An imported flanged rimsherd discovered on the early medieval site of Kilree 3, Ireland: a study in archaeological deposition and provenance using automated SEM-EDS analysis (QEMSCAN)

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Introduction

The following investigations were prompted by the discovery of a flanged rim sherd at the site of an Early Medieval double enclosure at Kilree 3, near Kilkenny town in the southeast of Ireland, in 2008 (Figures 1 and 2). The sherd was originally classified as African Red Slip Ware (henceforth ARSW) Form 91C based on its

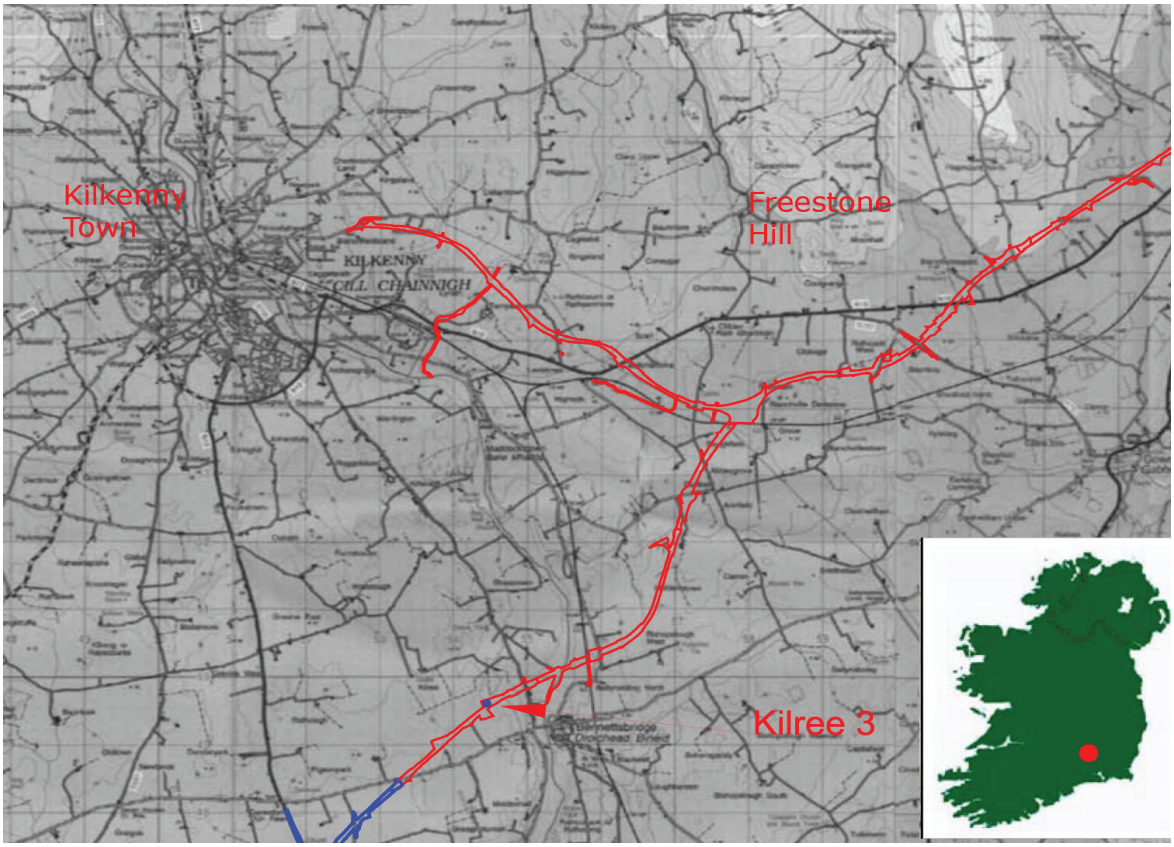

Figure 1. Location of Kilree 3 on the N9/N10 Kilcullen to Waterford Road Scheme (courtesy of IAC Ltd)

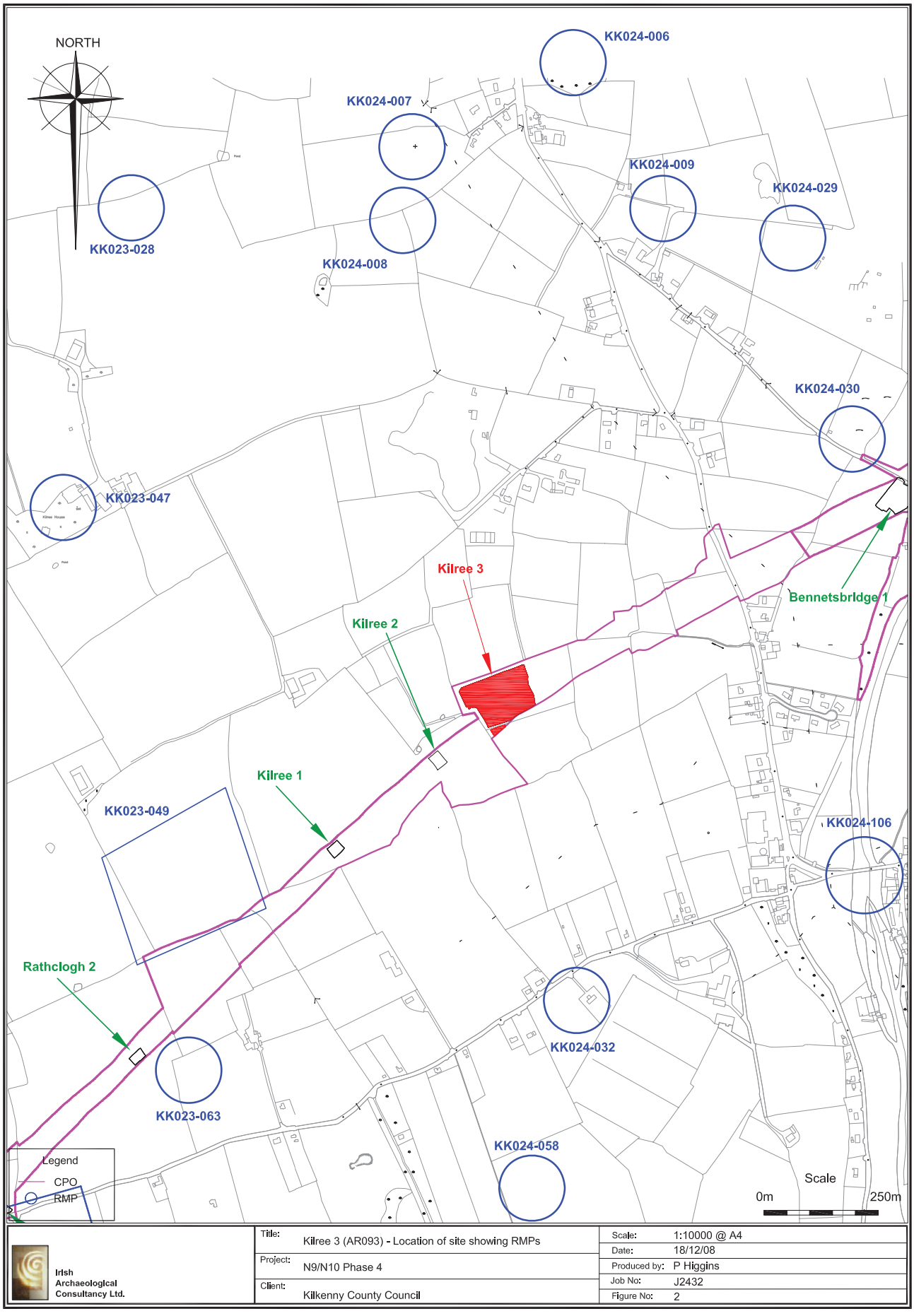

Figure 2. Kilree 3 RMP sites (courtesy of IAC Ltd)

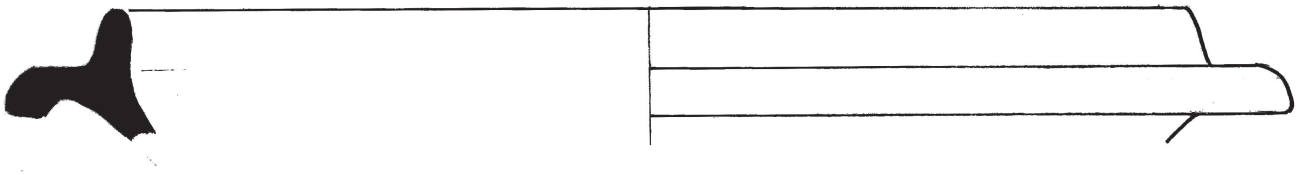

Figure 3. Kilree 3 sherd (E3643:587:5) profile (drawn by Amanda Kelly)

distinctive profile (Doyle 2009: 19; Kelly 2010: 63). ARSW Form 91C, the classic African flanged bowl (Figure 3), was produced in northern Tunisia in the 6th century AD, where it constituted a late form in the lengthy production series of ARSW. The sherd's evaluation here is considered within the context of a growing corpus of contemporary Mediterranean ceramic imports found on sites in Ireland.

If we are to accept the ARSW classification, the distance between the bowl's source of production and its final depositional context (in which it stands out as a rare import), while not unprecedented, is nonetheless extensive. A detailed examination of the sherd's fabric (including Polarised Light Microscopy, Laser Raman Spectroscopy and automated SEM-EDS using QEMSCAN technologies) was conducted to test the bowl's place of origin. These investigations sought to identify the component minerals, to quantify their proportions and to highlight textures through compositional mapping. The results of the mineralogical studies are presented here with a view to contributing to the emerging narrative instigated by the discovery of the sherd and to allow for further comparative studies within the growing corpus of such fabric analyses.

1. An imported flanged rimsherd discovered in an Irish context

The Kilree 3 rim sherd (E3643:587:5) measures *c.* 16cm in diameter, while the exterior flange, extending horizontally 0.09cm below the rim, has a hooked edge with a diameter of 19cm (Figure 3). The sherd is unique on the island of Ireland, in that its profile is distinct from the imported Phocaean Red Slip Wares (henceforward PRSW) forms which otherwise dominate distributions of late Mediterranean red slip fine wares found in Ireland (Figure 4).

The Kilree 3 rim's distinctive profile demonstrates a marked similarity with published profiles of Hayes' ARSW Form 91C, as exemplified by rim sherds found in the Athenian Agora (Figure 5A). Hayes qualifies Form 91 as the classic form of the ARSW flanged bowl (Hayes 1972: 140-144; Lamboglia 1963: 190-191). He describes the form as a hemispherical bowl, with a plain or slightly rolled rim, featuring a broad flange, which is often hooked along its edge, extending below the rim on the exterior of the vessel (Hayes 1972: 140; 2008: 70).

If an ARSW classification for the Kilree 3 sherd were to be confirmed through the fabric analyses, then the sherd would constitute the only securely-identified fragment of ARSW discovered in an Irish context. The ware was not reported in Irish contexts by either Thomas (1981: 8-9) or Campbell (2007: 18), although it is attested in Britain.[1] The classification would contest the reported absence of ARSW in the Irish ceramic record put forward by Edwards (2005: 290).[2]

2. A surprising find in an Irish context

The flanged rim sherd in question (E3643:587:5) was discovered at the Early Medieval double enclosure site of Kilree 3 (Figure 6).[3] The enclosure contained a timber-lined souterrain (Souterrain A), an earth-cut passageway (i.e. Souterrain B), kilns, evidence for metalworking, five human burials and canine remains (Seaver 2011: 122) (Figure 7).

Souterrain B, in which the sherd was found, was located in the southwestern quadrant of Ditch 1: the outer ring ditch measuring c. 85m in diameter (Figure 7). The ceramic rim sherd (Figure 3; Figure 8), two rim fragments of a decorated copper vessel E3643:587:2-3 (Figures 9A and B) and two iron knife fragments (E3643:587:1; E3643:587:4) were recovered from the same charcoal-rich deposit, i.e. C587, at the base of the drop-hole leading into the passageway (Coughlan *et al.* 2014: 18-9).

The uppermost fill of the drop-hole contained a metal ring-pin (Figure 9C), while another ring-pin and animal bone were recovered from another charcoal-rich deposit at the base of the passage (Figure 9D). A decorated

[1] In Britain, late forms of ARSW were reported by Ralegh Radford as early as 1956 (1956: 59–70). By the early 1980s, Thomas reported late ARSW forms at Gwithian, Tintagel, Lydford, Cadcong, South Cadbury, Iona, with a possible example at Goodrich and a stamped example at Cadcong (Thomas 1981: 8-9; 1988) and Dinas Emrys. By the mid-1990s, Reynolds added ARSW Form 91C to Forms 99, 103 and 104A as forms that reached Britain via the Atlantic, rather than through Gaul, from the late 5th and 6th centuries AD (1995: 29). In 2007, Campbell cited ten findspots in Britain where late ARSW was found, adding Dinas Powys and Whithorn to Thomas' list (2007: 18 - Campbell cites Fulford's forms, rather than Hayes' which is fitting for their British context). Fulford and Rippon added three late ARSW forms found at Pevensey Castle in Sussex (this collection included Hayes' Form 75 in phase 3, Form 91 in phase 5, Form 99C in phase 14) (2011: 43, 49, 145).

[2] Curiously, Thomas marked ARSW at Garranes in his distribution map of A wares, but did not expand on this inclusion in his accompanying text—Thomas 1976: fig. 1).

[3] The site was directed by Patricia Lynch on behalf of Irish Archaeological Consultancy Ltd, as part of the National Roads Authority N9/N10 Rathclogh to Powerstown Scheme.

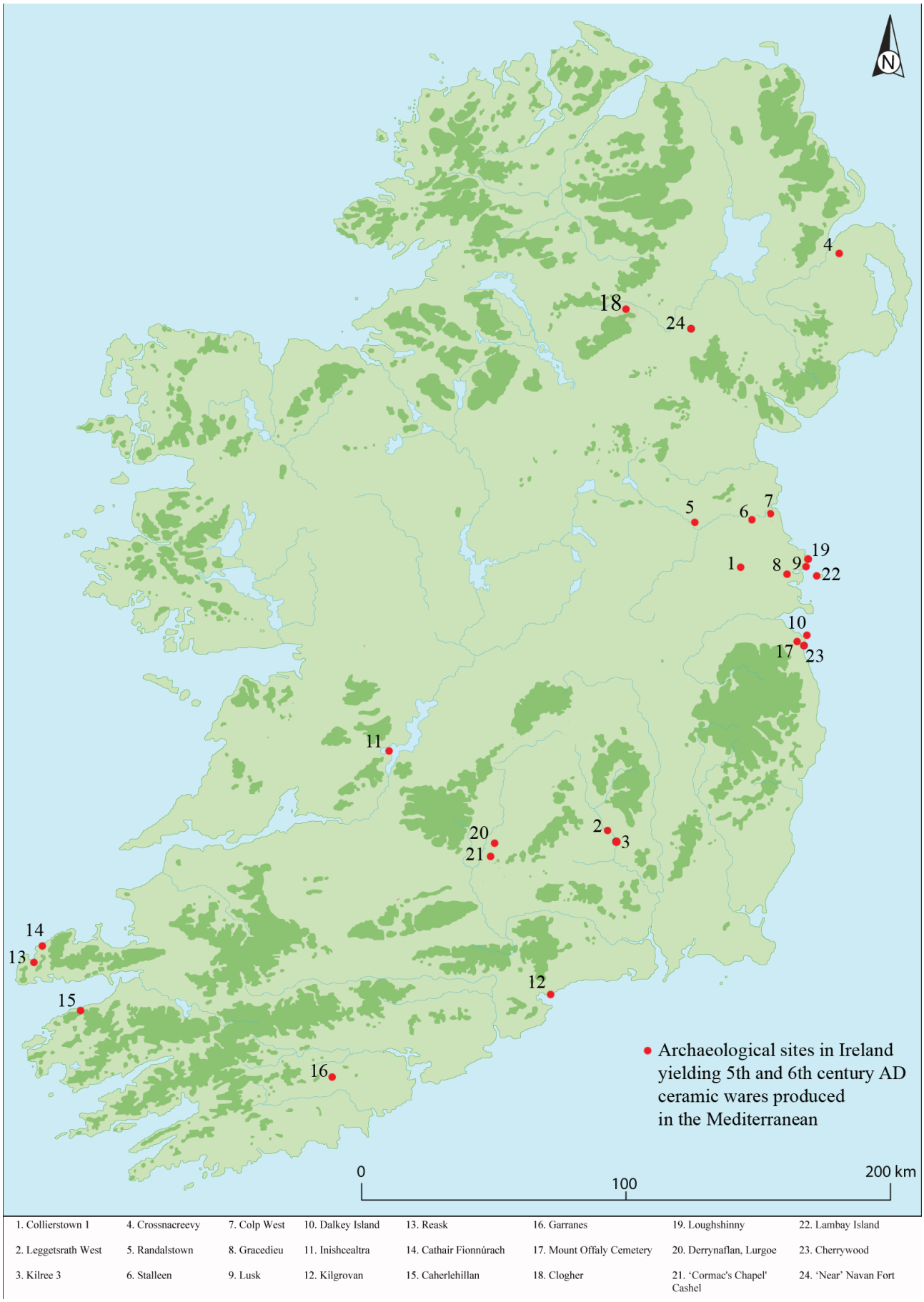

Figure 4. Late Mediterranean ceramic distributions in Ireland (distribution drawn by Amanda Kelly)

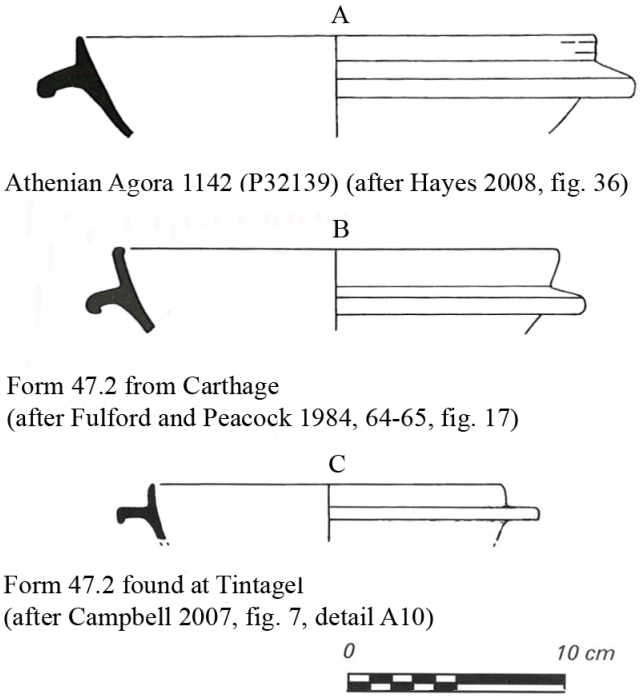

Figure 5. (A) Athenian Agora Form 91C (after Hayes 2008: 79-80, 231, fig. 36, no. 1142), (B) Form 47.2 from Carthage (after Fulford and Peacock 1984: 64, fig. 17), (C) Form 47.2 found at Tintagel (after Campbell 2007: fig. 7, detail A10)

Figure 6. Plan of Kilree 3 (after Coughlan et al. 2014, courtesy of IAC Ltd)

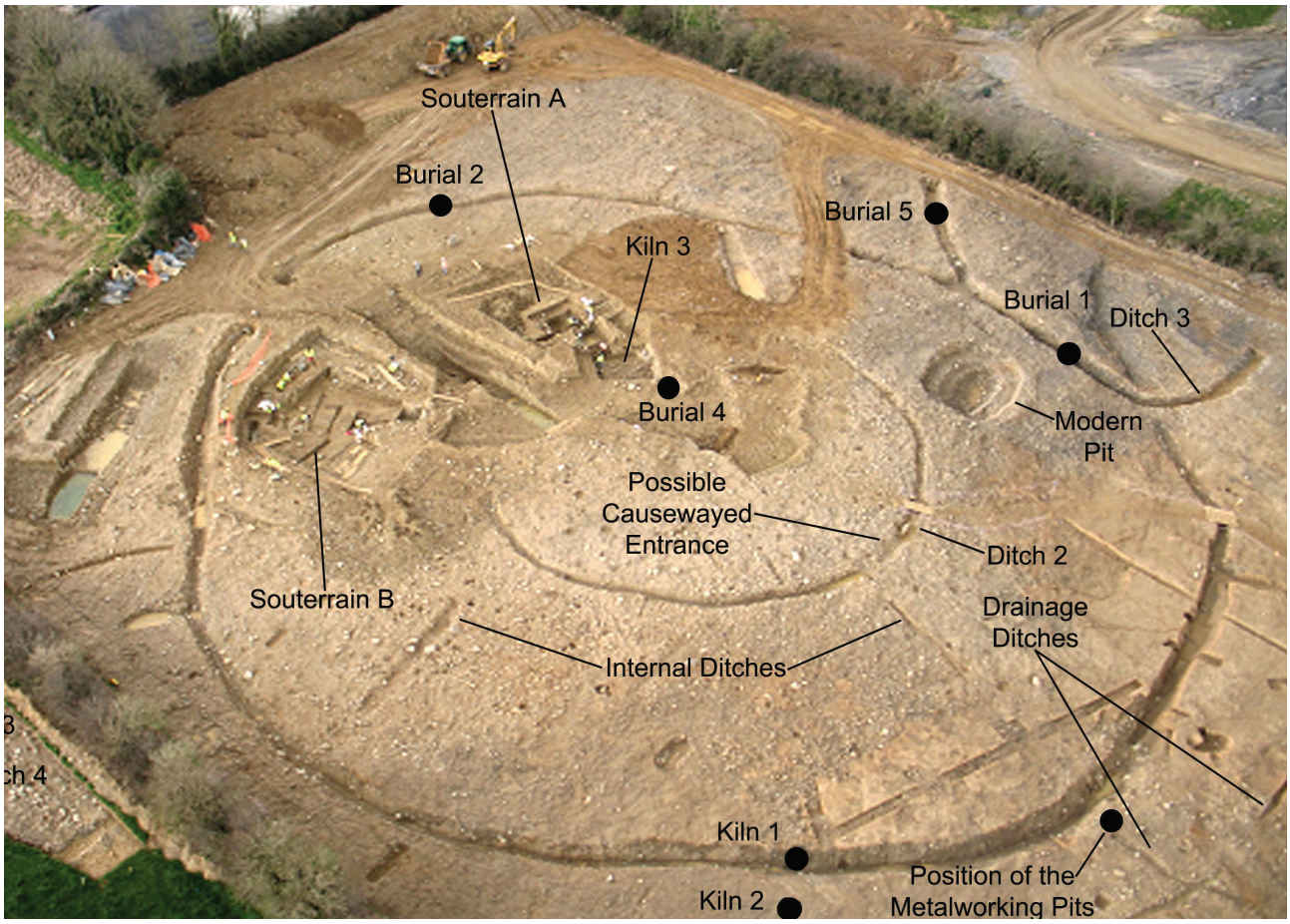

Figure 7. Aerial photograph of site (Courtesy of IAC Ltd, AR093 Excavation Bulletin)

copper-alloy pseudo-penannular brooch (Figure 9E), dating to the 8th or 9th century AD, was recovered from the chamber itself (Coughlan *et al.* 2014: 20-21).

The date range for the deposition of small finds within Souterrain B represents a *terminus ante quem* for the use of this feature. Radiocarbon dates of cal. AD 691–881 (provided by the central burial, Burial 4) and cal. AD 659–772 (returned for the floor surface of the second souterrain: Souterrain A), together with dates generally attributed to pseudo-penannular brooches (Coughlan 2011: 45-46; Tobin 2011: 41), push the date range for the assemblage later than that offered by any red slip fine ware sequence.

It might be argued, however, that such late dates might, at least, support the classification of the Kilree 3 sherd as a late product of a red slip series which would complement its identification as ARSW Form 91C. This classification would present a suite of artefacts covering a chronological range from the 6th–9th centuries AD, corresponding with timescales of activity attested at other high status sites in Ireland, such as Moynagh Lough and Lagore crannógs (Gleeson 2012: 4-8).

Figure 8. Kilree 3 rimsherd (E3643:587:5)

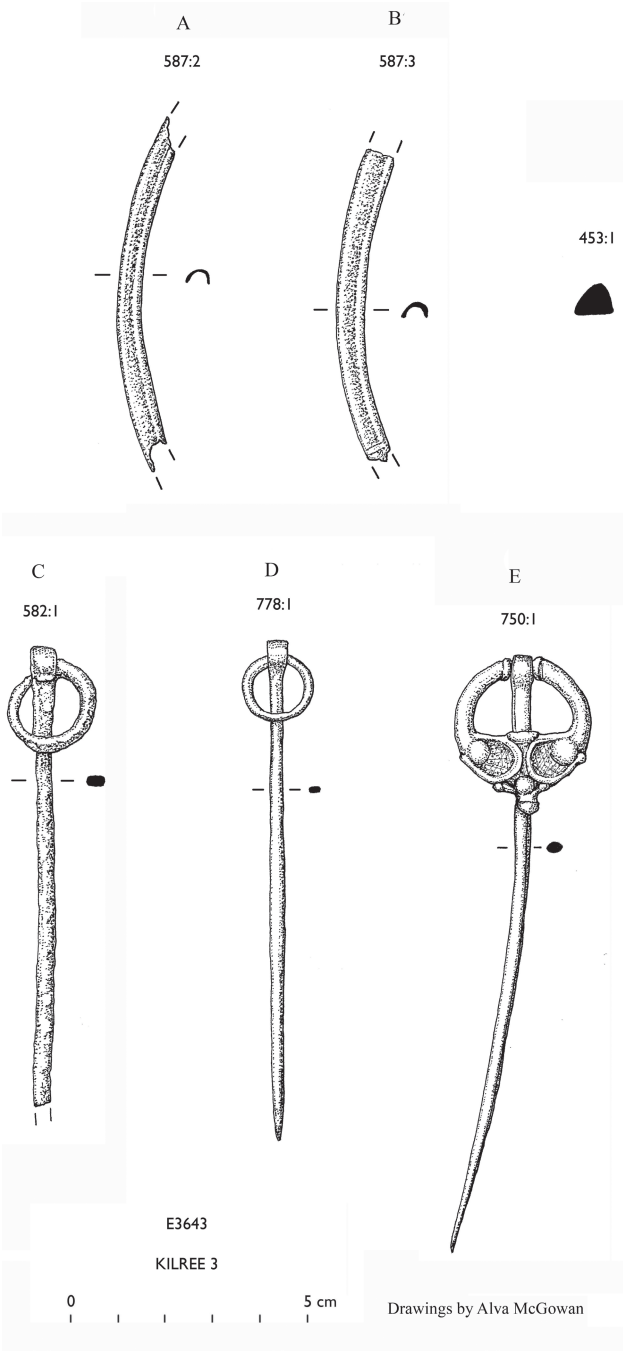

Figure 9. Kilree 3 small metal finds (drawn by Alva McGowan, courtesy of IAC Ltd)

Yet, the anomaly remains that the date range provided by the radiocarbon evidence, namely the 7th and 8th centuries AD, points to a period in Ireland where the only securely-identifiable locally-produced ware in Ireland is Souterrain Ware; a hand-built coarse ware wholly distinct from wheel-made importations on both aesthetic and technological levels (see Edwards 2004: 73–75). Prior to the production of Souterrain Ware in Ireland, which loosely coincides with the importation of E wares from the Continent, the island remained largely devoid of ceramic table wares for the duration of red slip production in the Mediterranean. The unexpected discovery of pottery, dating to the 4th century AD, at nearby Freestone Hill (on a rise 8km northwest of Kilree: see Figure 1) by the late Professor Barry Raftery is remarkable, given that up to that point '*securely dated Iron Age pottery [had] been entirely absent from Ireland*' (1969: 91). The pottery from Freestone Hill has recently been identified as Severn Valley ware and Nene Valley colour-coated ware pointing to contacts in this direction (Ó Drisceoil 2013, 10).

3. An elite network

Kingsley states that '*conventional pottery studies are still our best source in determining which strata of society consumed imported produce and what volume of material was involved in that trade*' (2003: 129). Any confirmation of the identity of the flanged rim sherd discovered at Kilree 3 as a Mediterranean import would feed into a growing narrative relating to wider connectivity and trade with Ireland at this time. The Kilree 3 sherd, if viewed in isolation, has limited impact, but if measured against a backdrop of trade, represented by distributions of PRSW and B-ware (LR1 and LR2) in Britain and Ireland, the sherd contributes to a more integrated model for Ireland's engagement beyond her shoreline (see Kelly 2010). From a brief look at the combined distributions of 5th and 6th century AD Mediterranean ceramic imports discovered on sites in Ireland, it becomes clear that long-distance exchange was associated with high-status settlement sites, often interpreted as royal sites in the Irish literature (Figure 4 from article).

The high caliber of metal finds from Kilree 3, and the presence of ceramic imports, both at Kilree 3 and at nearby Leggetsrath West in Kilkenny town (where Bii/LR1 sherds have been reported, see below), complements interpretations of high status Early Medieval sites as gateway sites, which regulated the filtering of prestige goods and foreign imports throughout their satellite communities (Comber 2001: 87).

The Mediterranean imported ceramics discovered in Ireland feature as exotic and specialised wares during a period when pottery was neither produced, or widely used, on the island. These wares constituted high-status commodities within a hierarchy of trade discernable through the material record. The redistributive role administered by high-status foci consolidated their prominence within a radially-decreasing ranked network operating throughout their broader hinterlands (Kelly 2010: 52).

Such redistributive roles are demonstrable at the elaborate trivallate enclosure of Garranes (16), in Cork, where a range of Mediterranean wares were found while the site itself lies within a landscape densely clustered with smaller ring-forts. Ó Ríordáin's site interpretation presented Garranes as a high-status centre constituting a hub of commercial exchange serving sites throughout its hinterland (1942: 140-144). Similarly, in the case of in the wider landscape of the royal site of Clogher (18), in Ulster, a 2km long linear feature connects the focal site with a series of ring-forts (Warner 1988: 62).

The site of Collierstown 1 (1) which also yielded PRSW, lies within the hinterland of the royal site of Tara. It sits in close proximity to a variety of Early Medieval sites and monuments, being less than 2km from enclosed settlements at Skreen (ME 032:032), Cabragh (ME 032:054), Collierstown (ME 038:003), Ross (ME 038:001) and Baronstown (A008/017) (Kelly 2010: 52-53). Collierstown 1's proximity to the royal site of Tara (to which it is connected by the Gabhra and Skane rivers) cannot be overemphasised and its physical connectivity to this focal point marks the site as an expected addition to the PRSW distribution if we attribute gateway dynamics to the site of Tara (Kelly 2010: 52).

At Kilree 3, the suite of metal finds associated with the depositional context of the imported sherd reflects the prestigious standing of the occupants of the site (at least on a relative scale in an Early Medieval Irish context). Other high status centres in the site's broader hinterland include the seat of Early Medieval Kilkenny (represented by the monastery of *Domhnach Mór*; Ó Drisceoil *et al.* 2008: 79-83, fig. 43) and the nearby ecclesiastical enclosure, KK024-020 (Coughlan *et al.* 2014, 52-53; see Gleeson 2012: 26-29 on the Christianisation of inauguration).[4] Kilree 3 lies within a cluster of RMP sites (Record of Monuments and Places) including KK024-030, KK024-106, KK024-032, KK023-047, KK023-049, KK024-058 and KK023-063 in the immediate vicinity (Figure 2). Cartographic studies, field inspections and geophysical survey (undertaken by IAC Ltd) have resulted in 35 sites being recorded in the wider Early Medieval landscape, including twenty enclosure sites, four ring-forts, four church sites and three burial sites (Coughlan *et al.* 2014: 51-54).

Kilree 3 lies 6km south from the bivallate ring-fort of Leggetsrath West in Kilkenny town which yielded two sherds of Bii/LR1 from a single amphora (identified by Doyle, as cited in Lennon 2004). The presence of imported wares at both Kilree 3 and nearby Leggetsrath West serves to highlight the role of navigable rivers in inland networks in Ireland as both sites are land-locked but would have been accessible via the River Nore which empties into Waterford Harbour. The river connects the sites, both with each other, and with the maritime networks operating along the west, southwest and east coasts of Ireland. That this trading corridor connected communities in central Kilkenny and the Roman world since the first half of the first millennium AD has been illustrated by Ó Drisceoil's distribution map of Roman and Romanised finds along the course of the river (2013, 15, fig. 4)

Long distance navigational trading routes reaching the south coast of Ireland would have been facilitated by harbourages at either Cove or Kinsale (as attested by the range of late Mediterranean wares found at Garranes), Dungarvan (with Kilgrovan yielding a Bii/LR1 sherd) and Waterford (as attested by finds at Kilree 3 and Leggetsrath West). From the south coast, vessels could tack the coast northwards into the Irish Sea to reach Dublin Bay, Malahide and Rogerstown estuaries (a stretch of the eastern coastline which is relatively crowded with Late Mediterranean ceramic findspots). The northern extent of this spread (excluding the notable outlier at Crossnacreevy (Figure 4, no. 4)) is marked by Drogheda bay with a findspot at Colp West (Figure 4, no. 7), from where boats accessed the Boyne river and its associated sites (Figure 4, nos. 5, 6 and 7).

4. Late Mediterranean fine wares beyond the circle of the strait

That Mediterranean trade was rounding the Strait of Gibraltar and skirting the Atlantic coast of Iberia in the 5th and 6th centuries AD is confirmed by a string of findspots of Mediterranean wares, most notably at Baelo, Lagos (Ramos *et al.* 2007: 85-98), Tróia (Magalhães 2012), Conimbriga (Alarçao *et al.* 1976; Carr 2002: 55; Reynolds 1995: 24), Braga (Quaresma and Morais 2012), Vigo and Gijón in the Bay of Biscay (Reynolds 2010: 101-105; Viegas 2007: 71-83, fig. 1). Reynolds' 2010 proposal of higher densities at Vigo (2010: 105) was based on the now published work of Adolfo Fernández (Fernández Fernández 2014).

Fernández has established Vigo as the main port destination for Eastern produce, acting as a regional redistribution centre in facilitating trade with nearby Braga (Bracara Augusta) and Lugo (Lucus Augusti) (Fernández Fernández 2010: 375–384; Quaresma and Morais 2012: 380).[5] Moreover, in light of the sheer density and variety of ceramics recorded at Vigo, Fernández convincingly argues that the site formed the hub of an extended network (acting as the main redistribution centre for a northern extension of the Mediterranean market), servicing ports as far north as Britain (Fernández Fernández 2014; also see Reynolds 2010: 101-105);[6] to which we can now add the harbourages of Ireland.

This market connectivity between Galicia and the northwestern islands is complemented by the

[4] Kilree 3 should not be confused with the monastic site of Kilree just south of Kells in Ossory.

[5] Quaresma and Morais have revealed significant Mediterranean trading at Braga (Roman Bracara Augusta), including numbers of ARSW Forms 91A and B (2012: 382; Reynolds 2010: 105, Table 19).

[6] The exact nature of Bordeaux's role (represented by the sites of Saint Christoly, Saint-Seurin and Place Camille-Jullian) in this extended network is still evolving (Duggan outlines the various models presented: 2016). The Bay of Biscay is, however, a notoriously dangerous coast to sail and any fall-off in imported late Mediterranean wares along this stretch of coastline may also be explained in navigational terms. The distributions, at least as presently mapped, point to a more direct route northwards from Vigo tracking deeper waters, although this model is not an exclusive framework for connectivity and direct routes between Vigo and Bordeaux are likely. Following Fernández, Reynolds champions Vigo as the site where ships broke their journey *en route* for Britain and his model for exchange allows for organised shipments between north-western Hispania and south-western Britain (2010: 105).

manuscripttraditions of both regions.[7] Orosius wrote in his *Historiae adversum Paganos*, c. AD 415-417, that a lighthouse in the Galician city of Brigantia looked out towards Britain (*Adv. Pag*., I, 2, 71; cited in Merrills 2005: 136 and 317; Almeida 2005: 14) and proceeded to claim that Spain was visible from the mouth of the River Scena (thought to be the Shannon) in the west of Ireland (Orosius *Adv. Pag*. I. 2.80–81). This theme of connectivity was appropriated in the later Irish tradition where the tower motif appears in the *Lebor Gabála Érenn* (Book of Leinster and Book of Fermoy) - a pseudo-historical narrative based on poems compiled in the 10th and 11th century AD (Ní Lionáin 2012: 33-34; LGÉ VIII.379).[8]

5. Fabric analysis and identification

regardless of its precise place of manufacture, this red finely-grained imported wheel-made bowl must have been an impressive possession on an island which had been largely devoid of ceramic table wares for over a millennium. Throughout Ireland's Iron Age and up until E wares were first imported in the 7th century AD (loosely coinciding with the production of souterrain ware on the island in the 7th or 8th centuries AD), ceramic vessels did not feature widely in the archaeological record leading to the widespread use of the term 'aceramic' in the associated modern literature (see Armit 2008). In light of the Kilree 3 sherd's unexpected depositional context, questions remained regarding its possible source of manufacture, mode of acquisition and possible date and it was decided to subject the sherd to in-depth fabric analysis. A mineralogical study of the sherd based on Polarised Light Microscopy, Laser Raman Spectroscopy and automated SEM-EDS using QEMSCAN technology was conducted to identify the component minerals, to quantify their proportions and to highlight textures through compositional mapping.

6. Sherd testing

6.1 Methodology

A polished thin section of the sherd was subjected to transmitted polarised light microscopy (a Leica Petrological Microscope) and Laser Raman Spectroscopy (LRS) at the National University of Ireland, Galway, to record its textural and mineralogical characteristics (Figures 10a, 10b and 11). The LRS analysis used a Horiba LabRam II spectrometer equipped with a 600 groove.mm^{1} diffraction grating, confocal optics, a Peltier-cooled CCD detector (255 by 1024 pixel array at -67°C) and an Olympus BX41 microscope arranged in 180° backscatter geometry. Sample excitation was performed using a Ventus diode-pumped, continuous wavelength, 532 nm laser with a maximum power output of 50 mW. Raman analysis was carried out using a 100x objective lens resulting in a laser spot size of ~ 2 µm. Excitation power at the sample typically ranged between 10 and 20 mW.

The polished thin section was then prepared for QEMSCAN analysis at the Camborne School of Mines, University of Exeter, UK (see Figure 12). QEMSCAN (Quantitative Evaluation of Minerals by Scanning electron microscopy) is a type of automated mineral analysis and a registered trademark of FEI Company which supplies the technology. QEMSCAN as an automated system was originally developed to provide quantitative mineralogical data for the mining sector (Goodall *et al.* 2005) but is now used to study a range of materials (rocks, minerals and ceramics) in diverse geological, archaeological and environmental settings (e.g. Knappett *et al*. 2010). This innovative system uses automated Scanning Electron Microscopy linked to Energy Dispersive Spectrometers (SEM-EDS) to map the mineralogy of rocks and ceramics, which in this case is a QEMSCAN® 4300 system. This system utilises a Zeiss EVO 50 SEM consisting of four light element Bruker SDD (Silicon Drift Droplet) Energy Dispersive X-ray Spectrometers, and uses a combination of backscattered electrons and X-rays to examine the sample under a high vacuum (see Gotlieb *et al.* 2000; Pirrie *et al.* 2004 and Pirrie and Rollinson 2011 for further information). At each analysis point the resultant chemical X-ray spectrum is compared with a database (Specie Identification Protocol or SIP) and assigned to the most appropriate mineral or chemical grouping. Collected data are then processed using iDiscover software, which is sample dependent and involves checking the mineral assignments are correct, database development and producing a simplified mineral/phase list. This step is critical, as this is when the data is examined and processed into a meaningful data-set for the context of the sample, in this case, for a ceramic sample. Once complete, data outputs include modal mineralogy and false colour mineral maps. There are, however, limitations regarding mineral identification, due to EDS X-ray overlaps, similar chemical compositions, mixed spectra (especially from fine grained material when the particle size is close to the beam diameter) and the 1000 X-ray counts that the QEMSCAN® operates (see Rollinson *et al*. 2011; Andersen *et al.* 2009). The sherd for this study was analysed using the Fieldscan measurement mode at a 10 micron X-ray pixel spacing (resolution) and in addition, for a smaller selective area (2 mm^{2}) a 1 micron X-ray pixel spacing, providing excellent modal mineralogy and textural detail.

6.2 Results

Transmitted polarised light petrography

Transmitted polarised light microscopy of the sherd shows that its grain size is heterogeneous, commonly ranging from ~50 to <10 microns. Angular to rounded monocrystalline grains of quartz and feldspar together with lath shaped grains of mica are set in a fine grained

[7] I am grateful to José Carlos Sánchez Pardo for drawing my attention to the passages in the *Historiae adversum Paganos*.
[8] The motif also reappears in the later *Book of Ballymote* and the *Annals of the Four Masters.*

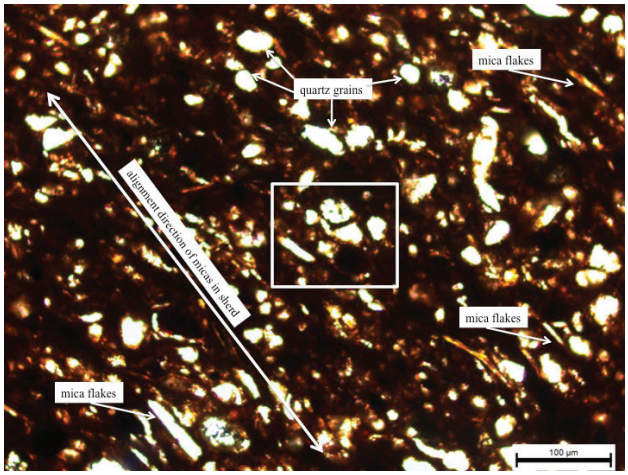

Figure 10a. Photomicrograph of sherd in plane polarised light showing the distribution of grains of quartz and feldspars and the NW alignment of lath-shaped micas defining a NW-SE trending fabric

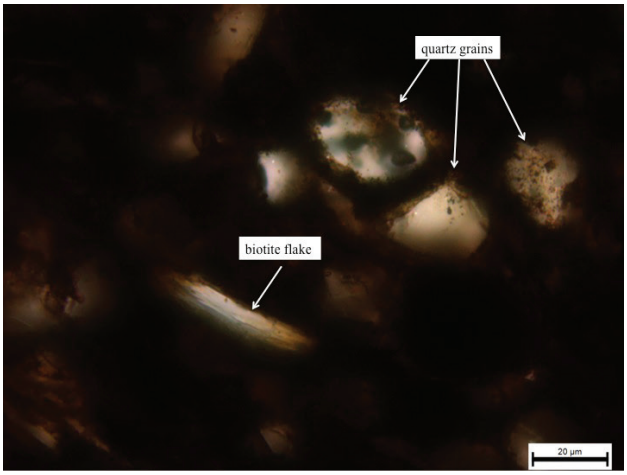

Figure 10b. Photomicrograph in transmitted plane polarised light of the area outlined in Figure 10a above. Despite the optically dense nature of the slip, a number of quartz grains are visible and are rimmed by iron oxide. Note the biotite flake with its long axis orientated NE-SW.

reddish brown iron oxide matrix (Figure 10a and b). The mineral grains are locally aligned parallel to the curvilinear edge of the sherd sample. This alignment is accentuated by the mica flakes similar to a schistosity fabric in a metamorphic schist (Figure 10a). The matrix is iron stained and many mineral grains are coated with iron oxide. In crossed polarised light the matrix is isotropic, however, the micas, quartz and feldspar grains are clearly visible and display a range of first and second order interference colours.

6.3 LRS Results

The LRS analysis of the sherd confirmed the presence of quartz and feldspar and rare anatase. The matrix is composed of iron oxide which coats the quartz grains and gives the sherd its red colouration (Figure 11).

6.4 QEMSCAN results

The sherd's mineralogy and mineral modes were determined using QEMSCAN analyses and are shown in Figure 12 and Figure 13. The false colour image in Figure 12 shows the grain-size variation and the predominance of quartz, feldspar and mica mineral grains in line with the petrographic observations above. The sample is dominated by angular to rounded monocrystalline grains of quartz (~24%), plagioclase feldspar (~17%), potassium feldspar (~11%) and micas (biotite ~22% and muscovite ~2%) see Figure 13. Other minerals detected include the clay minerals chlorite and possibly kaolinite. Trace amounts of rutile/anatase, titanite, ilmenite, zircon, apatite and calcite have also been detected (Figure 13).

6.5 Petrographic discussion

The results of petrographic analyses using transmitted polarised light microscopy and QEMSCAN analysis

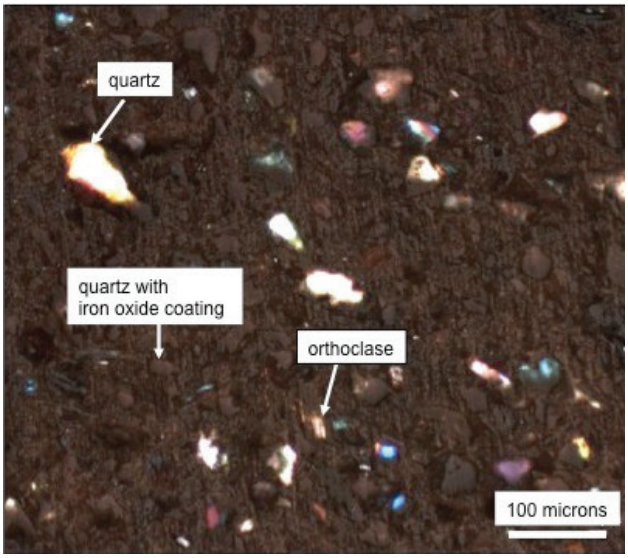

Figure 11. Laser Raman Spectroscopic analysis of the sherd.

suggests that the source of the material used in the making of this paste is a quartz and feldspar-rich rock like granite. While the mineralogical composition of the sherd has similarities to the petrographic and mineralogical properties reported by Sherriff *et al.* (2002: 835–861) for ARSW from Leptiminus, Tunisia, their thin section analyses of fine ware, amphorae and coarse ware indicate 17 to 27% void space whereas the Kilree 3 sherd sample shows 2.5% void spaces (which may also be due to plucking of grains during sample preparation).

Temper in the Tunisian ware accounts for ~28% with 90% made up of quartz. Limestone, sandstone and grog fragments also occur in the temper; mineralogical and lithological characteristics reflect the local bedrock

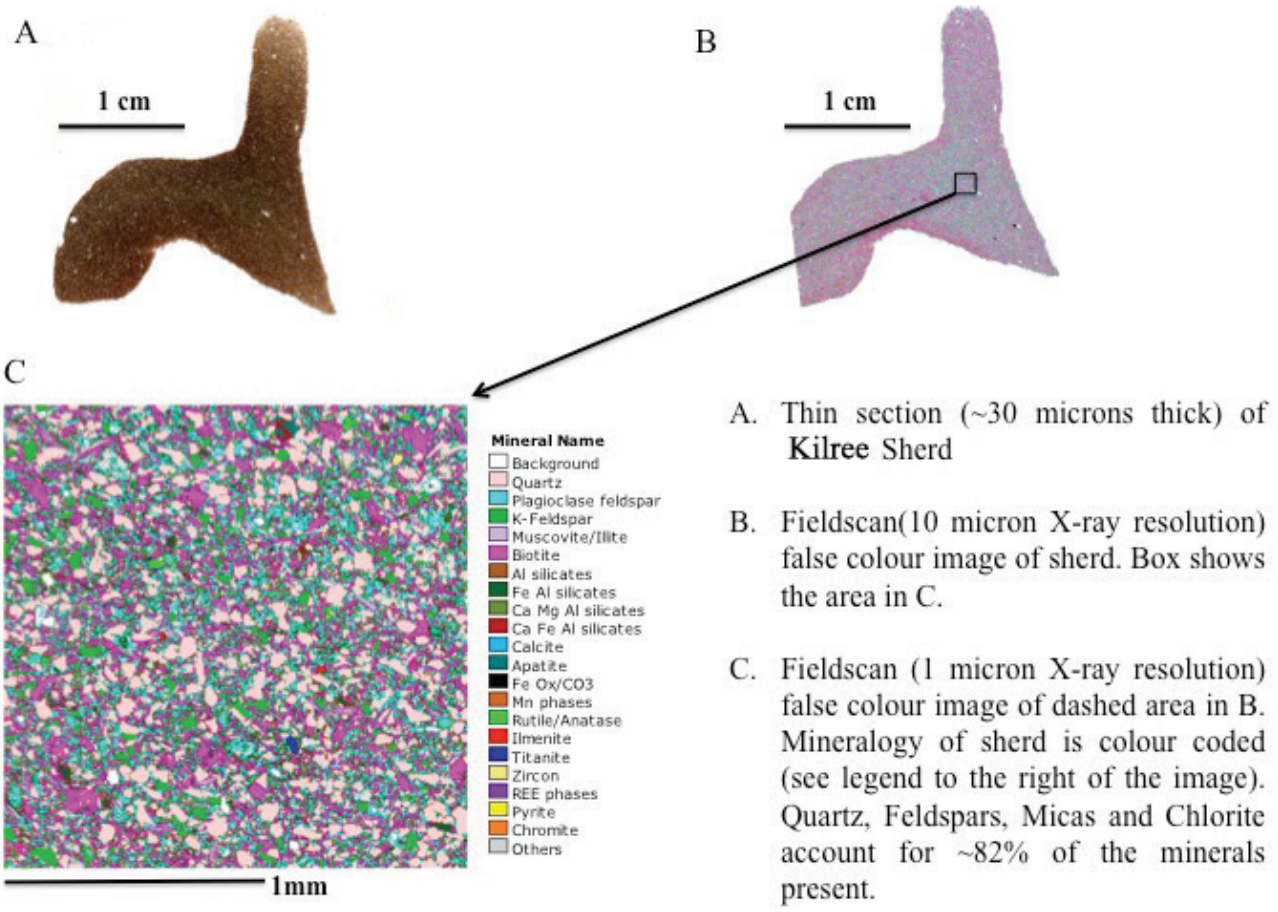

Figure 12. QEMSCAN Analysis

QEMSCAN category	Minerals included within the category	Modal % mineralogical Data using QEMSCAN
Quartz	Silicon Dioxide SiO_2	24
Plagioclase feldspar	Na-Ca bearing feldspar	17
K-feldspar	Potassium(K) bearing feldspar	11
Muscovite	K-bearing mica may also include illite (clay mineral)	2
Biotite	Mg-,Fe- and K-bearing silicates e.g. biotite and phlogopite and Mg rich illite-smectite	22
Al-silicates	Kaolinite/Halloysite/Dickite and Topaz	9
Fe-Al-silicates	Chlorite may also include hematite finely mixed with clays	6
Ca-Fe-Al silicates	Epidote and Zoisite	7
Calcite	Calcium carbonate	0.10
Apatite	Ca phosphate	0.03
$FeOx/CO_3$	Iron oxides carbonates e.g. Siderite, Hematite	0.10
Rutile/Anatase	Ti and O bearing phases	0.42
Ilmenite	Fe, Ti, O phase	0.10
Titanite	Ca, Ti-bearing silicate	0.10
Zircon	Zr bearing silicate	0.02
Others	Any other mineral present in trace amounts	2.0

Figure 13. Summary of the main minerals /mineralogical groupings determined by QEMSCAN

chlorite, all of which account for the majority of the sherd's mineralogy.

7. Conclusion

The Kilree 3 sherd is the only wheel-made flanged rim sherd found in an Early Medieval Irish context; its form remains distinct from the PRSW profiles which dominate distributions of Late Roman Mediterranean fine wares found in Ireland (Figure 4). Discoveries of PRSW across Britain and Ireland are now becoming more widely reported (Thomas 1981; Campbell 2007; Doyle 2009; Kelly 2010) and their numbers are growing (most notably documented by the on-going work of Maria Duggan 2012, 2016).

Bii ware (LR1 amphorae) is clearly the predominant amphora type found in Irish contexts (Kelly 2010: 58-60), with Bi (LR2) sherds identified at four sites (6, 16, 17, 18), and only one potentially imported Bv amphora reported in the published record (albeit as a passing reference), at the promontory fort of Loughshinny (19) (Edwards 2004: 70).[9]

While the Kilree 3 rim sherd is reminiscent of ARSW Form 91C in form, its micaceous content (as revealed through the detailed fabric analyses), rather problematically, serves to remove its fabric from a North African geology. We can, however, reasonably deduce that the sherd is an import to Ireland, given the sherd's red colour and fine-grained fabric (which point to the application of a high level of firing technology in its manufacture), coupled with the dearth of wheel-made ceramic vessels found in Early Medieval Ireland (and the preceding Iron Age). We can further propose, from the wider distributions of Late Mediterranean wares discovered at other high status Early Medieval enclosures across Ireland (and the growing distributions of these wares across Britain), that it is possible that the sherd's deposition is a result of this Mediterranean trade, which is ultimately facilitated by the redistributive hub at Vigo.

Nevertheless, the exact source of this flanged rim sherd recovered from an Early Medieval deposit in an Irish souterrain remains somewhat elusive. Therefore, we present our mineralogical study here, in its entirety, to invite discussion of comparable fabrics in the hope of finally confirming, or equally debunking, the evolving narrative surrounding this unique find in an Early Medieval Irish context.

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[9] None of the wares reported from Loughshinny have been seen by the present authors. It should also be cautioned that while Bv ware is traditionally considered to be produced in North Africa, Paul Reynolds has argued for a southern Spanish origin (2010: 292–293).

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