}C$ value, where the $\delta^{13}C$ values of most abundant fatty acids are subtracted from one another ($\delta^{13}C_{16:0} - \delta^{13}C_{18:0}$), reflect only the differences in metabolisms of animals, and are therefore a useful indicator of lipid origin when such variations in isotope values occur. Illus 16 displays the $\delta^{13}C$ value plotted against $\delta^{13}C_{16:0}$ value for the Knappach Toll Beaker. The ranges on the left side of the plot belong to the modern reference fats. $\delta^{13}C$ values obtained for the analysed Beaker extract confirm the presence of ruminant dairy lipids.

7.2.3 Conclusions

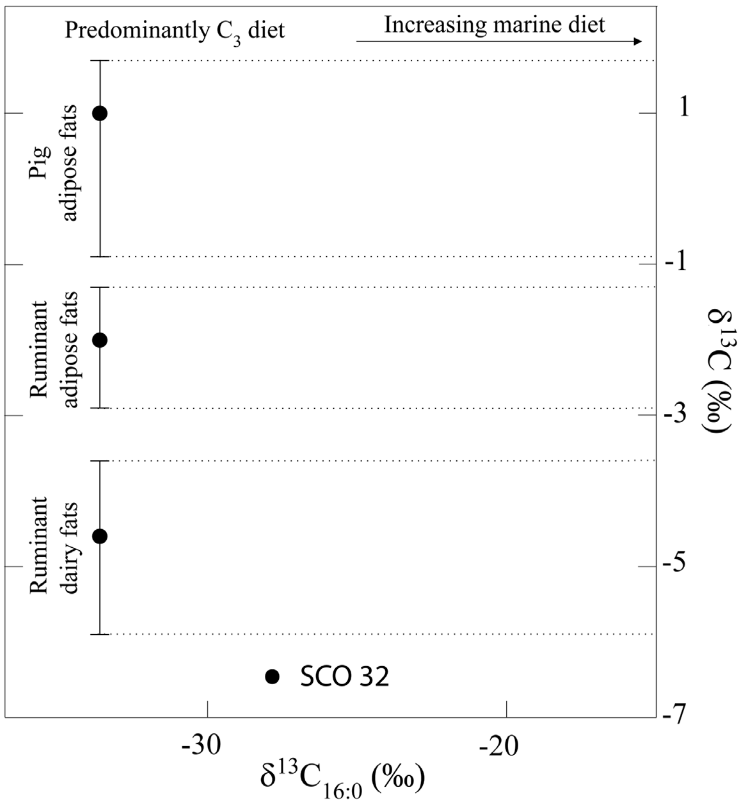
Lipid residue analysis of the Beaker revealed the excellent preservation of lipids absorbed within the vessel walls. Gas chromatograms of the lipid extract show the presence of compounds, indicative of partially degraded animal fat with free fatty acids



Illus 14 Partial HTGC profile of the trimethylsilylated total lipid extract from the Beaker illustrating the distribution of compounds characteristic of degraded animal fat. © Northlight Heritage



Illus 15 Scatter plot showing the $\delta^{13}C$ values of $C_{16:0}$ and $C_{18:0}$ fatty acids prepared from the total lipid extract of the Knappach Toll Beaker. © Northlight Heritage



Illus 16 Plot showing the difference between $\delta^{13}C$ values ($\delta^{13}C_{18:0}$ - $\delta^{13}C_{16:0}$) and $\delta^{13}C$ values obtained from the $C_{16:0}$ fatty acids extracted from the Beaker potsherd. The ranges for the modern reference fats are plotted to the left of the diagram with indicated standard deviation. © Northlight Heritage

(palmitic and stearic acid predominantly), and mono-, di- and triglycerides. The sherd extract also displayed the presence of odd-carbon-number fatty acids with their branched homologues indicating the presence of ruminant animal fat, which was also confirmed by the preserved TAG distributions.

The measurement of $\delta^{13}C$ values of most abundant free fatty acids provided an additional confirmation that the lipids preserved in the walls of the Beaker can be assigned to a ruminant dairy source. These results, together with the absence of mid-chain ketones, which are formed during exposure to high temperatures, suggest that the vessel was used for the consumption of dairy products. Despite frequently referenced ethnographic reports of milk being used as a sealant for porous ceramic matrix (Rice 1987; Palmer 2002), modern degradation experiments have shown that such lipid concentrations, commonly found preserved in archaeological pottery, can only be the result of long-term vessel use to hold commodities with high dairy fat concentrations (Copley et al 2005b). A study from 2011 (Šoberl 2011) inferred that while most British Beaker vessels analysed were not used as cooking pots, the predominant presence of dairy fats and lipids originating from plants would suggest a specialised function. In conclusion, while historically Beakers have been associated with ritual feasting and the consumption of alcoholic beverages (Sherratt 1987; Guerra-Doce 2006; Rojo-Guerra et al 2006), organic residue analysis can provide further insight into the nature and type of these drinks.