IQUA

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Editor: Susann Stolze

1. Editor's Note

Dear IQUA members,

Welcome to IQUA newsletter No. 68.

This issue contains information on past IQUA events and the upcoming INQUA meeting in Rome 2023. It features abstracts of talks and posters presented at the IQUA Spring Meeting held at Queen's University Belfast and a report on the Spring Field Meeting to County Sligo this past April.

I would like to thank all who contributed to this edition.

Kind regards,

Susann Stolze, CSM, Colorado, September 2022 (sstolze@mines.edu)

2. Cúpla Focal

[lit.] A couple of words ... from the Secretary

There has never been a more important time to understand the Quaternary as temperature records continue to be broken across the world, glaciers are in rapid retreat and fires seem to be breaking out everywhere. Is climate change accelerating?

I get the sinking feeling that our understanding of several feedbacks in the Earth system is poor. In my research I am particularly concerned with soil carbon-climate feedbacks. I spent a fortnight this July in Abisko, Northern Sweden, a place I have visited several times previously. It is quite sobering to see the landscape change in front of your eyes as this region rapidly warms. The permafrost peatlands are all cracking open like eggshells and several have deflated as permafrost thaws. Lakes are also expanding – which may sound good, but in reality, these lakes are methane hotspots. As scientists, we are now in the somewhat depressing realm of documenting the demise of these permafrost peatlands rather than understanding their dynamics.

The Quaternary record is very important for contextualising the current crisis we are in – glacier retreat and landscape evolution, feedbacks and non-linear dynamics in the climate system, vegetation responses to climate change, human responses and adaptation to rapid environmental change, changes in the carbon cycle (and more!). Gill Plunkett (IQUA President) in the previous Cúpla Focal stated "it can be easy to lose sight of the human timescale when looking far into the past". I think this is something we must fully engage with as Quaternary scientists – we have a role to play in using the past to understand the present and the future, and communicating the real-world relevance of Quaternary science to the general public.

Looking forward to seeing many of you at the upcoming Autumn Symposium!

Graeme Swindles, IQUA Secretary

3. IQUA Committee (2022)

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Limerick; Sam Kelley, University College Dublin; Sam Roberson, British Geological Survey, Belfast

4. IQUA Spring Meeting 2022

The IQUA Spring Meeting on was held at Queen's University Belfast on April 30th, 2022. The meeting was opened by IQUA secretary Graeme Swindles and followed by talks and poster presentations.

Abstracts

Turning the tide? An archaeological reassessment of Mesolithic Dalkey Island

Martin Moucheron

School of Archaeology, University College Dublin

This contribution introduces an ongoing PhD project aiming to reassess three Mesolithic (c. 8000–4000 BC) shell midden sites on the east coast of Ireland using archival, archaeological, and geoarchaeological methods. The shell middens in Dalkey Island and Sutton, Co. Dublin, and Rockmarshall, Co. Louth, are reference sites for the Irish Mesolithic, yet they have remained unexplored for the past fifty years despite the impact of both coastal erosion and growing urbanisation on the archaeology of the Irish East Coast.

In particular, the development of landscape archaeology, and the increasing precision in data analysis, have imposed change as a key element to understand time and space – the sites in their landscape evolved throughout the Mesolithic, and were different to what they are today. Together with the original excavations' material and archives, the extraordinary technological progress in data acquisition and analysis are being mobilised to assess what archaeological potential has been preserved on our three sites using a combination of archaeological and geoarchaeological methods selected in line with international best practice as a practical contribution to the archaeology of Early Holocene landscapes.

This presentation proposes a particular focus on Dalkey Island, where ongoing damage to archaeological contexts, recorded in the initial phase of this project, has led the National Monuments Service to support a short fieldwork campaign whose first observations offer exciting and challenging perspectives.

A multicore palynological investigation of Mesolithic plant and land-use at Derragh Island, Co. Longford

James Perkins [1*], Gill Plunkett [1], Laura Basell [2]

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Archaeobotanical and pollen records from Britain and north-west Europe indicate that Mesolithic people structured woodlands through the intensive use and management of wild plants, and the creation of small-scale clearings. Whether the same is true in Ireland is less clear. Here, despite hints in the archaeobotanical and palynological records that hunter-gatherers actively managed plants and cleared woodland, very little is known about the environmental impacts of these practices. This is due in part to a lack of concerted palynological research into Mesolithic woodland disturbance since the 1980s, and because few detailed palaeoenvironmental investigations have specifically targeted areas with Mesolithic archaeology/archaeobotany.

One site where peat deposits of Mesolithic age were discovered alongside a contemporary archaeological site with a rich archaeobotanical assemblage is Derragh Island, Co. Longford. To determine whether the site's occupants shaped woodland through the creation of clearances or through their plant-use strategies, three monoliths taken from within a 40 m radius of the archaeology were analysed at multi-decadal (10–30 year) resolution for pollen, charcoal and ^{14}C. This paper presents the results of those investigations and discusses their significance. Despite the archaeobotanical evidence for extensive plant use, the pollen records do not clearly demonstrate signs of vegetation disturbance. The results have significant implications for our ability to infer Mesolithic occupation from pollen records.

Linking ecological, environmental and human Holocene change using laminated lake sediments in the Irish Midlands

Lewis Howell

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Cornaher Lough is a small, freshwater lake located in County Westmeath, Ireland and holds a record of extensive palaeoenvironmental change. Originally

investigated by Alyson Heery of Trinity College, Dublin in 1998 the study yielded a unique record of environmental change in response to Holocene climatic change presenting a picture of a diverse landscape undergoing several key transitions from the early Holocene to the present. The occurrence of laminated sections throughout the sequence have sparked new interest in the site. The current investigation focuses on rapid climate events within the Holocene, their impacts on the palaeoenvironment and vegetation of the site with a focus on the human-environment relationship in the area. The study is utilising a range of proxies namely pollen, NPP, geochemistry and magnetic susceptibility data and local archaeology. It is hoped that the laminations present, when analysed for dateable material, will represent several key climate events during the Holocene (e.g., 8.2, 4.2, 2.8 ka events). The Theory of Adaptive change and Ecological Resilience first identified by C.S Holling in the 1970s will be applied to the sequence obtained sitting within a developing niche of Quaternary Science concerned with assessing palaeovegetation and ecological resilience to climatic variability. Specific focus will be given to key archaeological transitions to investigate whether they occur at the same time as key climatic transitions. So far, magnetic susceptibility and stratigraphic information has yielded some interesting results which will lay the foundation for future study. It is also hoped that a similar site in Wales, specifically near the Shropshire hills can be sought to enable a comparative analysis.

Enhanced freshwater export to the subpolar North Atlantic: a trigger for abrupt climate change?

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Recent studies of Marine Isotope Stage (MIS) 11 (424-403 ka), a long and unusually warm Quaternary interglacial, have found that the Atlantic Meridional Overturning Circulation remained strong despite continued background melting of the Greenland Ice Sheet that resulted in a fresh and cold surface ocean in the Nordic Seas. These investigations suggest deep-water formation may not be as susceptible to future melting of the Greenland Ice Sheet as previously thought. Here we test this hypothesis and present a palaeoceanographic investigation of an abrupt climate event recorded in the eastern North Atlantic during peak interglacial conditions, when the Greenland Ice Sheet was smaller than today. Using sediment core DSDP-610B recovered from the Rockall Trough, we reconstruct the evolution of Nordic Seas Deep-Water (NSDW) by means of grain size analysis and endmember modelling. Further, a combination of planktonic foraminiferal assemblage census and Ice-Rafted Debris (IRD) counts enabled a reconstruction of sea surface temperature and the movement of oceanic fronts throughout this event. Our results link a reduction of NSDW with a sudden release of fresh waters from the Nordic Seas to the subpolar North Atlantic. We hypothesise that the ocean-atmosphere climate dynamics linking the Nordic Seas with the subpolar North Atlantic could play a crucial role for the stability of current NSDW formation pathways in the future.

Digital soil mapping of peatlands using airborne radiometric data and supervised machine learning

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Peatlands are important carbon sequestration centres. Through restoration projects they may become carbon neutral or possibly carbon negative. Restoration plans require a knowledge of peatland extent and spatial distribution across large geographic areas.

Current peatland maps are created using combination of optical satellite remote sensing and legacy soil/quaternary maps. Optical remote sensing cannot detect peatlands under landcover such as forest or grassland. Legacy maps are often created from sparse in-situ augur or trial pit data. These types of measurements do not allow for accurate measurement of boundaries.

Airborne geophysical datasets offer a means to update national and local scale peatlands maps. Radiometrics, a geophysical method that measures radiation from geological materials, is particularly suited to peatland studies. Modelling of radiometric attenuation indicates that statistical relationships exist between acquired datasets. Peat is a mostly organic material and so is, generally, not a source of radiation. Peat has low bulk density and is usually very porous and saturated. These effects combined means that peatlands can be differentiated from non-peat soils.

This study uses airborne radiometric data combined with machine learning classification to examine the current spatial distribution a peatland database in the west of Ireland. The Quaternary Geology database maps peatland extent where peat thickness is greater than 1 m at the surface. The methodology shows that a direct measurement, such as radiometric data, analysed in a supervised machine learning framework, provides increased resolution of peatland extent in this region.

Conservation of Northern Ireland's Quaternary geoheritage – where are we, how did we get here, and where next?

Michael Dempster

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Northern Ireland has a rich and varied Quaternary geoheritage. Landforms and sediments from the last glacial phase of the Late Pleistocene are most prevalent, though the record extends from the last interglacial (MIS 5e) to the Holocene. The glacial record in the region continues to play a crucial role in the development of models of the last British-Irish Ice Sheet, with many sites having international significance. It is the role of the Northern Ireland Environment Agency to legally protect and conserve this important Quaternary heritage, and a programme of statutory protection of these sites as Areas of Special Scientific Interest (ASSIs) has been in place for over twenty years. This talk will look at how conservation of Quaternary sites and features has been approached and achieved in Northern Ireland to date, consider its current status and future needs to ensure its continued protection and recognition as a vital part of the natural heritage of the region.

Controls on the accumulation rates of European peatlands

Graeme T. Swindles [1,2]

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Peat accumulates when there is a positive mass balance between plant productivity inputs and litter/peat decomposition losses. Here we examine the peat accumulation rates from 28 well-dated European peatlands. Peat accumulation rates range between 0.005 and 0.448 cm yr^{-1} (sample mean = 0.140 cm yr^{-1}; inter-site mean = 0.118 cm yr^{-1}). Our work provides important context for the commonplace assertion that peatlands grow vertically at ~1 mm yr^{-1}. We find that summer temperature is the strongest control on the site average and highest recorded accumulation rates across our European sites. Peatland accumulation rates tend to also be higher when water-table (reconstructed from testate amoeba subfossils) is within the 5–10 cm range. When a Gaussian response curve is fitted to the data, the optimal water-table depth for greatest peat accumulation is ~10 cm. Peat accumulation rates appear to be generally lower when water table depths are <0 cm (standing water) or >25 cm, which may relate to a decrease in plant productivity and increased decomposition losses, respectively. These findings corroborate previous experimental studies which examined the relationship between peatland water-table depth, or the thickness of the aerobic surface layer (the 'acrotelm'), and the rate of peat formation. Our work suggests that an average water-table depth of around 10 cm is optimal to enable rapid peat growth and carbon sequestration in the long term, which should inform peatland restoration and rewetting projects.

PRISM: Preservation by Record of Ireland's Shell Middens [poster]

Rory Connolly [1], Martin Moucheron [1*], Carolyn Howle Outlaw [2]

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Coastal shell middens are an important archaeological resource with the potential to shed light on many aspects of human-coastal interaction over time and contribute with environmental reconstruction. Over 500 sites containing these shell deposits can be found at various locations along the *c.* 7500 km of the Irish coastline, dating from *c.* 6000 BC to the modern era. Understanding these sites may assist researchers, policy makers, and community leaders in developing new approaches and building resilience along the coast today. However, these shell middens are rapidly being lost due to both natural — sea-level rise, coastal erosion, increased storm surges, and isostatic shift — and anthropogenic factors — trampling by footfall, removal of shells and other archaeological material, certain agricultural practices, and encroaching development.

PRISM, Preservation by Record of Ireland's Shell Middens, is a citizen science participatory mapping scheme devised to assist volunteers in recording midden sites and the effects of erosional factors in their own communities. An interactive website has

been developed to include digital mapping tools and information for assisting such recording. The project aims to foster pride in local coastal heritage for the volunteer citizens along with creating a more complete record of shell middens within their cultural and geological context. This poster will show the website and how to interact with it to continue to spread PRISM throughout the research community and the interested public.

Investigating the timing and causes of nitrogen cycle changes in Bronze Age Ireland [poster]

Sarah Ferrandin [*], Gill Plunkett

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Archaeological and palaeoenvironmental evidence suggests that the Irish Bronze Age was a time of substantial, recurrent societal and environmental changes that would have affected human life on many levels. Against a backdrop of fluctuating climate, repeated phases of land clearance and abandonment changed the nature of the Irish landscape. Previous research on herbivore bone collagen $\delta^{15}N$ has suggested that an intensification in farming and deforestation activities triggered a shift in nitrogen trophic levels at a broad regional scale. Such an intensification is generally supported by palynological and archaeological evidence, but anthropogenic impacts were not sustained. Might then the nitrogen shift be explained by other factors? Nitrogen stable isotopes are often very hard to interpret as they mirror a complex synergy of causes, including climate. The Irish Bronze Age is marked by a number of climate transitions, including a possibly significant drought event around 900 BCE.

This paper outlines a research project that aims to effectively distinguish between climate and land-use changes during the Irish Bronze Age. The study will apply a multi-proxy approach combining the use of pollen, testate amoebae, carbon, and nitrogen stable isotope analyses to examine the occurrence of the nitrogen shift in sedimentary records and compare its timing with climate and land-use changes. The work targets paired sites of ombrotrophic peat bogs and lake sediments from areas with known Bronze Age settlement: ombrotrophic peat bogs get all their nutrients from the atmosphere which is why their $\delta^{15}N$ values are only affected by climate change, unlike lake sediments which also reflect land-use changes. Herbivore bone collagen reflects years of dietary intake, therefore providing a greater spatio-temporal perspective.

Landscapes of production: exploring the palaeoenvironmental context of stone tool quarrying, manufacture, use and deposition on Neolithic Shetland [poster]

Hazel Mosley [*], Will Megarry

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Palynological analysis shows considerable variation in openness, inferred vegetation and landscape history across Shetland during the middle Holocene, likely influenced both by topography and anthropogenic factors.

During the last decade, new radiocarbon dates and reanalysis of Shetland sites long suspected to be Neolithic, such as Ness of Gruting and the stone buildings at Scord of Brouster, has suggested an early Bronze Age chronology, challenging previously held beliefs about settlement and landuse during the Neolithic and creating a gap in our understanding of this important period. More recently, radiocarbon dates from felsite stone tool quarries in North Roe and a cache of polished axes and knives at Modesty in West Mainland have indicated extensive quarrying and distribution networks in the early to middle Neolithic. Polished felsite axes and knives are found across the archipelago, suggesting widespread settlement activity.

A review of the palaeoenvironmental and archaeological data has shown north-west Mainland has a wealth of Neolithic archaeology and limited palaeoecological coverage, something this project seeks to redress. This poster will summarise existing mid-Holocene palaeoenvironmental studies, which are mostly focussed on south and west Mainland. It will then outline the project aims to for new palaeoenvironmental investigations targeting areas associated with felsite production and use in north-west Mainland, and new analysis of the palaeoenvironmental sequence and chronology at Scord of Brouster. The project will use geospatial analysis and visualisation, integrating new and existing pollen data to explore vegetation cover across Neolithic Shetland.

Examining landscape evolution during the final deglaciation of the Cairngorms, NE Scotland [poster]

Cormac O'Brien [1*], Sam Kelley [1], Graeme Warren [1], Elyeah Schweikert [2], Alice Doughty [2]

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In Scotland, the influence of deglaciation on Late Glacial–Early Holocene hunter-gatherer activity in mountain landscapes remains unclear. We will contribute to the debate by constraining the timing of the final deglaciation of the Cairngorms to characterise the evolution of the Late Glacial landscape. To constrain the timing of deglaciation, we have collected bedrock and boulder samples for ^{10}Be and ^{14}C cosmogenic isotope exposure dating. Our new chronology, along with recalibrated exposure ages, will constrain our computational models of ice mass evolution. To provide a further constraint on the models, we have compiled published data on the locations of long-lasting modern snow patches in the Cairngorms, as an analogue for where Late Glacial/Early Holocene snow and ice may have accumulated. We find that snow tends to last the longest on slopes with a NE aspect, and that years with no surviving snow have become more frequent since records began. This research is part of a larger project which seeks to characterise the Late Glacial and Early Holocene landscape of the Cairngorms, which were home to hunter gatherers in the Holocene and near areas of hunter-gatherer settlement in the Late Glacial, using field observations, cosmogenic exposure dating, and computational glacier modelling.

5. IQUA Early Career Researcher Workshop 2022

Adrienne Foreman [1] and Ryan Smazal [2]

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In April of this year, IQUA held its first Early Career Researcher Workshop at Queen's University Belfast. The topic of the workshop was Bayesian statistics in Quaternary research. Speakers at this event featured Dr. Maarten Blaauw (QUB) and Dr. Niamh Cahill (Maynooth University). Dr. Blaauw began day one by discussing uncertainties in age-depth models, how the use of Bayesian statistics is applied to mitigate these uncertainties, and applications with real data. On the second day, participants heard from Dr. Cahill, who discussed the theories behind Bayesian modelling, the importance of 'priors', and different types of models including the Errors in Variables Integrated Gaussian Process (EIV IGP) model, with applications to sea-level change data.

The success of the event was twofold, bringing in two excellent speakers, and the opportunity for ECRs to learn and interact in person for the first time for many. With 16 participants over the two days, we hope to continue supporting and hosting events for ECRs. Special thanks goes to the event organisers Mark Coughlan, Adrienne Foreman, and Ryan Smazal, on site help from Graeme Swindles and Gill Plunkett, our knowledgeable speakers Dr. Niamh Cahill and Dr. Maarten Blaauw, and the participants themselves.

6. IQUA Award News

Eileen Reilly Postgraduate Research Award

The winners of this year's Eileen Reilly Postgraduate Research Awards presented at the IQUA Spring Meeting 2022 at Queen's University Belfast are David O'Leary and Fermin Alvarez.

PhD candidate Dave O'Leary of the National University Galway used the award to travel to EGU2022 in Vienna, Austria, 23–27 May 2022, to present his research to a broad international audience as part of an early career session at the EGU: BG3.10 – 'Old Peat, New Voices: Insights into Global Peatland Research from Early Career Researchers'.

Regional Mapping of Peatland Boundaries using Airborne Radiometric Data and Supervised Machine Learning

David O'Leary [1*], Eve Daly [2], Colin Brown [1]

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Peatlands are recognized as important carbon sequestration centres. Through restoration projects of

peatlands in which the water table is raised, they may become carbon neutral or possibly carbon negative. National restoration plans require a knowledge of peatland extent and spatial distribution across large geographic areas.

Recently the availability of large geo-spatial datasets has increased. These range from soil, quaternary, and geology maps to airborne geophysical and satellite remote sensing data. Combining such datasets may provide a means to spatially map peatland extents and boundaries traditionally mapped via in-situ measurements. However, such datasets, and the relationship between them, are often complex. Modern Machine Learning methods can play a role in combining and analysing such multi-variate data within the discipline of Digital Soil Mapping.

Current peatland maps are created using combination of optical satellite remote sensing and legacy soil/quaternary maps. Optical remote sensing cannot detect peatlands under landcover such as forest or grassland. Legacy maps are often created from sparse in-situ augur, borehole, or trial pit data. These types of measurements do not allow for accurate measurement of boundaries or intra-peat variation.

Modern airborne geophysical datasets offer a potential means to update national and local scale peatlands maps. Radiometrics, a geophysical method that measures radiation emitted from geological materials, is particularly suited to peatland studies. Peat is a mostly organic material and so is, generally, not a source of radiation. Peat is also very saturated and water acts to scatter the emitted gamma rays. These effects combined means that peatlands act as a blanket to any source of radiation from below and show as “low” radiometric signal in the landscape.

This study aims to use Airborne Radiometric data combined with modern machine learning classification techniques to examine the current spatial distribution a peatland database in the west of Ireland. The Quaternary Geology database currently maps peatland extent where peat thickness is greater than 1m at the surface and was created using traditional mapping techniques. The methodology shows that a direct measurement, such as radiometric data, analysed in a supervised machine learning framework, provides more accurate and justifiable estimates of peatland extent in this region.

7. IQUA Spring Field Meeting 2022

Archaeology and Landscape History of Neolithic County Sligo, 22–24 April 2022

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It was a hit for the first trip back since Covid-19’s disruption to the annual field meetings! The trip covered archaeology, palaeoecology, palaeoclimatology, and geology at different field sites, focusing on the Neolithic in County Sligo. Those who have missed the trip can find detailed descriptions of the sites visited in IQUA Field Guide No. 36 prepared by the field trip leader Susann Stolze.

This field meeting focused on recent studies carried out in County Sligo that looked at the palaeoecological and archaeological inventories in the Bricklieve Mountains – Lough Arrow region and on the wider Cúil Iorra peninsula region. The latest results of the archaeological investigations at both the Carrowmore and Carrowkeel passage tomb complexes were presented. Multi-proxy palaeoenvironmental studies including pollen, chironomid, and geochemical data conducted in proximity to the Neolithic passage tomb complexes were discussed to examine Neolithic land-use dynamics.

The IQUA members met at the Riverside Hotel in Sligo at 7 pm on the 22nd of April for a brief lecture on the ‘Archeology and the Landscape History of the Neolithic County Sligo’ by Susann Stolze. The Neolithic period marks the arrival of agricultural in Ireland and County Sligo has a high concentration of prehistoric and Neolithic monuments. Sligo also has several geographical features such as lakes, bogs, and mountains that keep a good record of the remains of this early civilization. The abundance of lakes and bogs preserving evidence of human activity (e.g., pollen and chironomids) from this time and the wealth of Neolithic archaeological sites make County Sligo an ideal location to reconstruct Neolithic land-use dynamics and their way of life.

On Saturday morning, the group headed off to explore the Carrowkeel passage tomb complex. The hike started at the car park at the base of the Bricklieve Mountains. The group would stop at cairns C, D, G, and K (Figure 1) and walk past cairns H and X. To everyone’s excitement members were able to go inside cairns G and K (Figure 2)! Pádraig Meehan recounted the archaeological knowledge of

the passage tombs and artifacts found. The site was first excavated in 1911 by R.A.S. Macalister and colleagues (Macalister et al., 1912), who dated the site to the Bronze Age using pottery fragments and assigned a lettering system to the cairns, which is still used today.

Figure 1. Carrowkeel Cairn K of the Carrowkeel passage tomb complex.

Figure 2. Inside cairn G part of the Carrowkeel passage tomb complex.

However, a later study of the human bones recovered by Macalister and colleagues was able to date the burials to between 3400 and 2700 BC (Kador et al., 2018; Meehan and Hensey, 2018). A recent study by Dr. Lara Cassidy of ancient DNA in bones from the passage tomb at Newgrange, County Meath, showed familial relatedness to people buried in Carrowkeel. One Newgrange individual was shown to be the offspring of incest. This was argued by the researchers as evidence of an elite lineage, where incest was acceptable, comparable to such elites in Ancient Egypt or Hawaii. The genetic data from Carrowkeel confirms Anatolian ancestry for the Irish Neolithic; though isotopic evidence shows most of the people buried at Carrowkeel grew up in the region, their remote ancestors had been part of a great migration that brought agriculture from the east (Cassidy et al., 2020).

Once IQUA members had a beautiful view of the horizon (Figure 3), Thomas Monecke spoke to the group about the geology of the region and informed members that the passage tombs were constructed from limestone, however, that there are also strategically placed sandstone rocks that absorbed shock and stabilized the monuments. He presented lovely posters to illustrate that the geomorphology of the region was influenced by former glacial activity, as seen with the drumlins that surround Lough Arrow, moraines, and randomly deposited erratics (Stolze and Monecke, 2021).

Figure 3. IQUA members in the Bricklieve Mountains looking out to the Ox Mountains and overlooking Lough Arrow.

Following lunch at McDermotts Bar and Restaurant in Castlebaldwin, Susann Stolze introduced the results of palaeoecological investigations carried out in a wetland in a valley in Treanscrabbagh Townland. The wetland consists of cut raised bog and surface and groundwater-fed areas. The wetland had been drained in 1946. Due to its proximity to the Carrowkeel passage tombs, several researchers studied the wetland deposits for evidence of Neolithic human activity for the past seventy years. Susann Stolze investigated the pollen content of lake sediments and peat layers that formed at Lough Availe located in Treanscrabbagh Valley and found that this site was possibly a lake during the Neolithic and thus a water source for the tomb builders (Stolze, 2021)!

Martin A. Timoney contributed local knowledge about the site, pointing out some circular depressions in the hillside at the entrance in Treanscrabbagh to the Carrowkeel valley. There are about two hundred close together nearby to the east in Cloghoge Lower. These depressions have been considered to be naturally occurring or man-made.

Timoney is more in favour of man-made as they appear to come in two sizes and similar depressions are rarely, if ever, found elsewhere. He mentioned other features elsewhere which occur in large numbers that he has published, namely the rectangular earthworks at Aughris, Portavaud, Lackan, Co. Sligo, and Kilcummin, Co. Mayo (Timoney, 2002) and also the pitfields of mid-north Roscommon (Timoney, 2009) which have recently been proven with absolute certainty by excavations on the new N5 road northwest of Strokestown, Co. Roscommon, to be man-made. There was no clear evidence for their use and dating is forthcoming, but they are certainly man-made. The Irish countryside has many problems to be solved, and these are just three of them.

The final stop on Saturday was at Loughbrick Bay of Lough Arrow. Susann Stolze introduced the field trip attendees to palaeoecological research carried out at the study site. In the past, Loughbrick Bay was a separate body of water from Lough Arrow. The bay was chosen for coring to study Neolithic vegetation dynamics and farming activities in the area (Stolze and Monecke, 2021). Susann Stolze and colleagues were able to retrieve a 10 m sediment core. Initially, she stained the sediments with Calberla's solution to create a 'smear slide' for quick pollen counting. This technique enabled her to easily locate palynological features typical for Neolithic deposits in the area such as the decline in elm pollen and select the core sequence that formed during the Neolithic period. She presented a poster with the smear slide pollen count to a full pollen count to display the technique. A multiproxy-analysis was conducted on a 90-cm long core segment. Pollen data placed the elm decline around 3800 BC, nearly two hundred years later than in the Bricklieve Mountains (Stolze and Monecke, 2021). Cereal pollen (wheat/barley) started to occur in 3750 BC. The cereal pollen record suggests that cereal farming at Loughbrick Bay was practiced for a longer period of time than at nearby study sites (Stolze and Monecke, 2021). There was a decline in human activity around the Mid-Neolithic, which may have been caused by a combination of climatic and biotic factors.

After a beautiful day outside, several field trip members met for dinner at Hooked in Sligo town.

On Sunday morning, the group met Sam Moore who introduced us to the Early Neolithic causewayed enclosure at Magheraboy. He stepped in for Ed Danaher who unfortunately could not attend the trip. Sam Moore provided everyone with a printed handout to better imagine the prehistorical site. Activity at the causewayed enclosure began in 4115–3850 BC. Although causewayed enclosures are definitively Neolithic, these dates, while early, are not particularly controversial. Charred hazelnut and hazel charcoal found in Rathquarter pit complex date to 4230–3960 BC and 4240–3990 BC respectively, suggesting a general trend of early Neolithic dates in Sligo (Danaher, 2007). Moore also shared with the group a new, still unpublished discovery of a Neolithic House that dates to earlier Neolithic life based on hazel charcoal. No cereal seeds were found, although there were charred seeds, indicating a potential small group of early farmers. The series of pits on site show evidence of being dug up and back filled with new debris and artifacts. This action may be as a ritual for remembering a person or family as the actions are believed to be intentional due to the artifacts' unique placements of unfired pottery, purposely broken tools, and quartz. The boundary of the site was also not defensive but seems to be more like a sanctuary boundary for religious rituals.

The following stop had members heading off to the Carrowmore passage tomb complex (Figures 4, 5) to meet head guide Austin McTiernan. He explained that the monuments had a numbering system applied by antiquarians. Some sites had suffered damage, with, for example, cairn material at one carried off to build colonial-era field walls, roads, and other structures. The largest cairn (Carrowmore 51; Figure 4) was reconstructed in 2004 to 'cover' the passage tomb; there is a walkable 'passage' into the tomb. Carrowmore 51 (Listoghil) is dated from bone to c. 3500 BC. Some of the smaller sites at Carrowmore may be more than 200–300 years older, from a dating project using bone pins. Tomb 51 is also the central tomb, with all the others being orbital and their passages pointing to 51. This tomb also has a chamber illuminated with the sunlight on October 31 and February 10, which correlates with Gaelic feast days at Samhain and Imbolc. The capstone is angled at 6-degrees slanted toward the rising sun, which contributes to this effect. There is also geometrical art on this tomb in the form of spirals. It is hard to know for sure the amount of people buried on site due to earlier excavations and grave robbers, although there is evidence there could be between 7–12. Carrowmore was dated in the twentieth century using charcoal, but this method is regarded today as unreliable. The old charcoal on the site might not be directly associated with the monuments as it might indicate forest fires or Mesolithic activity on the site.

Figure 4. Listoghil (Carrowmore tomb 51).

Figure 5. Tomb 3 of the Carrowmore passage tomb complex.

The final stop of the field meeting was at Lough Dargan (Figure 6) where Aaron Potito discussed the usage of chironomids to reconstruct past environments, which Karen Taylor, who was unable to attend, had conducted in collaboration with him. He presented a poster that showed how non-biting midge flies (also known as chironomids) are identified by their teeth. It is possible to use this family as a record of lake histories because they live most of their entire lifecycle at the bottom of lakes and respond to changes in water chemistry and temperature. One lake can host over fifty chironomid species that will outcompete one another under different temperatures and trophic conditions.

Lough Dargan is a mostly stagnant lake, allowing good sedimentation, and has a water depth of 10 m. The 7.5-m long lake core had nearly 2 m of Neolithic – Bronze Age material.

They were able to determine land-use intensity and if the lake would recover after its intensification by using chironomid analysis and comparing the results with a pollen record from the same site (Taylor et al., 2013).

Figure 6. Lough Dargan with ruins of Dargan castle in the background.

They found that the Neolithic land use did cause a change in the chironomid community, but the lake recovered, while a major disturbance occurred during the Bronze Age which showed a more permanent change. Chironomids sampled from multiple lakes can help determine if changes in the lake record were from localized human impacts (i.e., farming) or climate. If increased productivity is only apparent at the farming site, then it is like not due to regional climatic changes (Taylor et al., 2017).

Acknowledgments

I would like to thank Pádraig Meehan, Thomas Monecke, Aaron Potito, Susann Stolze, and Martin A. Timoney for their edits and suggestions to improve this report.

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8. Recent Graduates

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PhD completed in March 2022

Niche construction and plant-use in the Mesolithic

In Britain and north-west Europe, the human-plant interactions of Mesolithic hunter-gatherers have been the focus of debate and study for nearly 60 years. The archaeobotanical and pollen records from these regions suggest that Mesolithic people actively constructed their own niches through the use and possible management of wild plants, and by creating and maintaining woodland clearances to increase their control over animal and plant resources. Recently, it was suggested that Mesolithic people in Ireland may have created their own niches through similar practices, but this hypothesis has not been tested. This project examines the human-plant interactions of Mesolithic people in Ireland and their environmental impacts through a systematic and critical review of the archaeobotanical evidence from Irish Mesolithic sites, as well as palynological investigations in the vicinity of three areas known to have been occupied in the Mesolithic: Derragh Island, Co. Longford; Eleven Ballyboes, Co. Donegal; and Frosses Bog, Co. Antrim. Overall, the archaeobotanical evidence from Mesolithic Ireland confirms that a wide range of trees, herbaceous plants, and wetland and aquatic taxa were potentially exploited for food, medicine and other uses. Charcoal and wood from these contexts attest to the fact that a broad spectrum of trees and shrubs were utilized for fuel, for constructing platforms, and for making fishing equipment and other artefacts. In some instances, certain taxa appear to have been specifically targeted for their burning or physical properties (e.g. oak for fuel, alder and hazel shoots for fish traps), but for some purposes plant-use was seemingly non selective (e.g. platforms). However, limitations in the archaeobotanical datasets and taphonomic factors have prevented the formulation of unequivocal interpretations regarding the absolute scale of hunter-gatherer plant-use/management in Ireland. Consequently, the environmental impacts of such practices could not be adequately determined. The pollen record highlights that even when plants were used on a repeated basis for food, fuel and timber, the

activity had little impact on local vegetation. One episode of woodland disturbance was noted in the pollen record, hinting at the possible opening up of woodland, perhaps to attract wild boar. Yet, evidence for this practice in Ireland is, at best, equivocal. Compared to Britain and north-west Europe, signs of woodland disturbance in Mesolithic Ireland are relatively rare. It seems, therefore, that hunter-gatherers in Ireland did shape their environment through the utilisation of wild plants, but not to the same extent as their British and north-west European counterparts, nor to such a degree to have left a clear signature in the pollen record.

9. Research Reports

Towards a late glacial history of the Burren: "Quantifying Ireland's Dust-bowl." (GSI short call 2020: 2020-sc-021)

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The Burren needs little introduction, with its karst landscape characterised by an absence of soil; it also has a wealth of glacial features and has been termed "glaciokarst". However, the interplay and chronology of these two processes is poorly understood. Even dating the end of the last ice cover has been difficult due to the scarcity of suitable rock types for modern dating techniques; but recent work is changing that. We now have four new beryllium-10 (^{10}Be) exposure ages from the Burren, two from granite erratics perched on bedrock and two from quartz rich hydrothermal veins, all indicating deglaciation between 18 and 17 ka. This chronology is supported by similar dates from Connemara and the Aran Isles presented recently by Foreman et al (2022). In the Burren, there is also another type of geochronology that can be used: U-Th dating of speleothem growth. In 1995, Dr. Frank McDermott of UCD published data showing that growth of the IR5 speleothem in Poulnagollum cave started at 17.97 ka (McDermott and Swabey, 1995), indicating that at this time the area was ice free and had sufficient soil development to promote limestone dissolution. Together these dates provide an incredible cluster of ages considering that they are based on different methodologies and different rock types. But what happened after c.17 ka?

A chironomid study at Fiddaun in South County Galway (Asch et al., 2012) suggests that the climate improved between 14.5 and 11.5 ka, with summer temperatures estimated to range between 13°C and 14°C. This was followed by the Younger Dryas, when average annual temperatures dropped briefly prior to the Holocene; but what about the 17–14.5 ka period?

Evidence of a former soil cover in the Burren was presented by Drew (1983), based on analysis of karren features found on the limestone pavements and fragments of mineral soil found under some Neolithic and Bronze age monuments. However, as we now know that the Burren was ice free by 17 ka, and that the ultra-pure Burren limestone leaves little residue after weathering that could form soil, it is unlikely that a soil cover could have formed solely from the bedrock. An extra ingredient is needed and one possibility is that there has been an input of loess immediately following deglaciation.

Loess can be broadly defined as a terrestrial sediment dominated by silt which has been transported and deposited by wind (Muhs, 2013). It is commonly formed as 'rock flour' from glacial 'grinding'. Loess arguably forms one of the key global, terrestrial paleoarchives of climate change (Li et al., 2020) with the potential to preserve high resolution records of paleoclimate and paleoenvironment. It is dominated by silt size particles (4–63 microns), but sand and clay also contribute to the particle size distribution; the proportion of these components is varied and gives further information about the palaeoenvironment. The chemical composition of loess reflects the source rocks that the sediment originated from, the transport processes, and any pedogenesis occurring after deposition but loess generally has a silica content between 40 and 80%. In Europe loess forms a broad belt with thicknesses up to 40 m in the east but generally it thins to the west; in the UK deposits of loess up to 4 m thick have long been recognised on the coast of Kent but since the 1970s the more widespread presence of thin loess deposits has also been recognised in many parts of the country (Bunce et al., 2022). However, it has not been formally recognised in Ireland before.

Here we describe one Burren location that shows a loess like deposit and may reveal the entire post last glacial development of the Burren. Poll Berrin is an oval shaped doline with a diameter of ~ 250 m (Figure 1) located on the col between Dobhach Bhrainin (above Black Head) and Gleninagh Mountain, it is named on Tim Robinson's map of the Burren.

Figure 1. Poll Berrin.

The rim of the doline is at an altitude of 220 m with the almost flat floor covered with grass and silverweed 25 m lower; there are cliffs on the east and west sides and grassy rock-strewn slopes on the north and south sides probably composed of till. Two soil pits have been dug near the centre of the depression both revealing ~ 70 cm of light brown, non-calcareous silt, becoming more clayey with depth, which overlies 30 cm of light grey, laminated, calcareous clays resting on a calcareous till (Figure 2).

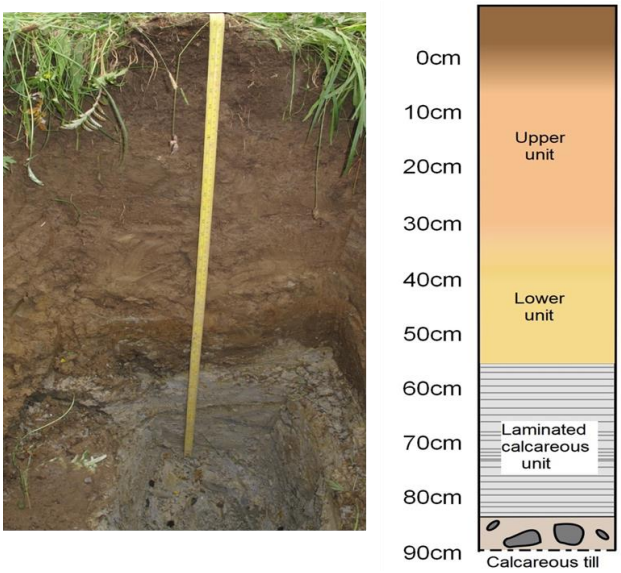

Figure 2. (a) Soil pit at Poll Berrin, (b) pit profile at same location.

Particle size analysis of the silts carried out at NUIG by Geography PhD student Marta Cabello has given the results shown in Table 1. Similar output has been recorded for many other locations across the Burren and reveal a remarkable consistency in the grain size and stratigraphy of these deposits.

X-ray florescence (XRF) analysis has been carried out on these silts at the Earth Surface Research Laboratory in TCD. Results for the major oxides are shown in Table 2, note the low level of CaO and the high level of SiO_2 for a deposit in an area surrounded by limestone which would indicate this deposit is not derived from the underlying bedrock. Again, very similar results have also been found in other similar deposits across the Burren.

Table 1 **PSD Poll Berrin**	Upper silty unit	Lower clayey silt unit
Mean µm	28	19.5
Mode µm	9.24	7.02
Clay (% vol)	9	8.7
Very fine & fine silt (% vol)	24.7	33.7
Medium silt (% vol)	30.7	37.3
Coarse & very coarse silt (% vol)	20.6	14.7
Total silt content (% vol)	**76%**	**85.7%**
Sand (% vol)	16	6.2
1mm plus (% weight)	0.21	0.16

Table 2 **XRF Poll Berrin**	Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2
Upper silty unit	14.25	0.72	4.77	2.17	0.96	0.27	0.54	0.35	63	0.96
Lower clayey silt unit	14.43	0.73	4.44	2.73	1.28	0.09	0.57	0.18	62.5	0.88

These deposits also contain grains of the mineral zircon that rarely occur in limestones but which are common in loess deposits. Zircons can be dated because they contain tiny amounts of uranium, thus allowing us to construct an age profile for various deposits that can help identify their source area. Dr. Martin Nauton-Forteu (NUIG) has already picked almost 400 individual zircons from a number of samples of these Burren silts and more are in progress. The zircon ages have been established by Dr. David Chew (TCD), with Dr. Shane Tyrrell (NUIG) recognising a very strong correlation with the age profile of the Upper Carboniferous sediments of West Clare as seen at The Cliffs of Moher.

Loess grains are commonly formed by glaciers crushing rock grains into silt-sized dust that often have a tabular or blade shape (Smalley et al., 1973). These particles are then transported in the air in suspension so they lack the edge-rounding and ‘frosted’ texture so characteristic of wind-blown sand grains (Rousseau, 2018). Individual grains were separated from a number of the Burren deposits and examined using an SEM at NUIG. These Burren grains typically have an angular shape with some showing a flat, platy appearance, conchoidal fractures (the result of glacial crushing) are common, parallel striations can also be seen; however, V-shaped percussion marks (another characteristic of loess grains) have not been recognised.

Loess deposits vary across the world but typically they contain 60–90 % silt-sized particles, have quartz as the most common mineral at 40–80 %, with the grains having a particular appearance, in the Burren we are finding this type of material in isolated but distinct units across the area; so, these Burren silts have all the characteristics of loess!

At the base of both soil pits dug at Poll Berrin we have found calcareous till which we can now probably date to about 18 ka, these deposits show the doline was present prior to the last ice advance. Overlying the till are laminated sediments (Figure 3), similar to varves, which must have formed in a small lake – maybe a temporary summer melt lake immediately following the melting of the ice. Examination of this unit for pollen by Dr. Karen Molloy (NUIG) has shown it to be almost barren, indicating a tundra like environment. Similar late glacial varve-like deposits have been described in Poll an Ionian cave (now called Doolin Cave) by Collingridge (1960). The overlying loess-like deposits are divided into two sub-units, at this location the contact between them is not clear but at another location there is a thin, pale grey layer that may be a paleo-soil horizon. We posit the lower more clayey unit is a remnant of a more widespread original air-fall loess deposit indicating that at least part of the period between 17 and 14.5 ka was characterised by seasonally dry, periglacial conditions conducive to dust entrainment and transport. The overlying, clay-poor silt unit contains charcoal dating to c. 3 ka; our current working hypothesis is that this unit represents extensive reworking of the original in-situ loess cover during the Bronze age, as postulated by several authors, most recently Spencer et al. (2021).

Figure 3. Push auger core of laminated unit, barrel width 20 mm.

A number of other dolines across the Burren show similar stratigraphies, but two dolines near Carran in the centre of the Burren show the loess-like deposits overlying an un-bedded calcareous clay, which in one case is at least 2 m thick. The key to fully understanding these deposits will be dating and we are working with Dr. Kathryn Fitzsimmons of Tübingen University in Germany on OSL dating, which can quantify how long some terrestrial sediments have been buried. We are also working with Dr. Tom Stevens of Uppsala University in Sweden on analysis of the magnetic fabric of these sediments and his initial results are confirming the idea that the upper unit has been reworked.

Special thanks to Marta Cabello, Martin Nauton-Forteu, Shane Tyrrell, Karen Molloy and Eadaoin Timmins at NUIG; as well as David Chew in TCD and the GSI for funding. We also thank Anne Pilkington for access to the site.

Project website address:
https://sites.google.com/view/burren-loess/home

Poster:
https://www.gsi.ie/documents/Bunce_IGRM2022.pdf

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10. Announcing a New Institute for Heritage and Environmental Science at Queen's University Belfast

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Archaeology-Palaeoecology at Queen's University Belfast (QUB) has recently been successful in securing a combined £5.1M investment for state-of-the-art equipment, leading to the establishment of new Institute for Heritage and Environmental Science. Funding includes a £2.1M equipment upgrade for the AMS at the 14CHRONO Centre from the Department for Environment Northern Ireland, and a £3M grant from the UK Research and Innovation and Arts and Humanities Research Council (UKRI-AHRC) Capability for Collections scheme and World Class Labs Fund, together supporting investment for the expansion and upgrade of research infrastructure in Archaeology-Palaeoecology and associated centres in the Schools of Maths & Physics and Biological Sciences (see below for list of new equipment). Researchers at QUB hope the equipment will attract users from across the island of Ireland and stimulate collaborative research in the fields of archaeological science and geosciences. For queries about access, potential applications or further knowledge, please contact Dr. Patrick Gleeson (p.gleeson@qub.ac.uk) or Dr. Maarten Blaauw (m.blaauw@qub.ac.uk).

- **Ionplus Gas Interface**: This interface is used for radiocarbon dating very small samples (e.g., just 6 fibres of a canvas), and facilitates minimal damage to collections when researching date, provenance or authenticity.
- **ELEMENTAR PrecisION IRMS**: Linking an IRMS with ^{14}CHRONO's recently developed ramped pyrolysis/pyroxidation system (RPO) enables live $\delta^{13}C$ readings, allowing better interpretation of the ^{14}C measurements of different temperature fractions for mortar dating and separation of preservatives from museum objects.
- **SERCON HS2022 IRMS**: An EA-IRMS for measuring C, N, S, H and O isotope values, and fundamental to assessing date reliability via C/N ratios.
- **ThermoFisher iCAP LA TQ ICP-MS**: The triple quadrupole (TQ) inductively coupled plasma mass spectrometer facilitates a wider range of isotope characterisation (e.g., ^{204}Pb & $^{87}Sr/^{86}Sr$, down to three decimal places). Interfacing with Ion Chromatography and Laser Ablation, to enable quantification of key elements (Fe, S and Ti) and rare earth elements, for source fingerprinting.
- **Ortec Alpha Counters**: Alpha counters facilitates ^{210}Pb dating of recent horizons in environmental samples (i.e., last 150–200 years).
- **ThermoFisher ATR FT-IR**: Fourier-transform infrared spectrometry (FTIR) is more generally used to explore and carry out organic/inorganic characterisation of archaeological artefacts or associated residues. More specifically, it will be used to measure the crystallinity index of cremated bone to select suitable candidates for dating, to characterise mortar or other samples, or to identify conservation or other material on artefacts/samples that can affect radiocarbon dates.
- **JOEL JXA-iHP200F Electron Probe Micro Analyser (EPMA)**: The EPMA allows geochemical fingerprinting and offers the only regional dedicated facility for the geochemical characterisation and provenancing of meteorites, rocks and minerals from natural history collections, and stone, ceramic, glass and glass glazes from archaeology collections (additionally, this item has an SEM-EDX). Expected installation date: late 2022/early2023.
- **BRUKER XRF**: Helium Purge M4 Tornado Micro-XRF facilitates X-Ray Fluorescence with spatial resolution, particularly 2D distribution of elements on samples (artefact, geological sample, or corrosion) key for research and conservation of collections. A large

chamber allows samples up to 5 kg and 30 cm long, allowing large areas to be measured quickly.

- **BRUKER Handheld Tracer 5 pXRF**: The Tracer 5 pXRF has a graphene window with higher transmission of X-rays throughout the energy spectrum to improve the transmission for light elements: this makes for better readings and more accurate, quicker data.
- **BRUKER Portable 2D Micro-XRF ELIO**: A fully portable Micro-XRF mapper, which permits 2D elemental mapping of very large and/or stationary specimens that cannot be brought into a lab or moved.
- **HOLOGIC X-Ray**: The UltraFocusXL detector allows analysis of substantial objects (e.g., human bones, metal objects) within a 50 x 50 cm chamber.

11. INQUA Roma 2023

Many IQUA members have organised sessions at INQUA 2023 in Rome, Italy.

Session 23: Mountain dynamics: From the Quaternary to the Anthropocene

Conveners:

Jasper Knight, University of Witwatersrand, South Africa, jasper.knight@wits.ac.za, (lead convener)

Stephan Harrison, University of Exeter, UK

Scientific theme 2B: Glacial and periglacial geomorphology

INQUA commission(s): TEPRO-Terrestrial Processes, Deposits and History; SACCOM-Stratigraphy & Chronology

Abstract: This session examines the dynamics of mountain systems under climate change and brings together new data and case studies in order to examine the responses of these systems to past and present climate change. The session is specifically concerned with sediment and geomorphic system processes, landforms and dynamics; and cryosphere (glacial, periglacial, paraglacial) processes, landforms and dynamics, that take place in both glaciated and non-glaciated mountains worldwide. Particular focus is paid to the role of climate forcing in mountain dynamics, under Quaternary climate phases and/or under present global warming of the Anthropocene.
Contributions are invited to this session based on field, remote sensing and modelling case studies from mountains worldwide. An outcome of this session is to develop a better understanding of mountain systems, their sensitivity to climate forcing, and their variable expressions in mountain landscapes.

Session 24: Fluid venting as a submarine geomorphic process

Conveners:

Daniele Spatola, Sapienza University, Rome, Italy, daniele.spatola@uniroma1.it, (lead convener)

Daniele Casalbore, Sapienza University, Rome, Italy

Aaron Micallef, University of Malta, Malta Christian Gorini, Sorbonne University, France

Daniel Praeg, Géoazur (CNRS UMR7329), France

Scientific theme 2A: Geomorphic processes and sedimentary record

INQUA commission(s): CMP-Coastal & Marine Processes

Abstract: Fluids including gas trapped within and underneath of sedimentary multilayers can move upwards to surface at discrete locations due to buoyancy. The process of “fluid venting” is a global phenomenon recognized in different geodynamic contexts, giving rise to diverse seabed morphologies (e.g., pockmarks and mud volcanoes) and to a range of associated geological, geochemical and biological phenomena. There are two main types of fluid seepage: (i) “cold seeps” characterized by low temperature fluid emissions and (ii) hydrothermal vents where fluids emerge at temperatures between 200–400°C. Marine geophysical data of varying frequency content may reveal the occurrence of gas in the water column (plumes), and below the seabed as acoustic anomalies including focused or diffused acoustic turbidity and blanking, bright spots, high-amplitude reflections, chimney or pipe structures, and bottom simulating reflectors (BSRs) associated with gas hydrate. This session aims to explore the role of active submarine fluid flow and venting: (i) as a geomorphic process and how it shapes the seafloor; (ii) as a potential marine geohazard, and (iii) as a driver of biological processes. Contributions are invited from any offshore region, from continental shelves to abyssal plains, based on multi-scale datasets including hydro-acoustic imagery, 2D/3D

seismic reflection data, samples and ROV observations.

Session 69: Quaternary palaeolandscape, palaeoclimatic and palaeoenvironmental change in the North Sea

Conveners:

Ruth Plets, Flanders Marine Institute, Belgium, ruth.plets@vliz.be, (lead convener)

Víctor Cartelle, Flanders Marine Institute, Belgium

Simon Fitch, University of Bradford, UK

Marc Hijma, Deltares, Netherlands Amy McGuire, University of Leeds, UK

Sytze van Heteren, Geological Survey of the Netherlands, Netherlands

Scientific theme 5B: Palaeogeographic, palaeoclimatic, palaeoceanographic and palaeoecological changes in marine and terrestrial systems

INQUA commission(s): CMP-Coastal & Marine Processes

Abstract: The Quaternary history of the North Sea has been one of continuous and often rapid change. Owing to its geological history, the preservation and lithology of Quaternary sediments are hugely variable throughout the North Sea region, almost absent in the South and more than 1 km in the North. Across the basin, these sediments and associated geomorphological features record the advance and retreat of ice sheets, changes in relative sea level, different successions of terrestrial/fluvial, intertidal and marine environments and evidence of Palaeolithic and Mesolithic human occupation. Academic research and commercial surveys (mostly for windfarm development) have resulted in new and usually high-resolution data sets that are revealing the diversity of environments preserved within the seabed in ever more detail. This session aims to bring together the multidisciplinary Quaternary North Sea community (marine geologists, geomorphologists, archaeologists, palaeoenvironmentalists, modelers, engineers, etc) to discuss recent advances and future opportunities. It will explore recent progress in reconstructing the complex Quaternary history of the dynamic North Sea environment through the synthesis of sedimentary, seismic, and geoarchaeological records of landscape and environmental change. It is timely that results are being shared and interpretations from local studies are linked to better understand the wider regional-scale evolution of the North Sea.

Session 120: Volcanic impacts on climate and society

Conveners:

Kevin Anchukaitis, University of Arizona, USA, kanchukaitis@arizona.edu, (lead convener)

Michael Sigl, University of Bern, Switzerland

Francis Ludlow, Trinity College Dublin, Ireland

Celine Vidal, University of Cambridge, UK

Allegra LeGrande, NASA GISS, USA

Matthew Toohey, University of Saskatchewan, Canada

Scientific theme 5: Climate record, processes and models

INQUA commission(s): PALCOM-Palaeoclimates; HABCOM-Humans & Biosphere

Abstract: Volcanic eruptions can inject large amounts of material into the atmosphere, which affects the Earth's climate system and human societies on across a range of spatial and temporal scales. This session will highlight novel results and insights emerging from interdisciplinary and collaborative efforts on the interactions between volcanic eruptions, climate variability and change, extreme events in the Earth system, and the history and archaeology of human society. We invite contributions focusing on one or more of the following topis: reconstruction of the climate and environmental consequences following eruptions, the effects imprinted in individual proxy records as well as proxy compilations, the analysis of volcanic effects using climate modeling experiments, and interdisciplinary research that seeks to understand how and to which extent volcanic eruptions contributed to shaping past societal changes.

Session 136: Understanding volcanic impacts through physical and chemical signatures in ice cores: advances, challenges and opportunities

Conveners:

Gill Plunkett, Queen's University Belfast, Northern Ireland, UK, g.plunkett@qub.ac.uk, (lead convener)

Siwan Davies, University of Swansea, UK

Andrea Burke, University of St Andrews, UK

Michael Sigl, University of Bern, Switzerland

Joe McConnell, Desert Research Institute, USA

Scientific theme 5C: Past global climate records in polar and mountain ice

INQUA commission(s): PALCOM-Palaeoclimates

Abstract: Polar ice cores comprise an unparalleled record of past volcanism through their highly resolved records of volcanic chemistry and particulates. Establishing the provenance of volcanic signals in the ice can presently only be achieved through the geochemical characterisation of co-registered volcanic ash (fine-grained tephra). Pinpointing the source can provide greater insight into the nature of the eruption (e.g., its magnitude, duration, column height), if known, and also enables informed estimates of stratospheric sulphate loading, and hence volcanic forcing potential, based on the relationship between the volcano location and sulphate deposition flux in the ice cores. The analysis of heavy metal and isotope signatures can help constrain further eruptive parameters as well as aerosol transport pathways, critical for differentiating the relative climatic forcing of these volcanic emissions. This session invites contributions that illustrate recent progress and innovations in the analysis of volcanic signals in polar ice cores, particularly with respect to reconstructing past climatic and societal impacts of volcanic eruptions. We welcome also presentations that highlight remaining challenges and possible solutions in isolating, analysing and interpreting the significance of ash particles and chemical signatures in ice cores.

Session 157: Peatlands through time: developmental dynamics and palaeoenvironmental reconstruction

Conveners:

Paul J. Morris, School of Geography, University of Leeds, United Kingdom, P.J.Morris@leeds.ac.uk, (lead convener)

Malin Kylander, Department of Geological Sciences and the Bolin Centre for Climate Research, Stockholm University, Sweden

Angela Gallego-Sala, Department of Geography, University of Exeter, UK

Jenny Sjöström, Department of Geological Sciences and the Bolin Centre for Climate Research, Stockholm University, Sweden

Graeme Swindles, School of Natural and Built Environment, Queen's University Belfast, UK

Scientific theme 5B: Palaeogeographic, palaeoclimatic, palaeoceanographic and palaeoecological changes in marine and terrestrial systems

INQUA commission(s): TERPRO-Terrestrial Processes, Deposits and History;

Abstract: Peatlands store vast amounts of soil carbon, and have played an important role in the Earth's climate system during the Quaternary. Stratigraphic records from peatlands provide valuable sources of information about the development of these ecosystems, the surrounding landscape, and local and regional climates. The peat palaeoenvironmental archive has been investigated using a wide variety of techniques, including biological, geochemical, geophysical and modelling techniques. Ample material for radiocarbon dating means that peat records often provide chronologically well-constrained archives of past changes in (for example) peatland vegetation, hydrological conditions, and atmospherically-derived pollen, tephra, charcoal, pollution and mineral dust. This broad session aims to bring together the latest ideas and advances across peatland Quaternary science, including the past development of these important ecosystems, and the rich variety of palaeoenvironmental records they provide. We welcome contributions from all areas of peatland Quaternary science, including field, laboratory, modelling and data-synthesis approaches. Suitable topics may include – but are not limited to – paleoecology, palaeohydrology, palaeoclimate reconstruction, carbon and/or nutrient cycling, geochemistry, past fire regimes, and novel analytical approaches. We welcome studies of peatlands in any and all geographical areas, from the tropics to the middle and high latitudes of both hemispheres.

Session 169: Quaternary Proglacial Lakes: Sediments, Landforms, Impacts

Conveners:

Cathy Delaney, Manchester Metropolitan University, UK, c.delaney@mmu.ac.uk, (lead convener)

Kathryn Adamson, Manchester Metropolitan University, UK

Adrian Palmer, Royal Holloway, University of London, UK

Renata Giulia Lucchi, National Institute of Oceanography and Applied Geophysics (OGS), Trieste, Italy

and UiT, The Arctic University of Norway, Tromsø, Norway, rglucchi@ogs.it, Universiteit Gent, Belgium

Matthew Carney, Manchester Metropolitan University, UK

Scientific theme 2A: Geomorphic processes and sedimentary record

INQUA commission(s): TERPRO-Terrestrial Processes, Deposits and History; SACCOM-Stratigraphy & Chronology

Abstract: Proglacial lakes are, and have been throughout the Quaternary, a fundamental component of the cryosphere. They impact on glacier/ice sheet, meltwater and groundwater dynamics, sediment flux, and local, regional and global climate. Ice-contact lakes alter ice sheet and glacier behaviour, changing ice flow dynamics, ice retreat rates and trajectories, and are increasingly included in computer-based modelling of past and future ice sheet evolution. Both ice-contact and distal, glacier-fed lakes act as sediment sinks and contain a high-resolution record of sediment and meltwater inputs, which can be interrogated using physical, biological and geochemical proxies. For this session, we invite presentations on all aspects of ice sheet, glacier and environmental reconstruction using proglacial lake archives, including sedimentological and geomorphological records. Of particular interest are presentations focusing on the application of these records to model the impact of ice- contact lakes on ice sheet and glaciers through time.

11. Recent Publications

Adamson, K., Lane, T., Carney, M., Delaney, C., Howden, A. 2022. The imprint of catchment processes on Greenlandic ice cap proglacial lake records: analytical approaches and palaeoenvironmental significance. *Journal of Quaternary Science*, https://doi.org/10.1002/jqs.3423.

Arsenault, J., Talbot, J., Brown, L.E., Holden, J., Martinez-Cruz, K., Sepulveda-Jauregui, A., Swindles, G.T., Wauthy, W., Lapierre, J.-F. 2022. Biogeochemical distinctiveness of peatland ponds, thermokarst waterbodies and lakes. *Geophysical Research Letters* 49, e2021GL097492.

Delaney, C. 2022. The development and impact of an ice-contact proglacial lake during the Last Glacial Termination, Palaeolake Riada, central Ireland. *Journal of Quaternary Science,* https://doi.org/10.1002/jqs.3412.

Fewster, R.E, Morris, P.J., Ivanovic, R.F., Swindles, G.T., Peregon, A.M., Smith C.J. 2022. Imminent loss of climate space for permafrost peatlands in Europe and Western Siberia. *Nature Climate Change* 12, 373–379.

Giglio, C., Benetti, S., Plets, R.M.K., Dunlop, P., Ó Cofaigh, C., Sacchetti, F., Salomon, E. 2022. Character of advance and retreat of the southwest sector of the British-Irish Ice Sheet during the last glaciation. *Quaternary Science Reviews* 291, 107655.

Jensen, B.J., Davies, L.J., Nolan, C., Pyne-O'Donnell, S., Monteath, A.J., Ponomareva, V., Portnyagin, M., Booth, R., Bursik, M., Cook, E., Plunkett, G., Vallance, J.W., Luo, Y., Cwynar, L.C., Hughes, P., Pearson, D.G. 2021. A latest Pleistocene and Holocene composite tephrostratigraphic framework for northeastern North America. *Quaternary Science Reviews* 272, 107242.

Knight, J. 2022. Geomorphology and landscapes of the Limpopo River system. In: Eckardt, F. (ed.) Landforms and Landscapes of Botswana. Springer, Switzerland, 287–298.

Knight, J. 2022. Multiple drivers of Late Holocene paraglacial sediment reworking in Ireland. *Boreas* 51, 136–148.

Knight, J., Abd Elbasit, M.A.M. 2022. Characterization of coastal sediment properties from spectral reflectance data. *Applied Sciences* 12, 6826.

Knight, J., Burningham, H. 2022. A morphological classification of coastal forelands, with examples from South Africa. *Geomorphology* 415, 108410.

Knight, J., Evans, M. 2022. Characterising the dynamics of river systems: An example of the Sabie River, South Africa. *Koedoe* 64, a1700.

Knight, J., Fitchett, J.M. 2022. Issues of measuring and interpreting wind direction. *South African Geographical Journal* 104, 35–52.

Knight, J., Harrison, S. 2022. Climate sensitivity and cryospheric systems. In: Haritashya, U.K. (ed.), Treatise on Geomorphology, 2nd edition, Vol. 4, Academic Press, Oxford, 616–628.

Mackay, H., Plunkett, G., Jensen, B.J.L., Aubry, T.J., Corona, C., Kim, W.M., Toohey, M., Sigl, M., Stoffel, M., Anchukaitis, K.J., Raible, C., Bolton, M.S.M., Manning, J.G., Newfield, T.P., Di Cosmo, N., Ludlow, F., Kostick, C., Yang, Z., Coyle McClung, L., Amesbury, M., Monteath, A., Hughes, P.D.M., Langdon, P.G., Charman, D., Booth, R., Davies, K.L., Blundell, A., Swindles, G.T. 2022. The 852/3 CE Mount Churchill eruption: examining the potential climatic and societal impacts and the tim-

ing of the Medieval Climate Anomaly in the North Atlantic region. *Climate of the Past* 18, 1475–1508.

Mandishona, E., Knight, J. 2022. Feedbacks and trade-offs in the use of wetland ecosystem services by local communities in rural Zimbabwe. *Sustainability* 14, 1789.

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O'Connell, M. 2022. Bog-deal in Co. Clare, with particular reference to bog-pine and its significance. *The Other Clare* 46, 9–17.

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Plunkett, G., Sigl, M., Schwaiger, H., Tomlinson, E., Toohey, M., McConnell, J.R., Pilcher, J.R., Hasegawa, T., Siebe, C. 2022. No evidence for tephra in Greenland from the historic eruption of Vesuvius in 79 CE: Implications for geochronology and paleoclimatology. *Climate of the Past* 18, 45–65.

Quik, C., Palstra, S.W.L., van Beek, R., van fer Velde, Y., Candel, J.H.J., van der Linden, M., Kubiak-Marterns, L., Swindles, G.T., Makaske, B., Wallinga, J. 2022. Dating basal peat: the geochronology of peat initiation revisited. *Quaternary Geochronology* 72, 101278.

Stolze, S. 2022. Archaeology and Landscape History of Neolithic County Sligo. 2nd ed. IQUA Field Guide No. 36, Irish Quaternary Association, Dublin.

Sun, C., Plunkett, G., Wang, L., Mingram, J., Han, J., Chu, G., Liu, J. 2022. Four widespread East Asian tephra marker horizons during early MIS 3:~ 60–50 ka tephrostratigraphy of Huguangyan Maar Lake, southern China. *Quaternary Science Reviews* 279, 107389.

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