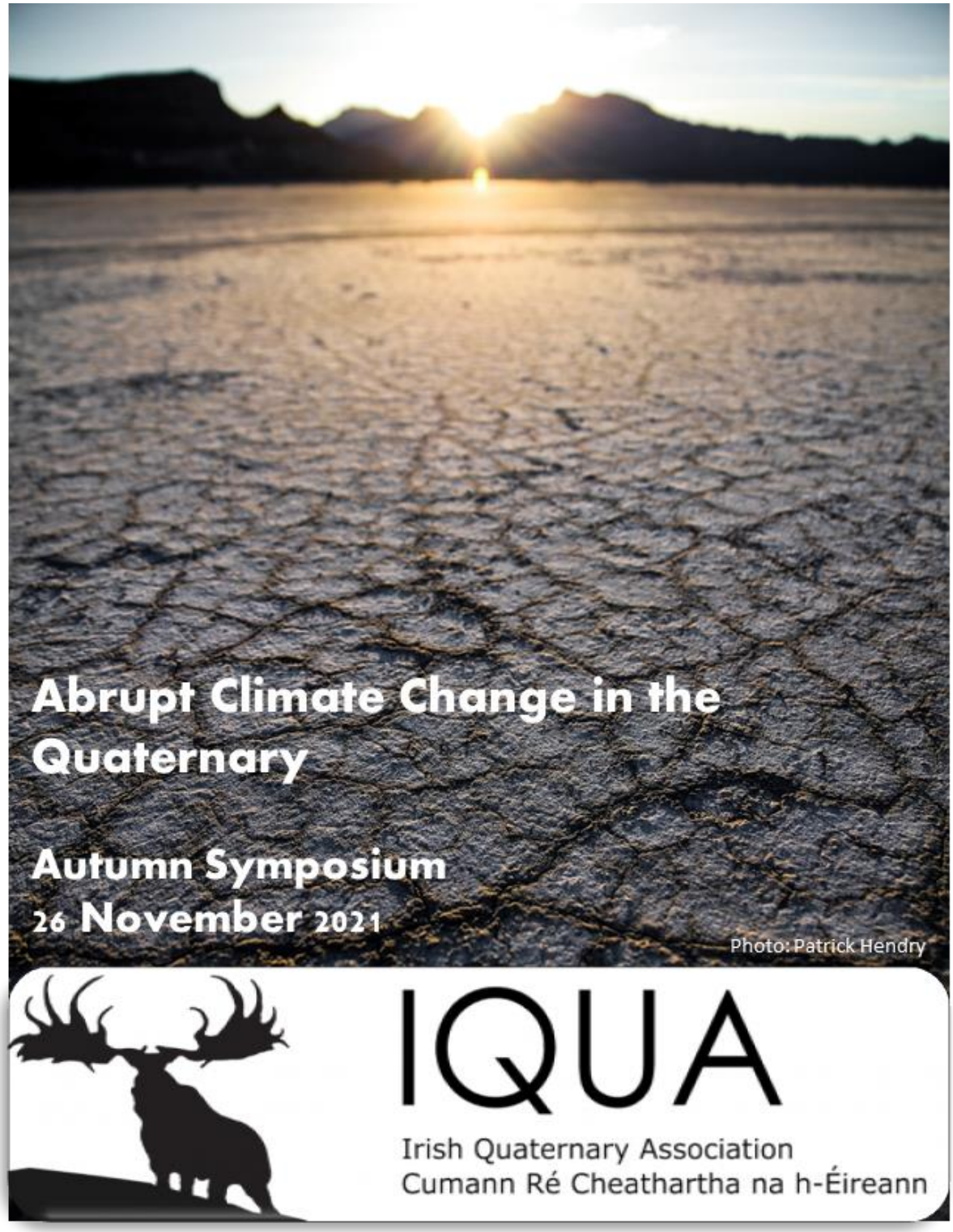
Autumn Symposium 2021

Abrupt Climate Change in the Quaternary

ABSTRACTS

Organisers: Gordon Bromley & Gill Plunkett


Abrupt Climate Change in the Quaternary
Autumn Symposium
26 November 2021
Photo: Patrick Hendry
IQUA
Irish Quaternary Association
Cumann Ré Cheathartha na h-Éireann

IQUA Symposium 2021
Online: 26 November 2021
Opens at 9.45

9.45 President's Welcome

Presentations

9.55 MIS 11 climate variability in Britain: a possible abrupt climate change signal in lacustrine faunal and geochemical data from Marks Tey, Essex.

Anna March, Queen Mary University of London

10.15 Rapid deglaciation of the Connemara ice dome at the end of the Last Glacial Maximum.

Adrienne Foreman, National University of Ireland, Galway

10.35 Post glacial climate change in the Burren: implications for abrupt climate change.

Colin Bunce, National University of Ireland, Galway

10.55 A fresh look at abrupt climate variability (a glacial perspective).

Gordon Bromley, National University of Ireland, Galway

11.15 Break (15 minutes)

11.30 The 4.2 kyr event in the Indian Ocean, and its impact on the Harappan civilization.

Nick Scroxton, Maynooth University

11.50 **Does size matter? Why some volcanic eruptions cause abrupt climate change and others do not**

Gill Plunkett, Queen's University Belfast

12.10 Bog-timbers in Ireland: recent investigations into bog-pine provide fresh insights into Holocene climate change.

Michael O'Connell, National University of Ireland, Galway

12.30 IQUA Awards & Prizes

13.00 Closing remarks

MIS 11 climate variability in Britain: a possible abrupt climate change signal in lacustrine faunal and geochemical data from Marks Tey, Essex

Anna March[1]; David Horne[1]; Jonathan Holmes[2]; Simon L Lewis[1]

1 School of Geography, Queen Mary University of London

2 Department of Geography, University College London

Abstract

A multiple-proxy study of ostracods was conducted on lake sediments from Marks Tey in Essex, which are considered the most complete British archive of Marine Isotope Stage (MIS) 11. Research focused on the exposed sediments that represent the period following the Hoxnian interglacial (MIS 11c). Oxygen isotope analyses of *Cytherissa lacustris* and temperature ranges reconstructed using the Mutual Ostracod Temperature Range method both provide independent evidence of considerable climate complexity, including up to four stadial-interstadial oscillations that can potentially be correlated with records from Europe and the North Atlantic. The oxygen isotope record is interpreted as recording fluctuations not only of temperature, but also of global ice-sheet extent.

These previously unrecognised MIS 11 climate fluctuations in Britain suggest opportunities for non-coeval migrations of humans into Britain, adding complexity to the interpretation of the archaeological record, which assigns post-Hoxnian human presence to a single interstadial (MIS 11a), following a single stadial (MIS 11b). The importance of the site at Marks Tey is, therefore, reinforced, not only for its Hoxnian record, but also for its record of MIS 11 beyond the interglacial period, a record that is unparalleled in Britain.

Rapid deglaciation of the Connemara ice dome at the end of the Last Glacial Maximum.

Adrienne Foreman [1], Gordon Bromley [1,2], Brenda Hall [2], Margaret Jackson [3]

1 Palaeoenvironmental Research Unit, Geography, NUI Galway

2 Climate Change Institute, University of Maine, USA

3 Geography, Trinity College Dublin

Abstract

This work is a reconstruction of the timing and nature of glacial fluctuations in Connemara, western Ireland during Heinrich Stadial 1 (HS1) through vertical and horizontal transects of cosmogenic nuclide surface-exposure dating, coupled with geomorphic mapping of glacio-fluvial landforms. Fifteen internally consistent cosmogenic beryllium-10 ages of erratic boulders indicate rapid and widespread deglaciation of the former Connemara ice centre at ~17.5 ka. The apparent abruptness of ice retreat, coupled with stratigraphic correlation with geomorphic features indicative of meltwater, suggests that deglaciation was driven by enhanced melting during the summer ablation season. This interpretation supports evidence for enhanced meltwater discharge and summertime warming elsewhere in Europe during HS1 but may conflict with the traditional view of stadials as severe year-round climate cooling events.

Post glacial climate change in the Burren

Colin Bunce

Palaeoenvironmental Research Unit, Geography, NUI Galway

Abstract

The Burren is an iconic example of glacio-karst with widespread examples of till deposits, striae and erratics overlapping with limestone pavements, dolines and caves; however, the interplay of these two processes is largely unknown. There is evidence that the Burren had a greater soil cover in the geologically recent past which prompts the question: *How did soils originate on a glaciated limestone substrate?* This project is examining a thin but widespread silt deposit found in the Burren, and elsewhere, that appears to be an immediately post-glacial loess deposit that may have been the parent material of the original soil in this area.

Here we present the results of some initial grain size measurements showing the strong predominance of silt sized material; describe its mineralogy, we will show S.E.M. images of individual grains which show typical loess textures and describe some unusual stratigraphy we have found at a number of Burren locations. This initial evidence supports the hypothesis that following deglaciation of the Burren there was a period of cold but dry climate allowing formation, transportation and deposition of glacially derived '*dust*'.

A fresh look at abrupt climate variability (a glacial perspective).

Gordon Bromley

Palaeoenvironmental Environmental Unit, Geography, NUI Galway

Abstract

Climate change is the greatest socio-economic force of the 21st Century, creating uncertainty and threatening to overthrow basic societal foundations. Just as pandemics can quickly upend the human landscape, our climate system also exhibits sudden shifts. Geochemical evidence from ice cores suggests that, in the geologically recent past, mean temperatures in the North Atlantic region have repeatedly jumped as much as 10°C, equivalent to the difference between the modern-day and ice age world, within a human lifespan. Today, anthropogenic greenhouse emissions are upsetting the planet's radiative balance, causing an overall warming the rate and uniformity of which are unprecedented in at least the last 2000 years. Global civilisation has thrived on a large degree of certainty and environmental stability, highlighting the importance of predicting the shape and form of the climatic disruption to which we are now committed.

As a front-line tool for climate projection, the numerical models used to simulate future climate and guide national adaptation strategies are first 'tested' against proxy-based reconstructions of past climate (palaeoclimate) events, such as the last glacial maximum. Here, I discuss the growing contribution that geologic records of glacial change are making to our understanding of the timing, rate, and manifestation of abrupt climate change during the geologically recent past. Coupled with recent refinements in cosmogenic nuclide geochronology, the abundance of relict glacial deposits at almost all latitudes on Earth affords a potentially massive trove of terrestrial palaeoclimate data that can help inform targets for climate models. Emerging glacial chronologies from the Southern Hemisphere, tropics, and Northern Hemisphere also show, however, that the traditional view of abrupt climate change – drivers, mechanisms, and impacts – is potentially more complex (and interesting!) than previously thought.

The 4.2 kyr event in the Indian Ocean, and its impact on the Harappan civilization.

Nick Scroxton

Geography, Maynooth University

The 4.2kyr event is one of the largest abrupt climate changes of the Holocene, yet it remains something of a climatic enigma. What is the global significance of the event? How did it impact past civilizations? And could the event really be a “Global Megadrought”? Limiting progress is uncertainty over the nature and spatial extent of the 4.2kyr event outside the data-rich heartland of the Mediterranean and Middle East.

In this study we investigate hydroclimate variability around the Indian Ocean basin and Middle East during societal collapse and deurbanization of the Harappan civilization in the Indus Valley between 4.2 and 3.4 kyr BP. Through a synthesis of high-resolution paleoclimate data we determine there was no summer monsoon drought during the 4.2 kyr event in the Indus Valley. Instead we document consecutive winter and then summer rainfall droughts over 800 years. Our Double Drought hypothesis provides more detailed climatic context for the Harappan civilization, resolves the cropping paradox, acknowledges societal resilience and adaptation strategies, and fits the spatial-temporal pattern of urban abandonment. The consequences for the new mid- to late- Holocene Global Boundary Stratotype Section and Point in a stalagmite from Meghalaya are explored.

Does size matter? Why some volcanic eruptions cause abrupt climate change and others do not

Gill Plunkett

Archaeology & Palaeoecology, School of Natural and Built Environment, Queen's University Belfast, Belfast Bt7 1NN

Volcanic eruptions are a leading natural cause of abrupt climate variability, arising chiefly from the scattering effects of stratospheric sulphate emissions on incoming solar radiation. With tens of eruptions occurring every year, what determines which eruptions have the potential to alter the climate system? It has long been thought that large eruptions – those capable of high atmospheric injection and with a recurrence interval of one or two per century – are the main culprits. Tephra preserved in annually resolved Greenland ice cores provides insights into which eruptions are linked to periods of documented climate and societal impacts during the Common Era. Amongst the tephras found in Greenland are those from the 946 CE Millennium Eruption, 852/3 CE Churchill eruption and 1362 CE Öraefajökull eruption (Iceland), all large events (Volcanic Explosivity Indices of 7, 6 and 5, respectively) and none of which is clearly associated with an observed climate or societal impact beyond their immediate areas. Here, I consider the characteristics of those eruptions that correspond with documented environmental effects, and attempt to identify commonalities amongst them that might provide insights into the kinds of eruptions that trigger abrupt climate change. I posit that eruption characteristics other than magnitude are critical factors in determining the climate impact of a given eruption.

Bog-timbers in Ireland: recent investigations into bog-pine provide fresh insights into Holocene climate change

Michael O'Connell

Palaeoenvironmental Research Unit, Geography, NUI Galway

Bog deal and especially pine timbers (stumps and trunks) are a feature of many blanket bogs in lowland and upland Ireland. In this lecture, data presented in recent publications, e.g. O'Connell, Molloy and Jennings 2020; O'Connell 2021; O'Connell, Jennings and Molloy 2021, will be discussed and evaluated as to its potential as an indicator of Holocene climate change, with particular reference to western Ireland.

O'Connell, M. 2021. Post-glacial vegetation and landscape change in upland Ireland with particular reference to Mám Éan, Connemara. *Review of Palaeobotany and Palynology*, 290, 104377, https://doi.org/10.1016/j.revpalbo.2021.104377

O'Connell, M., Molloy, K. and Jennings, E. 2020. Long-term human impact and environmental change in mid-western Ireland, with particular reference to Céide Fields — an overview. *E&G Quaternary Science Journal*, **70,** 1–32; https://doi.org/10.5194/egqsj-70-1-2020

O'Connell, M., Jennings, E., Molloy, K. 2021. Holocene vegetation dynamics, landscape change and human impact in western Ireland as revealed by multidisciplinary, palaeoecological investigations of peat deposits and bog-pine in lowland Connemara. *Geographies*, **2021**, *1* (3), 251–291; https://www.mdpi.com/2673-7086/1/3/15