IQUA

Irish Quaternary Association
Cumann Ré Cheathartha na h-Éireann

IQUA

SPRING MEETING

ULSTER UNIVERSITY COLERAINE

27th April 2024

Ulster University

School of Geography and Environmental Sciences

INSTITUTE of GEOLOGISTS of IRELAND

This meeting is generously sponsored by Ulster University School of Geography and Environmental Sciences and the Institute of Geologists of Ireland (IGI)

10:00: Welcome – Professor Paul Dunlop and Jack Mason

10:10: Keynote

The Schmidt hammer as a late Quaternary dating tool

Dr Peter Wilson

10:45 – Session 1: Archaeology
Chair: Jack Mason

The dynamics of Bronze Age upland settlements in Ireland and Northern Britain: a comparative perspective

Cherie Edwards*, Dirk Brandherm , James O'Driscoll , Gill Punkett

Landscapes of production: Exploring the palaeoenvironmental context of stone tool quarrying, manufacture, use and deposition on Neolithic Shetland

Hazel Mosley*, Dr Will Megarry, Dr Ed Schofield

11:45 – Tea Break

12:00 – Session 2: Peatlands
Chair: Thomas Garner

Blanket peat and challenges in dating its genesis: a case study for the Mourne Mountains, County Down

Helen Essell*, Gill Plunkett

Assessing the impact of a drier/warmer climate on a peatland system: a Mid-Holocene case study

James Dill-Russell*, Gill Plunkett, Jo Smith, Graeme Swindles

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13:00 – Lunch

Poster session will run during lunch.

14:00 – Session 3: Geology, Archaeology and Ecology

Chair: Rebecca Davage

Marginal marine microbialite facies associations from an MIS 11 shoreline at Cape Freycinet, Western Australia.

Thomas W. Garner*, J. Andrew G. Cooper

Turritella-dominated shellbeds record a drastic ecological shift during the late Holocene in Galway Bay.

R.S.Healy* , P.J.Orr , S.Benetti , A. M.Holmes , P.D.W.Haughton , F.X.O'Beirn and L.Healy

New digital mapping of glacial geomorphology in eastern Northwest Territories, Canada (NTS map 75P)

Clara Crowell, S.E Kelley, E. Brouard, J.E. Campbell*

Poster Presentations

Preliminary analysis of the spatial and stratigraphic implications of shellbeds formed during the late Holocene in Galway Bay using Xray imagery.

R.S.Healy, P.J.Orr, S.Benetti, A. M.Holmes, P.D.W.Haughton, F.X.O'Beirn and L.Healy

Monitoring the changes in the glacial lakes in the Southern Alps, New Zealand from 2000-2023 using an Object-Based Image Analysis (OBIA) approach in Google Earth Engine (GEE)

Tomos Morgan, Robert W. McNabb, Paul Dunlop

15:30 – IQUA Awards

15:40 – AGM

EDI Statement

The IQUA Spring Meeting strives to be inclusive of all. We have done this by providing a balanced schedule of talks, ensuring the room is accessible to all by being wheelchair accessible and being fitted with a hearing loop. We have also sent out a form to all members to assess their dietary needs and have provided vegetarian, vegan and halal sandwiches.

We ask that all attendees promote a professional and respectful atmosphere in which all participants are treated with courtesy, respect and consideration.

The IQUA Spring Meeting organising committee will not tolerate scientific or social misconduct of any kind. This includes making disparaging or hurtful remarks. Any perpetrators will be asked to leave the meeting, and any crimes committed (such as hate speech) will be reported to the police.

If you need to report an incident, please approach Jack Mason, Gill Plunkett or Graeme Swindles, or send an email to mason-j3@ulster.ac.uk. This email will be monitored continuously through the day.

The Schmidt hammer as a late Quaternary dating tool

Dr Peter Wilson[1*]

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The Schmidt hammer (SH) is a comparatively cheap, light and portable instrument that has been used for both relative and calibrated (numerical) exposure-age dating of bedrock surfaces and boulder-strewn landforms, such as rock-slope failures and moraines, of late Quaternary age. However, it has not been used to the same extent in Ireland as in several other areas. This is unfortunate because large amounts of data can be gathered quickly and it has been demonstrated that for certain rock types the calculated exposure ages are equivalent within uncertainties to exposure ages determined through use of cosmogenic-nuclide dating. Therefore, greater usage of the instrument in Ireland is warranted.

This presentation will mention previous applications of the SH in Ireland and Norway but will focus on exposure ages determined for bedrock surfaces on several summits in the Mountains of Mourne.

Five summits were sampled – Ben Crom (526 m), Doan (594 m), Slieve Corragh (640 m), Slieve Bearnagh (739 m) and Slieve Binnian (747 m). On two of these (Doan and Slieve Binnian) samples for cosmogenic exposure-age dating had previously been taken by others in the IQUA community. The results of their work, when available, and the results presented here will provide for interesting comparisons.

The SH results are based on 250 impacts over small surface areas of a few square metres on upstanding bedrock outcrops on each summit. On Doan and Slieve Binnian measurements were made adjacent to the sites of cosmo sampling. For each SH data set the mean R (rebound) value and 95% confidence interval were determined and these were input into the calibration equation determined and published by Matt Tomkins (Manchester University) based on 54 granite surfaces with cosmogenic ages and SH measurements from sites elsewhere in Ireland and Britain.

The calculated ages for the Mourne summits range from 17.98±0.36 ka to 18.97±0.37 ka. The interpretation and significance of these ages will be explored in the presentation.

Chair: Rebecca Davage

The dynamics of Bronze Age upland settlements in Ireland and Northern Britain: a comparative perspective

Cherie Edwards[1*], Dirk Brandherm[1], James O'Driscoll[2], Gill Punkett[1]

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The Irish and Northern Britain Bronze Age artifact record is rich in finds of extraordinary beauty and artisanal skill, yet upland settlement sites that offer reliable absolute dating can be elusive. Many sites have traditionally been dated through finds typology or relative dating. Settlement patterns in upland areas have indicated contradictions indicate simultaneous settlement expansion and contraction during periods of climate change. The need to understand how past societies dealt with major climate events has been acknowledged by scholarship, however the existing archaeological record in most upland areas of Northern Britian and Ireland is not granular enough to avoid false 'cause and effect' conclusions and requires refinement to generational levels where possible. This project is an effort to generate a more granular and refined chronology through expanding existing chronologies of selected archaeological zones using radiocarbon dating of untested archived samples, new samples and re-evaluation of finds by typologies. This talk introduces preliminary conclusions showing that settlement persisted on a highly regionalized basis despite climate shifts and the evidence remains insufficient to establish any climate driven change.

Landscapes of production: Exploring the palaeoenvironmental context of stone tool quarrying, manufacture, use and deposition on Neolithic Shetland

Hazel Mosley[1]*, Dr Will Megarry[1], Dr Ed Schofield[2]

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Little is known about the distribution of Neolithic archaeological sites in Shetland, as few have been excavated and even fewer independently dated, but recent work suggests that the production and use of felsite artefacts was important both economically and culturally to Shetland's Neolithic inhabitants. Felsite quarry sites are confined to the north-west part of the archipelago, but polished felsite artefacts are widely distributed.

The landscape of Shetland today is an almost treeless patchwork of farmland, heath and blanket bog, but palynological studies show that Neolithic vegetation was much more diverse. Several records show high values of tree and shrub pollen, but, due to the problem of wind transport, researchers are circumspect about whether these really represent local woodlands. Previous studies have focussed on south and south-west Mainland, meaning the palaeoenvironmental context of felsite quarries and key felsite-associated sites in the north-west has not been fully examined.

Through analysis of pollen, non-pollen palynomorphs and microcharcoal from new peat cores, we uncover divergent patterns of land cover, land use and human impact at sites associated with the quarrying, production, use and deposition of felsite artefacts. This new data is integrated with existing palaeoecological studies to explore regional variations in vegetation.

Session 2: Peatlands

Chair: Thomas Garner

Blanket peat and challenges in dating its genesis: a case study for the Mourne Mountains, County Down

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Blanket peat is widespread along the Atlantic coast and in uplands of Ireland. The traditionally held view is that blanket peat initiation is a Bronze Age phenomenon caused by anthropogenic land use activities. Climatic causality has also been discussed, with recent studies showing that conditions were suitable for peat formation after 6000 BP. Understanding of the timing, thus cause of blanket peat initiation is, however, confounded by uncertainties pertaining to the definition of basal peat and the methods used to date peat. Here, we investigate these challenges with a view to better understanding the genesis of blanket peat in Ireland. We compare radiocarbon and tephra derived chronologies from five peat sequences collected in the Mourne Mountains, County Down, to assess the accuracy of radiocarbon ages, and we discuss the implications of this for dating blanket peat initiation. Additionally, we use these records to date the timing of peat initiation in the Mournes, where the genesis of blanket peat has not previously been investigated. We then contextualise these results against existing studies to re-examine the genesis of Irish blanket peat and discuss potential causes of its formation. These results will inform understanding of upland environmental change and crucially will emphasise the carbon storage capacity of blanket bogs.

Assessing the impact of a drier/warmer climate on a peatland system: a Mid-Holocene case study

James Dill-Russell*[1], Gill Plunkett[1], Jo Smith[2,] Graeme Swindles[3, 4]

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Ombrotrophic peatlands, reliant on precipitation for nutrients and water, are sensitive to climatic changes and have been used extensively to reconstruct past shifts to wetter and/or colder climate. However, there exists uncertainty regarding the impact of climate change on ombrotrophic peatland systems under drier or warmer conditions. Due to relatively continuous accumulation of organic matter the impact of changes in precipitation, temperature and other environmental conditions are preserved in peat in varying proxies from macrofossils to C:N ratios. Here we consider the period between 6000–5000 BP when one or more episodes of drying in the UK and Ireland have been suggested by previous peatland studies. Applying testate amoebae and macrofossil analysis to peat cores from a raised bog in Northern Ireland, we reconstruct water-table depth and bog vegetation to investigate the nature and timing of climate impacts on the bog. We calculate bulk carbon content to explore carbon accumulation, informed by C:N ratios, to consider the effects of the observed changes on carbon accumulation. We test the replicability of our findings within the bog through a study of sequences from three different areas of the bog system. Our preliminary results suggest a shift to drier bog surface vegetation types at 5400 cal. BP, observed in all three sequences, that is accompanied with a decrease in bulk carbon. We explore the significance of our findings in relation to potential future drying events and implications for carbon emissions from ombrotrophic systems.

Chair: Rebecca Davage

Marginal marine microbialite facies associations from an MIS 11 shoreline at Cape Freycinet, Western Australia.

Thomas W. Garner*[1], J. Andrew G. Cooper[1,2]

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While modern and Holocene tufa microbialites have been documented globally on groundwater spring-fed supratidal rock coasts, few pre-Holocene examples have been reported, and their potential as palaeo-shoreline indicators is yet to be demonstrated. At Cape Freycinet, Western Australia, microbialite and microbialite-associated carbonate deposits form a distinctive assemblage of distinctive marginal marine facies from the upper-intertidal to supratidal zones of a former rock coast. These discrete palaeo-spring-associated deposits consist of five distinct facies that define a Quaternary palaeo-shoreline. A landward palaeosol facies representing a hinterland vegetated soil, passes laterally into tufa microbialite on sub-horizontal bedrock, associated with oncoids and intraclast tufa. The most seaward facies is a microbially-cemented beachrock that represents upper-intertidal to supratidal deposition. Facies distribution depends on bedrock topography in relation to palaeo-sea-level. and forms a distinct marginal marine perched springline facies model. These facies define a Quaternary palaeo-shoreline at ca. +13 m above sea-level, providing the first evidence of an MIS 11 shoreline in Australia. These findings prove the utility of marginal marine microbialite deposits on rock coasts as reliable indicators of Quaternary sea-level.

Turritella-dominated shellbeds record a drastic ecological shift during the late Holocene in Galway Bay.

R.S.Healy[1*] , P.J.Orr[1] , S.Benetti[2] , A. M.Holmes[3] , P.D.W.Haughton[1] , F.X.O'Beirn[4] and L.Healy[4]

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As part of a study of the stratigraphic and environmental significance of shellbeds preserved in the Holocene succession below Galway Bay, the structure of a highly distinctive example has been investigated in detail.

This shellbed extends across much of Mid to Outer Galway Bay across circa 250 km^2, ~20 vibrocores, reaching up to 0.8 m thickness. As yet uncalibrated radiocarbon dates indicate examples between cores are coeval; thus, the shellbed formed (near)simultaneously, between 6.4 kyr and 4.5 kyr ago. The shellbeds from 2 cores have been separated into 10 mm increments, sieved and the faunal remains recovered identified and their taphonomy studied. There is limited variation in the composition of the shellbed throughout its thickness; its lower and upper parts can contain a slightly more diverse molluscan assemblage, but it is dominated by examples of the gastropod Turritellinella tricarinata (formerly Turritella communis); the middle parts of the shellbed are essentially monospecific. The shells are extremely densely packed and typically oriented parallel to bedding. Various criteria identify the shellbed to be the remains of an in-situ community. The age of individual shells consistently youngs upwards, although occasional reversals occur (mainly at the base and top of the shellbed). There is no evidence of either current-induced winnowing or abrasion and fragmentation as might be expected if the shells had experienced transportation. Absence of encrustation more likely reflects minimal residence time on the sea floor before burial as opposed to the absence of encrusting organisms. In each increment a wide and continuous range of shell sizes are present. Entire shells are in pristine condition, with the apex almost invariably intact. Fragmentation of shells is confidently attributed to successful predation; the patterns match healed breakages on the shells attributed to failed predation attempts. Direct evidence for potential predators is minimal; the breakage patterns match those produced by crab predation on modern shells. The Galway Bay Turritella shellbeds therefore have been classified as a biogenically accumulated, in situ palaeocommunity representative of a long-lived event in the palaeoenvironmental history of Galway Bay.

Similar Turritella-dominated shellbeds have been identified in NE Europe and have been attributed to the 8.2kyr event. Although similar in taphonomy, the younger age of the onset of the Galway Bay Turritella

shellbeds suggests they are an ecological response to a different event. Formation of these highly distinctive shellbeds is attributed to a (as yet unknown) set of environmental conditions that favoured development of an opportunistic community during the Holocene transgression of Galway Bay. This tentative link between the community's formation and an episode of rising sea level may have implications for understanding the future ecological structure of this and similar ecosystems in response to anthropogenically driven ongoing rise in sea level.

New digital mapping of glacial geomorphology in eastern Northwest Territories, Canada (NTS map 75P)

Clara Crowell[1,2], S.E Kelley[1,2], E. Brouard[3], J.E. Campbell[3]*

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The unique landscapes of northern Canada are a direct product of the paleo-ice sheets of the Quaternary; yet remote regions like eastern Northwest Territories (NWT) pose challenges for field data collection, limiting our understanding of the regional glacial history. Thus, the glacial history in such remote regions primarily comes from mapping remotely sensed imagery (e.g., air photographs and Landsat data). The recent advent of high-resolution (2m) satellite-derived imagery (e.g. hillshade images derived from ArcticDEM) presents a pivotal opportunity for more detailed mapping in remote areas and for developing new knowledge on Canada's glacial past and landscape evolution. Hence, the Geologic Survey of Canada initiated the West-central Keewatin Glacial Dynamics Activity to leverage the new satellite-derived data (ArcticDEM, Landsat) and fieldwork, to produce high-resolution digital geomorphology maps in mainland Nunavut and NWT.

Here, we present a preliminary geomorphology map (scale 1:24,000) of a subsection of NTS map 75P (NWT), alongside detailed descriptions of observed glacial landforms (e.g. eskers, drumlins, beaches, meltwater channels). The inventory of mapped landforms will serve as a foundation for identifying glacial landsystems and exploring the landscape changes that occurred during the last glaciation.

Preliminary analysis of the spatial and stratigraphic implications of shellbeds formed during the late Holocene in Galway Bay using Xray imagery.

R.S.Healy[1], P.J.Orr[1], S.Benetti[2], A. M.Holmes[3], P.D.W.Haughton[1], F.X.O'Beirn[4] and L.Healy[4]

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Shallow-marine, soft-bottom, macrofauna in Irish coastal regions and elsewhere are increasingly facing threats posed by unpredictable environmental changes, including sea level fluctuations, as well as changes in nutrient fluxes and water geochemistry, largely as a result of anthropogenic activities. The near-time geohistorical record offers an opportunity to identify how these communities have responded in the recent past to episodes of environmental change that may have been triggered by similar ecological stressors.

Shellbeds, high-density accumulations of complete and/or fragmented remains of marine shells in a sedimentary sequence, potentially capture the structure of the preservable fauna of these communities. They offer the opportunity to recover large volumes of bioclastic material from the small sample volumes recoverable by coring.

Shellbeds can vary in thickness, spatial geometry, species composition, internal structure, and level of shell preservation. This reflects the complex processes that are often involved in their formation, for example via sedimentological processes including storm events and current winnowing. Alternatively, they can form as in situ biogenic accumulations. Identifying the processes responsible for the formation of shellbeds offers insight into the local ecological, physical, and environmental conditions at the time of their formation.

Highly distinctive Holocene in age shellbeds, up to 1m thick, occur in circa 50 sediment cores recovered from Galway Bay. X-ray imaging of the cores suggests the spatial extent of the shellbeds extends across most of Galway Bay, an area ~450km^2. Initial regional-scale observations suggest a lateral transition in the shellbed biofacies from easterly, nearshore, bivalve-dominated shellbeds to westerly, near mono-specific Turritelladominated offshore shellbeds. The vertical stacking of the latter on the former locally is attributed to Holocene transgression in Galway Bay, and consistent with this. The bivalvedominated shellbeds are more similar in composition to the extant populations in the upper parts of the sediment column in Galway Bay. Various criteria identify the Turritelladominated shellbeds, for which we cannot find an identical modern

analogue, as in situ communities. A preliminary chronostratigraphic framework based on a limited number of radiocarbon dates suggests the shellbeds are contemporaneous across Galway Bay. If confirmed by additional radiocarbon analyses, these populations would represent a singular, widespread, regional event, that developed rapidly and simultaneously across Galway Bay for a sustained period before terminating abruptly.

The environmental driver(s) triggering the formation (and subsequent cessation) of these distinctive shell communities remains to be determined. Resolving this will confirm the potential of shellbeds as an indicator of the sensitivity of shallow-marine ecosystems to environmental variations and potentially, as a prediction of what could reoccur in the future as these ecosystems continue to come under increasing environmental stress from anthropogenic activities.

Monitoring the changes in the glacial lakes in the Southern Alps, New Zealand from 2000-2023 using an Object-Based Image Analysis (OBIA) approach in Google Earth Engine (GEE)

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Glacial lakes are growing rapidly, driven by climatic change and glacial retreat. The growth of glacial lakes may increase the magnitude and frequency of glacial lake outburst floods (GLOFs), posing a hazard to downstream populated regions. Satellite remote sensing provides a way to improve monitoring efforts, though automatic methods are needed to monitor changes accurately and rapidly in these lakes. In this study, we develop and apply an Object-Based Image Analysis (OBIA) approach to 71 multispectral Landsat 5-9 Top-Of-Atmosphere (TOA) satellite imagery in Google Earth Engine (GEE) to monitor the changes of 14 lake-terminating glacial lakes across the Southern Alps of New Zealand outside of the winter season (June-September) between 2000-2023. The Southern Alps of New Zealand are experiencing increasing glacial mass loss and despite previous glacial lake monitoring it remains necessary to continue monitoring these glacial lakes to understand the magnitude of their contribution to past regional ice mass loss. Our results show that the collective area of these 14 glacial lakes increased by 69% between 2000-2023, from 12.84 ± 0.06 km^2 to 21.71 ± 0.1 km^2. We evaluate the accuracy of this method by comparing automatically generated classification to manually classified points, using a stratified random sampling approach. Preliminary results derived for the accuracy of Landsat 9 satellite imagery resulted in an overall accuracy of 89%, with a producer's accuracy and user's accuracy of 98% and 96% respectively, for water. These preliminary results suggest that the method has the potential to map glacial lakes accurately and rapidly and can be applied to other glaciated regions.

BELFAST 2024

QRA

POSTGRADUATE SYMPOSIUM

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