
THE UNIVERSITY *of* EDINBURGH

# Constructing Lordship in North Atlantic Europe

## the archaeology of masonry mortars in the medieval and later buildings of the Scottish North Atlantic.

Mark Thacker

Volume II:

Appendices 1-6 and bibliography

Doctor of Philosophy

The University of Edinburgh

2016

# VOLUME II - CONTENTS

## APPENDIX 1

### 1.1 SURVEY REGIONS, CASE STUDY SITES & MORTAR DISTRIBUTIONS.



### 1.2 REGIONAL MORTAR DISTRIBUTION TABLES



## APPENDIX 2

### 2.1 CERASTODERMA EDULE SHELL-LIME.

## 2.2 OSTREA EDULIS SHELL-LIME



## 2.3 SHELL-LIME VITREOUS INCLUSIONS OF THE NORTH-WEST REGION

# APPENDIX 3

## 3.1 MAERL-LIME MORTARS



# APPENDIX 4

## 4.1 RELICT MORTAR FUEL IN THE SCOTTISH NORTH ATLANTIC



# APPENDIX 5

## 5.1 CORE MORTAR DEGRADATION

## APPENDIX 6

### 6.1 FIGURES & SUPPORTING INFORMATION FOR CHAPTER SIX



## VOLUME II – MAPS, GRAPHS, TABLES AND FIGURES

# Maps:

# Graphs:



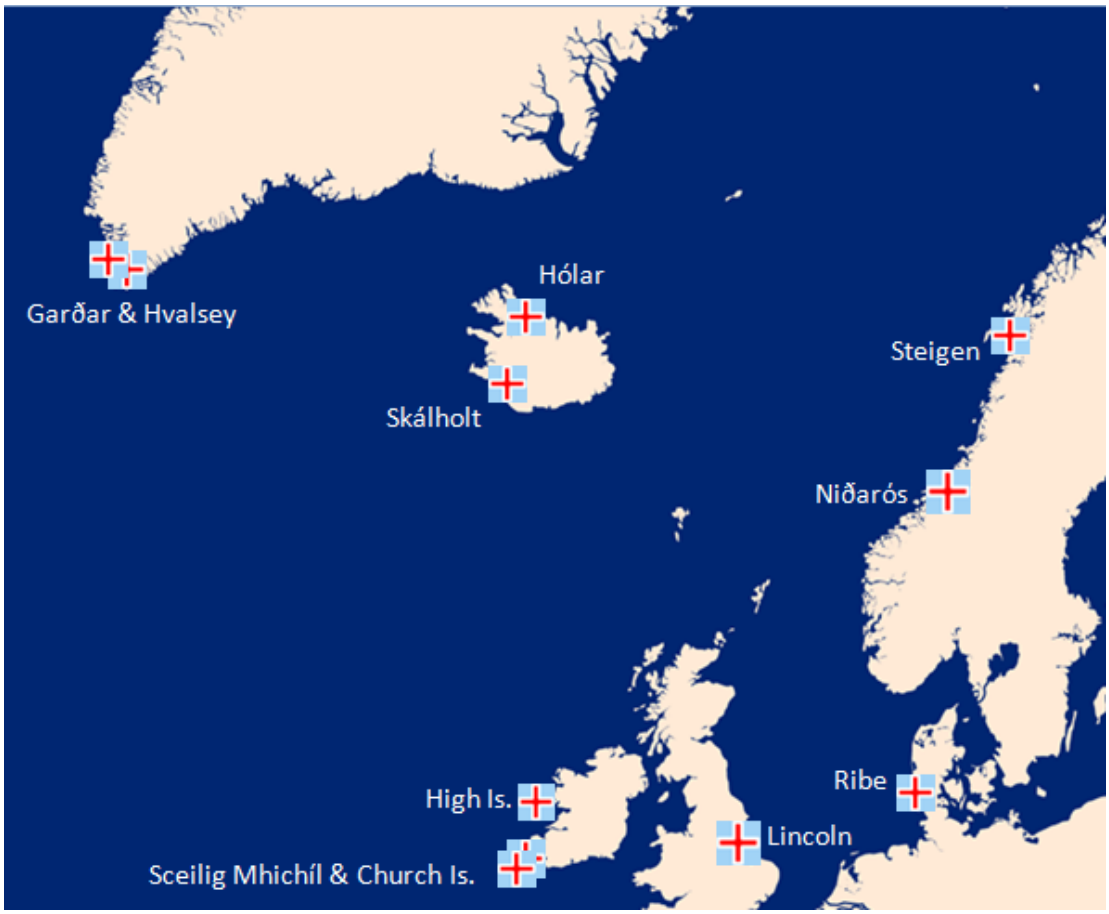
# Tables:



# Figures:

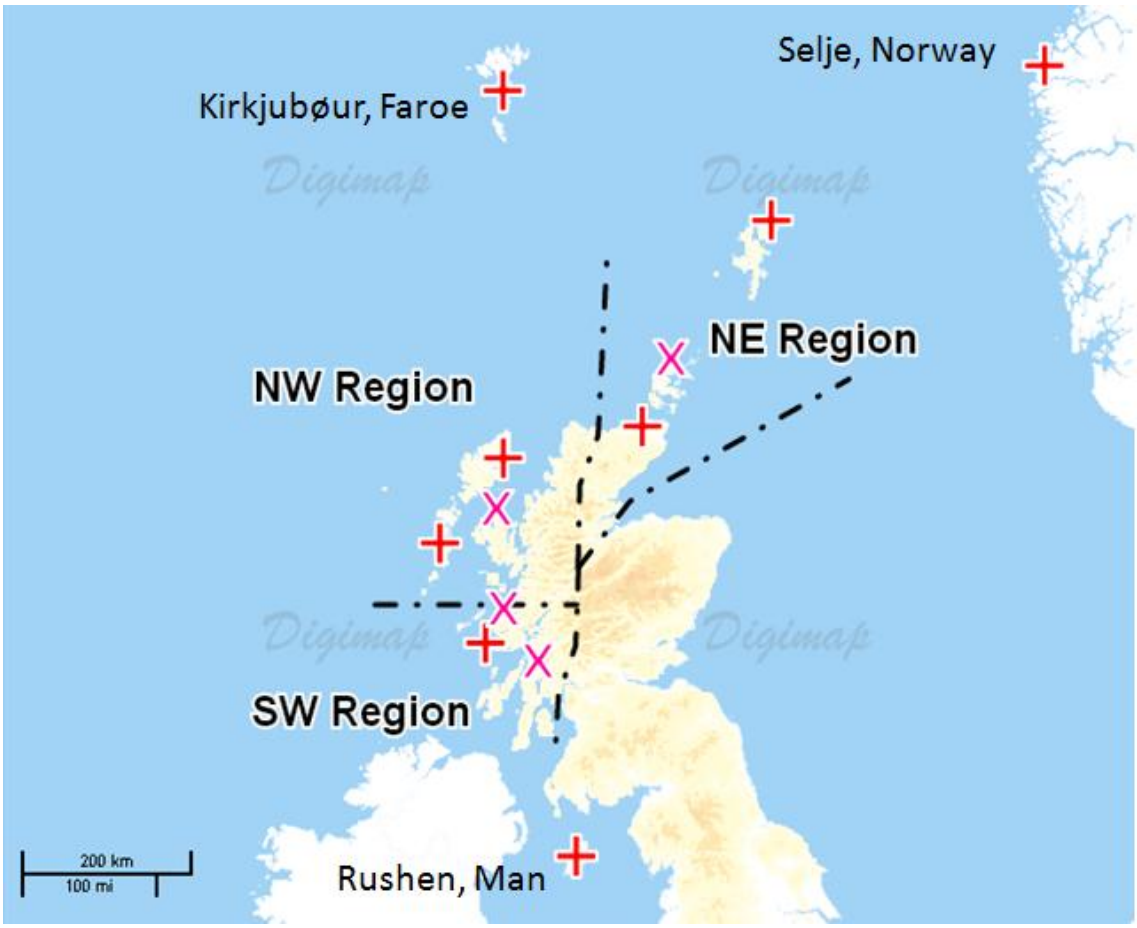
# APPENDIX 1.

## 1.1 SURVEY REGIONS, CASE STUDY SITES AND MORTAR DISTRIBUTIONS.




Map. 1.1.1 – North Atlantic Europe.

The locations of some important ecclesiastical sites from the wider region are plotted here to inform the main thesis text.




# Map 1.1.2 – The Scottish North Atlantic.

The survey area includes sites north and west of the dashed-and-dotted line, and is divided into three sub-regions. North-East, North-West and South-West, as marked. Also marked here are important sites from outside the survey area in Norway, Faroe and Man. 


# Map 1.1.3 – THE SOUTH-WEST REGION

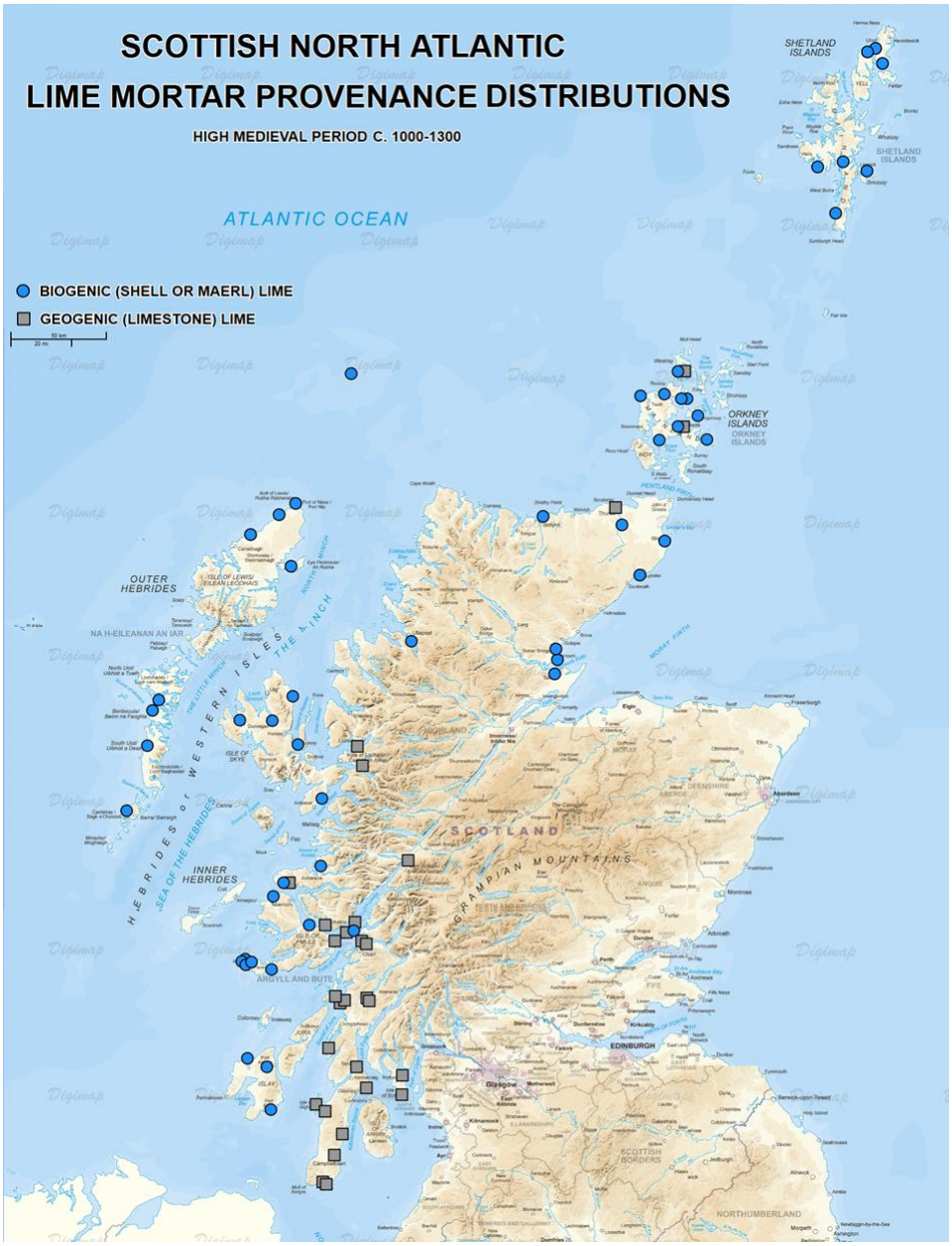
Three case study sites are located in the South-West Region, as plotted above, include the main secular sites of Castles Fincharn and Mingary, and the ecclesiastical site of Iona Nunnery. Each of these sites was also associated with a nearby parish church, and on Iona a range of different buildings were examined. (© Crown copyright and Landmark Information Group Ltd. 2016).


# Map 1.1.4 – THE NORTH-WEST REGION

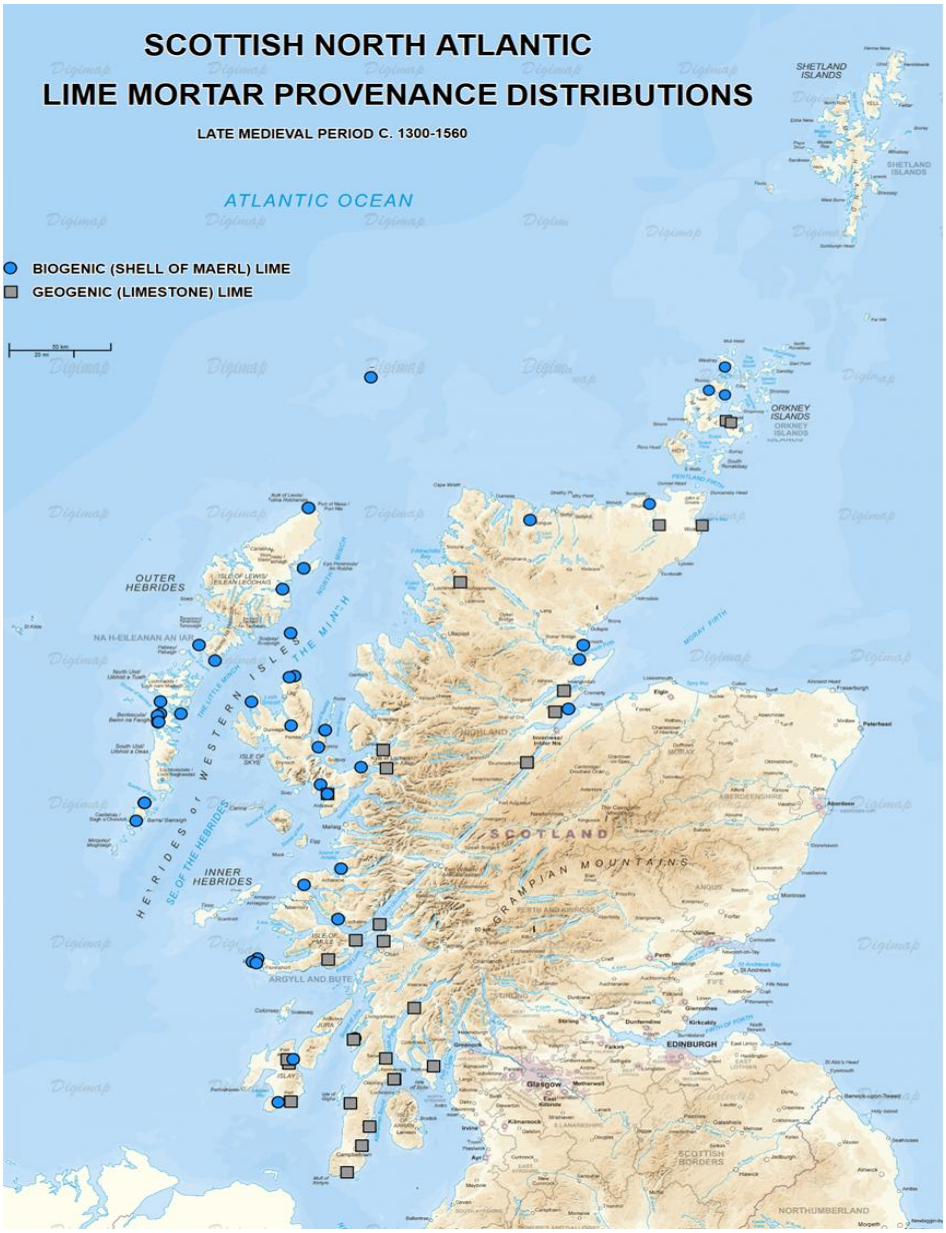
The main case study sites in the North-West Region, as plotted above, include the ecclesiastical sites of Howmore (South Uist) and Eaglais na h'Aoidhe (Lewis), whilst the secular site for this region is Duntulm Castle (Skye). The opportunity has also been taken to mark the location of the chapel of Teampull Ronain on the small island of North Rona. (© Crown copyright and Landmark Information Group Ltd. 2016).


# Map 1.1.5 – THE NORTH-EAST REGION

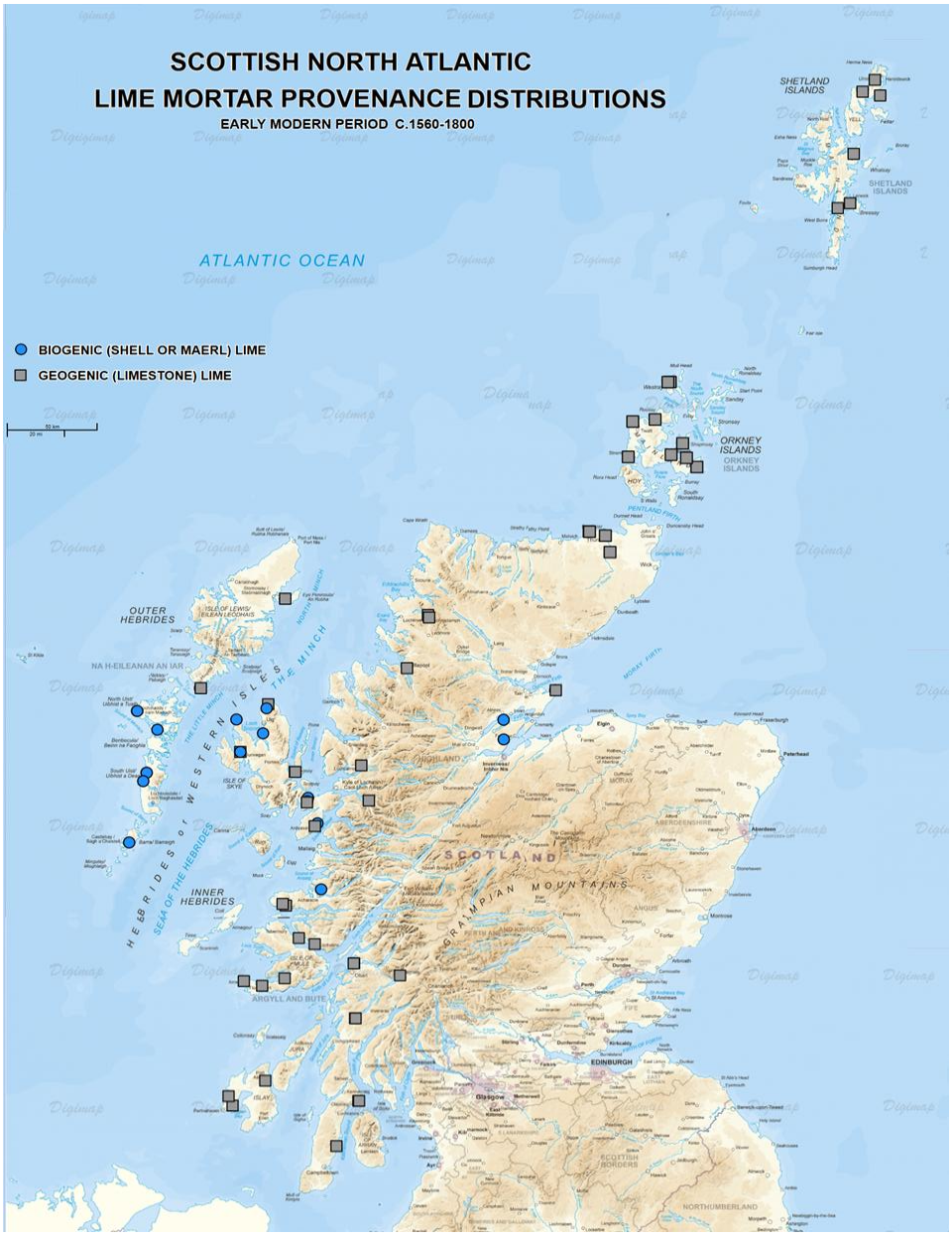
The main case study sites in the North-East Region, as plotted above, includes the ecclesiastical sites of St Peter's Thurso (Caithness) and Uyea chapel (Shetland), whilst the secular case study is Tuquoy Hall coupled with Cubbie Roo's Castle, Wyre (both Orkney). Both of these secular sites are also associated with nearby churches.



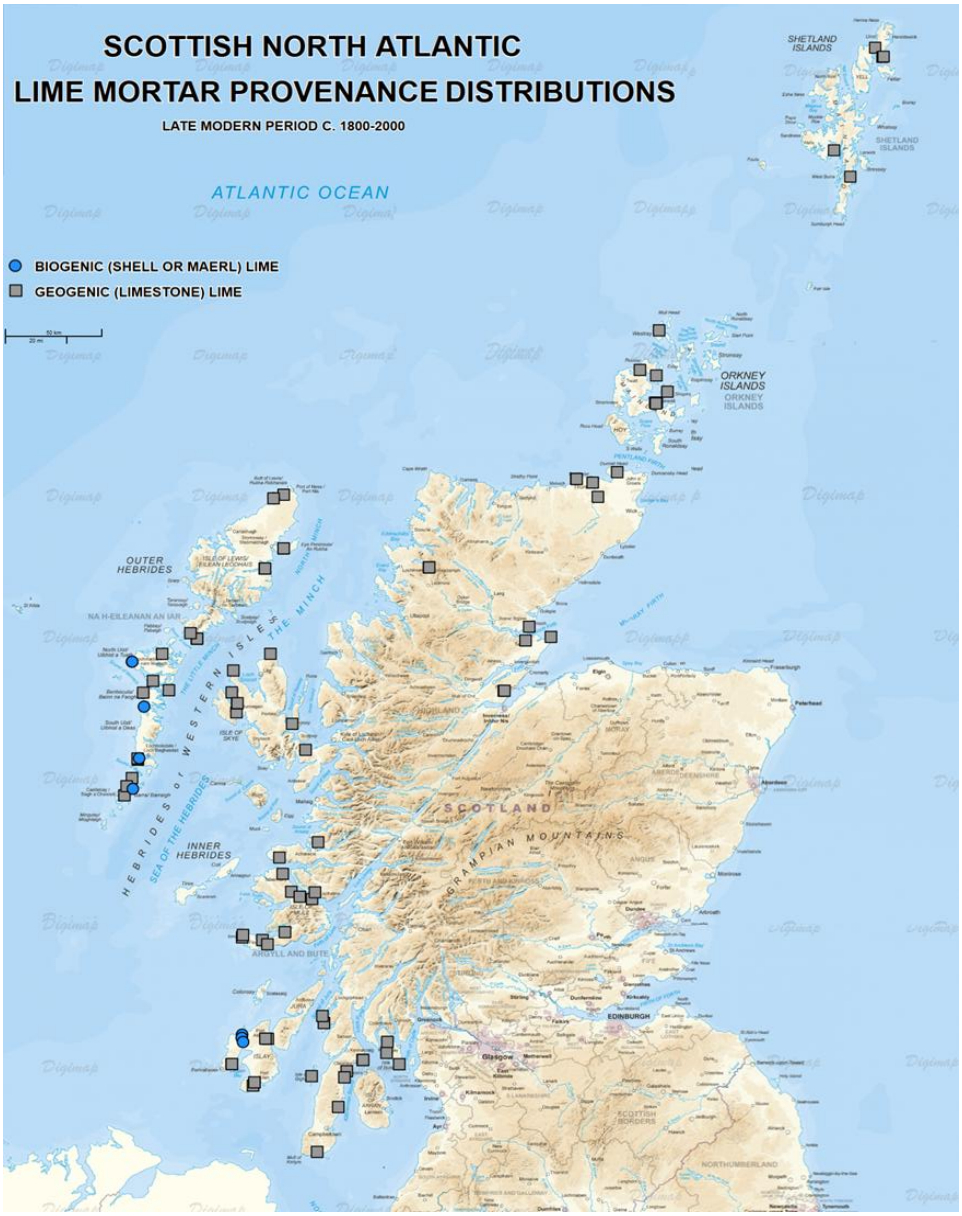

Map 1.1.6 - HIGH MEDIEVAL (c.1000-1300 AD) MORTAR DISTRIBUTIONS IN THE SCOTTISH NORTH ATLANTIC.




Map 1.1.7 - LATE MEDIEVAL (c.1300-1560 AD) MORTAR DISTRIBUTIONS IN THE SCOTTISH NORTH ATLANTIC.




Map 1.1.8 – EARLY MODERN (c.1560-1800 AD) MORTAR DISTRIBUTIONS IN THE SCOTTISH NORTH ATLANTIC.




Map 1.1.9 – LATE MODERN (c.1800-2000 AD) MORTAR DISTRIBUTIONS IN THE SCOTTISH NORTH ATLANTIC.

Map 1.1.10 – Main distribution of limestone within the survey area. After Scottish Lime Centre (2003, 11) with some added outcrops in Skye and Caithness. Where applicable local outcrops are plotted in more detail in volume III case studies.

# 1.2 – REGIONAL MORTAR DISTRIBUTION TABLES

## 1.2.1 NORTH-WEST REGION MORTAR DISTRIBUTION TABLE

Key: S-lime – Shell-lime; L-lime – limestone-lime; M-lime – Maerl-lime. n/e – no surviving evidence noted. Oblique/ - indicates mixed materials in same phase. Ampersand & indicates distinct materials in same phase. Semi-colon; separates phases. Brackets () indicate subsidiary buildings on same site. Superscript[1] – reported by third party. Star* - coating.

High Med: 1000-1300; Late Med: 1300-1560; Early Modern: 1560-1800; Late modern: 1800-2000

| Locality | Site | High Medieval | Late Medieval | Early Modern | Late Modern |
|---|---|---|---|---|---|
| North Rona | St. Ronan's Chapel | S-lime | S-lime | S-lime | |
| Lewis | Tigh an t'sagairt, | n/e | | | |
| Lewis | Eaglais na h-Aoidhe. | S-lime | S-lime | L-lime & S-lime. | L-lime |
| Lewis | Teampull Eoin | S-lime | | | |
| Lewis | Tigh a Bheannaich | Clay | | | |
| Lewis | Teampull Moluag, Ness | S-lime | | | |
| Lewis | Teampull nan Cro Naimh | S-lime | | | |
| Shiants | St Mary's Chapel. | | S-lime | | |
| Lewis | T. Choluim Chille, Lochs | | S-lime | | |
| Lewis | Teampull Pheadair, Ness | | S-lime | | |
| Harris | St Clements | | S-lime | | |
| Harris | Rubh' an Teampull | | S-lime | | |
| Lewis | Carloway Broch | | S-lime | | |
| Harris | Rodel Sth Cabeal | | | S-lime | |
| Harris | Campbell Cabeal, Rodel | | | L-lime | |
| Lewis | Kirkibost Chapel | | | ?S-lime | |
| Harris | MacLeod Cabeal 1, Rodel | | | S-lime | |
| Harris | MacLeod Cabeal 2, Rodel | | | | L-lime |
| Harris | Morrison Cabeal | | | | L-lime |
| Harris | Leverburgh Cottages | | | | L-lime |
| Lewis | Dell Manse | | | | L-lime; Clay & L-lime |
| Lewis | Burial Grd Wall TCC lochs | | | | L-lime |
| Lewis | Galson Cabeal 3 | | | | L-lime |
| Lewis | McRae Cabeal, TCC lochs | | | | L-lime |
| Lewis | Carn Cabeal, Aoidhe | | | | L-lime |
| Lewis | North Cabeal TCC lochs | | | | ?L-lime |
| Lewis | East Cabeal E na H'Aoidhe | | | | L-lime; L-lime |
| Lewis | Galson Cabeal 1 | | | | L-lime |
| Lewis | Galson Cabeal 2 | | | | S-lime |
| Lewis | Shaken's Doune Carloway | | | | Clay & L-lime |

High Med. – 1000-1300; Late Med.– 1300-1560; Early Modern – 1560-1800; Late modern – 1800-2000

| Locality | Site | High Medieval | Late Medieval | Early Modern | Late Modern |
|---|---|---|---|---|---|
| North Uist | St Clement's, Tigharry | n/e | | | |
| South Uist | St Mary's, Howmore | S-lime | | | |
| South Uist | St Columba's, Howmore | S-lime | | | |
| Benbecula | Teampull Colm Chille | S-lime | S-lime | | |
| Barra | Craigston | S-lime | | | |
| Barra | Kisimul Castle. | | S-lime | S-lime | L-lime |
| Barra | Cille Bharra. | | S-lime | | |
| Barra | Sth. Chapel, Eoligarry. | | S-lime | | |
| Barra | Nth. Chapel, Eoligarry. | | S-lime | | L-lime |
| Benbecula | Borve Castle | | S-lime | | |
| Benbecula | Nunton Chapel | | S-lime | | |
| Benbecula | Teampull Bhuirgh | | S-lime | | |
| Grimsay | Teampull Mhichael | | S-lime | | |
| North Uist | Teampull na Trionaid | S-lime | | S-lime | L-lime |
| North Uist | Cille Criosd, Baleshare | | S-lime | | |
| South Uist | Cab Ic Ailean, Howmore | | | S-lime; S-lime | |
| South Uist | Cab. Dubghail, Howmore | | | S-lime | |
| South Uist | Ormacleit Castle | | | S-lime | |
| North Uist | St Mary's, Hougharry | | | S-lime | |
| North Uist | BalRanald Cab, Hougharry | | | S-lime | |
| Barra | Northbay Mill | | | | L-lime |
| Benbecula | Nunton Steadings | | | | L-lime/S-lime |
| North Uist | Cameron Cab. Hougharry | | | | S-lime |
| North Uist | Shaw Cabeal, Hougharry | | | | S-lime |
| North Uist | Truimsgarry Church | | | | L-lime |
| South Uist | Sth Cab, South Boisdale | | | | L-lime |
| South Uist | Nth Cab, South Boisdale | | | | S-lime |
| South Uist | Large Cab, South Boisdale | | | | L-lime |
| South Uist | Boisdale Kirk NF74189 | | | | S-lime |
| South Uist | Ardkenneth Blackhouse | | | | S-lime |
| North Uist | Scolpaig Cab. Hougharry | | | | S-lime |
| Barra | Nth Cabeal, Cuithir | | | | L-lime |
| South Uist | Maclean Cab. Howmore | | | | S-lime; L-lime |
| South Uist | 1887 Cabeal, Howmore | | | | L-lime |
| Barra | Croft 189 Balnabodach | | | | S-lime |
| Ronay | An Staidhre | | | | L-lime |

High Med: 1000-1300; Late Med: 1300-1560; Early Modern: 1560-1800; Late modern: 1800-2000

| Locality | Site | High Medieval | Late Medieval | Early Modern | Late Modern |
|---|---|---|---|---|---|
| Raasay | St Moluag's Church | S-lime | S-lime | L-lime | |
| Skye | Skeabost Cathedral | S-lime | | | |
| Skye | Dunvegan Castle | S-lime | | | |
| Skye | Dun Hasan, Trotternish. | S-lime | | | |
| Skye | Castle Camus, Sleat | S-lime | | S-lime; L-lime | |
| Skye | Dun Ringall | | S-lime | | |
| Skye | DunTulm | | S-lime; S-lime | L-lime; L-lime | |
| Skye | Dun Scaith, Sleat. | | S-lime; L-lime | ?M-lime | |
| Skye | St Columba's, Portree | | n/e | | |
| Skye | Kilmaluag church, Trott. | | S-lime | | L-lime |
| Skye | Trumpan Church, Watern. | | S-lime | | |
| Skye | Castle Maol | | S-lime | | |
| Raasay | Brochel Castle | | S-lime | | |
| Skye | Nicholson Aisle, | | S-lime | | |
| Raasay | Brochel Chapel | | S-lime | | |
| Skye | Castle Uisdean | | | S-lime | |
| Raasay | West cab, St Moluags | | | L-lime | |
| Skye | Mackinnon House, Strath | | | S-lime | |
| Skye | Mackinnon cab Strath | | | S-lime | |
| Skye | Bharkasaig Cab. | | | S-lime | |
| Skye | Unish House, | | | S-lime | L-lime |
| Skye | Suidhisnais Manse, Strath | | | L-lime | |
| Skye | St Mary's Dunvegan | | ?S-lime | L-lime | |
| Skye | Kilmore, Sleat | | | ?S-lime; L-lime | |
| Skye | MacD/Nich Cab, Sleat | | | ?S-lime; L-lime | |
| Skye | Maclean Cab., Kilmoluag | | | S-lime | |
| Skye | Redhouses, Ardvasaar | | | | L-lime; L-lime |
| Skye | Orbost Farm Walled Garden | | | | L-lime |
| Raasay | Raasay Macleod Cab. | | | | L-lime |
| Skye | Ebost Cab, St Marys, Dunv | | | | L-lime |
| Skye | MacLeaod Cab. Dunveg. | | | | L-lime |
| Skye | Strath Whitehouse | | | | L-lime |
| Skye | Camas Bàn, Dunvegan | | | | L-lime |
| Skye | Tigh a' chuirn, Trotternish | | | | Clay & lime |

High Med: 1000-1300; Late Med: 1300-1560; Early Modern: 1560-1800; Late modern: 1800-2000

| Locality | Site | High Medieval | Late Medieval | Early Modern | Late Modern |
|---|---|---|---|---|---|
| Lochaber | Castle Tioram | S-lime | S-lime | | |
| Lochaber | Inverlochy Castle | L-lime | | | |
| Ross-shire | Eilean Donnain Castle | L-lime | L-lime | | |
| Ross-shire | Strome Castle | L-lime | L-lime | | |
| Ross-shire | Dun Lagaidh, Ullapool | S-lime | | | |
| Lochaber | Kilmory Church, Arisaig | | ?S-lime | | |
| Sutherland | Aird Bhreac, Assynt | | L-lime; L-lime | | |
| Sutherland | Castle Bharraich, | | S-lime | | |
| Sutherland | MacLeod Aisle, Assynt | | ?L-lime | | |
| Sutherland | Calda House, Assynt | | | L-lime | |
| Lochaber | Ranald Aisle, Arisaig | | | ?S/M-lime | |
| Ross-shire | Inverinate Church | | | L-lime | |
| Ross-shire | LochCarron Church | | | L-lime | |
| Ross-shire | Ullapool Burial cab | | | L-lime | |
| Sutherland | Kelly Cabeil, Assynt OPC | | | L-lime | |
| Lochaber | Port a Bhata Mill, | | | S-lime | |
| Lochaber | Port a Bhata settlemnt | | | | L-lime |
| Sutherland | Willianson Cab, Assynt | | | | L-lime |
| Sutherland | Ledbury Cab, Assynt | | | | L-lime |

# 1.2.2 – SOUTH-WEST REGION MORTAR DISTRIBUTION TABLE

Key: S-lime – Shell-lime; L-lime – limestone-lime; M-lime – Maerl-lime. n/e – no surviving evidence noted. Oblique/ - indicates mixed materials in same phase. Ampasand & indicates distinct materials in same phase. Semi-colon; separates phases. Brackets () indicate subsidiary buildings on same site. . Superscript[1] – reported by third party. Star* - coating.

High Med: 1000-1300; Late Med: 1300-1560; Early Mod: 1560-1800; Late mod: 1800-2000

| Locality | Site | High Medieval | Late Medieval | Early Modern | Late Modern |
|---|---|---|---|---|---|
| Islay | Bruichladdich, Rhinns | n/e | | | |
| Islay | Duisker 1 | n/e | | | |
| Islay | Nereabus 1 | n/e | | | |
| Islay | Trudernish | n/e | | | |
| Islay | Glen na Goath | n/e | | | |
| Islay | Kilchiaran Church | ?S-lime | | | |
| Islay | Kildalton | ?S-lime | | | |
| Islay | Dunyvaig Castle | ?S-lime; L-Lime | L-lime | | |
| Islay | Eilean Mor, Finlaggan | S-lime | L-lime | ?S-lime | |
| Islay | Ardnave (mainld) Church | S-lime | | | S-lime |
| Islay | St Columba's Keills | | S-lime | | L-lime |
| Islay | KilNaughton | | S-lime | | |
| Islay | Nereabus 2 | | ?-lime | | |
| Islay | Kilmeny OPC | | L-lime | | |
| Islay | Kilbride Church | | | Clay | |
| Islay | McKay Cab, Nereabus | | | L-lime | |
| Islay | Mulreesh Leadworks | | | L-lime | |
| Islay | Kilchiaran Cabeal | | | L-lime | |
| Islay | Lechgruinart Whitehouse | | | | S-lime;L-lime;Clay |
| Bute | Kilchattan Limehouse | | | | L-lime |
| Islay | Mulreesh Farmstead | | | | L-lime |
| Islay | Larabus Settlement. Oa | | | | L-lime |
| Islay | 1861 cabeal, Nereabus | | | | L-lime |
| Islay | KilNaughton Cabeals | | | | L-lime |
| Islay | Laughlin Prie Cab Nereabus | | | | L-lime |
| Islay | Campbell Cabeal, Keills | | | | L-lime |
| Islay | Grunart w/house NR28667 | | | | S-lime |

High Med: 1000-1300; Late Med: 1300-1560; Early Mod: 1560-1800; Late mod: 1800-2000

| Locality | Site | High Medieval | Late Medieval | Early Modern | Late Modern |
|---|---|---|---|---|---|
| Ardnmur | Mingary Castle | L-lime | S-lime | L-lime | |
| Ardnmur | Kilchoan OPC | S-lime | | L-lime | |
| Morvern | Ardtornish Castle | L-lime | | | |
| Iona | St Ronans | Clay/lime; S-lime | | | |
| Iona | St Mary's Chapel | S-lime | | | |
| Iona | Priory | S-lime; S-lime | M-lime? | | |
| Iona | Abbey | S-lime | M-lime? | L-lime | |
| Mull | Kilvickeon Church | S-lime | | | |
| Mull | Pennygown Church | S-lime | | | |
| Mull | Aros Chapel, Glen Aros | L-lime | | | |
| Mull | Castle Duart | L-lime | L-lime | | |
| Lismore | St Moluags Cathedral | S-lime*; | L-lime | | |
| Lismore | Coeffin Castle | L-lime | | | |
| Lismore | Achadun | L-lime | | | |
| Mull | Dun Ara | S-lime | | | |
| Mull | Castle Moy | | L-lime | | |
| Morvern | Keils Church | | S-lime | | |
| Iona | Bishop's House | | M-lime? | | |
| Morvern | C18th Cabeal, Keils | | | L-lime | |
| Mull | MacLean Cabeal, Penny-X | | | L-lime | |
| Morvern | Castle nan Con | | | L-lime | |
| Mull | Bunessan Mill | | | L-lime | L-lime |
| Mull | Aros Cabeals, Glen Aros | | | | L-lime |
| Mull | Tobermory Church/Cafe | | | | L-lime |
| Mull | Fishnish Byre NM 64574 | | | | L-lime |
| Mull | Pennygheal Puffer Shed | | | | L-lime |
| Mull | Mural memorial | | | | L-lime |
| Ardnmur | Fatience Caibeal | | | | L-lime |
| Mull | Kilvickeon Cabeal | | | | L-lime |
| Iona | Clachan Ard Barn | | | | L-lime |
| Iona | Cornerhouse | | | | L-lime |
| Morvern | Rahoy Cabeal, Keils | | | | L-lime |
| Bute | St Ninian's Chapel | Clay | | | |
| Bute | Kilhouseland | Clay | | | |
| Bute | Kilmichael's Chapel | Clay | | | |

High Med: 1000-1300; Late Med: 1300-1560; Early Mod: 1560-1800; Late mod: 1800-2000

| Locality | Site | High Medieval | Late Medieval | Early Modern | Late Modern |
|---|---|---|---|---|---|
| Bute | St Blanes | L-lime; L-lime | | | |
| Kintyre | Saddell Abbey Church | L-lime | L-lime | | |
| Bute | Rothesay Castle | L-lime; L-lime | L-lime | | |
| Knapdale | Castle Sween | L-lime | ?S-lime; L-lime | | |
| Lorn | Craignish OPC | L-lime | | | |
| Gigha | St Catan's OPC | L-lime | | | L-lime |
| Kintyre | Kilhousland OPC, Cambltn | L-lime | L-lime | | |
| Kintyre | Kilbrannan Skipness | | L-lime; L-lime | | |
| Kintyre | St Columba's Southend | L-lime | L-lime | | L-lime |
| Kintyre | Skipness Castle | L-lime | L-lime | L-lime | |
| Knapdale | Keils Chapel | L-lime | | | |
| Kintyre | Killean Church | L-lime; L-lime | L-lime | S-lime | |
| Knapdale | Kilmory Knap Chapel | L-lime | S-lime | | |
| Lorn | Dunstaffnage Castle | L-lime | L-lime | L-lime | |
| Lorn | Dunstaffnage Chapel | L-lime | | L-lime | |
| Lorn | Fincharn Castle, Loch Awe | L-lime | | | |
| Lorn | Killenuar Church | L-lime | | L-lime | |
| Kintrye | Dunaverty | L-lime | | | |
| Kintyre | Tarbert Castle | L-lime | L-lime; L-lime | | |
| Cowal | Lachlan Castle | | L-lime | | |
| Lorn | Kilchurn Castle | | | L-lime | |
| Bute | St Blane's Manse | | | n/e | |
| Lorn | Carnasserie Castle | | | ?L-lime | |
| Lorn | Killenuar Oratory | | | L-lime | |
| Kintyre | Saddell Mill NR 78653 | | | L-lime; L-lime | |
| Kintyre | Campbell cabs. Skipness | | | L-lime | L-lime |
| Kintyre | Carradale cab. Saddell | | | | L-lime |
| Bute | St Colmac's Church | | | | L-lime |
| Bute | Building Ninans point | | | | L-lime; L-lime |
| Kintyre | Skipness Boat Shed | | | | L-lime |
| Knapdale | Sween houses NR 70603 | | | | L-lime |
| Knapdale | Keils Whitehouses | | | | L-lime |
| Kintyre | Crossaig Whitehouse | | | | L-lime; L-lime |
| Kintyre | Cour Whitehouse | | | | L-lime |

# 1.2.3 – NORTH-EAST REGIONAL TABLES

Key: S-lime – Shell-lime; L-lime – limestone-lime; M-lime – Maerl-lime. n/e – no surviving evidence noted.

Oblique/ - indicates mixed materials in same phase. Ampasand & indicates distinct materials in same phase.

Semi-colon; separates phases. Brackets () indicate subsidiary buildings on same site. Superscript[1] – reported by third party. Star* - coating.

High Med: 1000-1300; Late Med: 1300-1560; Early Mod: 1560-1800; Late mod: 1800-2000

| Locality | Site | High Medieval | Late Medieval | Early Modern | Late Modern |
|---|---|---|---|---|---|
| Orkney | Eynhallow | M-lime & Clay | M/S-lime | L-lime | L-lime |
| Orkney | St Magnus, Kirkwall | ?M-lime;L-lime | L-lime | L-lime, | L-lime |
| Orkney | Bishops Palace, Kirkwall | ? | L-lime | | L-lime |
| Orkney | Tuquoy Hall, Westray | M-lime & Clay | S/M-lime | | |
| Orkney | Cubbie Roos Castle, Wyre | M-lime | Clay & M/S-lime | | |
| Orkney | St Peters, Brough Birsay | ?M-lime | | | |
| Orkney | St Mary's, Wyre | M-lime | | | L-lime |
| Orkney | St Nicholas, Orphir | ?M-lime* | | | |
| Orkney | Newark | ?M/S-Lime | | L-lime&clay | |
| Orkney | St Magnus, Egilsay | ? | | | |
| Orkney | Crosskirk, Tuquoy | L-lime | | | |
| Orkney | Linton Chapel, Shapinsay | M-lime | | | |
| Orkney | Pierowall Church | Clay | | L-lime | |
| Orkney | Brough Chapel, Deerness | S-lime | | | |
| Orkney | Quoygrew, Westray | Clay & S-lime[1] | | | |
| Orkney | Castle Howe | | n/e | | |
| Orkney | St Mary's, Rousay | | Clay & ?M-lime | | |
| Orkney | Earls Palace, Birsay | | | L-lime | |
| Orkney | Noltland Castle, Westray | | | L-lime; S-lime* | |
| Orkney | Earls Palace, Kirkwall | | | ?L-lime; ?S-lime* | |
| Orkney | Breckness House | | | Clay & L-lime | |
| Orkney | The Wirk, Rousay | | | ?L-lime; Clay | |
| Orkney | Balfour Aisle, Shapinsay | | | L-lime | |
| Orkney | Baikie Aisle, Tankerness | | | L-lime | |
| Orkney | The Barn, Westray | | | | L-lime |
| Orkney | Townhouses, Kirkwall | | | | L-lime; Clay & L-lime |
| Orkney | Shapinsay Barns | | | | Clay & L-lime |

High Med: 1000-1300; Late Med: 1300-1560; Early Mod: 1560-1800; Late mod: 1800-2000

| Locality | Site | High Medieval | Late Medieval | Early Modern | Late Modern |
|---|---|---|---|---|---|
| | | | | | |
| Caithness | St Peters Thurso | L-lime | ?S-lime | L-lime, lime/clay. | L-lime |
| Caithness | Old Wick Castle | S-lime, (clay) | | | |
| Caithness | Forse Castle | S-lime, (clay) | | | |
| Caithness | Braal Castle, Halkirk | S-lime | | | L-lime |
| Caithness | Crosskirk, Lybster | n/e | | L-lime | L-lime |
| Caithness | Olgrinbeg Chapel | n/e | | | |
| Caithness | St Mary's, Clow | n/e ?-lime[2] | | | |
| Caithness | Chapel Geo, Dunnet | | n/e | | |
| Caithness | Sinclair/Girnigoe Castle | | L-lime (clay) | | |
| Caithness | Bucholie Castle | | ?-lime[1], (clay) | | |
| Caithness | Berriedale Castle | | Clay | | |
| Caithness | St Thomas, Skinnet | | Clay | n/e | |
| Caithness | St Magnus, Spittal | | L-lime | | |
| Caithness | Halkirk OPC | | | L-lime | |
| Caithness | Mackay Aisle, Raey | | | ?-lime | |
| Caithness | Gunn Aisle, Lybster | | | L-lime | L-lime |
| Caithness | Forse 'Quarry; House | | | | Clay & L-lime |
| Caithness | X-kirk Houses | | | | Clay & L-lime |
| Caithness | Ham lime kiln | | | | ?S-lime; L-lime |
| Caithness | Ham Mill | | | | L-lime; S-lime |

| County | Site | High Medieval | Late Medieval | Early Modern | Late Modern |
|---|---|---|---|---|---|
| Sutherland | Dornoch Cathedral | S-lime | | | L-lime |
| Ross-shire | St Duthocs OPC, Tain | S-lime | | | |
| Sutherland | Skelbo Castle | S-lime | | | |
| Ross-shire | Castle Urqhart | | L-lime; L-Lime | S-lime | |
| Ross-shire | St Duthoc's Chapel, Tain | | S-lime | | L-lime |
| Ross-shire | Fortrose Cathedral | | S-lime | | |
| Sutherland | Bishop's Palace, Dornoch | | S-lime | | |
| Ross-shire | St Duthoc's, Suddie | | L-lime | | |
| Ross-shire | Kirk Michael, Resolis | | L-lime | | |
| Ross-shire | Grant chapel, Resolis | | | S-lime | |
| Ross-shire | E. Aisle, Suddie | | | S-lime | L-lime |
| Ross-shire | Matheson Encl. Suddie | | | | L-lime |
| Ross-shire | Tarbat OPC, Portmhomack | | | L-lime | |
| Ross-shire | Burial Aisles, Tarbat | | | S-lime | L-lime |

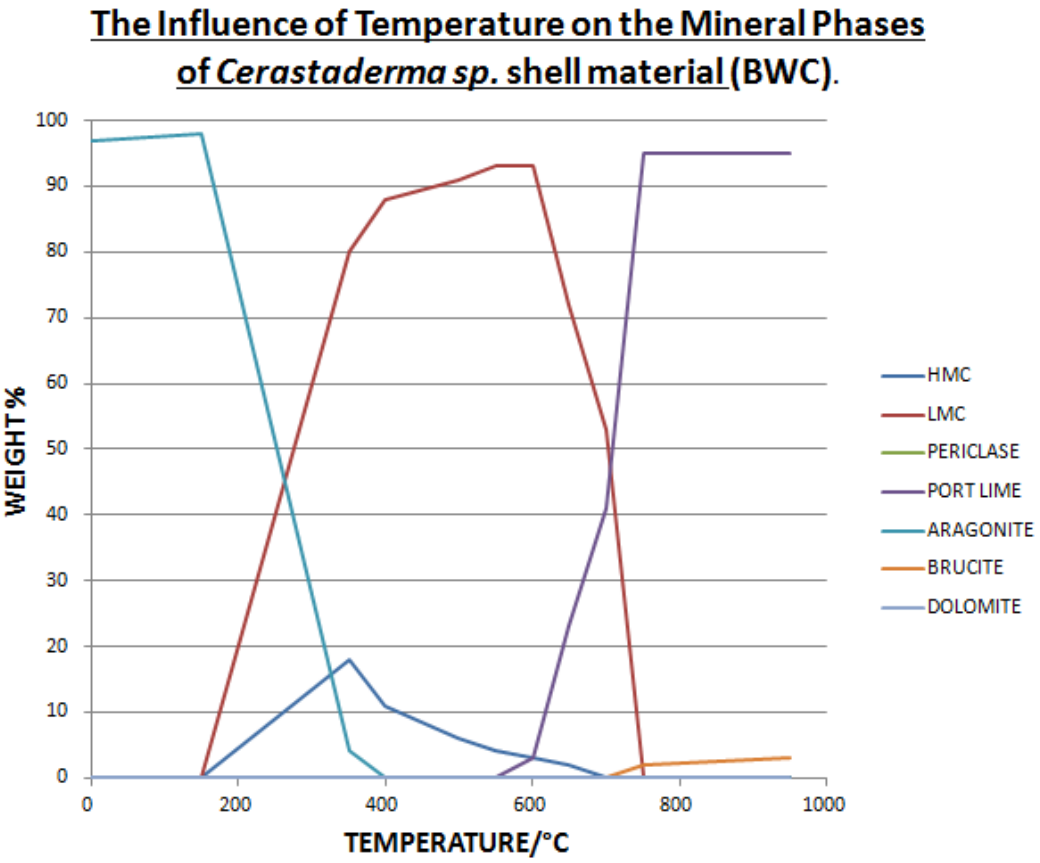
High Med: 1000-1300; Late Med: 1300-1560; Early Mod: 1560-1800; Late mod: 1800-2000

| Locality | Site | High Medieval | Late Medieval | Early Modern | Late Modern |
|---|---|---|---|---|---|
| Shetland | St Ninian's | S-lime | | | |
| Shetland | St Olaf's Lundawick, Unst | S-lime | | Clay & ?S-lime | L-lime |
| Shetland | Uyea Chapel, Uyea, Unst | S-lime | | Clay | Dry-stone |
| Shetland | Kirk o' Ness, North Yell | S-lime | | | |
| Shetland | Castle Holm | S-lime | | | |
| Shetland | Crosskirk, Clibberswick | n/e | | | |
| Shetland | St Mary's, Sandsting | S-lime | | | |
| Shetland | St Mary's, Bressay | S-lime | | Clay | |
| Shetland | Burial Aisle, Tingwall | | ?S-lime | | |
| Shetland | Muness Castle, Unst | | | L-lime | |
| Shetland | Scalloway Castle | | | L-lime | |
| Shetland | Sumburgh House | | | Clay & L-lime | |
| Shetland | Greenwells Booth, Unst | | | Clay & L-lime | |
| Shetland | Baliasta Church, Unst | | | L-lime | |
| Shetland | Fort Charlotte, Lerwick | | | L-lime | |
| Shetland | Sand Haa, Walled Garden | | | Clay & L-lime | |
| Shetland | Vöesgrind, Unst | | | Clay & L-lime | |
| Shetland | Booth of Lunna | | | Clay & L-lime | |
| Shetland | Whitehouse, Cullivoe | | | | Clay & L-lime |
| Shetland | Sand farmhouse | | | | L-lime |
| Shetland | Haa of Uyea, Uyea, Unst | | | | L-lime |
| Shetland | Whitehouse, Uyea | | | | L-lime |
| Shetland | Fladdabister whitehouse | | | | L-lime |
| Shetland | Framgord 'chapel', Unst | | | | Dry/earth |

# APPENDIX 2 – SHELL-LIME MORTARS

## 2.1 *CERASTODERMA EDULE* SHELL-LIME

### 2.1.1 - MINERAL PHASES OF HEATED *C. EDULE* SHELL




Graph 2.1. (above) – Weight % mineral phases of C. edule plotted against temperature.

Table 2.1 (below) XRF Mineral phases in *C. edule* shell.

| Temperature | SiO2 | Al2O3 | Fe2O3 | MgO | CaO | Na2O | K2O | TiO2 | MnO | P2O5 | Balance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **BWC.000** | -0.04 | 0.01 | 0.01 | -0.02 | 54.68 | 0.26 | -0.002 | 0.001 | 0.001 | 0.028 | 45.071 |

Table 2.2. (below) Weight % mineral phases of experimentally heated *C. edule* shells

| | HMC | LMC | PERICLASE | PORT/LIME | ARAGONITE | BRUCITE | DOLOMITE |
|---|---|---|---|---|---|---|---|
| **0** | 0 | 0 | 0 | 0 | 97 | 0 | 0 |
| **150** | 0 | 0 | 0 | 0 | 98 | 0 | 0 |
| **350** | 18 | 80 | 0 | 0 | 4 | 0 | 0 |
| **400** | 11 | 88 | 0 | 0 | 0 | 0 | 0 |
| **500** | 6 | 91 | 0 | 0 | 0 | 0 | 0 |
| **550** | 4 | 93 | 0 | 0 | 0 | 0 | 0 |
| **600** | 3 | 93 | 0 | 3 | 0 | 0 | 0 |
| **650** | 2 | 72 | 0 | 23 | 0 | 0 | 0 |
| **700** | 0 | 53 | 0 | 41 | 0 | 0 | 0 |
| **750** | 0 | 0 | 0 | 95 | 0 | 2 | 0 |
| **950** | 0 | 0 | 0 | 95 | 0 | 3 | 0 |

Table 2.3. (below) Mol. % Ca/Mg Calcite ratios in heated *C. edule* shells.
(LMC is assumed to have zero Mol% Mg in Reitveld analysis.

| **Temperature** | HMC-Ca | **HMC-Mg** | | Cell Vol. |
|---|---|---|---|---|
| **350** | 85 | **15** | | **362** |
| **400** | 100 | **0** | | **361.77** |
| **500** | 96 | **4** | | **360.85** |
| **550** | 90 | **10** | | **360.39** |
| **600** | 100 | **0** | | **360.05** |
| **650** | 100 | **0** | | **360.08** |

## 2.1.2 MASS CHANGES IN EXPERIMENTALLY-HEATED *C. EDULE* SHELL.

| Sample | Temp/˚C. | Weight before (whole shell)/ g | Weight after (whole shell)/ g | Weight after (shattered)/g | Weight retained/%. |
|---|---|---|---|---|---|
| BWC.000 | 000 | | | | 100% |
| BWC.150 | 150 | 5.447500 | 5.393055 | | 99.0 |
| BWC.350 | 350 | 8.102275 | 7.954470 | | 98.2 |
| BWC.400 | 400 | 5.747530 | 5.632875 | 29.43 | 98.0/98.1 |
| BWC.500 | 500 | 7.420400 | 7.195545 | 29.44 | 97.0/98.1 |
| BWC.600 | 600 | 7.043695 | 4.891760 | 28.98 | 69.4/96.6 |
| BWC.650 | 650 | 6.015690 | 3.349090 | 25.22 | 55.7/84.1 |
| BWC.700 | 700 | 11.10996 | 6.152695 | 21.48 | 55.4/71.6 |
| BWC.750 | 750 | 6.141735 | 3.402715 | | 55.4. |
| BWC.950 | 950 | 2.792130 | 1.542480 | | 55.2 |

Table 2.4. (above) Mass changes in experimentally-heated *C. edule*.

## 2.1.3 – EXPERIMENTALLY-HEATED *C. EDULE* SHELL – Hand Samples

Figure 2.1 - BWC 000 – Unheated *C. edule* shattered and whole valves.

Figure 2.2 - BWC 150 – Shattered and whole *C. edule* valves heated to 150°C.

Figure 2.3 - BWC 350 – Shattered and whole *C. edule* valves heated to 350°C.

Figure 2.4 - BWC 000 – Shattered and whole *C. edule* valves heated to 400°C.

Figure 2.5 - BWC 500 – Shattered and whole *C. edule* valves heated to 500°C.

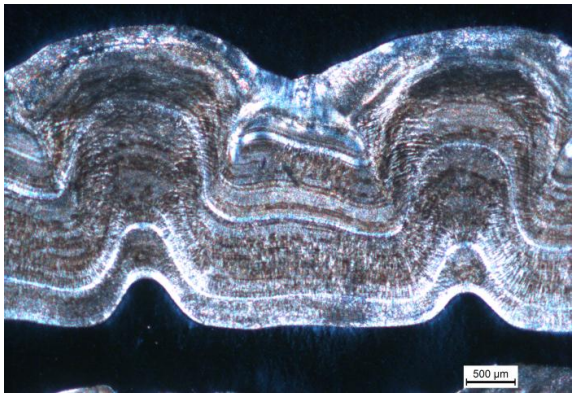
Figure 2.6 - BWC 550 – Shattered and whole *C. edule* valves heated to 550°C.

Figure 2.7 - BWC 600 – Shattered and whole *C. edule* valves heated to 600°C.

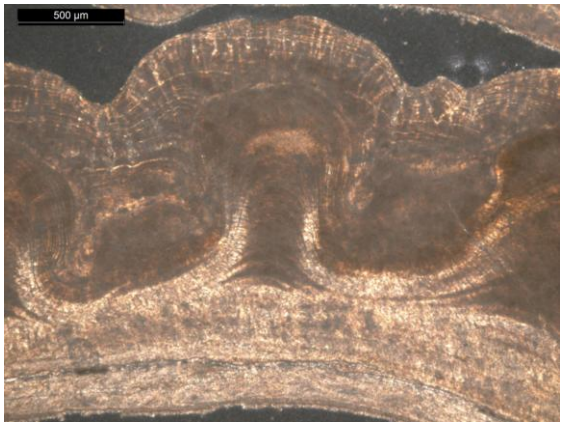
Figure 2.8 - BWC 750 – Shattered and whole *C. edule* valves heated to 750°C.

Figure 2.9 - BWC 950 – Shattered and whole *C. edule* valves heated to 950°C.

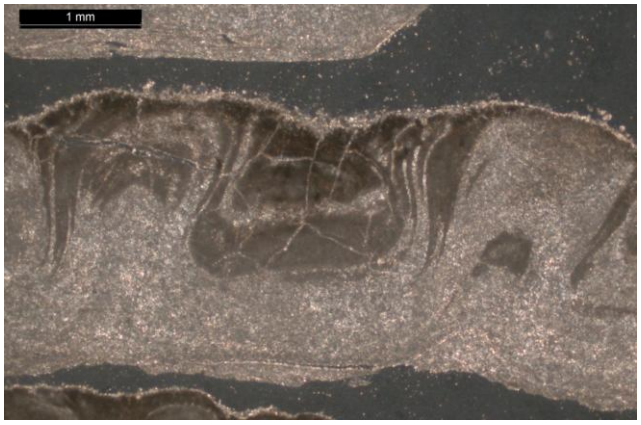
## 2.1.4 – EXPERIMENTALLY-HEATED *C. EDULE* SHELL
## Thick & Thin-Sections




Figures. 2.10 & 2.11 (above) - BWC.000 – Thick & thin-section; unheated *C. edule* shell.




Figures.2.12 & 2.13 (above) - BWC.350 – Thick & thin-section; *C. edule* shell heated to 350°C.




Figures. 2.14 & 2.15 (above) - BWC.550 – Thick & thin-section; *C. edule* shell heated to 550°C.

## 2.1.4 – HEATED *C. EDULE* SHELL KILN-RELICTS – *IN SITU*

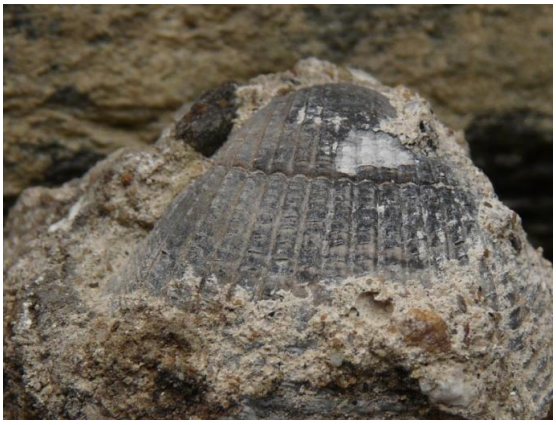


Fig. 2.16 - Castle Bharraich Sutherland

Fig. 2.17 Teampull Mòr, South Uist.

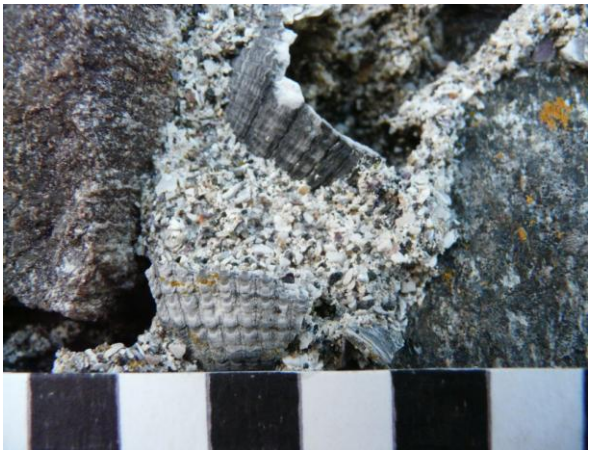
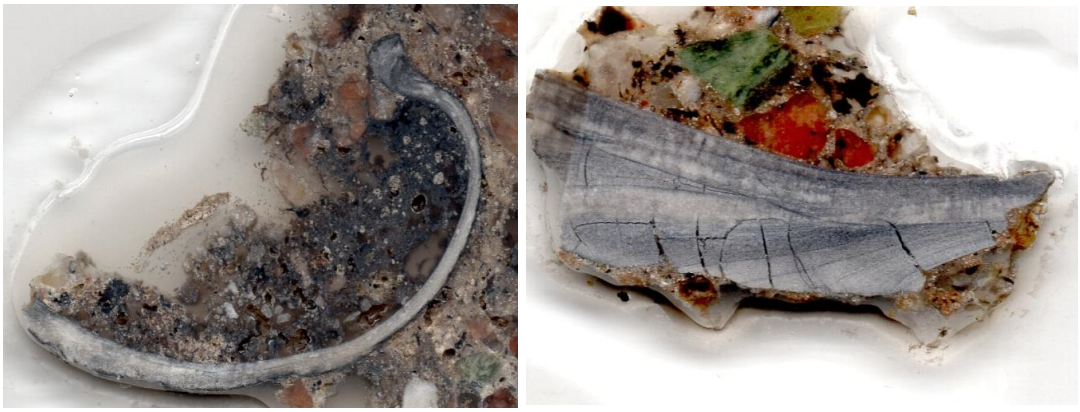


Fig. 2.18 - Rubh' an Teampail, Harris.

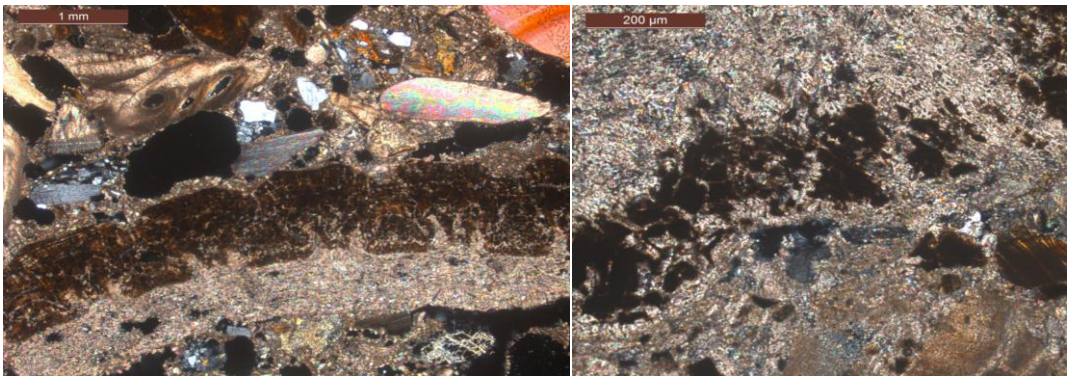
Fig. 2.19 - West Cloister, Iona.

## 2.1.5 – HEATED *C. EDULE* SHELL KILN-RELICTS – Thick & Thin Sections

Figure 2.20 (above) – Thick-section from 189 BALNABODACH BARRA.



Figs. 2.21 & 2.22 – Thick-sections ENH 19 & ENH 15 from *Eaglais na h'Aoidhe*, Lewis.




Figs. 2.23 & 2.24 – Thin-sections from *Rubha an Teampail*, Harris


Figure 2.25 (above) – Thin section MHU.01 Mosaic photomicrographs of a heated *C. edule* clast longitudinal section with hinge. XPL; Scale 1mm; photomicrographs M. Thacker

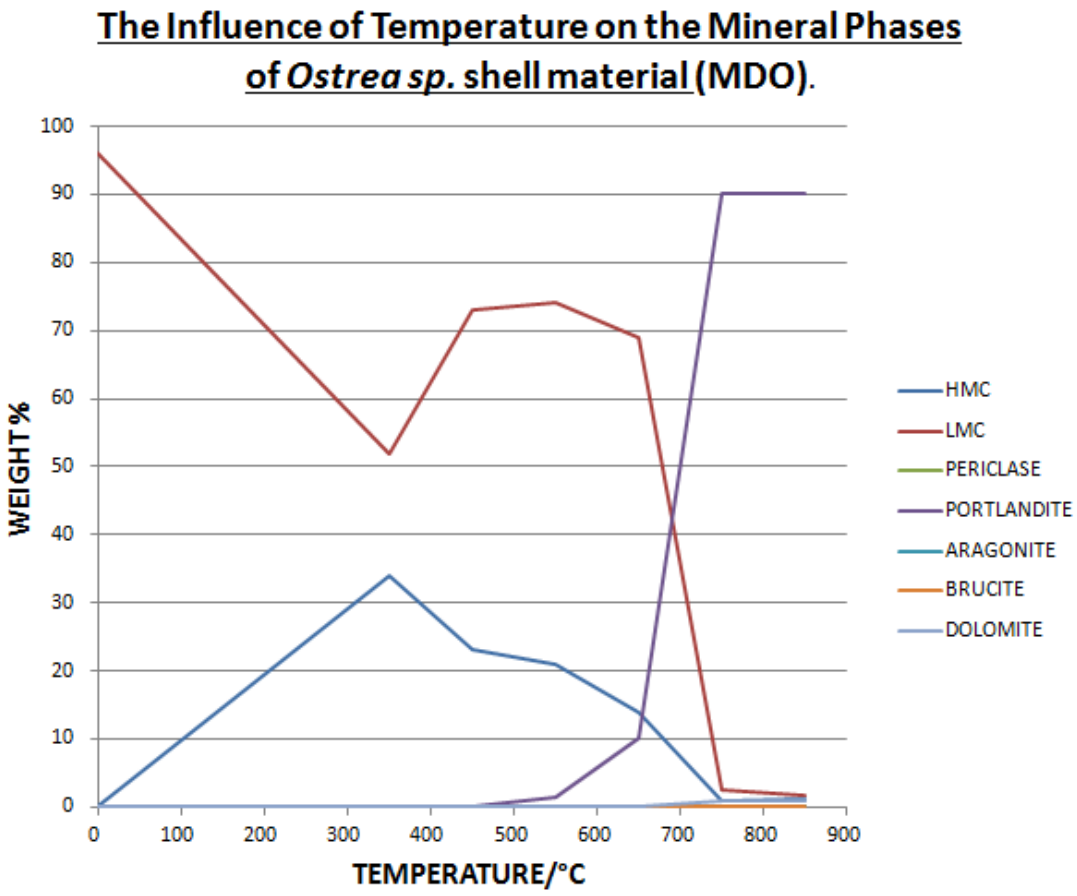
Figure 2.26 (above) – In situ *C. edule* mortar kiln-relicts; Borve Castle Benbecula.

Figure 2.27 (above) - *C. edule* kiln-relicts from public demonstration and experimental shell-lime burn in replica 19th-century kiln, Barra.

## 2.2 - *OSTREA EDULIS* (OYSTER) SHELL-LIME

Post-mortem Atlantic oyster shells sourced from the intertidal low gradient shore of Loch Moidart were washed, rinsed, dried and shattered (see chapter 2 of main thesis text), before 20g samples were held in the electric muffle furnace for 23 hours at various temperatures. Each sample was cooled for half an hour, before being weighed and described, and a fraction of each sample was then ground by hand to prepare for XRD analysis, whilst a further fraction was cast in resin for thin-sectioning.

### 2.2.1 MINERAL PHASES OF EXPERIMENTALLY-HEATED *O. EDULIS* SHELLS




Graph 2.2 (above) Mineral phases of O. Edulis; weight % plotted against temperature

Table 2.5 (below) Weight % mineral phases in experimentally-heated *O. edulis* shell

| Temperature | HMC | LMC | Periclase | Portlandite | Aragonite | Brucite | Dolomite |
|---|---|---|---|---|---|---|---|
| **0** | 0 | 96 | 0 | 0 | 0 | 0 | 0 |
| **350** | 34 | 52 | 0 | 0 | 0 | 0 | 0 |
| **450** | 23 | 73 | 0 | 0 | 0 | 0 | 0 |
| **550** | 21 | 74 | 0 | 1.3 | 0 | 0 | 0 |
| **650** | 14 | 69 | 0 | 10 | 0 | 0 | 0 |
| **750** | 1 | 2.5 | 0 | 90 | 0 | 0 | 1 |
| **850** | 1.2 | 1.7 | 0 | 90 | 0 | 0 | 1 |
| | | | | | | | |

Table 2.6 (below) Mol. % Ca/Mg ratios for HMC in experimentally-heated *O. edulis* shell.
(LMC is assumed to have zero Mol% Mg in Reitveld analysis).

| Temperature | HMC-Ca | **HMC-Mg** | Cell Vol. |
|---|---|---|---|
| **0** | | | |
| **350** | 72 | **28** | **362** |
| **450** | 66 | **34** | **362** |
| **550** | 64 | **36** | **361.64** |
| **650** | 50 | **50** | **362** |
| **750** | 50 | **50** | **362** |
| **850** | 50 | **50** | **362** |

## 2.2.2 MASS CHANGES IN EXPERIMENTALLY HEATED *O. EDULIS* SHELL.

| *Ostrea Edulis* Sample | Furnace Temperature/$^{o}$C | Sample Weight Before Heating/g | Sample Weight After Heating/g | Percentage Weight loss/% |
|---|---|---|---|---|
| MDO.000 | 000 | 20.0 | 20.0 | 0.0 |
| MDO.350 | 350 | 20.0 | 19.5 | 2.0 |
| MDO.450 | 450 | 20.0 | 19.2 | 4.0 |
| MDO.550 | 550 | 20.0 | 18.8 | 6.0 |
| MDO.650 | 650 | 20.0 | 17.7 | 11.5 |
| MDO.750 | 750 | 20.0 | 11.5 | 42.5 |
| MDO.850 | 850 | 20.0 | 11.5 | 42.5 |

Table 2.7 (above) Mass changes in experimentally heated O. Edulis shell.

## 2.2.3 – EXPERIMENTALLY-HEATED *O. EDULIS* SHELL – Hand Samples

**MDO.000** Generally white laminated shell comprised of alternate very thin (<1.0mm) lustrous harder layers and much wider porous soft and non-lustrous layers. Both internal and external surfaces are lustrous. Some rounded 'drill-holes' in external surface probably represent biological attack.

**MDO.350**. After heating to 350$^{o}$C, the shell has a light blue and white mottled colouration which is more marked at the feathered edges of the shell layers and upon the outer surface (both upper and lower) of each layer. In cross section, the internal material of each shell layer is predominantly very white, producing a striped effect as this is separated by finer layers of blue shell. The layers of the shell have retained lustre and the shattered fragments have remained complete. At x20 magnification the complexity of the undulating layering in cross section is revealed and the observations regarding shell coloration made above are supported. The white material forming the internal body of the shell layer appears to be structured perpendicularly to the (finer and harder) surface of each layer.

**MDO.450.** In cross section, the previously white internal layers of the shell now also display a general blue/grey colouration, although this remains lighter than the shell layer surfaces. A softer surface texture and loss of internal lustre are also apparent, and the shell has begun to delaminate into small fragments. At x20 the fully integrated nature of some fine quartz-rich sand layers between the shell layers is apparent in this sample.

**MDO.550.** Is heterogeneous. Some fragments display an even blue/grey colouration in all layers including in cross-section. Other fragments are very white and have turned into a white-coloured powdery material. There is a marked increase in delamination and fragmentation and, in cross-section, extensive radial cracking between shell layers can be seen. At x20 the structure of the shell layers in cross section is variable. Where the shell material has turned to powder the perpendicular structure appears to have been lost.

**MDO.650.** The shell displays some slight brown coloration, which appears to be related to the sand content of the material, and some slight marbled blue/grey colouration on the surface of the shell layers. Otherwise the material is now completely white with very little density, highly fragmented and powdery. At x20 in cross section some fragments still display a slight but distinct grey colouration to the layer surfaces and white internal material. Others are now completely white, and in one deliberately fractured completely white example, the perpendicular structure of the internal layers was still evident.

**MDO.750.** Some brown (sand) and green (organic growth) remain on some layer surfaces, but no blue/grey colouration is apparent and the shell material now appears completely white, with very little inter-layer coherence, although individual layers do hold together if gently handled. At x20 the perpendicular structure of the internal shell layer material is no longer evident.

**MDO.850.** This sample retains some brown coloration where sand was adhering to the shell material but otherwise the shell is completely white and highly fragmented. Almost the whole sample is now only single or double layer material of very fragile fragments up to 12mm$^2$. At x20 a microstructural layering is apparent within shell layers which had previously appeared to be homogeneous.

Fig. 2.28 - MDO.000; Unheated shattered *O. edulis* shell.

Fig. 2.29 - MDO.450; *O. edulis* shell heated to 450°C for 23 hours.

## 2.2.4 – EXPERIMENTALLY-HEATED *O. EDULIS* SHELL
## Thick & Thin-sections

The structure of the shell of *O. edulis* is reported to be composed of three main layers: a *periostracum*, an outer prismatic layer and a foliated *ostracum* structure although, as in many species of oyster, this foliated structure can also be interrupted by layers of a porous calcite, generally referred to as 'chalk' (Dauphin et al 2013; MacDonald 2011; Karringa 1952, 270). This chalky material was certainly noted in the shell assemblage collected for these experiments, although, as with the *C. edule* shell assemblage, the periostracum did not survive on any of the oyster shells collected for this study.

The foliated structure is very clear in section MDO.350 and appears to be composed of bundles of finer fibres, irregularly orientated but roughly parallel to the orientation of the shell surface (Bøggild 1930, 249). In three-dimensions these 'fibres' are reported to be sheet or ribbon-like structures, termed folia, which form the majority of the shell volume in most oyster genera. Quantitatively, this is true in many of the experimental clasts although in others these foliated layers alternate with a much thicker layer which, as also noted with the hand lens appears to be composed of a much finer material oriented perpendicularly to the shell surface. These 'chalk' layers are only found only in oyster shells (Dauphin et al 2013) but appear to be distributed differently in different species (for instance at the hinge of *C. Gigas in* Macdonald 2011), and their high concentration in this assemblage supports the 'extensive deposits' also reported by in *O. edulis* elsewhere (Karringa 1952, 270; and Mayawaki 1954 in *Gryphaea*). In the shell sections examined here, these chalky layers are often also associated with rounded sand-filled or voided cavities.

The foliated structure in MDO.350 is lustrous with high birefringence and the finer folia remain clear in structure and orientation. In contrast, the chalk layer displays very dull first order colours, and the boundary between these layers is abrupt, even at higher magnification.

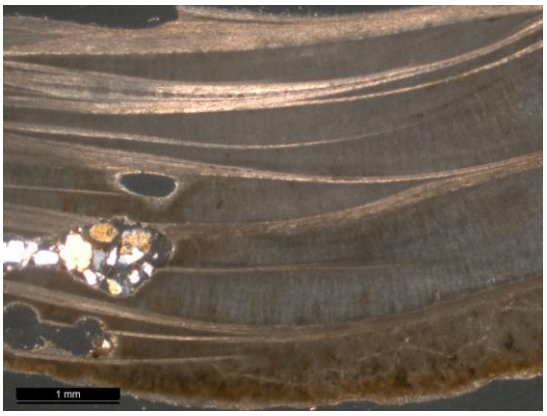
In MDO.550 the foliated layer is still recognisable but has now lost its birefringence and lustre and displays much darker first order browns. The coherence of the finer folia has been lost in localised patches. By contrast, chalk layers now appear coarser and more highly birefringent, although the boundaries between these and the foliated layers are much less distinct, and the overall effect is an apparent homogenisation of the general structure. Some fracturing of the shell structure is also evident in MDO.550, both internally and at the external shell surfaces.

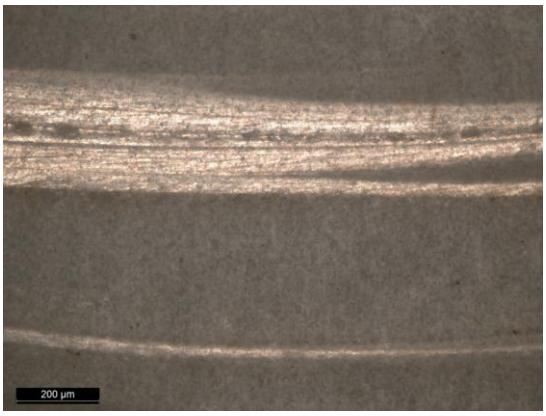
Thick sections

Fig. 2.30 - MDO.350; *O. edulis* 350°C.

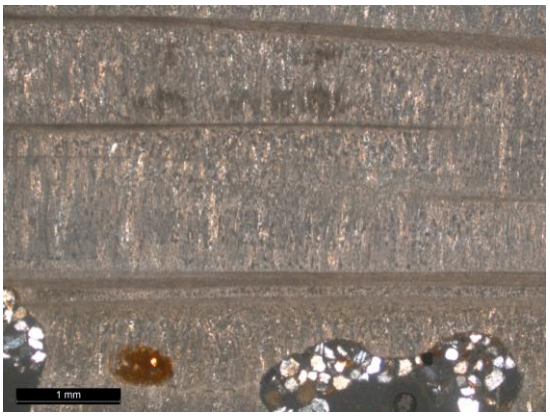
Fig. 2.31 - MDO.550; *O. edulis* 550°C.

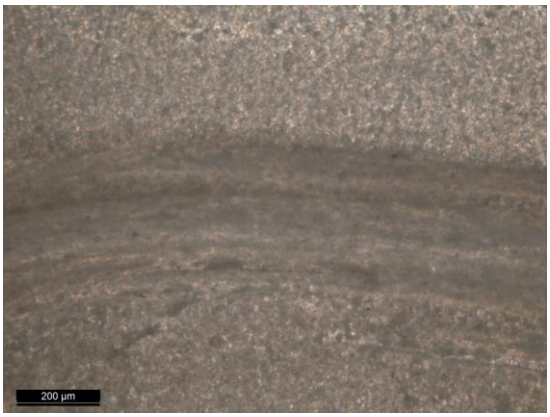
Thin sections




Figures 2.32 & 2.33 - MDO.350; Thin-section of *O. edulis* shell heated to 350°C for 23 hours.




Figures 2.34 & 2.35 - MDO.550; Thin section of *O. edulis* shell heated to 550°C for 23 hours.

## 2.2.5 SUMMARY OF RESULTS OF EXPERMENTALLY HEATED *O. EDULIS*

Thin-section and XRD analysis of post-mortem *O. edulis* shell fragments confirms previous reports that these shells are mainly composed of alternate foliated and chalk layers, both of which are calcite. Although the temperature-specific changes in the shell mineralogy noted in aragonitic *C. edule* are not therefore apparent, these heated *O. edulis* clasts do display a characteristic thermal profile, the mineral phases of which are presented in a line graph and tables below.

At increased low temperatures there is discolouration in the *O. edulis* foliated layers but not in the chalky *ostracum* layers (MDO.350) and this reflects their relative proteinous concentrations (Karringa 1952, 270). This discolouration is also associated with significant increase in the high magnesium calcite (HMC) fraction, and an equivalent decrease in low magnesium calcite (LMC). At temperatures higher than 350$^{o}$C, however, this HMC fraction decreases as the Mg/Ca mol% increases, suggesting the magnesium is being concentrated into a smaller number of unit cells. The relationship between these polymorphs will be discussed further in chapter 3, but from a more pragmatic perspective it is worth noting here that although these antagonistic rising and falling Ca/Mg concentrations cannot be simply correlated with temperature (as they present similar wt % ratios at two contrasting temperatures), when also correlated with mol% and lime or portlandite levels then a useful a useful geo-thermometer does indeed appear to pertain.

Significantly here, once again the XRD results suggest that the shell calcite of *O. edulis* begins to dissociate at low temperatures: beginning at 550$^{o}$C, losing some mass and forming lime in a process which has increased markedly by 650$^{o}$C and is complete by 750$^{o}$C. Again, similar to *C. edule*, these are far lower temperatures than is often quoted 900$^{o}$C required for lime production (see chapter 2) and that this appears to be a reasonably gradual process over the 550-750$^{o}$C range is a significant piece of evidence for our archaeological interpretations of the in-situ materials and underlying production process.

## 2.2.6 – HEATED *O. EDULIS* SHELL KILN-RELICTS – *IN SITU*

Figure 2.36 (above) – Heated O. edulis shell kiln-relict in mortar of Mingary castle N. range.

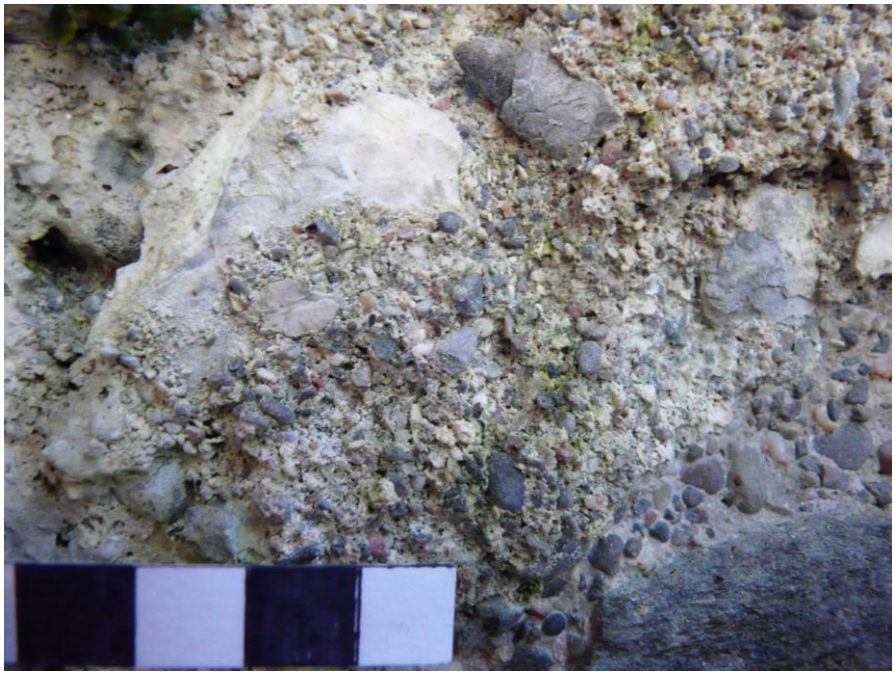


Figure 2.37 (above) – Range of heated *O. edulis* shell kiln-relicts in internal coating mortar of St Ronan's parish church, Iona. Scale 10mm.

## 2.2.7 – HEATED *O.EDULIS* SHELL KILN-RELICTS – Thick Sections

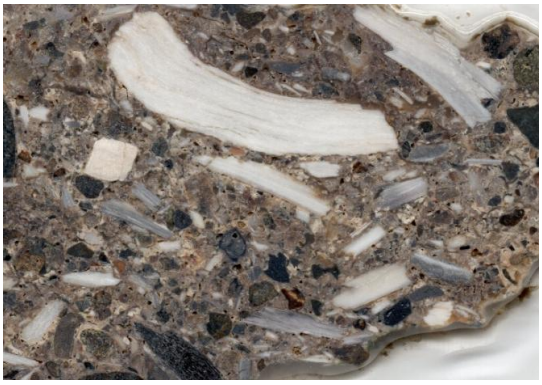


Fig. 2.38 - MCA.033;Mingary N curtain.

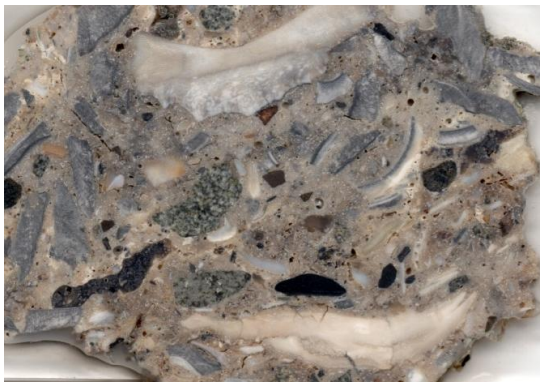


Fig. 2.39 - MCA.016; Mingary SE curtain.

Fig. 2.40 - MCA.044; Mingary N. Hall.

Fig. 2.41 - DCS.B; Duntulm S. Tower.

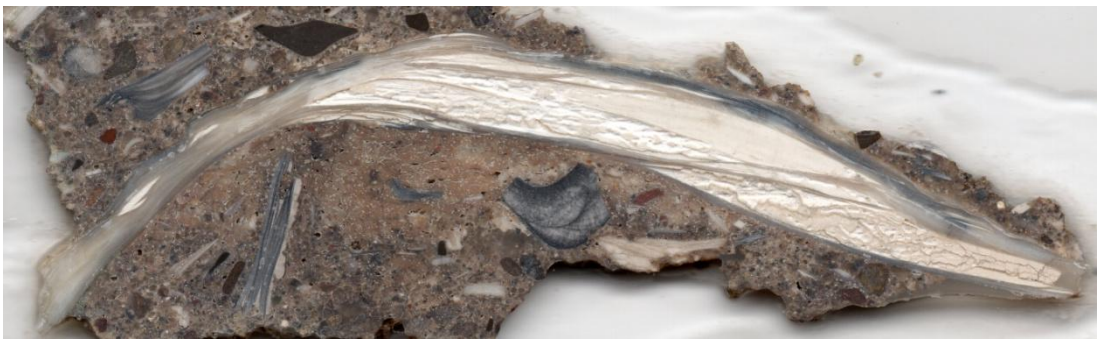


Fig. 2.42 - DCS.G; Duntulm Castle.

## 2.2.8 – HEATED *O.EDULIS* SHELL KILN-RELICTS – Thin Sections

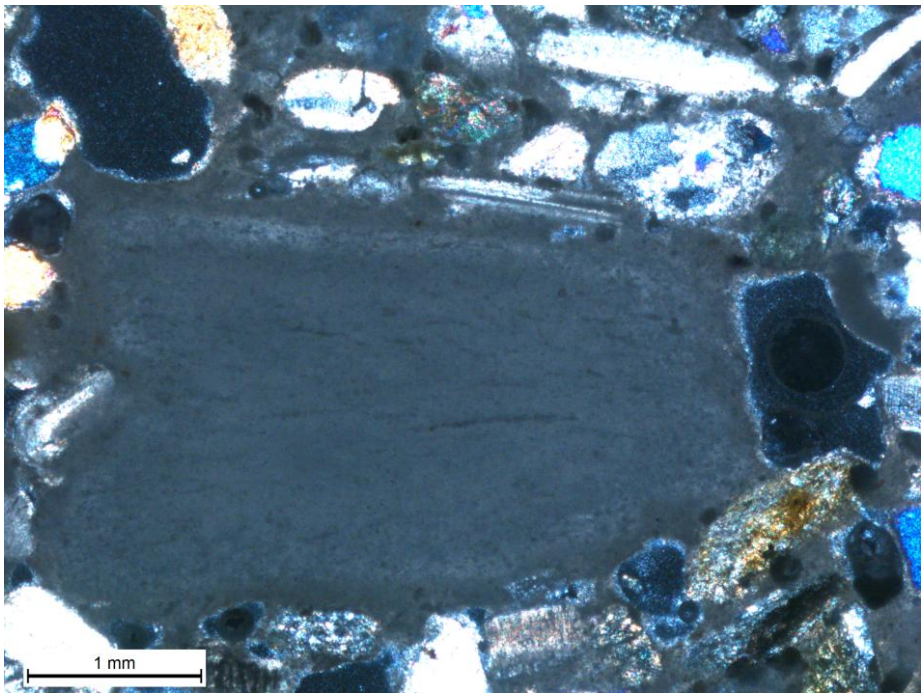



Figure 2.43 (above) – Thin section UCS.02; Uyea Chapel, Shetland; Some relict laminates, but generally almost complete loss of structure and grain boundary becoming increasingly incoherent. Optical continuity with mortar matrix and invasion by lithic temper grains. XPL; Sclae 1.0mm; photomicrograph M. Thacker.

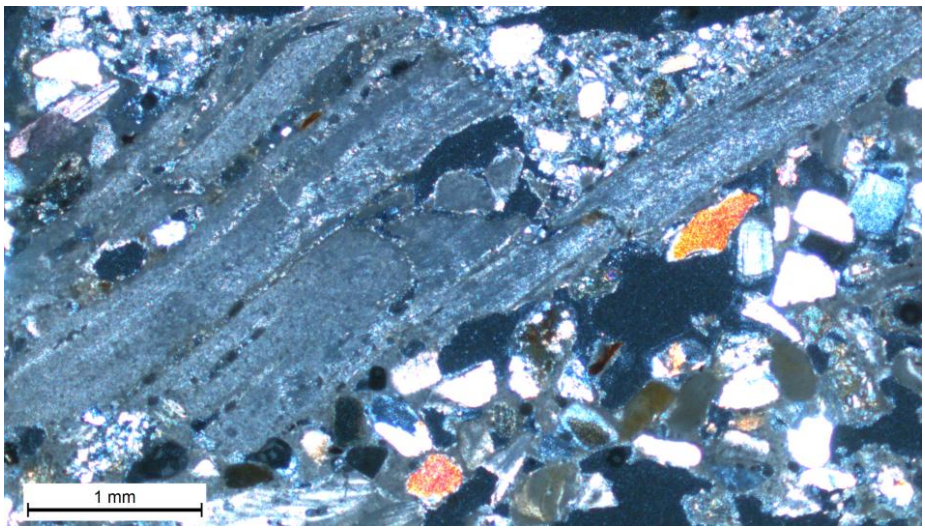



Figure 2.44 (above) – Thin section UCS.02; Uyea Chapel, Shetland; Much retained laminate structure, but fracturing and loss of nternal microstructure. XPL; Scale 1.0mm; photomicrograph M. Thacker.

# 2.3 SHELL-LIME VITREOUS INCLUSIONS OF THE NORTH-WEST REGION

The term 'vitreous inclusion' has been adopted to describe various 'slaggy' melt inclusions noted within a high number of mortars investigated for this thesis. Whilst slags are often associated with over-burnt limestone in published literature, and this phenomenon has occasionally been noted during the research (eg. in the western aisle of *Eaglais na h'Aoidhe*), vitreous inclusions within this survey area are more commonly associated within the shell-lime mortars.

These inclusions are generally black or red in colour, bulbous or spherical in shape, with a very smooth and sometimes lustrous surface texture, and with a high concentration of spherical vesicles internally. As these materials degrade they appear red and apparently iron-rich, and are often clearly fragments of a larger whole. These materials are not associated with all shell-lime mortars, and can be very rare or in high concentration depending on the site or phase.

It is certain that the simplistic terminology adopted here covers a range of different materials but, as biogenic-limes are so rarely described in published research, this study represents a preliminary attempt to characterise a number of examples. In line with the methodology adopted throughout the thesis, the fundamental challenge initially is to determine whether the clast under examination is a kiln-relict, added-temper, or something completely different, and vitreous inclusions from three North-West Region medieval mortars – at Teampull Ronain (North Rona), Rubh an Teampail (Harris) and Duntulm Castle (Skye) - were subject to further investigation. These included a very high volume of often large (grading up to 30mm+) variously shaped examples noted in the shell-limes of Duntulm Castle; a very high concentration of much smaller highly spherical inclusions in *Teampull Ronain* North Rona, and a very low concentration of bulbous fragments to 15mm from *Rubh an Teampail*, Harris. Added to these studies is a preliminary investigation of vitreous inclusions from an experimental shell-lime burn.

## 2.3.1 VITREOUS MATERIAL; DUNTULM CASTLE

The vitreous evidence at Duntulm Castle is in particularly high concentration in DCS.H where inclusions to 32mm are evident which in a range of subangular to rounded shapes, and a spectrum of colours from a very deep rusty red to completely black. The macroscopic form of these clasts is more visible in thick-section, where a high concentration of small spherical vesicles is clear (see figures), and this evidence initially suggests three main processes: 1, the spherical shape of

these vesicles indicates gas exchange; 2, the size of the vesicles indicates the clast must have been molten when that gas was exchanged; and 3, the survival of the vesicles indicates those gas bubbles were trapped when the clast solidified.

Given the igneous geology of the region, however, this thick-section morphology still does not demonstrate whether these inclusions are 'kiln-relict' or 'temper-addition', and so we need to examine the thin-sections to make a petrographic evaluation.

In thin-section a range of clasts have a relict dolerite core which suggest these inclusions have been formed from a mafic protolith, and from this earlier stages of the reaction process where doleritic and gabbroic crystalinities have been only very partially altered can be noted. The grain boundaries of these low grade clasts are fractured and evidence a porosity as the general coherence of the polymineralic protolith has been lost, and these clearly contrast with those of the higher grade altered clasts which display clear, smooth and very opaque external and vesicled boundaries. Indeed, many of the high grade products which are not very rounded are clearly fractured fragments of a once larger opaque bulbous clast. There is a close relationship between these vitreous inclusions and some highly calcined lime carbonate contexts within the mortar, but the lime does not appear to be the primary driver of the clast alterations.

Further investigation of the Duntulm vitreous assemblage has been temporarily stymied by a lack of comparative temper samples. The alteration of feldspar-rich rocks in detrital aggregates and increased porosity of grain boundaries is not uncommon in aggregates sourced from marine environments and, although these vitreous inclusions are only associated with shell-limes, the added relationship between the shell-lime assemblage from this site and coarser gabbroic gravel added tempers makes the association problematic until a range of possible tempers can be collected for comparative analysis. At two other sites within the research, however, this comparison was possible and led to interesting results.

### 2.3.2 VITREOUS MATERIAL; *TEAMPULL RONAIN* & *RUBH AN TEAMPAIL*

At the chapel sites of *Teampull Ronain* (North Rona) and *Rubh' an Teampail* (Harris), somewhat similar vitreous clasts were included within the mortars but were not present in the shoreline aggregate which had been confidently identified as the added-temper in both cases.

In thin-section the North Rona inclusions are revealed to be beautifully layered reaction products, in which a generally thin opaque rim surrounded a larger mass of well-developed acicular crystals, which had evidently grown relatively unhindered into a low viscosity melted core. Many of these crystals appeared to have grown from the rim into the melt, but spinaflex textures elsewhere also indicated some crystal seeding from within the melted core itself. These crystals displayed red and yellow first-second order colours in XPL, were pleochroic, with a hint of cleavage, optically negative, and uniaxial. At higher magnification, the rim, or clast boundary, was associated with blocky opaque crystals of magnetite, so confirming these products were indeed Iron-rich. This high iron content had led the candidate to suspect the peat fuel used to burn this shell-lime may have contributed to these reaction products. Vitrified peat slag is well described in both the archaeological and industrial literature but the further investigation of the Rona thin-section evidence indicates there were other contrasts evident between the added-temper of the historic mortars and its putative aggregate source.

The first mortar samples from North Rona had been collected from loose or ex-situ contexts, and, although displaying the same general peat-fired/shell-lime/lithic-tempered technologies, these mortars were interpreted as representative of two different phases on the basis of contrasting ratios of poorly-heated to well-heated shell material, and different lithic/mineral grades. Moreover, in thin section, only one of these mortar types displayed the very evolved iron-rich reaction products described above, whilst the other mortar contained a high concentration of translucent red monocrystalline amphibole clasts, which were often very fractured and displayed very thick opaque iron oxide (‘oxyhornblende’) rims (see figures). Even further, the ‘oxyhornblendes’ of both these mortar materials contrasted with the clean, pleochroic, second order green amphiboles of the aggregate source. This evidence suggests the mineral has been hydroxylated, and the boundaries of the clast and cleavage planes subsequently oxidised. Further comparison revealed that the very well-fired mortar, which showed an extremely high concentration of well-heated (Type 3-4) shells, also displayed the very complex polycrystalline reaction products seen above, whilst the mortar with a high concentration of poorly-heated (Type 2-3) shell clasts, contained no well-developed polycrystalline reaction product evidence at all in thin-section. These North Rona sections suggest that detrital lithic (amphibole sand) grains were included with the shells in the kiln-charge and these have been variously altered, in different constructional phases, depending on the historic firing conditions.

## 2.3.3 VITREOUS MATERIAL; THE BARRA BURN

During the course of this thesis research I was commissioned by Historic Scotland to build a masonry limekiln, modelled on the surviving 19th-century kiln at Ardkenneth (South Uist), and manage a peat-fired cockle shell-lime burn as a public demonstration. The event was also recorded and sampled as an experiment by myself, and of particular relevance to this chapter was the high incidence of vitreous products which were produced.

The burn materials were donated by various people, and, as each contribution was examined by the candidate before the kiln was charged, the high volume of beach sand trapped within many of the *C. edule* shells, and the rusty-red staining of many of the peats was particularly notable. I was particularly interested in establishing what might happen to that all sand in the kiln and after the burn was complete a high concentration of vitreous melt was evident. These very large clasts (150mm+) were particularly concentrated around the edges of the kiln and at the vent, lining the kiln walls but also laying on top of the burnt-out charge remains. A lower concentration was evident within the general charge, mixed in with the other kiln products of altered shell, peat charcoal and a large quantity of ash. These vitreous clasts, however, were clearly reaction products which had not been included within the kiln charge, but had actually been formed during the firing process.

Three characteristics of these vitreous products were immediately apparent, in-situ and hand sample: 1, this material had evidently been very fluid during the burn, as it was now surrounding and binding other kiln-relicts; 2, that the material was now very hard and brittle and displayed a high concentration of vesicles; and 3, that the material was associated with a high concentration of Iron, although this was difficult to distinguish from the orange peat ash in many contexts. Thick and thin sections of the vitreous product from this experimental burn again revealed vesicles trapped within a material characterised by well-developed acicular crystals growing into a low viscosity melt and surrounded by an opaque iron rich rim.

## 2.3.4 XRD OF VITREOUS MATERIAL; NORTH RONA, HARRIS AND BARRA.

Bulk samples of vitreous product from the experimental Barra burn, and bulk samples of selected vitreous inclusions from the medieval mortars of *Rubh' an Teampail* (Harris) and *Teampull Ronain* (North Rona) were ground and analysed by XRD as previously described (see chapter 2). The resultant plots were calibrated by

aligning the small quartz peak, and each sample ultimately correlated to the same suite of 25 mineral phases, a summary of which is included in the table below.

| MINERAL PHASE | BARRA EXPERIMENT/% | TEAMP. RONAIN NORTH RONA/% | RUBH TEAMPULL HARRIS/% | Notes. |
|---|---|---|---|---|
| | | | | |
| QUARTZ | 0.10 | 0.30 | 0.80 | |
| CALCITE | 0.51 | 1.17 | 0.83 | |
| DOLOMITE | 0.64 | 0.03 | 2.97 | |
| ILLITE | 2.21 | 6.00 | 5.50 | |
| MICROCLINE | 1.58 | 7.00 | 7.00 | Alk felds. K-rich |
| MUSCOVITE | 5.10 | 7.00 | 6.40 | |
| ANKERITE | 0.14 | 0.40 | 1.02 | |
| BRUCITE | 0.22 | 0.00 | 0.62 | |
| PORTLANDITE | 0.30 | 0.02 | 0.54 | |
| PERICLASE | 1.11 | 0.00 | 1.21 | |
| ARAGONITE | 0.95 | 0.34 | 1.47 | |
| CALCITE Mg | 1.54 | 0.80 | 1.57 | |
| AUGITE Px | 29.40 | 1.50 | 13.00 | pyroxene |
| ANDALUSITE | 0.62 | 1.52 | 0.46 | |
| OLIGOCLASE 16 | 0.00 | 5.50 | 4.50 | Plag bet, Na & Ca |
| OLIGOCLASE 25 | 3.80 | 7.30 | 6.20 | |
| ANDESINE C-1 | 0.00 | 10.00 | 12.30 | Plag |
| ANDESINE C1 | 1.00 | 0.00 | 6.0 | |
| LABRADORITE | 23.00 | 5.00 | 12.5 | Plag, int to calcic |
| BYTOWNITE | 0.40 | 5.30 | 3.70 | Plag calcic end |
| ANORTHITE | 2.00 | 7.30 | 4.80 | Plag calc end |
| FAYALITE Mg | 3.40 | 3.00 | 1.80 | Olivine, /Fe rich |
| FORSTERITE Fe | 13.20 | 5.80 | 1.50 | Olivine, Mg rich |
| HEMETITE | 1.42 | 9.8 | 0.0 | Fe 3+ |
| MAGNETITE | 7.26 | 15.2 | 3.47 | FE2+ & Fe3+ |

Table 2.8 (above) Mineral phases of various vitreous inclusions measured by XRD.

Most fundamentally it is the essentially lithic, siliceous, and metamorphic or igneous characteristics of these samples which is, once more, in evidence. Feldspars

dominate the compositions of all three vitreous materials (31% of the Barra, 47% of the North Rona, and 57% of the Harris samples), and most of these are plagioclases towards the calcic end of the spectrum. The high pyroxene levels from the Barra and Harris evidence is also notable, as is its absence from North Rona.

The high iron content of the North Rona sample is salient and only hematite fits the description of the red, very well developed crystals described above, and so both magnetite and hematite are very apparent in both analyses (see figures). The high iron content of the experimental Barra product, noted in hand sample, is also a feature of this XRD plot.

The lack of quartz in all the samples is quite remarkable given the similarly gneissic geologies of these three outer Hebridean islands (perhaps especially since both the North Rona and Harris chapels are also near localised pegmatite outcrops). Although It must be remembered that statistically these samples and their associated thin sections only represent a very few small contexts from a much larger archaeological assemblage, these results are consistently siliceous.

### 2.3.5 TOWARDS A GEOLOGY OF THE VITREOUS SHELL-LIME INCLUSIONS OF THE NORTH-WEST REGION

The standard reported data might suggest that melting some of the protoliths above would not be attainable in a medieval peat-fired (as at *Rubh' an Teampail* and *Teampull Ronain*) or wood-fired (as at Duntulm Castle) lime kiln, but the evidence suggests that an altogether more complex alteration process than simple thermodynamic fusion pertains here. Although we can only extrapolate crystallisation paths from geogenic systems with extreme care, we may find some parallels for this anthropogenic process in geological contexts where the re-melting of igneous and metamorphic rocks is evident.

Although the liquidus of the most challenging material discussed above, the basalt/dolerite of Duntulm, is reported to be 980$^{o}$C at one atmosphere, the solidus (or lower limit of flow) of this rock class is significantly lower at around 800$^{o}$C (Carmichael et al 1974), and the material may be quite plastic below this temperature. Furthermore, the solidus and liquidus temperatures for the gneisses of the outer Isles in Barra, Harris and North Rona are significantly lower than this value. The various shell heating experiments undertaken during this PhD research indicate that temperatures above 700$^{o}$C must have pertained in large volumes of these lime kilns, to effectively dissociate the shell from which these mortars have been manufactured, and in some contexts kiln temperatures are likely to have been significantly higher. These temperatures are high enough to make these rocks more

ductile, but crucially are also hot enough to begin to melt various constituents within these polymineralic sands and gravels. Certainly any of the included clays evidenced in the XRD results would have begun to melt by this stage, releasing their constitutional water as a volatile and beginning to react with the surrounding plagioclase common to these igneous and metamorphic lithogies (cf. Kitchen 1985, 660). Pre-reaction alteration and increased porosity in detrital feldspar-rich rocks may even enable this reaction to proceed much earlier, but it is clear, from the thick- and thin-section vesicle evidence from all the sites discussed above, that volatiles were exsolved from these clasts as gas or vapour phases. A high carbon pressure is also likely to pertain within the lime-kiln as a result of the dissociation of the biogenic carbonates, and from the burning fuel (see chapter 2), and this will reduce volatile solubility even further, causing the water vapour to exsolve more rapidly and forming numerous vesicles in the process (Dick 987).

The mass of vesicles which survive in the Duntulm inclusions, however, indicate these exsolved vapours were only able to move very slowly through an evidently quite viscous molten material, and this is consistent with a reaction progressing at temperatures close to the solidus of the rock. Some of the Duntulm vitreous clasts do display much larger vesicles, suggesting they have been held at higher temperatures or for longer durations, allowing the volatile bubbles to coalesce; forming larger vesicles and once more altering the dynamics of the reaction melt in complex ways (see Herd & Pinkerton 1993). This coalescence is also visible in mid-process in a number of clasts, where the perforated inter-vesicle walls have survived to some extent, and this further supports the above interpretation that the clast had high viscosity, and perhaps suggests burn duration, rather than temperature is the more important parameter here. Ultimately this coalescence has reduced the strength of the resultant clast, once it had cooled, leaving it more vulnerable to the fragmentation often observed in these clasts.

Amphibole was the subject of a furnace experiment, not dissimilar to the carbonate experiments described in this thesis, and dehydroxylation to oxyhornblende was reported to begin around 700$^{o}$C with structural decomposition at 930$^{o}$C (Lee et al. nd). This also supports the petrographic interpretations of the contrasting and increasingly opaque mineralogies in the North Rona thin sections described above.

More work is required on the mineralogy of the cooled inclusions of Duntulm, but the opacity of the vitreous inclusion evidence in polarised light suggests the ductile reaction processes outlined above has ultimately changed the ferric-ferrous ratio of the material, and this is supported by the XRD results of the other materials investigated above.

## 2.3.6 TOWARDS AN ARCHAEOLOGY OF THE VITREOUS SHELL-LIME INCLUSIONS OF THE NORTH-WEST REGION

Archaeologically, this investigation of the distribution and microstructure of the vitreous inclusions of the NWR is most significant in clearly demonstrating their lithic origins, and their association with shell-lime mortars. The vitreous inclusions investigated here at North Rona, Harris and Barra are not kiln linings (s.s) or sintered limestone, but are incidental relicts of the shell collection and lime burning process. Neither have they imparted any significant hydraulicity to the mortar (contra. Müller & Correa 2005); in section the vitreous inclusions of Duntulm and North Rona most usually display very clear grain boundaries, and this should be contrasted with hydraulic evidence elsewhere in this thesis which is much more pervasive within, or integral to, the mortar matrix.

Another 'incidental' source of detrital lithic materials is most especially associated with *O. edulis* shell-limes, as it is evident that detrital sands are often incorporated between shell laminations, and quartz is evident in the XRD results of many shell materials. Pavia (2010) has suggested this may have formed hydraulic products in the shell-lime mortar of *Skellig Michíl*, but this has not been a salient feature of the shell-limes examined for this thesis so far.

A preliminary investigation of vitreous shell-lime material has been used to differentiate built masonry phases different shell-limes at North Rona, and suggested phase-specific kiln environments may have pertained. Elsewhere, archaeologists have used similar amphibole alterations to identify material provenances and firing techniques in a range of ceramics where it is important to differentiate added tempers from materials naturally included within the clay paste. In a number of studies 'hornblende has been partially or wholly altered to oxyhornblende [and the] degree of alteration seems to relate to firing conditions (Stark et al. 2000: 312; my italics; see also Dickinson & Green 1973, np).
That firing temperatures in ceramic and lime kilns can be of very similar orders is indicated by Bedford et al's investigation of fired tempers in the late medieval/early modern ceramics from the Old and New worlds, where the archaeologists are also concerned with the parallels and potential of comparing geogenic and anthropogenic evidence as:

"...oxyhornblende... occurs in selected Oceanian tempers ...only as acicular needle-like crystals in temper sands derived exclusively from volcanic rocks. Its ubiquitous occurrence in the Spanish sherds, both as separate mineral grains and as crystals within granitic rock fragments, stems from kiln firing that achieved higher

temperatures than the bonfires used for indigenous Oceanian pottery making. Ordinary igneous hornblende was converted to oxyhornblende, unknown naturally from granitic rocks or derivative sands, by oxidation in kilns where high-temperature oxidizing environments mimic conditions that produce oxyhornblende during volcanic eruptions…" (Bedford et al. 2009:83).

Hornblende oxidises during cooling, but these inclusions effectively demonstrate how extreme the physico-chemical environment of the lime-kiln can be.

## 2.3.7 SHELL-LIME VITREOUS INCLUSIONS - FIGURES

Figure 2.45 (above) - Vitreous inclusions within mortar of *Teampull Ronain*, North Rona. Field of view approximately 35mm.

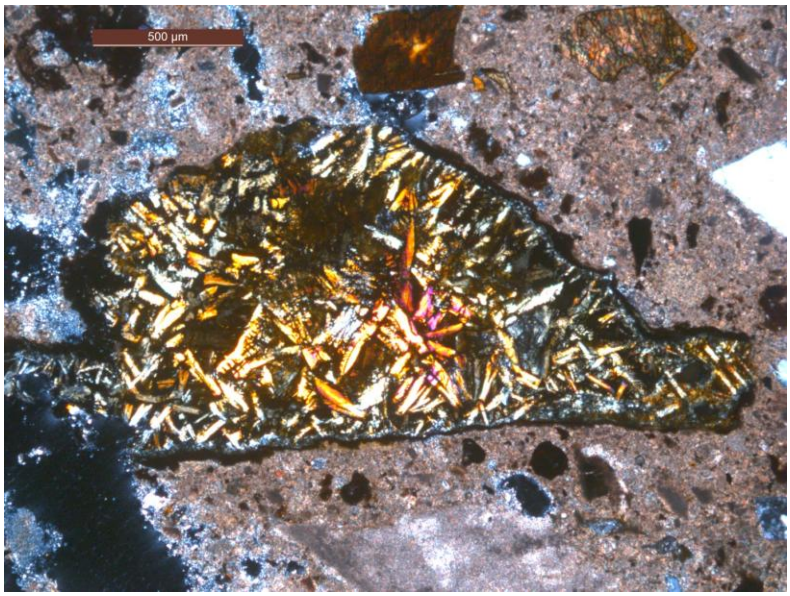



Figure 2.46 (above) – Thin section of vitreous inclusion from *Teampull Ronain* North Rona, exhibiting well-formed crystals growing unhindered into a melt. These display red and yellow first-second order colours and are pleochroic, with a hint of cleavage, optically negative, and uniaxial. Sclae 500µm; photomicrograph M. Thacker.

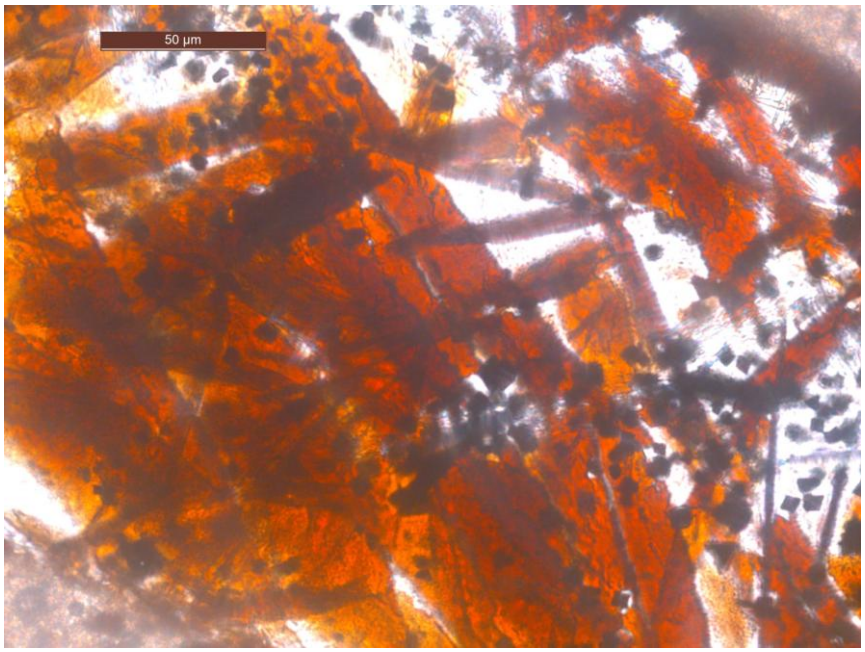
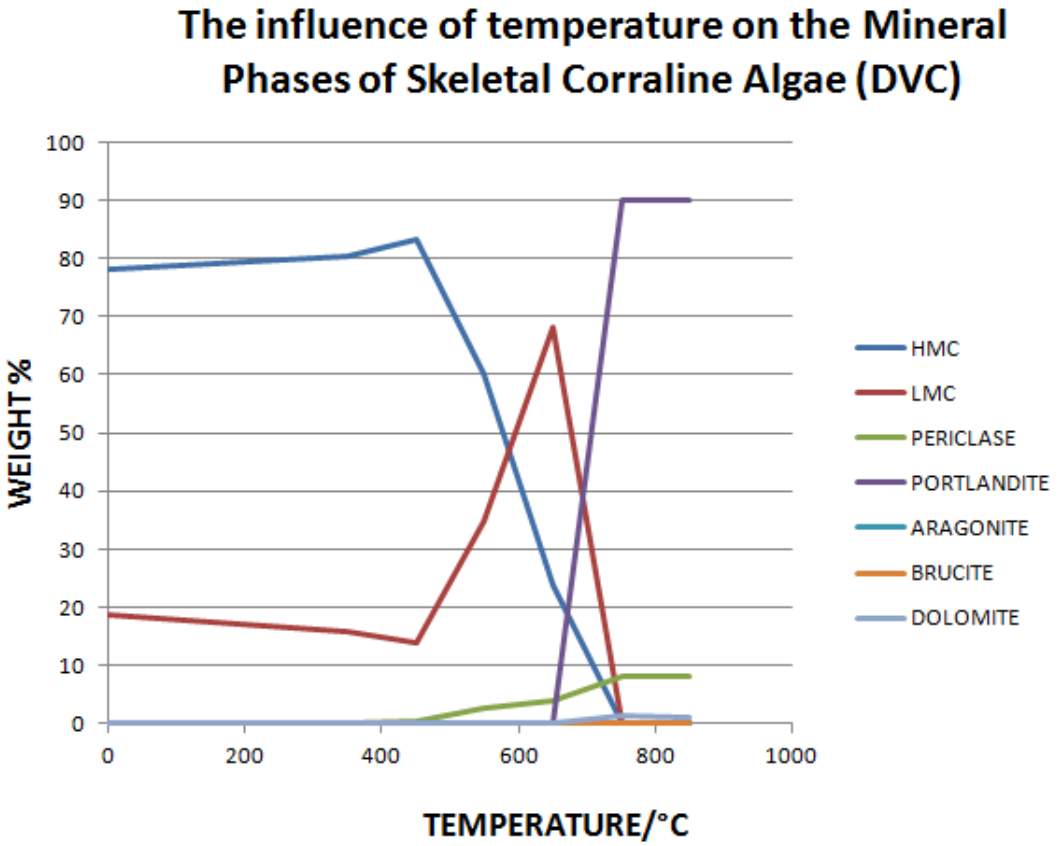



Figure 2.47 (above) – Thin section of vitreous inclusion from *Teampull Ronain* North Rona at higher magnification in PPL, note the blocky opaque crystals of magnetite. PPL; Scale 50µm; photomicrograph M. Thacker.

# APPENDIX 3

## 3.1 – MAERL-LIME MORTARS

### 3.1.1 MINERAL PHASES OF HEATED MAERL




Graph 3.1 (above) Mineral phases of Maerl; Weight % plotted against temperature.

Table 3.1 (below) Weight % mineral phases of experimentally heated Maerl.

| TEMPERATURE | HMC | LMC | PERICLASE | PORTLANDITE | ARAGONITE | BRUCITE | DOLOMITE |
|---|---|---|---|---|---|---|---|
| **0** | 78.2 | 18.8 | 0 | 0 | 0 | 0 | 0 |
| **350** | 80.5 | 15.9 | 0 | 0 | 0 | 0 | 0 |
| **450** | 83.3 | 13.8 | 0.4 | 0 | 0 | 0 | 0 |
| **550** | 60.1 | 34.7 | 2.7 | 0 | 0 | 0 | 0 |
| **650** | 23.9 | 68.2 | 4.1 | 0 | 0 | 0 | 0 |
| **750** | 0 | 0 | 8 | 90 | 0 | 0 | 1.3 |
| **850** | 0 | 0 | 8 | 90 | 0 | 0 | 1 |

Table 3.2 (below) Mol. % and Ca/Mg ratios of HMC in experimentally heated Coralline Algae. (LMC is assumed to have zero Mol% Mg in Reitveld analysis.

| **Temperature** | HMC-Ca | **HMC-Mg** | Cell Volume |
|---|---|---|---|
| **0** | 85 | **15** | 353.94 |
| **350** | 88 | **12** | 353.7 |
| **450** | 89 | **11** | 353.39 |
| **550** | 91 | **9** | 359.41 |
| **650** | 96 | **4** | 361.34 |

## 3.1.2 MASS CHANGES IN EXPERIMENTALLY HEATED MAERL.

| SAMPLE CODE | TEMPERATURE/°C | WEIGHT/g | Weight Retention |
|---|---|---|---|
| DVC.000 | 000 | 30.00 | 100% |
| DVC.350 | 350 | 29.1 | 97% |
| DVC.450 | 450 | 28.7 | 96% |
| DVC.550 | 550 | 27.8 | 93% |
| DVC.650 | 650 | 26.5 | 88% |
| DVC.750 | 750 | 16.3 | 54% |
| DVC.850 | 850 | 17.1 | 57% |

Table 3.3 (above) Mass changes in experimentally-heated maerl.

Figure 3.1 (above) – High concentration of maerl in literal cell on west side of Wyre (Orkney). Scale 500mm; photograph M. Thacker.

## 3.1.3 EXPERIMENTALLY-HEATED MAERL – HAND SAMPLES

Fig. 3.2 - DVC.000 – unheated maerl.

Fig. 3.3 - DVC.350 – maerl heated to 350°C.

Fig. 3.4 - DVC.450 – maerl heated to 450°C.

Fig. 3.5 - DVC.550 – maerl heated to 550°C.

Fig. 3.6 - DVC.650 – maerl heated to 650°C.

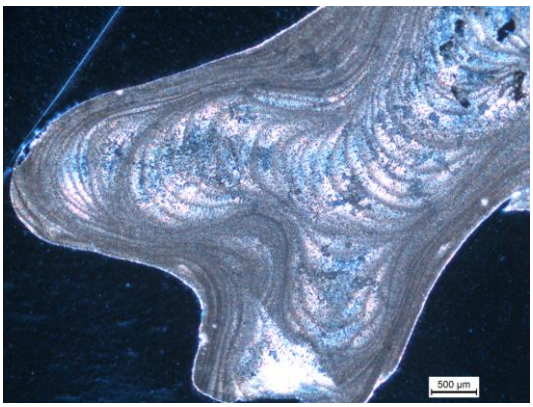
Fig. 3.7 - DVC.750 – maerl heated to 750°C.

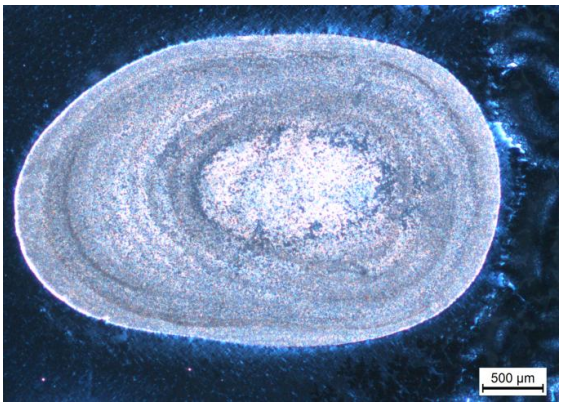
## 3.1.4 EXPERIMENTALLY-HEATED MAERL – THICK-SECTIONS

Figure 3.8 (above) - DVC.350 – Thick-section of maerl heated to 350°C.

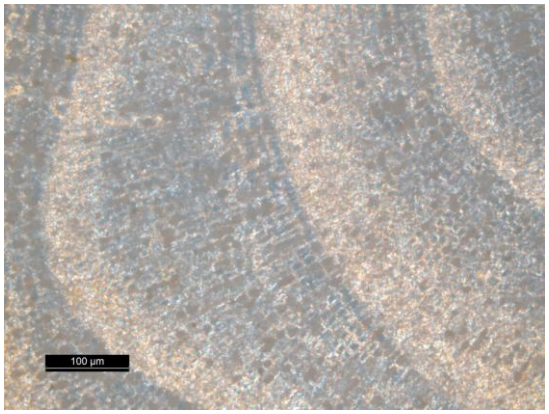
Figure 3.9 (above) - DVC.550 – Thick-section of maerl heated to 550°C.

## 3.1.5 EXPERIMENTALLY-HEATED MAERL – THIN-SECTIONS

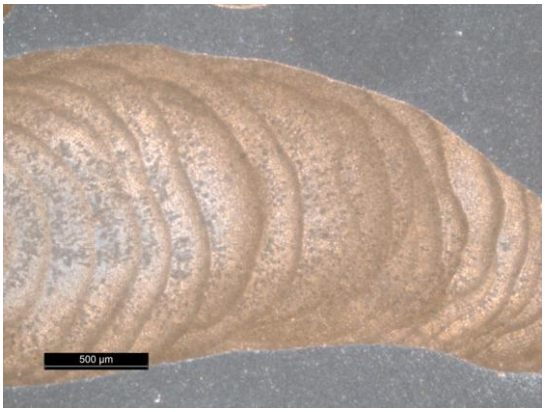


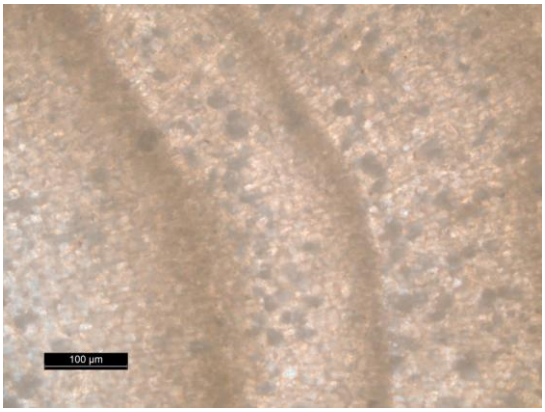




Figs. 3.10 & 3.11 (above) – DVC.000 Thin-section displaying oblique/longitudinal section of unheated probable *L. Glaciale* thalli. XPL; Scale 500µm; photomicrograph M. Thacker.


Figs. 3.12 & 3.13 - DVC.350–Thin section; Sharp definition summer and winter growth. XPL.




Figs. 3.13 & 3.14 - DVC.550 – Thin section; Concentric structure still very salient, but a loss of birefringence in winter growth which is now much darker; Radial filaments are still complete in large areas and lumen filled; Loss of definition between summer and winter growth with very fine material around winter growth. XPL; photomicrograph M. Thacker

## 3.1.6 MAERL-LIME MORTARS *IN SITU*.

Figures 3.15 & 3.16 (above) – Altered maerl in primary coating; Eynhallow Church, Orkney. Scale 10mm; photographs M. Thacker.

Figure 3.17 (above) – Range of altered maerl clasts in primary coating at St Mary's, Wyre, Orkney (Scale 10mm; photograph M. Thacker.

Figure 3.18 (above) – Range of altered maerl clasts in primary bedding mortar at St Mary's, Wyre, Orkney. Scale 10mm; photograph M. Thacker.

Figure 3.19 (above) – Range of altered maerl clasts in primary bedding mortar at St Mary's, Wyre, Orkney. Field of view approx. 60mm; photograph M. Thacker.

## 3.1.7 MAERL-LIME MORTARS – THICK SECTIONS

Figure 3.20 (above) – Thick section SMW.02; St Mary's, Wyre, Orkney.

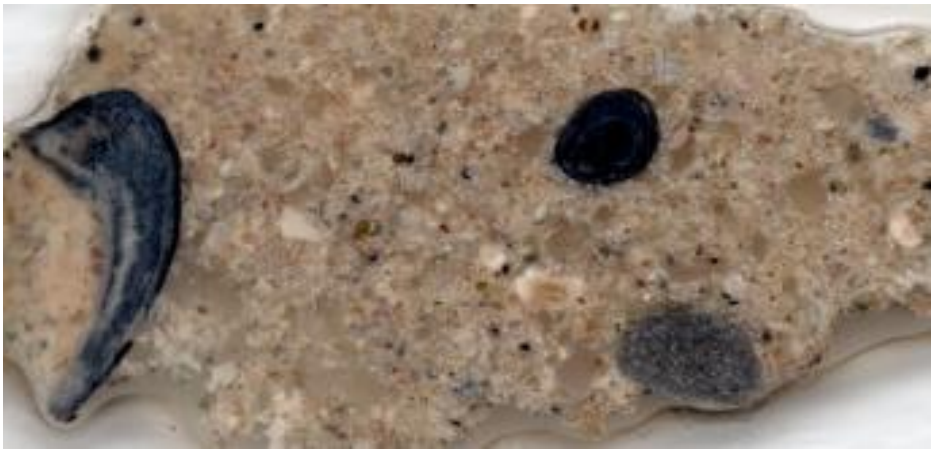


Figure 3.21 (above) – Thick section SMW.03; St Mary's, Wyre, Orkney.

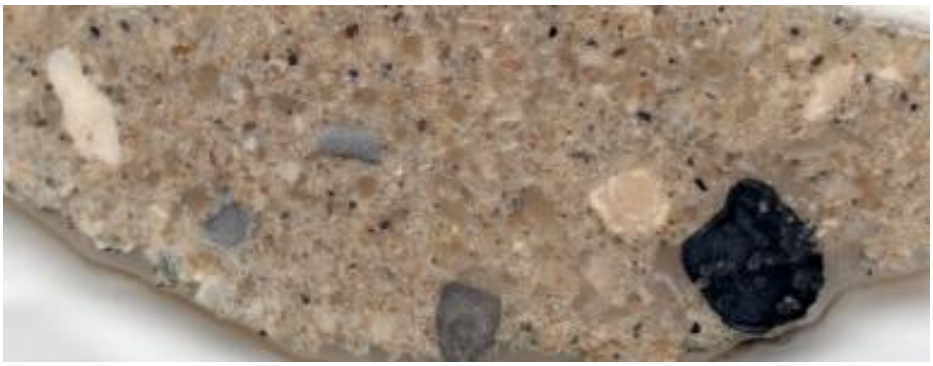
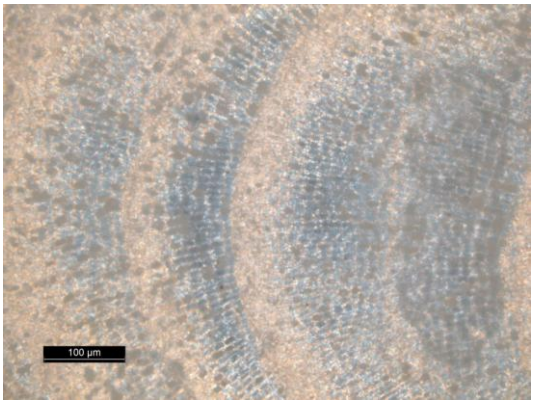
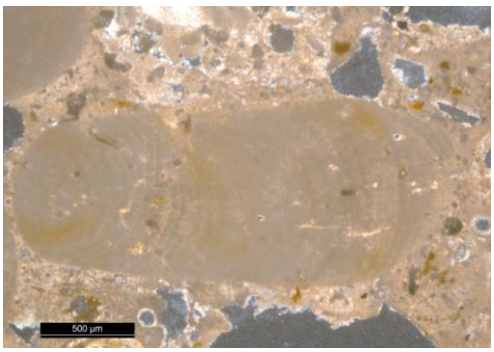


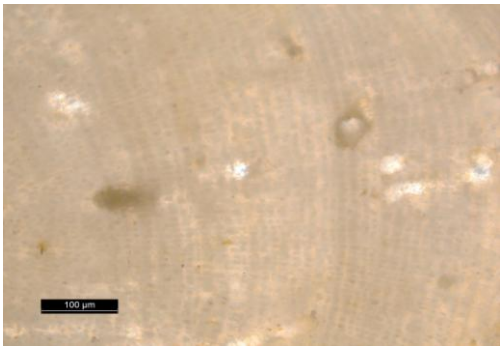
Figure 3.22 (above) – Thick section SMW.03; St Mary's, Wyre, Orkney.

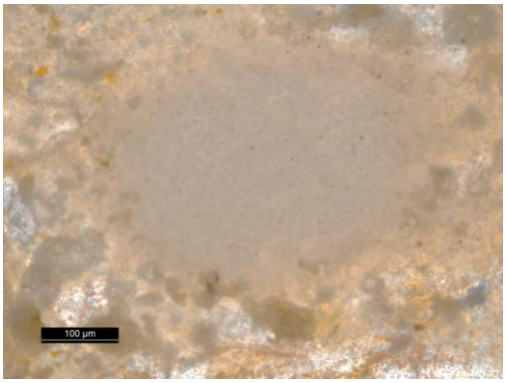
## 3.1.8 MAERL-LIME MORTARS – THIN SECTIONS

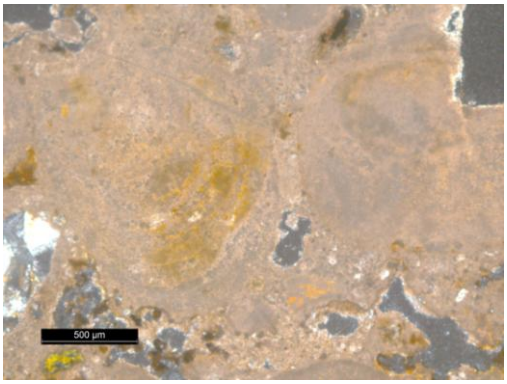




Figs. 3.23 & 3.24 - DWH.01 – Thin sections; Wide view of temper clast. Note clearly defined grain boundary and summer/winter growth; radial filaments and clear lumen. XPL.

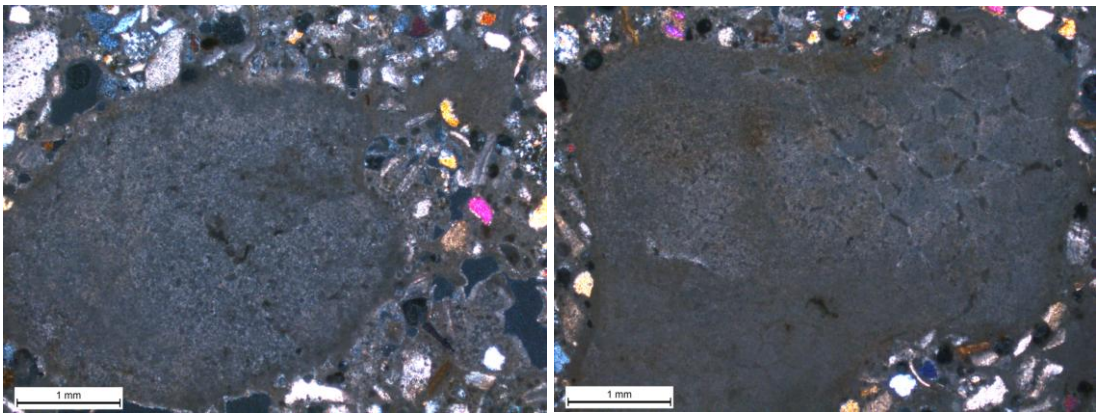



Figs 3.25-3.28 – Sample IPA.09 – Thin sections; Little or no burst cells apparent here. The oblique/longitudinal section clast also displays an apparently finer crystallinity at this scale, with some bright orange/brown 'staining'; relict cellular structure is now defined by lumen filled with darker cryptocrystalline carbonate, rather than the filaments which now appear coarser in external form and crystalline texture: i.e. opposite to DVC.550. In general, however, these grains betray a finer hazy cryptocrystalline texture and optical continuity with the mortar matrix.XPL.




Figures 3.29 & 3.30 - SMW.02 – Wyre church; transverse and oblique sections; both exhibit loss of microstructure and grain boundary, mosaic crazing and cryptocrystallinity. XPL .

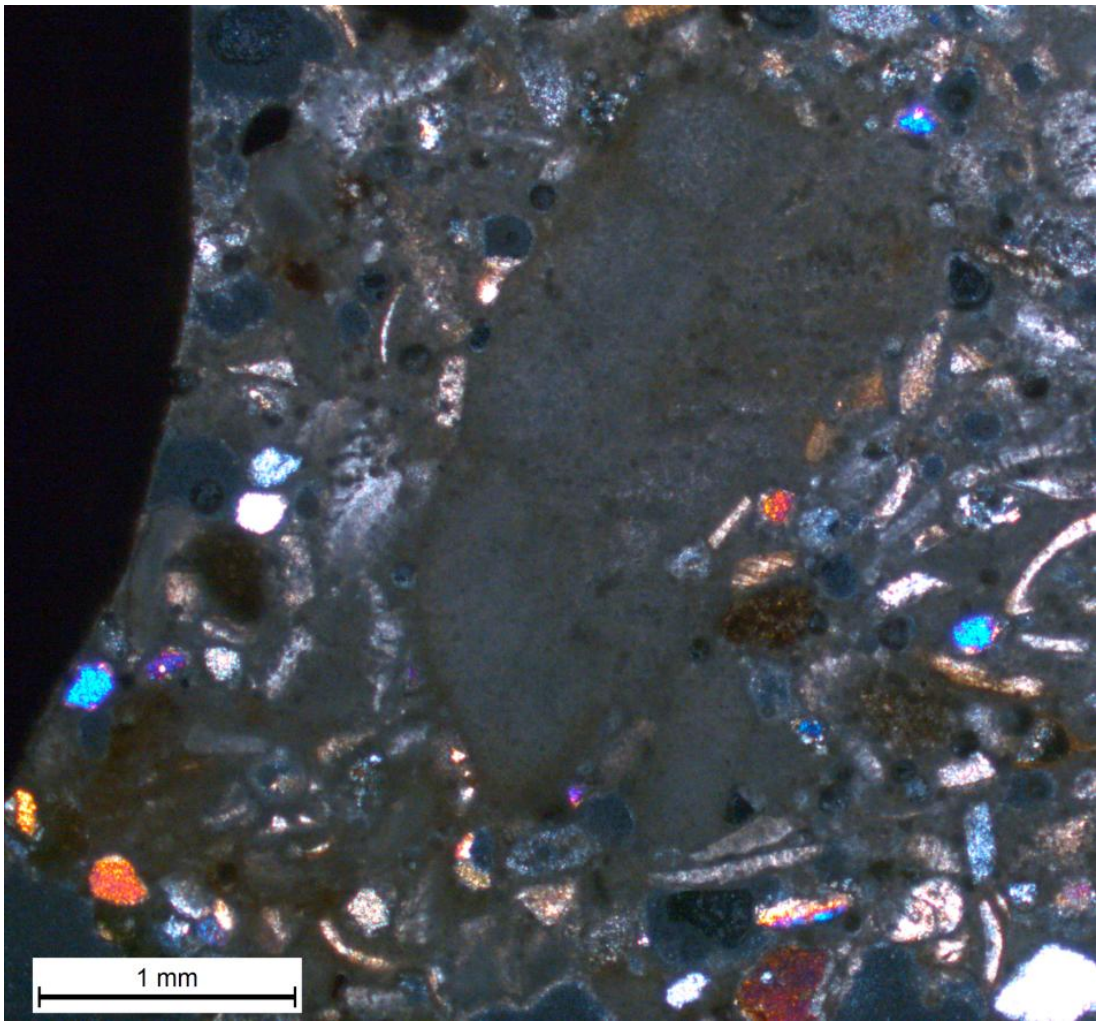
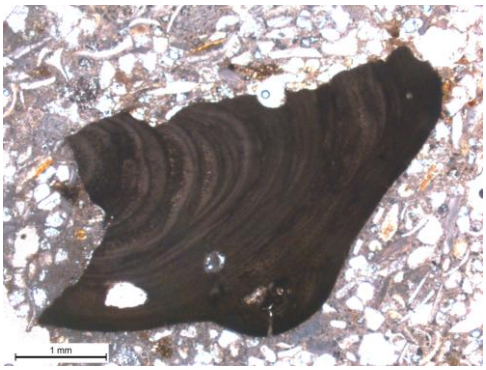



Figure 3.31 - SMW.02 – St Mary's Wyre; longitudinal section of an altered maerl clast exhibiting almost complete loss of structure and boundary and is close to complete optical continuity with mortar matrix. XPL; photomicrograph M. Thacker.



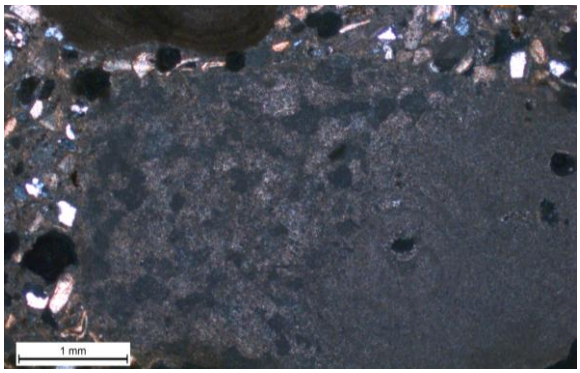




Fig. 3.32 - CWO.02; discoloured maerl. PPL. Fig. 3.33 – CWO.02; coarse mosaic crystallinity.

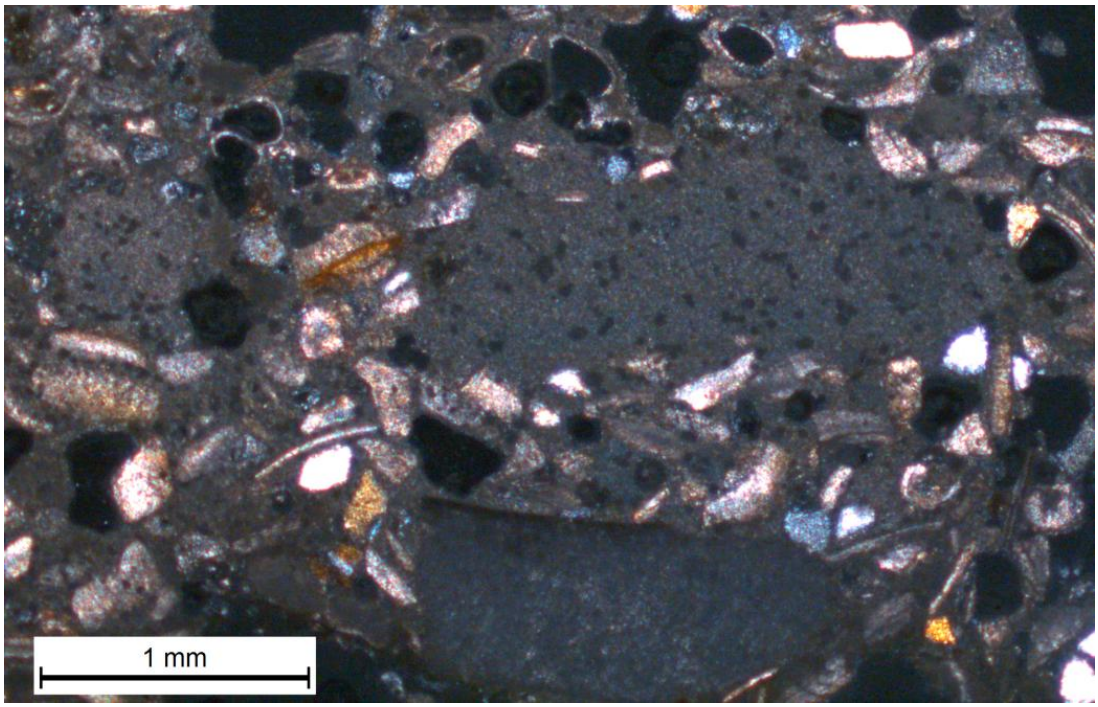



Figure 3.34 (above) – CWO.02; Cubbie Roo's Castle, Wyre, Orkney; range of highly altered maerl clasts with almost complete loss of structure and close to optical continuity with mortar matrix. XPL; photomicrograph M. Thacker.

# APPENDIX 4

## 4.1 RELICT MORTAR FUEL IN THE SCOTTISH NORTH ATLANTIC

### 4.1.1 MEDIEVAL FUEL RELICT EVIDENCE IN SOUTH-WEST REGION

| MEDIEVAL SITE | HAND SAMPLE/IN SITU | THIN SECTION |
|---|---|---|
| Aros Castle | wood char | |
| Castle Sween | wood char | |
| Dunyvaig Castle | wood char | |
| Dunstaffnage | wood char | |
| Iona | wood char; peat later. | |
| Keills chapel Islay | wood char | |
| Ardnave Church, Islay | wood char | |
| Kildalton Church, Islay | wood char | |
| Mingary Castle | wood char | wood char |
| Rothesay Castle | wood char | |
| St Blane's Chapel | ?wood char | |
| Tarbert Castle | wood char | |
| Fincharn Castle | wood char | |
| Killneuar Church | wood char | wood char |
| Craignish Church | wood char | |
| Skipness Castle | ?wood char | |
| Dunaverty Castle | wood char | |
| Lachlan Castle | Wood char | |
| Killean Chapel, Kintyre. | Wood char | |

| | |
|---|---|
| Kilmory Knap Church | Wood char |
| Saddell Abbey | Wood char |
| Southend Kintyre | Wood char |
| Duart Castle, Mull | Wood char |
| Castle Moy, Mull | Wood char |
| Kilviceuen, Mull | Wood char |
| Ardtornish Castle | Wood char |
| Coeffin Castle | Wood char |
| Achadun Castle | Wood char |

### 4.1.2 MEDIEVAL RELICT MORTAR FUEL EVIDENCE IN NORTH-WEST REGION

| MEDIEVAL SITE | HAND SAMPLE/IN-SITU | THIN SECTION |
|---|---|---|
| Borve Castle (BENBECULA) | Peat | |
| Eaglais na h'Aoidhe (LEWIS) | Peat | Peat |
| Rubh' an Teampail (HARRIS) | Peat | Peat |
| Howmore (SOUTH UIST) | - | Peat |
| Trumpan church, (SKYE) | Peat | |
| Castle Camus (SKYE) | Wood char | |
| Duntulm (SKYE) | Wood char | |
| Dunscaith (SKYE) | Wood char | |
| St Marys Shiants (SHIANTS) | - | Wood char |
| Brochel Castle (RAASAY) | Wood char | |
| Castle Tioram (LOCHABER) | Wood char | |
| Inverlochy Castle (LOCHABER) | Wood char | |

| | |
|---|---|
| Eilean Donnain Castle (ROSS) | Wood char |
| Strome Castle (ROSS) | Wood char |
| Ardvreck Castle (SUTHERLAND) | Wood char |
| Castle Varraich (SUTHERLAND) | Wood char |

### 4.1.3 MEDIEVAL RELICT MORTAR FUEL EVIDENCE IN NORTH-EAST REGION

| MEDIEVAL SITE | HAND SAMPLE/IN SITU | THIN SECTION |
|---|---|---|
| Tuquoy Hall (ORK) | - | Peat |
| Crosskirk Tuquoy (ORK) | Fuel | Peat |
| St Marys Wyre (ORK) | Peat Char | |
| Cubbie Roo's Castle (ORK) | - | Peat |
| Linton chapel (ORK) | - | Fuel |
| Uyea chapel (SHET) | - | Peat |
| St Peter's Thurso (CAITH) | Fuel | Peat |
| Muness Castle (SHET) | Peat | |
| St Duthoc's, Suddie (ROSS) | Peat | |
| Urquart Castle (ROSS) | Wood Char | |
| Duthoc's Chapel, Tain (ROSS) | Wood Char | |
| St Duthoc's OPC, Tain (ROSS) | Wood Char | |
| Portmahomack, Tarbat (ROSS) | Wood Char | |
| Skelbo Castle (ROSS) | Wood Char | |

## 4.1.4 MEDIEVAL RELICT MORTAR FUEL EVIDENCE - FIGURES

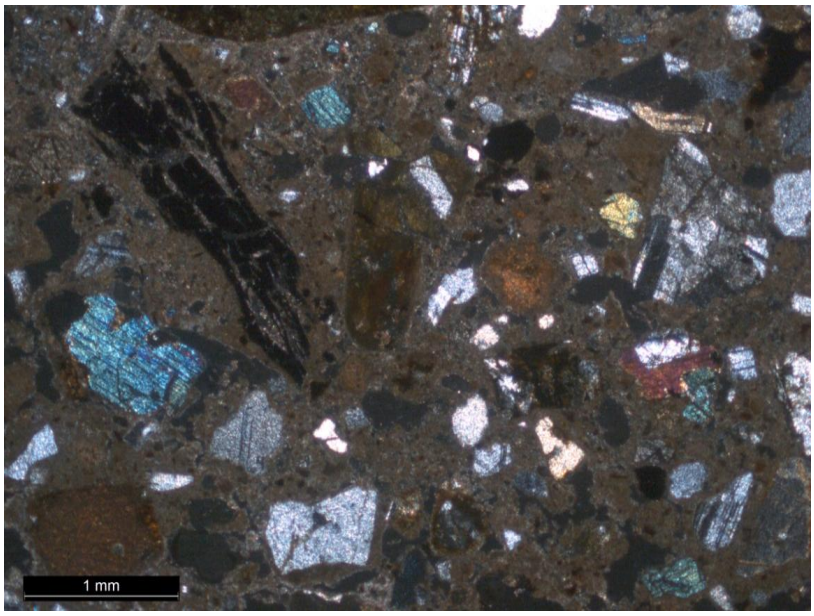



Figure 4.1 (above) – Sample MCA.024; Mingary Castle curtain wall; includes longitudinal section of probable *Quercus* mortar-fuel kiln-relict. XPL; Scale 1.0mm; photomicrograph M. Thacker.


Figure 4.2 (above) – Sample MCA.040; Mingary Castle; transverse/oblique section of wood charcoal mortar fuel kiln-relict; exhibits ring-porous roundwood. XPL; Scale 1.0mm; photomicrograph M. Thacker.

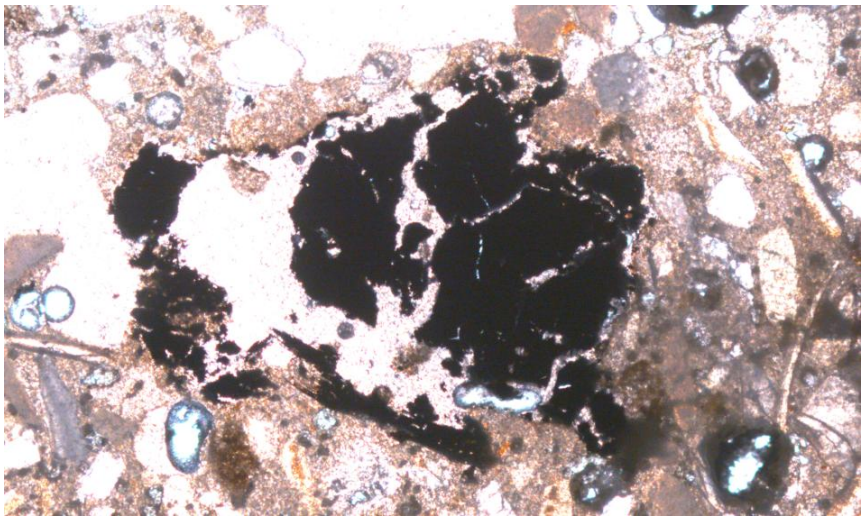


Figure 4.2 (above) – Sample CWO.02; Cubbie Roo's Castle, Wyre; Orkney; amorphously-shaped, crazed and fibrous opaque inclusion; probable peat relict mortar fuel. PPL; Scale 1.0mm; photomicrograph M. Thacker.

# APPENDIX 5

## 5.1 CORE MORTAR DEGRADATION

Over the course of this thesis research it has become increasingly evident that core mortars in ruined buildings often degrade much faster than the mortar binding the rubble of the wall facing. This is probably the result of a number of factors including increased perculation through the wall from unprotected wallheads, and a lack of compression in initial depostion. Ultimately, however, this can often confuse the archaeological evidence as monuments which were originally fully lime-bonded begin to resemble clay-bonded and limecoated initially, and then dry-stone and lime pointed.

This is an issue which affects both lime-bonded and clay-bonded buildings and is a particular concern for the characterisation of some very early monuments, where only lime coatings remain (see chapter 5). This also appears to be a particular issue for buildings constructed from flat-laid flaggy stones, as the inherent structural stability of this stone emplacement technique allows buildings to remain upstanding even where no mortar remains. That these are often also early buildings may compound the characterisation issue.

### 5.1.1 CORE MORTAR DEGRADATION - FIGURES

Figures 5.1 & 5.2 (above). Formerly fully lime-bonded, the core mortar in these structures has degraded much faster than the bedding and coating leaving a very voided core which can look like pointed or coated dry-stone. Kilvickeon, Mull and St Ninian's Point, Bute. Scale 500mm; photographs M. Thacker.

Figure 5.3 (above) – An example of 'shelly clay'. This medieval wall was previously fully lime-bonded, but the core mortar has almost completely degraded to leave a mixture of silty temper and Type 3 *C. edule* shell kiln-relicts. St Duthoc's Chapel, Tain. Scale 10mm; photograph M. Thacker.

Figure 5.4 (above) – Important fragments of core mortar survive in-situ, binding rubble to the back of a face stone. Despite surviving as an almost completely dry-stone structure in which the beds are also largely devoid of mortar, this church was evidently formerly fully lime-bonded. *Teampull Choluim Chille*, Benbecula. mm and cm scale; photograph M. Thacker.

# APPENDIX 6

## 6.1 FIGURES AND SUPPORTING INFORMATION FOR CHAPTER 6

### 6.1.1 MAP 6.1 (below)DISTRIBUTION OF LANDS WITHIN MACGILLECHRIST'S 1240 ROYAL CHARTER 


13 of the 16 farms detailed in the 1240 Royal charter to Gillescop MacGillechrist (MacPhail 1916) are in the parish of Glassary. The Red line on this map indicates parish boundary as described by *Origines Parochiales Scotiae* Vol. 3 part 1(Lizars 1854, 43) and late 18th-century statistical account for Glassary. (Campbell 1791-99).

After MacPhail (1916) and especially Butter (2007, 257-259): *Fyncharne*: Fincharn NM 9003; *Glennane*: Olennan NM 8501 or Glenan in Cowal at NR 9270; *Askol*: Asgog at NR 9468; *Rudol superiori*: Rhudle NR 8494; *Kelmikhel*: Kilmichael Glassary NR 8593; *Kerchennan*: ?Kimun NR 8795; *Naheass*: Auchoish, NR 8690; *Keldouenegarth*: Kildomongart , NR863896; *Drummulin*: Druim a' Mhuilinn, NR 866884; *Cnocnagoloran*: Knocnagullaran, NR932920; *Akhenbreth*: Achnabreck NR 8590; *Strohon*: Strone, NR9697; *Glenfynport*: Glen Finart, NS 1690; *Letherlochhake*: Loch Eck NS 1487; *Rudol inferiori:* Rhudle NR 8494.

# 6.1.2 DISTRIBUTIONS OF NAVE & CHANCEL AND TWIN-LANCET CHURCHES

Figure 6.1 (above) – St Columba's Craignish, Argyll; Twin-lancet, unicameral, lateral nave entrance, coursed rubble, fine-dressed sandstone details, limestone-lime; probably mid- 13th-century; Scale 500mm.

Figure 6.2 (above) – St Mary's Wyre, Orkney; no east window, bicameral, west nave entrance, no fine-dressed sandstone features, biogenic-lime; probably early 12th-century; Scale 500mm.

Map 6.2 (above) – Distribution of bicameral churches and twin-lancet churches in the Scottish North Atlantic. In addition some early bicameral churches in Ireland are shown. 

**+** - NAVE AND CHANCEL CHURCHES IN SCOTTISH NORTH ATLANTIC AND IRELAND;

**+** - TWIN-LANCET CHURCHES IN SCOTTISH NORTH ATLANTIC.

**+** 12TH-CENTURY BICAMERAL NAVE-AND-CHANCEL CHURCHES

Shetland: Uyea; Crosskirk Clibberswick; Kirk o' Ness; St Mary's Sandsting; St John's Norwick; Kirkaby Westing; Hascosay; Kirkhouse Fetlar; Gunstie Noss; St Ninian's .

Orkney: St. Peter's Birsay; St Magnus Birsay; St Magnus Egilsay; Eynhallow; Orphir; St Mary's Wyre; St Thomas Rendell; St Catherine's Linton; St Nicholas Papa Stronsay; Crosskirk Tuquoy; Ladykirk Westray; St Brides Stronsay; St Peters Evie.

Caithness: St Peter's Thurso; St Mary's Lybster; St Drostan's; St Mary Clow; Gavin's Kirk Dorrery; Kirk o' Banks.

Outer Hebrides: Teampull Ronain North Rona; St Peters Shader; Teampull Eoin Bragar; Kildonnan South Uist; St Michael's Barra.

Argyll: St Blane's Bute; St Marnock's Bute.

Ross: Tarbat OPC.

Ireland: Reefert; Trinity; St Peters Waterford; Ratass; Killaloe.

## + 13TH-CENTURY UNICAMERAL TWIN-LANCET CHURCHES

Argyll: St Brides Kilbride; St Columba's Craignish; St Columba's Kilneuair; St Kenneth's Inchkenneth; KilDalton Islay; St Blane's Bute; St John's Killean; Southend Kintyre; Kilmory Knap; St Cormac's; Nave Island; Dunstaffnage; Iona Nunnery; St Michael's Faslane.

Outer Hebrides: Teampull Mòr Howmore.

The Irish churches included here are Ó' Carragáin's type 4 nave and chancel churches (2005), and so does not include those with barrel-vaulted chancels although the Killaloe church near Limerick has been added here to illustrate the distribution more clearly. Were more of these added the concentrated distributions would be even more marked. Only the twin-light churches in the Scottish North Atlantic are included here, and twin light churches in Ireland have not been mapped. Were all 13th-century churches in the Scottish north Atlantic included the concentration in Argyll would be even more marked, as would a heavy concentration in western Ireland.

## 6.1.3 NARROW CHANCEL ARCHES AND WEST NAVE ENTRANCES

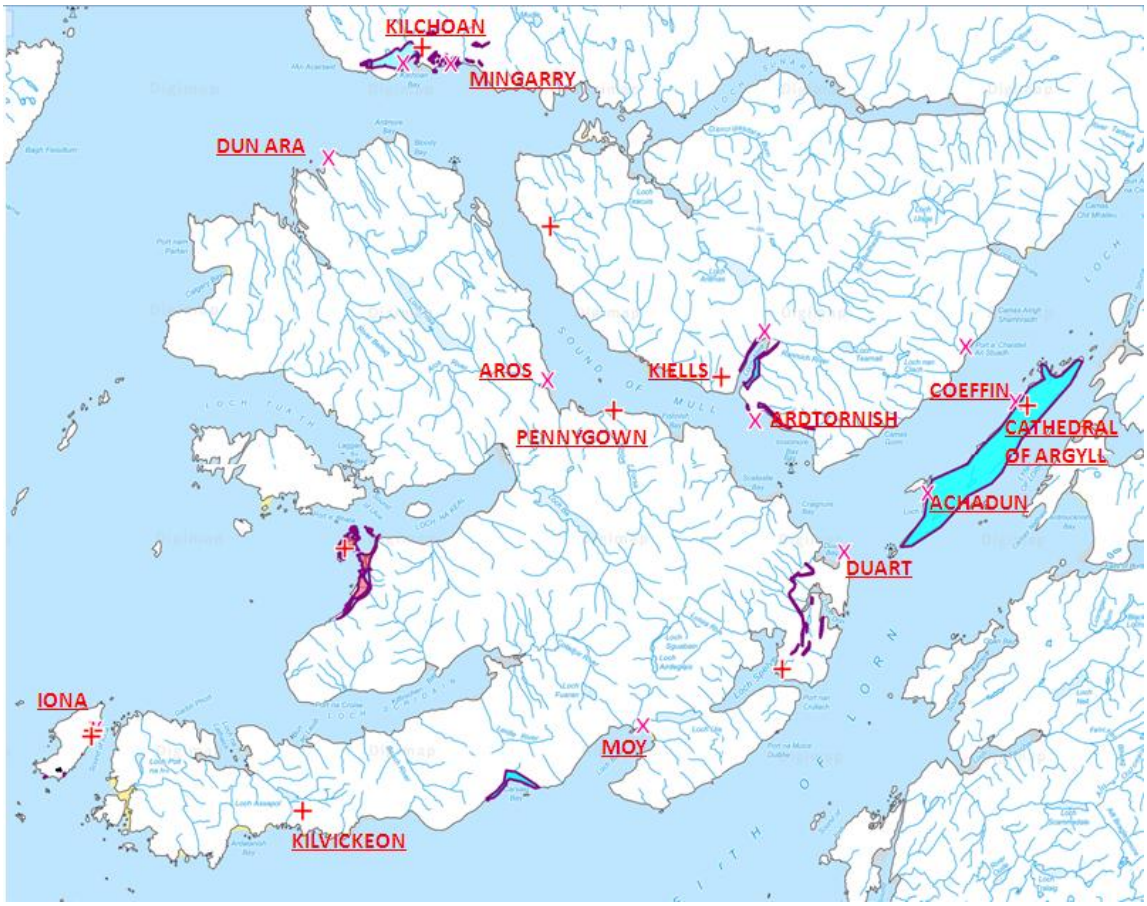
Figures 6.3 & 6.4 (above) - Crosskirk, Lybster, Caithness; Bicameral church; chancel arch in left image and west doorway in right image. Scale 500mm.

Figures 6.5 & 6.6 (above) – Uyea Shetland; Bicameral church; chancel arch in left image and west doorway in right image. Scale 500mm.

Figures 6.7 & 6.8 (above) – Wyre Chapel, Orkney; Bicameral church; chancel arch in left image and west doorway in right image. Scale 500mm.

Figures 6.9 & 6.10 (above) – Cille Donnain Chapel, South Uist, in the left image, had a chancel arch approximately 900mm wide and a probable west nave entrance; St Ninian's Shetland, in the right image had a chancel arch of approximately 900mm wide and a west nave entrance. Scales 500mm.

# 6.1.4 CASTLES, PARISH CHURCHES AND LIMESTONE SOURCES IN SOUND OF MULL




Map 6.3 (above) – Locations of major church and castle sites within Mull and the Sound of Mull relative to main sedimentary outcrops. 

+ - Upstanding Medieval Parish Churches in Iona, Mull, Morvern, Arnamurchan and Lismore.

X - Upstanding Medieval Castles in Iona, Mull, Morvern, Arnamurchan and Lismore.

Sedimentary Mesozoic and Triassic outcrops are plotted in blue and purple.

# BIBLIOGRAPHY

Abrams, L. (1998). The Conversion of the Scandinavians of Dublin. Anglo-Norman Studies 20: 1-29.

Abrams, L. (2007). Conversion and the Church in the Hebrides in the Viking Age: "A Very Difficult Thing Indeed". In, B. Balin Smith, S. Taylor and G. Williams (eds.).West over sea. Studies in Scandinavian sea-borne expansion and settlement before 1300. Brill: Leiden. pp. 169-193.

Addyman, T. (2000). Five ancient monuments in the Uists and Benbecula: Feasibility study for conservation work. Unpublished document, and summary provided in D & ES (2000, 99).

Addyman, T. and Oram, R. (2012). Mingary Castle, Ardnamurchan, Highland. Analytical and Historical Assessment for Ardnamurchan Estate. Unpublished document.

Adey, W. and Adey, P. (1973). Studies on the biosystematics and ecology of the Epilithic Crustose Corallinaceae of the British Isles, British Phycological Journal 8: 343-407.

Agrell, S. (1965). Polythermal metamorphism of limestones at Kilchoan, Ardnamurchan. Minerological Magazine 34: 1-15.

Aitken, W. (1955). Excavation of a chapel at St. Ninian's Point, Isle of Bute. Transactions of the Buteshire Natural History Society 14: 62-76.

Al-Bashaireh, K. (2008). Chronology and technological production styles of Nabatean and Roman plasters and mortars at Petra (Jordon). Unpublished PhD Thesis, University of Arizona.

Al-Bashaireh, K. (2013). Plaster and Mortar Radiocarbon Dating of Nabatean and Islamic Structures, South Jordon. Archaeometry 55 (2): 329- 354.

Alexandersson, T. (1974). Carbonate cementation in Coralline Algal nodules in the Skagerrak, North Sea: biochemical precipitation in undersaturated waters. Journal of Sedimentary Petrology 44 (1): 7-26.

Allen A. (1995). The maritime cultural landscape of Viking and Late Norse Orkney. Unpublished PhD Thesis. University of Durham.

Ambers, J. (1987). Stable carbon isotope ratios and their relevance to the determination of accurate radiocarbon dates for lime mortars. Journal of Archaeological Science 14: 569-576.

Amorosi, T., Buckland, P., Dugmore, A., Ingimundarson, J. andMcGovern T. (1997). Raiding the Landscape: Human Impact in the Scandinavian North Atlantic. Human Ecology 25 (3): 491-518.

Anderson, A. (1922). Early sources of Scottish history AD 500-1286. Oliver and Boyd: Edinburgh.

Anderson, J. (1881). Scotland in early Christian times. The Rhind lectures in archaeology – 1879. David Douglas: Edinburgh.

Apted, M. (1965). Excavation at Kildrummy, Aberdeenshire, 1952-1962. PSAS 96: 208-236.

Armi, C. (1990). Report on the Destruction of Romanesque Architecture in Burgundy. Journal of the Society of Architectural Historians 55 (3): 300-327.

Armit, I. (1991). The Atlantic Scottish Iron Age: Five levels of chronology PSAS 121: 181-214.

Armit, I. (2008). Irish-Scottish connections in the first millennium AD: an evolution of the links between Souterrain ware and Hebridean ceramics. Proceedings of the Royal Irish Academy 108C: 1-18.

Ashmore, P. (1999). Radiocarbon dating: avoiding errors by avoiding mixed samples. Antiquity 73: 124-130.

Baas-Becking, L. and Galliher, E. (1931). Wall structure and mineralization in coralline algae. Journal of physical chemistry 35 (2): 467-479.

Bacci, M. (2009). Side Altars and "Pro Anima" Chapels in the medieval Mediterranean: evidence from Cyprus. In. J. Kroesen & V. Schmidt. The Altar and its Environment. Brepols: Belgium. pp.11-30.

Balcon, S., Berry, W. and Sapin, C. (2003). Architecture and sculpture at Autun around the millenium. In. N. Hiscock (ed.). The white mantle of churches. Brepols: Belgium. pp. 197-220.

Barbour, J. (1996). Excavations at St. Magnus kirk, Birsay. In. C.D. Morris (ed.). The Birsay Bay Project 2: 11-32. University of Durham: Durham.

Barnwell, P. (2004a). The Laity, the Clergy and the Divine Presence: The Use of Space in Smaller Churches of the Eleventh and Twelfth Centuries. Journal of the British Archaeological Association 157: 41-60.

Barnwell, P. (2004b). Churches built for Priests? The Evolution of Parish Churches in Northamptonshire from the Gregorian Reform to the Fourth Latheron Council. Ecclesiology Today 32: 7-23.

Barnwell. P., Butler, L. and Dunn, C. (2003). The confusion of conversion: Streanæshalche, Strenshall and Whitby and the Northumbrian Church. In. M. Carver (ed.). The cross goes north; processes of conversion in northern Europe, AD300-1300. York Medieval Press: York. pp. 311-326.

Barrell, A. (2000). Medieval Scotland. Cambridge University Press: Cambridge.

Barrell, A. (2003). The church in the West Highlands in the late Middle Ages. The Innes Review 54 (1): 23-46.

Barrett, J. (2003). Christian and Pagan Practice during the Conversion of Viking Age Orkney and Shetland. In M. Carver (ed.). The Cross goes North; Processes of conversion in northern Europe, AD 300-1300. York: York Medieval Press. pp. 207-226.

Barrett, J., Beukens, R., Simpson, I., Ashmore, P., Poaps, S., and Huntley, J. (2000). What was the Viking Age and when did it happen? A view from Orkney. Norwegian Archaeological Review 33 (1): 1-39.

Barrett, J. and Gerrard, J. (2012). The Quoygrew Sequence. In, J. Barrett (ed.). Being an Islander: production and identity at Quoygrew, Orkney, AD 900-1600. McDonald Institute Monographs. Oxbow: Oxford. pp. 47-96.

Barrière, B. (1992). The Cistercian Convent of Coyroux in the Twelfth and Thirteenth Centuries. Gesta 31 (2): 76-82.

Barrow, G. (1980). The Anglo-Norman era in Scottish history. Clarendon Press: Oxford.

Barrow, G. & Royan, A. (1985) James Fifth Stewart of Scotland, 1260(?) – 1309. In, K. Stringer, Essays on the Nobility of Medieval Scotland. John Donald: Edinburgh. pp. 166-190

Barrowman, R. (2005). Lewis Coastal Chapel-Sites Survey 2004/5. Glasgow: Glasgow University.

Barrowman, R. (2008a). Splendid isolation? Changing perceptions of Dùn Èistean, an island on the north coast of the isle of Lewis. In. G. Noble, T. Poller, J. Raven and L. Verrill (eds.). Scottish Odysseys: the archaeology of islands. Tempus: Stroud.

Barrowman, R. (2008b). Archaeological Evidence for Early Christianity in Ness, Lewis. In I. Stewart-Hargreaves & R. Barrowman Early Christianity in Lewis: The Ness Connection. Islands Book Trust: Lewis.

Barrowman, R. (2012). The Chapel and Burial Ground on St Ninian's Isle, Shetland, Excavations Past and Present. Society for Medieval Archaeology Monographs, Volume 32. Maney.

Bathurst, R. (1976) Carbonate sediments and their diagenesis. Elsevier Scientific Publishing: London & New York.

Bauer, E. (2008). Power and Piety: Church Topography and Episcopal Influence in Northern Iceland 1106-1318 A.D. Unpublished Master's Thesis. University of Oslo.

Bayanne (2016). www.bayanne.info/Shetland/getperson.php?personID=150514&tree=ID1

Beaton, E. (1993). The Pattern of Moray Building: An introduction to traditional building materials and practices. In W. Sellar (ed.). Moray Province and People. Scottish Society for Northern Studies: Edinburgh. pp. 225-252.

Bede [731]. Ecclesiastical History of the English People; trans. L. Shirley-Price. 1990. Penguin: London.

Bedford, S., Dickinson, W., Green, R. and Ward, G. (2009). Detritus of Empire: Seventeenth Century Spanish Pottery from Taumako, Southeast Solomon Islands, and Mota, Northern Vanuatu. Journal of the Polynesian Society 118 (1): 69-89.

Beith, A. (1836). Parish of Glenelg. County of Inverness, New Statistical Accounts of Scotland, 1834-45. Vol. 14: 128-144.

Bell, T. (1998). Churches on Roman buildings: Christian associations and Roman masonry in Anglo-Saxon England. Medieval Archaeology 42: 1-18.

Bennett, K., Fossitt, J., Sharp, M. and Switsur, V. (1990) Holocene Vegetational and Environmental History at Loch Lang, South Uist, Western Isles, Scotland. The New Phytologist 114 (2): 281-298

Berger, R. (ed.) (1970). Scientific Methods in Medieval Archaeology. University of California Press: California.

Berger, R. (1992). 14C Dating Mortar in Ireland. Radiocarbon, 34 (3): 880-889.

Berger, R (1995) Radiocarbon Dating of Early Medieval Irish Monuments. Proceedings of the Royal Irish Academy. Section C: Archaeology, Celtic Studies, History, Linguistics, Literature 95C (4): 159-174.

Bethune, J. (1791-99). Parish of Dornoch, County of Sutherland. Statistical Accounts of Scotland, 1791-99. Vol. 8: 1-19.

Beveridge, E. (1911). North Uist: its archaeology and topography. Edinburgh.

Bhaba, H. (1994). The location of Culture. Routledge: London.

Biek, L. (1965). The Mortars. In. M. Apted. Excavation at Kildrummy, Aberdeenshire, 1952-1962. PSAS 96: 208-236. pp. 221-223.

Bigger, F. (1916). Some Notes on the Churches of Saint Tassach of Raholp and Saint Nicholas of Ardtole, and their Surroundings, in the Barony of Lecale in Down. The Journal of the Royal Society of Antiquaries of Ireland 6 (2): 121-135.

Binski, P. (1991). Painters. Medieval Craftsmen. British Museum Press: London.

Birkett, D., Maggs, C. & Dring, M. (1998). Maerl (volume 5). An overview of dynamic and sensitivity characteristics for conservation management of marine SACs. Scottish Association for Marine Science. (UK Marine SACs Project).

Birks, H. (1993). The Inner Hebrides. In J. Gordon & D. Sutherland (eds.). The Quaternary of Scotland. Springer: Dordrecht.

Birrell, J. (1969). Peasant craftsmen in the medieval forest. Agricultural History Review 17: 91-107.

Blair, J. (1993). Hall and Chamber: English Domestic Planning 1000-1250. In. G. Meirion-Jones and M. Jones (eds.). Manorial domestic buildings in England and northern France. Volume 15 of occasional papers from: The society of Antiquaries of London: London. pp. 1-21.

Blair, J. (2005). The Church in Anglo-Saxon society. Oxford University Press: Oxford.

Blezard, R. (1998). The history of calcareous cements. In. Hewlett, P. (ed.). Lea's Chemistry of Cement and Concrete. Oxford: Butterworth-Heineman. pp.1-24.

Blindheim, M. (1965). Norwegian Romanesque Decorative Sculpture, 1090–1210. Tiranti: London.

Blindheim, M. (1987). The roof-truss heads of the nave of Værnes Church in Trondelag, Norway. In, Romanesque and Gothic: essays for George Zarnecki 1: 15-17.

Blunden, G., Campbell, S., Smith, J., Guiry, M., Hession, C. and Griffin, R. (1997). Chemical and physical characterization of calcified red algal deposits known as maërl. Journal of Applied Phycology 9: 11–17.

Blundell, O. (1917). The Catholic Highlands of Scotland – The Western Highlands and Islands. Sands: Edinburgh.

Boardman, S. (2006). The Campbells 1250 – 1513. John Donald: Edinburgh.

Boate, G. (1652). The Natural History of Ireland. Can be viewed at http://www.ucc.ie/celt/published/E650002-001/ last viewed 22/07/2016.

Bogdanski, C. (2013). A "North Sea School of Architecture?": Nidaros Cathedral's Romanesque Transepts and North Sea Medieval Architecture. Across the Sólundarhaf: Connections between Scotland and the Nordic World Selected Papers from the Inaugural St. Magnus Conference 2011 Journal of the North Atlantic Special Volume 4: 77–106.

Bøggild, O. (1930). The shell structure of the molluscs. D. Kgl. Danske Vidensk. Selsk. Skr. (Naturvidensk og mathem.) 9 (2): 231–326.

Bollingtøft, P. (1993) Early Gothic wall paintings: an investigation of painting techniques and materials of 13th-century mural paintings in a Danish village church. ICOM committee for conservation 2: 531-535.

Bolvig, A. (2004). The adaptation of an established European visual language in Denmark from the twelfth to fourteenth centuries. In, J. Adams and K. Holman (eds.). Scandinavia and Europe 800-1350: contact, conflict and coexistence. Brepols: Turnhout. pp. 237-251.

Bond, C. (1981). Woodstock Park under the Plantagenet Kings: The exploitation and use of wood and timber in a Medieval Deer Park. Arboricultural Journal: The International Journal Of Urban Forestry 5 (3): 201-13.

Bond, C. (1988). Church and parish in Norman Worcestershire. In J. Blair (ed.) Minsters and Parish churches: the local church in transition, 950-1200. pp. 119-158.

Bond, F. (1916). The chancel of English Churches. Oxford University Press: London.

Bond, J. (2007). Medieval charcoal-burning in England. In, J. Klápšte and P. Sommer (eds.). Arts and Crafts in medieval rural environment. Ruralia 6. Brepols: Turnhout. pp. 277-94.

Bond, J. (2013). Excavations at Hamar and Underhoull. In, V. Turner, J. Bond and A. Larsen (eds.). Viking Unst: Survey and excavation in northern Shetland 2006 – 2010. Shetland Heritage Publicatins: Lerwick. pp. 123-179.

Bond, J., Outram, Z. and Freeth, C. (2007). Excavations at Hamar and the upper house, Underhoull: field season 2007. Interim report no. 2 (data structure report). Shetland Amenity Trust and University of Bradford.

Borradaile, G. (1970). The West Limb of the Loch Awe Syncline and the Associated Cleavage Fan. Geological Magazine 107 (5): 459-467.

Borradaile, G. (1977). The Dalriadan rocks of the northern Loch Awe. Scottish Journal of Geology 13:155-164.

Boscence, D. (1991). Coralline Algae: Mineralisation, Taxonomy and Palaeoecology. In R. Riding (ed.). Coralline algae and Stromatolites Berlin: Springer. pp. 98-113.

Bosence, D. and Wilson, J. (2003). Maerl growth, carbonate production rates and accumulation rates in the northeast Atlantic. Aquatic Conservation: Marine And Freshwater Ecosystems 13: 21–31.

Boyd, T. (1978). The Arch and the Vault in Greek Architecture. American Journal of Archaeology 82(1): 83-100.

Bowman, S. (1990). Radiocarbon Dating. University of California Press: California.

Brady, K. and Johnson, P. (2000). Unst Chapel-sites Survey 1999. Phase 1: Report 2; Vol.1: Analysis. Unpublished GUARD report.

Brand, J. [1700] (1703). A Brief Description of Orkney, Zetland, Pightland-Firth & Caithness. Edinburgh.

Brayley, E. and Britton, J. (1814). The beuaties of England and Wales, or delineations, topographical, historical & descriptive, of each county. T. Maiden: Wiltshire.

Breen, C., Forsyth, W., Raven, J. and Rhodes, D. (2010). Survey and excavation at Dunstaffnage Castle, Argyll. PSAS 140: 165-178.

Breeze, D. (1984). The Roman fort on the Antonine wall at Bearsden. In. D.Breeze (ed.). Studies in Scottish Antiquity presented to Stewart Cruden. Edinburgh. pp. 33-68.

Brindlecombe, P. (1975). 'Industrial air pollution in thirteenth century Britain.' Weather 30 (12): 388-396.

Brindlecombe, P. (1976). Attitudes and responses towards air pollution in Medieval England. Journal of the Air Pollution Control Association, 26 (10): 941-945.

Brindlecombe, P. (2012).The Big Smoke: A history of air pollution in London since medieval times. Routledge: London.

Brink, S. (1998). The formation of the Scandinavian parish, with some remarks regarding the English impact on the process. In J. Hill and M. Swan (eds.). The community the family and the saint: patterns of power in early medieval Europe. Turnhout: Brepols. pp. 19-44.

British Geological Survey (1992). Geology of the Outer Hebrides. HMSO: London.

Brooks, N. (2006). From British to English Christianity: Deconstructing Bede's interpretation of the conversion. In, C. Karkov and N. Howe (eds.). Conversion and colonization in Anglo-Saxon England. ACMRS: Arizona. pp. 1-30

Brothwell, D. (1977). On a mycoform stone structure in Orkney, and its relevance to possible further interpretations of so-called souterrains. Bulletin of the London Institute of Archaeology 14: 179-190.

Broun, D. (1999). The Irish identity of the kingdom of the Scots in the twelfth and thirteenth centuries. The Boydell Press: Woodbridge.

Brown, A. (1791-99). Parish of Moffat, County of Dumfries. The Statistical Accounts of Scotland 1791-99. Vol. 2: 285-298.

Brown, A. and Duncan, A. (1957). The Cathedral church of Lismore. Transactions of the Scottish Ecclesiological Society 15 (1): 41-50.

Bruce, J. (1968). Sixth report on the Antiquities of the Isle of Man. Manx museum and National Trust: Douglas.

Bruun, D. (1918). Meddelelser om Grønland. kommissionein for ledelsen af de geologiske og geografiske undersøgelser i Grønland, Dorothy Buchwaldt (trans.) .

Butler, L. (1988). The Cistercian abbey of St Mary of Rushen: excavations 1978-79. Journal of the British Archaeological Association 141: 60-104.

Butler, L. (2002). The Cistercian abbey of St Mary of Rushen, Isles of Man: excavations on the easy range. Journal of the British Archaeological Association 155: 168-194.

Butter, R. (2007). Cill- names and saints in Argyll: a way towards understanding the early Church in Dál Riata? Unpublished PhD Thesis. University of Glasgow.

Byock, J. (1985). Cultural Continuity, the Church, and the Concept of Independent Ages in Medieval Iceland." Skandinavistik 15 (1):1-14.

Byock, J. (1988). Medieval Iceland: Society, Sagas and Power. University of California Press: California.

Calder, J. (1861). Sketch of the civil and traditional history of Caithness from the tenth century. Thomas Murray and son: Glasgow.

British Geological Survey. (1992). Geology of the Outer Hebrides. HMSO: London.

Caldwell, D. (2008). Islay: the land of the Lordship. Birlinn: Edinburgh.

Caldwell, D. and Ruckley, N. (2005). 'Domestic Architecture in the Lordship of the Isles'. In. R. Oram & G. Stell. Lordship and Architecture in Medieval and Renaissance Scotland. John Donald: Edinburgh. pp. 97-122.

Caldwell, D., Hall, M. & Wilkinson, C. (2009). The Lewis Hoard of Gaming Pieces: A Reexamination of their Context, Meanings, Discovery and Manufacture. Medieval Archaeology 53: 155-203.

Cambridge, E. (1988). The architectural context of the Romanesque cathedral at Kirkwall. In B. Crawford (ed.). St Magnus Cathedral and Orkney's twelfth century renaissance. Aberdeen University Press: Aberdeen. pp 11-126.

Cameron, A. (1934). The apostolic Camera and Scottish Benefices 1418-1488. Oxford University Press: London.

Cameron, J. (1791-99). Parish of Halkirk, County of Caithness. The Statistical Accounts of Scotland 1791-99. Vol. 19:1-70.

Cameron, J. (1833). Parish of Stornoway, County of Ross and Cromarty. The New Statistical Account of Scotland, 1834-45. Vol 14: 115-140.

Campbell, D. (1843). Parish of Kilfinichen and Kilviceuen. County of Argyle. New Statistical Acoounts of Scotland, 1834-45. Vol. 7: 296-339.

Campbell, D. (1844). Parish of Glassary. County of Argyle. New Statistical Account of Scotland, 1834-45. Vol. 7: 675-700.

Campbell, M. (1984). Mid Argyll: An Archaeological Guide. The Natural History & Antiquarian society of Mid Argyll.

Campbell, M. & Sandeman, M. (1961-62). Mid Argyll: a field survey of the historic and prehistoric monuments. PSAS 95: 1-125.

Cannel, J. and Tabraham, C. (1994). Excavations at Duffus Castle, Moray. PSAS 124: 379-390.

Cannell, S. (2001). Rural architecture in the north of the Isle of Man. Scottish Vernacular Buildings Working Group, Regional & Thematic Studies 6.

Cant, R. (1975). The medieval churches and chapels of Shetland. Shetland Archaeological Society: Lerwick.

Cant, R. (1988). Norwegian influences in the design of the Transitional and Gothic Cathedral. In B. Crawford (ed.). St Magnus Cathedral and Orkney's twelfth century renaissance. Aberdeen University Press: Aberdeen. pp. 127-139.

Caple, C. (nd). interim report, accessed 01/09/2013. http://www.ilg.org.uk/resources/archaeology/pdfs/research/05.BritishArchaeology-NevernCastle.pdf)

Caple, C. & Davies, W. (2005-8). Surveys and excavations at Nevern Castle 2005-8. Archaeology in Wales 48: 39-46.

Carmichael, I., Turner, F. and Verhoogen, J. (1974). Igneous Petrology. Mcgraw-Hill: New York.

Caroscio, M. (2007). Pyrotechnology and local resources in Chianti shire: from clay, limestone and wood to bricks, lime and pottery making. Some preliminary notes. In D. Gheorghiu (ed.) Fire as an instrument: the archaeology of pyrotechnologies. BAR International Series 1619. pp. 105-118.

Carter, R. (1967). On the nature and definition of the lunule, escutcheon, and corcelet in the Bivalvia. Proceedings of the Malacological Society 37: 243-263.

Carver, M. (2008). Portmahomack: monastery of the Picts. Edinburgh University Press: Edinburgh.

Chapman, W. (1991). Slave villages in the Danish West Indies: changes of the late eighteenth and early nineteenth centuries. Perspectives in Vernacular Architecture 4: 108-120.

Chappell, J. and Polach, H. (1972). Some effects of partial recrystallisation on C14 dating Late Pleistocene corals and molluscs. Quaternary Research 2: 214-252.

Chave, K. (1954). Aspects of the Biogeochemistry of Magnesium 1. Calcareous Marine organisms. The Journal of Geology 62 (3): 266-283.

Cheape, H. (1993a). Caisteal Bharraich, Dun Varrich and the wider tradition. Northern Studies 30: 53-62.

Cheape, H. (1993b). Woodlands on the ClanRanald Estates: A case study. In T. Smout (ed.) Scotland since pre-History. Scottish cultural Press: Aberdeen.

Cherns, L., Wheeley, J. and Wright, V. (2008). Taphonomic windows and molluscan preservation. Palaeogeography, Palaeoclimatology, Palaeoecology 270 (3): 220-229.

Cherns, L., Wheeley, J. and Wright, V. (2011) Taphonomic bias in shelly faunas through time: early aragonitic dissolution and its implications for the fossil record. In A, Allison and D, Bottjer (eds). Taphonomy: process and bias through time. Aims and Scopes in Geobiology book series. Springer. Vol. 32:79-105.

Chever, L., Pavia, S. and Howard, R. (2010). Physical properties of magnesian lime mortars. Materials and Structures 43 (1): 283-296.

Chiverrell, R. (2002). Changing landscapes of the Isle of Man. In, P. Davey & D. Finlayson (eds.) Mannin Revisited: Twelve essays on Manx culture and environment. Scottish Society for Northern Studies: Edinburgh. pp.1-9.

Christie, H. (1966). Old Oslo. Medieval Archaeology 10: 45-58.

Chu, V., Regev, L., Weiner, S., and Boaretto, E. (2008). Differentiating between anthropogenic calcite in plaster, ash and natural calcite using infrared spectroscopy: implications in archaeology. Journal of Archaeological Science 35: 905-911.

Church, M., Peters, C. & Batt, C. (2007a). Sourcing Fire Ash on Archaeological Sites in the Western and Northern Isles of Scotland, Using Mineral Magnetism. Geoarchaeology: an International journal, 22 (7): 747-774.

Church, M. Dugmore, A. Mairs, K., Millard, A., Cook, G., Sveinbjarnardóttir, G., Ascough, P. And Roucoux, K. (2007b). Charcoal production during the Norse and early medieval periods in Eyjafjallahreppur, southern Iceland. Radiocarbon 49 (2): 659-672.

Claasen, C. (1998). Shells. Cambridge manuals in archaeology. Cambridge University Press: Cambridge.

Clancey, G., Stetson, M., Henry, R. and Leeke, J. (1995). Mapping patterns of cracking and moisture migration in early brickwork and replicating shell-lime mortar. Materials Research Society Symposium Proceedings 352: 333-340.

Clancy, T. (2010). The Big Man, the footsteps, and the fissile saint: paradigms and problems in studies of Insular saints cults. In. S. Boardman, J. Reuben Davies and E, Williamson. Saints Cults in the Celtic World. The Boydell Press: Woodbridge. pp. 1-20.

Clancy, T. (2011). Iona vs. Kells: succession, jurisdiction and politics in the Columban *familia* in the later tenth century. In F, Edmonds and P. Russell (eds.), Tome: Studies in Medieval Celtic History and Law in honour of Thomas Charles Edwards. The Boydell Press: Woodbridge. pp. 89-101.

Clarke, D. and Heald, A. (2002). Beyond Typology: combs, economics, symbolism and regional identity in Late Norse Scotland. Norwegian Archaeological Review 35: 81 – 93.

Cleary, R., McClatchie, M. and McKeown, S. (2008). Excavation of an early medieval settlement and other sites at Dromthacker, Tralee, Co. Kerry. Proceedings of the Royal Irish Academy 108C: 19-64.

Clemmennsen, M. (1911). Kirkeruiner fra Nordbotiden m. M. I Julianehaab Distrikt, undersoøgelsesrejse i sommeren 1910. In Meddelelser om Grønland, bind XLVII: 283-358.

Clerk, A. (1838). Parish of Ardnamurchan, County of Argyle. The new Statistical Accounts of Scotland, 1834-45. Vol. 7: 117-163.

Clouston, J. (1926). An early Norse Castle. PSAS 60: 281-304.

Clouston, J. (1931a). Tammaskirk in Rendall. Orkney Antiquarian Society: Kirkwall.

Clouston, J. (1931b). Early Norse Castles. Kirkwall.

Clouston, J. (1932). A history of Orkney. MacKintosh: Kirkwall.

Clouston, W. (1791-99). United parishes of Sandwick and Stromness, County of Orkney. Statistical Accounts of Scotland, 1791-99. Vol. 16: 409-468.

Clwyd-Powys Archaeological Trust (2008). Autumn Newsletter. Welshpool: Wales. (See also the trusts entry for this site in the HER www.cofiadurcahcymru.org.uk).

Colgrave, B. (1940). Two lives of St Cuthbert. Cambridge University Press: Cambridge.

Colvin, H. (1963). The History of the Kings works, Volume 2. HMSO: London.

Colvin, H. (1971). Building Accounts of Henry lll. Clarendon Press: Oxford.

Connerton, P. (1989). How Societies Remember.Cambridge University Press: Cambridge.

Cooper, L. (2011). Artisans and Narrative Craft in late Medieval England. Cambridge University Press: Cambridge.

Coppins, A. and Coppins, B. (2010). Atlantic Hazel. Scottish Natural Heritage: Edinburgh.

Coulton, G. (2010). Medieval panorama: the English scene from conquest to Reformation. Cambridge University Press: Cambridge.

Coventry, M. (1997). The Castles of Scotland. Goblinshead: Edinburgh.

Cowan, I. (1961). The development of the parochial system in Medieval Scotland. The Scottish Historical Review 40 (129, part 1): 43-55.

Cowan, I. (1967). The parishes of Medieval Scotland. Scottish Record society: Edinburgh.

Cowan, I. (1980). The Medieval Church in Argyll and the Isles. Records of the Scottish church History Society 20: 15-29.

Cowan, I. and Eason, D. (1976). Medieval religious houses Scotland. Longman: London.

Cramp, R. (1976) Monastic Sites. In D. Wilson (ed.). The archaeology of Anglo-Saxon England. Methuen: London. pp. 223-9.

Cramp, R. (2006). Wearmouth and Jarrow, monastic sites. Volume 2. English Heritage, London.

Craven, J. (ed.) (1907). Records of the diocese of Argyll and the Isles, 1560-1860. Kirkwall.

Crawford, B. (1985). The Earldom of Caithness and the Kingdom of Scotland 1150-1266. In. K. Stringer (ed.) Essays on the nobility of medieval Scotland. John Donald: Edinburgh.

Crawford, B. (1987). Scandinavian Scotland. Leicester University Press: Leicester.

Crawford, B. (1989). Norse earls and Scottish bishops in Caithness. In C. Batey, J. Jesch and C. Morris. The Viking Age in Caithness, Orkney and the North Atlantic. Edinburgh University Press: Edinburgh. pp. 129-147.

Crawford, B. (1995) Earl and Mormaer: Norse-Pictish relationships in Northern Scotland. Groam House Museum: Rosemarkie.

Crawford, B. (2005). The Papar Project – Inception, Parameters and Purpose. www.paparproject.org,uk . Last viewed 06/10/2010.

Crawford, B. (2006). Thorfinn, Christianity and Birsay: what the Saga tells us and archaeology reveals. In O. Owen (ed.). The world of the Orkneyinga saga: the broad-cloth Viking trip. Orkney Island Council: Kirkwall. pp. 88-110.

Crawford, B. (2013). The Northern Earldoms. Orkney and Caithness from AD870 to 1470. Birlinn: Edinburgh.

Crawford, B. (1993). Norse Earls and Scottish Bishop's in Caithness, a clash of cultures. In, C. Batey, J. Jesch and C. Morris (eds.) The Viking Age in Caithness, Orkney and the North Atlantic. Edinburgh University Press: Edinburgh. pp. 129-147.

Crawford, B. and Ballin-smith, B. (1999). The Biggings, Papa Stour, Shetland: the history and archaeology of a royal Norwegian farm. Society of Antiquaries of Scotland: Edinburgh.

Crawford, B. and Taylor, S. (2003). The southern frontier of Norse settlement in north Scotland place-names and history. Northern Scotland 23 (1): 1-76.

Cressey, M. and Whitelaw, L. (2011). *Teampull na Trionaid*. Historic building survey report no. 1917. Unpublished CFA archaeology (Edinburgh) report.

Crone, A, (1998). Wooden Objects. In G. Ewart & F. Baker. Carrick Castle: symbol and source of Campbell power in south Argyll from the 14th to the 17th century. PSAS 128: 977-982.

Crone, A. (n.d.). Wood use in the medieval Scottish burgh: timber supply and building design. PDF from tafac.org.uk. last viewed 01/10/2015.

Crook, J. (2000). The architectural setting of the cult of saints in the early Christian west c.300-c.1200. Clarendon Press: Oxford.

Crosbie, A. (1844). Parish of Buittle. County of Kirkcudbright. The New Statistical Accounts of Scotland 1834-45. Vol 4: 200-214.

Crow, J. (1991). A Review of Current Research on the Turrets and Curtain of Hadrian's Wall. Britannia 22: 51-63.

Cruden, S. (1960). The Scottish Castle. Nelson: Edinburgh.

Cruden, S. (1965). Excavations at Birsay, Orkney. Proceedings of the 4th Viking Congress. Edinburgh. pp 22-31.

Cruden, S (1998). The founding and building of the twelfth-century cathedral of St Magnus. In, B. Crawford (ed.). St Magnus Cathedral and Orkney's Twelfth Century Renassance. Aberdeen University Press. pp.78-87.

Cubbon, M. (1982). The early church in the Isle of Man. In S. Pearce (ed). The early church in Western Britain and Ireland. Studies presented to C. A. Ralegh Radford. BAR British Series 102. pp 257-282.

Cubbon, M. (1983). The archaeology of the Vikings in the Isle of Man. In C. Fell, P, Foote, J. Graham-Campbell, & R. Thomson (eds.) The Viking Age in the Isle of Man: Selected papers from the Ninth Viking Congress, Isle of Man, 4-14 July 1981. Viking Society for northern research, University College of London. pp.13-26.

Curle, C. (1982). Pictish and Norse finds from the Brough of Birsay 1934-74. Society of Antiquaries of Scotland. Monograph Series Number 1: Edinburgh.

Dahl, S. (1968). Extracts from a lecture on Kirkjubøur. In B. Niclasen (ed.). The Fifth Viking Congress, Torshavn, July 1965. Føroyá Fornminnissavn: Tórshavn. pp. 187-192.

Darvill, T. (2002). White on blond: quartz pebbles and the use of quartz at Neolithic monuments in the Isle of Man and beyond. In, A. Jones and G. MacGregor (eds.). Colouring the past – the significance of colour in archaeological research. Berg: Oxford.

Dauphin, Y. and Denis, A. (2000). Structure and composition of the aragonitic crossed lamellar layers in six species of Bivalvia and Gastropoda. Comparative Biochemistry and Physiology Part A 126: 367-377.

Dauphin, Y., Ball, H., Castillo-Michel, H., Chevallard, C., Cuif, J., Farre, B., Pouvreau, S. and Solomé, M. (2013). In situ distribution and characterisation of the organic content of the Oyster shell *Crassostrea gigas* (Mollusca, Bivalvia). Micron 44: 373-383.

Davey, P. (2002). At the crossroads of power and cultural influence: Manx archaeology in the high Middle Ages. In, P. Davey & D. Finlayson (eds.). Mannin Revisited: Twelve essays on Manx culture and environment. Scottish Society for Northern Studies: Edinburgh. pp. 81-102.

Davids, K. (2008). The rise and decline of Dutch Technological leadership: technology, economy and culture in the Netherlands, 1350-1800. 2 volumes. Brill: Leiden.

Davidson, C. (1999). Change and change back: the development of English parish church chancels. Studies in Church History 35: 65-77.

Davies, P (2007). Castles of the Welsh Princes. Y Lolfa Cyf, Talybont.

De Grave, S. & Whitaker, A. (1999). A census of maerl beds in Irish waters. Aquatic Conservation: marine and freshwater ecosystems 9: 303–311.

De Paor, L. (1967). Cormac's Chapel: the beginnings of Irish Romanesque. In, E. Rynne (ed.). North Munster Studies: essays in commemoration of Monsignor Michael Moloney. The Thomond Archaeological Society: Limerick.

De Paor, M. and De Paor, L. (1958). Early Christian Ireland. Thames and Hudson: London.

De Vegvar, C. (2003). Romanitas and Realpolitik in Cogits Description of the Church of St Brigit, Kildare. In M. Carver (ed.) The Cross goes North: Processes of Conversion in Northern Europe, AD 300-1300. York: York Medieval Press. pp. 153-170.

De Yoreo, J. Chung, S. and Neilsen, M. (2013). The dynamics and energetic of matrix assembly and mineralization. Calcified Tissue International 93: 316-328.

Dick, H. (1980). Vesicularity of Shikoku Basin basalt: a possible correlation with the anomalous depth of back-arc basins. In Init. Repts. DSDP 58: 895-904.

Dickinson, W and Green, R. ( 1973). Temper sands in A.D. 1595: Spanish Ware from the Soloman Islands. Can be viewed at http://www.jps.auckland.ac.nz/document//Volume_82_1973/Volume_82,_No._3/Temper_sands_in_A.D._1595%3A_Spanish_ware_from_the_Solomon_Islands,_by_William_R._Dickinson,_p_293-300/p1. Last accessed 15/02/2013.

Dickson. C. (1998). Past uses of turf in the Northern Isles. In, G. Coles & C. Mills (eds.). Life on the edge: human settlement and marginality. Oxbow Books: Oxford. pp. 105-109.

Dickson, J. (1992). North American driftwood, especially Picea (spruce), from archaeological sites in the Hebrides and Northern Isles of Scotland. Review of palaeobotany & Palynology 73 (1-4): 49-56.

Dickson, J. (2003). Neomorphism and recrystallisation. In G. Middleton (ed.) Encyclopedia of Sediments and sedimentary rocks. Kluwer: Dordrecht.

Dixon, P. (1992). From hall to tower: the change in seigneurial houses on the Anglo-Scottish border after c.1250. In, P. Cross and S. Lloyd (eds.). Thirteenth Century England IV. Proceedings of the Newcastle upon Tyne Conference 1991. The Boydel Press: Woodbridge. pp. 85-107.

Dixon, P. (1993). *Mota, Aula et Turris* : the manor-houses of the Anglo-Scottish border. In. G. Meirion-Jones and M. Jones (eds.). Manorial domestic buildings in England and northern France. Volume 15 of occasional papers from: The society of Antiquaries of London: London. pp. 22-45.

Dixon, D. (1994). Mortar analysis. In. J. O'Sullivan, Excavation of an early church and a woman's cemetery at St. Ronan's medieval parish church, Iona. PSAS 124: 327-365. pp. 345-347.

Dockrill, S., Turner, V. and Bond, J. (1997) Old Scatness/Jarlshof Environs Project (Dunrossness parish), multi-period settlement mound. D and ES: 69-70.

Dockrill, S., Bond, J., Turner, V., Brown, L., Bashford, D. Cussans, J. and Nicholson, R. (2010). Excavations at Old Scatness, Shetland. Volume 1: The Pictish Village and Viking Settlement. Shetland Heritage publications: Lerwick.

Dodgeshon, R. (1998). From Chiefs to landlords: social and economic change in the western Highlands and Islands, c.1493-1820. Edinburgh University Press: Edinburgh.

Donnachie, I. (1971). The lime industry in south-west Scotland. Transactions of the Dumfriesshire and Galloway Natural History and Antiquarian Society 48: 146-152.

Downham, C. (2007). Viking kings of Britain and Ireland. The Dynasty of Ívarr to AD1014. Dunedin Academic Press: Edinburgh.

Driscoll, S. (1998a). Formalising the mechanisms of state power: early Scottish lordship from the ninth to the thirteenth centuries. In S. Foster, A MacInnes and R. MacInnes (eds.). Scottish power centres from the early Middle Ages to the twentieth century. Glasgow. Pp. 33-58.

Driscoll, S. (1998b). Picts and prehistory: cultural resource management in early medieval Scotland. World Archaeology 30: 142-158.

Driscoll, S. and Yeoman, P. (1997). Excavations within Edinburgh Castle in 1988-91. Society of Antiquaries of Scotland monograph series number 12. Edinburgh.

Dryden. H. (1866). Drawings from 'Ruined churches in Orkney and Shetland, 1867-74, re-published collection of Orcadian newspaper articles. Digitalised by RCAHMS (now HES) in Canmore at https://canmore.org.uk/site/2170/eynhallowmonastery last viewed 13/07/2016.

DSWA (2009) 'Dry stone church ruins which constructed in Beaverton, Ontario' http://dswa.ca/story/beaverton-dry-stone-ruins accessed 16/05/2014

Duffy, S. (2006). The royal dynasties of Dublin and the Isles in the Eleventh Century. In S. Duffy (ed.). Medieval Dublin VII. Four Courts Press: Dublin.

Dumville, D. (1997). The Churches of North Britain in the first Viking Age. The 5th Whithorn Lecture 1996. The Friends of the Whithorn Trust: Whithorn.

Dunbar, J. (1981). The medieval architecture of the Scottish Highlands. In L. MacLean. The Middle Ages in the Highlands. Inverness.

Dunbar, J. and Duncan, A. (1971). Tarbert Castle: a contribution to the history of Argyll. The Scottish Historical Review 50: 1-17.

Duncan, A. And Brown, A. (1957). Argyll and the Isles in the earlier Middle Ages. PSAS 56-57: 192-220.

Dunshea, P. (2013). *Druim Alban, Dorsum Britanniae* – 'the spine of Britain'. The Scottish Historical Review 92 (2): 275-289.

Earwood, C. (2007). Wood and woodland: The worked wood from Mills 1 and 2. In McErlean, T. and Crothers, N. (2007). Harnessing the tides: The early medieval tide mills at Nendrum Monastery, Strangford Lough. Northern Ireland Archaeological Monographs No. 7. Environment and Heritage service: Belfast. pp. 222-254.

Eckmeier, E., Van Der Borg, K., Tegtmeier, U., Schmidt, M. And Gerlach, R. (2009). Dating Charred Soil Organic Matter: Comparison Of Radiocarbon Ages From Macrocharcoals And Chemically Separated Charcoal Carbon. Radiocarbon 51 (2): 437-443.

Edwards, K. Guttesen, R. and Sigvardsen, P. (2008). A peatland landscape at Akraberg, Suðuroy, Faroe Islands: Peat mounds and a cautionary lesson. Geografisk Tidsskrift Danish Journal of Geography 108 (2): 27-35.

Ellison, M, McCombie, G. MacElvaney, M. Newman, M., O' Brien, C. and Tavener, A. (1993). Excavations at Newcastle quayside: waterfront development at the Swirle. Archaeologia Aeliana 21: 151-134.

Elsen, J. (2006). Microscopy of historic mortars – a review. Cement and concrete research 36: 1416 – 1424.

Empey, A. (2002). The layperson in the parish, 1169 – 1536. In R. Gillespie and W. Neely (eds). The laity and the church of Ireland. Four courts press: Dublin. pp. 7-48.

Encyclopaedia Londinensis (1814). Encyclopaedia Londinensis, or, Universal Dictionary of Arts, Sciences and Literature. Vol. 12. John Wilkes: London.

Evans, C. and Rutherford, A. (1998). Castle Tioram. Part 4. Building analysis and interpretation. GUARD: Glasgow.

Ewan, E. (1993). An urban community: The crafts in Thirteenth-century Aberdeen. In A. Grant & K. Stringer (eds.). Medieval Scotland. Edinburgh University Press: Edinburgh. pp. 156-173.

Ewart, G. (2001). Dundrennan Abbey Archaeological investigation within the south range of a Cistercian house in Kirkcudbrightshire (Dumfries & Galloway), Scotland Scottish Archaeological Internet Report 1, 2001. www.sair.org.uk.

Ewart, G. with B. Ford, L. Ewan, D. Gallagher, P. Graves, J. Gater, S. Dockrill, A. Gibson, R. Grove, G. Haggarty and M. Spearman. (1996). Inchaffray Abbey, Perth & Kinross: excavation and research, 1987. PSAS 126: 469-516.

Ewart, G. and Baker, F. (1998). Carrick Castle: symbol and source of Campbell power in south Argyll from the 14th to the 17th century. PSAS 128: 937-1016.

Fairhurst, H. (1984). Excavations at Crosskirk Broch, Caithness. Monograph series number 3. Society of Antiquaries of Scotland: Edinburgh.

Farrow, G. (1972). Periodicity structures in the bivalve shell: analysis of stunting in Cerastoderma edule from the Burry inlet (South Wales). Palaeontology 15 (1): 61-72.

Fawcett, R. (1988). Kirkwall Cathedral an architectural analysis. In, B. Crawford (ed.). St Magnus Cathedral and Orkney's Twelfth Century Renaissance. Aberdeen University Press: Aberdeen.

Fawcett, R. (2002). Scottish medieval churches: architecture and fittings. Tempus: Stroud.

Fawcett, R. (2011). The Architecture of the Scottish Medieval Church. Yale University Press: New Haven and London.

Fawcett, R. (2012). Barrel-vaulted churches in late medieval Scotland. In J. Franklin, T. Heslop and C. Stevenson (eds.). Architecture and interpretation: essays for Eric Fernie. Boydell Press. pp. 60-77.

Feilberg, H. (1922). Dansk bondeliv, saaledes som det i mands minde førtes, navnlig i Vestiylland. Ved udvalget for folkeoplysnings fremme. Kjøbenhavn, I kommission hos G. E. C. Gad.

Fenton (1985). The shape of the past 1. John Donald: Edinburgh.

Fenton, A. (1997). The Northern Isles. Tuckwell Press: East Linton.

Fernie, E. (1986). Early church architecture in Scotland. PSAS 116: 393-411.

Fernie, E. (1988). The church of St Magnus Egilsay. In B. Crawford (ed.). St Magnus Cathedral and Orkney's Twelfth Century Renaissance.Aberdeen University Press: Aberdeen. pp. 140-161.

Fernie, E. (2002). The architecture of Norman England. Oxford University Press: Oxford.

Finan, T. (2004). A nation in medieval Ireland? Perspectives on Gaelic national identity in the Middle Ages. BAR British Series 367.

Finlay, A. and Faulkes, A. (2011). Snorri Sturluson, Heimskringla Vol. 1: The beginnings to Óláfr Tryggvason. Viking Society for Northern Research, University College London: London.

Finlay, J. (1984). Faunal evidence for prehistoric economy and settlement in the Outer Hebrides to c.400 AD. Unpublished D.Phil. University of Edinburgh.

Fisher, I. (1993). Orphir Chruch in its south Scandinavian context. In C. Batey, J. Jesch & C. Morris (eds.). The Viking Age in Caithness, Orkney and the North Atlantic. Edinburgh University Press. pp. 375-380.

Fisher, I. (1997). Early Christian Archaeology in Argyll. In G. Ritchie (ed.). The Archaeology of Argyll. Edinburgh University Press: Edinburgh. pp. 181-205.

Fisher, I. (2005). The heirs of Somerled. In. R. Oram & G. Stell. Lordship and Architecture in Medieval and Renaissance Scotland. John Donald: Edinburgh. pp 85-96.

Flanagan, M. (2010). The transformation of the Irish church in the 12th and 13th centuries. The Boydell Press: Woodbridge.

Fleming, A. (2012). The Blacklands Survey: Cill Donnain and Gearraidh Bhailteas townships. In M. Parker Pearson (ed.). From Machair to Mountains. Oxbow books: Oxford. pp. 74-82.

Fleming, A. and Woolf, A. (1992). Cille Donnain: a late Norse Church in South Uist. PSAS 122: 329 – 350.

Flessa, K., Cutler, A. and Meldahl, K. (1993). Time and taphonomy: Quantitative estimates of time-averaging and stratigraphic disorder in a shallow marine habitat. Paleobiology 19: 266-286.

Flessa, K. (1998). Well-travelled cockles: Shell transport during the Holocene transgression of the southern North Sea. Geology 26 (2): 187–190.

Flessa, K. and Kowalewski, M. (1994). Shell survival and time-averaging in nearshore and shelf environments: estimates from the radiocarbon literature. Lethaia 27: 153-165.

Folk, R. and Volastro, S. (1976). Successful technique for dating of lime mortar by Carbon-14. Journal of Field Archaeology 3: 203-208.

Forbes, H. (2002). The uses of the uncultivated landscape in modern Greece: a pointer to the value of the wilderness in antiquity? In, J. Salmon & G. Shipley (eds). Human Landscapes in Classical Antiquity: Environment and Culture. Routledge: London. pp 68-97.

Foster, M. (2001). Rhodoliths: between rocks and soft places. Journal of Phycology 37: 659-667.

Foster, S. (2011). Physical evidence for the early church in Scotland. In: buildings for worship in Britain: Celtic and anglo-Saxon, Department of continuing educaton, Oxford, Jan. 2010. eprints.gla.ac.uk/48594/

Francisco, S. (2007). The way we do things round here: Specification versus craft culture in the history of building. The American Behavioural Scientist 50 (7): 970-988.

Fraser, V. (1990). The architecture of conquest, building in the Viceroyalty of Peru 1535-1635. Cambridge University Press: Cambridge.

Freiwald, A. (1995). Bacteria induced carbonate degradation: a taphonomic case study of *Cibicides lobatulus* from a high boreal carbonate setting. Palaois 19: 337-346.

Freke, D. (2002). Excavations on St Patricks Isle, Peel, Isle of Man: 1982-88. Liverpool University Press: Liverpool.

Galloway, J., Keene, D. and Murphy, M. (1996). Fuelling the City: Production and Distribution of Firewood and Fuel in London's Region, 1290-1400. The Economic History Review 49 (3): 447-472.

Gell, A. (1992). The technology of enchantment and the enchantment of technology. In, J. Coote and A. Shelton. Anthropology, art and aesthetics. Clarendon Press: Oxford.

Gem, R. (1983). Towards an iconography of Anglo-Saxon architecture. Journal of the Warburg and Courtauld Institutes 46:1-18.

Gem, R. (1988). The English parish church in the 11th and early 12th centuries: A Great Rebuilding? In, J. Blair (ed.). Minsters and parish churches; The local church in transition 950-1200. Oxford University Committee for Archaeology Monograph no. 17: Oxford.

Gem, R. (2009). Gruffudd ap Cynan and the Romanesque church of Penmon, Anglesey. In, N. Edwards (ed.). The archaeology of the early medieval Celtic churches. Maney: Leeds.

Gibbon, S. (2007). Medieval Parish formation in Orkney. In B. Ballin Smith, S. Taylor and G. Williams (eds.). West over sea. Studies in Scandinavian sea-borne expansion and settlement before 1300. Brill: Leiden. pp.235-250.

Gifford, J. (1992) Highlands and Islands. The buildings of Scotland series. Penguin: London.

Gittos, H. (2003). Architecture and liturgy in England c.1000: problems and possibilities. In. N. Hiscock (ed.). The mantle of white churches: architecture, liturgy, and art around the Millennium. Brepols: Turnhout.

Gjerland, B. and Keller, C. (2009). Graves and Churches of the Norse in the North Atlantic: A Pilot Study. Journal of the North Atlantic 2009-10: 161-177.

Goffey, S., Kolak, J. and Bronnimann, C. (1991). Effects of drying, heating, annealing and roasting on carbonate skeletal material, with geochemical and diagenetic implications. Geochimica and Cosmochimica 55 (6): 1627-1640.

Goldberg, P. Holliday, V. and Reid Ferring, C. (eds.) (2001) Earth Sciences and archaeology. Kluwer Academic: New York.

Goldberg, P. and MacPhail, R. (2006). Practical and theoretical geoarchaeology. Blackwell: Malden.

Good, G. and Tabraham, C. (1988). Excavations at Smailholm Tower, Roxburghshire. PSAS 118: 231-266.

Gosselain, O. (1992). Bonfire of the enquiries. Pottery firing temperatures in archaeology: What for? Journal of Archaeological Science 19: 243-259.

Government of Northern Ireland. (1966). An Archaeological Survey of County Down. HMSO: Belfast.

Gower, P. (1977). The Dalradian rocks of the west coast of the Tayvallich peninsula. Scottish Journal of Geology 13: 125-133.

Graham, A. and Collingwood, R. (1923). Skipness Castle. PSAS 57: 266-287.

Grant, I. (1959). The MacLeods. The history of a clan 1200-1956. Faber and Faber: London.

Grant, I. (2007). Land opposite the Llais Afon Inn, Betws-Yn-Rhos, Conwy. Archaeological Excavation. CPAT Report No 872.

Grew, F., Hassall, M and Tomlin, R. (1980). 'Roman Britain in 1979'. Britannia 11: 345-417.

Haflidason, E. (1890). The life of Laurence bishop of Hólar in Iceland. Translated from the Icelandic by Oliver Elton. Rivingtons: London.

Halkin, J. and Roland, C. (1909). Recueil des Chartes de l'Abbaye de Stavelot-Malmedy, (Brussels: Academie Royale de Belgique, 1909), p. 292; reprinted in Roy C. Cave & Herbert H. Coulson, A Source Book for Medieval Economic History, (Milwaukee: The Bruce Publishing Co., 1936; reprint ed., New York: Biblo & Tannen, 1965), pp. 365-366.

Hall-Spencer, J., Kelly, J. and Maggs, C. (2010). Background Document for Maërl beds. OSPAR Commission Biodiversity Series.

Hamilton, J. (1956). Excavations at Jarlshof. HMSO: Edinburgh.

Hamlin A. (1976). The Archaeology of Early Christianity in the North of Ireland. Unpublished Ph.D thesis, Department of Archaeology, Queens University Belfast.

Hamlin, A. (1985). The archaeology of the Irish church in the eighth century. Peritia 4: 279-299.

Hammond, M. (2010). Royal and aristocratic attitudes to saints. In S. Boardman and E. Williamson (eds.). The cult of saints and the Virgin Mary in medieval Scotland. pp. 61-86.

Handler, J. and Bergman, S. (2009). Vernacular houses and domestic material culture on Barbadian sugar plantations, 1640-1838. Journal of Caribbean History 43 (1): 1-36.

Hansen, S. (1991). Toftanes: a Faroese Viking Age farmstead from the 9th-10th centuries AD. Acta Archaeologica 61: 44-53.

Harbison, P. (1970). How old is Gallerus Oratory? Medieval Archaeology 14: 34-59.

Harbison, P. (1982). Early Stone Churches. In H. Lowe (ed.), *Die Iren und Europa im Fröheren Mittelalter*. Stuttgart. 618-629.

Harbison, P. (1990). Pilgrimmage in Ireland: The monuments and people. Barrie & Jenkins: London.

Harbison, P. (2008). The Churches of Medieval Clare. In M. Lynch & P. Nugent (eds.). Clare: history and Society. Interdisciplinary essays on the history of an Irish County. Geography publications: Dublin. pp. 1-26.

Harding, D. (2000). The Hebridean Iron Age: Twenty years research. University of Edinburgh, Department of Archaeology, Occasional Papers series No. 20.

Hare, M. (2000). Cnut and Lotharinia: two notes. Anglo-Saxon England 29: 261-278.

Hare, M. (2009). The 9th-century west porch of St. Mary's church, Deerhurst, Gloucestershire: form and function. Medieval Archaeology 53: 35-93.

Hare, M. and Hamlin, A. (1986). The study of early church architecture in Ireland: an Anglo-Saxon viewpoint. In, Butler, L and Morris, R. (eds.). The Anglo-Saxon Church; papers on history, architecture and archaeology in honour of Dr. H. M. Taylor. CBA Research Report 60: London.

Harrison [1577] In F. Furnivall (ed.). (1877) Harrison's description of England in Shakespeares youth. London. Clairegrapper.info/materials-and-uses.html. Last accessed 07-06-2016.

Hastrup, K. (1984). Defining a society: the Icelandic free state between two worlds. Scandinavian studies 56: 235-255.

Hayden, A. (2006). Excavation of a medieval house in the grounds of Howth house, County Dublin. . In S. Duffy (ed). Medieval Dublin VII: proceedings of the friends of medieval Dublin symposium, 2005. Four Courts Press: Dublin. pp. 103-112.

Hayden, A. (2013). Early medieval shrines in north-west Inveragh: new perspectives from Church Island, near Valencia, Co. Kerry. Proceedings of the Royal Irish Academy 113C: 67-138.

Helms, J. (1870). *Ribe Domkirke*. Copenhagen.

Henderson, J. (2000). The Science and archaeology of materials: an investigation of inorganic materials. Routledge: London and New York.

Henry, A. and Stewart, J. (2012). (eds.). Practical Building Conservation: Mortars, Renders and Plasters. English Heritage/Ashgate: Aldershot.

Henry, F. (1970). Irish art in the Romanesque period AD. 1020-1170. Methuen: London.

Herd, R. and Pinkerton, H. (1993). Bubble coalescence in magmas. In Lunar and Planetary Inst., Twenty-Fourth Lunar and Planetary Science Conference. Part 2: G-M pp. 641-642.

Hesselbo, S., Oates, M., and Jenkyns, H. (1998). The lower Lias Group of the Hebrides Basin. Scottish journal of Geology 34 (1): 23-60.

Heywood, S. (1988). The round towers of East Anglia. In J. Blair (ed). Minsters and parish churches: The local church in transition 950-1200. Oxford University Committee for Archaeology Monograph No. 17. pp. 169-177.

Hiler, H. (1934). Notes on the technique of painting. Faber and Faber: London.

Hill, P. (1991). Whithorn 4, Excavations 1990-91, Interim Report. Whithorn Trust: Whithorn.

Hill, P. (1997). *Whithorn and St. Ninian: The Excavation of a Monastic Town 1984-91*. Alan Sutton Publishers/Whithorn Trust: Stroud.

Hilton, R. (2003). Bond men made free: Medieval peasant movements and the English Rising of 1381. Routledge.

Hingley, R. (1992). Society in Scotland from 700BC to AD 200 PSAS 122: 7-53.

Hirth, K. (2010). Craft Production, Household diversification, and domestic economy in prehispanic Mesoamerica. In, K. Hirth. Archaeological papers of the American Anthropological Association, Housework: Craft production and domestic economy in ancient MesoAmerica. Wiley: New York. pp.13-32.

Hiscock, N. (2003). The Ottonian Revival; church expansion and monastic Reform. In, N. Hiscock (ed.). The White mantle of churches: architecture, liturgy and art around the millennium. Brepols: Turnhout. pp. 1-28.

Historic Scotland. (1971). External reference listed in Canmore event ID 962259. www.canmore.org.uk/event/962259. Last viewed 29/09/2015

Holland, M. (2000). Dublin and the reform of the Irish Church in the eleventh and twelfth centuries. Peritia 14: 111-60.

Holland, P. (1996). The Anglo-Normans and their castles in County Galway. In G. Moran & R. Gillespie, Galway: History and Society. Geography Publications: Dublin. pp. 1-25.

Hudson, B. (2006). Irish Sea studies 900-1200. Four Courts Press: Dublin.

Hughes, J. (ed.) (2013) Proceedings of the 3rd Historic Mortars Conference, HMC13, Glasgow Sept 2013, University of West of Scotland. Rilem: Glasgow.

Hughes, J. and Cuthbert, S. (2000). The petrography and microstructure of medieval lime mortars from the west of Scotland: implications for the formulation of repair and replacement mortars. Materials and Structures 33: 594 – 600.

Hurley, M. (1998). Viking Age towns: archaeological evidence from Waterford and Cork. In. M. Monk and J. Sheehan (eds.). Early medieval Munster: archaeology, history and society. Cork University Press: Cork.

Innes, C. (1854). *Origines Parochiales Scotiae*: The Antiquities Ecclesiastical and Territorial of the Parishes of Scotland, Volume 2. Lizars: Edinburgh.

Iona Club (ed.). (1847). *Collectanea de Rubus Albanicus*: consisting of original papers and documents relating to the history of the Highlands and Islands and Islands of Scotland.

Irvine. L. and Chamberlain, Y. (1994). Seaweeds of the Bitish Isles. Volume 1. *Rhodophyta*, Part 2B *Corallinales*, *Hildenbrandiales*. HMSO: London.

Jackson, D., Biek, L., and Dix, B. (1973). A Roman Lime Kiln at Weekley, Northants. Britannia 4: 128-140.

James, H. (2009). Medieval rural settlement: a study of Mid-Argyll, Scotland. Unpublished PhD thesis. University of Glasgow.

James, H. and Yeoman, P. (2008). Excavations at St. Etheran's monastery, Isle of May, Fife: 1992-7. Tayside and Fife Archaeological Committee Monograph 6.

James, N. and Choquette, P. (1984). Limestones – The meteoric diagenetic environment. Geoscience Canada 11 (4): 161-194.

Jamieson, J. (1808). Jamieson's etymological dictionary of the Scottish language online. 2 volumes. www.scotsictionary.com last accessed 14/02/2016.

Jennings, A. (1998). Iona and the Vikings: survival and continuity. Northern Studies 33: 37-54.

Jennings, A. and Kruse, A. (2009). One coast – three peoples: names and ethnicity in the Scottish west during the early Viking period. In A. Woolf (ed.) Scandinavian Scotland: 20 years After. The proceedings of a day conference held on 19th February 2007. University of St Andrews: Committee for dark Age Studies. pp.75-102.

Johnson, D. (2008). The archaeology and technology of Early-Modern lime burning in the Yorkshire Dales: developing a clamp kiln model. Industrial Archaeology Review 30 (2): 127-143.

Johnson, D. (2010a). Hushes, delfs and river stonary: alternative methods of obtaining lime in the gritstone Pennines in the early modern period. Landscape History 31 (1): 37-52.

Johnson, D. (2010b). Liming and agriculture in the Central Pennines: the use of lime in land impreovement from the late thirteenth century to c. 1900. BAR British Series 525.

Johnson, M., Photos-Jones, E. & Hichman, S. (2006). A Medieval Bloomery Mound in Glen Docherty, Kinlochewe, Highland. Scottish Archaeological Journal 28 (2): 125-149.

Johnstone, G. and W. Mykura. (1989). British Regional Geology: The Northern Highlands of Scotland. HMSO: London.

Jones, W. (1971). The Image of the Barbarian in Medieval Europe. Comparative Studies in Society and History 13 (4) 376-407.

Jorge, M. (2012). Women and the architecture of al-Andalus (711-1492): an historiographical analysis. In T. Martin. (ed.). Reassessing the roles of women as 'makers' of medieval art and architecture. 2 volumes. Brill: Leiden. pp. 479-521.

Kamenos , N. and Law, A. (2010). Temperature controls on coralline algal skeletal growth 1. Journal of Phycology 46 (2): 331-335.

Kamenos, N. (2010). North Atlantic Summers have warmed more than winters since 1353, and the response of marine zooplankton. PNAS 107 (52): 22442-22447.

Karkov, E. and Howe, N. (2006). Conversion and colonisation in Anglo-Saxon England. Medieval and Renaissance texts and studies 138. Arizona Center for Medieval and Rennaissance Studies: Arizona.

Karringa, P. (1952). Advances in Oyster Biology. The Quarterly Review of Biology 27 (3): 266-308.

Keary, P. (2001). The new Penguin dictionary of Geology. Second edition. Penguin Books: London.

Kemp, B. (1980). Monastic possession of parish churches in England in the twelfth century. The Journal of Ecclessiastical History 31 (2): 133-160.

Kermode,P. (1908). First report of the Antiquities of the Isle of Man. Proceedings of the Isle of Man Natural History & Antiquities Society: Douglas.

Kermode,P. (1910). Second report of the Antiquities of the Isle of Man. Proceedings of the Isle of Man Natural History & Antiquities Society: Douglas.

Kermode,P. (1911). Third report of the Antiquities of the Isle of Man. Proceedings of the Isle of Man Natural History & Antiquities Society: Douglas.

Kermode,P. (1915). Fourth report of the Antiquities of the Isle of Man. Proceedings of the Isle of Man Natural History & Antiquities Society: Douglas.

Kermode,P. [1918] (1935). Fifth report of the Antiquities of the Isle of Man. Proceedings of the Isle of Man Natural History & Antiquities Society: Douglas.

Kidwell, S. and Boscense, D. (1991). Taphonomy and time averaging of marine shelly faunas. In, P. Allison and D. Briggs (eds.). Taphonomy: releasing the data locked in the fossil record. Plenum Press: London and New York. pp. 115-209.

Kingston, S. (2004). Ulster and the Isles in the Fifteenth Century. The lordship of the Clann Domhaill of Antrim. Four Courts Press: Dublin.

Kirk, J. Tanner, R and Dunlop, A. (1997). Calender of Scottish Supplications to Rome. Voluume 5: 1447-1471. Scottish Academic Press.

Kitchen, D. (1985). The partial melting of basalt and its enclosed mineral filled cavities at Scat hill, Co. Antrim. Mineralogical Magazine 49: 655-662.

Klein, C. and Hurlbut, C. (1993). Manual of mineralogy. John Wiley and Sons: New York.

Knoop, D. and Jones, G. (1978). The genesis of freemasonry: an account of the rise and development of freemasonry in its operative, accepted, and early speculative phases. london: q.c. correspondence circle ltd. first published by manchester university press 1947, http://www.phoenixmasonry.org/genesis_of_freemasonry.htm

Knott C. and Thacker, M. (2011). *Eaglais na h'Aoidhe*. Archaeological Survey. Unpublished document prepared for *Urras Eaglais na h'Aoidhe* and Historic Scotland.

Kubach, H. (1972). Romanesque architecture. Abrams: New York.

Kudlacz, K. (2013). Phase transitions within the lime cycle: implications in heritage conservation. Edititorial de la Universidad de Granada. Can be viewed at digibug.ugr.es/bitstream/10481/30353/1/22494650.pdf. last viewed 23/05/16.

Lamb, D. (2008). Peeling back the layers: reconstructing a vanished Iron Age landscape. In G. Noble, T. Poller, J. Raven and L. Verril (eds.). Scottish Odysseys: the archaeology of islands. Tempus: Stroud.

Lamb, R. (1974). The Cathedral of Christchurch and the monastery of Birsay. PSAS 105: 200-205.

Lamb, R. (1982). The archaeological sites and Monuments of Scotland, 16: Egilsay, Rousay and Wyre. RCAHMS: Edinburgh.

Lamb, R. (1993b). Congress diary. In, C. Batey, J. Jesch and C. Morris (eds.). The Viking age in Caithness, Orkney and the North Atlantic. Select papers from the proceedings of the eleventh Viking Congress, Thurso and Kirkwall, 22 August – 1 September 1989. Edinburgh University Press: Edinburgh.

Lamb, R. (1993a). Tuquoy: The Norse Magnate Farmstead. In, C. Batey, J, Jesch & C. Morris (eds.). The Viking Age in Caithness, Orkney and the North Atlantic. Edinburgh. p. 82.

Lamplugh, G. (1903). The geology of the Isle of Man. http://www.isle-of-man.com/manxnotebook/fulltext/geo1903/index.htm

Larsen, A. (2013) The excavation at Belmont, Wadbister, Unst, Shetland. In V. Turner, J. Bond and A. Larsen (eds.) Viking Unst: Survey and excavation in northern Shetland 2006 – 2010. Shetland Heritage Publications: Lerwick.

LaViolette, A. (2008). Swahili cosmopolitanism in Africa and the Indian Ocean world. A.D. 600-1500. Archaeologies: Journal of the World Archaeological Congress 4 (1): 24-49.

Lawson, B. (1991). St. Columba's Church at Aignish. Bill Lawson Publications: Harris.

Leask, H. (1955). Irish Churches and Monastic Buildings 1: The First Phases and The Romanesque. Dundalk: Dundalgan Press.

Leask, H. (1958). Irish Churches and Monastic Buildings. Vol. 2: Gothic architecture to 1400. Dundalgan Press: Dundalk.

Lee, J., Onstott, T., Cashman, K., Cumbest, R. and Johnson, D. (1991). Incremental heating of hornblende in vacuo: Implications for $^{40}Ar/^{39}Ar$ geochronology and the interpretation of thermal histories. Abstract: Geological Society of America.

Lelong, O. (2000). 'Raitts Chapel, Lynchatt, Highland (Alvie parish), early medieval chapel', *Discovery and Excavation in Scotland 1:* 46.

Lelong, O. and Wood, J. (2000). A Township through Time: excavation and Survey at the deserted settlement of Easter Raitts, Badenoch, 1995-99. In J. Atkinson, I. Banks & G. MacGregor (Eds.). Townships to Farmsteads: Rural Settlement Studies in Scotland, England and Wales. BAR 293.British Series. pp. 40-49.

Lewis, J. and Pringle, D. (2002). Spynie Palace and the bishops of Moray: history, architecture and archaeology. Society of Antiquaries of Scotland monograph series no. 21: Edinburgh.

Li, Y., Changsui, Z., Chen, H., Duan, L. and Chen, X. (2009). CO2 capture behavior of shell during calcination/carbonation cycles. Chem. Eng. Technol. 32 (8): 1176–1182.

Liddell (1791-99). Parish of Orphir, County of Orkney. The statistical Accounts of Scotland 1791-99. Vol. 19: 394-419.

Liddiard, R. (2013). Introduction: The North Sea. In. D. Bates and R. Liddiard (eds.). East Anglia and its North Sea world in the Middle Ages. Boydell Press: Woodbridge.

Lidén, H. (1969): From pagan sanctuary to Christian church the excavation of Mære church in Trøndelag, Norwegian Archaeological Review 2 (1): 3-21.

Lidén, H. (2007). The church of St Clement in Oslo. In B. Ballin Smith, S. Taylor and G. Williams (eds.). West over sea. Studies in Scnadinavian sea-borne expansion and settlement before 1300. Brill: Leiden. pp. 251-264.

Lindqvist, J. and Johansson, S. (2013). The development of binders and mortars in Sweden. Proceedings of the 3rd Historic mortars conference, Glasgow, 2013. Rilem: Glasgow.

Lindroos, A., Heinemeier, J., Ringbom, Å., Braskén, M. & Sveinbjörnsdóttir, Á. (2007). Mortar Dating Using AMS $^{14}C$ and Sequential Dissolution: examples from medieval, non-hydraulic lime mortars from the Åland Islands, SW Finland. Radiocarbon 49 (1): 47–67.

Linck, D. and Modreski, P. (1983). Fluoresence of shell fragments as an aid to the study of Early American mortars. Journal of the Fluorescent Mineral Society 12: 6-15.

Livingstone Smith, A. (2001). Bonfire II: The Return of Pottery Firing Temperatures Journal of Archaeological Science 28: 991–1003.

Loeber, R. (2001). An architectural history of Gaelic castles and settlements, 1370-1600. In, P. Duffy, D. Edwards and E. Fitzpatrick (eds.) Gaelic Ireland c.1250-c.1650, Land Lordship and Settlement. Four Courts Press: Dublin. pp. 271-314.

Long, A. and Rippeteau, B. (1974). Testing Contemporaneity and Averaging Radiocarbon Dates. American Antiquity 39 (2): 205-215.

Loudon, J. (1825) An encyclopeadia of Agriculture. London: Longman, Hurst, Rees, Orme, Brown and Green.

Low, G. (1791-99). The United parish of Birsay and Harray, County of Orkney. Statistical Account of Scotland, 1791-99. Vol. 14: 311-333.

Low, G. [1774] (1879). Tour through Orkney and Shetland in 1774. William Peace: Kirkwall.

Lowe, C. (1987). Early ecclesiastical sites in the Northern Isles & Isle of Man: an archaeological field survey. 2 vols. Unpublished PhD thesis. Archaeology. University of Durham.

Lowe, C. (1993). Crosskirk. In O. Owen. Tuquoy, Westray, Orkney: a challenge for the future? In, C. Batey, J, Jesch & C. Morris (eds.). The Viking Age in Caithness, Orkney and the North Atlantic. Edinburgh University Press: Edinburgh.

Lowe, C. (2000). Survey and recording of an eroding cliff-section at Newark Bay, Deerness, Orkney: Archaeological Data Structure Report. Unpublished Headland Archaeology Project NDO00 prepared for Historic Scotland.

Lowe, C. (2001). Newark. D & ES 1:66.

Lowe, C., Buteux, S. and Hunter, J. (2000). St Nicholas Chapel, Papa Stronsay, Orkney (Stronsay Parish). Iron Age activity, medieval chapel. D & ES 1: 67-68.

Lowe, C., Dalland, M. and Middleton, M. (2002). The Cille-Bharra church-group, Eoligarry, Barra, Western Isles: historic building survey of St Barr's Church and the south chapel. Unpublished Headland Archaeology (Edinburgh) report.

Lugli, S., Marchetti, S. and Caroselli, M. (2013). Petrography of mortars and plasters as a tool to distinguish construction phases for the historical buildings of the Modena area (Northern Italy). Proceedings of the 3rd Historic mortars conference, Glasgow, 2013. Rilem: Glasgow.

Lynn, C. (1974). 'Early Christian Period Domestic Structures: A Change from Round to Rectangular Plans?' Irish Archaeological Research Forum 5: 29-45.

Lynnerup, N. (1998). The Greenland Norse: a biological-anthropological study. Meddelelser om Grønland. Commision for scientific research in Greenland: Copenhagen.

Lyttleton, J. & O' Keefe, T. (2005). The manor in medieval and early modern Ireland. Four courts Press: Dublin.

Macalister, R. (1935). Ancient Ireland. Methuen: London.

MacDonald, J. (2011). Microstructure, crystallography and stable isotope composition of *Crassostrea Gigas*. Unpublished PhD thesis submitted to Glasgow University.

MacGibbon, D. and Ross, T. (1896). The ecclesiastical architecture of Scotland from the earliest Christian times to the seventeenth century. 3 volumes. David Douglas: Edinburgh.

MacIntyre, M. (1993). Making Hydrated Lime from Seashells: As recalled by Domhnall lain Monk,Benbecula. Recorded December 1992 by Martin Maclntyre. Transcript published in Comunn Eachdraidh nan Eilean mu Dheas. No. 4. p. 8.

Mackenzie, C. (1791-99). Parish of Stornoway. County of Ross and Cromarty. Statistical Account of Scotland 1791-99. Vol 19: 241- 262.

MacKenzie, W. (1919). The book of the Lews: the Story of a Hebridean Isle. Paisley: A. Gardner.

MacKenzie, W. (1927). The Mediaeval castle in Scotland. Rhind lectures in archaeology, 1925-6). Methuen: London.

MacKinlay, J. (1910). Ancient church dedications in Scotland. David Douglas: Edinburgh.

MacKinnon, J. and May, E. (1990). Small Scale Maya Lime Making in Belize: Ancient and Modern. Ancient Mesoamerica 1: 197-203.

MacLean, R. (1837). Parish of South Uist, County of Inverness. The New Statistical Accounts of Scotland, 1834-45. Vol. 14: 182-197.

MacLeod, F. (1997). The Chapels in the Western Isles. Acair: Stornoway.

Macleod, R. (1925). A West Highland Estate during three centuries. The Scottish Historical Review 22 (87): 61-181.

MacNab, P. (1970). The Isle of Mull. David & Charles: Newton Abbot.

MacNeil, T. (1997). Castles in Ireland: feudal power in a Gaelic world. Routledge: London.

MacPhail, J. (1914). Highland Papers, vol. I. The Scottish History Society. Second series. Edinburgh University Press: Edinburgh.

MacPhail, J. (1916). Highland Papers, vol II. The Scottish History Society. Second series. Edinburgh University Press: Edinburgh.

MacQuarrie, A. (1987). Kings, Lords and Abbots: Power and patronage at the medieval monastery of Iona. Transactions of the Gaelic Society of Inverness 54: 355-370.

MacQueen, E. (1791-99). The parish of Barray. County of Inverness. The Statistical Account of Scotland 1791-1799. Vol 13: 326-342.

MacVean, D. (1964). Woodland and Scrub. In, J. Burnett (ed.) The vegetation of Scotland. Oliver and Boyd: Edinburgh. pp. 144-167.

MacVean, D. & Ratcliffe, D. (1962). Plant Communities of the Scottish Highlands. HMSO: London.

Mahé, K., Bellamy, E., Lartaud, F. and de Rafélis, M. (2010). Calcein and manganese experiments for marking the shell of the common cockle (*Cerastoderma edule*): tidal rhythm validation of increments formation. Aquatic Living Resources 23: 239–245.

Majewski, O, (1969). Recognition of invertebrate fossil fragments in rocks and thin sections. Brill: Leiden.

Maldonado, A. (2011). Christianity and burial in late Iron Age Scotland, AD 400-650. Unpublished PhD thesis, Univeristy of Glasgow.

Malone, C. (2003). St Bénigne in Dijon as exemplum of Rudolf Glaber's metaphoric "White Mantle". In. N. Hiscock (ed.). The White mantle of churches: architecture, liturgy and art around the millennium. Brepols: Turnhout. pp. 160-179.

Maniatis, Y. (2009). The emergence of ceramic technology and its evolution as revealed with the use of scientific techniques. In A, Shortland, I. Freestone and T. Tehren (eds.). From mine to microscope. Oxbow: Oxford. pp. 11-27.

Manning, C. (1997). The date of the round tower at Clonmacnoise. Archaeology Ireland 11: 12-13.

Margalha, G., Veiga, R., Santos Silva, A. and Brito, J. (2011) Traditional methods of mortar preparation: the hot lime mix method. Cement and concrete composites 33: 796-804.

Marinowitz, C., Neuwald-burg, C. and Pfeifer. M. (2012). Historic documents in understanding and evaluation of historic lime mortars. In J. Valek, J. Hughes, J. Casper and W. Groot. Historic mortars: characterization, assessment and repair. Springer. pp. 15- 24.

Marshall, J. (1935). Old kiln of Kilwhinlock. Transactions of the Buteshire Natural History Society 11: 84-87.

Marston, J. (2009). Modeling wood acquisition strategies from archaeological charcoal remains. Journal of Archaeological Science 36: 2192–2200.

Marstrander, C. (1937).Treen og Keeill Et Førnorsk Jorddelingsprinsipp På De Britiske Øyene Norsk Tidsskrift For Sprogvidenskap Bind Viii, Oslo.

Marti, R. (2005). The early medieval potteries from Basle's hinterland (Switzerland): origin, production and diffusion of the pottery ware. Ruralia 6: 3-16.

Martin, D. (1791-99). Parish of Kilmuir, County of Inverness. The Statistical Accounts of Scotland 1791-99. Vol. 2: 547-557.

Martin, M. [1695]. A description of the Western Islands of Scotland ca 1695 and a late voyage to St Kilda. (1999) edition introduced by C. Withers and R. Munro. Birlinn: Edinburgh.

Matheson, J. (1791-99). Parish of Kilmuir Easter, County of Ross and Cromarty. Statistical Accounts of Scotland 1791-99. Vol. 6: 183-196.

Matheson, W. (1981). Transactions of the Gaelic Society of Inverness LI: 320-337.

Mathews, J. (2001). Radiocarbon Dating of Architectural Mortar: A Case Study in the Maya Region, Quintana Roo, Mexico. Journal of Field Archaeology 28 (3/4): 395-400.

Mathison, C. (1838). Parish of Kilmuir Easter, County of Ross and Cromarty. Statistical Accounts of Scotland 1834-45. Vol. 14: 301-312.

Maxwell-Irving, A. (1995). Torthorwald Castle. Transactions of the Dumfiesshire and Galloway Natural History and Antiquarian Society. Third Series 68: 97-106.

McCoy, S. and Kamenos, N. (2015). Coralline algae (rhodophyta) in a changing world: integrating ecological, physiological, and geochemical responses to global change. Journal of Phycology 51: 6-24.

McDonald, A. (1995). Scoto-Norse kings and the Reformed religious orders: patterns of monastic patronage in twelfth-century Galloway and Argyll. Abion 27 (2): 187-219.

McDonald, A. (1997) Kingdom of the Isles. Scotland's Western Seaboard c. 1100-1336. Tuckwell: East Linton.

McDonald, A. (1999). Coming in from the margins: the descendents of Somerled and cultural accommodation in the Hebrides, 1164-1317. In, B. Smith (Ed.). Britain and Ireland 900-1300; Insular responses to medieval European change. Cambridge University Press: Cambridge. pp. 179-198.

McDonald, A. (2014). The Manx sea kings, the Isle of Lewis and the gaming pieces: is there a Manx context for the Lewis chessmen? In, D. Caldwell and M. Hall (eds.). The Lewis Chessmen: new perspectives. National Museums of Scotland: Edinburgh. pp. 95-120.

McDonald, A. (2015). Man, Somerled and the Isles: the rise of a new dynasty, c. 1100-64. In, S. Duffy and H. Mytum, A New History of the Isle of Man, Volume 3: The Medieval Period 1000-1406. pp. 58-77.

McErlean, T. and Crothers, N. (2007). Harnessing the tides: The early medieval tide mills at Nendrum Monastery, Strangford Lough. Northern Ireland Archaeological Monographs No. 7. Environment and Heritage service: Belfast.

McGrath, M. (1987). The Materials and Techniques of Irish Medieval Wall-Paintings. The Journal of the Royal Society of Antiquaries of Ireland 117: 96-124.

McNeill, T. (2001). The archaeology of Gaelic lordship east and west of the Foyle. In. P. Duffy, J. Edwards & L. Fitzpatrick (eds.). Gaelic Ireland. Four Courts Press: Dublin. pp. 346-56.

McRae, F. (1837). Parish of North Uist, County of Inverness. The New Statistical Account of Scotland. Vol. 14: 159-181.

Megaw, B. (1950). The Monastery of Saint Maughold. Proceedings of the Isle of Man Natural History & Antiquitied Society 5 (2): 169-180.

Meredith-Lobay, M. (2009). Contextual Landscape Study of the Early Christian Churches of Argyll, the persistence of memory. BAR British Series 488. Archaeopress: Oxford.

Miket, R. and Roberts, D. (1990). The Mediaeval castles of Skye and LochAlshe. Birlinn: Edinburgh.

Millar, H. and Kirkhope, J. (1964). Discovery and Excavation, 1964. Council for British Archaeology. Scottish Regional Group.

Millard, A. (2013). The Radiocarbon Dates. In D. Parsons & D. Sutherland, The Anglo-Saxon Church of All saints Brixworth Northanptonshire: Survey, excavation and analysis 1972-2010. Oxbow books: Oxford. pp 271-282.

Milliman, J. (1974). Recent Sedimentary Carbonates. Part 1: Marine Carbonates. Springer : New York.

Mills, P. (2009). Folk Housing in the Middle of the Pacific: architectural lime, creolized ideologies, and expressions of power in nineteenth-century Hawaii. In C. White (ed.), The materiality of individuality: archaeological studies of individual lives. Springer science and business media: New York. pp. 75-91.

Miranda, J., Carvalho, A. and Pires, J. (2012). Assessment of the binder in historical mortars by various techniques. Archaeometry 54 (2): 267-277.

Mitchell, H. (1935). The microscopic structure of the shell and ligament of *cardium* (*cerastoderma) corbis martyn*. Journal of Morphology 58 (1): 211-220.

Miyawaki, M. (1954). Notes on the Shell Structure of the Oyster, *Gryphaea* (*Ostrea*) *gigas* from the Akkeshi Lake. Jour. Fac. Hokkaido Univ. Ser VI, Zool, 12: 116-119.

Moberley, R. (1970). Microprobe study of diagenesis in calcareous algae. Sedimentology 14: 113-123.

Mohamed, M., Yusup, S. and Maitra, S. (2012). 'Decomposition study of Calcium Carbonate in Cockle shell'. Journal of Engineering Science and Technology 7(1): 1 – 10.

Monro, D. [1549]. A description of the Occidental ie, Western Islands of Scotland. 1999 Birlinn edition introduced by C. Withers and R. Munro. Birlinn: Edinburgh.

Monro, H. (1791-99). The Parish of Uig, County of Ross and Cromarty. The Statistical Account of Scotland 1791-1799. Vol. 19: 280-288.

Mooney, S. and Tinner, W. (2011). The analysis of charcoal in peat and organic sediments. Mires and Peat 7: 1-18.

Moore, H. and Wilson, G. (1998). Orkney coastal survey 1998. Westray, Papa Westray, Mainland. Discovery and Excavation Scotland 1998: 69.

Moore, P. (1977). Stratigraphy and Pollen analysis of Claish Moss, North-west Scotland: significance for the origin of surface-pools and forest history. Journal of Ecology 65 (2): 375-397.

Moore, R. (1969). Treatise on invertebrate paleontology. Part N (Volume 1 of 3) Mollusca 6 Bivalvia. Geological society of America and the University of Kansas.

Morison, J. (1791-99). Parish of Canisbay, County of Caithness. The Statistical Accounts of Scotland, 1791-99. Vol. 8: 142-169.

Morris, A. (1815). On Spanish Peasantry, their improved lime-kilns and economical cooking stoves. Memoirs of the Philadelphia Society for Promoting Agriculture, Volume 4. Philadelphia: Benjamin Warner. pp 9-10.

Morris, C. (1983). The survey and excavations at Keeil Vael, Druidale, in their context. In C. Fell, P, Foote, J. Graham-Campbell, & R. Thomson, The Viking Age in the Isle of Man: Selected papers from the Ninth Viking Congress, Isle of Man, 4-14 July 1981. Viking Society for northern research, University College of London. pp. 107-132.

Morris, C., with N. Emery. (1986). The Chapel and enclosure on the Brough of Deerness, Orkney: survey and excavations, 1975-1977. PSAS. 116: 301-374.

Morris, C. (1995). The Birsay Bay Project: A Résumé. In C. Batey, J. Jesch & C. Morris (eds.). The Viking Age in Caithness, Orkney and the North Atlantic. Edinburgh University Press: Edinburgh. pp. 284-307.

Morris, C. (2004). From Birsay to Brattahĺlđ: recent perspectives on Norse Christianity in Orkney, Shetland, and the North Atlantic region. In, J. Adams and K. Holman (eds.). Scandinavia and Europe 800-1350: contact, conflict and coexistence. Brepols: Turnhout. pp. 177-195.

Moropoulou, A., Bakolas, A. and Aggelakopoulou, E. (2001). The effects of limestone characteristics and calcinations temperature to the reactivity of the quicklime. Cement and concrete research 31 (4): 633-639.

Mouat, T. and Barclay, J. (1791-99). The parish of Unst, County of Shetland. Statistical Accounts of Scotland 1791-99. Vol. 5: 182-202.

Muhegi, B. and Schilderman, T. (1995). Tanzania. In E. Angevi, O. Ruskulis and T. Schilderman (eds.). Lime and alternative binders in East Africa. Intermediate technology publications in association with the overseas development administration: London. pp. 3-30.

Muir, T. (1861) – Characteristics of old church architecture etc. in the mainland and western isles of Scotland. Edmonston and Douglas: Edinburgh.

Muir, T. (1885). Ecclesiological notes on some of the islands of Scotland. David Douglas: Edinburgh.

Möller, U. and Kanan, M. (2005). The microstructure of traditional Brazillian lime plasters – the custom house of Florianopolis.VI Simpósio Brasileiro de Tecnologia de Argamassas; I International Symposium on Mortars Technology, Florianópolis, 23 a 25 de maio de 2005. pp.736-745.

Müller-Wille, M. (2003). The Cross goes north: Carolingen times between Rhine and Elbe. In. M. Carver (ed.). The Cross goes north; processes of conversion in northern Europe, AD300-1300. York Medieval Press: York. pp. 443-462.

Murray, G. (2010). Altars in Ireland, 1050-1200: a survey. The Journal of Irish Archaeology 19: 101-112.

Mykura, W. (1976). Orkney and Shetalnd. British Geological Series. HMSO: Edinburgh.

Mylne, R. (1893). The Master masons to the Crown of Scotland. Scott and Ferguson: Edinburgh.

Nagasawa, H. (2013). The molecular mechanism of calcification in aquatic organisms. Bioscience, Biotechnology and Biochemistry 77 (10): 1991-1996.

Nash, M., Troitzsch, U., Opdyke, B., Trafford, J., Russell, B. and Kline, D. (2011). First discovery of dolomite and magnesite in living coralline algae and its geobiological implications. Biogeosciences 8: 3331–3340.

Nash, M., Opdyke, B., Troitzsch, U., Russell, B., Adey, W., Kato, A., Diaz-Pulido, G. Brent, C., Gardner, M., Prichard, J. and Kline, D. (2013a). Dolomite-rich coralline algae in reefs resist dissolution in acidified conditions. Nature Climate Change 3: 268-272.

Nash, M., Opdyke, B., Wu, Z., Xu, H. and Trafford, J. (2013b). Simple x-ray diffraction techniques to identify mg calcite, dolomite, and magnesite in tropical coralline algae and assess peak asymmetry. Journal of Sedimentary Research 83: 1085–1099.

Nedkvitne, A. (2009). Lay belief in Norse Society, 1000-1350. Museum Tusculanum Press, University of Copenhagen.

Nemliher, J., Nsuaadu, K. and Kallaste, T. (2009). 'Temperature-induced changes in crystal lattice of bioaragonite of Tapes Decussatus Linnaeus (Mollusca: Bivalvia)'. Journal of Thermal Analysis and Calorimetry 97 (1): 27–32.

Newell, R. (1998-99). Reduction and oxidation in English medieval kiln practice. Medieval Ceramics 22-23: 124-34.

Newman, C., O'Connell, M., Dillon, M. and Molloy, K. (2007). Interpretation of charcoal and pollen data relating to a late Iron Age ritual site in eastern Ireland: a holistic approach. Vegetation History and Archaeobotany 16: 349–365.

Newman, R. and Brennand, M. (2007). The Early Medieval Period Research Agenda. Archaeology North West 9 (19): 73-94.

NGU (2005). Mneral recourses in Norway. The Norwegian mining and quarrying industry in 2004. Geological Survey of Norway Report 2005.042. Can be viewed at www.ngu.no/filearchive/227/2005_042.pdf, last viewed 07/07/2016.

Ni Ghabhlain, S. (1995). Church, parish and polity: the medieval diocese of Kilfenora, Ireland. Unpublished PhD. Thesis. University of California.

Nicholaison, W. (1969). Norse settlement in the Northern and Western Isles. Scottish Historical Review 48 (1): 6-17.

Nicholls, K. (1972). Gaelic and Gaelicised Ireland in the Middle Ages. The Gill history of Ireland 4. Gill and MacMillan: Dublin.

Nicolson, J. (1972) Shetland. David and Charles: Vancouver.

Nisbet, H. and Gailey, R. (1960). A survey of the antiquities of North Rona. Archaeological Journal 117: 86-115.

Nisbet, J. (1905). A practical treatise on British forestry and arboriculture for landowners, land agents, and foresters. Vol. 1. William Blackwood and Sons: Edinburgh and London.

Norlund, P. with Roussell, A. (1930). Norse ruins at Gardar, the Episcopal seat of medieval Greenland. Meddelelser om Grønland 76: 1-70

Nyegaard, G. (2009). 'Restoration of the Hvalsey Fjord Church'. Norse Greenland: Selected Papers from the Hvalsey Conference 2008. Journal of the North Atlantic. Special Vol. 2: 7-18.

Ó Carragáin, T. (2003). The architectural setting of the cult of relics in early medieval Ireland. The Journal of the Royal Society of Antiquaries of Ireland 133: 130-176.

Ó' Carragáin, T. (2005a). Regional variation in Irish pre-Romanesque architecture. The Antiquarries Journal 85: 23-56.

Ó' Carragáin, T. (2005b). Habitual masonry styles and the local organisation of church building in early medieval Ireland. Proceedings of the Royal Irish Academy 105C (3): 99-149.

Ó' Carragáin, T. (2010). Churches in early medieval Ireland. Yale University Press: New Haven and London.

O' Connor, T. and Evans, J. (2005). Environmental Archaeology: principles and methods. Second edition. Sutton Publishing: Gloucestershire.

Ó Corráin, D. (1998). The Vikings in Scotland and Ireland in the ninth century. Peritia 12: 296-339.

Ó Danachair, C. (1957). Materials and Methods in Irish Traditional Building. The Journal of the Royal Society of Antiquaries of Ireland 87 (1): 61-74.

O' Dell, A. (1959). Excavations at St. Ninian's Isle. Scottish Geographical Journal 75: 41-43.

OED (2016). Oxford English Dictionary online. www.oed.com

Ó Floinn, R. (2006). The Foundation relics of Christ Church cathedral and the origins of the diocese of Dublin. In S. Duffy (ed). Medieval Dublin VII: proceedings of the friends of medieval Dublin symposium, 2005. Four Courts Press: Dublin. pp. 89-102.

O' Keefe, T. (1994). Lismore and Cashel: Reflections on the beginnings of Irish Romanesque Architecture in Munster. The Journal of the Royal Society of Antiquaries of Ireland 124: 118-152.

O' Keefe, T. (1998a). The fortifications of Western Ireland, AD 1100 - 1300, and their interpretation. Galway Archaeological and Historical Society 50: 184-200.

O' Keefe, T. (1998b). Architectural traditions of the Early Medieval Church in Munster. In M. Monk and J. Sheehan (eds.). Early medieval Munster: Archaeology, History and Society. Cork University Press: Cork. pp. 112-124.

O' Keefe, T. (2004). The Gaelic peoples and their archaeological identities, A.D. 1000-1650. Quiggin pamphlets on the sources of Mediaeval Gaelic history 7. University of Cambridge: Cambridge.

O' Keefe, T. (2014). Halls, 'hall-houses' and tower-houses in medieval Ireland: disentangling the needlessly entangled. The Castle Studies Group Journal 27: 252-262.

Ó Néil, J. (2006). Excavation of pre-Norman structures on the site of an enclosed Early Christian cemetery at Cherrywood, County Dublin. In S. Duffy (ed.). Medieval Dublin VII: proceedings of the friends of medieval Dublin symposium, 2005. Four Courts Press: Dublin.

O'Neill, B. (1951). Castle Rushen, Isle of Man. Archaeologia (second series) 94: 1-26.

Opalinski, P. and Harland, T. (1981). The middle Ordovician of the Oslo Region, Norway, 29. Stratigraphy of the Mjøsa limestone in the Toten and Nes-Hamar areas. Norsk Geologisk Tiddskrift 1: 59-78.

Oram, R. (2008). Royal and lordly residence in Scotland c. 1050 – c. 1250: an historiographical review and critical revision. The Antiquarries Journal 88: 165-189.

Oram, R. (2012). Alexander II: King of Scots 1214-1249. Birlinn: Edinburgh.

Oram, R. (2014). Between a rock and a hard place. Climate, weather and the rise of the Lordship of the Isles. In, R. Oram (ed.). The Lordship of the Isles. Brill: Leiden. pp. 40-61.

Oram, R. and Adderley, P. (2008). Lordship and environmental change in Central Highland Scotland, c.1300 – c. 1450. Journal of the North Atlantic 1: 74-84.

O' Reilly, J. 2009. 'All that Peter Stands For': The Romanitas of the Codex Amiatinus reconsidered. In, J. Graham-Campbell, and M. Ryan (Eds.) Anglo-Saxon/Irish Relations before the Vikings. Proceedings of the British Academy 157. Oxford University Press: Oxford. pp. 367-396.

O'Reilly, S., Hurley, S., Coleman, N., Monteys, X., Szpak, M., O'Dwyer, T. and Kelleher1, B. (2012). Chemical and physical features of living and non-living maerl rhodoliths. Aquatic Biology 15: 215–224.

O.S. (1875a). Ordnance Survey first edition 6-inch map, 1843-1882. Argyllshire Sheet CXXXIX (includes Glassary; Kilmartin). Surveyed 1871.

O.S. (1875b), Ordnance Survey first edition 6-inch map, 1843-1882. Argyllshire Sheet XXIV (includes Ardnamurchan). Surveyed 1872.

O.S. (1875c), Ordnance Survey first edition 6-inch map, 1843-1882. Argyllshire Sheet XV (includes Ardnamurchan). Surveyed 1872.

O.S. (1875d), Ordnance Survey first edition 6-inch map, 1843-1882. Argyllshire Sheet XXV(includes Ardnamurchan). Surveyed 1872.

O.S. (1876-78) Ordnance Survey Name Books. Inverness-shire OS1/18. Vol. 1-8. Block 5.

O.S. (1878).Ordnance Survey 1st edition six-inch to the mile map. Inverness-shire (Isle of Skye) sheets IV and IVA, surveyed 1878.

O.S. (1881). 1st edition 6-inch to the mile map. Inverness-shire Sheet L. Survey date 1878.

O.S. (1972). Dun Ara https://canmore.org.uk/site/22069/mull-dun-ara Last accessed 14/07/2016.

Østergaard, U. (1992). The construction of a Faroese identity: Nordic, Norwegian, Danish – of Fareose? In, Siedler-identitäten. Landnahme, Kolonisation und die problem der Identität von Siedlern in Altertum, Mottelater und Neuxeit, 39. Deutschen Historikertag in Hanover, September 1992.

O'Sullivan, J. (1994). Excavation of an early church and a woman's cemetery at St. Ronan's medieval parish church, Iona. PSAS 124: 327-365.

O'Sullivan, A., McCormick, F., Harney, L., Kinsella, J. and Kerr, T. (2010) Early medieval dwellings and settlements in Ireland AD 400 – 1100. Early Medieval Archaeology Project (EMAP) Report 4.2.

O'Sullivan, J. and Ó Carragáin, T. (2008). Inishmurray: monks and pilgrims in an Atlantic landscape. Volume 1: Archaeological survey and excavations 1997-2000. The Collins Press: Cork.

Otway-Ruthven, J. (1980). A History of medieval Ireland. Ernest Benn: London.

Owen, O. (1983). Tuquoy phasing. Unpublished interim summary report of phasing and structure as understood from 1982-83 excavation. Kindly supplied by O. Owen.

Owen, O. (1993). Tuquoy, Westray, Orkney: a challenge for the future? In C. Batey, J. Jesch and C. Morris (eds.) The Viking Age in Caithness, Orkney and the North Atlantic. Edinburgh University Press: Edinburgh. pp. 318-339.

Owen, O. and Lowe, C. (1999). Kebister. The four-thousand-year-old story of one Shetland township. Society of Antiquarries of Scotland monograph series number 14: Edinburgh.

Owen, O. (2005). History, archaeology and Orkneyinga Saga: the case study of Tuquoy, Westray. In O. Owen (ed.). The world of the Orkneyinga saga: the broad-cloth Viking trip. Orkney Island Council: Kirkwall. Pp. 88-110.

Padfield, T., Bøllingtoft, P., Eshøj, B. and Christensen, M. (1994). The Wall Paintings of Gundsømagle Church, Denmark. Preventive conservation: practice, theory and research. Preprints of the contributions to the Ottaa Congress, 12-16 September 1994, pp. 94-98.

Palmer, J. (2009). Anglo Saxons in a Frankish world, 690-900. ISD: Virginia.

Pálsson, H. and Edwards, P. (1978). Orkneyinga Saga. The History of the Earls of Orkney. Penguin: Middlesex.

Panda, A. and Misra, M. (2007). Traditional lime preparation: A case study in coastal Orissa, India. Indian Journal of Traditional Knowledge 6 (2): 262-269.

Parker Pearson, M. (2012). The machair survey. Pp. 12-73. In M. Parker Pearson (ed.) From machair to mountains; archaeological survey and excavation in South Uist. Oxbow Books: Oxford.

Parker Pearson, M. and Smith, H. (2012) Introduction. In M. Parker Pearson (ed.) From machair to mountains; archaeological survey and excavation in South Uist. Oxbow Books: Oxford. pp. 1-11

Parsons, D. (1990). Review and Prospect: The stone industry in Roman, Anglo-Saxon and Medieval England. In D. Parsons (Ed.). Stone quarrying and building in England AD 43 – 1525. Phillimore: Sussex. pp.1-15.

Parsons, D. and Sutherland, D. (2013). The Anglo-Saxon Church of All Saints Brixworth Northanptonshire: survey, excavation and analysis 1972-2010. Oxbow books: Oxford.

Pavia, S. (2010). Analysis of mortar samples from Skellig St. Michael's Church, Co. Kerry. Unpublished document prepared for Grellan Rourke, Senior Conservation Architect National Monuments, Dun Scène. Kindly supplied by Grellan Rourke.

Pearsall, D. (2000). Paleoethnobotany: a handbook of procedures. Second edition. Academic Press: California.

Pearson, A. (2006). The work of giants: stone and quarrying in Roman Britain. Tempus: Stroud.

Pesce, G. L. A. and Ball, R. J. (2012) Dating of Old Lime Based Mixtures with the "Pure Lime Lumps" Technique. In: Radiometric Dating. In Tech. ISBN 9789535105961

Pesce, G., Micheletto, E., Quarta, G., Ugge, S., Calcagnile, L. and Decri, A. (2013). Radiocarbon dating of mortars from the baptismal font of the San Lorenzo cathedral of Alba (Cuneo, Italy) : Comparison with thermoluminescence dating of related bricks and pipes. Radiocarbon 55 (2-3): 526-533.

Peterkin, A. (1820). Rentals of the Ancient Earldom and Bishoprick of Orkney. Edinburgh.

Philpott, M. (1998) Some interactions between the English and Irish churches. AngloNorman Studies 20: 187-204.

Phipps, C. (1939). The problem of dating ancient Irish buildings. Hermathena 29 (54): 54-92.

Piggott, S. (1966). A Scheme for the Scottish Iron Age. pp. 1-15. In A. Rivet (ed.). The Iron Age in Northern Britain. Edinburgh University Press: Edinburgh.

Poole, A and Sims, I. (2016). Concrete Petrography: A handbook of Investigative Techniques. Second edition. CRC Press: Florida.

Poole, R. (1911). The Scottish islands in the Diocese of Sodor. The Scottish Historical Review 8 (31): 258-263.

Potter, J. (2006). Stone emplacement in early Scottish churches: evidence of early Christian craftsmanship. PSAS 136: 227-236.

Potter, J. (2009). Patterns in stonework: the early church in Britain and Ireland. BAR British series 496. Archaeopress: Oxford.

Potts, T. and Potts, D. (2002). The architectural background of the Ely octagon. Journal of the British Archaeological Association 155: 195-202.

Power, R. (2015). The Isles of Man and the Kings of Norway: Magnús Barelgs and after. In, S. Duffy and H. Mytum, A New History of the Isle of Man, Volume 3: The Medieval Period 1000-1406. pp. 27-57.

Profantová, N. (2009). Archaeology and written sources on eighth- to tenth-century Bohemia. Early Medieval Europe 17 (3): 286-310.

Qualtrough, J. (2007). Field Guide to St Michaels Isle. Douglas.

Quiney, A. (1999). Hall or Chamber? That is the Question. The use of rooms in post-conquest houses. Architectural History 42: 24-46.

Rackham, O. (1982). The Growing and Transport of Timber and Underwood. In. S. McGrail (ed.). Woodworking Techniques before A.D. 1500. BAR International Series 129. pp. 199-218.

Rackham, O. (2003). Ancient Woodland: its History, Vegetation and Uses in England. Castlepoint Press: Dalbeatie.

Rackham, O. (2009). Implications of historical ecology for conservation. In, W. Sutherland (ed.). Conservation Science and action. John Wiley & Sons: London. pp. 152-175.

Radcliff, J. (1803). On burning lime with peat. Prize essays and transactions of the Highland Society of Scotland. William Creech: Edinburgh. pp. 160-163.

Radford, R. (1950) Excavations at Whithorn 1949. Transactions of the Dumfries & Galloway Natural History and Antiquries Soiety 27: 85-126.

Radford, R. (1962). Art and Architecture, Celtic and Norse'. In F. Wainwright (ed.). The Northern Isles. Nelson: Edinburgh. pp. 163-187.

Radford, R. (1988). St Magnus Cathedral, Kirkwall, and the development of the cathedral in north-west Europe. In, B. Crawford (ed.). St Magnus Cathedral and Orkney' Twelfth Century Renassance. Aberdeen University Press. pp. 14-24.

Rae, A. and Rae, V. (1974). The Roman Fort at Cramond. The Cramond Association: Edinburgh, reprinted from Britannia V (1973).

Raey, D. (2014). Newark Bay. Survey and Excavation Data Structure Report. ORCA Project no. 481. Unpublished ORCA report prepared for Historic Scotland.

Randsborg, K. (2003). Bastrup – Europe. A massive Danish Donjon from 1100. Acta Archaeologica 74: 65–122.

Rashidi, N., Mohamed, M. and Yusup, S. (2011). A study of calcination and carbonation of cockle shell. World Academy of Science, Engineering and Technology 60: 818-823.

Raven, J. (2005). Medieval Landscapes and Lordship in South Uist. Unpublished PhD thesis. University of Glasgow.

RCAHMS (1911). The Royal Commission on the Ancient and Historical Monuments and Constructions of Scotland. Third Report and Inventory of Monuments and Constructions in the County of Caithness. HMSO: London.

RCAHMS (1928). The Royal Commission of the ancient and Historic Monuments and Constructions of Scotland. Ninth Report with the inventory of the monuments and constructions of the Outer Hebrides, Skye and the Small Isles. RCAHMS: Edinburgh.

RCAHMS (1946a). The Royal Commission on the Ancient Monuments of Scotland. Twelfth Report with an Inventory of the ancient monuments of Orkney and Shetland. Volume II. Inventory of Orkney. HMSO: Edinburgh.

RCAHMS (1946b). The Royal Commission on the Ancient Monuments of Scotland. Twelfth Report with an Inventory of the ancient monuments of Orkney and Shetland. Volume III. Inventory of Shetland. HMSO: Edinburgh.

RCAHMS (1971). The Royal Commission of the Ancient and Historic monuments of Scotland: Argyll: an inventory of the ancient monuments: Vol. 1: Kintyre. RCAHMS: Edinburgh.

RCAHMS (1975). The Royal Commission of the Ancient and Historic monuments of Scotland: Argyll: an inventory of the ancient monuments: Vol. 2: Lorn. RCAHMS: Edinburgh.

RCAHMS (1980). Royal Commission on the Ancient and Historical Monuments of Scotland. An Inventory of the monuments in Argyll, vol. 3: Mull, Tiree, Coll and Northern Argyll. RCAHMS: Edinburgh.

RCAHMS (1982). Royal Commission on the Ancient and Historical Monuments of Scotland. An Inventory of the monuments in Argyll, vol. 4: Iona. RCAHMS: Edinburgh.

RCAHMS (1984). Royal Commission on the Ancient and Historical Monuments of Scotland. An Inventory of the monuments in Argyll, vol. 5: Islay, Jura, Colonsay and Oronsay. RCAHMS: Edinburgh.

RCAHMS (1992). Royal Commission on the Ancient and Historical Monuments of Scotland An Inventory of the monuments in Argyll, vol. 7: Mid Argyll and Cowal. RCAHMS: Edinburgh.

Redknap, M. (1977). Excavations at Iona Abbey, 1976. PSAS 108: 228-253.

Rennel, R. & McHardy, I. (2009). Baile Sear Community Archaeology Project, Sloc Sàbhaidh, Baile Sear, North Uist, Season 3 (2008), Data Structure Report. Scape Trust.

Reynolds, A, Hamilton,M and Raven, J. (2005). Howmore ecclesiastical complex (South Uist Parish). Standing Building Recording, Earthwork and Geophysical Survey. Discovery and Excavation in Scoland 5: 139-40.

Richey, J., MacGregor, A., and Anderson, F. (1961). The Tertiary Volcanic Districts of Scotland. Third edition. British Geological Survey/Natural Environment Research Council. HMSO: Edinburgh.

Rick, T., Vellanoweth, R. & Erlandson, J. (2005). Radiocarbon dating and the ‘‘old shell’’ problem: direct dating of artifacts and cultural chronologies in coastal and other aquatic regions. Journal of Archaeological Science 32: 1641-1648.

Rigby, A. (1927). Castle Rushen. Douglas. http://isle-of-man.com/manxnotebook/fulltext/rg1927 Last accessed 19-06-2016.

Roesdahl, E. (1984). The end of Viking-age fortifications and what followed. Château Gaillard XII : 39-47.

Romankiewitz, T. (2011). The complex roundhouses of the Scottish Iron Age. An architectural analysis of complex Atlantic roundhouses (brochs and galleried duns), with reference to wheelhouses and timber roundhouses. BAR British Sreies 550. 2 vols. Archaeopress: Oxford.

Rose, L. (1836). Parish of Nigg, County of Ross and Cromarty. Statistical Accounts of Scotland 1834-45. Vol. 14: 18-37.

Rosenthal, M. (1989). Muschelkalk nach altem rezept gebrannt. Bautenschutz + Bausenierung. Filderstadt: Edition lack und chemie. 12: 28-29.

Roussell, A. (1934). Norse Building Customs in the Scottish Isles. Copenhagen; Williams & Norgate: London.

Rowlands, M. (1993). The Role of Memory in the Transmission of Culture. World Archaeology 25 (2): 141-151.

Russell, B. & Dahlin, B. (2007). Traditional Burnt-Lime Production at Mayapán, Mexico. Journal of Field Archaeology 32 (4): 407-423.

Rutgers, L., De Jong, A, & Van der Borg, K. (2002). Radiocarbon Dates From the Jewish Catacombs of Rome. Radiocarbon 44 (2): 541–547.

Ryan, M. (1988). Fine metalworking and the early Irish Monasteries. In. J. Bradley (ed). Settlement and Society in Medieval Ireland. Studies presented to F. X. Martin. Botheus Press: Kilkenny. pp. 33-48.

Sahlén, D. (2011). Technology as skill, the case of casting moulds from late prehistoric Scotland. Paper given at the Scottish Archaeological Forum 'The Experience of Technology' conference, 22-23 October 2011, University of Glasgow.

Sanderson, M (1975). The Mauchline account books of Melrose Abbey, 1527-28. In: Ayreshire Archaeological and Natural History Soc. Ayreshire collections, Vol 11 (5): 86-107.

Sansum, P. (2004). Historical resource use and ecological change in semi-natural woodland: western oakwoods in Argyll, Scotland. Unpublished PhD thesis. University of Stirling.

Sansum, P. (2005). Argyll Oakwoods: Use and ecological change, 1000 to 2000 AD - a palynological-historical investigation. Botanical Journal of Scotland 57 (1-2): 83-97.

Schofield, J. and Edwards, K. (2011). Grazing impacts and woodland management in Eriksfjord: Betula, coprophilous fungi and the Norse settlement of Greenland. Vegetation History & Archaeobotany 20: 181–197.

Schneider-Storz, B., Nebelsick, J., Wehrmann, A. and Federolf, C. (2008). Comparative taphonomy of three bivalve species from a mass shell accumulation in the intertidal regime of North Sea tidal flats. Facies 54: 461–478.

Schweingruber, F. (1990). Microscopic Wood Anatomy. Structural variability of stems and twigs in recent and subfossil woods from Central Europe. Swiss Federal Institute for Forest, Snow and Landscape Research: Switzerland.

Scottish Lime Centre Trust. (2003). Preparation and use of lime mortars. Historic Scotland: Edinburgh.

Sellar, W. (1971). Family origins in Cowal and Knapdale. Scottish Studies 15: 21–31.

Sellar, W. (2000). Hebridean Sea kings: The successors of Somerled, 1164-1316. In. E. Cowan and R. McDonald (eds.) Alba: Celtic Scotland in the medieval era. Tuckwell: Edinburgh. pp187-218.

Shackleton, C. and Prins, F. (1992). Charcoal analysis and the "principle of least effort" – a conceptual model. Journal of Archaeological Science 19: 631-637.

Sharman, P., Murray, D. and Ewart, G. (2002). St Mary's Chapel, Wyre (Rousay and Egilsay parish). Standing building recording. D & ES 3.

Sharpe, R. (1977). Raasay: a study in island history. Grant & Cutler: London.

Sharples, N. (2005). A Norse farmstead in the Outer Hebrides. Excavations at Mound 3, Bornais, South Uist. Oxbow books: Oxford.

Sharples, N. and Parker-Pearson, M. (1999). Norse Settlement in the outer Hebrides. Norwegian Archaeological Review 32: 41 – 62.

Sharples, N. and Smith, R. (2009). Norse settlement in the Western Isles. In. A. Woolf (ed.). Scandinavian Scotland – twenty years after: the proceedings of a day conference held on 19th February 2007. St John's House Papers no. 12: St Andrews. pp. 103-130.

Shaw, F. (1980). The Northern and Western Isles of Scotland: their economy and society in the seventeenth century. John Donald: Edinburgh.

Shennan, S. (1988). Quantifying archaeology. Edinburgh University Press: Edinburgh.

Shepherd, C. (2011). Agrarian and Settlement Characterisation in Post-Medieval Strathbogie, Aberdeenshire, 1600–1760. Rural History 22 (1): 1–30.

Shirreff, J. (1814). General View of the agriculture of the Orkney Islands with observations on their means of Improvement. Archibald Constable & Co.: Edinburgh.

Shortland, A., Freestone, I. and Rehren, T. (eds.). (2009). From mine to microscope. Oxbow: Oxford.

Siddall, R. (2013). Medieval Mortars and the Gothic Revival: The Cosmati Pavement at Westminster Abbey. Proceedings of the 3rd Historic mortars conference, Glasgow, 2013. Rilem: Glasgow.

Silverman, S. (1983). The concept of Peasant and the concept of culture. In J. Mencher (ed.). Social anthropology of peasantry. Somaiya Publications: Bombay. pp.7-31.

Simpson, D. (1960). The building accounts of Tattershall Castle, 1434-1472. Lincoln Record Society Volume 55.

Simpson, D. (1961a). The castles of Duffus, Rait and Morton reconsidered. PSAS 92: 10-14.

Simpson, D. (1961b). The Castle of Bergen and the Bishop's Palace at Kirkwall; a study in early Norse architecture. Oliver & Boyd: Edinburgh.

Simpson. I., Vesteinsson, O., Adderley, P. & McGovern, T. (2003). Fuel resource utilisation in landscapes of settlement. Journal of Archaeological Science 30: 1401–1420.

Skene, W. (1837). The Highlanders of Scotland: their origin, history and antiquities. Vol. 1. Eneas MacKay: Stirling.

Slade, H. and Watson, G. (1989). St Peter's Kirk, Thurso, Caithness c.1150-1832. PSAS 119: 297-325.

Slattery, P. (2009). Woodland management, timber and wood production, and trade in Anglo-Norman Ireland, c.1170 to c.1350. Journal of the Royal Society of Antiquarries of Ireland 139: 63-79.

Small A. (1966). Excavations at Underhoull, Unst, Shetland. Proceedings of the Society of Antiquaries of Scotland 98: 225-248.

Small. A. (1973). The site: its history and excavation. In A. Small, C. Thomas and D. Wilson, St Ninian's Isle and its treasure. Volume 1. Text. Oxford University Press: Oxford.

Smith, G. (ed.) (1895). The Book of Islay: documents illustrating the history of the island. Edinburgh.

Smith, L. (2005). Norse farmsteads, Shetland (Unst Parish) survey. D &ES 6: 129.

Spence, J. (1825). Letter to William Watt reporting on 'experiment about the plaster'. Watt of Breckness and Skaill 1783-1825. Orkney archives D3/34.

Spennemann, D. & Colley, S. (1989). Fire in a pit: the effects of burning on faunal remains. Archaeozoologia 3 (1-2): 51-64.

Stalley, R. (2012). Diffusion imitation and evolution: The uncertain origins of beakhead ornament. In J. Franklin, T. Heslop and C. Stevenson (eds.). Architecture and interpretation: essays for Eric Fernie. Boydell Press. pp. 111-127.

Stanley, S., Ries, J., & Hardie, L. (2002). Low-Magnesium Calcite produced by coralline algae in sea water of Late Cretaceous composition. PNAS 99 (24): 15323–15326.

Stark, M., Bishop, R., and Miksa, E. (2000). Ceramic technology and social boundaries: Cultural practices in Kalinga clay selection and use. Journal of Archaeological Method and Theory 7 (4): 295-331.

Steer, K. and Barrowman, J. (1977). Late monumental sculpture in the West Highlands. RCAHMS: Edinburgh.

Stell, G. (2006) Castle Tioram: A statement of cultural significance. Unpublished report. Can be viewed at www.historic-scotland.gov.uk/tioram-stell-fullversion-part1and2pdf. Last accessed 10/05/2016

Stelzle-Hueglin, S. (2007). 'Reovatio imperii' on the Muensterhuegel of Basle? A reappraisal of mechanical mortar mixers. http/medieval-europe-paris-2007.univ-paris/.fr/Stelzle-Hueglin.pdf last accessed 24/06/2016.

Stevenson, J. (1870). Documents illustrative of the history of Scotland from the death of king Alexander the Third to the accession of Robert Bruce. Volume II. HM General Register House: Edinburgh.

Stevenson, R. (1981) Christian sculpture in Norse Shetland. Frodskaparrit 28-29: 283-292.

Stocker, D. and Everson, P. (2006). Summoning St Michael: early Romanesque towers in Lincolnshire. Oxbow books: Oxford.

Stokes, M. (1894). Early Christian Art in Ireland. Chapman & Hall Ltd: London.

Stoltman, J. (2001). The role of petrography in the study of archaeological ceramics. In. P. Goldberg, V. Holliday & C. Reid Ferring (eds.). Earth sciences and archaeology. Kluwer: New York.

Strachan, S. (2008). A Fifer in the north: William Bruce and the Laird's houses of early modern Shetland. In. G. Noble, T, Poller, J, Raven and L, Verrill (eds.), Scottish Odysseys: the archaeology of islands. Tempus: Stroud.

Surge, D and Barrett, J. (2012). Marine climatic seasonality during medieval times (10th to 12th centuries) based on isotopic records in Viking Age shells from Orkney, Scotland. Palaeogeography, Palaeoclimatology, Palaeoecology 350–352: 236–246.

Sweetman, D. (1998). The Hall-House in Ireland. Archaeology Ireland 12 (3): 13-16.

Sweetman, D. (1999). Medieval Castles of Ireland. The Boydell Press: Woodbridge.

Swift, C. (1987). Irish influence on ecclesiastical settlements in Scotland a case study of the island of Islay. Durham theses, Durham University. http://etheses.dur.ac.uk/6698/

Symson, A. [1684] (1823). A Large Description of Galloway. W & C. Tait: Edinburgh.

Tait, I. (2012). Shetland Vernacular buildings 1600-1900. Shetland Times Ltd: Lerwick.

Talbot, E. (1978). Excavations at Clow Chapel, Watten. Caithness Field Club Bulletin. www.caithness.org/caithnessfieldclub/bulletins/978/april/clowchapel.htm Last accessed 08/05/16.

Taylor, H. & Taylor, J. (1965). Anglo-Saxon Architecture. Volume 1. Cambridge University Press: Cambridge.

Taylor, S. (2014). The medieval parish in Scotland. The Journal of Scottish Name Studies 8: 93–114.

Thacker, M. (2011). An archaeology of the lime and shell-lime mortars of the Western Isles. Unpublished MA thesis, University of York .

Thacker, M. (2012). Towards on on-site mortar archaeology of the Isle of Lewis. Journal of the Buildings lime Forum 19: 38-44.

Thacker, M. (2013a) Making lime at the edge of the world. Proceedings of the 3rd historic mortars conference, Glasgow, 2013. Rilem: Glasgow.

Thacker, M. (2013b). The Late Norse 'coral' or mearl-limes of Orkney – an on-site mortar archaeology of Cubbie Roo's castle and chapel. Proceedings of the 3rd Historic mortars conference, Glasgow, 2013. Rilem: Glasgow.

Thacker, M. (2014). Petrographic microstructural analysis of lime mortar samples taken from the Tuquoy excavation. Unpublished report prepared for Historic Scotland.

Thacker, M. (2015a). Cille Donnain revisited: negotiating with lime across Atlantic Scotland from the 12th century. Journal of the North Atlantic. Special Hebridean edition.

Thacker, M. (2015b). 'The Quick & the Dead – the architectural development of post-Reformation burial aisles in the northern Hebrides. In search of Colmcille: the legacy of St. Columba in Ireland and Scotland. Island Book Trust: Stornoway.

Thacker, M. (2015c) D & ES. Building survey and analysis. Interim report. Newark Chapel.

Thacker, M. (2015d) D & ES. Building Survey and Analysis for SMCCCP. Eynhallow Church.

Thacker, M. (2015e). D & ES. Building Survey and analysis. Interim report. Howmore.

Thacker, M. (2015f). D & ES. Building Survey and Analysis. Interim report. Castle Fincharn.

Thacker, M. (2015g). D & ES. Building Survey and Analysis. Interim report. Mingary Castle.

Thacker, M, (2015h). D & ES. Building Survey. Kisimul Castle.

Thacker, M. (2016a). Castle Aros. A buildings archaeology study. Unpublished report SMCCCP/ACM/FIN/01prepared for Historic Environment Scotland.

Thacker, M. forthcoming a. 'MacGillechrist's Castle'. Proceedings of Barra 2015 conference to re-assess west Highland Galley Castles. Islands Book Trust: Stornoway.

Thacker, M. in prep. The Norse Church in the Northern Hebrides: A reassessment of the chapel of North Rona [working title].

Thakuria, T. (2012). An ethnoarchaeological study of shell fishing and lime manufacturing technique at Manikapatana, Orissa, India. Man and Environment 37 (2): 89-101.

Théry-Parisot, I., Chabal, L. And Chrzavzez, J. (2010) Anthracology and taphonomy, from wood gathering to charcoal analysis. A review of the taphonomic processes modifying

charcoal assemblages, in archaeological contexts. Palaeogeography, Palaeoclimatology, Palaeoecology 291: 142–153.

Thomas, C. (1967). An Early Christian cemetery and chapel on Ardwall Isle, Kirkcudbright. Medieval Archaeology 11: 127–188.

Thomas, C. (1971). The Early Christian Archaeology of North Britain. London: Oxford University Press.

Thomas, F. (1873). Notices of Three Churches in North Uist, Benbecula, and Grimsay, said to have been built in the forteenth century. Archaeologia Scotica 5: 225-248.

Thomas, S. (2008). From Rome 'to the ends of the habitable world': provision of clergy and church buildings in the Hebrides, circa 1266 to 1472. Unpublished PhD thesis. University of Glasgow.

Thomas, S. (2014). Bishops, priests, monks and their patrons; the Lords of the Isles and the Church. In, R. Oram (ed.). The Lordship of the Isles. Brill: Leiden. pp 123-145.

Thomson, W. (2002). Ouncelands and Pennylands in the West Highlands and Islands. Northern Scotland 22: 27-43.

Thurlby, M. (2003). Anlgo-Saxon architecture beyond the Millenium: its continuity in Norman building. In N. Hiscock (ed.). The white mantle of churches. Brepols: Turnhout. pp. 119-137.

Thurlby, M. (2006). Romanesque architecture and sculpture in Wales. Logaston Press: Herefordshire.

Tite, M. (1969). Determination of the firing temperature of ancient ceramics by measurement of thermal expansion: a reassessment. Archaeometry 11, 131–143.

Tite, M. (1972). Methods of physical examination in archaeology. Seminar Press: London.

Toft, L. (1988). Limeburning on the Gower peninsula's limestone belt. Industrial Archaeology Review 11 (1): 75-85.

Train, J. (1845). Historical and statistical account of the Isle of Man from the earliest times to the present date; with a view of its ancient laws, peculiar customs, and popular superstitions. Mary Quiggin: Douglas.

Trotter, J. (1791-99). Parish of Preston-pans, County of East Lothian. The Statistical Accounts of Scotland, 1791-99. Vol. 17: 61-88.

Tucker, M. and Bathhurst, R. (2009). Carbonate Diagenesis. John Wiley and Sons: Oxford.

Turner, D. (1998). The Bishops of Argyll and the Castle of Achanduin. Lismore AD1180-1343. PSAS 128: 645-652.

Turner, S., Semple, S. and Turner, A. (2013). Wearmouth and Jarrow: Northumbrian monasteries in an historic landscape. University of Hertfordshire Press: Hertfordshire.

Turner, V. (2010). Introduction. In S. Dockrill, J. Bond, V. Turner, L. Brown, D. Bashford, J. Cussans and R. Nicholson, Excavations at Old Scatness Shetland, Volume 1: The Pictish Village and Viking Settlement. Shetland Heritage publications: Lerwick.

University of St Andrews. (2007-13). The Records of the Parliaments of Scotland to 1707. http://www.rps.ac.uk/ John Balliol, second roll of parliament.

Urbańczyk, P. (1999). North Atlantic turf architecture as an example of environmental adaption. Archaeologia Polana 37: 119-233.

Válek, J., Groot, C. and Hughes, J. (eds.). (2010). Proceedings of the 2nd Historic Mortars Conference and Rilem TC 203-RHM repair mortars for historic masonry final workshop. Prague 22-24 September 2010. Rilem.

Válek, J., van Halem, E., Viani, A., Pérez-Estébanez, M., Ševčík, R. and Šašek, P. (2014). Determination of optimal burning temperature ranges for production of natural hydraulic limes. Construction and Building Materials 66: 771-780.

Valverde, J. and Medina, S. (2015). Crystallographic transformation of limestone during calcinations under CO2. Physical Chemistry Chemical Physics 17 (34): 21912-26.

Vaschalde, C., Durand, A., Figueiral, I. & Thiriot, J. (2013). Charcoal analysis of lime kiln remains in Southern France: an original process of mediaeval and modern traditional lime burning. In F. Damblon (ed). Proceedings of the Fourth International Meeting of Anthracology Brussels, 8–13 September 2008 Royal Belgian Institute of Natural Sciences. BAR International Series 2486. Pp. 251 – 258.

Vebæk, C. (1968). The Church topography of the Medieval Norse East Settlement in Greenland. In B. Niclasen (ed.). The Fifth Viking Congress, Torshavn, July 1965. Føroyá Fornminnissavn: Tórshavn. pp. 37-54.

Veitch, K. (1999). A study of the extent to which existing native religious society helped to shape Scotland's reformed monastic community 1070-1286. Unpublished PhD thesis. University of Edinburgh.

Veitch, K. (2001). Replanting paradise: Alexander I and the reform of religious life in Scotland. Innes Review 52: 132-166.

Villagran, X., Balbo, A., Madella, M., Vila, A., & Estevez, J. (2011). Experimental micromorphology in Tierra del Fuego (Argentina): building a reference collection for the study of shell middens in cold climates. Journal of Archaeological Science 38: 588-604.

Wainwright, F. (1962). The golden Age and after. In F. Wainwright (ed.). The Northern Isles. Nelson: Edinburgh. pp. 188-192.

Waldbusser, G., Steenson, R. & Green, M. (2011). Oyster shell dissolution rates in estuarine waters: effects of pH and shell legacy. Journal of Shellfish Research 30 (3): 659–669.

Walker, F. (2000). Argyll and Bute. The buildings of Scotland. Penguin: London.

Walker, L. (2001). Culture and contacts in the Scottish Romanesque. In. T. Liszka and L. Walker (eds.). The North Sea World in the Middle Ages. Four Courts Press: Dublin. pp. 127-163.

Wallace, J. (1684). Description of the Isles of Orkney. www.scan.org.uk last viewed 24/02/2011.

Watson, G. (1929-30). Orkney Notebooks, MS/36/106; MS/36/107. Can be viewed at RCAHMS library.

Watson, G. (2011).Old St Peter's Church, Thurso, Caithness. Caithness Field Club: Thurso.

Welinder, S. (2003). Christianity, politics and ethnicity in early medieval Jämtland, Mid Sweden. In. M. Carver (ed.). The Cross goes north; processes of conversion in northern Europe, AD300-1300. York Medieval Press: York. pp. 509-530.

Wessex Archaeology. (2007). Speke Keeill Mount Murray Hotel, Isle of Man: Archaeological Evaluation and Assessment of Results. Wessex Archaeology: Salisbury.

Wessex Archaeology. (2010). Baliscate, Isle of Mull Archaeological Evaluation and Assessment of Results. Wessex Archaeology: Salisbury.

White Marshall, J. and Rourke, G. (2000). High Island: an Irish monastery in the Atlantic. Town and Country House: Dublin.

White Marshall, J. and Walsh, C. (2005). Illanloughan Island: an early medieval monastery in County Kerry. Wordwell: Wicklow.

Whyte, I. (1979). Written leases and their impact on Scottish agriculture in the seventeenth century. Agricultural History Review 27 (1): 1-9.

Wilkinson, B. (2009). A Study of Turf: Historic Rural Settlements in Scotland and Iceland. Architectural Heritage 20: 15 – 32.

Williams, G. (1997). Land assessment and military organization in the norse settlements in Scotland c.900-1266AD. Unpublished PhD thesis. University of St Andrews.

Williams, J. (1907). A narrative of missionary enterprises in the South Sea Islands; with remarks upon the natural history of the islands, origin, languages, traditions and usages of the inhabitants. John Snow: London.

Williams, R. (1983). Keywords: a vocabulary of culture and society. Fontana Press: London.

Williams, R. (2004). Limekilns and limeburning. Shire Publications: Princess Risborough.

Woelkerling, W., Irvine, L. and Harvey, A. (1993). Growth forms in non-geniculate coralline red algae (Corallinales, Rhodophyta). Australian systematic Botany 6 (4): 277-293.

Wolf, K. (1965). 'Grain-dimunition'of algal colonies to micrite. Journal of sedimentary petrology 35 (2): 420-427.

Wooding, J. (2013). The medieval and earl modern cult of St Brendon. In. S. Boardman, J. Reuben Davies and E, Williamson. Saints cults in the Celtic world. The Boydell Press: Woodbridge.

Woolf, A. (2000). Community, Identity and Kingship in Early England. In W. Frazer and A. Tyrrell (eds.). Social Identity in Early Medieval Britain. London: Leicester University Press.

Woolf, A. (2002). Amlaíb Curán and the Gael. In S. Duffy (ed.). Medieval Dublin III. Four Courts Press: Dublin. pp.941-981.

Woolf, A. (2003). The diocese of the Sudreyar. In S. Imsen (ed.) Ecclesia Nidrosiensis 1153-1537. Søkelys på Nidaroskirkens og Nidarosprovinsens Historie. Tapir Akademisk Forlag. pp. 171-181.

Woolf, A. (2005). The origins and ancestry of Somerled: Gofraid mac Fergusa and 'The Annals of the Four Masters'. Medieval Scandinavia 15: 199-213.

Woolf, A. (2007a). From Pictland to Alba: Scotland, 789-1070 (New Edinburgh History of Scotland series). Edinburgh University Press: Edinburgh.

Woolf, A. (2007b). The wood beyond the world: Jäimtland and the Norwegian kings. In, B. Balen Smith, S. Taylor and G. Williams (eds.). West over sea: studies in Scandinavian sea-borne expansion and settlement before 1300. Brill: Leiden. pp. 153-166.

Woolf, A. (2015). The early history of the diocese of Sodor. In, S. Duffy and H. Mytum A New history of the Isle of Man. Vol. 3. Liverpool University Press: Liverpool.

Wright, A. (2011). Early Portland Cement: its uses and influence on architectural design. Architectural Heritage 22: 99-114.

Wright, P. (1985). Seasonal banding in the algal Solenopora Jurrassica from the middle Jurrassic of Gloucestershire, England. Journal of Paleontology 59 (3): 721-32.

Yeoman, P. (1995). Medieval Scotland. Historic Scotland: Edinburgh.

Yeoman, P. (2009). Investigations on the May Island, and other early medieval churches and monasteries in Scotland. In N. Edwards (ed.). The archaeology of the early medieval Celtic churches. Maney Publishing: London.

Young, A. (1909). Travels during the Years 1787, 1788 and 1789. George Bell: London.

Young, A. (1813). A General View of the Agriculture of the County of Sussex. Richard Phillips: London.