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Quaternary Newsletter



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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 numbers are 1st 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 (500 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 or .jpg format. In case of the latter, a 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. PhD 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: Detailed guidelines on the formatting of contributions are now available via the QRA webpage and from the editor, including an EndNote style file to help with the formatting of bibliographies for submissions to *QN*.

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COVER PHOTOGRAPH

View of Coumshingaun, Comeragh Mountains, Ireland (see report by Coleman in this issue).

EDITORIAL

I hope you all had a good start to 2016.

This is my last issue of *QN* in my role as editor. I still find it hard to believe that my term of four years has gone by in a flash! It has been a real privilege and highly rewarding experience to serve as *QN* editor, and I will certainly miss having my finger on the pulse of the Quaternary community as closely through reading all the numerous reports and articles (often more than once!) and being in regular contact with members via email and, in a few cases, handwritten letters. As I said before on numerous occasions, to me it is this communication and the willingness to engage in lively discussion (and controversy!) that sets the QRA and its membership apart and has made my role (and at times life) as an editor all the more enjoyable.

QN would not be what it is without the efforts of the community as a whole, i.e. you! Therefore, I would like to thank all the contributors to *QN* who have written research and feature articles, obituaries, meeting and other reports, and who have submitted their thesis abstracts as well as reviews of books and maps. One often invisible element of all this is the time and energy the reviewers invested to scrutinise work submitted to *QN* – often at incredible speed and with no less input than a longer journal article would attract – and without which the level of quality would be harder to maintain. Thank you to all of you who contributed in this way and who chose to remain anonymous. Last but certainly not least I would like to take this opportunity to thank Val Siviter for typesetting *QN* so capably and patiently (especially when dealing with the outgoing editor) and to Gwasg Ffroncon for printing it.

The new editor of *QN* is Abi Stone, who despite her surname spends most of her research time investigating sand-rich sediments. She completed an MSc in Quaternary Science at Royal Holloway, University of London in 2004, after an undergraduate degree in Geography at Keble College, Oxford. She completed her DPhil at the University of Oxford in 2009 on ‘Multiproxy reconstructions of late Quaternary environments in western southern Africa.’ After a number of short-term research and teaching positions Abi worked as an Early Career Fellow at St John’s College Oxford from 2011 to 2014 before taking up a lectureship in Physical Geography at the University of Manchester in September 2014. Her research interests are centred on dryland regions, including environmental change, landscape dynamics and groundwater resources over a range of timescales from the late Quaternary to the present day. Abi is a geochronologist, applying luminescence dating to constrain landscape dynamics in sand-rich dryland regions. She does however recognise that there is more to Quaternary drylands than sand, and has experience using U-series methods to date terrestrial carbonates, such as tufa. Most recently, Abi has been applying geochemical tracer approaches to

assess rates of groundwater recharge and issues relating to groundwater quality. This means more digging in the sand to extract pore moisture and also includes the use of these chemical tracers as novel palaeomoisture proxy in regions of drylands where it is difficult to obtain other proxies. Abi has published widely in Quaternary and Physical Geography journals, and has contributed to books. As a long standing QRA member (since 2003) she is looking forward to her term as editor of *QN*, working with the other members of the Executive, and being in contact with QRA members!

I wish Abi well for her term as *QN* editor and hope that QRA members will be as forthcoming with articles and other material for *QN*, thereby supporting her in her task.

With thanks and the very best wishes,

Sven Lukas

OBITUARY

NICHOLAS STEPHENS (1926-2014)

Nicholas (“Nick”) Stephens was born in Basingstoke but was brought up in Tavistock where he attended the Grammar School (now Tavistock College). He completed his first degree in Geography and Geology at Bristol University in 1949, where he stayed on as Demonstrator in Geography and completed an MSc thesis on “*Erosion cycles in south-west Devon*” in 1952. His doctoral thesis, entitled “*Geomorphological studies in Ireland and western Britain with special reference to the Pleistocene Period*” was completed in 1966 at Queen’s University, Belfast, where he had been appointed as a Lecturer in the Geography Department in 1959. Following promotions at Queen’s to Senior Lecturer (1966) and Reader (1968), he moved to Aberdeen as Professor in Geography in 1974. After a period of four years there, he was appointed Professor of Physical Geography at Swansea in 1978, becoming Head of Geography in 1981 before taking early retirement in 1988 to move to Emsworth in Hampshire.

The change in interest between his Masters and doctoral theses, from pre-Quaternary to Quaternary and subsequently also to measuring rapid mass movements, resulted in him becoming relatively early on in his career a leading light in the new field of process geomorphology together with various aspects of Quaternary science, including periglacial geomorphology which, at the time, had even fewer exponents than is the case today. His main areas of interest in Quaternary science and geomorphology can perhaps be summarised in terms of the following themes: (1) Pleistocene deposits and environmental reconstruction in south-west England; (2) late- and post-glacial shorelines in Ireland and south-west Scotland; (3) geomorphology of Ireland; and (4) rapid mass movement processes. He was also keen to try to bring the excitement of discovery in the field of Quaternary science to undergraduates and people outside of academia. Thus, he instigated a series of laboratory-based exercises for students in which they were presented on paper with a section of Quaternary sediments based on actual examples together with some key evidence. They were set the task each week of ‘solving’ a Quaternary ‘puzzle’. A selection of these exercises was published with suggested answers and an appraisal as a teaching tool in 1982. For a wider audience, he edited in 1990 *Natural landscapes of Britain from the air*. Each chapter written by an expert in his or her field addressed a different aspect of the British landscape drawing on the resources of the Cambridge University Collection of Aerial Photography. Publication of the book occurred after his retirement. On delivering co-authors’ copies to Swansea, he wistfully confided that it would probably be his ‘swansong’, but as the publications list indicates, this was not to be the case.



Nick enjoying a well-earned break while on an undergraduate field course in the New Forest in the mid-1980s.

Although Nick single-authored research papers, particularly early in his career, he also greatly enjoyed working with others and such collaborative research gave rise to some of his best contributions to science. Perhaps highest in this category was his partnership with Francis Synge. He and Nick undertook what, during the 1960s, was pioneering research into late- and post-glacial shorelines in the northern part of the Irish Sea Basin. While still at Belfast he also collaborated with David Prior in a series of studies of present-day active mass-movement processes. This interest in earth surface processes and the practical significance of geomorphology remained a theme of Nick's work throughout his academic career, illustrated by his inaugural lecture at Swansea, entitled *Geomorphology in the Service of Man*, but still occupying him many years later, writing in 1997 on geomorphological hazards in Ireland.

In his other principal area of research interest, south-west England, he worked for many years in the 1970s and 1980s with Chris Green, a collaboration that began as an exchange of papers disagreeing emphatically about the role of glacial meltwater in the Axe valley. It is a measure of Nick's unassuming and generous nature that this led not to vituperation and an academic stand-off, but to a detailed study with Chris of the Axe Valley and in particular of the important Palaeolithic site at Broom where they spent several field seasons together with a JCB unravelling the stratigraphy of the terrace deposits. This work came finally to fruition in a monograph published in 2013 shortly before Nick passed away.

Nick also made a significant contribution to the field of geological and geomorphological conservation, supporting publication of the first volume in the Geological Conservation Review series (*Quaternary of Wales*) and both writing sections for and co-editing the 14th volume in the series (*Quaternary of South-West*

England). In addition to his detailed site-specific and process-based studies, Nick should be remembered for his outstanding and pioneering regional Quaternary syntheses and correlations, which illustrate the breadth of his knowledge and the importance he attached to establishing a framework for Quaternary events across Great Britain and Ireland.

Nick undertook with gusto the organisation of undergraduate field trips and would greatly enjoy teaching in the field, because he liked getting to know the students and probably also because it took him away from the day-to-day paperwork and niggles of running a department. Nick had what might be described as an impish, infectious sense of humour on such trips. For example, accepting his every word on matters of Quaternary science, students would be completely taken in by his faux-serious demeanour (not knowing quite whether there really was a twinkle in his eye or they were imagining it) on the few occasions when he spun some outrageous yarn (e.g. pointing out a classic glacial meltwater channel near Corfe Castle!), but enjoyed the joke with him when he later revealed any deliberate gaff. No doubt it also helped them not to accept without thinking everything said to them in the field and in lectures. A comment from one student, that Nick was his idea of a 'real professor', is a testament to how highly he was regarded amongst students. A measure of his geniality and approachability was also witnessed during one of Nick's favourite outings – a second-year Swansea University student excursion to north Devon – when one research student had arranged for him to be served a dessert in the form of an immaculately trimmed block of the dark brown Fremington clay from Branham's Clay Pit, masquerading as a choc ice! This potential pitfall was neatly side-stepped by Nick who commented something along the lines of "...this looks interesting, but I don't think I'll eat it!" He certainly appreciated the humour!

Generosity was another key quality of Nick's character. At Swansea, he would periodically entertain research students and members of staff alike at his home. Such evenings were eagerly anticipated, particularly by the financially-struggling research students, as Nick would not only feed and 'water' his guests, but ply them with his wicked sense of humour in the form of his Tom Lehrer and Joyce Grenfell records, which always surfaced as the evenings progressed and the mood mellowed!

Nick contributed to a number of QRA field meetings including the INQUA field excursion to south-west England in 1977, and he co-led a QRA meeting to west Cornwall in 1980. In retirement to Hampshire, he turned to his passion of stamp collecting and ran a small business with his son Timothy, specialising in stamps of the British Commonwealth. His enthusiasm, generosity, kindness and sense of humour will be fondly remembered by all who knew him. He is survived by his wife Dorothy, daughter Clare, grand-children Zoe and Dale and twin great grandchildren Ella and Jessica. Sadly, his son Timothy died a few years ago.

Publications

Stephens, N. (1952). *Erosion Cycles in South-west Devon*. Unpublished MSc thesis, University of Bristol.

Stephens, N. and Collins, A.E.P. (1960). The Quaternary deposits at Ringneill Quay and Ardmillan, Co. Down. *Proceedings of the Royal Irish Academy* 61C, 41–77.

Morrison, M.E.S. and Stephens, N. (1961). Stratigraphy and pollen analysis of the raised beach deposits at Ballyhalbert, Co. Down. *New Phytologist* 59, 153–62.

Stephens, N. (1961a). Re-examination of some Pleistocene sections in Cornwall and Devon. *Abstracts of the Proceedings of the Fourth Conference of Geologists and Geomorphologists working in the South-west of England*. Camborne. 1961. Royal Geological Society of Cornwall, 21–23.

Stephens, N. (1961b). Pleistocene sea-levels in North Devon. A reply to M.A. Arber. *Proceedings of the Geologists' Association* 72, 469–471.

Stephens, N. (1963). Late-glacial sea-levels in North-East Ireland. *Irish Geography* 4, 345–359.

Morrison, M.E.S. and Stephens, N. (1965). A submerged Late Quaternary deposit at Roddans Port on the north-east coast of Ireland. *Philosophical Transactions of the Royal Society, London* 249B, 221–55.

Stephens, N. (1964). The land. In: Common, D.R. (ed.) *Northern Ireland from the air*. Queen's University, Belfast.

Stephens, N. (1966a). *Geomorphological studies in Ireland and Western Britain with special reference to the Pleistocene Period*. Unpublished PhD thesis (2 vols), The Queen's University, Belfast.

Stephens, N. (1966b). Some Pleistocene deposits in north Devon. *Biuletyn Peryglacjalny* 15, 103–114.

Stephens, N. and Syngé, F.M. (1966). Pleistocene shorelines. In: Dury, G.H. (ed.) *Essays in Geomorphology*. Heinemann, London, 1–66.

Stephens, N. (1970a). The coastline of Ireland. In: Stephens, N. and Glasscock, R.E. (eds) *Irish Geographical Studies in Honour of E. Estyn Evans*, The Queen's University, Belfast, 125–145.

Stephens, N. (1970b). The West Country and Southern Ireland. In: Lewis, C.A. (ed.) *The Glaciations of Wales and Adjoining Regions*. Longman, London, 267–314.

Stephens, N. (1970c). The Lower Severn Valley. In: Lewis, C.A. (ed.) *The Glaciations of Wales and Adjoining Regions*, Longman, London, 107–124.

Stephens, N. and Glasscock, R.E. (eds) (1970). *Irish Geographical Studies in Honour of E. Estyn Evans* The Queen's University, Belfast.

Prior, D.B. and Stephens, N. (1972). Some movement patterns of temperate mudflows: examples from Northeastern Ireland. *Bulletin of the Geological Society of America* 83, 2533-2544.

Stephens, N. (1973). South-west England. In: Mitchell, G.F., Penny, L.F., Shotton, F.W. and West, R.G. (eds) *Correlation of Quaternary Deposits in the British Isles*, Geological Society of London Special Report 4, 36-45.

Stephens, N. (1974). Some aspects of the Quaternary of South-West England; Westward Ho!; The Fremington area; North Devon; Hartland Quay and Dunhole Point; Chard area and the Axe Valley section. In: Straw, A. (ed.) *Exeter Field Meeting, Easter 1974, Quaternary Research Association Field Handbook*, Exeter, pp. 5-7; 25-27; 28-29; 35-42; 45; and 46-51.

Stephens, N., Creighton, J.R. and Harmon, A. (1975). The Late Pleistocene Period in north-eastern Ireland: an assessment 1975. *Irish Geography* 8, 1-23.

Stephens, N. (1977). The Axe Valley. In: Mottershead, D.N. (ed.) *South West England, INQUA X Congress. Guidebook for Excursions A6 and C6*. Geo Abstracts, Norwich, 24-29.

Stephens, N. and McCabe, A. M. (1977). Late-Pleistocene ice movements and patterns of Late- and Post-Glacial shorelines on the coast of Ulster, Ireland. In: Kidson, C. and Tooley, M. J. (eds) *The Quaternary History of the Irish Sea*. Seel House Press, Liverpool, 179-198.

Stephens, N. and Green, C.P. (1978). Quaternary deposits at Broom, Devon. *Quaternary Newsletter* 26, 14.

Stephens, N. (1980a). Introduction and Porthleven. In: Sims, P.C. (ed.) *West Cornwall. Quaternary Research Association Field Handbook, West Cornwall Field Meeting, September 1980*, pp. 1-7 and 17.

Stephens, N. (1980b). *Geomorphology in the Service of Man*. University of Wales, Swansea, 40pp.

Stephens, N. and Sims, P.C. (1980). Pendower. In: Sims, P.C. (ed.) *West Cornwall, Quaternary Research Association Field Handbook, West Cornwall Field Meeting, September 1980*, 31-32.

Stephens, N. and Shakesby, R.A. (1982). Quaternary evidence in south Gower. In: Humphrys, G. (ed.) *Geographical Excursions from Swansea, Vol. 1: Physical Environment*. Department of Geography, University College, Swansea, 33-50.

Stephens, N. (1983.) Francis Millington Synge 1923-1983. *Irish Geography* 16, 126-130.

Stephens, N. (1985a). Ireland. In: Bird, E.C.F. and Schwartz, M.L. (eds) *The World's Coastline*. Van Nostrand Reinhold, New York, 377-383.

Stephens, N. (1985b). Ireland. In: Bird, E.C.F. (ed.) *Encyclopaedia of the World's Coastal Landforms*. Springer, Netherlands, 377-383.

Stephens, N. (1990). Coastal landforms. In: Stephens, N. (ed.) *Natural Landscapes of Britain from the Air*, Cambridge University Press, Cambridge, 191-231.

Stephens, N. (1997). Ireland. In: Embleton, C. and Embleton-Hamann, C. (eds) *Developments in Earth Surface Processes 5: Geomorphological Hazards in Europe*. Elsevier, Amsterdam, 263-285.

Stephens, N. (1998). Introduction. The Quaternary History of north Devon and west Somerset. In: Campbell, S., Hunt, C.O., Scourse, J.D. and Stephens, N. (eds) *Quaternary of South-west England*, Joint Nature Conservation Committee, Chapman and Hall, London, 193-203.

Synge, F.M. and Stephens, N. (1960). The Quaternary Period in Ireland: an assessment, 1960. *Irish Geography* 4, 121-130.

Synge, F.M. and Stephens, N. (1966). Late- and post-glacial shorelines and ice limits in Argyll and north-east Ulster. *Transactions of the Institute of British Geographers* 39, 101-125.

Prior, D.B., Stephens, N. and Douglas, G.R. (1970). Some examples of modern debris flows in north-east Ireland. *Zeitschrift für Geomorphologie* 14, 275-288.

Prior, D.B., Stephens, N. and Douglas, G.R. (1971). Some examples of mudflow and rockfall activity in north-east Ireland. In: Brunsden, D. (ed.) *Slopes: form and process. Institute of British Geographers Special Publication* 3, 129-140.

Hutchinson, J.N., Prior, D.B. and Stephens, N. (1974). Potentially dangerous surges in an Antrim mudslide. *Quarterly Journal of Engineering Geology*, 7, 363-376.

Mitchell, G.F. and Stephens, N. (1974). Is there evidence for a Holocene sea-level higher than that of today on the coasts of Ireland? *Colloque International CNRS* 219, 115-25.

Davies, G.L.H. and Stephens, N. (1978). *The geomorphology of the British Isles: Ireland*. Methuen, London.

Shakesby, R.A. and Stephens, N. (1982). An introduction to the interpretation of Pleistocene sedimentary sequences – a short programme of laboratory practical work. *Journal of Geography in Higher Education* 6, 29-38.

Campbell, S., Hunt, C.O., Scourse, J.D. and Stephens, N. (eds) (1998). *Quaternary of South-west England*. Joint Nature Conservation Committee, Chapman and Hall, London.

Campbell, S., Stephens, N., Green, C.P. and Shakesby, R.A. (1998). Broom Gravel Pits. In: Campbell, S., Hunt, C.O., Scourse, J.D. and Stephens, N. (eds)

Quaternary of South-west England. Joint Nature Conservation Committee, Chapman and Hall, London, 307-317.

Green, C.P., Hosfield, R.T., Stephens, N. and Shakesby R.A. (2013). New investigations at Broom. In: Hosfield, R.T. and Green, C.P. (eds) *Quaternary history and Palaeolithic Archaeology in the Axe Valley at Broom, South West England*. Oxbow Press, Oxford, 84-146.

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JAMES CROLL AWARD

James Croll Medal - Alayne Street-Perrott

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, 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.

Alayne Street-Perrott is currently Research Professor of Physical Geography, University of Swansea prior to which she held a demonstratorship/lectureship in Geography at the University of Oxford (1976-95) and was latterly Programme Leader in Palaeoclimatology in the Environmental Change Unit at the same institution.

Alayne's work is focused on palaeoclimatology and biogeochemical cycling, mainly in low latitude regions and with particular emphasis on lake-sediment and peat records. Her research has employed a wide variety of sedimentological, geochemical, isotopic and palaeoecological indicators for a diverse array of problems. Her early work on tropical lake-level variations inspired new directions in the use of databases



in Quaternary science as well as moving forward our understanding of the Quaternary in the tropics, which had hitherto been largely overlooked. Her work on Milankovitch forcing of tropical monsoons undoubtedly paved the way for our understanding of long-term cycles of effective moisture in low-latitude regions, and involved broad international cooperation (e.g. within COHMAP) with other palaeoclimatologists and with climate modelers. On shorter timescales, Alayne was amongst the first scientists to identify the existence and significance of sub-Milankovitch scale, abrupt climate changes in low latitude regions, and in the role of North Atlantic circulation in their forcing. The work of Alayne and her students in Mexico helped to identify the complex interplay between climate change and human activity in driving landscape change during the Holocene.

More recently, Alayne has turned her attention to palaeo-records of elemental cycling, using novel molecular isotopic indicators. Her work on high-altitude lakes in East Africa has revealed important findings about carbon cycling, and the role of $p\text{CO}_2$ as a driver of vegetation change on glacial-interglacial cycles. Her work on the silicon cycle in lacustrine environments is at the cutting edge. After a 2014 EGU presentation, she was invited to review orbital forcing on the Si cycle that she discovered in East African lakes, for Quaternary Science Reviews. The resulting paper is an internationally-significant contribution to this emerging science area.

Alayne's regional specialisms have been in challenging parts of the world including East and West Africa, Mexico and Jamaica. Until very recently, she has supported students in these difficult regions, a testament to her career-long dedication to the advancement of her science. Alayne has made countless contributions to the national and international research community throughout her career including: NERC, the Royal Society, the QRA and RGS/IBG within the UK, and has represented UK global change science within COHMAP, PMIP, IPCC, IAMAP, IDEAL and INQUA.

She has attracted prestigious amounts of funding from RCUK and other sources. In summary, Alayne's research career has been exceptional, marked by novel, cutting-edge research of the very highest quality in several disciplines, which addresses 'big' questions in Quaternary Science. She has promoted the importance of tropical environments through international cooperation and leadership, and developed fundamental concepts. She has made an immense contribution to our understanding of global change in the Quaternary, raising the discipline to new levels of scientific rigour.

Moreover, she has inspired and mentored a second and third generation of men and women in Quaternary science, including a good number who are now professors and scientific leaders in their own right. Alayne is an extremely worthy recipient of the Croll Medal.

LEWIS PENNY AWARD

QRA Lewis Penny Medal -Tom White

The Lewis Penny Medal is aimed at a young (normally less than 35 years old) or new research worker who has made a significant contribution to the Quaternary stratigraphy of the British Isles and its maritime environment. This is notionally taken to mean Britain, Ireland and surrounding offshore areas but adjacent areas of continental Europe that have relevance to the British Isles may also be taken into account. Quaternary Stratigraphy is considered here to include both Pleistocene and Holocene records and to be broad-based, encompassing lithostratigraphy, chronostratigraphy, biostratigraphy or other relevant fields.

Tom White is a first-rate early-career researcher with a level of versatility that extends across the range from archaeology to biology, Earth science and geography, with particular expertise in aspects of Quaternary geo-archaeology. Tom's ability to pursue various research initiatives will be apparent from his bibliography: his publications show a healthy range from contributions to team research (very much a feature of Quaternary science) to papers in which he is first author and instigator.



Tom's dedication to the furtherance of science is readily apparent from his involvement as a volunteer officer in two learned societies: the Malacological Society as well as the Quaternary Research Association. For the latter he has contributed to the discussion meeting (joint with the Essex Field Club) at Basildon in 2014 and field meetings in 2007 (Trent), 2013 (Durham/N. Yorkshire) and 2014 (Lower Thames / Essex), being a field guide editor for those in 2007 and 2014. He has also presented Trent and Fenland project data at various outreach meetings and his PhD findings on Lower Thames biostratigraphy and Pleistocene sea-level change on several occasions, notably at a NERC Science Day in Durham (July 2010) and at the Fluvial Archives Group (former QRA research group) biennial meeting in September 2010, Castelo Branco, Portugal.

FLUVIAL ARCHIVES, LOWLAND GLACIATION AND INTERGLACIAL CLIMATES

Dr Tom S. White (Department of Zoology, University of Cambridge)

Introduction

I would like to express my sincere gratitude to the QRA for awarding me the 2015 Lewis Penny medal. I have gradually made the transition from archaeologist to Quaternary malacologist by way of the Palaeolithic period, which was my primary interest as an undergraduate and later masters student at Durham University. The Palaeolithic remains one of the common threads running through my various research interests, although molluscs have become my main passion. My career has followed a slightly unconventional path, in that I spent three years working as a research associate on projects funded by the Aggregates Levy Sustainability Fund (ALSF) before starting my Ph.D. The first of these, the Trent Valley Palaeolithic Project (TVPP), was awarded in 2005 to Mark White and David Bridgland (both Durham) and Andy Howard (Birmingham), who gambled on an untested former student with relatively little research experience to be their RA. The TVPP provided me with something of a crash-course in multidisciplinary Quaternary science, and introduced me to many of the influential Quaternary scientists with whom I continue to enjoy working. Since then, I have been fortunate to work in a variety of university departments and museums, allowing me to develop a broad range of research interests.

River terraces and the British Palaeolithic

An interest in the British Palaeolithic inevitably leads to an interest in rivers, which have been the unifying feature of most of my work to date. The Trent is one of several important British rivers that preserve an extensive archive of Pleistocene river terraces from which biostratigraphical and archaeological evidence has been recovered. In addition, the Trent catchment is located in a region that has been glaciated on at least three occasions and its fluvial archive can therefore provide valuable evidence for the timing and extent of lowland glaciation in Britain. However, prior to the TVPP, there had been little modern research on the Trent system (see Howard *et al.*, 2007 and references therein).

The initial stages of the TVPP were concerned with gathering as much geological, palaeoecological and archaeological information relating to the Trent and its tributaries as possible. Active gravel pits were monitored for potential exposures of worthwhile sediments, and I spent many long days logging sections and recovering samples for analysis by sedimentologists, palaeoecologists and dating specialists.

Where quarrying had ceased (or had never been viable, as was the case for the highly fragmented older terraces), we cut our own sections in search of gravel. My own contribution to the large body of data being generated by the TVPP took the form of clast lithological analysis, a skill taught to me by David Bridgland.

At some sites in the Middle Trent we encountered archaeological material, much of which was manufactured using local 'Bunter' quartzite pebbles instead of flint (White *et al.*, 2008). The Palaeolithic artefact collections held by several local and national museums were also analysed in detail, together with private collections of related material that were eventually sold into unknown hands; the published archive resulting from the TVPP (Bridgland *et al.*, 2014) therefore contains details of material that is no longer available for study.

The TVPP also introduced me to another influential collaborator, Danielle Schreve, with whom I recorded museum collections of vertebrate fossils from the Trent valley; the largest of these, mostly recovered from sites in the Lower Trent reach in Lincolnshire, is held by the National Museum of Scotland. New vertebrate assemblages from TVPP fieldwork, including a large haul of elephant teeth, were found towards the end of project in 2006 at Norton Bottoms Quarry, also in Lincolnshire. This site was later excavated in more detail, new sections exposed in 2009 yielding a well-preserved aurochs skull (painstakingly conserved by Pierre Schreve), together with a comprehensive suite of fossil assemblages (pollen, plant macrofossils, molluscs, ostracods, insects and vertebrates) suitable for detailed palaeoecological analyses. The Norton Bottoms site has been dated to MIS 7 on the basis on biostratigraphy (Schreve, 2007) and aminostratigraphy (Penkman *et al.*, 2011, 2013).

Late Middle Pleistocene glaciation of the British Isles

An important but unforeseen aspect of the TVPP was the potential for the Trent fluvial archive to clarify the timing and extent of late Middle Pleistocene glaciation in the English Midlands. Several sequences in the Middle and Lower Trent provide evidence for a post-Anglian, pre-Devensian glaciation that affected large areas of central and eastern England and which can be attributed to a cold stage no younger than MIS 8 (White *et al.*, 2010). Early versions of these arguments sparked debate in *Quaternary Newsletter* with Allan Straw (Straw, 2011; White *et al.*, 2011), who had long advocated an MIS 8 age for some of the glacial deposits in Lincolnshire and elsewhere; an expansion of our MIS 8 hypothesis, incorporating many of Allan's views, was recently published in *JQS* (White *et al.*, 2016, and references therein).

The footprint of this glaciation was well within Anglian ice but substantially greater than the Late Devensian ice sheets. The corollary of the suggested MIS 8 age is that there remains no compelling evidence for widespread lowland glaciation during MIS 6 on the western flank of the southern North Sea Basin north of the

Wash. The best evidence for the attribution of glacial deposits in this region to MIS 8 comes from biostratigraphy, reinforced by amino acid geochronology at sites such as Norton Bottoms (see above). However, in order to discriminate between MIS 8 and MIS 10, there is a reliance on arguments from uplift/incision modelling (Westaway, 2016) and the negative evidence of non-occurrence of sediments that can be assigned to MIS 11–9 inclusive (White *et al.*, 2016). The latter also provides a compelling explanation for the condition of the Palaeolithic archaeology recovered from the older Trent terrace deposits, much of which was severely abraded and had been heavily frost-fractured. It is now clear that the main assemblages from the Trent have been derived from older deposits, probably representing MIS 11 and 9, and reworked into the MIS 8 gravels.

Further research is needed to substantiate or modify aspects of this record; in particular, work is needed to distinguish between the glacial deposits of Anglian and post-Anglian age in the wider region beyond the range of the Late Devensian ice sheets, notably in the Middle Trent, in northern East Anglia and in the South Midlands (White *et al.*, 2016).

Molluscs: biostratigraphy, biogeography and palaeoecology

The TVPP was followed by a short-lived project on the Fenland rivers of Cambridgeshire, leading to a review of these related fluvial archives (Boreham *et al.*, 2010). However, in 2008 I was awarded a NERC CASE studentship (in partnership with Wessex Archaeology) and began working on non-marine molluscs at the University Museum of Zoology, Cambridge (UMZC). Appropriately, the ideas that formed the basis for my Ph.D. project were first discussed in the bar on the 2007 QRA Field Meeting to Northern East Anglia.

My doctoral research was primarily supervised by Richard Preece and David Bridgland, but I was also fortunate to have Phil Harding as a third supervisor based at Wessex. The project was originally devised to consider sites dated to several late Middle Pleistocene interglacials, but the final dissertation focused on Hoxnian (MIS 11) localities (White, 2012). These included the stratotype at Hoxne and several well-known Thames localities (Swanscombe, East Hyde and Clacton-on-Sea). As part of the CASE partnership I also collaborated with Francis Wenban-Smith on molluscan material from the Southfleet Road elephant butchery site, discovered during the construction of the Channel Tunnel Rail Link, and numerous gravel samples from developer-funded work undertaken by Wessex Archaeology at various lower Thames localities.

The most significant findings came from Dierden's Pit, Swanscombe. Analysis of a sequence of samples, excavated in 1975 and archived in the UMZC, revealed a significant pattern in the appearance of the 'Rhenish' suite of freshwater molluscs that characterise the Swanscombe Middle Gravels. The six 'Rhenish' species did not appear simultaneously, but rather in a characteristic sequence, with the

earliest to appear being *Pisidium clessini*, *Theodoxus danubialis* and *Belgrandia marginata*, followed by *Corbicula fluminalis*, *Borysthenia naticina* and finally *Viviparus diluvianus* (White, 2012, 2014; White *et al.*, 2013). However, it remained unclear as to whether this pattern of colonization was characteristic of the Lower Thames system or was simply a reflection of local conditions at Swanscombe. Corroborating evidence from Clacton-on-Sea was unsatisfactory, because only four ‘Rhenish’ species had been recorded there; nevertheless, the Clacton succession clearly has *P. clessini* as a pioneer species, followed by *B. marginata* and finally *Corbicula fluminalis* in the estuarine part of the sequence. Important evidence was obtained from the site at East Hyde, Tillingham, the only other site in Britain to have yielded all six ‘Rhenish’ species, where the order of appearance of the ‘Rhenish’ suite matches that of Dierden’s Pit and can be directly related to the Hoxnian pollen record (Roe, 2001; White, 2012).

I was also able to work on ostracod faunas, with support from John Whittaker, Jonathan Holmes and David Horne. These provided not only palaeoclimatic information via the mutual ostracod temperature range (MOTR) method (Horne *et al.*, 2012), but also a means to quantify palaeosalinity and thus investigate sea-level change in the estuarine reach of the Thames (White *et al.*, in prep.). Shortly after completing my Ph.D., I was offered a short-term post at the Natural History Museum to work with Adrian Lister; although this project was brief, it yielded a wealth of interesting data, and led me to a broader interest in developing a multi-proxy palaeoecological approach to understanding interglacial climates, using a variety of Pleistocene fossil groups (beetles, ostracods, plant macrofossils and vertebrates). These provide Mutual Climatic Range (MCR) and MOTR estimates, together with threshold values for summer and winter temperature minima derived from the known ecological tolerances of various plant and animal species. The British Pleistocene record is ideal for a critical assessment of such reconstructions, owing to its well-resolved Pleistocene chronology and abundance of fossiliferous localities; furthermore, Britain’s position on the periphery of northwest Europe means that it is particularly sensitive to climatic and environmental changes. Elements of the resulting dataset have been used to interpret the British archaeological record (Candy *et al.*, 2015), and the results of this work will be published in the near future.

The Quaternary of Arabia

Most recently, I have been diverted from my NW European comfort zone to work on the Palaeodeserts project, investigating the Pleistocene mollusc and ostracod faunas of the Arabian Peninsula. Although this work is not directly relevant to the awarding of the Lewis Penny medal, a better understanding of the Arabian record is being achieved through application of research methods honed over many

decades in Britain and NW Europe. Despite the importance of this vast region to debates surrounding human dispersals out of Africa, the terrestrial Pleistocene record remains poorly understood, primarily due to its poor state of preservation and the difficulties of working in remote desert environments. Consequently, new findings are difficult to place in secure stratigraphical and chronological frameworks; techniques such as radiocarbon and optically stimulated luminescence can be used to date individual sequences, but the lack of perennial fluvial systems is a major hindrance to understanding the Pleistocene record on a regional scale. Although Arabia lacks a long tradition of research enjoyed by regions such as Britain, the ongoing work of projects like Palaeodeserts is contributing a wealth of new data to a steadily growing body of research on this region (e.g. Hilbert *et al.*, 2014; Groucutt *et al.*, 2015).

Acknowledgements

The QRA is an organisation of which I am proud to have been a member for many years; at the outset of the TVPP, I was advised by David Bridgland to join the Association at the earliest opportunity and I have benefitted hugely from the vast knowledge of its members. I have enjoyed co-organising field meetings to the Trent and Lower Thames (White *et al.*, 2007; Bridgland *et al.*, 2014) and contributing to the day-to-day running of the Association as Treasurer. It is worth noting that Lewis Penny was the first Secretary/Treasurer of the QRA, and I am sure that he would be very pleased that the Association is now able to award more than £25,000 in research and travel grants to support Quaternary research each year.

I am indebted to a great many people, most of them long-standing members of the QRA, who have supported me over the years as teachers, collaborators and friends. In particular, I would like to thank Mark White, whose lectures first inspired my interest in the Palaeolithic, David Bridgland, who has been an influential mentor and friend throughout my career, and Andy Howard, who patiently guided me in the field as an inexperienced RA. I would also like to thank Richard Preece for revealing to me the wonderful world of molluscs and the joy of working in museums, and Peter Allen, Ian Candy, Jim Rose and Danielle Schreve for their long-standing support and friendship. Finally, thanks to my wife and parents, who have put up with sacks of gravel and snail ephemera cluttering up their houses.

References

Boreham, S., White, T.S., Bridgland, D.R., Howard, A.J. and White, M.J. (2010). The Quaternary history of the Wash fluvial network. *Proceedings of the Geologists' Association*, 121, 393–409.

- Bridgland, D.R., Allen, P. and White, T.S. (2014). *Quaternary of the Lower Thames and Eastern Essex: Field Guide*. Quaternary Research Association, London.
- Bridgland, D.R., Howard, A.J., White, M.J. and White, T.S. (2014). *Quaternary of the Trent*. English Heritage Monograph, Oxbow Books, Oxford.
- Bridgland, D.R., Howard, A.J., White, M.J., White, T.S. and Westaway, R.W.C. (2015). New insight into the Quaternary evolution of the River Trent. *Proceedings of the Geologists' Association*, 126, 466–479.
- Candy, I., Schreve, D.C. and White, T.S. (2015). MIS 13 to 12 in Britain and the north Atlantic: understanding the palaeoenvironmental context of the earliest Acheulian. *Journal of Quaternary Science*, 30, 593–609.
- Groucutt, H.S., White, T.S., Clark-Balzan, L., Parton, A., Crassard, R., Shipton, C., Jennings, R.P., Parker, A.G., Breeze, P.S., Scerri, E.M., Alsharekh, A. and Petraglia, M.D. (2015). Human occupation of the Arabian Empty Quarter during MIS 5: evidence from Munda'fan Al-Buhayrah, Saudi Arabia. *Quaternary Science Reviews*, 119, 116–135.
- Hilbert, Y.H., White, T.S., Parton, A., Clark-Balzan, L., Crassard, R., Groucutt, H.S., Jennings, R.P., Breeze, P., Parker, A., Shipton, C., Al-Omari, A., Alsharekh, A.M. and Petraglia, M.D. (2014). Epipalaeolithic occupation and palaeoenvironments of the southern Nefud desert, Saudi Arabia, during the Terminal Pleistocene and Early Holocene. *Journal of Archaeological Science*, 50, 460–474.
- Horne, D.J., Curry, B.B. and Mesquita-Joanes, F. (2012). Mutual climatic range methods for Quaternary ostracods. *Developments in Quaternary Science*, 17, 65–84.
- Howard, A.J., Bridgland, D., Knight, D., McNabb, J., Rose, J., Schreve, D., Westaway, R., White, M.J. and White, T.S. (2007). The British Pleistocene fluvial archive: East Midlands drainage evolution and human occupation in the context of the British and NW European record. *Quaternary Science Reviews*, 26, 2724–2737.
- Parton, A., White, T.S., Parker, A.G., Breeze, P.S., Groucutt, H.S. and Petraglia, M.D. (2015). Orbital-scale climate variability in Arabia as a potential motor for human dispersals. *Quaternary International*, 382, 82–97.
- Penkman, K.E.H., Preece, R.C., Bridgland, D.R., Keen, D.H., Meijer, T., Parfitt, S.A., White, T.S. and Collins, M.J. (2011). A chronological framework for the British Quaternary based on *Bithynia* opercula. *Nature*, 476, 446–449.
- Penkman, K.E.H., Preece, R.C., Bridgland, D.R., Keen, D.H., Meijer, T., Parfitt, S.A., White, T.S. and Collins, M.J. (2013). An aminostratigraphy for the British Quaternary based on *Bithynia* opercula. *Quaternary Science Reviews*, 61, 111–134.
- Roe, H.M. (2001). The Late Middle Pleistocene biostratigraphy of the Thames Valley, England: new data from eastern Essex. *Quaternary Science Reviews*, 20, 1603–1919.

Schreve, D.C. (2007). Mammalian assemblages from the Trent. In: White, T.S., Bridgland, D.R., Howard, A.J. and White, M.J. (eds): *The Trent Valley and Adjoining Regions: Field Guide*. Quaternary Research Association, London, 49–57.

Straw, A. (2011). The Saale glaciation of Eastern England. *Quaternary Newsletter*, 123, 28–35.

Westaway, R. (2016). Isostatic compensation of Quaternary vertical crustal motions: coupling between uplift of Britain and subsidence beneath the North Sea. *Journal of Quaternary Science*, DOI: 10.1002/jqs.2832.

White, T.S. (2012). *Non-marine molluscan and ostracod successions and their relevance to Palaeolithic archaeology*. Unpublished Ph.D. thesis, University of Cambridge.

White, T.S. (2014). Invertebrate biostratigraphy of the Lower Thames. In: Bridgland, D.R., Allen, P. and White, T.S. (Eds): *Quaternary of the Lower Thames and Eastern Essex: Field Guide*. Quaternary Research Association, London, 12–19.

White, T.S., Bridgland, D.R., Howard, A.J. and White M.J. (2007). *The Trent Valley and Adjoining Regions: Field Guide*. Quaternary Research Association, London.

White, T.S., Bridgland, D.R., Howard, A.J. and White, M.J. (2008). Lower Palaeolithic quartzite artefacts from the Trent Valley at East Leake, Nottinghamshire (SK 558248): new light on a hidden resource. *Quaternary Newsletter*, 114, 10–20.

White, T.S., White, M.J., Bridgland, D.R. and Howard, A.J. (2009). Palaeolithic and Quaternary research in the Trent Valley (UK): contributions by early collectors. *Proceedings of the Geologists' Association*, 120, 223–232.

White, T.S., Bridgland, D.R., Howard, A.J. and Westaway, R. (2010). Evidence from the Trent terrace archive, Lincolnshire, UK, for lowland glaciation of Britain during the Middle and Late Pleistocene. *Proceedings of the Geologists' Association*, 121, 141–153.

White, T.S., Bridgland, D.R. and Westaway, R. (2011). A response to 'The Saale glaciation of eastern England'. *Quaternary Newsletter*, 124, 3–6.

White, T.S., Preece, R.C. and Whittaker, J.E. (2013). Molluscan and ostracod successions from Dierden's Pit, Swanscombe: insights into the fluvial history, sea-level record and human occupation of the Hoxnian Thames. *Quaternary Science Reviews*, 70, 73–90.

White, T.S., Bridgland, D.R., Westaway, R. and Straw, A. (2016). Evidence for late Middle Pleistocene glaciation of the British margin of the southern North Sea. *Journal of Quaternary Science*, DOI: 10.1002/jqs.2826.

White, T.S., Holmes, J.A. and Horne, D.J. (in preparation). Multi-proxy faunal and geochemical evidence for sea-level change during MIS 11: new data from the River Thames, UK.

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HONORARY MEMBERS

Chris Caseldine

Chris Caseldine has been a long time supporter of the QRA. He first became interested in Quaternary science and especially pollen analysis spying on two predecessors in the pollen lab in Geography at the University of St Andrews, John Lowe and Kevin Edwards, so having completed an MA in 1973 stayed on to do a PhD on 'Some Aspects of the Vegetation History of South East Perthshire', eventually completed in 1980 – passed without a single radiocarbon date as there were no funds associated with the University scholarship. He subsequently moved to become a



Lecturer at the University of Exeter in 1976 and whilst starting research in the southwest he managed to continue research in collaboration with Exeter colleague Robin Cullingford on sea-level change in Scotland with a number of papers, especially one in *Nature* (1980) and also in collaboration with Kevin Edwards on interglacial/interstadial sites in NE Scotland.

Chris started work on Dartmoor looking at the evolution of the upland landscape, developed especially with long-time RA Jackie Hatton, building on the work of Ian Simmons concentrating on the high moor to look at interrelationships between Mesolithic communities and the opening up of the landscape, especially by the use of fire. Whilst in St Andrews he made his first visit to Iceland in 1975 as a field assistant on Joint Universities (East Anglia/Cardiff) Breidamerkurjökull Expedition led by Geoff Boulton and he subsequently returned in 1977 before taking the first of many groups from Exeter to Iceland in 1979. Research in Iceland at first concentrated on glacier change in the Tröllaskagi peninsula using mapping and lichenometry before broadening out in later years to examine peat sequences and eventually lake sediments from western and NW Iceland, especially in collaboration with Pete Langdon, now at Southampton, and Naomi Holmes at Sheffield Hallam. This research involved developing a chironomid-based approach to Holocene temperature reconstruction to extend previous pollen-based work. Interests in Iceland also led to two edited volumes in 1991 and 2005, and to annual Exeter fieldclasses at a range of times from December to April.

At the same time as working in Iceland Chris began a stint as part of the long-running Jotunheimen Research Expeditions in southern Norway led by John Matthews – these proved rewarding in terms of a series of papers over the 1980s and 1990s, again principally pollen based, and also involved the delights of him sharing a tent for several weeks with John, who (Chris says) as most people know is perhaps the tallest glacial geomorphologist around thus his memories of the fieldwork are imbued with trying to find space to sleep.

Whilst at Exeter, and arising out of experience on various archaeological sites in Scotland as a ‘specialist’ in days when they were treated with a deal of suspicion, he made contact through Bryony Coles with Barry Raftery who was beginning his work on prehistoric trackways, especially the Corlea Iron Age ‘road’ in the Irish Midlands. This led to a series of projects looking at the environmental contexts of prehistoric trackways, first around Corlea and then as part of major project run by Margaret Gowan in advance of a zinc mine at Derryville, still in the Irish Midlands but further south, involving analysis of some 14m of peat sequences across a range of features of differing age. This also involved working with on the foremost peat stratigraphers of the 20th century, the late Wil Casparie, who introduced him to a whole new perspective on how to view bog development . The contacts made in Ireland also led to work with the Discovery Programme – this time further north and including some of the first detailed environmental work on a crannog from Lough Kinale/Derragh Lough area. The majority of the analytical work was able to be concentrated in Geography at Exeter at the time as we had a burgeoning Palaeo group including both Pete Langdon and Tony Brown, both later to move on and reinforce PLUS at Southampton. This after initial growth with the appointment of Andy Baker and the development of speleothem related research.

The Irish work continued by changing the focus to the west and Co Mayo, again in collaboration with archaeologists, examining Holocene changes on Achill Island, and the long prehistoric legacy of environmental change in this extreme western tip of Ireland. Largely through Scandinavian interests Chris became one of the core group of a new Scandinavian-based NORFA-funded research network led by Mari-Jose Gaillard-Lemdhall, now at Kalmar, POLLANDCAL, which sought to develop a pollen modelling approach to landscape reconstruction – founded largely on the ideas of Shinya Sugita- a development which encouraged international collaboration and which we were able to apply to some of the work in Ireland in Mayo.

Chris became a Reader at Exeter in 1997 and Professor of Quaternary Environmental Change in 2003. He was the non-professorial Head of Geography in 1993 and subsequently Head of the School of Geography. He was also involved in the plans for the new campus at Penryn in Cornwall which opened in 2005 and in 2007 moved campuses to Penryn. He was a member first of the NERC Oxford Radiocarbon Accelerator Dating Steering Committee (ORADSSC) from 2000 and

link member to NERC Radiocarbon Laboratory Steering Committee (RCLSC), before as Chair overseeing the merger of the two committees to form the NERC Radiocarbon Laboratory Steering Committee (RCLSC) from 2007.

For the QRA Chris was a frequent attender of early field meetings benefitting from the presence of many of the ‘founding fathers’, although in the 1970s was eventually put off gravel pits for a considerable time, and was a committee member and Minutes Secretary between 1987-1990. Aside from meetings his main work for the QRA was through the Editorship of the *Journal of Quaternary Science* between 2005-10, Assistant Editor 2002-04 and 2011-12, and he was heavily involved with ongoing discussions with the publishers, then John Wiley and Sons, concerning the details of the contract and hence income to the QRA.

Chris always enjoyed the teaching side of the job and getting students involved in the joys of Quaternary science and was delighted to get an ‘Outstanding Teacher Award’ from the Student Guild in two of the last three years – he says it made an old man very happy! One of the more unusual experiences of recent years was when Penryn had a Poet-in-Residence in the department and following a fieldclass to Iceland Chris co-produced a short joint book of poetry, prose and images, *6 Days in Iceland*, which has led to occasional readings at book festivals and hopefully spread the word of some aspects of Quaternary science to audiences not usually aware of its importance.

Rick Shakesby

Rick completed his Ph.D. thesis in 1976 on glacial sediments and processes. From the mid-1980s he took the opportunity to carry out research of an applied nature concerning land degradation and especially soil erosion. This began with a joint Swansea and Khartoum Geography Departments investigation of desertification in Sudan. Rick’s contribution was the mapping and interpretation of the landforms and processes in the study region. During several British Council funded visits to Zimbabwe, he undertook a number of joint research projects including several dealing with aspects of soil erosion. Since the late 1980s, his interest in land degradation has been linked to the Mediterranean region, especially Portugal, and Australia. This research has been financed mainly by EU, British Council and NERC grants. In addition, Rick has co-authored a number of



publications concerned with soil water repellency which is an important, though largely neglected soil property and its potential impacts on hydrogeomorphological processes.

Following completion of his Ph.D. at Edinburgh, his interest in cold-climate geomorphology and Quaternary science extended to include the areas of periglacial and paraglacial processes and landforms and the reconstruction of past environmental change on Holocene glacial activity in southern Norway. Rick also carried out research in South Wales concerning the dating, limits and style of last glaciation ice sheet wastage and the reinterpretation of the effects of Late Glacial cold-climate conditions in the Brecon Beacons. Because the latter area is the most southerly in Britain known to have nurtured glacier ice in the Late-glacial, a good understanding of the intimate relationship of glaciers to topography here arguably provides a unique insight into palaeoclimatic conditions, as a result of the sensitivity of the small ice bodies to climatic change.

Rick's critical impacts can be summarised as falling in the following areas:

1. Glacial, paraglacial and periglacial geomorphology

Rick has continued his research interests in this general field since his Ph.D. Since being at Swansea, his publications have led to a re-assessment of the diagnostic criteria and processes involved in the formation of pronival (protalus) ramparts. His publications in the area of periglacial geomorphology have extended to cover other periglacial processes and deposits in Norway for example, he has co-authored papers on patterned ground and snow avalanche impacts in southern Norway and paraglacial slope instability in Austria.

2. Holocene environmental change

In addition to research into cold climate landforms and processes in Norway alluded to above, he has also had a long-standing interest in the reconstruction of Holocene glacier fluctuations in Norway and a particular interest in applying and developing the use of the Schmidt hammer as both relative and calibrated age dating techniques in dating glaciated surfaces. This led to testing the validity of using the technique as a calibrated age dating technique. He has also been involved in the application of cosmogenic dating to unravelling the ages of Holocene moraines in southern Norway.

3. Pleistocene environmental change

Rick has had a long-term interest in Quaternary environmental change and especially the timing and style of glaciation in South Wales, with work published, for example, in *Nature*, *Proceedings of the Geologists' Association*, *Geological*

Journal and *Boreas*. His main *foci* have been the Brecon Beacons and Gower in this region. He has co-edited and co-led 2 QRA field trips to Brecon Beacons (2007) and Gower (2015). In 2011 he carried out joint research on St Kilda to re-examine whether the islands had been covered at the LGM or nurtured their own glaciers.

4. Wildfire effects on soil characteristics and soil erosion

This has been an important focus of Rick's research effort since the late 1980s, funded by a number of EU, NATO, British Council and NERC research contracts. He co-authored a major review of post-fire erosion with a global perspective in 2006 and single-authored major review focusing on post-fire erosion in the Mediterranean in 2011. Both reviews were published in *Earth-Science Reviews*. He has subsequently co-authored with US colleagues another review in the same journal, which was a 'deliverable' for an AGU conference held in Colorado in 2013, of which he was a co-convenor. Following devastating wildfires in NSW and Victoria during the 2000s he carried out research into post-fire erosion in conjunction with colleagues in the UK and Australia. This research led to a number of journal articles and book chapters together with keynote presentations at international conferences (e.g. EGU).

5. Soil water repellency

The extreme severity of soil water repellency (hydrophobicity) in the forested area of north-central Portugal, which was the research location for earlier EU-funded projects (1988-91 and 1992-4), made it an important though subsidiary focus of interest and several of his publications relate to this interest in Portugal but also wider afield. He has co-supervised a number of PhDs on this topic.

Rick has been able to draw on different strands of research interest in human impact on landforms and processes, cold-climate geomorphology and environmental change in editing and providing entries for the *Encyclopaedic Dictionary of Environmental Change* first published in 2001 and its second edition entitled *Encyclopedia of environmental change* published in 2014. He has also contributed to the *Encyclopedia of Geomorphology*.

Tony Stuart

Tony, an acknowledged and respected expert on Quaternary mammals, graduated in 1967 with a BSc Hons. In Geology from the University of Manchester and subsequently was awarded a PhD from the University of Manchester (Dissertation: on British Pleistocene mammals) in 1971. He was awarded a DSc University of Manchester (Quaternary/ Pleistocene vertebrates) in 1992.

For more than 45 years his research and publications have focussed on the mammals and other vertebrates of the Quaternary ('Ice Age'). Tony has worked at the Department of Zoology, University of Cambridge, as a curator at the Norfolk Museums Service, at University College London, Biology Dept. Research (NERC) on 'Late Quaternary Megafaunal Extinctions in Europe and Northern Asia' and (Leverhulme funded) 'Mammoth, Vertebrate Fauna and Palaeoenvironment of the Cromerian Stratotype', at University College London/Natural History Museum London. He has also carried out research on the 'Pleistocene to Holocene extinction dynamics of Northern Eurasian megafauna in relation to human activity and environmental change' and subsequently has been a Visiting Professor in the School of Biological and Biomedical Sciences, University of Durham.

During the past 16 years he has worked in close collaboration with Prof. Adrian Lister (Natural History Museum London) and colleagues at Durham University and the Oxford Radiocarbon Laboratory, on megafaunal extinction in northern Eurasia and North America—funded by a series of research grants from the Natural Environment Research Council.

Tony was consultant for the 3-part BBC2 TV series 'Ice Age Giants', which was broadcast between 19 May and 2 June 2013. Tony and Adrian Lister assembled an international team of specialists and subsequently edited a series of 18 papers on the Cromerian type site (early Middle Pleistocene) for a special issue of *Quaternary International*: "*The West Runton Freshwater Bed and the West Runton Mammoth*", published in 2010.



David Sugden

Graduating from the University of Oxford, David Sugden completed his Doctorate on the Glaciation of the Cairngorms in 1965 and then taught at the University of Aberdeen for 21 years. He became Professor of Geography and Head of the Department of Geography, University of Edinburgh in 1987, and Head of the new School of GeoSciences, University of Edinburgh in 2003-2006. He has studied ice-sheet history



and the way ice sheets modify the landscape in Scotland, Greenland, North America, Patagonia and Antarctica. He has worked in Antarctica on 15 occasions both with the British Antarctic Survey and the United States Antarctic Program. He has published three books and ~ 150 scientific papers. He has awards for his Antarctic research including, The Polar Medal from the Queen, the Vega Medal from the King of Sweden, and the Seligman Crystal from the International Glaciological Society. He is a Fellow of the Royal Society of Edinburgh and chaired a major RSE Inquiry on Climate Change, the report of which was published in 2011. He was last in Antarctica in 2014, spending 3 months camping in a small tent hundreds of km from any base.

An extract from an appreciation of David written by George Denton summarises his importance to British Quaternary studies:

“Professor David E. Sugden of the University of Edinburgh in Scotland is an extraordinary scientist whose career spans more than four decades. He has had a profound influence on numerous aspiring young students, mentoring more than 40 at graduate level. Under his tutelage, many of these students have become broad-thinking scientists who themselves have made significant contributions to an understanding of the iceage world, thus carrying on David’s traditions. David’s books and papers have set a new standard for research that combines glaciology and glacial geomorphology.

The power of this combination is clearly expressed in his early masterful text entitled Glaciers and landscape: a geomorphological approach, which he co-authored with Brian John, published in 1976 and reprinted 13 times. This book set the scene for modern interdisciplinary studies of glacial landforms and landscapes. It also formed the basis for David’s subsequent lifetime of research.”

– **from:** George H. Denton. 2014. Professor David E. Sugden – an appreciation. *Antarctic Science* **26(6)**, 603. doi:10.1017/S0954102014000388

Pete Coxon, QRA President

***QRA*¹⁴CHRONO AWARD**

LATE GLACIAL TO HOLOCENE RELATIVE SEA-LEVEL CHANGE IN ASSYNT, NORTH WEST SCOTLAND

Background and Rationale

The British Isles are regarded as extremely useful for improving understanding of relative sea-level (RSL) change and glacial isostatic adjustment (GIA) modelling. This area provides a compact case-study including northern glaciation, Holocene land subsidence in the south and was also affected by the Fennoscandian forebulge collapse (Peltier, 1998). Scotland has been the focus of sea-level research for over a century, however Assynt, western Sutherland remains an understudied region of the British Isles. By comparison, research from the Arisaig area, further south on the west coast of Scotland, has produced the longest and most complete archive of RSL change from the British Isles (Shennan *et al.*, 2005). This data has proved critical in testing and improving geophysical models of GIA (e.g. Bradley *et al.*, 2011). Further empirical data from the Assynt region will provide an important further test of the model predictions, which have limited constraint.

In 2013, isolation basins on the north coast of the Assynt area were investigated. Palaeoenvironmental reconstruction was primarily based on diatom analysis, supported by particle-size and organic content. The diatom assemblages from Loch Duart Marsh and Duart Bog (Figure 1) identified clear transitions from marine to freshwater conditions as well as freshwater to marine. Radiocarbon dates from these isolation and ingression contacts, supported by the QRA: ¹⁴CHRONO Centre Radiocarbon Dating Award, enabled new sea-level index points to be produced for this region.

Results

New Late Glacial, early and late Holocene sea-level index points were generated for the region. The altitude of the rock sills, diatom assemblages and qualitative pollen analysis however suggest that the ¹⁴C date for index point 1 (Figure 2) is erroneously young. Quantitative pollen analysis will be completed in an effort to support this interpretation.

Significance

The sea-level index points for Assynt, from both Duart (as part of this study) and Coigach (Shennan *et al.*, 2000), produce a post-LGM RSL record documenting

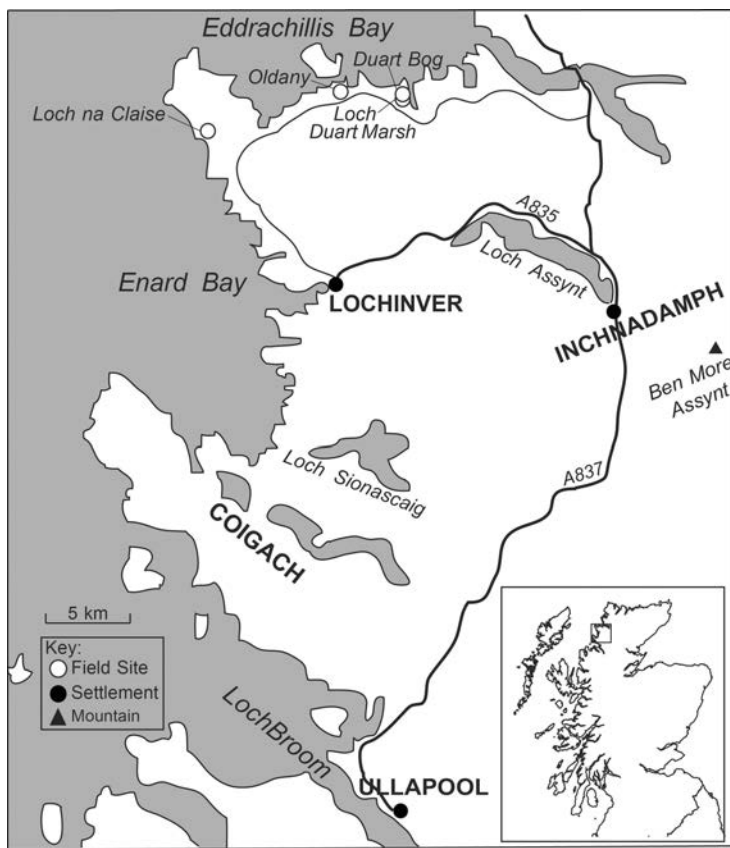


Figure 1. Map of the Assynt region illustrating the site locations on the northern coast of the region.

a pattern of fall-rise-fall (Figure 2). The current GIA model for the British Isles (Bradley *et al.*, 2011) underestimates RSL during the Late Glacial and early Holocene in Assynt, suggesting more ice and therefore more rebound is needed in the region, whilst the timing of the predicted Late Glacial RSL fall appears to be too early and the predicted early Holocene RSL rise appears to be too late. This mismatch may be due to discrepancies in the ice model used by the GIA model. These uncertainties are partly associated with geomorphological data i.e. the use of global ^{10}Be production rates to obtain surface exposure ages and the incorporation of trimline data into ice models (e.g. Ballantyne, 2010; 2012).

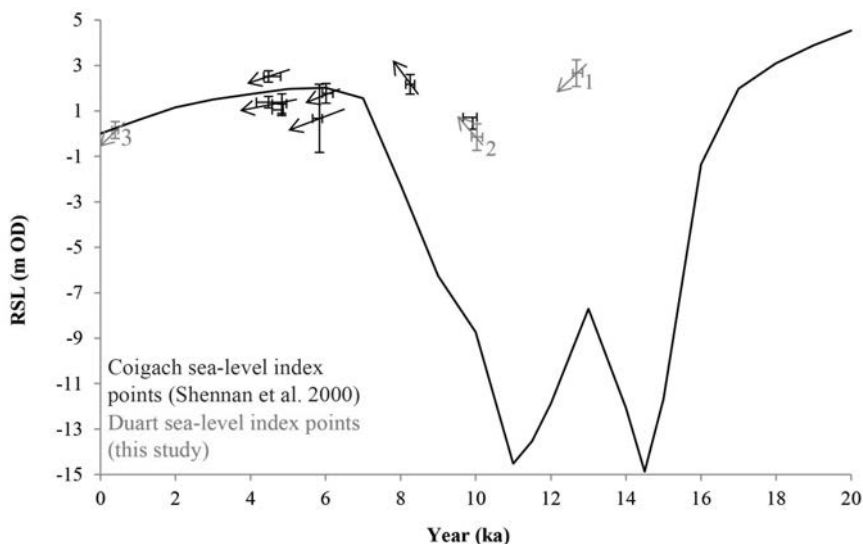


Figure 2. Bradley *et al.* (2011) model predictions for Assynt, including previous sea-level index points from Coigach (black) (Shennan *et al.* 2000) and those generated from Duart in this study (red). The arrows indicate the positive or negative tendency associated with each sea-level index point; increasing arrow indicates RSL increase for example.

Acknowledgements

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Bibliography

- Ballantyne, C.K., (2012). Chronology of glaciation and deglaciation during the Loch Lomond (Younger Dryas) Stade in the Scottish Highlands: implications of recalibrated 10 Be exposure ages. *Boreas*, 41(4), pp.513–526.
- Ballantyne, C.K., (2010). Extent and deglacial chronology of the last British-Irish Ice Sheet: implications of exposure dating using cosmogenic isotopes. *Journal of Quaternary Science*, 25(4), pp.515–534.

Bradley, S.L. *et al.*, (2011). An improved glacial isostatic adjustment model for the British Isles. *Journal of Quaternary Science*, 26(5), pp.541–552.

Peltier, W.R., (1998). Postglacial variations in the level of the sea: Implications for climate dynamics and solid-earth geophysics. *Reviews of Geophysics*, 36(4), pp.603–689.

Shennan, I. *et al.*, (2005). A 16000-year record of near-field relative sea-level changes, North-west Scotland, United Kingdom. *Quaternary International*, 133–134, pp.95–106.

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NEW RESEARCHERS AWARD SCHEME

DEVELOPING LUMINESCENCE CHRONOMETERS TO ESTABLISH THE TIMING OF LATE QUATERNARY ENVIRONMENTAL CHANGES IN SOUTH AFRICA

Background and rationale

Soil erosion is widespread across the interior of South Africa, particularly in dryland regions where numerous dongas (extensive gullies and badland-type terrain) have eroded up to 30 m into Quaternary colluvium and alluvium. In some areas donga formation has been attributed to human disturbance such as overgrazing (Boardman *et al.*, 2003). However, recent work in the upper Blood River catchment has suggested that donga initiation, formation and incision appear to be linked to periods of abrupt climatic changes, such as the 'Medieval Climate Anomaly' and the 'Little Ice Age' (Lyons *et al.*, 2013). Thus, there is a key need to develop detailed chronologies for these sediments in order to improve reconstructions of the timing and drivers of sedimentation, pedogenesis and erosion during the mid to late Quaternary.

Method

Forty-nine samples were collected from five donga sites across South Africa to ensure coverage of a range of geographical conditions, specifically different geologies, climates, vegetation covers and land-use histories. At each site, samples were selected in order to obtain a chronology for the entire stratigraphic exposure. Some sites have been subject to limited prior geomorphological, sedimentological and chronological work (see Brink *et al.*, 2012; Lyons, 2012; Wintle *et al.*, 1995), which provides useful background context for this research.

Optically stimulated luminescence (OSL) ages are being generated for each site using a combination of quartz OSL and K-feldspar post-infrared infrared stimulated luminescence (post-IR IRSL) on coarse-grain sediments. This combined approach allows for reliable dating of the entire stratigraphic section, as OSL is suited to young material (<150 ka) and post-IR IRSL to older material (up to ~600 ka).

Preliminary results

Preliminary luminescence ages from a site along an unnamed tributary of the Moopetsi River, Limpopo Province (Figure 1) show a good correlation between quartz and K-feldspar luminescence ages for sediments younger than ~15 ka. However, the correlation is poor for ages older than ~50 ka and this is thought to be due to the averaging effect of the signal on the feldspar small aliquots, which

contain 20-30 grains (Colarossi *et al.*, in press). Thus, single grain measurements were undertaken on the feldspar separates. The younger samples (< 15 ka) now show excellent agreement between the quartz and feldspar ages, whilst the agreement between the older samples has improved dramatically.



Figure 1. The donga site along the unnamed tributary of the Moopetsi River in Limpopo province, South Africa (view looking upstream). The ~8 m tall exposure in the middle distance reveals a succession of relatively weathered sediments and palaeosols formed over a timespan in excess of 100 ka.

Significance

Preliminary results from the unnamed tributary site of the Moopetsi River are promising, and it seems that the post-IR IRSL protocol has the ability to date sediments as old as the last interglacial and beyond, thereby improving reconstructions of the timing and drivers of sedimentation, pedogenesis and erosion. Now, the same comparative dating approach is being applied to a second site, with radiocarbon dates providing some independent age control. If successful this will lead to the application of this comparative approach at the remaining sample sites and ultimately enable a regional comparison for the onset of sedimentation and recent erosion across South Africa.

Acknowledgements

This research was funded in part by the QRA New Research Workers Award, which facilitated the international travel required during the first field work season, as well as the Geological Society of South Africa Research Education and Investment fund and the British Society for Geomorphology Postgraduate Research Grant. The author's doctoral research is funded by an Aberystwyth University Doctoral Career Development Scholarship.

References

- Boardman, J., Parsons, A. J., Holland, R., Holmes, P. J. and Washington, R. (2003). Development of badlands and gullies in the Sneeuberg, Great Karoo, South Africa. *Catena*, 50, 165–184.
- Brink, J. S., Herries, A. I. R., Moggi-Cecchi, J., Gowlett, J. A. J., Bousman, C. B., Hancox, J. P., Grün, R., Eisenmann, V., Adams, J. W. and Rossouw, L. (2012). First hominine remains from a ~1.0 million year old bone bed at Cornelia-Uitzoek, Free State Province, South Africa. *Journal of Human Evolution*, 63, 527-535.
- Colarossi, D., Duller, G. A. T., Roberts, H. R., Tooth, S. and Lyons, R. (In press). Comparison of paired quartz OSL and feldspar post-IR IRSL dose distributions in poorly bleached fluvial sediments from South Africa. *Quaternary Geochronology*.
- Lyons, R. (2012). Chronology and controls of late Quaternary sedimentation, pedogenesis and erosion across interior South Africa. Unpublished PhD Thesis. Aberystwyth University.
- Lyons, R., Tooth, S. and Duller, G. A. T. (2013). Chronology and controls of donga (gully) formation in the upper Blood River catchment, KwaZulu-Natal, South Africa: Evidence for a climatic driver of erosion. *The Holocene*, 23, 1875-1887.
- Wintle, A. G., Botha, G. A., Li, S-H. and Vogel, J. C. (1995). A chronological framework for colluviation during the last 110 kyr in Kwazulu/Natal. *South African Journal of Science*, 91, 134-139.

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REVISED CHRONOSTRATIGRAPHY OF THE FAZZAN BASIN, LIBYAN SAHARA

Background and Rationale

The Fazzan Basin covering ~450,000km² in south-west Libya is one of a few regions in the Sahara to record a long history of North African palaeohydrological change (Armitage *et al.*, 2007). Within the basin, evidence of more humid intervals in the form of shorelines and sedimentary deposits are present, the most extensive of which belongs to the Al Mahruqah formation, and are believed to have been deposited by Lake Megafazzan (Geyh and Thiedig, 2008; Drake *et al.*, 2008, 2011). The origin and age of this formation is subject to ongoing debate, with research, using OSL and U-Series, suggesting a Pleistocene age (Armitage *et al.*, 2007; Geyh and Thiedig, 2008). However, as only a small proportion of Quaternary lacustrine outcrops have been studied (Mattingly *et al.*, 2007), important gaps remain in our understanding of the age and palaeoclimate/environment of the region.

The late Quaternary history of the basin has, in recent years, become reasonably well understood, yet the chronological framework of the early Quaternary and older units in the basin is lacking. There is also a poor understanding of regional relationships between the Cenozoic sediments in the basin. Over four field seasons between 2007-2011, numerous sediment samples were collected from outcrops at six study sites from across the Fazzan Basin, including locations where the Al Mahruqah formation is found. Extensive geochemical and sedimentological analyses have been undertaken, along with palaeomagnetic dating. The funding received from the QRA's New Research Workers' Award allowed the final palaeomagnetic measurements to be completed at the CEMP Laboratory at Lancaster University. These measurements were crucial in order to gain a more complete chronology of the investigated sediments and aid understanding of the palaeoenvironmental history of the Fazzan Basin.

Preliminary Results

Palaeomagnetic measurements were conducted using a CCL GM400 3Axis Cryogenic Magnetometer following thermal demagnetisation. The magnetostratigraphy of three sections analysed from the eastern side of the basin can be seen in Figure 1. Data analysis is still being conducted to finalise an age for the sections however, the number of reversals seen in the magnetostratigraphy suggests the sediments to be several million years old. Along with geochemical and sedimentological analyses, the palaeomagnetic ages indicate that the Fazzan has undergone significant climatic and environmental changes. Figure 1 shows how the sections are believed to correlate with one another. This has been formulated based on field knowledge and similar lithology within the sections.

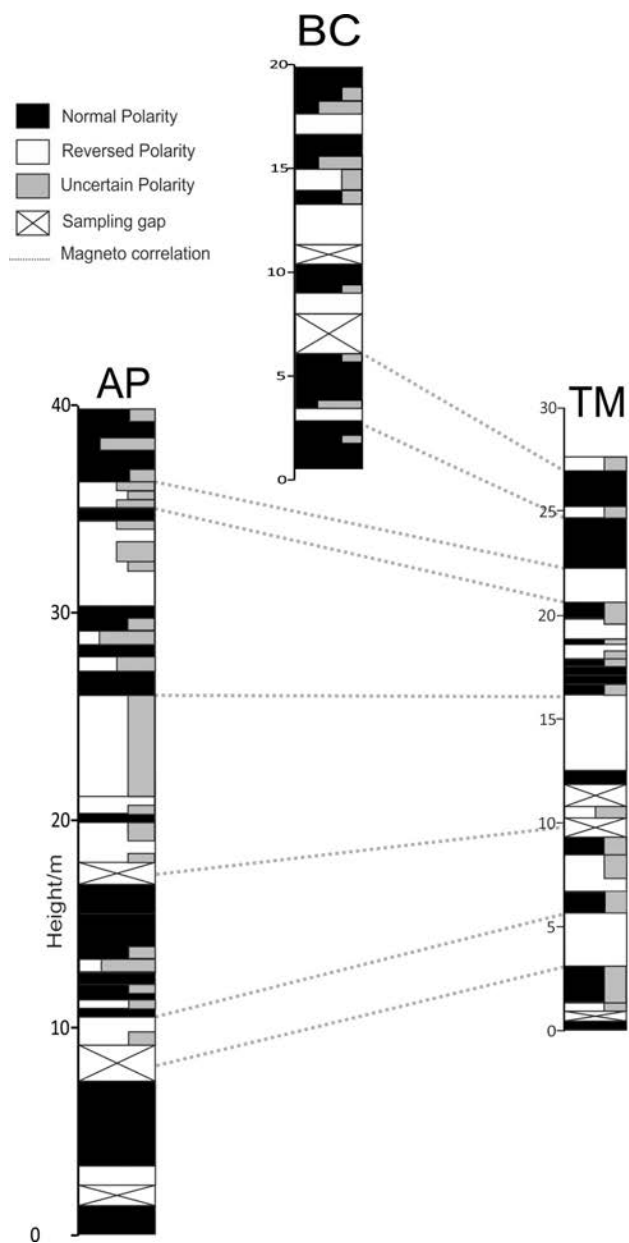


Figure 1. Magnetostratigraphy of three analysed sections from the eastern side of the Fazzan Basin. Normal polarity-magnetic field is the same as the present day, reversed polarity-opposite to present day magnetic field.

In the absence of any biostratigraphic evidence in the sections to help confirm the ages or correlate between them, magnetostratigraphy has proven to be a valuable tool in this investigation.

Significance

The research undertaken in this study extends and builds on the late Quaternary knowledge of the Fazzan Basin. The magnetostratigraphic data, is allowing new assessments to be made and previous research to be re-evaluated. For example, it brings into question the proposed ages of the Al Mahruqah formation suggested by previous researchers (e.g. Geyh and Thiedig, 2008). Not only does this research help to fill the palaeoclimatic gap of the central Sahara, it also has the potential to aid understanding of the wider Saharan palaeoclimate.

Acknowledgments

I would like to thank Dr. Sue McLaren, Dr. Mark Hounslow, Prof. Nick Drake and Dr. Arnoud Boom for their supervision throughout the project. I am grateful to the many people who collected the sediment samples during a number of field seasons to Libya. As a self-funded student, I would also like to thank and gratefully acknowledge the QRA New Research Worker's Award for help with the completion of the palaeomagnetic measurements conducted at Lancaster University.

References

- Armitage, S.J., Drake, N.A., Stokes, S., El-Hawat, A., Salem, M.J., White, K., Turner, P. and McLaren, S.J. (2007). Multiple phases of North African humidity recorded in lacustrine sediments from the Fazzan Basin, Libyan Sahara. *Quaternary Geochronology*. 2:181–186
- Drake, N.A., El-Hawat, A.A., Turner, P., Armitage, S.J., Salem, M.J., White, K.H. and McLaren, S. (2008). Palaeohydrology of the Fazzan Basin and surrounding regions: The last 7 million years. *Palaeogeography, Palaeoclimatology, Palaeoecology*. 263:131-145
- Drake, N., Salem, M., Armitage, S., Francke, J., Hounslow, M., Hlal, O., White, K. And El-Hawat, A. (2011). DMP XV: Palaeohydrology and Palaeoenvironment: Initial Results and Report of 2010 and 2011 Fieldwork. *Libyan Studies*. 42: 139-149
- Geyh, M.A. and Thiedig, F. (2008). The Middle Pleistocene Al Mahruqah Formation in the Murzuq Basin, northern Sahara, Libya evidence for orbitally-forced humid episodes during the last 500,000 years. *Palaeogeography, Palaeoclimatology, Palaeoecology*. 257:1-21

Mattingly, D., Lahr, M., Armitage, S., Barton, H., Dore, J., Drake, N., Foley, R., Merlo, Stefania., Salem, M., Stock., J. and White, K. (2007). Desert Migrations: people, environment and culture in the Libyan Sahara. *Libyan Studies*. 38:1-42

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QUATERNARY RESEARCH FUND

LATE-GLACIAL AND EARLY HOLOCENE TRANSITION IN TIERRA DEL FUEGO, PATAGONIA – CLIMATE DEFINITION

Background and Rationale

Southern South American archaeological evidence suggests that people moved quickly into newly deglaciated areas with people and animals taking advantage of land-bridges associated with lower sea-levels (Morello *et al.*, 2012). However, the archaeological record from Tierra del Fuego indicates that despite early and rapid colonisation at *c.* 10 500 BP there appears to be a subsequent gap in the occupation of the region between *c.* 10 500 and *c.* 5000 BP (Morello *et al.*, 2012; Figure 1). Palaeoecological data suggests that there are a series of shifts in aridity between *c.* 10 300-8200 BP (McCulloch and Davies, 2001, McCulloch and Morello, 2009) thus population declines could be in response to a substantial climate driven ecological change that impacted on resource availability. However, interpretations of climate evidence remain problematic in terms of individual climatic variables and a potential lag time in the ecological responses.

The overall aim of the project is to generate a chironomid inferred temperature record for Fuego-Patagonia. The Quaternary Research Fund provided funding to support the cost of travel to Tierra del Fuego where fieldwork was carried out to investigate potential sites and sample a suitable site. The main study region for the fieldwork (Figure 1) was informed by archaeologists from Instituto de la Patagonia who are working in the region. Sites investigated for potential palaeoclimatic records were located in landscapes which were considered attractive to early hunter gatherers offering sufficient resources for example proximity to coastal marine resources, woodland and hunting areas.

Results

Palynological research conducted within the study region (Mansilla-Andrade, 2015) had already identified several sites with sediments suitable for palaeoclimatic analysis. In the field these potential sites were investigated and one site, Punta Yartou was cored and sampled (Figure 1). The site sampled has excellent chronological control facilitated by a well-established tephra-chronology for the region and contain sediments with material suitable for AMS radiocarbon dating. The sediment stratigraphy was sampled from an infilled kettle hole with the upper 7m consisting of humified and poorly humified sphagnum peat, there is then a transition, between 7-9.8m, through gyttja to increasing clay rich organic lake sediments. The basal sequence of lacustrine sediments (9.8 -11.1m) lie below the

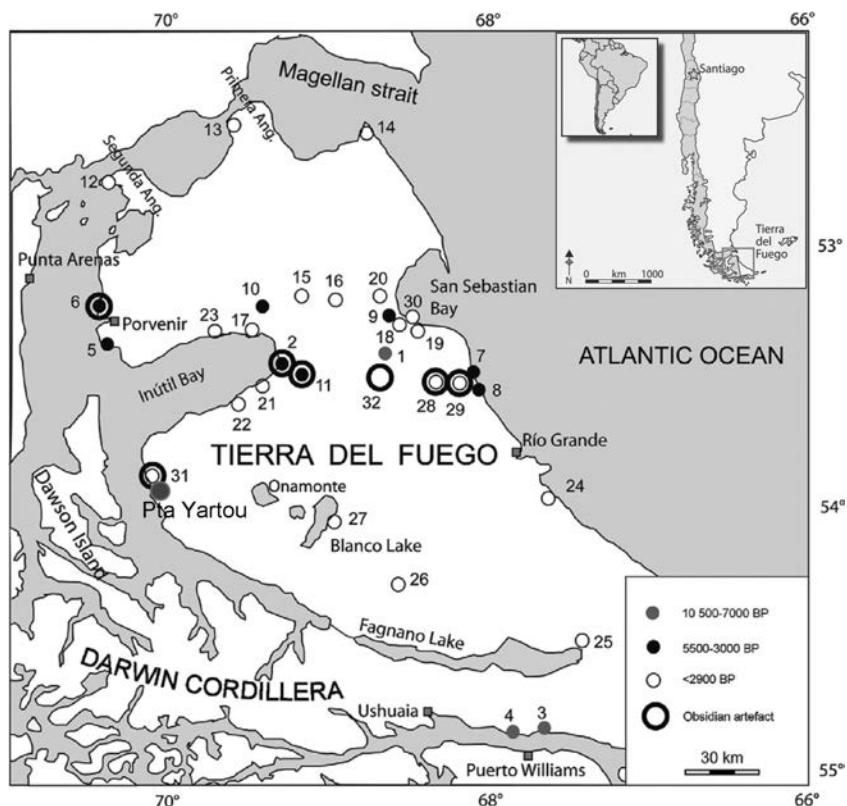


Figure 1. Location of Punta Yartou sampling site shown with Holocene archaeological sites and location of obsidian artefacts in Tierra del Fuego from Morello *et al.* (2012).

Reclús tephra (c. 15 510-14 350 cal. years BP) and consist of laminated marls and organic rich silts and clays lying above barren blue grey glacial clays at the base. This suggests that lacustrine sediment stratigraphic record spans the correct time frame that is Late glacial and early Holocene, has a good resolution and is made up of lacustrine sediments suitable for chironomid preservation as well as potential for high species abundance and diversity.

Significance

Achironomid inferred temperature record will help define of the nature, timing and rate of climate change for the study region. This record central to any discussion of potential impacts on resource availability for hunter gatherer peoples in the region.

In addition, the regional glacial geomorphology is mapped in detail (McCulloch *et al.*, 2005) however, there are limited regional and local palaeoclimatic data sets to support the interpretation of ice dynamics.

Acknowledgements

Travel to Patagonia was funded through the QRA Quaternary Research Fund. Thank you to Flavia Morello and her colleagues at Instituto de la Patagonia for field support and discussions on site selection. The support in the field and the lab of Dr Bob McCulloch, University of Stirling is also gratefully acknowledged.

References

- Manzilla-Andrade, C.A. (2015). Palaeoenvironmental changes in southern Patagonia during the Late-glacial and the Holocene: implications for forest establishment and climate reconstructions. Unpublished PhD thesis, University of Stirling.
- McCulloch, R.D. and Davies, S.J. (2001). Late-glacial and Holocene palaeoenvironmental change in the central Strait of Magellan, southern Patagonia. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **173**, 143-173.
- McCulloch, R.D., Bentley M.J., Tipping, R.M. and Clapperton, C.M. (2005). Evidence for Late-Glacial ice dammed lakes in the central Strait of Magellan and Bahía Inútil, southernmost South America. *Geografiska Annaler* 87 A (2) 335-362.
- McCulloch, R.D. and Morello, F. (2009). Evidencia glacial y paleoecológica de ambientes tardiglaciales y del Holoceno temprano. Implicaciones para el poblamiento temprano de Tierra del Fuego, in Salemme, M., Santiago, F., Álvarez, M., Piana, E., Vázquez, M. and Mansur, M.E. (ed) *Arqueología de Patagonia: una mirada desde el ultimo confin*: 119-136. Ushuaia: Editorial Utopías.
- Morello, F., Borrero, L., Massone, M., Stern, C., García-Herbst, A., McCulloch, R., Arroyo-Kalin, M., Calas, E., Torres, J., Prieto, A., Martínez, I., Bahamonde, G. and Cárdenas, P. (2012). Hunter-gatherers, biogeographic barriers and the development of human settlement in Tierra del Fuego. *Antiquity* 86, 71-87.

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REPORTS

SEA-LEVEL AND COASTAL CHANGE (SLACC) CONFERENCE AND FIELD MEETING

16-18 September 2015, Cumbria

This year saw the first meeting of the QRA's Sea Level and Coastal Change (SLaCC) Research Group. SLaCC aims to create an interdisciplinary community for scientists from the UK and NW Europe researching past, present and future sea-level and coastal changes and their impacts for the coast. The first conference and field meeting, organised by **Natasha Barlow** and **Sarah Woodroffe**, in association with **Jerry Lloyd** (all Durham University), was based in Cumbria. The meeting provided opportunities for oral presentations and posters from across the sea-level and coastal community and to explore the stratigraphy, geomorphology and modern use of the Cumbrian coastline. Cumbria is an important location for research into relative sea-level (RSL) changes and coastal evolution from the Lateglacial to Holocene (e.g. Lloyd *et al.*, 1999; 2013). A number of the locations visited have been key in the constraint of geophysical model predictions for the region. Alongside the opportunity to visit key field locations and present new research outputs, the conference also provided an opportunity to celebrate the career of the keynote speaker, **Cecile Baeteman** (Belgian Geological Survey), whose research, particularly on the Belgian coast, has contributed greatly to the sea-level community.

Wednesday 16th September

Sarah Woodroffe began proceedings by welcoming the participants to the conference held at Kendal College. The morning sessions outlined ongoing sea-level research, particularly for the Holocene, occurring throughout the UK (**David Smith**, Oxford; **Antony Long**, Durham) and further afield in Iceland (**Martin Brader**, Durham), the Falkland Islands (**Roland Gehrels**, York), Newfoundland (**Robin Edwards**, Trinity Dublin) and Croatia (**Jason Kirby**, Liverpool John Moores). Additionally, attention was drawn to research of recent storm surge sedimentological signatures (**Sue Dawson**, Dundee) and how their preservation alters as they integrate into the sedimentary record - an important point for members of the palaeo-sea-level community.

Cecile Baeteman's keynote presentation and those delivered by **Antony Long**, **Roland Gehrels** and **Sue Dawson** to celebrate her career were highlights of the

conference. As noted by Cecile, the opportunity to regularly attend IGCP, INQUA and QRA meetings played a key role in the development of collaborations and discussions of ideas, as well as occasional confrontations. Cecile's reflections on her career and previous meetings attended, well-illustrated through a great selection of photos, taught the young scientists in the audience many lessons of how sea-level science has changed and progressed through the years. The importance of gathering at meetings such as this, discussing our research and providing mutual support, was evident for the early career researchers present. The research group's commitment to providing a supportive community for postgraduates and ECRs was evident from the number of oral presentations given by these researchers. Several talks in the day's final session provided insights into the interdisciplinary research being undertaken by the community (e.g. **Tom Holmes**, York), particularly the links with archaeology (**Megan Clement**, CITiZAN Project; **Rhiannon Philip**, Cardiff). Concluding the conference day, the poster session featured work from a number of locations, including northwest Scotland, Cumbria, Shetland, the Netherlands and South Georgia. The poster session provided an opportunity for old friends and new acquaintances to come together in a relaxed environment to discuss their research and reminisce - this theme continued throughout the meeting. Over the course of the conference sessions, the range of research undertaken by members of the QRA sea-level community was clearly evident and the conference provided a great overview of current research endeavours.

Thursday 17th September

Site 1: Drigg (SD 045 984)

We were greeted, much to our relief, by sunshine as we set off north to the west Cumbrian coast for the first day of fieldwork. **Jerry Lloyd** and **Paul Fish** (CH2M) explained how the coastal lowlands at Drigg have evolved; their proximity to Sellafield and the Low Level Waste Repository (LLWR) makes this particularly important. As a result of these commercial interests, the historical and future potential coastal changes at Drigg have been extensively explored. Research undertaken by **Paul Fish** and colleagues at Halcrow (now CH2M) concluded that whilst the dune system is currently stable, future scenarios for rising sea level and limited sediment supply will erode the existing sand dunes. The dunes are believed to have minimal significance for the coastal evolution over a few hundred to a thousand years. The UK's primary low level radioactive waste disposal facility, however, sits adjacent to this coastline and 5-20 m above present sea level. Beyond this period, the evolution of the coastline presents scenarios which will require careful consideration. The group then investigated the peat outcrops on the Drigg foreshore at the northern end of the dune system. Radiocarbon dating and surveying of the exposed peat, undertaken by **Jerry Lloyd** and colleagues, produced a limiting point for early Holocene Cumbrian RSL (Lloyd *et al.*, 2013).

Additionally, freshwater pollen flora preserved in the peat indicates that sea level was below this point when deposited. This research built upon a previous investigation of these deposits by **Michael Tooley** in the 1980s. Following an exploration of the dune system, the group departed for the LLWR.

Site 2: Tour of the Low Level Waste Repository (LLWR)

In the afternoon, **John Shevelan** of the LLWR gave a presentation outlining the work undertaken at the facility and the research completed to determine the future coastal impact of a range of sea-level scenarios. Following lunch, generously provided by LLWR, we were given a tour of the Repository facilities. John outlined the different stages material undergoes when it reaches the site and discussed the extensive planning undertaken for the Environment Agency in order to maintain the site as the UK's primary low level waste facility for the future. The site has been in operation for over 50 years, with the first engineered vault (Vault 8) being commissioned in 1988. In 2010, Vault 9 was completed and it is estimated to hold 5,500 steel containers of waste giving it an operational lifetime of 8 years, illustrating the importance of maintaining facilities such as this for future waste. The tour demonstrated the applicability, and importance, of our research for industries such as nuclear waste processing, given the proximity of key sites to the coast.

Site 3: Holme Bridge (SD 076 985)

The afternoon provided an opportunity for some coring and the group travelled south to Holme Bridge, a site which **Jerry Lloyd** and colleagues had surveyed to produce Lateglacial sea-level index points (SLIPs) for northwest England. Jerry drew in a larger than anticipated crowd when he began to explain the stratigraphy previously found in the cores, with the cows taking a particular interest.

The group sampled at several points in search for the continuation of the transition between blue-grey clay and organic-rich clay documented in the dated core previously sampled at the site. The particularly keen members of the group even wrapped up one of the sampled gouge cores to be taken back to Durham. Radiocarbon dating at this transition from freshwater dominated flora to organic-rich clay dated the fall in sea level to 15402 – 16565 cal a BP (Lloyd *et al.*, 2013). This new Lateglacial SLIP enabled geophysical models, which were predicting a highstand above present for this time period, to be tested. These new Lateglacial SLIPs above present day sea level, marking the RSL highstand, may be useful in verifying geophysical model predictions (e.g. Bradley *et al.*, 2011). Additionally this data from Holme Bridge constrains the minimum deglaciation age for the Ravenglass area to 16.8 k cal a BP (Lloyd *et al.*, 2013).

A brilliant day of fieldwork was topped off with a tour of Jennings Brewery in Cockermouth which provided a great opportunity to socialise with other conference attendees over a pea and pie supper.

Friday 18th September

Site 1: Silloth

On Day 3, we visited the Solway Coast Discovery Centre for a tour of the AONB Exhibition, which provides an overview of the wildlife, landscape development and human occupation of the region. The exhibition highlighted the interaction of human occupants with the environment, as well as the key flora and fauna found in the Solway marshes and wider coastal environments. **Brian Irving**, the Solway Coast AONB Manager, provided an insight into the previous and current research undertaken in the region, as well as the development of the Discovery Centre. Brian also guided the meeting participants to a number of the subsequent locations.

Site 2: Bowness Common

Following the visit to the Discovery Centre, Brian led the group from Silloth to higher ground overlooking Bowness Common, allowing us to gain an understanding of the coastal morphology of the region. Areas of stratigraphic interest were highlighted to the participants, as well as possible locations for future research. Following this introduction, the group descended onto Bowness Common via the Solway Wetlands Centre. After crossing the common, we were able to undertake some coring to explore the underlying stratigraphy, led by **Jerry Lloyd** and **Michael Tooley**, which revealed extensive peats and woody deposits. Discussions underlined the importance of Bowness Common for environmental and sea-level research in northwest England. Following the visit to Bowness Common, the group proceeded to the nearby present-day coastline, where Brian provided an overview of the contrasting coastal environments and habitats surrounding the Solway Firth. This summary offered a useful analogue for some of the palaeo-environments explored during the meeting.

Summary

The first conference and field meeting of SLACC provided a fantastic opportunity for sea-level scientists, archaeologists and palaeo-environmental researchers to meet, share their work and explore key research locations in northwest England. The conference and field visits stimulated interesting discussions of the RSL changes and coastal evolution of the region, as well as highlighting potential future research questions. In turn, the SLACC research group meeting offered a



SLaCC Field Meeting 2015 participants (Photograph: Christine Hamilton).

welcoming environment for postgraduates and early career researchers to present and share their ideas, as well as creating an opportunity to engage with other sea-level and coastal change researchers. We are looking forward to the next meeting in 2016 and the opportunity to explore other research locations around the UK. Further information about the research group can be found on the dedicated webpages at www.durham.ac.uk/geography/slacc or by following the research group on Twitter @QRA_SLaCC.

Acknowledgements

On behalf of the participants, we would like to thank **Natasha Barlow** and **Sarah Woodroffe** for organising the conference and field meeting and **Jerry Lloyd** for leading several field discussions (as well as his expert minibus driving). Thanks are also due to **Paul Fish**, **John Shevelan** and **Brian Irving** for their contributions to the meeting and the LLWR for their hospitality. We would also like to acknowledge the QRA's support for this research group, in particular promoting postgraduate attendance.

Bibliography

Bradley, S.L., Milne, G., Shennan, I. and Edwards, R. (2011). An improved glacial isostatic adjustment model for the British Isles. *Journal of Quaternary Science*, 26, 5, 541–552.

Fish, P. (2012). Significance of the Dune system at Drigg. LLWR ESC Technical Queries. Halcrow Ltd. Available online [<http://llwrsite.com/wp-content/uploads/2013/11/63-Memo-LLWR-ESC-MeM-13-193-Halcrow-Response-TQ-SUE-022-Dun.pdf>]

Lloyd, J. M., Shennan, I., Kirby, J. R. and Rutherford, M. M. (1999). Holocene relative sea-level changes in the inner Solway Firth. *Quaternary International*, 60, 83-105.

Lloyd, J. M., Zong, Y., Fish, P. and Innes, J. B. (2013). Holocene and Lateglacial relative sea-level change in north-west England: implications for glacial isostatic adjustment models. *Journal of Quaternary Science*, 28, 1, 59-70.

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IQUA/QRA SEPT 2015 FIELD MEETING SOUTH-EAST IRELAND 25-29 SEPTEMBER 2015

Introduction

It had been seven years since a field meeting collaboration between IQUA and the QRA, and thirty four years since IQUA visited the south east of Ireland. The group met at Trinity College Dublin on the Friday morning and with the weather on our side, the Sunny South East very much lived up to its name. The group travelled by coach covering multiple sites in counties Wexford, Waterford and Cork.

Day 1 Friday 25th September 2015

The trip's glacial discussions were led by **David Evans** (Durham University) and **Colm Ó Cofaigh** (Durham University). The first two stops of the field meeting were to view the glacial deposits at the Screen Hills and Blackwater Harbour. Located south of Cahore Point in County Wexford, the hummocky topography of the Screen Hills retains a record of the temporarily stabilised Irish Sea Ice Stream as it retreated from the Celtic Sea. The deposits demonstrate the subglacial to subaqueous processes associated with the ice stream. Walking along the impressive coastal cliff exposures at the Screen Hills (Figure 1), the group witnessed a sequence containing evidence of an ice deposition centre resulting from the oscillating glacier margin. The meeting then moved on to Blackwater Harbour where the group learned that the basal deposits record a southward advance of a grounded Irish Sea Ice Stream into the Celtic Sea. Here, the overlying deposits indicate shallow glacialacustrine deposition while the top of the sequence records an ice marginal environment during deglaciation.

Following on from these sites **Pete Coxon** (Trinity College Dublin) pointed out some impressive kettle holes whose size demonstrates the scale of ice coverage in the landscape. Venturing further south, the group visited the coastal cliff exposures at Ely House. This site was described as some of the best examples of glacialacustrine sediments with associated dropstone structures in southern Ireland.

Later that afternoon the field meeting travelled to the Irish National Heritage Park in Ferrycarrig, County Wexford. **Michael Monk** (University College Cork) gave demonstrations on a corn drying kiln and on the workings of a reconstructed horizontal mill driven by a jet of water funnelled from a mill pond. The group discovered that based on evidence from cultivation experiments on charred remains of emmer and bread wheat from the park, it is believed that these grains were among the first grains to be used by early farmers in Ireland. That evening we were treated to a talk on the history of glaciation studies in the south of Ireland by Colm Ó Cofaigh who discussed the importance of the south of Ireland in



Figure 1. Walking along the impressive coastal cliff exposures at the Screen Hills.

reconstructing the British Irish Ice Sheet. The group was also given an overview of the activities of the NERC funded BRITICE CHRONO study and how it fits in with the overall reconstruction of the British Irish Ice Sheet.

Day 2 Saturday 26th September 2015

The next day started with a trip to Kilmore Quay, County Wexford to view the glacial sediment exposures related to the onshore flow of the Irish Sea Ice Stream, where it was explained that the site of St Patrick's Bridge represents a recessional moraine ridge of ice pause and retreat. Saint Patrick's Bridge is a long ridge of shingle stretching out from the mainland shore towards Saltee Island Little. At low water, the ends of the bridge may be seen jutting out from the townland of Nemestown on the mainland and from the north-eastern corner of Saltee Island Little. St Patrick's Rock is one of several large, named glacial erratics of Carnsore Granite scattered along the seashore on the eastern side of the bridge. These erratics are believed to have been deposited by the Irish Sea Glacier as it flowed south in the Irish Sea during the last glaciation.

Post lunch the party headed inland where **Dominic Berridge** (Wexford Wildfowl Reserve, County Wexford) gave a physical and cultural history of the Corrock River and Mulmontry Gorge. The gorge formed a natural barrier between lands to the south east and the rest of the country. This possible glacial meltwater channel provided a natural divide that led to the formation of the Anglo Norman colony and Baronies of Forth and Bargo. These baronies are noted for the late survival of an old English dialect named Yola. During the fifteenth and sixteenth centuries the area was known as the second Pale.

The rest of the day was spent observing the relict pingos at Camaross (Figure 2). These fossil landscape features form under periglacial conditions to create dome shaped ice features. Notably, there were 200 pingos in the Camaross area that have now been destroyed by agricultural activity. That evening, in the Viking Hotel, the group was treated to talks on the Viking settlements in Waterford. **David Pollock** (Waterford Archaeology, Co. Waterford) revealed that the settlement of



Figure 2. The group spent time observing the relict pingos at Camaross.

Woodstown was initially attempted 9km up the River Suir noting its occupation from AD 850 to 950. However, this settlement failed and during its demise another site closer to the open sea was taking shape. This site was Waterford and was the beginning of the city that stands there today. Waterford's growth was assisted by its location along the river in close proximity to the sea. The site along the River Suir also provided a natural border that is still in existence dividing the provinces of Leinster and Munster.

The talks continued with **Eileen Reilly** (University College Dublin) discussing the environment during the Viking Age in Waterford. Pollen analysis has determined that prior to the Viking settlement a largely pastoral environment existed in the early medieval period, while woodland dominated during the seventh and eighth centuries. Research revealed some disturbance indicators at the very top of the cores which may reveal the early settlement of Vikings. However, it was also explained that limited pollen evidence has been found surrounding Waterford City due to the lack of preservation capability.

Day 3 Sunday 27th September 2015

The next morning the group made their way to the Copper Coast Geopark in County Waterford. Prior to the group splitting for different site visits the group heard about palaeoenvironmental change in the Comeragh and Monavullagh Mountains. A detailed description of methodology and results was given by **Bettina Stefanini** (Maynooth University Ireland) with the resulting Mesolithic dates putting previous beliefs of peatland formation into question. After the talk the group split, with some hiking up the Comeragh Mountains to Coumshingaun (Figure 3) while the rest of the group stayed in the Geopark centre. Following a short video on the history of the Copper Coast's mining history, the participants took a bus journey along the magnificent coastline. With geologist **Mike Sweeney** (Copper Coast Geopark Chairperson) as a guide, the group made stops to learn about the area's geo-tourism initiatives and discover how the Geopark status has brought the local community together endeavouring to protect their geological heritage.



Figure 3. The Comeragh Mountains to Coumshingaun.

Moving inland once again, the reunited group visited Ballynamindra Cave. Led by **Richard Jennings** (University of Oxford) the Dungarvan Valley Caves Project was outlined. Through new surveys and excavations this project aims to reassess the Pleistocene faunal remains in the area. Hidden away from the road the cave contains an opening extending 10m which leads into a lower chamber with two short passages further on. A total of 50 human bones and other bone fragments have been discovered in Ballynamindra Cave, and although previously thought to have been contemporaneous with Irish Elk bones they were later dated to 3020-2580 cal BC. Previous excavations were thought to have exhausted the cave of evidence but in 2005 the above project located a Pleistocene stratigraphic sequence. With new scientific techniques such as radiocarbon and uranium series dating, together with ancient DNA and isotope analysis, the project hopes to enhance the Irish Quaternary Fauna Project and the Human Remains from Irish Caves Project.

Day 4 Monday 28th September 2015

The next morning the group moved onto County Cork as a base for the rest of the trip. After crossing the Eamon de Valera Bridge, County Cork, the first stop of the following morning was at Cobh Harbour where the group took a short trek to visit a captivating site. The bridge's construction in the 1970s led to the discovery of highly overconsolidated clay and organic sequences beneath gravels with a recognised Pleistocene provenance. The group learned that the retrieval of these interglacial deposits has met with many barriers, demonstrating the many complexities of palaeolandscape reconstruction. An investigation in 1987 did not yield the Pleistocene deposits, due to technical difficulties. Interglacial deposits were retrieved in 1994 when the use of a professional drilling company employed during the Cork Harbour Commission project made the entire quay vibrate. Following that investigation the retrieved overconsolidated clay could not be recovered from the steel tubes due to broken equipment. However, on this occasion, the group were lucky enough to witness the red diamicton above the olive green overconsolidated interglacial base.

The next stop was at Howes Strand where the group visited the glacial features described by Wright and Muff (1904): a till deposit above a wave cut platform lying above a raised beach. At Howes Strand the sands are hummocky cross stratified and swaley cross stratified overlain by coarse grained massive diamict. Having formed in a shallow marine environment the hummocky cross stratified deposits overlay the raised beach thought to have formed during a storm. Today this wave cut platform is now described as erosional furrows or p-forms believed to be developed by subglacial meltwater. Participants then travelled to Courtmacsherry Bay. The raised beach noted at Howes Strand runs from Carnsore Point, South East Wexford to West Cork, but is best developed at Courtmacsherry. OSL dates from the site put the deposits at marine isotope stages 4-3. Located above the shore

platform the lower horizontally bedded sands and gravels are well sorted while the upper part of the sequence is a massive, matrix supported diamict with striated faceted clasts. This sequence is said to have once been a beachface which was then covered by subglacial till deposited by the terrestrial ice originating from south west Ireland. Synge (1978) thought the sand was deposited by aeolian processes but this sand is now thought to have formed in a shallow marine environment.

Day 5 Tuesday 29th September 2015

Once again the group was fortunate with the weather and on the final day the group visited the last site of Ballycroneen. Heading across the valley mouth from the carpark the group viewed the deposits at Ballycroneen East. The deposits to the east of the carpark demonstrate a possible movement of the Irish Sea Ice Stream onshore. The evidence for a glacially dammed lake came in the laminated and rhythmic nature of the overlying sediments which importantly contain no marine macrofauna. While heading back towards the carpark the last discussion of the trip centred around an impressive exposure thought to have formed as a debris apron flow resembling a perfect example of remobilised sands coming down into fan.

Acknowledgements

The program ran smoothly due to the great organisation by Gayle McGlynn, Bettina Stefanini and Randal McGuckin. Thanks to all the contributors to the field guide. Thanks must also be given to the coach driver, Stephen Nolan, whose skillful driving got us down every little road.

References

- Wright, W.B., Muff, H.B., (1904). The pre-glacial raised beach of the south coast of Ireland. *Scientific Proceedings of the Royal Dublin Society* 10, 250-324.
- Synge, F.M., (1978). Pleistocene events. In: Davies, G.L., Stephens, N. (Eds.), *The Geomorphology of the British Isles: Ireland*. Methuen, London, pp. 115-180.

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GLWG 16 AND QRA JOINT FIELD MEETING: GOWER PENINSULA, SOUTHWEST WALES, 22 – 25 October 2015

The 16th Glacial Landsystems Working Group (GLWG) field meeting and the 2nd joint session with the Quaternary Research Association (QRA) reconvened (with another cracking field guide) in Gower, southwest Wales. As usual, this was a popular meeting, attracting attendees from all over the UK, and even Poland and Norway. This year was made extra special by the debut of the new GLWG t-shirt range (Figure 1), which is still available at a very affordable price (contact Dave Evans for sizes). This GLWG/QRA session was led by **John Hiemstra** and **Richard Shakesby** from Swansea University who gave an excellent introductory talk on the Thursday evening outlining the purpose of the meeting: to establish the limit of the British Irish Ice Sheet (BIIS) during the Last Glacial Maximum (LGM) on the peninsula. This was followed by a trip to The Worms Head in Rhossili to try the local food and ales and prepare for the next few days in the field.



Figure 1. GLWG official t-shirts (photo: Dave Evans).



Figure 2. GLWG and QRA members enjoying the sunshine at Port Eynon Bay (photo: Dave Evans).

Friday 23rd October

The first stop of the day was at Maen Ceti (Arthur's Stone), a Neolithic tomb on one of the highest points in central Gower. An introduction to the geology of Gower was given by **Geraint Owen** (Swansea University) and a brief history of UK Neolithic monuments by **George Nash** (University of Bristol). The group then debated whether the large capstone, made of Twrch Sandstone (which is not found in Gower) was transported by people or by ice. Nash suggested that the stone was initially transported by ice and dropped in its location after which, Neolithic people propped stones under it to create the burial tomb.

The next stop was at Broughton Bay, northwest Gower. This site is important because it contains evidence of *in situ* glacial till (mostly obscured now by coastal erosion defences). The sediment section revealed shelly and stony diamicton overlying a raised beach, which yielded a date of Marine Isotope Stage (MIS) 5e, using Amino Acid Ratio (AAR) dating. **Stewart Campbell** (Natural Resources Wales) and **Richard Shakesby** argued that this was strong evidence for the bay being covered by ice during the LGM. The stony diamicton contained bits of coal and generally had a north-south orientation suggesting a northern origin. They proposed that LGM ice moved south into Broughton Bay, picking up shells and sediment from Carmarthen Bay and deposited them on land.

After an excellent pub lunch in the King Arthur's Hotel, the afternoon involved a stop at a trapezoidal Neolithic burial tomb in Parc-Le-Breos-Cwm. This was followed by a visit to Cathole Cave, where members tried to avoid banging their heads on the low ceiling to catch a glimpse of a reindeer engraving, believed to be ~12,000 years old, and bear claw scratch marks! There was a bonus site for the more enthusiastic members of the group, at a prominent ridge in north central Gower that was identified on the LiDAR survey. While there was some debate about whether it was an esker or a moraine, there was general consensus that it was of glacial origin.

Saturday 24th October

The second day kicked off at Rotherslade which is a key site on Gower because, while there are several interpretations about the LGM limit on the peninsula, all of them run through this site. This is due to the presence of what has traditionally been interpreted as *in situ* basal till. However, Hiemstra and Shakesby wanted to challenge this view. They argued that instead, the glaciogenic sediment showed signs of glaciofluvial reworking, channelled through pre-existing dry valleys (slades) which would put the LGM limit 500 m further east towards Swansea Bay than previous interpretations have proposed.

One tasty pub lunch later (the Gower Inn this time) and the group arrived at Port Eynon Bay, south-west Gower. This area has been a matter of debate because the raised beaches in Eastern Slade and Western Slade and in Horton have yielded different AAR dates, leading to different chronological interpretations of these sediment sections. However, **Danny McCarroll** (Swansea University) argued that AAR dating is known to be unreliable, and suggested that the beaches were most likely the same age (MIS 5e) and therefore the stratigraphic sequences in both places were the same. Developments in marine shell dating techniques will hopefully clarify this in the future.

The group debated the origin of a slug of exclusively glaciogenic material, located at the mouth of Eastern Slade and surrounded by limestone head. Shakesby proposed two hypotheses: 1) the material was transported down the dry valleys via a combination of colluvial and alluvial processes, 2) it was part of a proglacial ice-contact fan. Richard Waller suggested that it could be the result of a high magnitude event, resulting in the sediment arriving in one go. Next the group discussed the age and origin of the 'Paviland Moraine' a broad linear ridge, 1-2 km in length. The group had the opportunity to investigate an impressive 12 m long core from the ridge revealing clear evidence of glaciogenic material. However, while the 'Paviland Moraine' has traditionally been interpreted as pre-Devensian due to its subdued nature and weathered clasts, Shakesby argued that this is not a strong argument for its age and it could be younger (possibly LGM).

Sunday 25th October

The third day was gloriously sunny and took the group down to Watch-house Bay and Foxhole Cove at Southgate. This bay is important because glaciogenic material is present in a number of exposures, but the location is well outside of the published LGM limits. Bethan and Danny McCarroll argued that it would be impossible to get glacial sediment here unless the ice sheet came over the top of the headland above Watch-house Bay and thus it must have overrun the whole of Gower. This suggests that the ice sheet was larger than any of the previous interpretations have proposed. A heated debate ensued between Hiemstra, who challenged this theory, suggesting that the sediment was a slurry of reworked glaciogenic material that was deposited by an ice sheet that stopped just inland of the headland, and Bethan and Danny McCarroll who argued that Hiemstra's theory did not explain the presence of sediment in the bay because sediment would not have been able to move uphill over the headland and into Watch-house Bay. At this point, some members of the group with long journeys ahead peeled off. The remaining members closed the meeting with a visit to Hunt's Bay, Deep Slade, 4 miles west of Rotherslade, to discuss the origin of glaciogenic sediments on the valley floor which Shakesby proposed were colluvially reworked proglacial outwash.

Overall, this was another very enjoyable and informative GLWG/QRA meeting with interesting discussions about the Devensian glaciation on Gower and some fresh interpretations about the location of the LGM limit on the peninsula. Those of you suffering from post-meeting blues can look forward to GLWG 2016 which will be taking place in Northern Ireland!

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ABSTRACT

QRA UNDERGRADUATE DISSERTATION PRIZE 2015

A PALAEOENVIRONMENTAL ANALYSIS OF THE EARLY PLEISTOCENE SILICEOUS MEMBER AT WESTBURY CAVE, SOMERSET, UK

The Early Pleistocene is poorly known in Britain and the majority of fossiliferous Early Pleistocene sites are found within the Crag Basin in East Anglia. Westbury Cave in the Mendip Hills of Somerset is an important exception and has provided a limited faunal assemblage dating to this period from a series of sand and gravel deposits known as the Siliceous Member. For the first time detailed sedimentological descriptions and systematic sampling for vertebrate fossils has been undertaken to study this rare period in British history. A new depositional model is proposed for the sediments, involving subterranean lake deposition, development of an entrance talus gravel, and cave stream sedimentation. Newly discovered fossils reveal new information about the regional fauna of Britain during the Early Pleistocene and suggest deposition was during a temperate interglacial. Porcupine (*Hystrix*) is discovered for the first time in the fauna and the vole *Victoriamys chalinei* is described for the first time in Britain and Northern Europe. Biostratigraphic correlations suggest a depositional age between 1.8-1.1 Ma with tentative correlations to Atapuerca Faunal Unit 1 in Spain and the Waalian interglacial in the Netherlands.

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GREENLAND ICE SHEET SUPRAGLACIAL LAKES: THEIR RELATIONSHIP WITH BED TOPOGRAPHY, ICE THICKNESS AND ICE FLOW VELOCITY

The formation of supraglacial lakes on the western Greenland Ice Sheet, in the immediate surroundings of Jakobshavn Isbræ, has been hypothesised to be due to the transmission of basal topography to the ice surface. These undulations cause depressions on the ice surface which can fill with water to form supraglacial lakes, drain to the bed and lubricate the ice-bed interface to enhance basal sliding rates. One-hundred and forty-three surface depressions were digitised from Landsat7 and MODIS imagery and confirmed to be forming in the same place year upon year by comparing their centroid points, before being correlated with corresponding bed depressions. Under the assumption that the slip ratio of the study was high enough to allow transmission of basal variability, the undulation span of the bed depressions and the ice thickness at each point was identified. Gudmundsson's (2003) ratio states that if the value of the undulation span divided by ice thickness falls between 3-8 it can be assumed that the bed topography is being transmitted to the surface; 38% of the twins in this study fell within the ratio range. There was also a statistically significant difference between the amplitude of the supraglacial depressions which fell between 3-8, as they were shown to be significantly larger by a Mann-Whitney U test. Sergienko's (2013) models of ice flow over bed undulations indicated that there would be a lag distance between the surface and bed depressions, with the surface depression occurring upstream from the bed depression. 71.3% of the lakes in the study observed a lag between the two features. Overall 54 of the 143 surface depressions fitted the criteria for all three hypotheses, and they are therefore likely to have formed due to transmission of basal variability to the ice surface. Further studies into the relationship between bed and surface topography, including deriving a theory for the length of lag distances, are the main avenues for future research, which must take place in areas of the ice sheet which are losing the most mass, for example the larger outlet glaciers.

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Contents

Page

- 1 **EDITORIAL**
- 2 **OBITUARY**
2 Nicholas Stevens *Stewart Campbell et al.*
- 10 **JAMES CROLL AWARD**
10 The James Croll Medal
- 12 **LEWIS PENNY AWARD**
12 The Lewis Penny Medal
13 Fluvial archives, lowland glaciation and interglacial climates *Tom White*
- 21 **HONORARY MEMBERS**
- 28 **QRA 14CHRONO AWARD**
28 Late glacial to Holocene relative sea-level change in Assynt, north-west Scotland
Christine A. Hamilton
- 32 **NEW RESEARCHERS AWARD SCHEME**
32 Developing Luminescence chronometers to establish the timing of late quaternary environmental changes in South Africa
35 Revised Chronostratigraphy of the Fazzan Basin, Libyan Sahara
- 39 **QUATERNARY RESEARCH FUND**
39 Late-glacial and early Holocene transition in Tierra del Fuego, Patagonia – climate definition *Eileen Tisdall*
- 42 **REPORTS**
42 Sea-level and Coastal Change (SLaCC) meeting, 16-18 September 2015
48 IQUA/QRA Sept 2015 Field Meeting south-east Ireland 25-29 September 2015
53 GLWG 16 and QRA Joint field meeting: Gower Peninsula, south-west Wales, 22-25 October 2015
- 58 **ABSTRACTS QRA Dissertation Prize**
58 A palaeoenvironmental analysis of the Early Pleistocene Siliceous Member at Westbury Cave, Somerset, UK *Neil Adams*
59 Greenland Ice Sheet supraglacial lakes: their relationship with bed topography, ice thickness and ice flow velocity *Thomas Dunn*