IQUA

Cumann Ré Cheathartha na h-Éireann

Irish Quaternary Association
http://www.iqua.ie

February 2018
NS 60
ISSN 0790-4096

Editor: Martha Coleman

1. Introduction

Dear IQUA member,

Welcome to IQUA newsletter No. 60.

There are some great things happening at IQUA in 2018. IQUA is upgrading the ways in which we communicate with our members and with INQUA 2019 drawing closer the IQUA committee are endeavouring to let more people know about our great association and the Quaternary research being carried out in Ireland.

With these new initiatives in mind IQUA are delighted to announce the new and improved website. There are some new videos and Quaternary related information up there so please take look on www.iqua.ie

This year has also seen IQUA's emergence on Twitter to keep you up to date with Ireland's current Quaternary related news. Check us out @Quaternary_Irl or by using the hashtag #IQUA. We're still active on Facebook so take a look on https://www.facebook.com/IrishQuatAssociation

As you can see IQUA has a new logo. This was designed by our very own Benjamin Thébaudeau who has taken the old logo and updated it. IQUA has also invested in a new pull up banner (seen at the Autumn 2017 Symposium) for events and photos opportunities.

INQUA 2019 is fast approaching and preparations are well underway. Our upcoming and informative Spring Meeting and AGM 2018 will be held in the Hunt Museum, Limerick with IQUA members being asked to contribute to a soon to be published booklet on Quaternary scientists. This year's Spring Meeting titled 'Standing on the Shoulders of Giants' offers a fantastic look back on the work of Quaternary scientists in Ireland.

Last September IQUA members were invited to south west Donegal to view and hear about the intriguing landscape and Neolithic people. In section 4 below we have reprinted an article published in the Donegal Post by Malcolm McClure and Benjamin Thébaudeau.

Thanks to all who contributed to this edition of the newsletter.

Finally, a big thank you to Ellen O'Carroll for her many years of service as Newsletter editor. Though she is moving on she is not leaving IQUA and thankfully will remain on as an ordinary member.

Kind regards,
Martha Coleman, February 2018

2. IQUA Committee (2017/2018)

The IQUA Committee is as follows:

President: Dr Catherine Dalton, MIC, University of Limerick (continuing)
Secretary: Dr Benjamin Thébaudeau, NUIG (continuing)
Treasurer: Dr Kieran Craven, Geological Survey of Ireland, Beggar's Bush, Haddington Rd, Dublin 4, (continuing)
Postgraduate rep: Martha Coleman, Maynooth University (elected 2017)
Website manager: Chris Randolph (continuing)
Publications Secretary: Sabrina Renken, Department of Geography, TCD (continuing)
Newsletter editor: Dr. Ellen O Carroll & Martha Coleman (Maynooth University)

Ordinary members: Dr Steve Davis, UCD (continuing), Dr Rory Flood, QUB (continuing), Darren Barry, MIC, University of Limerick (continuing), Dr Sara Benetti, University of Coleraine (continuing), Dr Frank Ludlow, TCD (continuing), Dr Gayle McGlynn, Department of Geography, TCD, (continuing).

3. IQUA Spring Meeting and AGM 2018

IQUA are planning on a range of new initiatives this year, the first of many in the lead up to INQUA 2019 (www.inqua2019.org/).

Spring Meeting

The core programme for IQUA Spring Meeting in the Hunt Museum, Limerick on April 21st is a selection of talks celebrating key Quaternary Scientists:

The Challenges Faced by Women Quaternary Scientists Bettie Higgs (UCC)
Robert Lloyd Praeger (1865-1953) Timothy Collins (NUIG)
Sydney Mary Thompson (1847-1923) Antoinette Madden & Catherine Dalton (Natural History Museum & Mary Immaculate College)
Bill Watts (1930- 2010) Keith Bennett (St Andrews University)
Valerie Hall (1946-2016) Gill Plunkett (QUB)
Frank Mitchell (1912-1997) Fraser Mitchell (TCD)

Our spring meeting is generally focussed on postgraduate research – so we would also like to invite postgraduates who would like to make a presentation (oral or poster) to let Catherine Dalton know at (catherine.dalton@mic.ul.ie).

Fee for this event is €20 for full members and €10 for students

We look forward to seeing you in Limerick.

Exhibition and Booklet

IQUA has applied for funding to translate the Spring Meeting talks into a pull-up banner exhibition and a booklet to be published by IQUA.

We are seeking further expressions of interest from IQUA members for a range of other written contributions. Quaternary scientists included in the booklet paper should have carried out Quaternary-related research in (or relevant to) Ireland, but do not necessarily need to be from Ireland.

Names that have been suggested in conversation with members include:

- Francis Synge
- Jean (Jeanne) Margaret White
- Hilda Parkes
- Susan Geraty
- Anthony Farrington
- Nick Stephens
- Anthony Orme
- William King
- Wood Martin
- JB Whittow
- Mary Sommerville (nee Fairfax)
- Barbara Miller
- Sybil Watson
- Mary Patricia Happer Kertland

We propose to include papers between 500-1000 words in length to **maximise the range of individuals included in this booklet**. Author guidelines will be forwarded to contributing authors.

Can I encourage IQUA academic members to encourage your postgraduates to suggest and prepare contributions on key individuals.

Please send your suggestions to catherine.dalton@mic.ul.ie or eocarro@tcd.ie or mcglyng@tcd.ie by April 1st 2018.

Deadline for submissions of papers will be 30th June 2018.

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4. IQUA/QRA 2017 Annual Fieldtrip

IQUA Fieldtrip to Donegal, 25th–29th September 2017.

The article below was published in the Donegal Post on October 11th 2017 and in the 22nd issue (Autumn/Winter 2017) of Earth Science Ireland.

Coming in from the cold: the end of the ice age and the early inhabitants of S.W. Donegal

Malcom McClure and Benjamin Thébaudeau

In mid-September 2017, a diverse group of 35 researchers and enthusiastic amateurs gathered in Ardara, Co Donegal for the 34th IQUA annual fieldtrip, Southwest Donegal. This area of Donegal with its ridge and furrows, megalithic tombs, coastal dunes and glaciated landscape provided a stimulating venue to discuss diverse factors responsible for our current landscape and the influence of ice and man.

A collective approach enhances investigation of our unique and complex landscapes and the membership of the Irish Quaternary Association (IQUA) includes archaeologists, palaeolimnologists, pollen, wood and bone specialists, glaciologists, geologists, geomorphologists, geographers and naturalists of every stripe. IQUA, therefore, is well placed to encourage collaboration in the hope of interpreting the Irish landscape over the last two million years.

Kicking the weekend off, Lochlann McGill, President of the Donegal Historical Society and Ardara native, delivered a warm welcome address. Helene Burningham, coastal geomorphologist at University College London then gave a very well illustrated talk about the Loughrosmore dune system. Highlights of her talk were the demonstration of the tidally induced movements of channels in Loughrosmore estuary. These continually erode the back of the dunes and over time recycle wind-blown sand, both inside and outside the dune system. Nature wastes little in its search for a new equilibrium.

On Saturday, Malcolm McClure led the way to Derryness Island, where firstly Ellen OCarroll described the submerged forest of pine trees covering an area of 2.5 ha that have recently been found to be 5000 years old through the use of radiocarbon dating. Submerged forests or woodlands (also known as sunken or drowned forests) were drowned by the rising water table and consequently preserved by peat growth or by the deposition of clay and sands. They are important evidence in the study of relative sea level, past woodland history of an area, as well as potential occupation evidence of areas now submerged by the sea. One can imagine the first hunter-gatherer inhabitants of Ireland fishing and foraging among these tall majestic pine trees. The field party then hiked across the island to see an extensive 'ridge and furrow' occurrence possibly eroded in ancient times by rising sea levels. Here, Malcolm indicated the Slieve Tooey range opposite where clear erosive features on the hill could be interpreted as terraces or, most likely, are due to ice sheet movement related erosion.

After lunch at Kilclooney Dolmen Centre, with its poster displays of local geomorphology and archaeology, the party visited the nearby Portal Tomb, where its significance to Neolithic people was explained by Brian Lacey, doyen of Donegal archaeology. The Neolithic period in Ireland is characterised by the adoption of farming as well as the use of cereal and a more cohesive cultural organisation. Houses were rectangular wooden framed structures and became more permanent dwellings with a differentiated use of space. The Neolithic people buried their dead in the Megalithic tombs. These tombs, such as those visited by IQUA members at Kilclooney and Cloghanmore incorporated the burials of human remains as well as being a ritual focus point in the landscape.

IQUA members at Cloghanmore Portal Tomb

At Narin overlook we were treated to an insightful and amusing account of the splendid view spread before us. Lochlann McGill explained the early monastic associations and significance of Inishkeel Island and the two preserved early medieval Churches and graveyard there. The chief artifacts associated with the island are St Conall's Bell and Shrine, which are among the most treasured possessions of the British Museum. They were loaned under conditions of great security to Donegal Museum in 2015; they were allowed to return to Kilclooney for just a brief visit and seen there by 1500 people then.

In the afternoon we went to the Sheskinmore Field Centre, where Bettina Stefanini gave an informative and enjoyable talk about a rescue archaeology project at Lough Mourne, just north of Barnesmore Gap. The strategic importance of the Gap throughout the Holocene Epoch (the most recent interglacial period – in which we are currently living) was underlined by the pollen results presented by Bettina. Additionally, a very unusual high proportion of birch pollen was found at the start of the Neolithic.

A brief shower having cleared, the party set off to explore Sheskinmore Nature Reserve, led by wildlife ranger Emer Magee and Helene Burningham, accompanied by Richard Nairn, who helped establish the reserve in the 1980s. The reserve is designated a Special Area of Conservation (SAC), a Special Protection Area

(SPA) and a Wildfowl Sanctuary and is of international importance. After a strenuous walk across the dunes, the entire party was stunned when we caught sight of Ballinreavy Strand, lapped by mirror reflections on Loughrosmore Bay. Without hesitation there was a general charge down the steep slope and by general consent our plans were revised to extend our dune walk by another mile to the furthest extremity of the beach. On the way, we saw the erosion and slumping described by Helene the previous night, the midden layer (a former organic soil layer), and reached fine examples of glacial striations and sediments on the rocks at Carrickalaghagh.

On Sunday the party drove to Glencolmcille via picturesque Glengesh, under cloudless skies. Seamus McGinley described a study he had undertaken with Karen Taylor of sediment cores from the (semi-)isolated and pristine Lough Meenchrinna and mentioned the environmental and temperature implications that are emerging. As a locally based archaeologist, Seamus is an authority on Glencolmcille's most interesting aspects and he gave a brief introduction to legends about St Colmcille and the Turas that grew around those legends. We visited a high engraved cross, one of the stations on the Turas and then descended into a much earlier souterrain, a carefully built rock-lined tunnel about 3m below ground level, easily missed, close to the church entrance.

IQUA members listening to Seamus McGinley

The field trip party then drove to the valley above Malinmore to visit Cloghanmore, a large Court Tomb, just one of the plethora of megalithic monuments that occur in this valley. Brian Lacey described the features of this tomb and pointed out the inscribed stones inserted into the walls of the court.

The final stop (after a brief interlude at the woolen mills) was at Malinbeg where high horseshoe-shaped cliffs dramatically enclose Malinbegs Silver Strand. Malcolm McClure drew attention to the two well-exposed rock units of different ages visible on the cliffs while Peter Wilson of University of Ulster provided an update on his study of the age of erratic boulders from various sites in Donegal determined by cosmogenic dating.

This fascinating and enjoyable weekend was enlivened at several points by vigorous debate about the Ice Sheet and how the land responded to its melting away.

Thanks to Ellen O'Carroll and Malcolm McClure for organising the trip.

5. IQUA 2017 Autumn Symposium

TALKS

KEYNOTE TALK

On the tangled but mesmerising mission to pin down the timing of the 'Younger Dryas' Readvance in the Scottish Highlands

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The geomorphological evidence for glacier advance during the Younger Dryas (*Loch Lomond, Nahanagan*) Stadial is by far the best preserved and most fully mapped of all the glacial episodes that have affected the Scottish Highlands, and is amenable to age constraint courtesy of a growing battery of dating methods. Yet, despite decades of intensive 'high-resolution' study coupled with ever-more 'refined' chronologies, perplexing (but intoxicating) conundrums persist. Things may have come to a head with a recent proposal that the Loch

Lomond Readvance glaciers that developed in Scotland were in an advanced state of decay by the middle of the Stadial. Bromley et al. (2014) use a suite of radiocarbon dates from sites in one of the main ice source areas, the Rannoch Moor plateau, to infer that the area was extensively deglaciated by 12.2 ka. Ballantyne (2012) also reports a suite of surface exposure age estimates that led him to conclude that the maximum extent of glacial cover on the Isle of Skye was achieved within the first half of the Stadial. These findings, if correct, would require a radical rethink of the traditional sequence of events in Scotland during the 'Younger Dryas', with attendant implications for palaeoclimatic and glacier dynamic reconstructions. In this talk I will attempt a mini-review of the current picture of events, and aim to clarify what we know, and what we don't know, about this enigmatic period. I will also present new evidence from Rannoch Moor that is inconsistent with the 'mid-Stadial' scenario, and link this to robustly dated evidence from the Glen Roy/Glen Spean and Loch Lomond basins, which collectively suggest that major ice lobes in the SW Scottish Highlands persisted until the end of the Stadial, and perhaps even beyond. The talk will close by (a) placing the evidence from Scotland within the wider perspective of the North Atlantic region, (b) offering some general comments about proposed links between climatic transitions and glacier adjustments during the Last Termination, and (c) prompting the audience for questions and comments concerning the implications of the material covered, with respect to the study of earlier glacial periods.

Ballantyne, C.K., 2012. Chronology of glaciation and deglaciation during the Loch Lomond (Younger Dryas) Stade in the Scottish Highlands: implications of recalibrated 10Be exposure ages. Boreas, 41(4), pp.513-526.

Bromley, G.R., Putnam, A.E., Rademaker, K.M., Lowell, T.V., Schaefer, J.M., Hall, B., Winckler, G., Birkel, S.D. and Borns, H.W., 2014. Younger Dryas deglaciation of Scotland driven by warming summers. Proceedings of the National Academy of Sciences, 111(17), pp.6215-6219.

Late glacial meltwater pathways and channels in county Kilkenny, revisited.

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This paper examines the geomorphology of a suite of deep channels around the village of Ballyfoyle on the Castlecomer Plateau, Co. Kilkenny, and suggests a mechanism for their formation. Sediments within two passages of the nearby Dunmore Cave were also examined. While the cave sediments represent flow within a karstic system from a stream with its origin outside of the cave system itself, and possibly indicate subglacial flow, the adjacent channels are all eroded into bedrock that would have acted as a poor aquifer beneath the glacier. The channels are therefore interpreted as subglacial meltwater channels. The paper suggests that the aquifer characteristics were important in determining the method of subglacial hydrology present during glaciation in this area.

The Rathcroghan Uplands, County Roscommon: complex drainage systems that are definitively not glacially-influenced, preserved in a glacially moulded landscape.

*Robbie Meehan[1], Caoimhe Hickey[2], Coran Kelly[3], Natalie Duncan[1], Sara Blake[4], Shane Carey[1], Damien Doherty[3], Monica Lee[2], Sojan Mathew[3], James McAteer[4], Robert Meehan[1], Sophie O'Connor[2], Sara Raymond[1], Melissa Spillane[1], Katie Tedd[1], Taly Hunter Williams[2]

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The Rathcroghan Uplands area sits in north central Ireland, in one of the areas where lowland ice was at its' thickest during the last glaciation. The Holocene drainage pattern there seems very much controlled by pre-existing subglacial bedforms, with stream drainage following interdrumlin channels and

peat bogs set between larger, higher ribbed moraine features. The area is underlain in the majority by Lower Carboniferous limestone, mapped as 'Undifferentiated' Visean limestones. Historically, it has been known to contain karst landforms, and the absence of a surface drainage pattern on the highest portion of the uplands hints at 'hidden' subterranean drainage. The investigation of important karst areas is one of the priority themes identified for pursuance through the Groundwater 3D project of the Geological Survey Ireland. Several of the karst springs within the region supply drinking water to public and group water schemes. Contamination of these springs is relatively common, and severe pollution incidents have occurred recently *e.g*. Ogulla Spring in 2014. Additionally, recent extensive flooding of the turloughs during wet weather has had severe impacts locally.

Groundwater behaviour in karst areas, particularly the direction of groundwater flow, is unpredictable. Dye tracing is one of the most important tools available to investigate groundwater flow directions in such terrain. In collaboration with the National Federation of Group Water Schemes, thirteen dye tracing investigations were carried out in 2015 and 2016 on and around the Rathcroghan Uplands. The results are impressive, with an intricate subsurface network of groundwater flow having been mapped out. This work has added to the conceptual understanding of the karst hydrogeology of the Rathcroghan Uplands and enabled geo-scientifically robust catchment areas to be defined for all of the water supply springs. The drainage pattern is complex and shows that the first impression of drainage patterns in any limestone landscape may require deeper scrutiny, having knock-on effects for a variety of stakeholders.

The sedimentology and significance of eskers in north-central Ireland

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Eskers are common glacial landforms in Ireland and form regionally-extensive networks that reflect stages of retreat of this sector of the late Devensian British–Irish ice sheet (BIIS). However, the sedimentary structures and composition of these eskers are poorly known, despite being able to offer valuable insight into subglacial hydrological processes during deglaciation. This study presents detailed morphological and sedimentary evidence from esker systems in north-central Ireland, an important ice dome of the Irish sector of the BIIS. Morphologically, esker ridges vary in length, size and continuity, with some esker systems ascending over hills (thus crossing watersheds) whereas other systems are confined to basin settings. Esker systems commonly appear to feed terminal outwash and glaciolacustrine deltas, but several systems do not show a clear meltwater terminus. The internal sediments within eskers vary from concentric sand and gravel beds formed within enclosed tunnel, to interbedded sands, gravels and diamictons, occasionally with water-induced soft-sediment deformations, that are likely formed in interlobate settings. In contrast with some previous glacier models that assume that esker systems are isochronous and were formed in solely subglacial settings, the esker systems described here are interpreted as being of different ages, formed in variously subglacial to ice-marginal settings, and thus cannot be used uncritically as a snapshot of the disposition of ice domes during stages of late Devensian ice retreat.

Glacial influences on post-glacial drainage in the Shannon basin.

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Although some parts of the Shannon drainage system may have an origin that pre-dates the Pleistocene glaciations (Simms and Coxon, 2016), long reaches of the Shannon and its main tributaries are much more recent. These drain extensive lowland basins, rather than occupying distinct valleys, and large areas are inundated during frequent flood events. Many former lake basins,

some dammed by lineated glacial bedforms, are evidenced by large areas of raised bog (many now drained / harvested).

The dominant structural control on these sections of channel appears to be the numerous glacial bedforms; the influence on present river courses can be seen from examination of the BRITICE glacial map of Ireland (Clark et al., 2017). The channel plan-form of some reaches is tortuous, where flow has been diverted around drumlins and mega-scale glacial lineations (MSGLs). The upper course of the Shannon is strongly influenced by drumlins, and, on the Suck, MSGLs create anomalously large 'meanders'. Channels are locally confined at pinch points where eskers, subglacial lineations and other glacial bedforms are crossed. The low topographic gradient, further reduced by channel tortuosity, results in channel reaches with very low stream powers and a limited capacity for morphological adjustment.

High-resolution airborne LiDAR data supplied by OSI allows closer observation of a 3 km reach of the River Suck upstream from Ballinasloe, where the damming and multiple breaches of a MSGL that crosses the valley can be seen. Recent developments in glacial mapping and the availability of high resolution topographic datasets provide exciting possibilities for further research.

Clark, C. D., Ely, J. C., Greenwood, S. L., Hughes, A. L. C., Meehan, R., Barr, I. D., Bateman, M. D., Bradwell, T., Doole, J., Evans, D. J. A., Jordan, C. J., Monteys, X., Pellicer, X. M. & Sheehy, M. 2017. BRITICE Glacial Map, version 2: a map and GIS database of glacial landforms of the last British–Irish Ice Sheet. Boreas. https://doi.org/10.1111/bor.12273

Simms, M.J. and Coxon, P. 2016. The Pre-Quaternary Landscape of Ireland. In, Editors Coxon, P., McCarron, S. Mitchell, F.J.G. , *Advances in Irish Quaternary Studies*, Paris, Atlantis Press, 2017, pp19 - 42.

Glacial Lake Blessington

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During a pronounced stand-still in the westward retreat of the LGM Midlands ice sheet (roughly 18-19 ka) the ice front stabilized on the Slievethoul ridge immediately W of Blessington, and further S abutted the Wicklow Mountains near Pollaphuca, blocking the R. Liffey. The resulting lake flooded the Blessington Basin to an altitude of c.280 m, as shown by several delta top-set levels. Water escaped via an overflow channel at Toor Glen and flowed S past the W side of the mountains, partly via sub-marginal rock-cut channels such as Hollywood Glen. Further south, where the ice diverged from the mountains, the sediment-laden water formed a series of fluvial channels and flats downstream at least as far as the Whitestown Terraces in front of the Glen of Imaal.

A large ice-contact delta complex, the Blessington Delta, formed in front of the ice front on the Slievethoul ridge and prograded SE into the lake basin. Sediment-laden melt water discharging from the base of the ice formed a sub-aquatic ridge of coalesced fans immediately in front of the ice. Small re-advances of the ice produced multiple thrusts in the fan deposits, helping to build up the ridge. The ridge forced the efflux current to flow up the back slope, depositing more sediment on it. When combined with steady ice retreat, this resulted in large-scale retrograding back-set beds at least 12 m high, resembling delta foresets dipping the wrong way. Occasional more pronounced local retreats left the back-sets unsupported, resulting in large-scale slumping towards the ice. Detached ice blocks left behind by the retreating ice were buried. As these slowly melted, the overlying sediments sank as fault-bounded downlobes 15-20 m across. Problematical open holes several metres deep with nearly vertical sides were lined by steeply dipping screes before general infilling by fan sediments. Spectacular diapiric structures are common, some the result of sediment loading on soft silts; others possibly a response to the pressure of ice re-advance. Eventually the fans built up to lake level, allowing a delta to develop and prograde basinward across fine bottom-set sediments belonging to the fan stage.

Two periods of delta growth were separated by an erosional phase, when temporary ice-retreat near Pollaphuca briefly unplugged the basin**.** A large channel (35-40 m deep, 100 m across at the top)

was cut through the first delta, leaving locally vertical (frozen?) walls, massive angular blocks of tilted sediment, and large channel-side screes. Outside the mouth of the channel shallow distributary channels were cut into the earlier bottom-set sands. When the ice again blocked the Liffey, the channel system was filled and a second phase of delta development followed.

Further out into the basin laminated, varve-like clays and silts at least 4 m thick were revealed in trenches cut for main drains in Blessington in 2003. While still soft, the laminites were overlain by sand 50-60 cm thick, which sank as rafts, deforming the laminites into diapiric structures 1-2 m across at the base. The structure of the diapirs could be traced from their "roots" in barely deformed laminae, up into their confined "trunks" and occasionally to extrusive sediment cones on the contemporary lake floor. In the root zone the water flowed in the coarser-grade laminae, confined by the clays; towards the trunk zone the clay bands become brecciated, and then streaked-out upwards. The age of the laminites in relation to the delta development stages is unknown.

On the NW side of the Slievethoul ridge, on the up-ice side of the delta, the sedimentary facies are quite different. Here extensive thick gravels and laterally extensive, highly deformed silt- and sand-dominated units reflect post-delta retreat of the ice sheet towards the lower ground to the NW. Rapid retreat produced large volumes of gravelly outwash, which buried the deeper levels of the ice. Subsequent melting led to the local collapse and intense deformation of overlying sediment, much of which had been deposited earlier in small temporary lakes. Hummocky topography was the final product in this area.

Exposed in several pits in the lower ground between the main delta and Blessington are extensive outwash gravels and sands, locally with thrust complexes associated with diamicts. These deposits are covered by bottom-set sands of the main delta and clearly belong to an earlier de-glacial phase, when the ice front lay E of the Slievethoul ridge. This phase could correspond to Francis Synge's (1977, fig.8) 'Boystown Sub-stage' of the Blessington Stage.

Leinster granite boulders >1 m across occur in the Blessington delta complex and W of the Slievethoul ridge at least 4 mls from the nearest possible source. These boulders must originally have been transported westward by mountain ice or by Irish Sea ice moving around the N end of the Dublin Mountains, before being picked up by ice from the Midlands moving SE during the LGM. This ice cap was apparently older and bigger than the one depicted by Ballantyne et al. 2006.

Ballantyne, C.K., McCarroll, D. & Stone, J.O., 2006, "Vertical dimensions and age of the Wicklow Mountains ice dome, eastern Ireland, and implications for the extent of the last Irish ice sheet"; Quat. Sci. Rev., 25, 2048-2058.

Synge, F.M., 1977, "Blessington", *in* Huddart, D. (ed.), *South East Ireland*, INQUA X Congress Guidebook for Excursion A14.

A late-glacial boulder deposit at Ballycahill townland, Nenagh, Co. Tipperary.

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An unusual assemblage of boulders was uncovered during archaeological excavations at Junction 26 of the M7 Nenagh to Limerick road scheme (Headland Archaeology Ltd. 2006–2009). The deposit, which is associated with lacustrine sediments and overlain by a thin layer of peat, is located within a branch valley of the Shannon drainage basin, known as the Carrigatogher lowland. Detailed evidence of the geomorphology of the assemblage was available in the excavation, and similar boulders were identified in nearby Tullahedy townland. Based on the study, the interpreted features include boulder pavements and trains formed by renewed ice advance. Interestingly, the predominant alignment of the boulder trains suggests that their distribution was controlled by the lake topography, and there is some evidence that they may represent degraded moraines. A chronology of associated sediments, obtained using AMS radiocarbon dating, indicates

that the landforms were created in the late-glacial period, and before 14 ka BP.

Interglacial sequences and the geomorphological history of the lower Lee estuary.

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Cork Harbour contains a relatively thick (> 35m) Quaternary record of marine and terrestrial sediments. Possible high level marine surfaces of Pliocene to early Pleistocene age flank the Harbour. Glacial and glacifluvial action have led to the cutting of deep drainage systems and the whole region is covered by a complex of glacigenic deposits. Seismic surveys, together with sediment coring, linked to a data base of earlier borehole records in the River Lee estuary – Cork Harbour, have established the sedimentary sequences, the pattern of estuary infilling in the late Quaternary and the links to the extra- estuary glacigenic record in the Cork city area (e.g. Scourse, 1997; Dowling et al., 1998; Devoy, 2002a, 2002b; Crowley et al., 2005; Coxon & McCarron, 2009).

Within the estuary – Cork Harbour basin glacigenic sediments are identified at c.-36m ODM, at their lowest point, overlying a former *kegel* karst topography, developed in the Carboniferous limestone. The glacigenics are replaced upwards by freshwater sediments, indicative of anastomosing river channels, comprising a range of former channel environments, including cut-offs, preserved within the contemporary estuary. The sediments studied show the occurrence of mainly low velocity conditions in the freshwater sediments, which also evidence the subsequent affect of periglacial disturbance. In turn, these are overlain by brackish water to fully marine interglacial sediments, containing *flaser* bedding and other indicators of tidal action in the earlier estuary. Both these sequences have been dated by palaeoenvironmental techniques and biostratigraphy to the Gortian and represent either MIS 7 or 9 (pre c.252 ka). This timing of the interglacial places the formation of the basal glacigenic deposits as MIS 8, or even pre-Gortian.

Thick deposits (>10m) of predominantly glacifluvial, ice outwash sands, gravels and coarser clastics (Courtmacsherry Formation) overlie the earliest glacial and later interglacial sediments. These have been found to be interbedded with biogenic sediments, again representing former back-channel, cut-off environments. In some areas of the Harbour, these gravel have been reworked under Holocene sea-level rise. Earlier relative sea-level changes in the main sequences are recorded by the marine inundation of the freshwater sediments, both within the River Lee channel in the city area, as well as throughout Cork Harbour, occurring at maximum levels in the harbor area at c.-29m ODM. Record of interglacial age sea-level changes, though not necessarily of the same Late Quaternary Stage as the interglacial sediments, are also shown by the development of preserved exposures of the south of Ireland shoreline platform within the Lee estuary and Harbour region (Devoy, 1983).

An erosional contact separates the interglacial sediments from the overlying glacifluvial and most recent Holocene (Littletonian) estuarine silts and clay sequences. Seismic signatures for the Holocene sediments, which are commonly >6m thick, show cyclical phases of marine deposition and have formed possibly in response to relative sea-level changes. The stratigraphic data show the occurrence of the interglacial along the c.13km northern margin of the estuary and its removal from areas southward, into outer Cork Harbour, through the effects of glacial - glacifluvial action and relative sea-level rise. Borehole data indicate an east-west height differential of c.24m for the interglacial surface, caused possibly by Quaternary neotectonic crustal movements. The Harbour stratigraphy shows that the region has been affected by ice action from possibly three glacial stages. A single glacial stage Midlandian model (MIS 5d/c – 2) for the preserved Quaternary of the region is not supported by the stratigraphy. The sedimentary and linked geomorphological data also show a relatively thin ice cover during the Mid - Late Midlandian (MIS 3-2), with no evidence for regional isostatic responses.

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POSTERS

The formation, evolution and characterisation of a tunnel valley system in the southern Irish Sea: an investigation of the Wicklow Trough.

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A number of submarine channel features have been previously identified on the Irish Sea seafloor including Beaufort's Dyke, Lambay Deep, Codling Deep and Wicklow Trough. These bathymetric features are distinctive from the surrounding seafloor by their steep depth and morphology and have been described as major incisions (Wingfield, 1989), enclosed deeps (Wingfield, 1990) and tunnel valleys (Callaway et al., 2011; Eyles and McCabe, 1989; Whittington, 1977). Aside from Beaufort's Dyke, which is an isolated tunnel valley located in the North Channel, other tunnel valleys in the Irish Sea (namely Lambay Deep, Codling Deep and Wicklow Trough) are believed to be part of a late- to post-glacial, rectilinear drainage network. The origin of the system feeding into Lambay Deep is unknown, but most likely has its origins further to the north. A main channel extending southwards from Dublin Bay can be seen to connect into Codling Deep and Wicklow Trough with a number of tributaries located immediately off the southeastern Irish coast. Based on the nature of seismic reflectors, these offshore channels are identified as cutting into subglacially deposited till and infilled by thick, well-bedded sediments with more recent sand deposits.

In this study, we focus on data gathered from the Wicklow Trough as part of the Irish Sea Marine Assessment (ISMA) in 2009. We use the spatial integration of multibeam echosounder (MBES) and sparker seismic data, supplemented by benthic grab samples, vibrocores and digital seabed photography, to characterise the present day morphology and sub-surface structure of the Wicklow Trough. Early analysis and results suggest a strong structural lineament control on the location of Wicklow Trough with multiple phases of erosion visible on seismic profile. As a result, a non-simultaneous formation and evolution of the Trough is inferred. The current sub-surface sedimentary

architecture of Wicklow Trough exhibits a moderate level of lateral variability with a primary infill of glaciomarine to glaciolacustrine sediments with some slump deposits on the flanks. Currently the data invokes a time transgressive model with headward erosion during ice sheet retreat accompanied by pressurised subglacial meltwater discharge. At present the seabed within Wicklow Trough is highly dynamic and variable consisting of large, actively migrating sediment waves throughout along with scour pits and coarse sediment deposits.

With additional analyses, we aim to further investigate the formation and development of Wicklow Trough. In addition we aim to discern the development of Wicklow Trough within the broader tunnel valley/glacial drainage system and relative to past ice-sheet dynamics. Similarly, we discuss post-glacial environments of the Wicklow Trough and assess its current geomorphology and active processes. As a result of this study, we will contribute to the growing understanding of British and Irish ice-sheet development and post-glacial, Holocene environments in the Irish Sea.

Morphology and development of the deeps and tunnel valleys in the western Irish Sea.

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Deeps and valleys in the western Irish Sea such as the Lambay Deep, Codling Deep and Wicklow Trough, are believed to be part of a complex, linked valley system. During the last glaciation, the Irish Sea Basin was occupied by the Irish Sea Ice Stream that was fed by converging ice streams from British and Irish ice centres of the British-Irish Ice Sheet. Interpretation of shallow seismic data by Whittington (1977) concluded that a till sheet blankets the pre-Pleistocene surface of the Irish Sea Basin and the valleys were cut into these subglacial sediments. The proposed formation of the channel system was (1) a sub-aerial fluviatile origin for the Codling Deep and Wicklow Trough during a period of low sea level based on morphology and minor tributaries from onshore rivers and (2) a subglacial stream erosion for the Lambay Deep. This late- to post-glacial, rectilinear drainage network is now partially infilled with Quaternary sediments and at present in parts it is undergoing active erosion.

The objective of our study is to reassess the morphology and formation theories of the deeps and valleys based on newly acquired seismo-acoustic data 40 years later and to define a Quaternary stratigraphic framework in the Irish sector of the Irish Sea. In spring 2017, we collected high resolution multichannel seismic and Sparker data on R/V Celtic Voyager (CV17013) in the western Irish Sea based Whittington's maps and the INFOMAR multibeam bathymetry data of the area. The seismic data was recorded with the GeoB seismic equipment of the University of Bremen. A 96-channel streamer was used for acquisition and a micro GI gun as a seismic source with a central frequency of 200 Hz. The seismic profiles are able to image the sedimentary strata generally down to the bedrock with a penetration of 50 mbsf, however, the bedrock reflection is difficult to pick due to the strong multiples in the data set.

Interpretation of the seismic data together with the present bathymetry of the area is ongoing. Preliminary results suggests that the Quaternary stratigraphy in the Irish sector of the Irish Sea is heterogeneous, complex and heavily influenced by channels. A poly-phase channel development is observed with the reoccupation of earlier ones. Later abandonment of drainage pathways resulted in buried/plugged channels in the area. The interpretation also indicates that the Wicklow Trough and Codling Deep could likely be linked towards the north to a paleo-Liffey channel that possibly pre-dates the last glaciation and was reoccupied during late and/or post-glaciation. Proposed mechanisms for the formation of the Codling Deep and Wicklow Trough are (1) subglacial meltwater erosion/tunnel valley formation or (2) sub-aerial drainage channels from nearby ice

fronts. The latter would implicate a non-marine deglaciation in the Irish Sea Basin.

This work has emanated from research supported in part by a research grant from Science Foundation Ireland (SFI) under Grant Number 13/RC/2092 and is co-funded under the European Regional Development Fund and by PIPCO RSG and its member companies.

CHERISH - an overview of aims, technologies employed and anticipated research sites.

With contributions from Louise Barker, Dan Hunt, Dr Sarah Davies, Dr Hywel Griffiths, Dr Patrick Robson, Anthony Corns, Robert Shaw, Gary Devlin, Edward Pollard, Sandra Henry, Sean Cullen, Cathal Jordan, James Barry, Dr Toby Driver.

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CHERISH (Climate Heritage & Environments of Reefs, Islands and Headlands) is a five year EU funded project that will increase cross-border knowledge and understanding of the impacts (past, present and near-future) of climate change, storminess and extreme weather events on the cultural heritage of reefs, islands and headlands of the Irish Sea. The CHERISH Project is a collaboration between two Irish organisations; the Geological Survey of Ireland and The Discovery Programme and two Welsh organisations; the Royal Commission on the Ancient and Historical Monuments of Wales and Aberystwyth University.

The project will target data and management knowledge gaps, employing innovative techniques to discover, assess, map and monitor heritage assets on land and beneath the sea. It will raise awareness about the impacts of climate change on heritage, train the citizen scientist and widely disseminate the results. It will also develop best practice and guidance, making recommendations for future adaptation.

This poster outlines the key technologies and methods to be employed by CHERISH. It will also present anticipated study sites in Ireland and Wales. We aim to promote awareness of the project and reach out to researchers working on complimentary projects in order to make possible linkages.

6. Bill Watts 14CHRONO AWARDS & IQUA Research awards

We are pleased to announce the winners of the **IQUA Research Awards** and the **Bill Watts 14CHRONO Awards** 2017 as well as detail on some of the research that the awards has gone on to fund. The awards are open to all paid-up IQUA members of at least one year's standing. They consist of four AMS radiocarbon dates sponsored by the 14CHRONO Centre of Queen's University Belfast and an additional IQUA grant designed to fund a further two radiocarbon dates, but which can alternatively cover other dating methods or laboratory fees (e.g. for DNA or isotope analyses).

The **Bill Watts 14CHRONO Awards** pay for six AMS radiocarbon dates for current postgraduate members of IQUA. Winners of the Awards are asked to present their research and the use of their awarded AMS ^{14}C dates at the Spring Meeting and to include their abstract in the IQUA Newsletter.

Winners of the 2017 Bill Watts 14CHRONO Awards went to Niamh Millward (UCD), Michelle Curran, NUIG and Martha Coleman (MU).

IQUA Research 2017 Awards went to Ros O Maolduin, Anthony Besse and Rosie Bishop (UCD).

8. Forthcoming workshops, seminars & conferences

The Institute of Archaeologists of Ireland (IAI) hold their annual conference on Friday 23rd and Saturday 24th March in the Clayton Hotel, Sligo Town, Sligo. This year's conference will feature four themed pillars on Research, Excavation, Specialisms and Science/Experimental.

The Irish Geological Association (IGA) will hold a lecture given by GSI's former director Peader McArdle titled Thomas Weaver: Geologist and Dissenter on 21st March 2018 6.30pm in the Geological Survey Ireland, Beggar's Bush, Haddington Road, Dublin 4.

The Conference of Irish Geographers (CIG) is being held 10th – 12th May 2018. This is the 50th Anniversary of the conference and is being held at Maynooth University.

INQUA 2019 Dublin 25th – 31st July 2019. Session proposals closing date is 31st March 2018 with all

proposals being reviewed by the scientific Programme Committee in April 2018.

9. Recent PhDs:

Title: Paleolimnological investigations on a nutrient polluted freshwater lake, Lough Muckno, Northeast Ireland – Reconstructing anthropogenic impacts across timescales

Carlos Chique

Abstract:

Paleolimnological analyses were carried out on a sediment core obtained from Lough Muckno, Northeast Ireland, a historically nutrient polluted (eutrophic) lake within the Irish inter-drumlin belt. This study focuses on the analysis, interpretation and integration of fossil pollen and chironomid (non-biting midge) sub-fossil records, as well as other paleoecological indicators, through time. The study implements a human-centric approach, focusing on Mid-Late Holocene environments in order to assess anthropogenic influences throughout consecutive "cultural" periods. This project represents the first paleoecological reconstruction enabling an account of vegetational change and land-use dynamics in the study region. Human activity and agriculture is first recorded during the Neolithic from c. 3870 – 3500 Before Common Era (BCE). After a period of undiscernible human activity of c. 950 years, farming resumes during the Early Bronze Age (c. 2600 BCE). During the prehistorical period agriculture has a strong focus on pastoral grazing with a limited, but relatively stable arable component. Levels of activity gradually increase until the early 20th century when a shift in Irish agriculture towards livestock production becomes evident in the pollen record. Interpretations of chironomid community structure suggest human activity, through landscape modifications and farming, was an important factor influencing in-lake habitats throughout the Mid-Late Holocene. In particular, redundancy analysis (RDA) indicates that grassland based agriculture, inferred from Poaceae, a dominant component of local palynological pastoral indicators (NAPp), was the main variable controlling chironomid community composition. Lower resolution chironomid analysis throughout the sediment sequence indicate important shifts in chironomid community composition, likely resulting from local farming activity, can be traced back to the onset of pervasive human activity within the catchment during the Bronze Age (c. 2000 BCE). High-resolution chironomid and pollen analyses in the top 2 m of the core enabled a detailed reconstruction of catchment conditions and human impacts on the lake environment during the last c. 200 years. The results provide insights into lake ecological conditions from an initial meso-eutrophic state in a 19th century agricultural setting to a highly eutrophic system in a landscape under modern pastoral management. The results have clear implications for midge-based characterizations of "background" or "reference" conditions in the context of lake management within the Irish Ecoregion. The paleolimnological approach of this investigation was expanded through the implementation of a chironomid sub-fossil "intra-lake" dataset, which provided important information on taxa autecological traits including depth habitat preferences which can be ii used enhance paleolimnological interpretations. Canonical analysis (CA) comparisons of modern (intra-lake) and "downcore" assemblages highlight c. 1890 CE as a "threshold" point for similarity in sample species composition, which is attributed to the radical shift in local agricultural practices and ensuing lake eutrophication from the onset of the 20th century

Title: Timing, forcing and onshore-offshore correlations on the western margin of the British-Irish Ice Sheet

Kevin Schiele

Abstract:

This research investigates the impact and timing of glaciations on the western Irish shelf and their sedimentary record. A multiproxy approach including seismic interpretation, marine sediment core analysis, radiocarbon dating, geomorphological analysis and Cosmogenic Nuclide (CN) exposure dating of landforms and erratics onshore is used to assess the glacial dynamics on the western margin of the British-Irish Ice Sheet (BIIS) during the last glacial period. The combination of the methodologies and materials used and subsequent correlation with proxy climate records allows for an interpretation of the forcing mechanisms associated with the waxing and waning of the BIIS in this region. Analysis of seismic profiles from the western Irish shelf reveals for the first time the internal stratigraphy of the large morainic complex, situated between ~52.5°N and ~54°N, which has been deposited by a grounded ice sheet on the mid-shelf. An early Quaternary shift in the style of sediment deposition at the outer Donegal Bay margin is associated with the onset of glaciations on the

western Irish shelf. Lithofacies interpretations and radiocarbon dating of marine sediment cores suggest an asynchronous retreat pattern of the last BIIS from north to south on the western Irish shelf. This study bridges the knowledge gap between previous investigations of the region and establishes a shelf-wide correlation of grounded ice sheet retreat on the western Irish shelf based on sediment core analysis and radiocarbon datings for the first time. The palaeoenvironmental changes during ice sheet retreat are assessed by an increased percentage of benthic foraminifera assemblages associated with temperate environments from a core at the outer shelf. The synthesis of CN exposure ages of erratics onshore, radiocarbon dated sediments from offshore and mapped glacial features allows for chronological constraint of a glacial readvance into Donegal Bay that flowed offshore from north county Mayo after 17.6 cal ka BP after the main-Last Glacial Maximum (LGM) ice sheet had retreated eastward towards the Sligo coast. The forcing mechanism for this ice margin readvancing into Donegal Bay is therefore interpreted as a glacidynamic response associated with debuttressing during general ice retreat, i.e. the retreat of an ice lobe eastward towards the Sligo coast that acted as a buttress to the ice lobe with a perpendicular ice flow pattern advancing from northern county Mayo into Donegal Bay; thus resulting in the ice margin readvance of the debuttressed ice lobe from northern county Mayo. Finally, dated deglacial offshore and onshore moraines and erratics available to this study are used to build a time-constrained reconstruction of the dynamic behaviour of the western margin of the BIIS from the LGM to its deglaciation during the Woodgrange Interstadial (Irish terminology/equivalent to the Bølling-Allerød Interstadial).

10. Recent Publications:

Barth, Aaron M, Clark, Peter U, Clark, Jorie, Roe, Gerard H, Marcott, Shaun A, McCabe, AM, Caffee, Marc W, Cuzzone, Joshua K and Dunlop, P. (2017 in press) *Persistent millennial-scale glacier fluctuations in Ireland between 24 ka and 10 ka.* Geology, n/a. pp. 1-4. DOI: 10.1130/G39796.1

Chique, C., Molloy, K. and A. Potito. 2017. Mid-Late Holocene vegetational history and land-use dynamics in County Monaghan, Northeastern Ireland - The palynological record of Lough Muckno. Journal of the North Atlantic 32: 1-24. DOI: 10.3721/037.006.3201

Chique, C., Potito, A. Molloy, K. and J, Cornett. 2018. Tracking recent human impacts on a nutrient sensitive Irish lake: integrating landscape to water linkages. Hydrobiologia 807: 207-231. DOI: 10.1007/s10750-017-3395-9

Ludlow, F. (2017) "Volcanology: Chronicling a Medieval Eruption", Nature Geoscience, 10 (2), 77-78, doi:10.1038/ngeo2881.

Ludlow, F. and Crampsie, A. (2018) "Environmental History of Ireland, 1550-1730", In: Ohlmeyer, J. (ed.), Cambridge History of Ireland: Volume 2, Early Modern Ireland, 1550-1730. Cambridge: Cambridge University Press, 671-704.

Manning, J. G., Ludlow, F., Stine, A.R. Boos, W., Sigl, M. and Marlon, J. (2017) "Volcanic Suppression of Nile Summer Flooding Triggers Revolt and Constrains Interstate Conflict in Ancient Egypt", Nature Communications, 8, Article 900. doi: 10.1038/s41467-017-00957-y

OCarroll, E. & Mitchell, F. J. G. 2017 Quantifying woodland resource usage and selection from Neolithic to post Mediaeval times in the Irish Midlands. *Environmental Archaeology* **22**, 219-32.

Organ, J, Dunlop, P., Benetti, S, Shaw, J and Bell, T (2017) *The Newfoundland Ice Sheet Shelf (NISS) Survey – Research Cruise: Bay d'Espoir to Burgeo, Newfoundland.* Newfound Labrador Department of Natural Resources Geological Survey. 10 pp.

Orme, L. C., Charman, D. J., Reinhardt, L., Richard T. J., Mitchell, F. J. G., Stefanini, B. S., Barkwith, A., Ellis, M. A. & Grosvenor, M. 2017 Past changes in the North Atlantic storm track driven by insolation and sea ice forcing. *Geology* **45**, 335-8.

Southall, DW, Wilson, P, Dunlop, P, Schnabel, C, Rodes, A, Gulliver, P and Xu, S (2017) *Age evaluation and causation of rock-slope failures along the western margin of the Antrim Lava Group (ALG), Northern Ireland, based on cosmogenic isotope (36Cl) surface exposure dating.* Geomorphology, 285 . pp. 235-246. DOI: 10.1016/j.geomorph.2017.01.041

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