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QUATERNARY NEWSLETTER

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Instructions to authors

Quaternary Newsletter is issued in February, June and October. Articles, reviews, notices of forthcoming meetings, news of personal and joint research projects etc. are invited and should be sent to the Editor. Closing dates for submission of copy (news, notices, reports etc.) for the relevant issues are 5th January, 1st May and 1st September. These dates will be strictly adhered to in order to expedite publication. **Articles must be submitted at least 6 weeks before these dates in order to be reviewed and revised in time for the next issue of QN, otherwise they may appear in a subsequent issue.**

Suggested word limits are as follows: obituaries (2000 words); articles (3000 words); reports on meetings (2000 words); reports on QRA grants (800 words); reviews (1000 words); letters to the Editor (500 words); abstracts (500 words). Authors submitting work as Word documents that include figures must send separate copies of the figures in .eps, .tif or .jpg format (minimum resolution of 300 dpi is required for accurate reproduction). Quaternary Research Fund and New Researchers Award Scheme reports should limit themselves to describing the results and significance of the actual research funded by QRA grants. The suggested format for these reports is as follows: (1) background and rationale (including a summary of how the grant facilitated the research), (2) results, (3) significance, (4) acknowledgments (if applicable). The reports should not (1) detail the aims and objectives of affiliated and larger projects (e.g. Ph.D. topics), (2) outline future research and (3) cite lengthy reference lists. No more than one figure per report is necessary. Recipients of awards who have written reports are encouraged to submit full-length articles on related or larger research projects.

NB: Updated guidelines on the formatting of contributions are available on the QRA website or from the editor.

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Participants in the QRA Engineering Group's North Yorkshire Field Meeting examining the 40 m cliffs at Filey Bay. *Photo: Jodie Geldard.*

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**JAMES CROLL MEDAL
PROFESSOR JAN PIOTROWSKI**

The James Croll Medal is the highest award of the QRA and is named in honour of James Croll (1821-1890). Croll is most closely associated with fundamental work on the astronomical theory of the ice ages, but he also made seminal contributions on the glacial geology of Scotland, on the mechanisms that drive ocean circulation and the impact of that circulation on recent climate, on tidal theory and the rotation of the Earth. These are all major issues that occupy Quaternary scientists to this day. Croll was effectively self-taught. His work and example demonstrate that any individuals from all backgrounds can rise to national eminence and generate science of lasting and major international impact, and that it is not who you are or where you come from but what you do that is important. These are the qualities that the QRA seeks to celebrate in the award of the James Croll Medal. The Medal is therefore normally awarded to a member of the QRA who has not only made an outstanding contribution to the field of Quaternary science, but whose work has also had a significant international impact. The QRA is pleased to announce that this year's recipient of the James Croll Medal is Professor Jan Piotrowski.

Driven by his appreciation of natural environments and outdoor experiences, Jan Piotrowski first studied geology at the University of Warsaw, Poland, and after receiving his BSc there, he moved to the University of Waterloo, Canada to work on a drumlin field for the MSc degree. Thereafter, he went to Kiel University, Germany where he conducted Quaternary and hydrogeological studies leading to PhD and habilitation degrees. After two more years at Kiel as Assistant Professor, he moved to Leipzig University, Germany as Professor of Quaternary Geology and shortly later followed a call for a professorship at Aarhus University, Denmark, where he has been for the past 25 years. In the meantime, he also worked as Chair in Sedimentary Systems at the Department of Geography, University of Sheffield, UK, and has been appointed Extraordinary Professor at the Nicolaus Copernicus University in Toruń, Poland. Besides research, Jan has also been involved in administration, notably as Head of Department at Aarhus, President of INQUA Commission on Glaciation, Secretary of the Peribaltic Group, and INQUA's Vice-President.

Ever since his graduate study at Waterloo, Jan has been conducting Quaternary research with focus on glacial geology and a main interest in deciphering the dynamics of past continental ice sheets based on the sedimentological and geomorphological record. His approach combines fieldwork in Europe, North America and Svalbard with experimental studies on subglacial sediment transport and deformation, and numerical modelling of subglacial hydrology to better understand the complexity of the ice-bed environment and glacier movement mechanisms. He has also been involved in applied geological studies mainly concerning groundwater flow dynamics in modern and past hydrogeological systems. Jan's major contributions relate to the nature of the interface between past ice sheets and their substrata seen as a mosaic of stable and deforming spots that modulate glacial erosion, transport and deposition on soft beds.

Jan has been teaching Quaternary, sedimentology,



geohazards, hydrogeology and basic geology courses in 10 countries, supervised and co-supervised 87 MSc and BSc students, 13 PhD students, published over 160 articles, organized and co-organized 27 international congresses, conferences and symposia, and gave 71 invited lectures. For the past 25 years he has been Editor-in-Chief of *Boreas*, an international journal of Quaternary research. Throughout his career, Jan has been strongly involved in collaborative research and science administration with British colleagues (e.g. 8 years on the editorial board of *Quaternary Science Reviews*). He holds the Danish order of chivalry, is member of Polish Academy of Arts and Sciences, and honorary member of Polish Association of Geomorphologists.

**HONORARY MEMBER
PROFESSOR HENRY LAMB**

Every year we nominate individuals for Honorary Membership of the Quaternary Research Association in recognition of significant, long-standing contributions to the QRA and to Quaternary science more widely. This year we are delighted to announce that we have awarded Honorary Membership of the QRA to Professor Henry Lamb.

Henry is a palaeoecologist with interests in peatlands, nature restoration and in human responses to environmental dynamics. His most recent work in eastern Africa focused on how climatic changes may have influenced the origin and dispersal of early modern humans. His route to retirement in central Ireland as Emeritus Professor at Aberystwyth, and Adjunct Professor at Trinity College Dublin, took him from Trinity (BA Natural Sciences, 1976), Minnesota (MSc Ecology, 1978) and Sidney Sussex College Cambridge (Research Fellow 1981-1983, PhD Botany 1982) to employment at Aberystwyth (Geography and Earth Sciences, 1983 - 2022).

He has worked on lake sediment records from Labrador, Morocco, Turkey, Kenya, Wales, Ireland, Japan and Ethiopia. Research on Lake Tana, the source of the Blue Nile, yielded a 250,000-year record of environmental change in the Ethiopian highlands, with implications for early human dispersal from Africa, and for the history of Egypt and the eastern Mediterranean (Lamb et al., 2007, 2018). Collaboration with colleagues in Germany, the US and the UK involved work on cores from locations close to some of the world's most important fossil hominin sites, including a 600,000-year record from Chew Bahir in south Ethiopia (Foerster et al. 2022, Trauth et al., 2024). He has also enjoyed working with Japanese, German and UK colleagues on the 60,000-year varved sequence from Lake Suigetsu, Japan (Bronk Ramsey et al., 2012; Nakagawa et al., 2021), and on high-resolution records from Central America.

He has a long-standing interest in the interface between

science and the arts, notably with Julian Ruddock (Aberystwyth), resulting in a 2022 exhibition 'The Hominin Project', based on research on Ethiopian palaeoenvironments (Ruddock, 2022). Current art-science involvement includes a project on nature restoration in partnership with Aberystwyth's School of Art, the National Botanic Garden of Wales, and the National Museum of Wales.

Henry and his wife Emma would be pleased to welcome QRA colleagues to their home, garden, apple orchard and peat bog near Athlone, central Ireland, should anyone be passing!

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**THE DOROTHEA BATE AWARD
JOURNAL OF QUATERNARY SCIENCE OUTSTANDING ECR PAPER 2024
SEAN FIELD**

We are pleased to announce that the recipient of the Dorothea Bate Award, presented in recognition of the outstanding work of an early career researcher, is Sean Field for his paper "[Climate and Community in Central Mesa Verde](#)". Sean is Assistant Professor at the University of Wyoming, having completed his PhD in Anthropology at Notre Dame University in 2023. The assessors commented that the paper is a robust examination of historical climate impacts on communities in SW USA based on a rigorous and sophisticated computational approach. The research is underpinned by an explicit and theoretically-informed scrutiny of the concept of acute drought stress and there was an excellent standard of visualisations supporting the text.

Climate and community in Central Mesa Verde

Journal of Quaternary Science (2024), 39(3), 488-504
Sean Field and Donna M. Glowaki

Periods of acute climate stress – the convergence of low subsistence yields due to poor climate conditions and ineffective buffering strategies due to climate variability – critically reduces peoples' ability to subsist and mitigate food shortages, thereby creating conditions that could result in profound social change. Here, paleoclimate reconstructions are used to identify periods of acute stress at three large Ancestral Pueblo villages in the US Southwest. These periods are examined in relation to occupation histories at each village showing that in certain instances, acute climate stress played a primary role in people's decisions to leave communities. However, not all of the communities reacted to stress in the same way indicating that distinct patterns of climate and social context played an important role in influencing how acute climate stress was experienced by different groups. Results from this study highlight the importance of community-specific histories when considering the impact of climate stress on past people.

**THE WINIFRED PENNINGTON-TUTIN AWARD
BEST BRITISH OR IRISH UNDERGRADUATE DISSERTATION 2024
MOLLY GATH**

The Quaternary Research Association awards the Winifred Pennington-Tutin Award annually to the best British or Irish undergraduate dissertation. The judges were impressed by the quality of the dissertations submitted and enjoyed reading and learning from the studies, which showcase the variety of topics that are inspiring the next generation of Quaternary scientists.

It is our pleasure to announce that the winner of the 2024 award is **Molly Gath** (Durham University) with the project *“Sedimentology and stratigraphy associated with the Late Devensian Welsh Ice Cap and Irish Sea Ice Stream: Glanllynau, Llŷn Peninsula, Northwest Wales”*. Molly’s dissertation was judged to be ‘a superb piece of research, which focuses on a critical location for understanding the Late Devensian dynamics of the Welsh and Irish glaciers. The study is fluently written, shows originality and critical awareness in the way it reanalyses a previously studied site using additional methods. The complex lithologies are presented to a high, professional standard and the findings are discussed in a balanced manner which shows a depth of understanding and makes effective use of an extensive literature.’

Two runners up were highly commended. **Dylan Flicker** (University of Cambridge) with the project *“The Upper Pleistocene Middle Stone Age Assemblage from Lon’garakak 1, West Turkana, Kenya”* and **Marcus Moon** (University College London) with the project *“Variations in carbonate preservation and grain size at the Shatsky Rise during the Late Pliocene and their relation to the intensification of Northern Hemisphere Glaciation”*.

The judges felt that Dylan’s dissertation project ‘presents clear and compelling rationale for the use of archaeological lithics assemblages to understand hominid evolution through innovations in tool production. It applies new scanning and quantitative techniques as a standardised way to explore a recent lithic assemblage, supported by clear illustrations.

The data are used very effectively to argue that Middle Stone Age communities in East Africa produced regionally distinctive tools.’

Marcus’s project was highly commended as ‘The broad geographical scope of this project makes it an ambitious topic for an undergraduate dissertation. The study demonstrates a clear grasp of the complexities of ocean-climate linkages, presents a thorough analysis of physical and chemical proxies for changing deep water currents and acidity, and shows maturity in exploring why the results contradict some initial expectations.’

The QRA are incredibly grateful to the two judges, Althea Davies (University of St Andrews) and Phil Gibbard (University of Cambridge), for giving considerable amounts of their time to review the submissions, and to Catherine Souch and the Higher Education team at the RGS-IBG for coordinating the submissions.

Abstracts

Winner: Molly Gath (Durham University) - Sedimentology and stratigraphy associated with the Late Devensian Welsh Ice Cap and Irish Sea Ice Stream: Glanllynau, Llŷn Peninsula, Northwest Wales.

Reconstructing the behaviour of palaeo-ice sheets is crucial to understanding cryospheric environments on centennial to millennial time scales. A combined sedimentological and stratigraphic approach has been employed to revise the succession at Glanllynau, Llŷn Peninsula, Northwest Wales. From this, the genetic origin of different lithofacies has been interpreted, the former depositional environment has been reconstructed, and a localised flow trajectory has been established in a regional context for the British-Irish Ice Sheet. New sedimentological and stratigraphic data provide insights concerning

ice-flow dynamics close to the suture zone of the terrestrial Welsh Ice Cap and marine-based Irish Sea Ice Stream. The multiple till sequence, separated by glaci-fluvial sands and gravels, records the advance, subsequent unzipping, retreat and readvance of Welsh ice during the Late Devensian. A subglacial traction till, containing evidence of locally plucked bedrock, was deposited by east-west ice flow over the site as part of the Cricceith Advance. Lithofacies thicken to the west where the surface is drumlinised and the upper zone was stained brown due to percolation via close contact with finer-grained deposits above. Initial phases of retreat are conducive to asymmetric ice-marginal conditions, with development of a newly recognised, local ice-dammed lake. This was followed by the Rhoslan Sandur that drained southwest from Irish Sea ice towards Glanllynau. A sandy subglacial till that caps the sequence is attributed to deposition by Welsh ice readvancing onshore. Here, the trajectory of the Arfon Readvance is more southeast to northwest than previously reconstructed. Glacitectonic deformation, such as polygonal burst-out structures, folds and thrusts identified throughout the succession, provide further evidence for more than one phase of ice-flow. Ball and pillow involutions document a period of periglacial conditions that extended beyond Snowdonia to the southern Llŷn.

Highly commended: Dylan Flicker (University of Cambridge) - The Upper Pleistocene Middle Stone Age Assemblage from Lon'garakak 1, West Turkana, Kenya

The exact origins of *Homo sapiens* remain unknown, with the scarcity of fossils available for study obscuring the region or population from which the species evolved. The relatively more continuous archaeological record may provide insights into the time during which events critical to the origins of anatomically modern humans occurred. Previous research into the archaeology of this period, referred to as the Middle Stone Age (MSA), has highlighted a difference between 'specific' regional variants and 'generic' widespread polythetic variation. The East African MSA lacks a specific variant, causing recent reviews to question if those two categories are applicable across the continent. Furthermore, numerous analyses have called attention to a possible technological shift in marine isotope stage (MIS) 5, about 130-80 thousand years ago (Ka). However, the East African archaeological record from MIS 5 is sparse. Here, I present the archaeological assemblage from Lon'garakak 1 (West Turkana, Kenya), which

has been dated to $\sim 130 \pm 6$ Ka. Located in the southwestern floodplain of Late Turkana, it is an open-air site with a rich faunal and lithic assemblage collected during surveys and excavations conducted in 2016 and 2023. In total, 190 lithic artefacts were recovered. Amongst them were 12 volumetric cores with a unique morphology. Here, I examined if that morphology was due to a shared means of production and function. The reduction sequence was remarkably consistent across the assemblage, suggesting a shared conceptual goal for their creation. The sequence calls attention to the creation and maintenance of a crest inferiorly oriented relative to the primary striking platform. This crest creates a triangular cross-section such that flakes struck from the striking platform are pointed. Further quantitative analysis of the degree of variation within the assemblage suggests very high to fairly high standardisation in the size and shape of the cores, as well as the technological choices made by their manufacturers, further supporting the hypothesis that these cores were produced to manufacture predetermined points. This analysis reveals surprising variation within the East African MSA, questioning the generic nature of the East African archaeological record and further contributing to our understanding of this critical region and time.

Highly commended: Marcus Moon (University College London) - Variations in carbonate preservation and grain size at the Shatsky Rise during the Late Pliocene and their relation to the intensification of Northern Hemisphere Glaciation

The intensification of northern hemisphere glaciation (iNHG) 2.73 Ma was a major reorganization of the global climate system, marking the transition from the relatively warm Pliocene into the cooler Pleistocene which oscillated between glacial and interglacial periods. Evidence from the Southern Ocean and the North Pacific suggests atmospheric CO₂ drawdown by the oceans played a significant role in amplifying this cooling, owing to a more efficient global biological pump which sequestered CO₂ in the ocean interior. Using the premise that higher oceanic CO₂ storage raises deep water corrosivity, this study presents foraminiferal fragment counts from ODP site 1209 in the Northwest Pacific as a proxy for corrosivity to examine the role of the Pacific in storing this CO₂. A grain size record is also presented, being used as a proxy for bottom current vigour to provide further evidence for palaeocirculation changes and oceanographic shifts. It is found that foraminiferal fragmentation levels decreased during the iNHG, alongside a shift

in grain size pattern towards consistent fluctuations between higher and lower values. This indicates that deep water corrosivity at ODP site 1209 decreased, which is the opposite of what was expected due to the coeval CO₂ flux from the atmosphere to the ocean. This unexpected change is thus attributed to ocean circulation changes occurring as part of the iNHG.

Two mechanisms are considered:

1. An increased export of noncorrosive North Atlantic Deep Water to ODP site 1209 via the Southern Ocean at the iNHG
2. An intensified North Pacific Intermediate Water production at the iNHG which would have ventilated ODP site 1209 with water low in regenerated CO₂.

It is concluded that mechanism 1 is the most likely candidate for the fragmentation decrease, with evidence from the North Atlantic and Northwest Pacific suggesting an increased interbasinal connection occurred at the iNHG.

EXPLORING GENDER EQUALITY TRENDS WITHIN THE QRA TO ESTABLISH OUR CURRENT BASELINE

Adrian P. Palmer, Laura Boyall, William J. Fletcher, Ed Garrett, Jane K. Hart, Holly N. Jenkins, Timothy P. Lane, Harold Lovell, David H. Roberts, Neil Roberts, Katherine H. Roucoux, Jenna L. Sutherland and Sophie Williams

Introduction

The QRA Executive has discussed equality, diversity and inclusion (EDI) issues regularly over the last 5-10 years, with a few notable milestones. The EDI committee was started in 2022, followed by the instigation of the new EDI Executive Officer role in 2024. The committee produced the QRA EDI statement (<https://www.qra.org.uk/equality-diversity-and-inclusion/>), incorporated “caring costs” into all QRA grants, and began a regular survey of Annual Discussion Meeting (ADM) participants. The EDI statement is an important step in continuing to co-ordinate and embed good practice within the activities that the QRA undertakes. Subsequently, QRA awards have been re-named after past members, with attention paid to gender balance, to reflect their achievements as positive role models. We have also initiated the opportunity for job-sharing of larger QRA roles to enable more people to participate and have assigned a member of the Journal of Quaternary Science (JQS) editorial board to have a watching brief on EDI issues in the journal. There have been very welcome moves to ensure ADMs are representative and respectful toward our broad membership by, for example, ensuring balance in the range of speakers presenting including different career stages, conducting panel discussions on EDI issues and collecting data on the composition of our meetings, amongst other activities. There will also be moves to generate data through questionnaires at ADMs to enable a more granular examination of the composition and needs of our membership and to help target ways to attract new members to the Association.

The purpose of this article is to examine recent trends in the organisation’s gender balance by exploring the available membership archives from the last 20-25 years. The article is broadly descriptive, explaining

how and why specific data have been targeted, and identifying some limitations that are inherent within the dataset. We then explore what these data tell us and how they might be used to establish future targets within the QRA under the EDI remit.

How were the data collected and how are they presented?

There were certain challenges in extracting representative information on gender balance throughout the 60 years of the QRA in its different guises. A recent attempt to explore how the membership has changed was difficult as specific questions about gender were not asked routinely when membership was organised via postal services, and paper membership lists were produced and distributed. Indeed, much of the older QRA archive has membership lists, but members’ forename initials were used, which are difficult to interpret in gender terms. Even with the advent of computers and electronic copies of membership lists, initials were still used. This issue should be rectified moving forwards with the new QRA website and, in conjunction with regular membership surveys, we can set benchmarks to enable more consistent comparisons and establish if interventions are having an impact on EDI within the QRA.

As a result, full membership lists that allow us to identify gender are not available. Consequently, we have pivoted to using data from awards rounds that extend back to 2002 for the Quaternary Research Small Grant (QRSG, formerly Quaternary Research Fund; Fig. 1), New Research Workers Grant (New Research Workers Award (NRWA); Fig. 2) and the Quaternary Conference Fund (QCF; Fig. 3), and back to 2003 for the INQUA awards rounds (Fig. 4). We have taken the data from the Awards Officer’s annual reports or

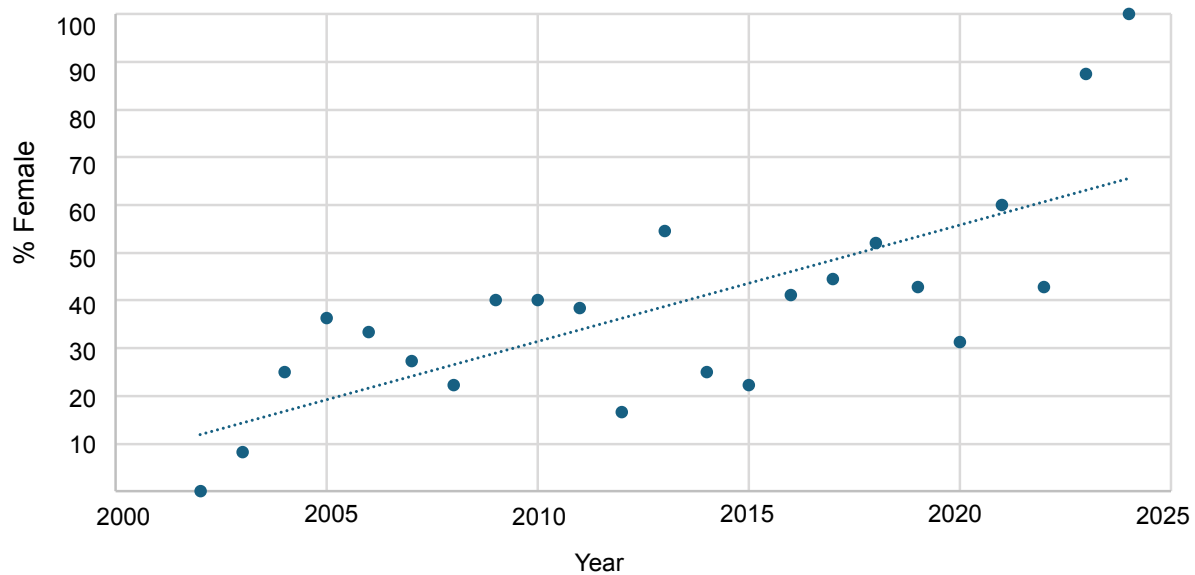


Figure 1. Gender balance of Quaternary Research Small Grant awardees from 2002 to 2024. (n = 256; mean awards per year = 12, st. dev = 5.). Blue dotted line is the linear trendline. The average for the whole period is 36% and the last 10 years sees this rise to 52% female representation.

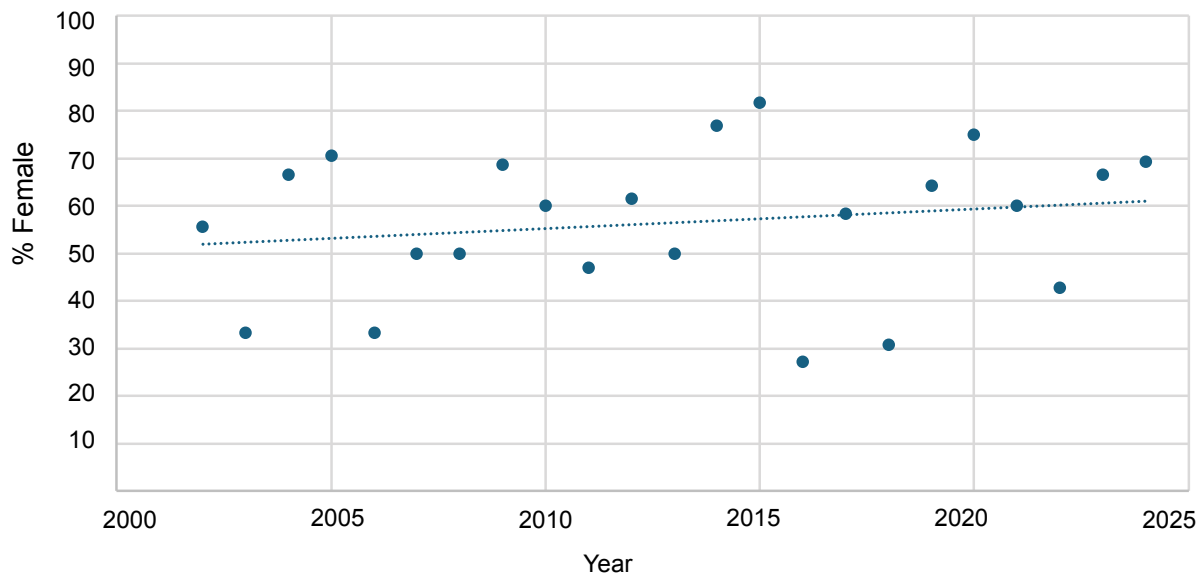


Figure 2. Gender balance of New Research Workers Grant awards from 2002 to 2024 (n = 275; mean awards per year = 13, st. dev = 4.) Blue dotted line is the linear trendline. The average for the whole period is 56% and the last 10 years sees this rise to 58% female representation.

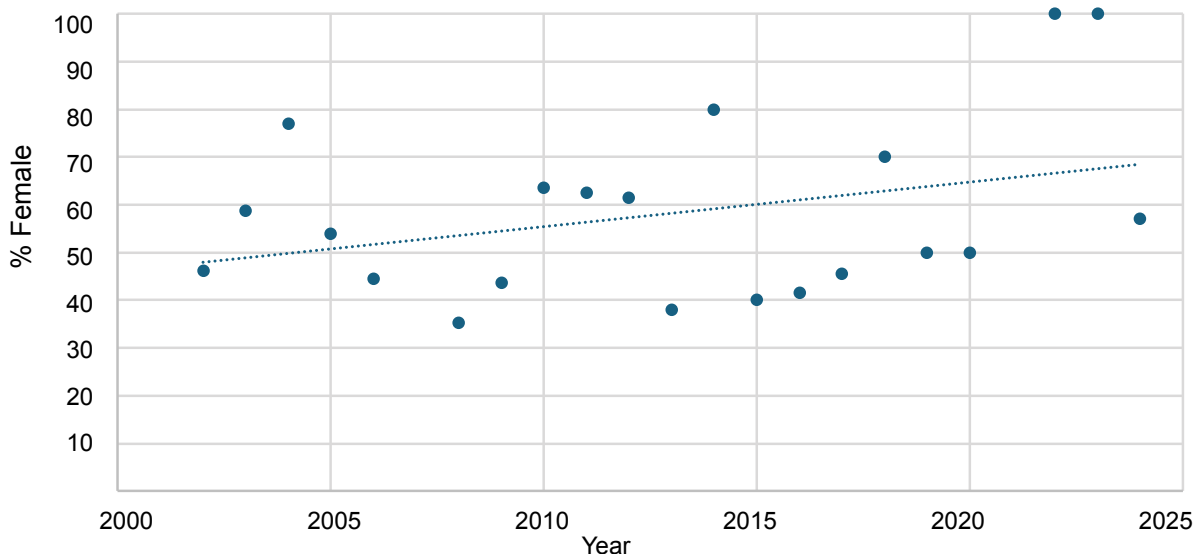


Figure 3. Gender balance of Quaternary Conference Fund awards from 2002 to 2024. (n = 247; mean awards per year = 11, st. dev = 7.). Blue dotted line is the linear trendline. The average for the whole period is 58% and the last 10 years sees this rise to 62% female representation.

explored the spreadsheets that were compiled for the awards panel to discuss applications. These data are effectively small samples of the active membership, but the largest sample size available that provides year-on-year data that were divided into groups of established researchers (QRSG; QCF), postgraduate students (NRWG), and the entire membership (INQUA fund). It is possible that the successful recipients of the INQUA funds could be skewed to early career researchers (ECRs) and postgraduates, as these groups were favoured in the decision-making process of the awards panel since they were less likely to be able to access funds from, for example, research council grants. The Postgraduate Meetings Award's data are not presented in this analysis as the sample size is very low and the total year-to-year applications vary greatly. Other assumptions include gender being based on traditional gender constructs for the first/given name, not distinguishing between overseas and home students, and only exploring successful grant applications.

In the presentation of the data (Figs. 1-6), the linear trendlines are used to guide the eye toward trends over the last 20 years in each of the categories. In the figure captions, we give the mean number of awards per year, but also provide a mean figure for the data since 2015 (10 years of awards rounds) to explore the change compared to the long-term mean with 10 years used, as this perhaps marks an arbitrary instigation point for engagement with EDI in the QRA's remit.

Gender balance in QRA awards

There are interesting trends that hint toward a healthy gender balance in the distribution of awards in the recent past. The QRSG for established academics was skewed towards male recipients in the earlier rounds of the award, but the trendline crossed 50% in 2018. There is still clearly work to do here because awards have only moved toward gender parity in the last few years, with the most recent 10-year mean at 52% female recipients (compared to a long-term mean of 36%).

The NRWG data shows that for the last two decades, the gender balance of awardees has varied considerably between years, but with an overall trend that started at around 50%, successful female applications have moved toward 60% in the last four years (Fig. 2). The long-term mean is 56% and the recent 10-year mean is 58% female awardees. A similar picture can be extracted from the QCF, with successful applicants

hovering around parity between males and females, a long-term mean of 58% female recipients, and a 10-year mean of 62% female successful applicants (Fig. 3). However, it is important to note that two recent awards rounds with 100% success for female applicants has drawn that trendline upward.

With reference to the INQUA dataset (Fig. 4), we note that these quadrennial rounds were open to the entire membership but with a positive selection process toward postgraduates and ECRs designed to support their attendance. The change in the trendline broadly mirrors that observed in the QRSG analysis with successful female applicants shifting from 30% to 70% since 2003. Whether this points to the strategy of supporting ECRs being successful or rather a shift in the gender balance of the association is not clear but should continue to be monitored. The recent increases of female applicants to the grant might reflect a wider imparity of access across the discipline to funding in general that includes conference participation. Awards Officers have also noted recently that female QRA members generally applied for a smaller percentage of their total costs. The reasons merit further exploration but hint at deeper gendered differences around grant application strategies and perception of barriers.

The picture presented from these data suggests that currently the QRA has a good gender balance in the recipients of awards in the postgraduate community and in the awards for the more established researchers. There is a clear shift away from a male dominance of QRSG awardees two decades ago, whilst the number of successful awards for NRWGs and QCF have always shown a good gender balance. Gender data that were available from past student lists of the MSc Quaternary Science/Past Climate and Environmental Change course at Royal Holloway, University of London provides some insight into how its gender balance has evolved in a comparable period. These data show a similar trend to the NRWG and QCF (Fig. 5), perhaps indicating a shift to a greater number of female MSc students over the last three decades, which might be the key factor seen in the shift in the NRWG awards. However, this does complicate our understanding of the factors driving the historically greater uptake of QCF by female QRA members in comparison to the QRSG. Whether this was driven by perceived barriers that inhibited applications to the QRSG, an unconscious bias in the awarding of grants, or a transition in the gender balance of the organisation in the early part of this census period, is quite difficult to establish without testimony from those members

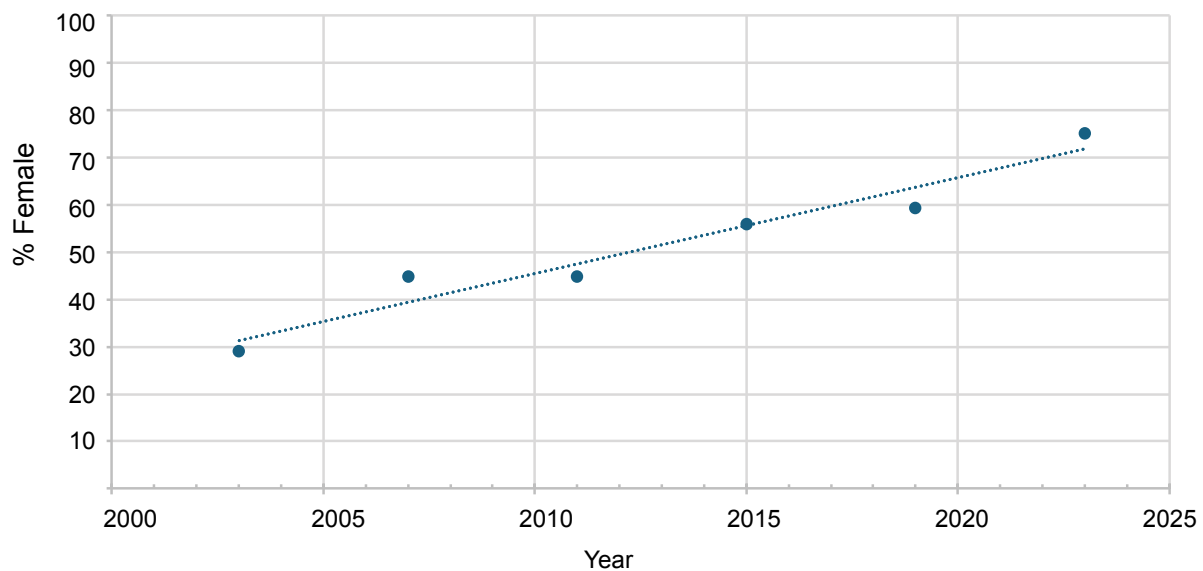


Figure 4. Changes in gender balance of INQUA awards from 2003 to 2023. (n = 259; mean = 43, st. dev = 20.)

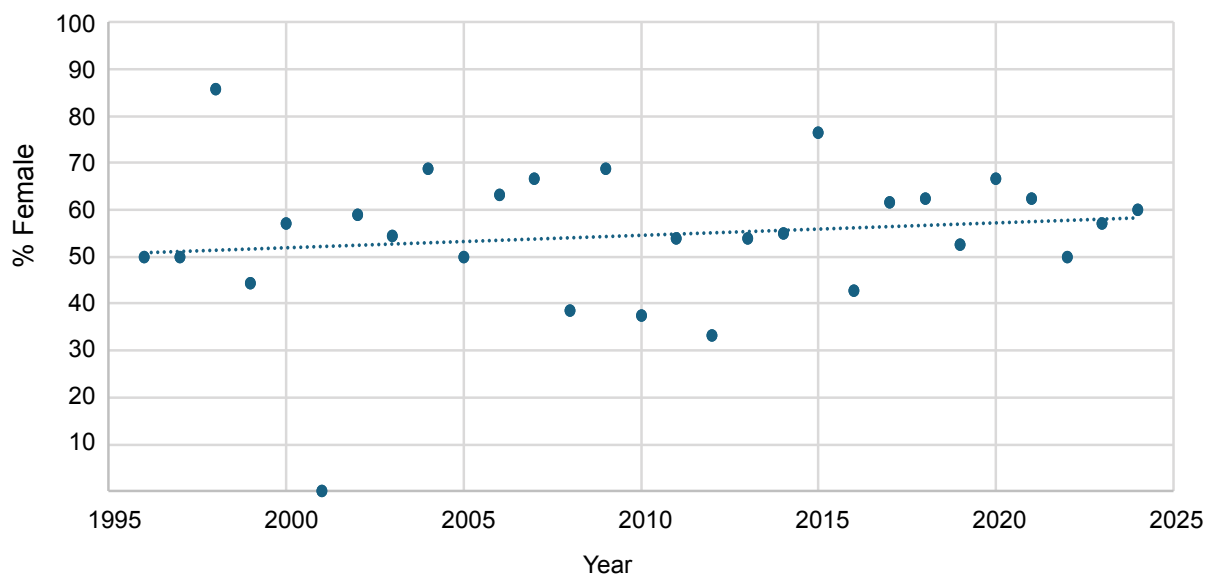


Figure 5. Gender balance of MSc Quaternary Science / Past Climate and Environmental Change students, Royal Holloway, University of London, since 1996 (% Female). Blue dotted line is the linear trendline. The average for the whole period is 54% female students and the last 10 years sees this rise to 58% female students.

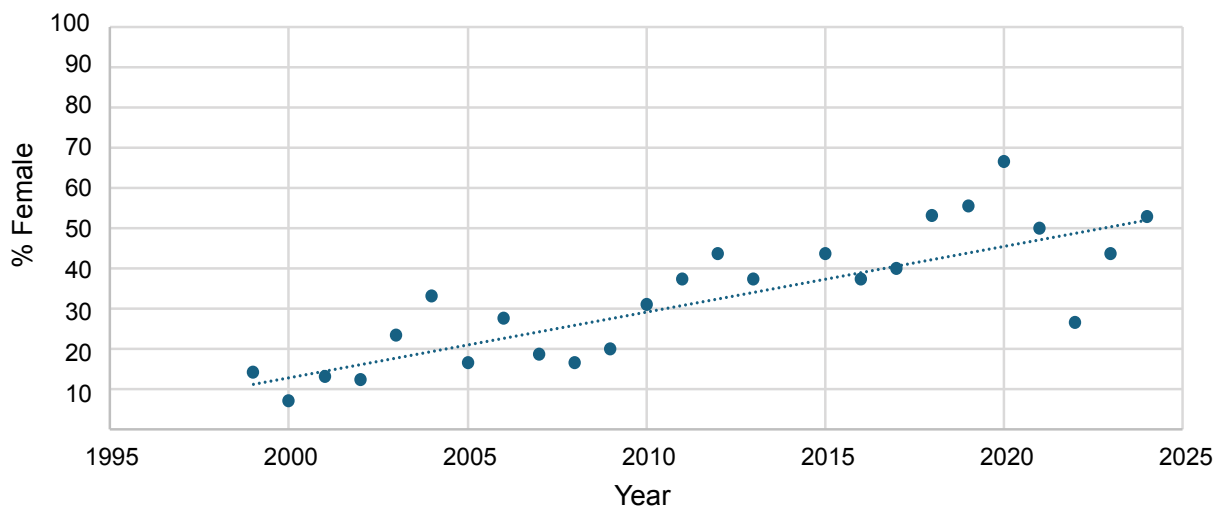


Figure 6. Gender balance of QRA Executive Committee since 1999. Blue dotted line is the linear trendline. The average for the whole period is 32% female committee members and the last 14 years sees this rise to 47% female representation.

at the time. However, the current distribution in the QRSB awards suggests that the pipeline does not have substantial leaks in it currently. Indeed, the QRA strategy of supporting postgraduate activities through the postgraduate symposium combined with research and conference grants over the last 20 years might be enablers to retaining people within the subject.

There are other indicators of gender balance within the sphere of the QRA awards schemes, although with lower sample sizes. These are i) the James Croll Medal, with 27% female winners (n = 15), ii) the

Lewis Penny Medal, with 25% female winners (n = 16), and iii) the Winnifred Pennington-Tutin Prize, with 55% female winners. There are many factors that contribute to this imbalance in the first two medals, driven by a male-dominated academy in the mid- to late- 20th century being recognised with the more senior awards, but there may also be a link to the gender of nominators and broader issues within academia associated with the transition from ECR to established academic.

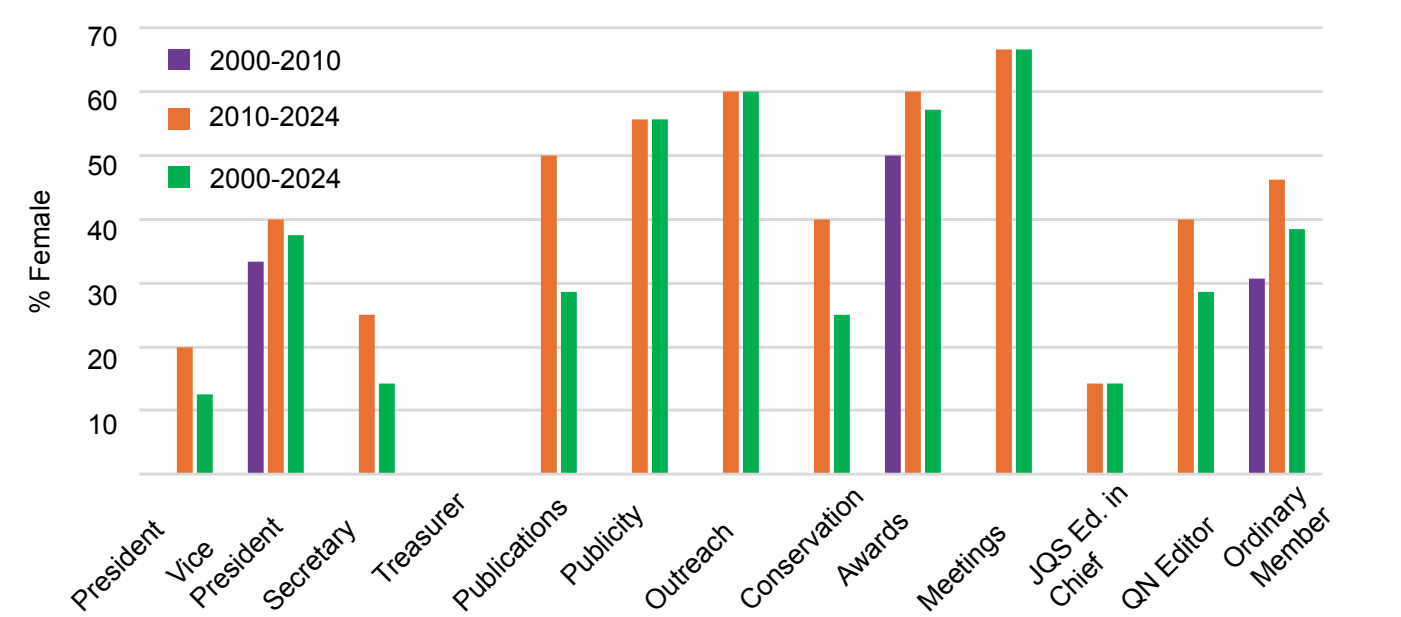


Figure 7. QRA Executive Committee gender balance by role (% Female) since 2000. Postgraduate and EDI Officer roles have not been included.

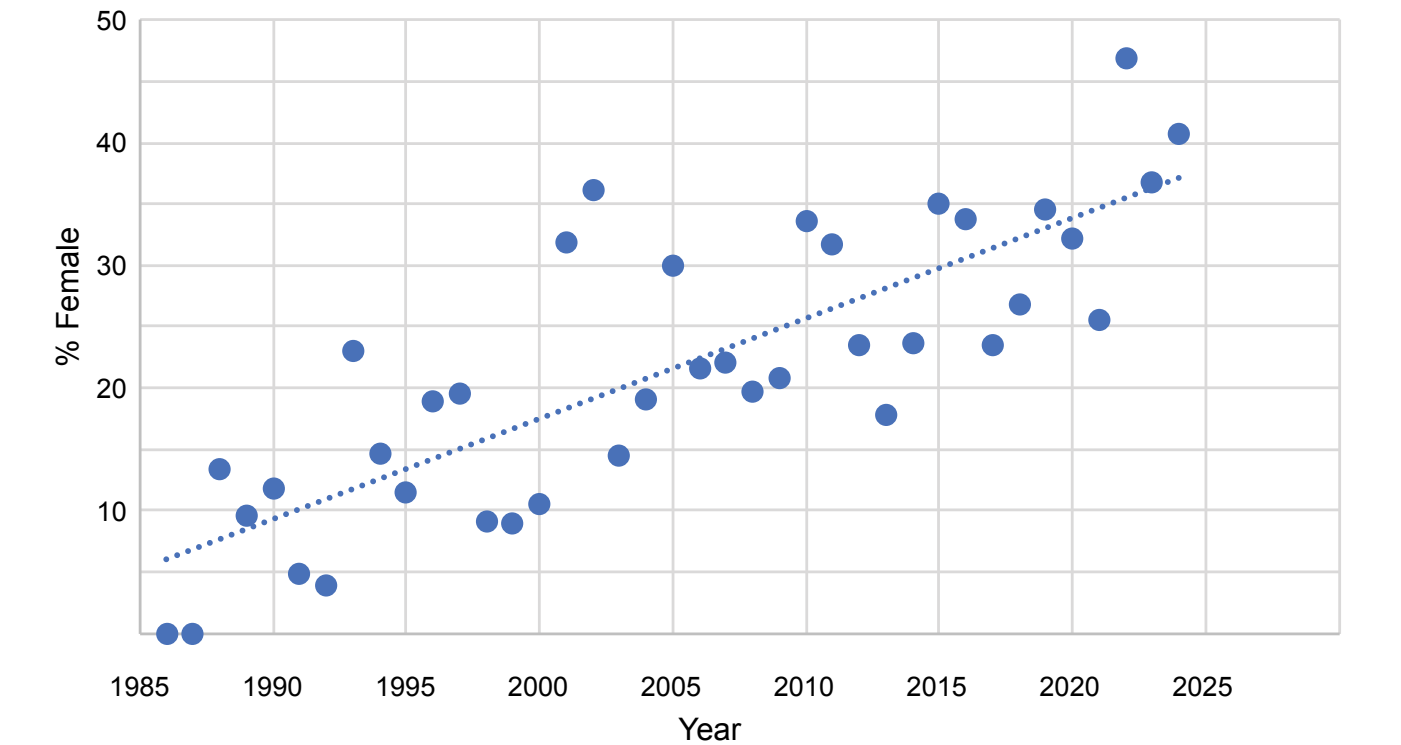


Figure 8. Annual proportion of Journal of Quaternary Science articles with female lead authors.

Gender Balance in the QRA Executive Officers

Other data about the gender balance of the QRA can be extracted from the composition of the Executive of the QRA since its inception. This analysis takes two forms: i) the gender balance since 1999 using minutes of Executive Meetings in the autumn of each year where available (Fig. 7). There are no data yet for 2014 and the specific time window was used to allow some comparison to the Awards rounds information presented above and uses first name to assign gender; ii) a breakdown of gender (% Female) in the Executive roles between 2000 and 2010, and then between 2010 and 2024 to explore recent changes (Fig. 8). In both instances, the terms of different roles range between 3-5 years and therefore examining year-to-year changes is a form of moving average.

The overall composition of the executive committee has evolved over the last 25 years in a similar trend to the QRSG, reaching parity in the last five years. There is clearly some work required to sustain this balance in the immediate future by ensuring that members feel that they can be nominated and contribute to the QRA's work. To help with this, it would be interesting for the EDI sub-committee to explore what the specific barriers are for QRA members when considering whether to volunteer for Executive Officer roles, e.g. workload, work-life balance, career stage and level of establishment etc.

Further work is required to move towards gender parity in certain Executive Officer roles (Fig. 7). Between 2000-2010 only the Vice-President, Awards and Ordinary Member roles had female representation; however, since 2010, there have been major changes in female representation in the Executive Officer positions, with Vice President, Publications, Publicity, Outreach, Awards, Meetings, QN Editor and Ordinary Members all being $\geq 40\%$. Whilst the President, Vice-President, and Secretary roles have had a high amount of male representation in the last 24 years, there is a recent shift to a higher percentage of females in these roles. There has been a single female Treasurer (Hillary Davies (1980-1984)) but none have served on the Executive in this sample period since 2000. The changes observed here might appear to lag the changes that are seen in the Awards data (Figs 1-4) and the composition of the MSc course at Royal Holloway (Fig. 5) and going forward it will be important to maintain a gender balance on the Executive across the portfolio of roles available.

JQS: historic trends in author gender

A longer time series of changing gender balance within QRA-related activities can be extracted from examining the first author gender of JQS articles. JQS began publication in 1986 as the "house journal" of the QRA. Initially, around a dozen papers were published each year, rising to ~90 by 2010. Data on author gender have not been collected as part of manuscript submission. The gender of lead authors has therefore been manually derived from the 2,275 articles published by JQS over the last 39 years based on traditional gender constructs for the first/given name.

The data do not include book reviews, correspondence or editorials. In around 11% of cases, it was not possible to obtain gender information easily, and thus lead author gender was classed as "unknown". This analysis, summarised in Figure 8, shows an upward trend from 0% female lead authorship in the first two volumes of the journal (with the lead author gender of two articles "unknown") to around 40% today. Because of the additional papers where gender was "unknown", the true proportion of female authors is likely to be slightly higher than this figure. This gradual rise reflects the increasing contribution of female researchers to Quaternary Science over recent decades, especially for ECRs, where there is now broad gender parity. At an editorial level, progress with gender parity has been slower, with the first female associate editor of JQS only being appointed in 2023, and the first female editor-in-chief appointed in 2025.

Summary

Overall, this paints a broadly positive picture of changes in gender balance across the range of activities in the QRA over recent decades. It is accepted that this is a quick and selective 'snapshot' of where the association is at this census point, with clear data limitations. However, it has proven to be an extremely effective exercise in highlighting the gaps in our data and identifying how we might want to collect data in a more targeted fashion in the future. Another level of analysis might explore in more granular detail the balance of funds awarded to established academics compared to ECRs. In terms of absolute numbers, successful awards slightly favour New Research Workers (ECRs), but not to a great extent. It is also important to recognise that whilst the composition or demographic balance has improved based on raw

figures, future work should explore more deeply the experience, perceptions and motivation of different genders in their interactions with different parts of the Association's activities.

As outlined at the start of this article, this should be seen as an essential starting point and will enable easier monitoring on a year-to-year basis to ensure there is no slippage in the positive trends that are displayed here. There might be scope to explore, if available, other related societies' gender datasets to examine if these trends are being experienced elsewhere, and equally if specific interventions enacted by the other societies have created a marked impact in outcomes. It will also be important to measure and monitor the impact of targeted practical measures that the QRA have introduced, such as the building in of funds for caring responsibilities into grants. Moving forward, EDI priorities should be focused on improving diversity within the Association more generally to help open the discipline to a wider talent pool. As always, we are very happy to discuss comments and ideas on these data with members; please pass these onto the EDI Officer or any Executive Officer.

**RESPONSE: THE PROVENANCE OF THE LIMESLADE IGNEOUS ERRATIC:
A MATTER OF NO IMPORTANCE?**

Brian John

A short article published in QN 162 contained some preliminary information on a large erratic igneous boulder found by Phil Holden on an intertidal rock platform in Limeslade Bay, Gower (John, 2024) (Fig. 1). The report included pXRF data provided by Dr Steve Parry and the late Prof Tim Darvill, and there was an assessment of its importance in the debate about the glaciation of the Bristol Channel. In the section on the possible origins of the boulder, the shortcomings of just three readings from one rock sample from the boulder were fully recognized, and the author looked forward to seeing more intensive and detailed analyses of other samples by other researchers. To quote (p 7): *“There is inadequate data for the creation of scatter diagrams or bivariate graphs involving the Limeslade boulder ppm readings. So it is not possible at present to say that the pXRF readings occupy a different visualised “compositional space” for trace elements than the readings for the Preseli tors.”*

In a comment published in QN 163, Pearce et al (2024) refused to accept the work as a valid starting point for future research, and subjected the note to a detailed and highly patronising scrutiny, while in the process questioning the competence of three geologists whose views about candidate provenances were accurately reported, and referring to the “ignorance” of the present author.

There is a certain irony in seeing so much synthetic fury directed by Pearce et al (2024) towards a matter which they claimed to be of so little consequence. They stated (p 17): *“The descriptions in John (sic) are based on transmitted light microscopy only, and hence miss the opportunities provided by total petrography.”* That is a statement of the obvious, in a situation controlled by financial and practical considerations. The original article was a short note, and not a doctorate thesis or a multifaceted research

report. Pearce, Ixer, Bevins and Scourse are no doubt experts in their chosen fields, and if they had wished to do so, with adequate resources behind them, they could have collected their own samples and subjected the Limeslade boulder to their own detailed scrutiny. People in greenhouses should maybe not throw stones. In the first paragraph of their critique, Pearce et al (2024) took exception to a reference to the “Irish Sea Glacier” where they considered that the term “Irish Sea Ice Stream” should have been used instead. This is not exactly a matter of great importance, since many researchers use the two terms more or less interchangeably, and have done for many years. The assumption that the term “Irish Sea Glacier” should correctly be used strictly for the segment that passed through the Cheshire Gap into the north Midlands is misguided (Scourse et al, 2019, 2021). The term “ice lobe” is much more appropriate, and indeed the term “ice piedmont” is more appropriate for the segment that occupied the Celtic Sea arena (John, 1968a, 2018). There is no consensus, and it is pedantic to pretend that there is.

In their section on geochemistry and petrogenesis Pearce et al (2024) subjected the initial pXRF findings of Parry and Darvill to minute and very hostile criticism. They accused the present author of having a preferred narrative driven by preconceptions, of ignoring clear and contradictory information, and of being ignorant of geological and geochemical processes. There is a deep irony here, since these accusations come from a team which has, over the last decade, refused to cite any “inconvenient literature” or to accept that any of their ideas are questioned or disputed by anybody else (Bevins et al, 2022, 2023; Ixer & Bevins, 2017; Pearce et al, 2022; Parker Pearson et al, 2021). No doubt many of their points were valid, but instead of accepting the pXRF work as a useful but limited initial contribution they



Figure 1. The igneous erratic boulder discovered by Phil Holden in the intertidal zone on Limeslade Beach, Gower. (Photo: the author)

descended into what can only be described as an *ad hominem* attack. This is deeply disappointing.

In a complex and convoluted discussion of rock samples from the Limeslade Boulder, Carn Meini and Carn Goedog, Pearce et al (2024) claimed to have characterised certain Preseli sills and to have discovered just a narrow range of compositional variations related above all else to changes within vertical profiles and differential cooling rates. They disputed the claim that there are substantial lateral variations across the Carn Meini intrusions which are visible to the naked eye. They claimed that there was great consistency in the scatter of plotted points on their bivariate graphs. The present author disagrees, and sees wide variations in the plotted results (Bevins et al, 2014). Carn Meini is an association of tors spread across a wide area. These tors may or may not all belong to the same sill (Kokelaar et al, 1984; Burt et al, 2012; Bevins et al, 2014; Potts et al, 2006; Jones et al, 2005), and visible changes in the appearance of surface exposures of spotted dolerite may even be related to multiple conduits feeding

magma from one magma chamber, or several, into a series of interconnected sills (Merriman et al, 1986). Pearce et al (2024) accuse the present author of being driven by preconceptions and arguing that their data are incorrect. That is strongly refuted. The concerns raised within the Limeslade note (John, 2024) were not related to the data, but to the interpretations.

In the second part of their article, with reference to the Stonehenge bluestone transport debate, Pearce et al (2024) accused the present author of “a polemic against the advocates of human transport (e.g. Parker Pearson et al., 2021)”. There is no such polemic. The assessment of the human transport thesis (on pp 10 and 11) was carefully phrased, and constituted a straightforward review of the narrative developed over the last fifteen years by Parker Pearson and his colleagues (Parker Pearson, 2012, 2016; Parker Pearson et al, 2015, 2021). Indeed, the comments made by John (2024) were validated by the dramatic retreats made by the team members from the spectacular claims about quarries and lost stone circles which they were making just a few years ago.

These retreats (for example on Waun Mawn, Craig Rhosyfelin and Carn Goedog) are well documented (Bevins et al, 2022; John, 2024; Parker Pearson et al, 2022).

The latter part of the Pearce et al (2024) comment concerned the glaciation/sea ice transport issue, and it is necessary to take issue with many of their key points. They provided no field evidence from West Wales relating to the Quaternary stratigraphic sequence or to inferred environmental changes. They sought from the outset to minimise the significance of the Limeslade erratic, stating that it is “simply another giant erratic” and “in no way exceptional”. Nobody has ever claimed that it is extraordinary. There are indeed hundreds of other erratics in SW Britain found inside and outside the modern intertidal zone, but this is the biggest “Irish Sea” igneous erratic yet described on the north shore of the Bristol Channel, and it demonstrates that the Irish Sea Ice Stream was so powerful, at one time, on its northern flank, that it crossed the coast of the Gower Peninsula, blocking or

deflecting ice flowing southwards from the Welsh Ice Cap. This was confirmed by Kokelaar (2021), who reported on a coarse-grained diorite erratic (possibly from northern Britain) at Reddenhill (SS 535 893) and a coarse-grained dolerite erratic found at 61m above sea level at Caswell Bay (SS 595 878), assumed to have come from north Pembrokeshire. He mentioned erratics at Western Slade on the shore platform that were purported to include volcanic conglomerates from Skomer Island. At Limeslade the presence of abundant smaller dolerite boulders and cobbles in the immediate vicinity of the large erratic suggests that there was once an erratic cluster here, or a glacial deposit on the local rock platform, subsequently destroyed by wave attack and other coastal processes (Fig. 2).

Pearce et al (2024) also questioned the suggestion that Cader Idris, Llyn and Snowdonia might be considered as candidate sources for the Limeslade boulder, stating “none of them would likely be a potential source”. On the contrary, given what we know about



Figure 2. Smaller sandstone and igneous erratic boulders found in crevices near the large Limeslade boulder. They are petrographically varied, and include ORS cobbles, suggesting the presence at one time of a suite of erratics carried in from the west. (*Photo: the author*)

the flowlines of the Irish Sea Ice Stream, some Bristol Channel erratics could perfectly well have come from North Wales.

Looking further afield at the Bristol Channel as a whole, it was suggested by Pearce et al (2024) that Scourse (2024) had provided a mechanism for the emplacement of coastal erratics by ice rafting “*arising from the asynchrony between Early and Middle Devensian regional ice sheet development and global sea level.*” Indeed he has, but the hypothesis needs to be supported by hard evidence in the field, and the evidence from the southern Irish Coast of contemporaneous periglacial or glacial conditions and adjacent beach formation is not entirely convincing. Thus far no evidence has been produced from West Wales, Devon or Cornwall which might suggest that some raised beaches are of Early or Middle Devensian age, formed at a time when RSL was at least 80 m lower than it is today. On the contrary, there is abundant evidence that the raised beaches are

for the most part interglacial (George, 1932; John, 1968b; Jenkins et al, 1985; Bowen, 2005; Shakesby and Hiemstra, 2015).

Scourse (2024) failed to provide any mechanisms or processes by which the coastal erratics were supposedly transported by floating ice. Ice floes made of sea ice are generally clean, and do not transport glacial detritus. Exceptions occur in situations such as the St Lawrence River in Canada, where freezeup and tidal processes combine to pick up, transport and deposit thousands of tonnes of sediment (including boulders) every year (Marie, 2022). In fjords, pro-glacial lakes and embayments where there are calving ice fronts, dirty tabular icebergs run deep and may initially float free. The great bulk of detritus is dumped close to the glacier calving front as icebergs adjust their positions and reduce in size, while isolated dropstones may be dumped onto more distant sea floor sediments and occasionally onto mud flats in the intertidal zone. Bergy bits may end up on



Figure 3. Assorted igneous and metamorphic glacial erratics found on a washed surface on Rödlöga Storskär in the Stockholm Archipelago, Sweden. This surface has been lifted clear of the water by isostatic rebound within historical time, and surrounding sediments have been washed away. There is no reason to assume that any of these erratics have been transported by floating ice. (Photo: the author)

coastal rock platforms, after dropping most of the large boulders they may have transported further out at sea. Catastrophic meltwater transport of boulders is generally associated with the spring melt in large polar rivers (such as the Yukon or Tanana Rivers in Alaska) or with the sudden drainage of substantial ice-dammed lakes. However, in almost all of the cases known to the present author, large boulders on washed surfaces appear to be derived from *in situ* glacial deposits destroyed by tidal scouring and wave action (Fig. 3). The ice rafting hypothesis is in general surplus to requirements.

It is accepted that isostatic responses to ice loading can be quite sensitive, but it is doubtful that the Pembrokeshire Peninsula could have carried an ice load about 300 m thick, sufficient to account for dramatic ice loading in Early or Mid Devensian (MIS 3 - 4) times. It is even more doubtful that the north coasts of Devon and Cornwall could have experienced contemporaneous crustal depression of between 80 m and 100 m. On the contrary, it is more likely that these coasts were actually raised because of the forebulge

effect (Bradley et al, 2023).

In spite of the fact that far-travelled glacial erratics occur well above the coastal platforms on the south shore of the Bristol Channel, and up to an altitude of at least 80 m, Pearce et al (2024) persist in the view that ice rafting mechanisms can explain the presence of the “vast majority” of boulders. They suggest the involvement of “grounded ice” or glaciolacustrine conditions in some locations. They also suggest that outside the Barnstaple - Croyde Bay area, the evidence of direct glaciation is “equivocal”. However, the evidence is no more equivocal than it is elsewhere on the Bristol Channel coasts. For example, the south Pembrokeshire cliffs are capped in places by patchy till, but there are stretches where there are no obvious traces of glaciation, because glacial depositional processes do not operate uniformly across the landscape. On cliff ramparts in a dynamic or high energy maritime environment, circumstances favourable for long-term glacial deposit survival are few and far between.



Figure 4. A segment of the Whitesands “boulder bed” near St Davids, Pembrokeshire. The bulk of the boulders are interpreted as lag boulders washed out of pre-Ipswichian glacial deposits at a time of interglacial high relative sea level. (Photo: the author)

Many past researchers who have examined exposures at sites including Fremington, Trebetherick, and the Isles of Scilly were content to describe certain diamictons as unaltered or degraded tills, associated with active glacier ice (Stephens, 1998; Clarke, 1969; Evans et al, 2012; Gilbertson and Hawkins, 1978). With reference to the glacial deposits of the Croyde area, Madgett and Inglis (1987) stated: *“.....the presence of erratics in these deposits is taken by the authors as supporting evidence for a former cover of till at higher levels in the Croyde area, now destroyed by periglacial and interglacial erosion. The Ramson Cliff epidiorite (Madgett and Madgett, 1974) may represent the last trace of such a cover at its former altitude.”* Further, according to Bennett et al (2024) *“.....the ice from both the Irish Sea and South Wales did not penetrate far beyond the present north Devon and Somerset coast. Presumably the relatively easily deformed marine deposits flooring the Bristol Channel allowed the ice to flow along or across the valley until reaching the resistant rocks on today’s northern coast of Devon.”* In the light of these conclusions it is a mystery why Pearce et al (2024) have been so reluctant to acknowledge that active glacier ice can have had anything to do with the abundant erratics on the Bristol Channel coasts (Fig. 4).

Here, scores of large erratic boulders associated with the “Whitesands boulder bed” rest on the modern beach around HWM. Others rest on an ice moulded bedrock surface of black shale, and are incorporated into a brecciated cemented layer and sandrock. This association is typical of the “Ipswichian raised beach” sequence. The boulders are overlain by uncemented slope breccia and glacial deposits including Irish Sea till. They must have been emplaced in glacial deposits prior to the last interglacial and then “washed out” at a time of higher relative sea level. There is no reason to think that floating ice had anything to do with any part of the Whitesands sedimentary sequence.

On the dating of glacial events, Pearce et al (2024) referred to the present author’s “contention” that these were associated with the Anglian Glaciation. Reference is indeed made in the text to the Anglian (MIS 12) glacial episode, but if Pearce et al had investigated further they would have discovered that the present author is no more wedded to the Anglian than anybody else, and that he has indeed suggested a Wolstonian age for a large pre-Ipswichian ice advance (John, 2019), in line with the most recent assessments of Gibson and Gibbard (2024) and Bennett et al (2024).

A Pembrokeshire coastal exposure which has a bearing on this issue can be seen at Whitesands, near St David’s.

Pearce et al (2024) stated that there is no evidence to extrapolate an ice transport route eastwards from the



Figure 5. Postulated ice edge for the Wolstonian (?) Glaciation, incorporating a Somerset ice lobe (Based on Gilbertson and Hawkins 1978 and an Earthwise (BGS) base map).

western Mendips towards Stonehenge. This implies that they do not accept the presence of a glacial diamicton at Greylake in Somerset (Hunt, 2006) or the evidence of ancient glacial deposits on Bathampton Down (Kellaway, 1971, 2002). Admittedly the origins and age of those deposits are debated and disputed, but more to the point they need to explain why ice from the Irish Sea Ice Stream can have left its traces at Kenn, Yew Tree Farm, Court Hill, Portishead Down and other localities up to c 80 m asl without first filling the substantial lowland of the Somerset Levels (Gilbertson and Hawkins, 1978). Reconstructed ice surface gradients suggest an ice margin — maybe on more than one occasion — at least 50 km inland from the current Somerset coast. This is supported by some of the more realistic glacier modelling studies (Boulton and Hagdorn, 2006; Hubbard et al, 2009; Patton et al, 2017; Clark et al, 2022) (Fig. 5).

Finally there is the parting shot (p 19) on the matter of John (2024): “*This article merely represents a disingenuous cover to justify a rehearsal of the now well-worn and increasingly tedious debate concerning transport of the Stonehenge bluestones.*” Nothing can be further from the truth. The article as published was expanded and fashioned in response to the constructive comments of the journal editor and referee. The “tedious debate” to which Pearce et al (2024) refer has been fuelled and perpetrated by a stream of journal and popular science magazine articles which they themselves have written, many of them recycling the same basic data, designed to promote the hypothesis that the Preseli bluestones at Stonehenge were targeted, quarried and transported by our Neolithic ancestors. It is unfortunate that they are apparently unprepared to accept that others might question both their evidence and their interpretations.

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QRA ENGINEERING GROUP NORTH YORKSHIRE FIELD MEETING
24TH – 27TH OCTOBER 2024

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The QRA Engineering Group field meeting on glacial sediments, sea-level change, landsliding and offshore ground models was held in Scarborough between the 24th and 27th of October 2024. The meeting was well attended, with 38 delegates from academic and industry backgrounds (Figure 1), and provided an important opportunity for informal discussions at a variety of sites around Scarborough, Filey and the North York Moors.

The meeting convened in the Victoria Room of the Grand Hotel, Scarborough where Paul Fish (Jacobs) gave the introductory talk. The North Yorkshire coast was introduced in presentations by **Jonathan Lee (BGS)**, who provided geological context to the area, and **David Roberts (Durham University)**,

who talked about the glacier history of the North Sea sector of the British and Irish Ice Sheet (BIIS) and the work of the BRITICE-CHRONO consortium.

Friday morning began in the fog at Flamborough Head (Figure 2) where **Jonathan Lee (BGS)** gave a site introduction overlooking the bay at North Landing [TA 23952 72026]. The bedrock here is composed of Welton and Burnham Chalk with continuous flint horizons and marl seams visible in the cliffs. The bay's location is due to the west-east faulting of the chalk beds. Conjugate jointing visible in the chalk cliffs shows evidence for Late Cretaceous to Miocene tectonics (Mortimore, 2019). Although the chalk here is very frost susceptible, it is harder than lithologies further south and only one chalk raft has been



Figure 1. Group photo at Cayton Bay (Photo: John Davis/Andy Emery).



Figure 2. Flamborough Head. A) Overlooking the bay and chalk cliffs with conjugate jointing at North Landing; and B) Dayton Dove discussing the offshore bathymetry [*Photos: Jodie Geldard*].

identified in the bathymetry offshore from the site. A till sequence on top of the chalk has strong Jurassic and Carboniferous lithology, containing both local (flint and chalk) and far-travelled lithologies (Scottish erratics). Dayton Dove (BGS) presented an extensive bathymetric dataset of the offshore area (Figure 2b) which has been combined with seismic data and cores to produce a map the surficial sediments and bedrock. The bathymetric data shows a series of offshore ridges to the south of Flamborough Head that are formed of boulders and gravel. These ridges were initially thought to have a glacial origin, however, since they closely follow the coastline, they are now interpreted to be palaeo-shoreline features.

David Roberts (Durham University) led the Friday afternoon excursion to Filey Bay [TA 12426 81542] which represents the onshore margin of the BIIS North Sea Lobe. Jurassic-age Corallian Limestone bedrock crops out at the base of the cliff and shows clear striations (Figure 3e) indicating north-south flow over the low bedrock ridge of Filey Brigg. The thick (~ 40 m) diamict deposits (Figure 3) which make up the cliff sections here have raised important questions surrounding how such a substantial sequence could form when contemporary subglacial traction till analogues are an order of magnitude thinner (Evans et al., 2024). Recent reappraisal of the Filey Bay diamict sequences (Evans et al., 2024) has addressed these questions and highlighted issues with labelling large diamict deposits as ‘till’. The basal 3 m of the cliff are composed of dark grey stratified deposits which display open and recumbent folding locally (Figure 3d). Laterally continuous units within this basal sequence can be identified by slight changes in grain size, colour and the presence of gravel lags. This lower sequence (0 – 3 m) is interpreted to be

formed by subaqueous debris flows that occurred down a shallow distal fan in a proglacial lacustrine setting (Lake Pickering), with folding occurring during or shortly after deposition. Boreholes just inland of Filey Bay record laminated lake deposits from this proglacial lake. Within the basal stratified unit is a feature (~ 2 m x 2 m) with upturned, slightly folded beds [TA 12218 81230] (Figure 3b). This is interpreted to be a hydrofracture formed as a result of over pressurised pore water within the stratified sediments during ice advance over the site. Above the basal deposit are a series of diamict units interrupted by sequences of stratified material and gravel lags with concave bases. These are interpreted as a subglacial environment where the formation of subglacial traction tills was interrupted by deposition within meltwater conduits (Evans et al., 2024). The Filey Brigg sequence at Filey Bay represents the change from ice distal to ice proximal conditions, with local ice marginal oscillations leading to the emplacement of a substantial stacked diamict sequence (Evans et al., 2024).

Friday evening began with **Jenna Sutherland (Leeds Beckett University)** who introduced an equality, diversity and inclusion (EDI) survey for the meeting. **Bethan Davies (Newcastle University)** then highlighted the upcoming QRA ADM in Newcastle (6th to 9th of January 2025) and encouraged everyone to attend. The evening discussion session, chaired by **Natasha Barlow (University of Leeds)**, highlighted applications of Quaternary geoscience to engineering. The first presentation was given by **Leah Arlott (RWE)** titled ‘Ground models for offshore wind, or “what makes engineers cry?”’. Leah introduced the likes and dislikes of geotechnical engineers working on offshore windfarms. Spoiler alert! They

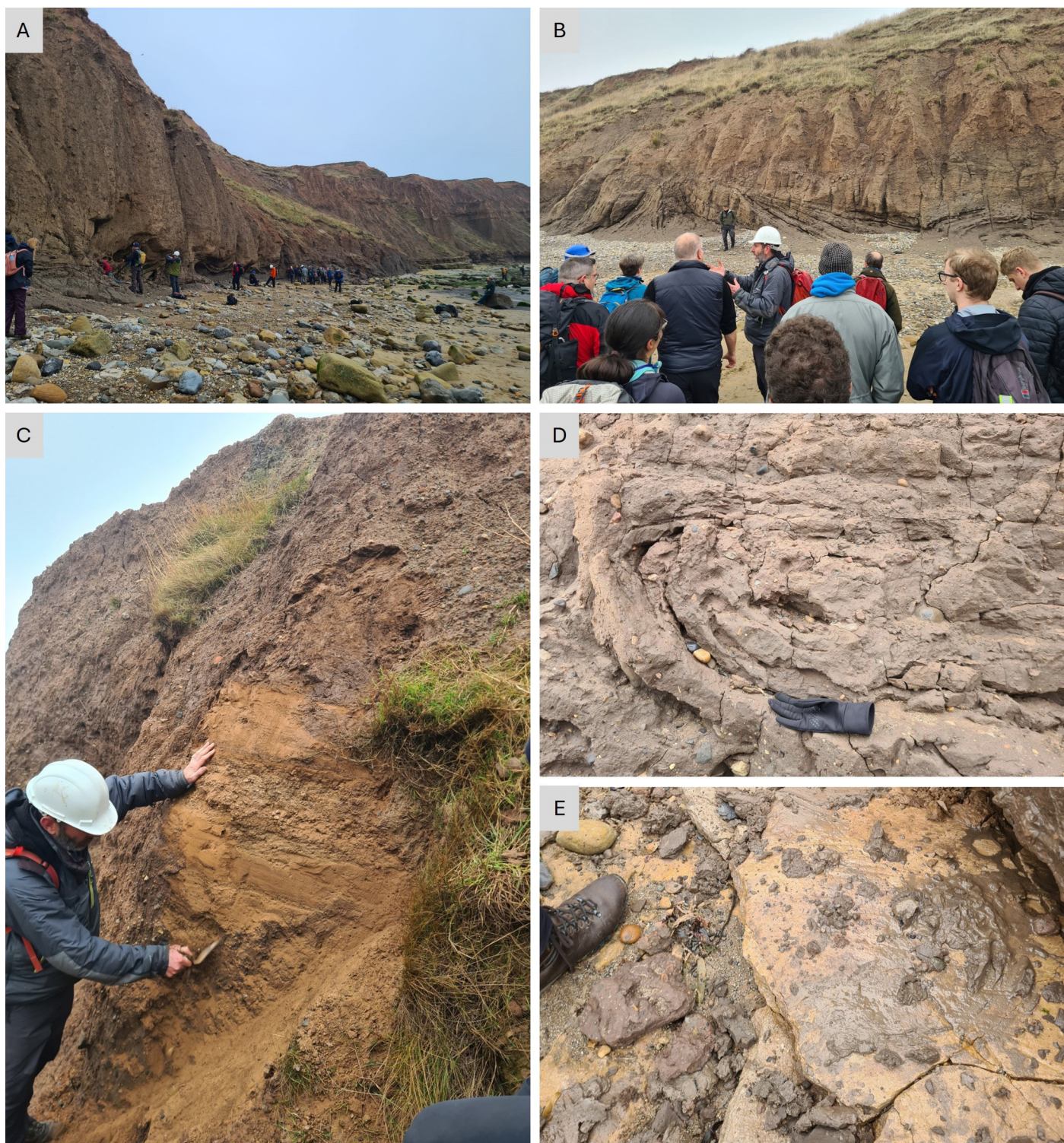


Figure 3. Filey Bay. A) The group examining the 40 m cliffs at Filey Bay with a prominent stratified lower unit; B) David Roberts discussing a hydrofracture feature in the lower unit (to the left of the person); C) David Roberts cleaning up a sediment section in the upper part of the cliff (accessed from above) showing sand layers interrupted by a gravel lag; D) A recumbent fold in the lower stratified unit (glove for scale); and E) striations on the outcropping limestone bedrock at the base of the diamict cliffs (boot for scale). (*Photos: Jodie Geldard*).

like consistency (pretty much just sand) and dislike inconsistency (boulders, peat and glacial sediments, obviously). Just like Goldilocks they like it to be ‘just right’. That’s where engineering ground models come in, which aim to eliminate unforeseen ground conditions (Baynes and Parry, 2022). These models combine knowledge of geological, geotechnical and stratigraphic data to predict site-wide hazards and

are used for the planning and design of offshore wind sites. Leah discussed how the use of engineering ground models facilitates the development of the huge windfarm planned to meet low carbon energy targets. The scale of the ground model and challenge to identify marine geohazards and geo-engineering constraints in a formerly glaciated margin (with plenty of inconsistencies) suddenly comes into perspective!

Andy Emery (Wessex Archaeology) followed Leah with a presentation on ‘North Sea Palaeolandscapes’. The North Sea has a long history of palaeolandscape finds, for example Dutch seafarers in the 1500s dredged up bones and peat from Dogger Bank, suggesting a former terrestrial landscape. The southern North Sea was once a relatively flat marshy environment with numerous river channels and low-level shrubs, such as *Betula nana* growing between 15 – 14 ka. The subsequent marine transgression inundated the terrestrial landscape and led to the deposition of sand bars. Understanding the palaeolandscape and cultural heritage of the North Sea is an important component of wind farm developments, and numerous government bodies are involved, such as Historic England. The final presentation of the evening moved away from wind farms to nuclear waste management. **Simon Norris and Alex Hughes (Nuclear Waste Services)** provided an insightful overview of the role of geoscience in nuclear waste disposal. Nuclear Waste Services is a public sector company tasked with providing a permanent solution to the UK’s high-activity radioactive waste. The development

of a geological disposal facility (GDF) for the safe disposal of high-level radioactive waste comes with many challenges, not least that the half-life of Uranium-238 is equivalent to the age of the Earth (4.5 billion years) and the need to develop signage to communicate the hazard to humans many thousands of years into the future (think of Carl Sagan’s Voyager plaque!). While the GDF would be located over 200 m below ground, periglacial weathering and glacial erosion have the potential to alter boundary conditions and affect groundwater and gas movement over the timescales of interest. Quaternary analogues are therefore important to understand what may happen in the future.

On Saturday morning we ascended into the cloud on the North York Moors and the Hole of Horcum [SE 84491 93397] lay invisible under its cloak of fog. An opportunistic visit to the car park coffee van was therefore taken to re-caffeinate. Luckily, the sun soon made a welcome return as we made our way into the Hole of Horcum (Figure 4ac) and afforded us an appreciation for the scale of the feature (which



Figure 4. Hole of Horcum. A) Descending into the Hole of Horcum; B) Jonathan Lee explaining the geology of the Hole of Horcum; and C) The Hole of Horcum from the footpath above it. (Photos: Jodie Geldard).

according to local legend was made by a giant). **Jonathan Lee (BGS)** provided context to the site, which is composed of Oxford Clay overlain by Lower Calcareous Grit that dips $\sim 1^\circ$ to the south-east (Figure 4b). The North York Moors were predominantly unglaciated during the Devensian, with the nearest ice 6 – 7 km north at Eskdale. Newtondale to the west is a deep valley speculated to have a meltwater

origin, perhaps formed during the Anglian or Early Pleistocene. Within the Hole of Horcum, the Oxford Clay controls the asymmetrical geometry with thicker deposits exposed on the north-west compared to the eastern side. The formation of the feature is assumed to be spring sapping at the boundary between the Oxford Clay and the Lower Calcareous Grit that has led to undermining and slumping. There was much



Figure 5. Cayton Bay. A) Overlooking the bay with cliffs composed of Oxford Clay and Lower Calcareous Grit capped by diamicton; B) Overlooking the bay showing the Cayton Cliff complex; C) Wartime pillboxes on the beach which once sat on the cliff tops; D) Landslide deposits on the beach; E) The toes of landslide deposits on the beach; and F) Trace fossils in bedrock at the base of the cliff. (Photos: Jodie Geldard).

debate on the absence of cambering failures, which might be expected where competent sandstones overlay less competent clays, and the mechanism of mass movement, mass wasting debris aprons or subtle rotational landslides. **Mike Streetly (Aberystwyth University)** added that groundwater from the area provides Scarborough's water supply and rapid flow through karstic voids risks contamination. To summarise, **Jonathan Lee (BGS)** confessed that the site was used for BGS training because of its complexity and questioned the value of defining landslide type when most were composite in nature.

Following lunch in Pickering, the next stop was Cayton Bay [TA 06558 84449] with discussions on the cliff instability and landslides led by **Paul Fish (Jacobs)**. The cliffs are composed of Oxford Clay overlain by Lower Calcareous Grit with a variable cap of interbedded tills and stratified sediments (Fish et al., 2006) (Figure 5a). A series of north-south faults lie parallel to the coast and bring the Oxford Clay to sea-level. Two major landslide units with different inferred mechanisms have been identified: Tenant's Cliff and Cayton Cliff. Tenant's Cliff has north-south back-tilted ridges formed by an old deep-seated translational landslide with no evidence of recent activity. In contrast, Cayton Cliff is composed of >10 m of till possibly masking a bedrock failure and forms a mudslide complex flowing over a series of bedrock scarps (Figure 5). The Cayton cliff complex reactivated in April 2008, causing head scarp retreat that ultimately led to compulsory purchase and demolition of several properties. Timing of the original failures are unclear, but since sea-level rose to current levels around 3 ka BP, it is likely that toe erosion initiated instability (Fish et al., 2006). The triggers of the 2008 failure probably relate to high antecedent rainfall over the previous 12 months. While the two to three months prior to the failure had been dry, the previous summer and winter had been very wet. No evidence was found for leaking fresh or wastewater supplies (Johnson and Fish, 2012).

Mark Lee (Ebor Geosciences) presented a short history of Scarborough's landslides on Sunday morning and described the variable glacial sediments encountered in ground investigations along the coastline. Mark has used archival data to document historical landsliding in Scarborough, recorded through Admiralty charts, artwork and newspaper reports. A painting depicting the December 1737 landslide that buried the original Spa at South Bay suggests it may have been ~ 200 m wide with ~ 5 m

of settlement, leading to the stranding of cows on a landslide block. The 1843 Admiralty chart of South Bay shows several 'fresh' landslide embayments at Belvedere Cliff and South Cliff Gardens and an 1895 landslide was reported at Belvedere Cliffs in a local newspaper. The most well-known landslide on the Scarborough coast is the 3rd – 5th June 1993 Holbeck Hall landslide. The cliff here is composed of 30 m of weathered mudstone of the Scalby Formation overlain by 30 m of glacial diamict. Prior to failure, the site was an intact steep coastal cliff protected by a seawall. The landslide's occurrence followed 2 months of wet weather with relatively dry conditions the previous winter and spring. Mark mapped the landslide a few days after failure and, despite the wet weather, noted that the failure mass was dry and included large blocks (~ 1.5 x 1.5 m) of laminated silty clay. Subsequent ground investigation revealed a basal shear surface in Jurassic bedrock several metres above sea-level, with runout over the seawall that remains buried by debris today. Discussions on the possible causes of shear surfaces within the bedrock unit included periglacial active layer detachments, frost weathering or tephra layers. After a vote of thanks to the meeting organisers and presenters by **Jim Rose (Royal Holloway)**, the group set off on a walking tour of South Bay led by **Mark Lee (Ebor Geosciences)**.

The first stop of the walking tour was the Scarborough Spa [TA 04436 87790] where Paul Fish (Jacobs) discussed how slope monitoring with piezometers and inclinometers is used to inform cliff instability risk. **John Davis (Geotechnical Consulting Group)** described the various engineering measures used to stabilise slopes in glacial sediments, pointing out soil nails, geotextile meshing, piles and counterfort drains. At the Clock Café [TA 04519 87559] Mark demonstrated how the landscaped gardens were geomorphologically mapped to define a series of rotational landslide blocks bound by lateral shears. The final stop on the walking tour was the Holbeck Hall site [TA 04951 87052]. Following the 1993 landslide, the Holbeck Hall hotel was demolished, the slope re-profiled, and drainage installed. The coastline now extends 20 m further offshore than prior to the landslide and is protected from coastal erosion by rock armour.

The assembled group then departed for lunch and travel home.



Figure 6. Scarborough South Bay. A) Mark Lee discussing Scarborough's landslide history; B) Soil nails in the slope above the Scarborough Spa; and C) The group on the footpath on the 1993 Holbeck Hall landslide. (Photos: Jodie Geldard).

Acknowledgements

Paul Fish (Jacobs) is thanked for organising and leading another fantastic field meeting. **Jonathan Lee (BGS)**, **Dayton Dove (BGS)**, **David Roberts (Durham University)** and **Mark Lee (Ebor Geosciences)** are thanked for leading field site sessions and providing their knowledge and expertise. **Andy Emery (Wessex Archaeology)**, **Leah Arlott (RWE)**, **Simon Norris** and **Alex Hughes (Nuclear Waste Services)** are thanked for their insightful presentations. **Natasha Barlow's (University of Leeds)** skilful chairing of the evening talks, allowing sufficient time for subsequent discussions in the pub, is gratefully acknowledged. Attendees are thanked for engaging with friendly and open discussions, making it a very memorable and enjoyable field meeting for all.

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QRA POSTGRADUATE SYMPOSIUM: BELFAST 2024
29TH - 31ST AUGUST 2024David Hatton¹*, Thomas Garner²¹ School of Natural and Built Environment, Queen's University Belfast² School of Geography and Environmental Science, Ulster University

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Introduction

The QRA Postgraduate Symposium was held between the 29th - 31st August 2024, in the department of Geography, School of Natural and Built Environment, at Queen's University Belfast, co-hosted by Ulster University, organised by David Hatton (QUB) and Thomas Garner (UU). This event brings together

postgraduate students (MSc and PhD) in the field of Quaternary science, from across the United Kingdom and beyond, to present their research in a supportive environment (Figure 1). The meeting was split into three parts: (1) age-depth modelling statistics workshop; (2) symposium meeting; and (3) field meeting. The meeting was attended by 17 PGR students from across the UK, Ireland and Belgium,



Figure 1. QRA Postgraduate symposium; Belfast 2024 logo: featuring foraminifera *Elphidium crispum*; plant macrofossil of Dwarf Birch (*Betula nana*) and antler of Irish Elk (*Megaloceros giganteus*) (TG), and branded lanyards and merchandise (with sustainability considered) for attendees.

with an equal attendee gender balance. Of the 17 attendees, 13 attended the optional statistics course, and 11 attended the field meeting. Catering was provided on both days, with vegan and vegetarian options available.

Statistics workshop

The symposium began with a morning workshop on 'Using rbacon: age-depth modelling using Bayesian statistics' delivered by Prof. Maarten Blaauw (Professor in the School of Natural and Built Environment, Culture and Society, Queen's University Belfast and director of the ¹⁴Chrono Centre). During the workshop the students had the opportunity to produce age-depth models in R studio, and to discuss issues such as modelling age uncertainty. Given the critical importance of establishing a robust chronological control in Quaternary research, we were very grateful to Prof. Blaauw for providing this opportunity to the attendees.

Postgraduate Symposium meeting: Day 1

The PGR symposium meeting opened with a keynote talk 'From the Quaternary to defective concrete: a career journey in the geosciences' from Prof. Paul Dunlop (Research Director for the School of Geography and Environmental Sciences, Ulster University). This talk overviewed Prof. Dunlop's career in Quaternary science, providing an informative and motivational discussion on the applicability of the Quaternary to understanding current day issues in science.

The first day of the symposium was concluded with a tour of the ¹⁴Chrono Centre (radiocarbon dating and isotope analysis laboratory) at Queen's University Belfast (Figure 2). The tour provided the students with a broad overview of the analyses completed by the laboratory, ranging from sample pretreatment to analysis by accelerator mass spectrometry (AMS). The students were also made aware of the exciting opportunity to apply for radiocarbon date awards, through the collaboration of the ¹⁴Chrono Centre and the QRA. For more details on this award please see <https://www.qra.org.uk/grants/qra-14chrono-centre-radiocarbon-dating-award/>.

Postgraduate Symposium meeting: Day 2

Day two of the symposium began with the second keynote talk 'Only time will tell: the importance of

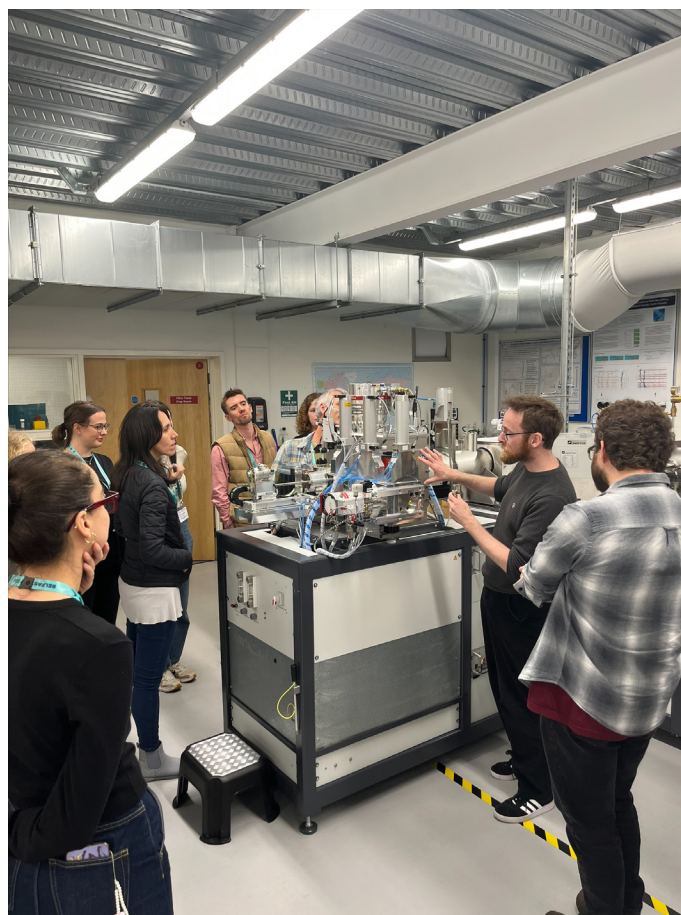


Figure 2. Students getting a guided tour of the AMS at the ¹⁴Chrono Centre, Queen's University Belfast.

chronology in Quaternary Science' from Prof. Gill Plunkett (Professor in the School of Natural and Built Environment, Culture and Society, Queen's University Belfast). This talk provided an informative overview of dating approaches, and their limitations, in Quaternary science, building on the themes of the previous day's statistics course and ¹⁴Chrono tour.

Following the final keynote talk the attendees took to the podium to present their own MSc or PhD research. Presentation themes ranged from the complexities of deglaciation, carbon storage dynamics in peatlands, Irish blanket peat initiation, and the impacts of Holocene land use and climate change upon Brazil's Araucaria Forests. To commemorate the students' hard work, a prize for best poster presentation and best presentation were chosen and presented by our two judges Dr Richard Fewster and Prof. Gill Plunkett. The winners were presented with wooden plaques made from ca. 1500 - 2000 year-old bog Yew from Magilligan Point, Co. Derry/Londonderry (Figure 3). Congratulations to our two winners: Despina Kyriakoudi for their presentation on 'Insights into glacial and post-glacial deposits in the southern North Sea during the late Weichselian and early Holocene' and Nina Herer for their poster on 'Using lake



Figure 3. Wooden plaques, made from ca. 1500 – 2000 year-old bog Yew from Magilligan Point, Co. Derry/Londonderry, which were presented to the winners of the best presentation and best poster.



Figure 4. Photograph of the Belfast 2024 QRA Postgraduate symposium attendees.

sediments to disentangle the human settlement of the Eastern Pacific’.

The meeting closed with the AGM (Figure 4), where PhD students Charlie Davies and Eve Horsfall volunteered to host the next QRA PGR symposium at the University of Reading, in collaboration with the University of Portsmouth. This event will take place at the end of August 2025 (Dates TBC) and will include student posters and presentations, a panel talk on science communication / outreach in Quaternary Research, and a field trip in the local area (attendee numbers permitting).

Field meeting

As many of the students attending the symposium were travelling from beyond Northern Ireland, we decided to host a field meeting on Saturday the 31st August. This provided the students with the opportunity to see Northern Ireland, beyond the university campus, and to learn about the Quaternary records from some of the region’s renowned landscapes. Drawing inspiration from the ‘QRA Field Guide to the North of Ireland’, the field meeting had three stops: (1) Lough Beg at Newferry; (2) Dead Island Bog; and (3) the Giant’s Causeway. We are very grateful to Prof. Helen Roe (Professor in the School of Natural and Built Environment, Culture and Society, Queen’s University Belfast) for guidance organising the field

meeting and providing engaging lectures at Lough Beg (Figure 5a) and Dead Island Bog (Figure 5b). Our final stop at the globally iconic Giant’s Causeway, included a discussion and tour of the UNESCO World Heritage Site by Prof. Andrew Cooper (Figure 5c) (Professor of Coastal Studies, School of Geography and Environmental Sciences, Ulster University). Across the three field meeting sites, the students learnt about broad themes in Quaternary research, including the history of glacial isostatic adjustment (GIA) in Northeast Ireland, and the palaeo-climate records derived from Irish peat bogs.

Acknowledgements

This event would not have been possible without the support and help from numerous individuals. Firstly, we would like to thank the QRA for giving us the opportunity to organise this event, and the financial support to cover many of the costs. We thank both our institutions, Queen’s University Belfast and Ulster University, for providing additional funding to support catering and field meeting transportation. We would also like to acknowledge the support of James Dill Russell and Hannah Campbell Hewson for helping to organise the meeting and providing support on the day. Finally, we thank the contributions of the ¹⁴Chrono Centre, Prof. Blaauw, Prof. Dunlop, Prof. Plunkett, Dr Fewster, Prof. Roe, and Prof. Cooper for their contributions to the meeting.

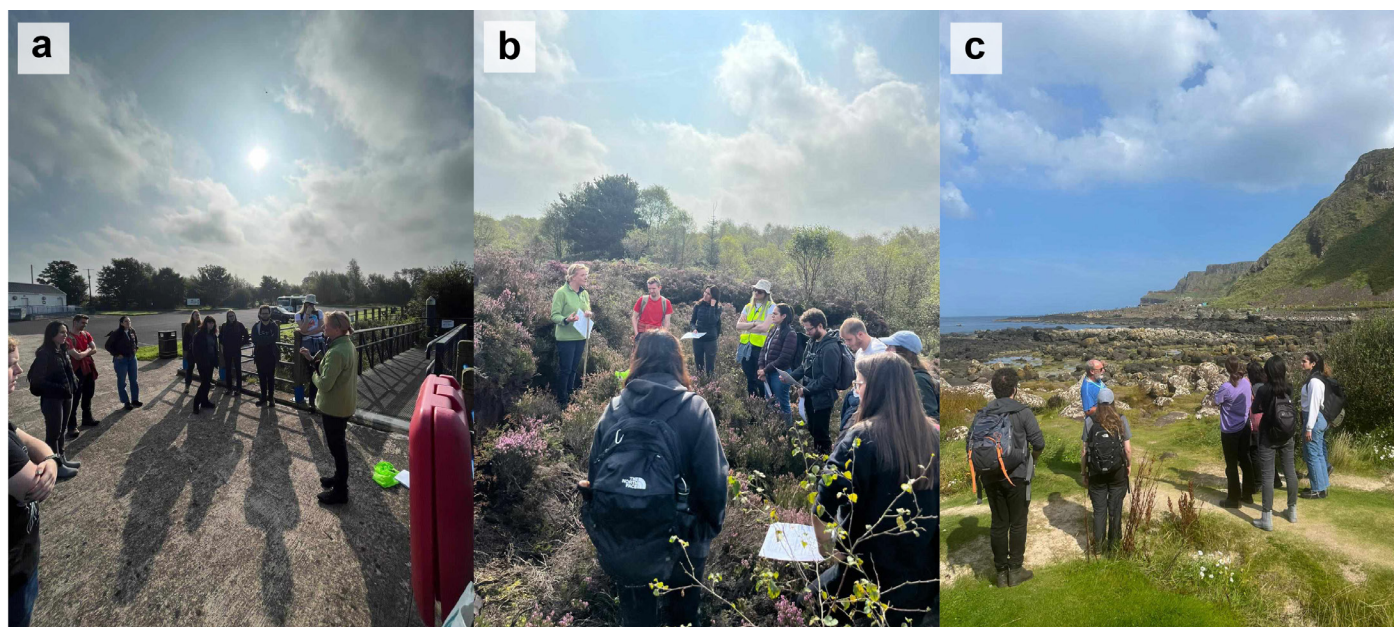


Figure 5. Photographs from the field meeting: (a) Lough Beg at Newferry; (b) Dead Island Bog; and (c) the Giant’s Causeway.

ECOLOGICAL UNIFORMITARIANISM - HELP OR HINDRANCE TO PALAEOECOLOGY, PALAEOCLIMATOLOGY AND CONSERVATION BIOLOGY? (JULY 2ND AND 3RD, 2024)

Convenors: Andrew Johnson^{1*}, Jean-François Cudennec¹, Liz Harper²,
Jan Hennissen³, Richard Twitchett⁴ and Tom White⁴

¹ University of Derby, School of Science

² University of Cambridge

³ British Geological Survey

⁴ Natural History Museum, London

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This online meeting was the second of two organised as part of a project, based at the University of Derby and funded by the Leverhulme Trust, on the topic of ecological uniformitarianism. It was hosted and publicised by The Palaeontological Association, with further publicity from the Quaternary Research Association and the History of Geology Group of The Geological Society. The QRA, in addition, provided a generous grant with the particular aim of facilitating free participation for those based in low- and middle-income countries (seven took up this offer). There were 14 presentations (listed below) over the two days of the meeting.

Readers of this Newsletter will be familiar with ecological uniformitarianism, in practice if not in name. It is the philosophy that underlies interpretation of ancient environments from fossil assemblages, by projecting onto these the niche characteristics of modern examples of the taxa represented. It involves the assumption that niches do not change, but unlike the basic laws and processes of the universe, whose uniformity in time and space is generally accepted and axiomatic to science, there is no fundamental reason why niche characteristics should be stable. Indeed, niche change must have happened on innumerable occasions (but at uncertain times) in the progression of life from the primordial soup. Ecological uniformitarianism is therefore a convenience rather than a necessity: we may use the fossil occurrence of beetle, foraminifera or plant species to infer the environment of the time, but we do not have to accept that the indications provided are true.

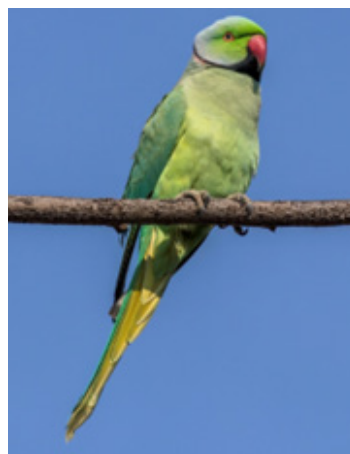


Fig. 1. Example of the ring-necked parakeet in its native habitat (Rajasthan, India). Image from Wikipedia, licensed under Creative Commons (*Image credit: Charles J. Sharp – own work, from Sharp Photography, sharpphotography.co.uk*)

The confidence with which we may interpret ancient environments from the constituents of fossil assemblages is dependent on the scale, frequency and locus of documented niche change. As a provocation to students of the past (heavily invested in uniformitarianism through its origin and development as a philosophy within geology) and an attraction to those with interests in present and future biotic change, an image of the widely invasive ring-necked parakeet (Fig. 1) was used as a symbol for this and the previous meeting. The species, whose native range is in the Indian Subcontinent and Africa, now occurs far more widely and in very much colder climates: for instance, European populations have 87% of their distribution outside their native climatic niche (Strubbe et al. 2015). But how common are such cases within species — might significant niche change be more normally associated with the evolution of new species?

The answer to this question depends very much on what is meant by niche change. In the opening talk, Andrew Townsend Peterson¹ revealed that much the same data from modern organisms has been interpreted by some authors as evidence of niche change, but by others as evidence of stability. The difference comes from whether one is speaking of the realised niche (the set of conditions under which an organism actually occurs in an area at a given time) or the fundamental niche (the set of conditions under which it could occur given access to a sufficient range of locations). For such reasons as release of competitive constraints on distribution, reduced predation or easier dispersal (e.g. through a lack of barriers), introduced/invasive species may come to occupy a larger niche space than in their native range, but this typically represents a change in realised, not fundamental niche. It seems that such changes are not uncommon (convincing cases in a lacustrine ostracod and marine gastropod were later presented by, respectively, **David Horne**⁴ and **Sierra Petersen**⁵) but Peterson argued that changes in fundamental niche are by contrast rare, at least over short timespans.

Lynn Wingard¹⁴ provided evidence of niche stability over an intermediate timespan (since the last interglacial, c. 120,000 ka) amongst molluscs in the Everglades area of south Florida, and **Harry Dowsett**⁹ provided evidence of the same over a long timespan (since the late Pliocene, 3 Ma) amongst planktic foraminifera of the North Atlantic and Pacific oceans. **Malcolm Hart**¹¹ pointed out the repeated appearance of specific morphotypes amongst benthic forams during Cretaceous and Quaternary transgressions—a kind of niche stability amongst multiple lineages.

However, there were a number of descriptions of niche change within lineages: in diet of the Paleocene mammal *Tetraclaenodon puercensis* from tooth-wear evidence (**Neil Adams**²); in the migratory behaviour of Rangifer (reindeer) in the late Pleistocene from strontium- and sulphur-isotope evidence (**Kate Britton**⁸); and in the thermal niche of the tortoise *Chersine hermanni* over the Quaternary from changes in altitudinal limit (**Rafael Marquina-Blasco**¹³), and of the bivalve *Arctica islandica* over the Cenozoic from oxygen-isotope evidence (**Jean-François Cudennec**⁶). This last example appears to represent a change in fundamental niche because the isotopic temperatures from Paleogene forms are well above the upper limit of tolerance in modern forms as determined by experiment.

Even if the other instances of change might constitute shifts in realised rather than fundamental niche, they are important to recognise, because it is the present realised niche that is usually the basis for interpreting the environment of fossil forms, and likewise for predicting the response of extant species to future environmental change. The need for proper understanding and care in application of uniformitarian thinking to the latter problem was as much a reason for holding the meeting as concern about the accuracy of the fossil-assemblage approach to interpreting past environments. Conservation biology talks were grouped at the end and included one from **Greg Dietl**¹² that neatly complemented earlier talks revealing the latent capacity for adaptation within species (the underfilling of fundamental niches). He showed that the bivalve *Nucula proxima* is characteristic of highly polluted settings in Long Island Sound but occurs in a wider range of settings farther south on the US eastern seaboard. He emphasised humility about what we know concerning niche parameters, the need to add estimates of uncertainty to the data passed on to conservation practitioners, and the benefits of wider research.

Insights from wider research, specifically over a long timespan, were supplied in three other talks. **Joanne Bennett**³ showed that modern plant and ectothermic animal species whose clades originated in cold climates are relatively tolerant of cold extreme temperatures, but that the converse is not true of modern species whose clades originated in warm climates. In conjunction with the fact that heat tolerance has evolved more slowly than cold tolerance, at least in ectotherms, this indicates that the rate and magnitude of current global warming will be beyond the adaptive capacity of very many species. From a study of extinction patterns amongst molluscs of the western North Atlantic over the last three million years, **Bruce Lieberman**⁷ indicated that species with a high metabolic rate will be particularly vulnerable. Finally, from a study of the climate, oceanography and molluscan fauna of the Mediterranean and adjacent areas during the last interglacial, **Paolo Albano**¹⁰ showed that the current ('Lessepsian') invasion of the Mediterranean by tropical species from the Red Sea will, with global warming, be supplemented by one from West Africa, profoundly altering the ecosystem.

In addition to the convenors and representatives of the host organisation, 64 people, based in 17 countries, participated in the meeting. All will surely have come away with a better understanding of what

uniformitarianism is and of the potential pitfalls of misapplying the philosophy. In highly relevant asides, Britton and Dowsett pointed out that the geochemical data discussed in their talks (isotope ratios and alkenone unsaturation ratios, respectively) appear to be governed by the kinds of basic laws and processes that fall within the purview of uniformitarianism. However, as mentioned by Dowsett in relation to results from the Pliocene, can one be 100% confident about the temperatures indicated by alkenone unsaturation when the variable/proxy relationship was worked out with different, modern species of Prymnesiophyceae (haptophyte algae)? There is a need for humility amongst the geochemists, too!

The full oral proceedings of the meeting are available as two YouTube videos (Day 1: <https://youtu.be/0zTQe4lc4W0>; Day 2: <https://youtu.be/y4L0rTMKkp0>) and it is intended to publish related papers as a special issue of Palaeontology. The convenors are extremely grateful to the Palaeontological Association for hosting the meeting at a very reasonable cost to paying participants (undoubtedly a major reason for the healthy and diverse attendance) and for the excellent technical support provided in online delivery.

Speakers and titles of talks, in order of presentation

Day 1

- 1 Andrew Townsend Peterson (University of Kansas)—Fundamental ecological niches that do and do not change and what happens as a result in terms of biological diversity
- 2 Neil Adams (Natural History Museum, London)—Dietary niche shifts and body size reduction as a terrestrial mammal response to an early Paleocene hyperthermal event
- 3 Joanne Bennett (Australian National University)—Evolution of thermal tolerance: Can historical climate adaptation inform species' vulnerability to future climate change?
- 4 David Horne (Queen Mary, University of London)—Quaternary—Recent ostracod niche stability
- 5 Sierra Petersen (University of Michigan)—When the Modern Analog mentality fails: examples relating to thermal tolerance of freshwater and marine mollusks

6 Jean-François Cudennec (University of Derby)—Long-term evolution of *Arctica* thermal niche: from Paleocene to Quaternary

7 Bruce Lieberman (University of Kansas)—Physiology, fitness, and macroevolution: Survival of the sluggish?

Day 2

8 Kate Britton (University of Aberdeen)—Exploring ecological plasticity in Late Pleistocene ungulates using multi-isotope approaches

9 Harry Dowsett (US Geological Survey)—Stability of planktic foraminiferal temperature preferences

10 Paolo Albano (Anton Dohrn Zoological Station, Naples)—The dawn of the tropical Atlantic invasion into the Mediterranean Sea

11 Malcolm Hart (University of Plymouth)—Evolution of benthic foraminifera in the 'stable' environment of the chalk facies

12 Greg Dietl (Cornell University)—Ecological uniformitarianism and conservation palaeobiology

13 Rafael Marquina-Blasco (University of València)—Quaternary altitudinal record for Hermann's Tortoise (*Chersine hermanni*) indicates a wider ecological tolerance

14 Lynn Wingard (US Geological Survey)—Species responses to change in south Florida viewed over different temporal and spatial scales

Reference

Strubbe D, Jackson H, Groombridge J, Matthysen E (2015) Invasion success of a global avian invader is explained by within-taxon niche structure and association with humans in the native range. *Diversity and Distributions* 21, 675–685; <https://doi.org/10.1111/ddi.12325>.

HOLOCENE ENVIRONMENTAL CHANGES IN THE WESTERN MEDITERRANEAN: NEW INSIGHTS FROM A CONTINENTAL ALLUVIAL FAN ON THE ISLAND OF SARDINIA

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Abstract

Spatiotemporally congruent proxy archives are critical for exploring the interplay between Holocene climate variability and local human-environmental interactions across the Mediterranean region. Continental archives, such as floodplain and lake records, have a high potential for preserving palaeoenvironmental data and have been increasingly studied to unravel Holocene hydrological changes, geomorphological dynamics, and past human impacts throughout the Mediterranean basin (Benito et al., 2015; Fletcher and Zielhofer, 2013; Macklin and Woodward, 2009).

The goal of this research is to assess the potential of fluvial sedimentary archives on the island of Sardinia for preserving Holocene palaeoenvironmental data and anthropogenic signals (Fig. 1). Fieldwork aimed to acquire sedimentary data through hand-augering at the bottom of a valley in the upland region of the island. A lithological description was carried out in the field and followed by a preliminary microfossil analysis. An accurate chronostratigraphic model was then produced based on the radiocarbon dating of hand-picked shell fragments of one of the sediment cores. The key findings of this initial study demonstrate that the evolution of the basin fill occurred over the last 7,000 years, confirming the potential of this sedimentary sequence to investigate human-environmental interactions over the Holocene.

Background and rationale

Floodplain fine deposits are sensitive indicators of shifting landscape conditions, as external drivers such as climate, land use, and tectonic activity

influence sediment mobility within the river catchment (Wolf and Faust, 2015). However, the entanglement of the different forcing factors on fluvial geomorphodynamics may complicate the use of fluvial archives to reconstruct past hydroclimate regimes or human trajectories (Wolf and Faust, 2015).

Despite being the second largest island of the Mediterranean and hosting a unique archaeological record, the palaeoenvironmental dynamics of Sardinia remain poorly understood. Local tectonic stability throughout the Holocene combined with a wealth of well-studied relative sea-level data (Serpelloni et al., 2013; Vacchi et al., 2018), makes the island's fluvial systems exceptional candidates for capturing detailed records of past hydroclimate shifts and human impacts. Nevertheless, all the currently available sedimentary archives for the Holocene period in the region are located in (peri)coastal settings (e.g. Melis et al., 2018; Pedrotta et al., 2021), whereas virtually no sedimentary records have been studied from the upland areas of Sardinia.

Methods

Fieldwork focused on a key site in south-central Sardinia, home to one of the island's densest concentrations of Bronze Age Nuragic monuments. Geomorphological investigations sought to reconstruct the architecture and evolution of the small Pauli Arbarei Valley (PAV) and interpret environmental and anthropogenic signals from its sedimentary sequence. To address these issues, three boreholes (Bh1-3) were hand-augered along a SW/NE transect across PAV. An autoptic lithological description was carried out in the field and bulk samples from the auger

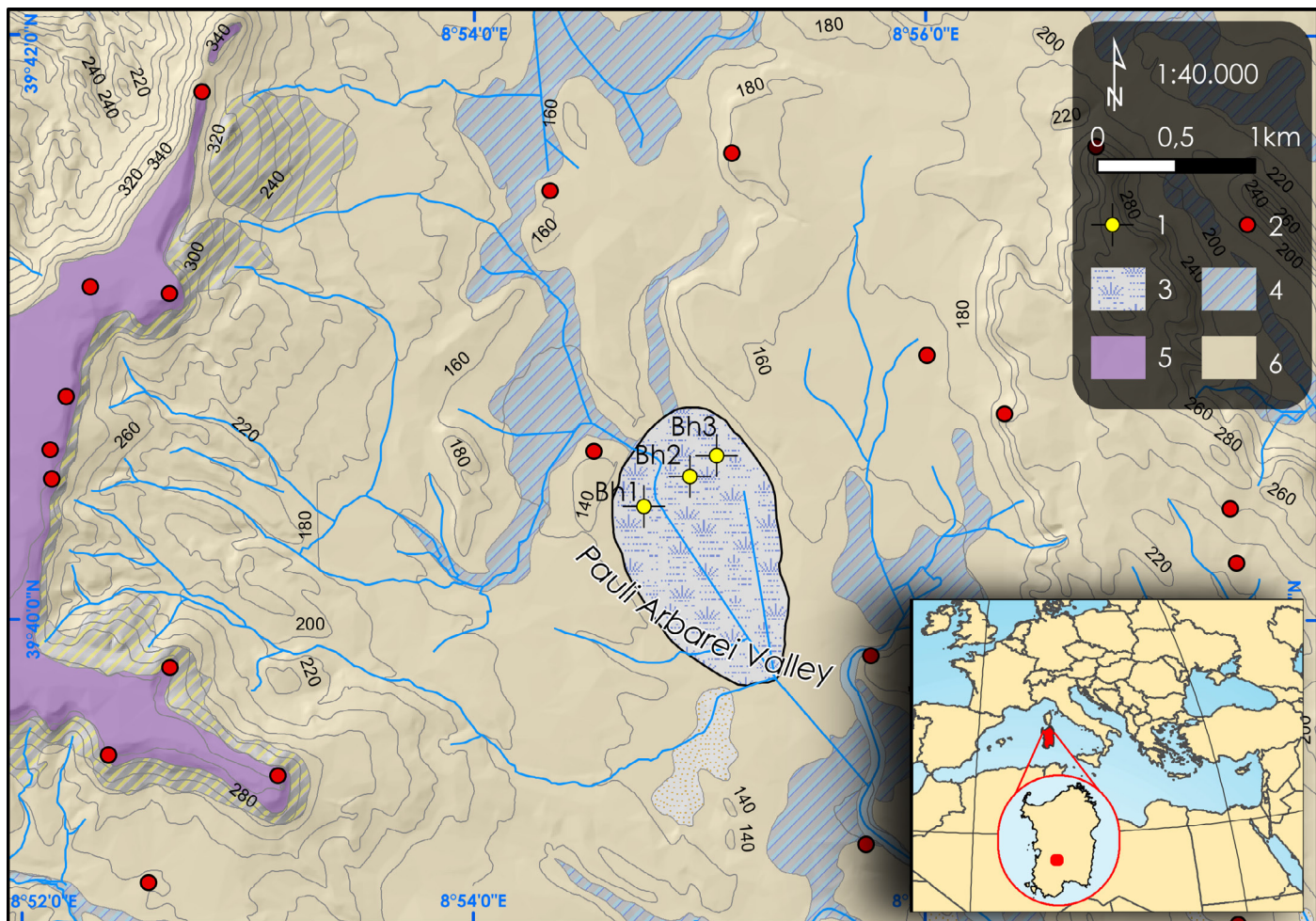


Figure 1: Location map of the area of fieldwork in southcentral Sardinia, indicating the position of the boreholes. Inset showing the investigated area within the context of the Mediterranean basin. Key to legend: 1. Borehole; 2. Bronze Age monument; 3. Lacustrine deposits; 4. Alluvial deposits; 5. Basalt; 6. Marls; distance between contours is 20m. (geological data from www.sardegnaegeoportale.it and archaeological data from www.nurnet.net)

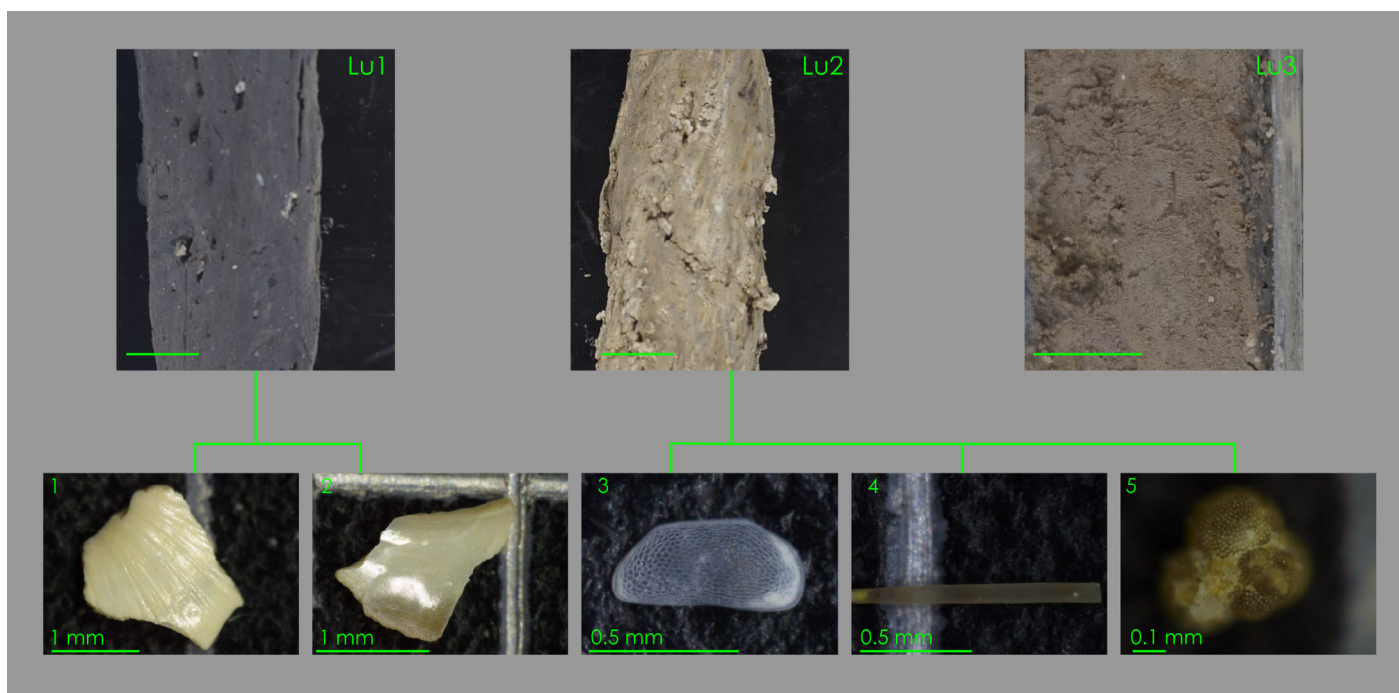


Figure 2: Photographs showing the field characteristics of the lithological units during augering (green bars are 1 cm), and photographs of the associated microfossil assemblages: 1, 2) pulmonated gastropod shell fragments; 3) freshwater ostracod; 4) Miocene sponge spicula; 5) Miocene foraminifera.

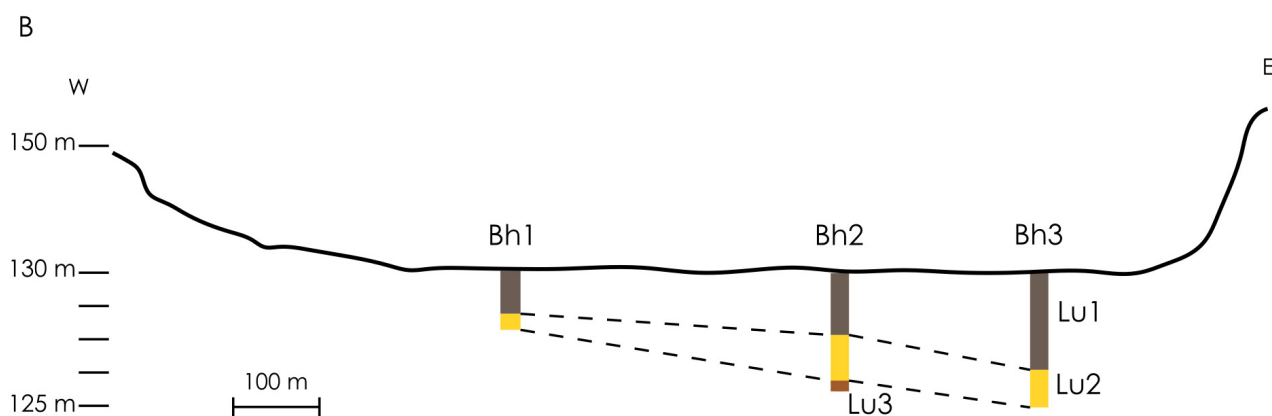
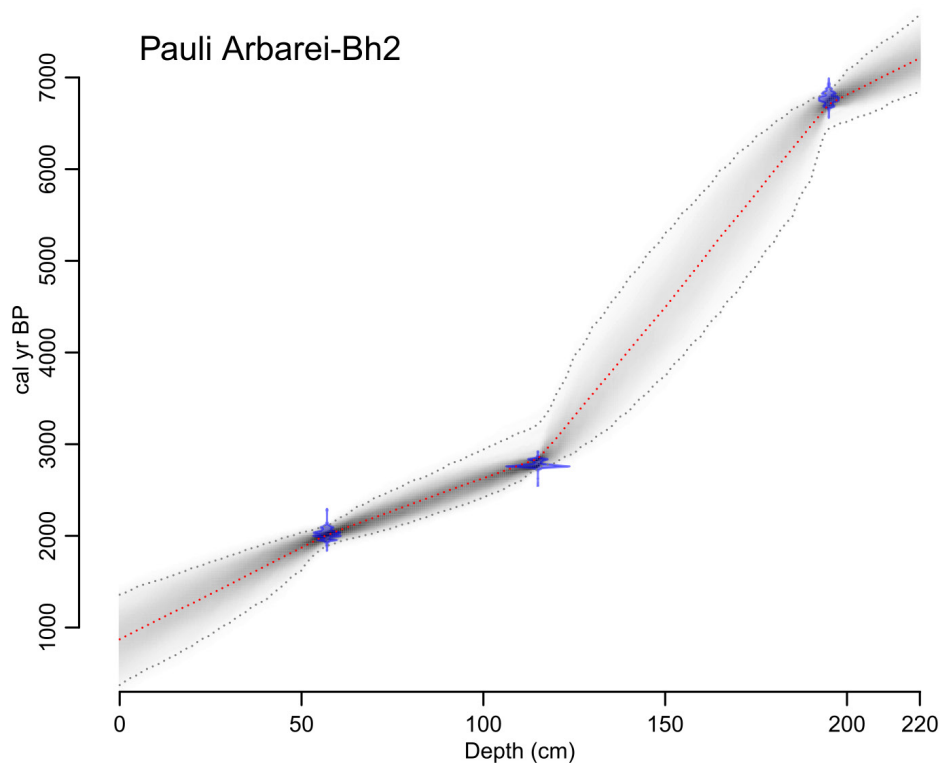
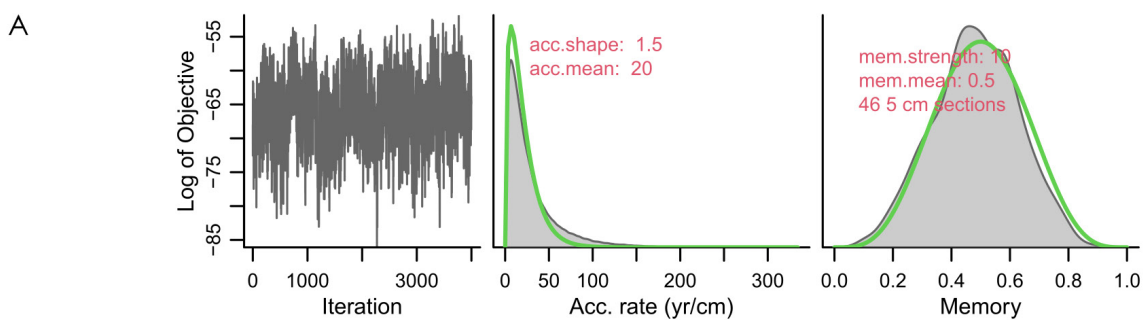


Figure 3: A) Age-depth model of Lu1 calculated through Bayesian methods using the radiocarbon dates obtained in this work; B) Schematic W-E transect showing the architecture of the PAV sequence.

head were collected every 10 cm from Bh2. Core Bh2's chronostratigraphy was established through radiocarbon dating of shell fragments hand-picked at the Radiocarbon Laboratory of the Earth Sciences Department at the University of Cambridge. Because of the small size and rarity of charcoal samples (<0.05 mg), shell fragments from the same depth at 2 cm intervals were clumped together to meet the required sample size and sent to the ¹⁴Chrono Centre in Belfast for radiocarbon dating. The Bayesian age-depth model was produced using the rbacon package (Blaauw and Christen, 2011) and dates were calibrated with the IntCal20 curve (Reimer et al., 2020).

Results

The three boreholes augered across PAV revealed a depositional sequence composed of two lithological units grading with a transitional contact from yellowish silty clays (Lu2) to dark loamy sands (Lu1), overlying with a sharper contact a thin oxidised gravelly and clay level (Lu3-Bh2) (Fig. 2). The maximum thickness of the deposits was reached in the eastern Bh3 at around 5 m, whereas Bh1 was significantly shallower, reaching the carbonatic sandstone bedrock at 2.6 m.

Sieving and picking datable materials allowed some preliminary observations on the microfossil content (Fig. 2). Lu3 lacked any fossil content, while Lu2 included rare (<1/cm²) freshwater ostracods, among abundant Miocene fossils such as fragments of sponge spicules and foraminifera. The microfossil content of Lu1 was significantly higher than Lu2, with >5/cm² of terrestrial or freshwater shells. For these reasons, only Lu1 provided enough materials for radiocarbon dating.

Three shell samples at 190 cm, 115 cm, and 57 cm provided a radiocarbon dating of Lu1 spanning from the Middle to the Late Holocene. The age-depth model shows that the deposition of this 2.2 m thick sandy loam unit started around 7,000 BP and was subject to a new depositional cycle at around 2,800 BP (Fig. 3A).

Significance

The preliminary findings indicate that the filling of the PAV system originates from an alluvial fan (Fig. 3B), which began aggrading into the basin around 7,000 BP. The accommodation space is likely dictated by an homoclinal fold structure architecture and the

differential erosion of the carbonatic marl-sandstone units of the Marmilla Formation. Notably, the timing of this initial aggradation phase aligns well with coastal plain records from Sardinia, which document similar processes following the stabilisation of sea-level rising rates around 6,000 BP (Melis et al., 2018), even though the PAV sequence predates these records slightly. After the first depositional cycle at 7,000 BP, another significant increase in sediment input occurred around 2,800 BP.

The question remains whether the fluvial activity during the Middle Holocene was driven by eustatic adjustments or influenced by Northgrippian rainfall variations. Likewise, excluding the roles of recent uplift and base-level drops over the Late Holocene, it is still unclear if the second aggradation phase resulted from a wetter hydroclimatic shift or from intensified human activities, like soil erosion. Despite being preliminary, these results underscore the high potential of continental sedimentary records for reconstructing Holocene environmental changes in the western Mediterranean. Future analyses will focus on disentangling the relative impacts of climate and human activity on sediment input, ultimately determining the key drivers of landscape change in island environments across the western Mediterranean.

Acknowledgements

I wish to thank the QRA for the funding provided through the New Research Worker's Award, which has significantly supported my PhD research. I must thank Dr Luke Skinner for his guidance during the research. I must also thank Antonello Piredda for his comments on the local geology. I would also like to thank Dr Ilaria Mazzini and Dr Salvatore Milli for their help on the microfossils and sequence stratigraphy. Finally, I must thank Julia Gustafson and Dr Eóin Parkinson for their help during the first field survey of the area.

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HUNTING MAYAN FOOL'S GOLD: GEOLOGICAL SURVEY FOR REFERENCE MATERIAL COLLECTION

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Background and Rationale

Ancient Mesoamerican iron ore mirrors exhibit highly specialised craftsmanship, and were culturally significant objects for the Olmec, Aztec, Maya and other cultures. In the Mayan area, mirrors have been reported from 79 archaeological sites (Barrientos et al., 2023). Some of them are made from a carved slate base with iron ore tiles adhered with a glue, in a mosaic-like arrangement (Gallaga, 2016).

Determining the provenance of these materials and goods will make it possible to understand the ancient geoeconomic exchange networks and the relationships between archaeological sites and distant areas outside

Mesoamerica. Today, little is known about the provenance of the raw materials used to make these objects in the Mayan Area. There is a single iron ore provenance study conducted in the Olmec area; the methodology had limitations and cannot be applied to broader areas (Pires-Ferreira, 1975; Pires-Ferreira and Evans, 1978). Consequently, with the exception of obsidian, there is a lack of robust regional provenance studies in Mesoamerica that can explain in detail how raw materials were obtained and how the ancient geoeconomy functioned.

To conduct a successful provenance study, a representative geological reference material is necessary to understand the homogeneity of the geological source and its chemical variations among other sources (Pollard, 2023). The proposed geological survey collected pyrite crystals, iron oxides pseudomorphs after pyrite, and phyllite-slate metamorphic rocks samples in Guatemala. Initially, planning to sample across three different departments: Huehuetenango, Chiquimula, and Alta Verapaz. Due to access limitations, the later two were sampled.



Figure 1: Locations where pyrite, iron oxides, slate, and phyllites were sampled.

Results

The geological survey was done thanks to the funding of this grant, covering accommodation, transport and food expenses during the field work. The survey covered four geological areas within the departments of Chiquimula and Alta Verapaz: San Diego Formation, Padre Miguel Group, Chochal Formation, and the Sierra de Santa Cruz Ophiolite Complex.

From these, 164 pyrite mineral samples, 14 iron oxide samples, 4 phyllite samples, and 5 slate samples were recovered (see Figure 1). These samples will be used as a reference to build up a chemical fingerprint using trace elemental techniques to then link the geological regions with the fingerprint in archaeological artefacts made of the same minerals.

A portion of the samples will be stored in a local academic institution, Universidad del Valle de Guatemala, to create a local reference collection of geological materials involved in the pre-Hispanic Mayan geo-economy.

Significance

This research project used an amalgamation of local (Guatemalan) and international cross-institutional collaborations to obtain geological reference samples, and subsequently, to validate the methods which will be used to provenance objects including archaeological project assemblages, and artefacts in museum collections.

Then, through the characterization of the geological specimens and archaeological artifacts, it will be possible to identify the region that locates the deposits that the pre-Hispanic Mayans exploited to extract minerals to manufacture mirrors.

This research helped to create a local collection of geological reference material for future studies in the area. And therefore, will contribute to the reconstruction of the pre-Hispanic Mayan geo-economy.

In future, this study aims to open the possibility of obtaining geological samples from other relevant locations in the Mayan Area, such as Huehuetenango and the Mayan Mountains in Belize.

Acknowledgments

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Thanks are due to Dr. Ben Stern, Dr. Catherine Batt, Dr. Alex Surtees, and Dr. Tomás Barrientos Quezada for the guidance and supervision of the overall PhD project.

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QUATERNARY DYNAMICS OF THE NAMIB SAND SEA: PORTABLE LUMINESCENCE READERS, POSTPONEMENTS, PLAN-CHANGES AND PANS.

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Background and Rationale

The Namib Sand Sea (NSS) is the central ~34,000 km² sand-rich portion of Namibia's west coast desert (Lancaster, 1989; Stone, 2013) (Figure 1A inset). The record of long-term dune dynamics in this region is currently based on a handful of sites, from which there are ~50 luminescence ages and four cosmogenic-nuclide burial ages (Bristow et al., 2005; 2007; Bubenzer et al., 2007; Vermeesch et al., 2010; Stone, 2013; Stone et al., 2010; 2015). Such records are useful for understanding past wind dynamics, but a dunefield-scale reconstruction requires robust chronologies using a sufficient spatial coverage of samples, which is time and resource intensive using laboratory-based luminescence dating (e.g. the global dataset of ~4000 dune luminescence ages was produced between the 1980s and 2016 (Lancaster et al., 2016)).

We planned to utilise a portable luminescence reader (port-OSL) across a north-south transect of sites. Port-OSL has an excellent track record of producing relative age information to guide targeted field sampling for laboratory analysis and has growing potential to provide rapid, low-fidelity age estimates, based on calibrating the signals against full laboratory-based ages (Stone et al., 2015; 2019 2024a; Nitundil et al., 2023). However, the COVID-19 pandemic postponed fieldwork in both 2020 and 2021.

By 2022, a new collaborative opportunity had arisen to work in the NSS with an international team of archaeologists to provide chronological control for Early and Middle Stone Age (ESA and MSA) archaeological sites (Figure 1A). The funds from the QRA were valuable to get me to the field in 2022, where the focus of the field campaign was the two

key archaeological sites of Narabeb and Namib IV (Figure 1A), which in the present day are interdune pans, flanked by chains of star dunes and complex linear dunes, respectively. Whilst my focus shifted to laboratory dating (in collaboration with the University of Liverpool luminescence laboratory), samples were also taken for port-OSL.

Results

Luminescence dating, using a pIRIR₂₂₅ signal (cf. Thomsen et al., 2008), at **Narabeb** is given in Stone et al., (2024b), alongside the description of the MSA assemblage, sourced from cobble-sized chert within a 10 km radius of the site. Sedimentary characterisation from seven geotrenches and preliminary suggestions from luminescence dating at **Namib IV** are given here, whilst a discussion of the Acheulean archaeology is given in Leader et al. (2023).

Port-OSL signals and ratios for both sampling locations at Narabeb gave insights into relative age for units with a similar mean particle size (and distribution), whilst finer-grained sediments had a different port-OSL signal behaviour (Stone et al., 2024b). This observation suggests that finer-grained sediments may also be of a contrasting sedimentary provenance to the sands: the former from the Naukluft Mountains transported west by the former Tsondeb River and the latter from long-range transport from the south, including that derived from the Orange River (Garzanti et al., 2012).

At Namib IV, the moderately-well sorted medium sand (mode 273 µm) with no silt on the lower star flank dune at the south of the pan provides a useful comparison for the pan surface sediments. We observe five types of sedimentary sequences:

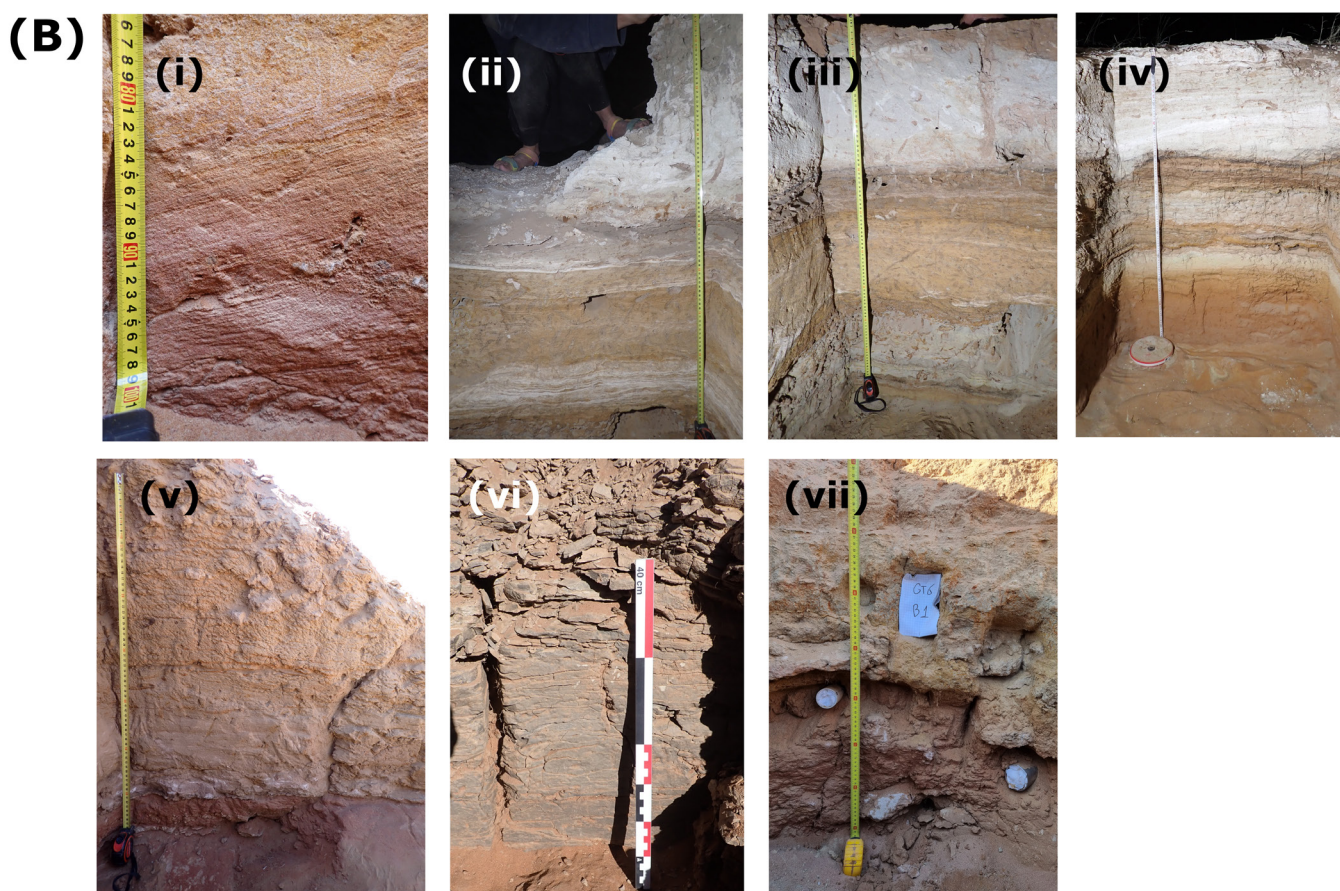
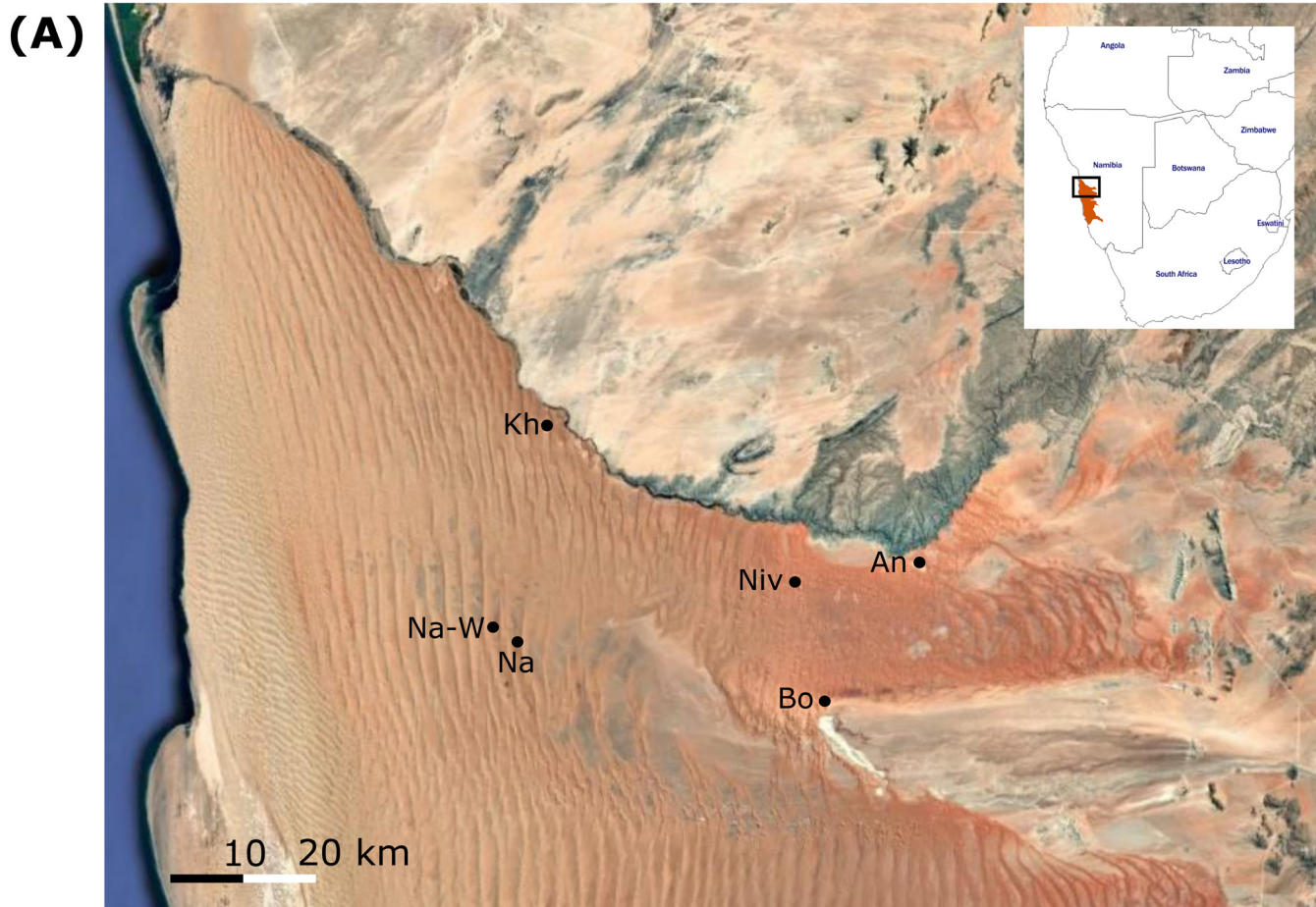


Figure 1. (A) Location of key archaeological sites in the northern Namib Sand Sea, including the sampling sites of Namib IV (Niv) and Narabeb (Na), (B) sedimentary sequences observed in test pits at Namib IV: (i) GT4, (ii) FB1 site 1, (iii) FB1 site 2, (iv) GT2, (v) GT1, (vi) GT3 and (vii) GT6 (for locations of the geotrenches the reader is referred to Fig. 2 on p4 of Leader et al. (2023).

1) Poorly-sorted fine sand (mode ~200 μm) with ~15% silt, with inclined bedding (angles between 14 and 17 degrees) in GT4 (Figure 1Bi). This is interpreted as dune sediment reworked by surface water flow, filling a small depression or gully. The sediment appears to have remained waterlogged for some time, forming iron nodules in places. Preliminary luminescence dating using feldspar pIRIR₂₂₅ signals suggests part of this sedimentary sequence dates to MIS 11.

2) Indurated lakebed/palustrine calcareous-rich marl, beneath which there are horizontally-bedded layers/units of moderately-sorted fine sands (modes of samples range from 150 to 190 μm) with 8 to 18% silt, of a range of colours (7.5 YR 6/8 reddish yellow, 2.5 YR 8/2 pale yellow, 2.5 Y 8/1 white, 10YR 8/3 yellow, 10YR 7/4 pale brown), some units containing laminations and interbedded calcareous-layers, whilst other units are unstructured/massive. This style of sequence is observed at FB1 (Figure 1Bii,iii) and GT2 (Figure 1Biv), and preliminary luminescence dating results suggest these fine-sands date to MIS 3. These are interpreted as water-lain sediments.

3) Moderately sorted, very-fine sand (mode 119 μm), with 12% silt (7.5 YR 8/2 pinkish white) containing patches of calcium-carbonate, overlying a discrete (~10 cm thick) calcium-carbonate unit, which overlies a 2.5YR 5/6 red sand-rich unit (not sampled for sedimentology). This was observed at GT1 (Figure 1Bv). These are interpreted as low energy water-lain sediments.

4) Highly-indurated silt-rich unit with horizontal layering and vertical desiccation cracks, observed at GT3 (Figure 1Bvi), but not a suitable target for luminescence dating. These are interpreted as very low energy water-lain sediments.

Subsequent fieldwork by Sepehr Akhavan Kharazian in a separate field campaign in 2023 deepened GT6 (Figure 1Bvii), with further samples taken for luminescence dating, and samples were taken to make thin-sections for micromorphological analysis (no current data). The units within all sequences remain to be formally assigned to a lithofacies, following the criteria of Miall (2006), or grouped into lithofacies associations, which is an approach that has been used very productively for a number of Namib Desert rivers (e.g. in the NSS, the Tsauchab at Sossus Vlei (Brook et al., 2006), and further north, the Hoarusib (Srivastava et al., 2005), and the Hoanib (Walsh et al., 2022).

Significance

This work, so far, demonstrates the applicability of feldspar pIRIR₂₂₅ signals for luminescence dating in this region, and furthermore, demonstrates that there were multiple phases during which water-lain sediments were deposited at both Narabeb and Namib iv. Narabeb lies along the former course of the Tsondab River (Stone et al., 2010; 2024a), whilst Namib iv is further north (Figure 1A) and most likely to have received water from surface water draining a few km of the surface south of the Khuseb River. Groundwater discharge may also have contributed to the presence of standing water, although the sedimentary textures (particle size analysis) and sedimentary structures observed at the sites indicate water flowing at some points and ponding at other points.

Acknowledgements

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This pilot work was extremely valuable in supporting our successful funding bid to The Leverhulme Trust to sample at a larger range of sites associated with the former Tsondab River course in a project “PANS: Palaeoenvironmental context of Palaeolithic Archaeology in the Namib Sand Sea”, which will run from 2025-2029.

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**PETROLOGICAL AND GEOCHEMICAL INSIGHTS INTO QUATERNARY
BASALTIC VOLCANISM AT THE KULA VOLCANIC PROVINCE,
WESTERN TÜRKIYE**

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Background and Rationale

Türkiye is a tectonically and volcanically active region situated on the boundary between the Eurasian Plate, the African Plate, and the Arabian Plate (Tokçaer et al., 2005). The Kula Volcanic Province (KVP) is a prominent volcanic area and represents the westernmost and youngest volcanism in the country. This area is a monogenetic volcanic field (MVF) and hosts a range of diverse geomorphological features from three eruptive periods, referred to as the first stage (Burgaz), second stage (Elikiçitepe), and third stage (DivlitTepe), representing three different active volcanic phases in the Quaternary Period.

The QRA New Researchers Award facilitated key geochemical analysis as part of a PhD project. The work involved the application of laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) in the elemental analysis of lava flows from the three periods of volcanic activity. This high-resolution technique is widely used for studying and understanding volcanic rocks, able to better assess magma chamber processes from the source origin, during residency in the crustal plumbing system, until finally cooling at the Earth's surface (Oggier et al., 2023). This has been achieved through the analysis of trace element concentrations in different mineral phases including clinopyroxene (CPX), olivine (Ol), amphibole (Amph), and plagioclase (Pl). This approach can help determine magma sources, understand magma evolution and differentiation, determine eruption conditions, and contribute to long-term volcanic monitoring and prediction.

Method

Trace element analyses of the mineral phases CPX,

Amph, Ol and Pl were performed at the Department of Earth Sciences "A. Desio" of the University of Milan using an Analyte excite 193 nm ArF excimer laser coupled with a Thermo Fisher Scientific iCAP-RQ mass spectrometer. The operating conditions were the following: 6 J/cm² fluence, 40 µm (CPX, Amph and Ol), 65 µm (Pl) spot size, and 10 Hz repetition rate. The acquisition time was 60 seconds on the sample and 40 seconds on the background. Data reduction was carried out with the software package GLITTER (Griffin, 2008) using SiO₂ wt% (Amph, Ol and Pl) and CaO wt% (CPX) concentrations from microprobe analyses as internal standard. The international reference material BCR-2G (Jochum et al., 2005) was used as a calibration standard and reference glasses (NIST612, Pearce et al., 1997; ARM-3, Wu et al., 2019; GSD-2G and ATHO-G, Jochum et al., 2005) were used to monitor accuracy. This study has used spot analysis at the core, intermediate, and rim points of individual mineral grains, providing high-precision elemental concentrations at different locations within a crystal. This approach can provide insights into mineral zoning, and the chemical evolution of individual mineral grains. The core represents the earliest part of the mineral to crystallise therefore its composition can reflect the initial conditions of the melt during the early stages of mineral formation. The intermediate zone reflects the transition between the core and the rim and often shows gradual and/or abrupt changes in composition due to changes in magma composition, temperature, or pressure, reflecting magma mixing, or the introduction of new material. The rim is the last to form and often reflects the final stages of crystallisation or later alteration occurrences. This can provide information about the conditions at the end of the crystal's growth such as cooling and magma solidification.

Results

Preliminary data shows the three episodes of volcanism have characteristic features of mid-ocean ridge basalt (MORB) normalised patterns for within plate alkaline basalts. This is characterised by the enrichment of highly incompatible elements such as rubidium (Rb), barium (Ba), and thorium (Th) relative to moderately incompatible elements such as zirconium (Zf), hafnium (Hf), and samarium (Sm). The ocean-island basalt (OIB) pattern is almost the same as that of the Kula lavas, except all three episodes are enriched in highly incompatible elements compared to OIB.

The rare earth element (REE) data has been normalised to chondritic REE abundances, as proposed by Sun and McDonough (1989). The chondrite-normalised REE patterns for the three periods exhibit characteristic alkaline basalt patterns with enrichment in light-REE (LREE) abundances from lanthanum (La) to europium (Eu) compared to chondritic values. The chondrite-normalised REE patterns for the first stage have the lowest REE abundances, with the first and third stages more depleted, and geochemically similar to one another. Overall, the three periods are greatly enriched compared to chondritic abundances. Since

we do not observe an Eu anomaly, it suggests that Pl was not a major fractionating phase, the magma might have crystallised at pressures where Pl was not stable, or primitive or undifferentiated sources, meaning Pl had not yet fractionated from the melt.

Significance

MVFs are found where small batches of magma can erupt effusively and/or explosively for weeks to decades, with monogenetic volcanism producing small-volume volcanoes, typically <1km³. As the term suggests, monogenetic volcanoes consist of singular eruptions, which means if an eruption stops, volcanism will not occur at the same eruptive centre again. Volcanism in the area may still be active, however, and may occur as newly developed eruptive centres within its monogenetic field. The hazard risks associated with these features are high, with intense urbanisation and population growth a risk to individuals and infrastructure. Using trace element data obtained from LA-ICP-MS, we can begin to develop geological interactions that influence volcanic behaviour and gain knowledge about the geodynamic environment over time. This is incredibly important for MVFs due to the unpredictable eruptive nature,

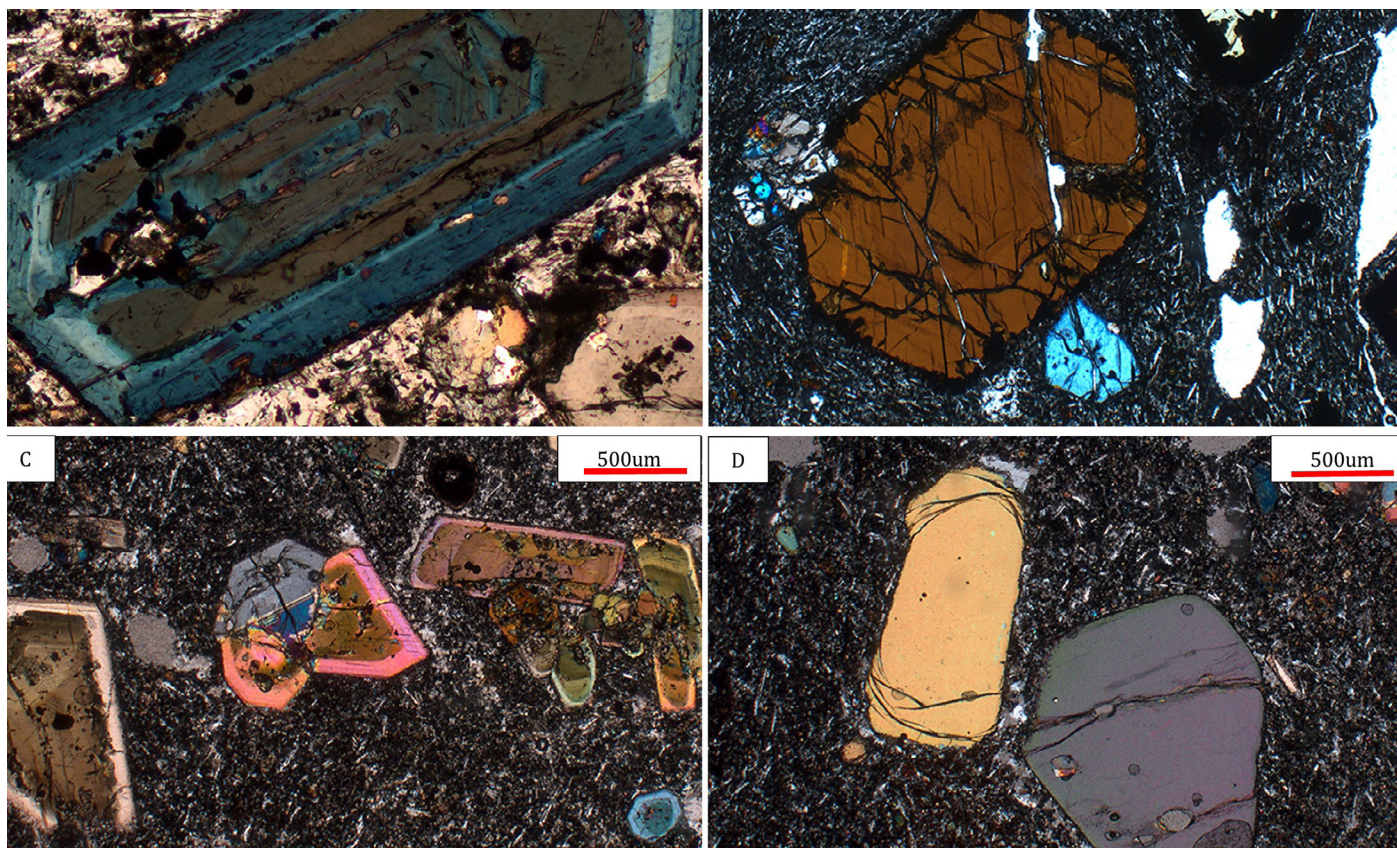


Figure 1: Thin section photographs of mineral phases analysed in cross-polarised light (XPL). A: first stage CPX showing concentric zoning B: first stage Amph with a prominent reaction rim C: multiple second stage CPX crystals with concentric zoning D: euhedral second stage Ol. Spot analysis at the core, intermediate, and rim points of each crystal was carried out to provide insights into any mineral zoning and chemical compositional changes that would have been recorded as the crystals grew.

and uncertainties on origin, longevity, and temporal-spatial distribution of eruptive centres (Jaimes-Viera et al., 2018). The data acquired from this work will be integrated into a detailed geochemical analysis of the temporal and spatial relationships from the volcano and help develop insights into the mechanics driving volcanic activity in the area.

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BOOK REVIEW: LANDSCAPE AND LANDFORMS OF THE NORTH COTSWOLDS

by Pete Jeans

The Gloucestershire Naturalists' Society – Special Issues Volume: 42

Paperback, June 2024, 152 pages, colour photos, colour maps

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This is a handy, pocket-sized book rather in the style of a field guide (resembling the A5 format of our familiar QRA guides), although the Gloucestershire Naturalists' Society's website (and a statement on the back cover) reveals that the content was originally published as a series of articles in GNS News between 2020 and 2023. These articles have been updated and are supplemented by a series of walks on which many of the features described can be seen.

There are sixteen short chapters, as follows: (1) Introduction, (2) Geological Summary, (3) The Thames story, (4) Wind Gaps and the Contrast between Scarp and Dip streams, (5) River Capture and Outliers, (6) Landslides, (7) Cambering, (8) Terraces [non-fluvial], (9) Strip Lynchets, (10) Typical landforms of river valleys, (11) Evolution of Cotswolds river valleys through time, (12) Lakes and the impact of Man on river valleys and water supplies, (13) Glacial Lakes, established and possible, (14) Weathering, (15) Biological Weathering and (16) Illustrative Walks. If that seems a somewhat random running order (borne out in reading and navigating through the book) that is perhaps a legacy of the origin as separate articles.

This is not a field guide, then, except perhaps in respect of the chapter describing the walks. As the chapter titles indicate, there is much of interest here, although some of it, from the point of view of QN readers, fits better under a geomorphological rather than a Quaternary heading; there are indeed valuable insights into the geomorphology of the North Cotswolds.

In terms of presentation, the book is a curious combination of modern high-tech imagery and engaging written descriptions, supplemented with an

eclectic mix of personal ideas, including some rather outmoded concepts and ambiguous statements. The imagery sometimes works poorly at this scale, not helped by injudicious use of colour as a background that obscures labelling and, perhaps worse, the overlaying of digital-terrain-model shading that is rather too prominent onto location maps. The labelling, often faintly visible under such circumstances, is in some cases too small. An example statement, from Chapter 3, tells the reader that "the present-day River Thames and its tributaries are mere shadows of what they once were, before the Great Ice Age". It is unclear as to what the last term refers. The context, in a chapter devoted to the Thames and the drainage by its headwaters of the Cotswolds dip-slope, suggests that the only ice sheet to reach this neighbourhood, during the Anglian Stage, was its inspiration. In any case, this misleads the uninitiated reader, since these rivers would have been repeatedly more impressive and powerful during the numerous colder climatic periods of the Quaternary, only to revert to lower-energy forms, again repeatedly, during the also numerous interglacials: forms comparable with those of the present day. Indeed, the writer states this later in the book, astutely noting that the maximum fluvial activity would have coincided with deglacial periods, linked to the enhanced meltwater supply at such times. But that is elsewhere in the book, rather emphasizing the problematic organization already noted. Although greatly interested in the subject matter, this reviewer found the book to be rather hard work. The handful of references that appear at the end of the chapters are puzzling; these often bear no obvious connection to the general chapter content, for most of which no further sources are indicated, and there is a lack of citation, even of those sources listed. The choice of 'references' (perhaps they should have been entitled

‘further reading’) generally omits the best sources for systematic information; for example, on the terraces of the Upper Thames, the formative contributions by Sandford (1924, 1926), Arkell (1947a, b) and, more recently, Hey (1986) are rather glaring omissions. The emphasis given to Quaternary uplift is welcome, but the reader is pointed only to the views of A.B. Watts and co-workers, whereas alternative and (arguably) more plausible interpretations from D. Maddy (1997; Maddy et al., 2000) and R. Westaway (2001; Westaway et al., 2002) are surely equally deserving of attention, being more solidly based on empirical geomorphological evidence.

Nonetheless, there is much here that draws the reader’s attention and whets the appetite for more. There are excellent descriptions, with useful photographs, of geomorphological features related to mass movement of various types, including cambering, as well as archaeological landforms, such as strip lynchets, ridge-and-furrow field-systems, moats and millponds. There is useful coverage of rock-weathering features too. In addition to these highlights, there are intriguing, albeit unsubstantiated ideas that encourage further exploration. An example is a suggestion (in Chapter 5) that in pre-Anglian times a continuation of the Upper Wye flowed NW–SE into the Thames system, cutting directly across the area now drained south-westwards by the Severn. With inspiration from W.M. Davis cited, this would appear to be based on the alignment of valley heads within the Wye, Leadon, Severn and Frome systems. Again, Richard Hey’s work can be recommended for valuable context and can in fact be used to falsify this interpretation: in this case the Hey (1991) paper on the Wye, in which he established a well-preserved terrace system upstream of the famous Wye gorge, assessing the ages of these terraces in relation to the depth of the gorge. Darrel Maddy subsequently built on that work in a QRA field guide (Lewis and Maddy, 1997) to establish that the Wye gorge represents incision by that river over the whole of the Pleistocene, essentially negating the idea that the Wye did not exist as an integrated system prior to the Anglian.

This book is perhaps one that invites repeated consultation, offering both impetus and inspiration for further investigation of particular northern Cotswolds features. If that was the author’s intention, then it can certainly be considered a success; anyone interested in the Quaternary and geomorphological history of the Cotswolds will want this in their bookcase.

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DR. ALISTAIR FRANK PITY

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Alistair had a brilliant career as a student, gaining a place at William Hulme's School in Manchester, where he passed four A Levels with flying colours. He then was awarded an Exhibition at Brasenose College, Oxford and achieved first class honours in geography (one of only six in a class of over ninety to do so). He stayed at Oxford to write a D.Phil. thesis about *Landform Studies in the Peak District of Derbyshire* (Pitty, 1966a). It was a challenging time for a young geomorphologist. There was a strong, entrenched tradition of analyses of evolution of landforms dominated by a belief in the existence of sequences of peneplains that was being challenged by a new wave of understanding the processes currently fashioning the landscape and the ways they had worked in the past. Alistair successfully straddled both camps. He became a master of the details of the landscape, often seeing things that both his predecessors and his contemporaries had missed. He read extremely widely and was able to trace the evolution of ideas on every topic he examined. His working career had two parts: an effective, highly productive fourteen years at the University of Hull, followed by some thirty

years of wide-ranging consultancy achievements. He also, like many of his contemporaries, spent time in retirement examining the evolution of the Norfolk landscapes around where he lived.

UNIVERSITY RESEARCH

Five of his important studies were:

1) Idea of down-dip breaching

In 1965 Alistair reviewed hypotheses about escarpment gaps in the Southern Pennines near Buxton (Pitty, 1965). Evaluating previous ideas, he eliminated them and developed a new theory: selective undercutting by down-dip shift and the lateral erosion of progressively higher horizons as funnel embayment developed. The breach would have enlarged and cut back the scarp until it eventually over-topped the divide. Much later he applied the idea to similar phenomena in Kuwait and Saudi Arabia.

2) Slope pantometer

Alistair's slope pantometer (Pitty, 1966a, 1967) was



Photo: Alistair (right) in 2010 with his colleague from the 1960 Oxford University Expedition to Cyrenaica, Mike Wilson.

designed to be lightweight and usable by one person to get a series of measurements at 1.52 metre intervals down a slope. The short unit lengths make realistic surveys of microrelief possible (Pitty, 1968), while the relative speed of the measuring process makes the prospect of surveying large-scale slopes undaunting (Pitty 1968b). Slope pantometers are mentioned in fieldwork for schools by the Royal Geographical Society (<https://www.rgs.org/schools/resources-for-schools/coasts-fieldwork-techniques>).

Instructions for making a pantometer can found at: <https://www.instructables.com/How-to-make-a-pantometer-for-slope-measurements-an/> and in the appendix of his book (Pitty, 1971). Later researchers have used the pantometer in diverse locations such as the Wasatch fault zone, Utah; the River Wye catchment and the Lake District, UK; Baja California, Mexico; the San Pedro region and Rondônia, Brazil; Peninsular Malaysia; and Jotunheimen, Norway.

3) Biotic influences on karst water chemistry

In his systematic sampling of water from springs in Poole's cavern, Buxton, Alistair found that peak concentration of calcium carbonate in the water, occurring in November, was related to high levels of biologically generated carbon dioxide in the surface soil during the previous spring and early summer. The slow passage of the groundwater through the limestone caused the time lag. He termed this warm period peak in solution: the "Spring burst" (Pitty, 1966b, 1971). While other factors than soil carbon have been shown to influence spring water chemistry, the spring-burst effect has been observed in many karst areas world-wide.

4) Contrasts in fluctuations of surface and groundwater temperatures in karst areas

Alistair found that in the southern Pennines, temperatures of emerging groundwaters and their geographical pattern revealed characteristics of water movement underground. The gross permeability of limestones in north-west Yorkshire was greater than that in Derbyshire, the rate of flows in sink resurgence systems taking 1.4 times longer in Derbyshire than in Yorkshire. Alistair's student, John Crowther, found similar contrasts in karst areas of Malaysia, with deeper groundwaters having minor variation in temperature, and water higher in the karst affected by air circulation having much greater variation in temperature (Crowther and Pitty, 1982).

5) Saharan dust

Alistair's ability to spot the significant factors in the environment led to an important paper in *Nature* (Pitty, 1968c). Rain in Britain on July 1st 1968 brought down large quantities of dust which, according to Meteorological Office reports, had travelled northward from Morocco where unusually strong thermal currents had carried the dust to heights of up to 35,000 feet. Such occurrences are unusual in Britain, and the dust fall aroused considerable popular interest. It also provided a rare opportunity for studying the particle size and degree of sorting in a natural dust, known to be transported by wind, unaltered by post-depositional modifications, and unlikely to be the product of reworking of an existing loess deposit.

CONSULTANCY WORK

1) Geographical abstracts

In 1960, Keith Clayton, the founder of Environmental Science at the University of East Anglia and a member of the National Radiological Protection Board, set up GeoAbstracts, an abstracting and indexing enterprise that, in those pre-internet days, allowed geographers and environmental scientists to discover one another's work more easily. Alistair had long prepared abstracts while at Hull and in the mid-1980s, when he had moved to Norwich, he was the editor for abstracts for economic geography and sedimentology. Keith also asked him to assist with work on the geomorphic problems related to potential nuclear disposal sites.

2) Nuclear waste disposal

a) Early work on the geomorphological processes affecting potential waste at the Dounreay site in Caithness, Scotland sought to ascertain what might affect the containment of waste. In 2024, at Dounreay, the former atomic power station was still being taken apart and removed for the Nuclear Decommissioning Authority (NDA). During the 1990s Alistair collaborated in several enquiries about the future suitability of Dounreay and other sites for storing nuclear waste.

b) Later, Alistair became involved in investigations of the potential impact of geomorphological processes in the safe geological disposal of higher activity radioactive waste deep in the bedrock, which is a process now on the verge of implementation, solving the last step in the nuclear fuel cycle. In the UK, the organisation responsible for the implementation of the Geological Disposal Facility (GDF), NWS,

is examining different potential host rock types and disposal concepts. Because high-level nuclear waste must be managed safely for up to a million years, scientific knowledge must be acquired for long-term process understanding from old archaeological artefacts or natural analogues (NA) from the geological record. Alistair helped to examine a variety of sites where the rocks had similar geochemical characteristics to the materials which would be used to contain nuclear waste. He went to sites in Jordan and Cyprus, not only making studies of geomorphological processes, but also becoming involved in editing some of the key reports.

3) Geoarchaeological research

For many years from the 1980s onward Alistair worked closely with Geoarchaeological Research Associates in the USA, contributing to the understanding of the natural processes that helped to fashion and change prehistoric sites. Much of the work, especially in Pennsylvania, Georgia and Florida, concerned low-lying coastal sites where accurate measurement of the low-level relief was essential. His pantometer was a vital tool in this work. He gave a paper on landform mapping and archaeology in the Sandhills, North Carolina to the 2000 Southeastern Archaeological Conference.

4) Collaboration with the Kuwait Institute for Scientific Research

Alistair worked with scientists in Kuwait to identify and map sand and gravel resources. In seeking to explain the gravel of the Ad-Dibdibba drainage system in the north of the country (Al-Sulaimi and Pitty, 1995), he identified escarpment gaps that had been created by the type of down-dip breaching he had found near Buxton in Derbyshire thirty years earlier.

RETIREMENT EXPLORATIONS

Alistair's nuclear waste disposal work led to the use of gamma radiation measurements in detecting changes in soil and surface sediment characteristics (Pitty, 2009). Using a portable instrument for measuring extremely low counts of radiation, he made regular observations for six years along a traverse of 24 measuring sites each 60 metres apart at Itteringham, 20 km northwest of Norwich. His data confirmed the contrasts between surface soil and subsoil properties. Significantly, the radiation measurements differed between soils developed on the tills of three Quaternary glaciations, suggesting that the youngest, Devensian, till might be

more extensive than previously thought. As always, his attention to detail and alternative explanations remained sharp and critical.

SUMMARY

Alistair's career of two parts and his local research in Norfolk showed a consistent dedication to, and enormous enthusiasm for, field work. It also demonstrated how the first part produced an outstanding grasp of the scientific literature, the diversity of theories, and potential explanations which were of great help when faced with the practical issues of fitting geomorphology into wider geoscientific and geoarchaeological enquiries. On top of all that, Alistair helped generations of students by writing a series of textbooks:

- 1971 *Introduction to Geomorphology*, London: Methuen
- 1979 *Geography and Soil Properties*, London: Methuen
- 1982 *The Nature of Geomorphology*, London: Methuen
- 1984 *Geomorphology (and Geography Applied)*, Oxford: Blackwell
- 1985 *Structure and Relief*, London: MacMillan Educational
- 1987 *Landforms and Time*, Oxford: Wiley-Blackwell (The Methuen books were re-issued by Routledge in 2021). He also edited two volumes of essays on geomorphology
- 1979 *Geographical approaches to fluvial problems*, Norwich: Geobooks
- 1985 *Themes in Geomorphology*, Beckenham: Croom Helm

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Pitty, A.F. (2009) *Evaluation of natural gamma radiation as an index of sediment and soil properties in the field* (unpublished ms.).

QUATERNARY RESEARCH ASSOCIATION

The Quaternary Research Association is an organisation comprising archaeologists, botanists, civil engineers, geographers, geologists, soil scientists, zoologists and others interested in research into the problems of the Quaternary. The majority of members reside in Great Britain, but membership also extends to most European countries, North America, Africa, Asia and Australasia. Membership (currently ~1000) is open to all interested in the objectives of the Association. The annual subscription is £30 with reduced rates (£15) for students, retired and unwaged members and an institutional rate of £60.

The main meetings of the Association are Field Meetings, usually lasting 3–4 days, in April, May and/or September, and a 2-3 day Annual Discussion Meeting held at the beginning of January. Short Study Courses on techniques used in Quaternary work are also occasionally held. The publications of the Association are the *Quaternary Newsletter* issued in February, June and October; the *Journal of Quaternary Science* published in association with Wiley; and the QRA Field Guide and Technical Guide Series.

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