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Editor: Susann Stolze

1. Editor's Note

Dear IQUA members,

Welcome to IQUA newsletter No. 66.

This issue of the IQUA newsletter features news and updates from our society. This includes the abstracts of the IQUA Spring Symposium held as a virtual meeting in April 2021, brief summaries of new initiatives by IQUA members, and updates on several research projects conducted in Ireland.

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

Kind regards,

Susann Stolze, CSM, Colorado, August 2021
(sstolze@mines.edu)

2. Cúpla Focal

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

Another strange summer has gone by, marked by a mix of optimism following the easing of COVID restrictions, and some degree of breath-holding (will we be back to square one in the autumn?). While we might take some solace from COVID not being the only news item discussed in these last months, no less concerning are the images of extreme events around the world that have flashed up on our screens. The record-smashing temperatures of 49.6 °C seen in Lytton, BC, Canada, in June were simply alarming, not least for the residents who lost their homes and entire village to raging fires the following day. Here, we relished a taste of a “proper summer”, with Ballywatticock, Co. Down, being put on the map in July with its record-breaking high of 31.2 °C, only to lose its place in the record books four days later to Castlederg, Co. Tyrone (31.3 °C). But the Orchard County was not to be left out, and Armagh City took first place on the podium the day after with 31.4 °C. Meanwhile, devasting floods spread across continental Europe and parts of Asia, and wildfires continue to ravage regions of southern Europe, Russia and western North America. And still there are nay-sayers, denying that climate change is an issue, denying the existence of a place called Ballywatticock…

Aptly, the theme of the Autumn Symposium will be on abrupt climate change. Quaternary records show us that climate transitions can be bumpy. How long to ride this one out? We hope we can run the Symposium as a real-world event on the last Friday in November and are presently searching for a venue (Beggar’s Bush is not currently available). By necessity, the IQUA Fieldtrip has been moved to Spring 2022, giving us something to look forward to during the bleak winter months.

Gill Plunkett, IQUA President

3. IQUA Committee (2021)

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4. IQUA Spring Symposium 2021

The IQUA Spring Symposium was held as a zoom meeting on April 16th, 2021.

Symposium Abstracts

Using the Quaternary record to project our future

Margaret Jackson

Department of Geography, Trinity College Dublin

Anthropogenic forcing is rapidly changing Earth's climate, but exactly how – and how much – climate will change in the future is uncertain. Past climate periods such as the Pliocene, when carbon dioxide was perhaps as high as it is today, may provide a window into potential future scenarios. But while these past time periods offer insight into an altered climate, the rapidity of modern warming is unique and so requires special attention. The Quaternary record holds evidence of rapid climate changes, largely centred in the North Atlantic, that may be useful analogues for the rate of modern warming. However, the nature of these rapid climate shifts and their impacts on terrestrial regions are not yet clear. Glaciers are highly sensitive to changes in climate, and so are an ideal means to investigate past terrestrial climate changes. This presentation will highlight emerging and planned work to utilise Ireland's glacial-geomorphic record to investigate periods of rapid climate change, and what these past climate shifts may mean for our future.

Reconstructing retreat dynamics of the last Irish Ice Sheet using proglacial lake sediments

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Understanding the rate and pattern of current deglaciation relies on long-term records of ice sheet behaviour spanning several millennia. Such a record can be found in Irish Midlands in the form of landforms and sediments preserved from the retreat and breakup of the Irish Ice Sheet (IIS) during the Last Glacial Termination (LGT, *c*. 21–14 ka).

Existing reconstructions of the IIS are based on geomorphological mapping of landforms, which are inherently discontinuous in their distribution and preservation. A more continuous archive is preserved in proglacial lake sediments. These lakes are sinks for glacially derived meltwater and sediment, and enable continuous, spatially integrated reconstructions of glacial and foreland environmental change, including annually or seasonally resolved (varved) records that far exceed the temporal resolution of geomorphological techniques. Thick sequences of laminated, varved, proglacial lake sediments from Palaeolake Riada are well-preserved in the Irish Midlands and provide valuable insights into IIS behaviour and lake sedimentation.

We present a new high-resolution analysis of laminated glacial lake sediment cores from Co. Offaly, close to IIS marginal landforms (moraines and eskers). A suite of physical and chemical analyses are used to reconstruct ice marginal processes and fluctuations of the IIS during the LGT. This paleoenvironmental reconstruction is put into context of wider ice sheet dynamics through radiocarbon dating of organic material extracted from these cores. This will produce insights into long term retreat patterns and behaviours of ice sheets during periods of climate amelioration, applicable to current and future dynamics of existing ice sheets.

Common Era Atlantic sea level change

Fermin Alvarez

Trinity College Dublin

Sea level rise (SLR) is one of the most challenging consequences of climate change (e.g., IPCC 2019). SLR varies in time and space in response to a suite of different controlling mechanisms. The World Climate Research Programme (WCRP) set the quantification and understanding of the mechanisms causing local to regional scale sea level variability as one of its Grand Challenges. However, modern-day sea level instrumental measurements are too short to reliably establish secular rates of SLR and unravel the relative contributions of the processes driving them. As an island nation, Ireland will be profoundly influenced by future SLR. My PhD research from part of the A4 project (Aigéin, Aeráid, agus Athrú Atlantaigh), which seeks to improve our projections of future SLR by better understanding the drivers of Irish sea level change over the past two centuries. This aim will be achieved by expanding the Irish tide gauge dataset through data archaeology and resurveying historical benchmarks around Ireland, and by the application of the "geological tide gauge" approach. This technique, based on the analysis of

sea-level indicators in buried high-saltmarsh sediment, capable of producing multi-decadal relative sea level (RSL) reconstructions from saltmarsh environments extending back several centuries to millennia. My PhD will produce a record of Common Era (past 2,000 years) RSL change that will contribute to a growing network of high-resolution RSL reconstructions from the Atlantic coast of north America. Spatio-temporal modelling of this expanded dataset will provide new insights into RSL variability.

The role of ocean forcing in early deglaciation of the British-Irish Ice Sheet during the Last Glacial Maximum: A micropalaeontological and sedimentological study of sediment cores from the Malin Sea and Slyne Trough

Brendan O'Neill (Supervised by Prof. Colm Ó Cofaigh and Dr. Jerry Loyd)

Department of Geography, Durham University

Thesis submitted December 2020 for the degree of Master of Science by research.

The contribution of the polar ice sheets to global sea level rise has tripled within the last two decades and remains the largest yet most uncertain source of future sea level rise. Critical to this problem are the sensitive marine-terminating margins of ice sheets, which can propagate marine-forced changes into the ice-sheet interior but whose responses remain insufficiently understood and difficult to simulate. Improving our understanding of ice sheet-ocean interactions is therefore an essential prerequisite to accurate projections of future sea level rise. Geological records of ice sheet-ocean interaction are valuable to this effort, as they can span centennial to millennial timescales, providing longer-term context to instrumental observations and important means of informing and testing numerical ice-sheet models used in predictions of sea-level rise. The last British-Irish Ice Sheet (BIIS) has important potential in this regard, due to its largely marine-based configuration and proximity to pathways of poleward heat transport in the northeast Atlantic. This study availed of this by investigating whether ocean forcing played a role in early deglaciation in two sectors along the Atlantic margin of the BIIS, the Malin shelf and Porcupine Bank-Slyne Trough region, using foraminiferal assemblages. The results suggest that warm Atlantic Water was present during early deglaciation (from ≥25.5 ka cal BP) in the Porcupine Bank-Slyne Trough region, and passively drove retreat offshore central western Ireland. In contrast, deglaciation on the Malin shelf occurred in a cold glacimarine environment from ≥25.9 ka cal BP and was likely internally driven through glacioisostatic adjustment-induced relative sea-level rise, consistent with recent results from two other sectors along the BIIS' Atlantic margin. The findings expose the role of bathymetry in locally conditioning the BIIS to ocean forcing and imply a BIIS influence by Atlantic Water advection in the northeast Atlantic during the coldest stadials of the last glacial period.

Preliminary results from a palaeoenvionmental study of Lough Feeagh, Co. Mayo

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An 8-m long sediment core was extracted from Lough Feeagh, a large freshwater lake in the Burrishoole catchment County Mayo. Stratigraphic, geochemical and chronological analysis including stratigraphy, Loss On Ignition (LOI_{550}), wet density, dry weight and 14AMS Radiocarbon sampling have been conducted. 14AMS Radiocarbon sampling suggests that this core is at least 10,000 YBP, suggesting a long-term record of environmental change in the catchment can be achieved. The sediment includes glacial clay at its oldest part of the core, and a transition from clay to lake sediment. This transition is also noted with an increase in LOI_{550} values. LOI_{550} values vary throughout the core, suggesting the possibility for various environmental interactions in the catchment.

The Joyce Country and Western Lakes geopark project; an asset and a facilitator for education and research

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The Joyce Country and Western Lakes (JCWL) geopark project 2020–2021 is an initiative led by Geological Survey Ireland and funded by Project Ireland 2040 under the Rural Regeneration Development Fund (RRDF) with significant contributions from Údarás na Gaeltachta, Mayo and Galway County Councils and other partners. The aim of the project is to apply for UNESCO Global Geopark status at the end of 2021 and become the newest Irish member of this international network by 2023.

The JCWL region is well-known to geologists, particularly in Ireland, Britain, and North America, for having the most complete record of the Grampian-Taconic Orogeny. Outcrops of note include Connemara Marble, the Lakes Marble in Cur Hill and the pillow basalts of the Lough Nafooey Arc. But the region is also rich with Quaternary features with Ireland's only fjord at Killary Harbour, a range of corries, glaciated valleys and moraines in the uplands, drumlin islands and the karst and epikarst landscape on the shores of Loughs Carra, Mask and Corrib. Notwithstanding a rich biological and archaeological landscape. This talk will introduce how the geopark project aims to foster and facilitate the organisation of student fieldtrips, mapping projects and research projects' fieldwork by providing the link to accommodation providers, landowners, and any other local resources at our disposal.

Digging the Burren – quantifying Ireland's dust-bowl

Colin Bunce

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The Burren is an iconic example of glacio-karst; however, the Quaternary history of the Burren is largely unknown. This GSI-funded project, based at NUIG with collaborators at Uppsala and Max Planck Institute, is examining a Late Quaternary deposit which is widely spread over the hillsides of the Burren and in dolines and caves. Pilot geochemical and grain-size analyses describe a quartz-rich silt that cannot be attributed to local bedrock. Our working hypothesis is that this deposit is an aeolian silt ('loess'). While previous researchers have speculated that similar deposits are loess, these Burren sediments have escaped rigorous geologic assessment; existing maps do not include these deposits. At this early stage of the project, we will present initial results and outline the project's direction and elaborate on the types of information that this deposit might reveal. This will be the first ground-based survey seeking to characterise the Burren silts and identify their extent, origin, transport, and environmental/climatic relevance.

There is evidence that the Burren had a greater soil cover in the geologically recent past, prompting the questions: How did soils originate on a glaciated limestone substrate? Where have these soils gone subsequently? Loess is the ideal candidate to answer both these questions. Blown in from glacial outwash deposits after ice retreat, colonized by vegetation in the early Holocene, then potentially eroded following woodland clearance by early settlers.

The Newgrange light-box: a triumph of Neolithic architecture or a creation of 1960s engineering?

Michael Gibbons

Originally known as the false lintel, the feature now known as the Newgrange light-box was discovered in the 1840s and first documented by William Wilde in 1847. Its discovery was one of the outcomes resulting from more than two centuries of episodic antiquarian diggings on, around and within the mound; no doubt spurred on by the repeated discovery of important gold artefacts.

During the course of the next one hundred and thirty years, further digging and conservation works took place before the entire monument was transformed under the direction of Professor M. J. O'Kelly in the 1960s and 1970s. This talk subjects the feature to a preliminary authenticity analysis: focused on a rigorous evaluation of the published work and of previously unexamined photographic, stratigraphic and documentary evidence. The results challenge the widespread acceptance that the original and authentic purpose of the light-box was to capture the beam of winter solstice sunlight and to direct it to the back of the chamber.

5. New IQUA Initiatives

Irish Quaternary Research on ResearchGate

Gill Plunkett

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A new repository for Irish Quaternary Research has been created in ResearchGate to showcase the breadth of research in this field. The IQUA community is invited to contribute to the repository any published work relating to Irish Quaternary Research (geographical focus should at least include Ireland). To add your research to the project, simply make sure that you "follow" any of the Project Collaborators and contact them to ask to be added as a collaborator. You will then be free to associate your publications to the project.

Shaping the Landscape – a 2nd Level Teaching Resource

Catherine Dalton

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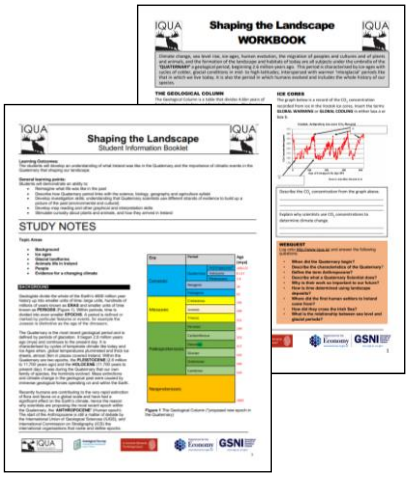
In the lead up to the 2019 INQUA congress IQUA generated a range of media and education materials. A 2nd level teaching resource was created following a successful application to the Heritage Council Community Fund.

The lesson plan is the first 2nd level teaching aid for Quaternary Science in Ireland. A range of materials were created initially by **Nicole Sloane (Geosciences teacher, Foyle and Londonderry College)**. These were collated and edited by the IQUA committee as an 8-page STUDY NOTES BOOKLET which describes Ice ages, Glacial landforms, Animal life in Ireland, People & Evidence for a changing climate, and a 4-page WORKBOOK with illustrated questions on the geological column, oxygen isotopes, as well as exercises such as pair up Quaternary definitions, IQUA WebQuest, Quaternary Wordbank, Quaternary Odd-one-out, and Quaternary True or False questions. The materials were then approved by Kirsten Lemon (GSNI) and Siobhan Power (GSI).

The instructional aid is focused on 2nd level students thus enabling direct contact with future geography and science undergraduates and potential postgraduates. The lesson plan links directly with relevant curriculum – science, biology, geography, and agriculture and includes the following key learning points:

- Reimagine what life was like in the past
- Describe how Quaternary period links with the science, biology, geography and agriculture syllabi



- Develop investigation skills; understanding that Quaternary scientists use different strands of evidence to build up a picture of the past (environmental and cultural)
- Develop map reading and other graphical and interpretation skills
- Stimulate curiosity about plants and animals, and how they arrived in Ireland

Thanks again to our Sponsors Heritage Council, GSI and GSNI.

6. Research Reports

Tsunamigenic sand interpreted at Barley Cove, County Cork, Ireland

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Introduction

An unusual dune stratigraphy has been identified in a sand cliff at Barley Cove (Fig. 1). Two sedimentary units are exposed along a 400 m long section (Localities A to F). These units are sand and calcarenite and overlying aeolian sand. Critically, the beds of the lower unit are characterised by distinctive sedimentary structures that indicate subaqueous debris flows and slumping. Nonetheless, both units are comprised of detrital sand with fragments of rock, quartz and shells.

Former Geomorphology

A palaeosol conveniently marks the top of the lower unit. Thus, it is clear that the earlier subaqueous deposit comprised two extensive and flat-topped mounds connected by a lower ridge. Indeed, these features form the core of the current dunes. The top of the smaller mound, at the western end of the section (Localities A and B) is estimated to have been at 6 m above current mean sea level (asl), while the larger mound (Localities D to G), at the opposite end, reached about 9.5 m asl. The larger mound's western flank (Localities D and E) appears to have had a steeper profile and minor faults there are interpreted as evidence of syn-depositional subsidence. The WNW/ESE length of the connected mounds is estimated to have been 400 m. Groups of residual calcarenite boulders were identified along the adjacent tidal channel (Fig. 1). The largest of these boulders (Locality G) appear to be close to

their locus of deposition, because they comprise tabular masses with bedding structures that are similarly orientated to those in the sand cliff (Fig. 2).

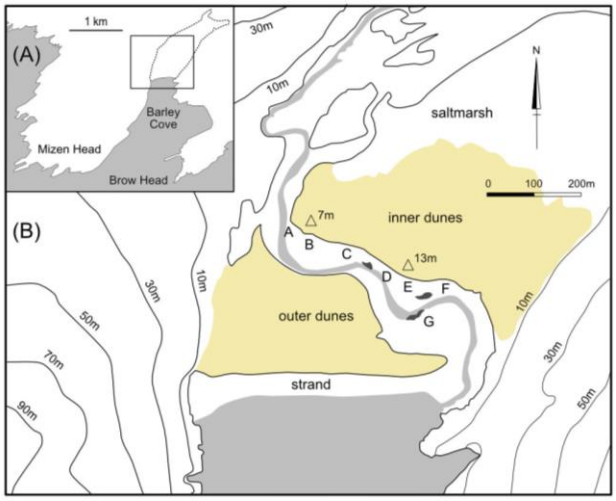

Figure 1. (A) Map showing location of Barley Cove with sand estuary outlined. (B) Map of Barley Cove showing elevation, dunes (yellow), boulder groups (dark grey) and sand cliff adjacent to tidal channel (Localities A to F).

Stratigraphy and Sedimentology

Five sequences of thinly to medium bedded sand and calcarenite were observed in the core of the highest dune (Locality E). Each sequence is defined by a basal erosion surface or unconformity. The sequences are between 0.8 and 1.8 m thick and contain packages of between five and ten beds, where each bed is between 10 and 40 cm thick. The total 6 m thickness of the succession is regarded as a minimum because the base of the unit is not exposed. Similar packages of beds are present along the remaining section but are not well exposed owing to an extensive covering of eroded sand. True depositional dips are either subhorizontal (up to 5 degrees) or gentle to moderate (5 to 20 degrees). The steeper dips, which seem to be located in marginal areas of the deposit, are interpreted as evidence of slumping on a sloping substrate. Each bed is characterised by two types of sedimentary structures: soft sediment structures in the lower part and horizontal laminations in the upper part (Fig. 3). This dual arrangement is considered to represent bimodal sand deposition where each turbid sand flow was followed by a watery sand flow with settling. Thus, each sequence represents repeated debris flows. It is suggested that the subaqueous sand and calcarenite represents a tsunami backwash deposit formed in dune depressions. At Barley Cove, it appears that two mounds accumulated at the bends in a former tidal channel. In this model, the sediment was fed into the linear feature by two return channels orientated north-south. The sand spread across the full length of the channel during the earlier backwash phases, and then stacked up at the ends of the return channels during the later phases.

Figure 2. Photograph of residual calcarenite boulders (*c*. 1 m high) at Locality G. Note slumping of beds.

Figure 3. Photograph of temporary sand exposure showing partial cementation of beds (10–20 cm thick). Note soft sediment structures and overlying laminations.

History and Heritage

A record of the impacts of the 1755 Lisbon Earthquake on the south coasts of Ireland and England is available in reports published by the Royal Society of London. Some descriptions were also published in early newspapers. In tandem with this contemporary record, there is a strong oral tradition in West Cork that has been found to be informative (Hickey and Beese 2018). Barley Cove is identified as one of the locations where the dunes 'came up' and is also remembered as an 'overnight strand'. Notably, high run-ups have been reported at other inlets along the adjacent coast such as at Rosscarbery Warren and at Long Strand, Castlefreke. Therefore, the expected age of the subaqueous sand is 266 y. It is now widely accepted that source and receiving environments determine the nature of tsunami dep-

osition. At Barley Cove, these environments were proximate. The inlet is situated at the southwestern corner of Ireland (Fig. 1A) and lies 1,600 km directly north of the epicentre off the coast of Portugal. It also is open to the south. Thus, the dunes there would have been vulnerable to erosion, even by a fading tsunami. Barley Cove is a deep-set, curving sand estuary. It is likely, therefore that the later flood phases, which entered the inlet, encountered the return flows from earlier floods, causing the sea level to rise progressively. Other historical factors, which may be relevant are that the 'sand hills' at Barley Cove were not fixed under marram grass until the twentieth century. Finally, the Lisbon Earthquake occurred during the Little Ice Age, when intermittent spells of freezing weather may have damaged the covering vegetation.

Timing of Formation

However, the reworked nature of the deposit is likely to be a complicating factor. The programme of sampling, testing and reporting is being directed by Professor Mark Bateman, Head of the Optical Luminescence Laboratory at the University of Sheffield.

Reference

Hickey, K., Beese, A. 2018. The 1755 Lisbon Earthquake-Tsunami and the West Cork Coast. [http://www.deepmapscork.ie/past-to-present/climate/1755-lisbon-earthquake-tsunami-west-corkcoast/].

Digging the Burren – Quantifying Ireland's dustbowl

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As every Irish schoolchild should know the Burren is an excellent example of a karst landscape, but the bare rocky hillsides seen there are not typical of most karst areas across the world.

A little more study leads to the term 'glacio-karst' (Simms 2006) which highlights the importance of glaciation in the development of the Burren's landscape. However, the Quaternary history of this area is largely unknown beyond the obvious scattered presence of tills and erratics, and some very limited dates (McDermot and Swabey 1995; Simms 2005). Evidence that the Burren landscape did once have a greater soil cover was demonstrated by Drew (1983), which then prompts the questions: *How did soils originate on a recently glaciated pure limestone substrate? and Where have these soils gone subsequently?*

Loess is an ideal candidate to answer the first question; it is composed of 'rock-flour' commonly generated by glacial grinding and then transported and deposited by wind. The word loess is pronounced in different ways: in England it is usually pronounced 'low-ess', in America it rhymes with 'fuss' and in Europe it is 'ler-ss'. The first person to recognise that some Burren soil may have been derived from loess was Dr. David Jeffrey (now retired professor of Botany in TCD). In 1987 his student Grace O'Donovan received a PhD for her research on the ecology of Mullaghmor (Burren National Park) which included evidence that some of the soils were derived from loess. In 1995 Grace published a paper with Richard and Norman Moles (Moles et al. 1995) describing three soil types in the same area, one of these they termed *'stone free drift*' and stated that *'aeolian transportation has been the dominant geomorphological agent*' in forming this deposit.

Following further study, however, the Moles Brothers withdrew this claim in 2002: *'In our initial study based on the analyses of 14 soil samples from the study area, we proposed a loessic origin for some non-drumlin granite-bearing soils (stone-free drift), but the subsequent discovery of granite pebbles in similar soils refutes this hypothesis*' (Moles and Moles 2002).

In 2004 Peter Vincent (who had studied loess in a similar karst landscape in NE England) described a sediment at Poll an bhallain (a large karst depression near Carran) as: *'at least 150 cm of homogeneous, buff-coloured loessic silt with no stones ... grain size measurements show it to have a mean particle size of 30 microns. X-ray diffraction indicate that quartz is the dominant mineral with small amounts of feldspar and mica. Scanning electron microscopy of individual grains reveals typical loessic shapes. All these data confirm the silt to be loess*' (Vincent 2004).

As part of a study of the Carran polje, one of the Burren's largest karst depressions, in 2016 (Drew and Bunce 2016) I discovered an unusual sticky, yellow clay; I grew up in Kent in SE England and so made a connection to a quaternary deposit found there called 'brickearth'. I sent a sample of the Burren clay to Professor Ian Smalley in the UK who assessed it as having a very high silt content. Subsequently, I came across Peter Vincent's paper and began logging similar deposits, which are widespread across the Burren and was soon fascinated with this material which appears to be hiding in plain sight. Similar deposits have also been described in two archaeological excavation reports: at Poulnabrone (Lynch 2014) and at Turlough Hill (O'Maolduin and McCarthy 2016), and also it has a local name 'daub-bui'.

In 2020, after 30 years working in the Burren as an outdoor education instructor, I took early retirement and together with Dr. Gordon Bromley in NUIG applied for and was granted funding from GSI for a one-year project through their Short Call programme to provide a detailed geologic assessment of this material.

It has been said that anyone who survived a high-school geography course knows three things about loess: it is yellow, it is deposited by the wind and it is found in China (Smalley and Rodgers 1996). While this may be a useful starting point to some of its common characteristics, as you read more about loess you quickly discover that it can be a bit of a chameleon; the colour can vary between yellow, brown, dark grey, white and red; it's texture can also vary as it can be easily modified by processes such as solifluction, slope wash and soil processes. It also occurs much more widely than just in China and is estimated to cover 10% of the earth's land surface including large parts of Europe and there are also thin deposits scattered across the UK.

So how does one prove a silt deposit is loess? Loess can be broadly described as a silt dominated (20–60 µm), terrestrial sediment that has been entrained, transported, and deposited by wind (Muhs 2013). Grain size, therefore, is critical in identification, detailed analysis of grain size variations can also give information on other processes that may have been occurring at the time of deposition. Loess is usually dominated (> 60%) by quartz, so chemical composition is also very important, but analysis of the mineral content of the other 40% is important in identifying the parent source of the loess and whether it has been generated locally or not. Aeolian transportation should give the deposit a widespread spatial distribution and can sometimes be identified from micro textures on individual silt grains. The age of the deposit is also important and because loess is largely composed of quartz silt it can be dated using OSL (Optically Stimulated Luminescence).

This initial study, funded by GSI under their Short Call 2020, is the first ground-based survey seeking to characterise these Burren silts and identify their extent, origin, transport, and environmental/climatic relevance. Colin Bunce and Gordon Bromley are mapping locations where this deposit is found; particle size analysis and scanning electron microscope imaging of samples from a number of sites is underway in NUIG. Initial results from seven samples from a section near Doolin show the silt fraction ranging from 70% to 88% (Fig. 1), with an average grain size of 7.5 µm (thanks to Marta Cabello in NUIG). Samples have been prepared for chemical composition by X-ray fluorescence (in collaboration with the Earth Surface Research Lab in TCD). Zircons have been identified in most samples and Dr. Shane Tyrell and Dr. Martin Nauton-Fourteu in NUIG will ascertain U-Pb ages from these to also help identify the provenance of these silts.

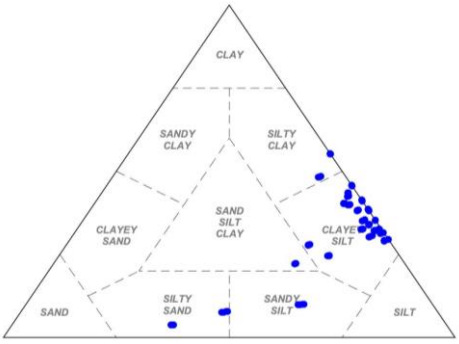

Figure 1. Ternary soil plot showing analysis of samples from the Trug, Doolin. Co. Clare. Thanks to Marta Cabello (NUIG).

With a lack of experience of loess studies in Ireland we are fortunate to have two expert collaborators on the project: Dr. Kathryn Fitzsimmons of the Max Planck Institute in Mainz, Germany will be training Gordon and Colin in OSL techniques to ascertain the age of these deposits; and Dr. Thomas Stevens in Uppsala University in Sweden will be examining the mineral magnetics to profile palaeoclimate and elaborate on some other information that this deposit might reveal.

Our website: https://sites.google.com/view/burren-loess/home shows photos of the deposit at several locations as well as some initial results and these will be updated as we progress.

The question arises as to whether loess might also occur elsewhere in Ireland. Thin deposits of loess

have a habit of disappearing into a soil profile but Scheib et al (2014) identified a signal of elevated Zirconium and Hafnium levels in soils that have a loessic component. They present maps of known loess deposits in Europe together with areas of elevated Zr/Hf levels and note the strong correlation between them. In Ireland they show an elevated signal along the Cork coastline between Clonakilty and Kinsale and also in Fermanagh that might be worth investigating. Peter Vincent claimed "*Once the Rubicon is crossed loess is seen everywhere, even by the inexperienced*". However, also bear in mind what Ian Smalley has said "*all loess is an accumulation of silt, but not every accumulation of silt is loes*s".

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West Cork palaeoecology – the Three Lakes site

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Following the retrieval of an initial core from the bog in 2018, which is still undergoing pollen and spore analysis, recent visits and retrieved cores have revealed further interesting details about the site.

Three Lakes lies halfway between Drimoleague and Dunmanway in West Cork. It is a glacially gouged basin with a rock lip that has restrained drainage resulting in a hydrosere environment. Currently occupied by three lakes in a NE/SW lineation, and surrounded by bog, this area was probably at an earlier time one large lake.

Initially this was to be an archaeological investigation, but following the retrieval in 2018, by Russian-corer, of a 5.9 m core of peat underlain by 10 cm of silt, it was decided to investigate the full Holocene history of the site.

Three radiocarbon dates were obtained for this core, funded by IQUA under the Bill Watts Chrono grant, and these indicated a full postglacial sequence. This first coring location is about 100 m from the lake, located nearer to the road. It was felt that further sediment could be retrieved below the 6 m depth, back to late glacial age.

A subsequent visit in May of this this year resulted in the retrieval of a 6.5 m core from the edge of the middle lake using a piston corer.

The top metre was very liquid and stratigraphy was not easily preserved in the sediment that was retained. However, the bottom of the core demonstrated, as expected, that further organic sediment lay below the silt layer, with a final, presumably late glacial silt, at the base. Radiocarbon dates have yet to be obtained.

Further investigations in July this year using a gouge corer revealed more. At the site of the original core a full depth of 7.1 m was obtained with good demonstration of the late glacial to post glacial cold-warm-cold transitions. This would clearly be a better location to extract a full core down to the basal stony deposit with the piston corer. This is planned for later this year.

Elsewhere in the bog nearby, and closer to a stream that flows into the basin from the north, a 5 m depth was obtained using the gouge corer, but, unexpectedly, with a band of diatomaceous sediment at 3.6–3.7 m depth. The base of this investigation also demonstrated the presence of two bands of silt, separated by organic sediment.

The Three Lakes site lies firmly within the West Cork siliceous sedimentary sequences of the Munster Basin. Indications of glacial erosion and deposition are clear in the area, which lies at just 100 m above sea level.

A cursory examination of the flora of the basin indicates that, as is to be expected, several habitat types are to be found, using Fossitt's Habitat type classification. These are:

Wet willow-alder-ash woodland	WN6
Cutover bog	PB4
Lowland blanket bog	PB3
Tall-herb swamps	FS2
Mesotrophic lakes	FL4
Reed and large sedge swamps	FS1

Further, more in-depth floral surveys will be undertaken to map the habitat types more closely. It is hoped to build a narrative of the Late Glacial and Post Glacial history of the site based on the results of analysis of sediment samples obtained so far, and to encourage preservation of the site, for educational and heritage purposes. But much work remains to be done. There is currently a group of four enthusiasts who are involved, but engagement from other interested individuals would be welcomed. Contact us at westcorkpalaeo@gmail.com.

Airborne radiometric data to map peat physical properties in the midlands of Ireland

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Introduction

Peatlands are an important part of the global ecosystem. They are known to contain vast amounts of carbon, are a home for high levels of biodiversity and have been considered a natural resource for humans as a main source of electricity generation in many nations (Page and Baird 2016). More recently peatlands have been recognised as potential areas for sequestration of carbon, or more correctly, stopping the release of carbon to the atmosphere (Kareksela et al. 2015). So called reclamation usually involves draining of the peatland and a subsequent restarting of the biological breakdown of the organic material present, a process normally dormant due to the anoxic environment of a "wet" peat. This has led to many projects and EU initiatives focused on the topic of "Peatland Restoration", that is restoring peatlands to their natural setting, i.e., a wet, anoxic environment (Ramsar 2002). Such projects usually involve the re-wetting of peatlands via irrigation and plugging of drains to promote a wetter environment and require initial site investigations, long-term management plans and a monitoring programme that is capable of capturing both the spatial and temporal changes to the lands, prior to, during and after any restoration work.

The initial site investigation and any potential monitoring programme pose potential issues for any land management plan as peatlands are often vast, inaccessible, and heterogeneous. Traditional in-situ point samples are expensive to acquire and do not contain information at the scale require for peatland site management. Airborne geophysical surveys, in

contrast, can be used to cover large area relatively quick and consistently (Minasny et al. 2019) and are sensitive to the subsurface. These are high resolution surveys with an in-line sampling interval of between 6–60 m and crossline sampling of 100–500 m providing consistently sampled spatial datasets. Increasingly, national surveys are being acquired which typically collect magnetic, electromagnetic (electrical conductivity) and radiometric (gamma ray spectroscopy) datasets which are freely available and have many potential applications in peatland management, including initial site investigation and acting as a baseline for future monitoring programmes.

Radiometric data, in particular, has application in overburden studies (Reinhardt and Herrmann 2019). A radiometric, or gamma spectroscopy, survey, is a geophysical method which measures the radioactive decay of certain elements found naturally in the earth's crustal material, most usually Potassium (^{40}K), Uranium (^{238}U) and Thorium (^{232}Th) (Minty 1997). Such surveys have been used in the mapping of near surface geology, radon mapping (Appleton et al. 2011) and in thematic soil studies (Rawlins et al. 2007), in the spatial mapping of peatland sites (Keaney et al. 2013).

Peat has a unique place within the radiometric method and several studies have demonstrated that such surveys can be effective at mapping peat extent due to the contrast in radiometric signal between a peat and a mineral soil (Beamish 2013). Peat is distinctive as it consists mostly of organic matter, and so not considered a source of gamma rays, and peat is usually considered to be water saturated. Combined, this means that the radiometric signal is very low over peatlands due to lack of minerals to create a source of gamma ray flux and an abundance of water which acts to scatter the gamma rays. With the understanding that radiometric data over a peatland would show as relative lows in the landscape, there is then potential to investigate the intra-peat variation of radiometric signal within these peatlands. As peat acts primarily as an attenuator of gamma rays originating from underlying geological material, such variation would be linked our understanding of radiometric attenuation in peat, namely changes in physical properties such as density, porosity, saturation, and thickness (Fig. 1).

The above acts as an introduction to work being conducted as part of my PhD project where I am including several novel components which have not been considered in previous work relating to radiometric data and peat studies.

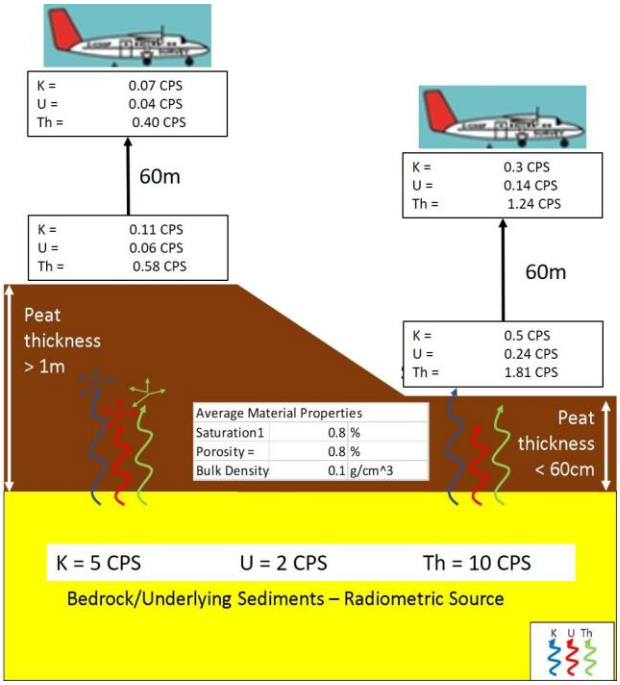

Figure 1. A graphical model of the attenuation equation for constant physical properties and two different peat thickness.

Firstly, the work will use all four datasets (K, U, Th and Total Count) of the recorded survey as separate datasets. The reason for the separation of the datasets is to allow for subsequent data clustering and optimisation to estimate averaged physical parameters across this peatlands site.

Secondly, this study will use a K-Means clustering methodology with the radiometric data as input to discover the appropriate number of zones that can describe this peatland. Each zone is then ascribed a single representative set of radiometric values, constituting a "clustered centre".

Finally, this study will consider all aspects of the attenuation equation (Beamish 2013) for soils, for each of the three elements of the radiometric survey (K, U, Th) individually. In this way, an optimised set of physical parameters can be defined for each cluster, which satisfy the "clustered centre" radiometric data, resulting in a map of the peatland site with zones of similar physical properties.

My PhD will use radiometric data acquired by the Tellus programme, a national geophysical survey conducted by the Geological Survey of Ireland (GSI) over a harvested peat bog in the midlands of Ireland, known locally as Garryduff bog as an example

(Fig. 2). The methods discussed can be applied to any peatland site where airborne radiometric data are present without the need for ancillary datasets.

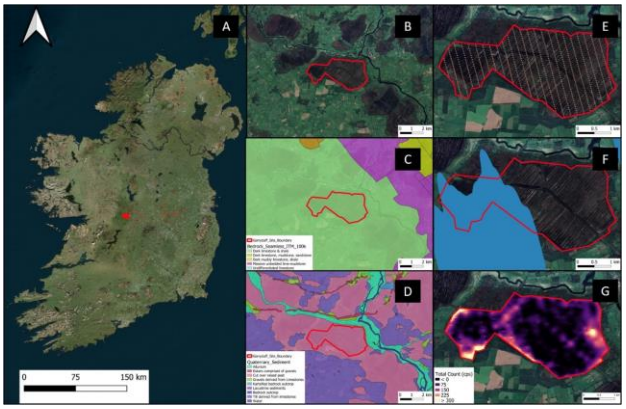

Figure 2. A) Map of Ireland showing Garryduff site location. B) Aerial photo of the site with boundary highlighted. C) Bedrock Geology underlying the site. D) Quaternary Geology description of the site and surrounding lands. E) Garryduff Bog with Tellus Radiometric locations. F) High fly zone (>90m) over site. G) Interpolated radiometric Total Counts (TC) data for Garryduff site.

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7. Recent Publications

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8. Upcoming Events

IQUA Autumn Symposium 2021

Our IQUA Autumn Symposium has been scheduled as an in-person event for Friday the 26th of November 2021. Please look out for more information via the IQUA mailing list.

9. Other News

Publish Open Access with Wiley

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Wiley has announced a new Open Access deal with Ireland. Quaternary Researchers from Universities in the Republic, like those in NI, will now be able to publish their papers as Gold Open Access in *Journal of Quaternary Science*, without any article processing charges (APCs).

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