Abstracts of other papers/posters presented at the Annual Conference, January 2016

The Scott Simpson Lecture

Southwest England – its contribution to stratigraphy and palaeontology

Andrew S. Gale

Earth and Environmental Sciences, University of Portsmouth, Burnaby Building, Burnaby Road, Portsmouth, PO1 3QL

South-West England has had, and continues to have, an important place in the development of stratigraphy and palaeontology. The Great Devonian Controversy saw Murchison argue with De La Beche over the age of plant fossils from north Devon, and the issue was finally settled, in 1840, by the creation of the Devonian Period. The amazing finds of articulated reptiles by Mary Anning at Lyme Regis in the 1820s and 1830s included the first ichthyosaurs and plesiosaurs, which were described by Conybeare and Buckland at an important, early stage, in the development of vertebrate palaeontology. Her other finds included belemnite ink and coprolites, which were interpreted by Buckland. The Lyme Regis finds finds also provided De La Beche with evidence to draw *Duria Antiquior* the first ever reconstruction of an ancient community which effectively marks the beginning of palaeocology. The extensive Jurassic cliffs of Dorset and Devon, with their abundant fossils, have contributed greatly to the development of international Jurassic stratigraphy, through the research of Lang, Spath, Arkell, Buckman and others on the ammonites. This is reflected in Stages being named after localities along the coast, which include the Charmouthian, Kimmeridgian, Portlandian and Purbeckian – although, of these, only the Kimmeridgian has made it into the Geological Timescale. The wonderful fossil finds made by Steve Etches around the village of Kimmeridge parallel those made by Mary Anning at Lyme Regis in the early 1800s, and the 'Jurassic Coast' continues to surprise and delight geologists and palaeontologists.

Durior Antiquior *(A More Ancient Dorset), one of the first palaeoecological reconstructions by Henry De La Beche.©The National Museum of Wales, Cardiff.*

Redcliffe Sandstone revisited

Alan Cattell

Structural Soils Limited, The Old School, Stillhouse Lane, Bedminster, Bristol, BS3 4EB

This contribution presents new data from >120 rotary cored boreholes drilled through the Triassic of central and southern Bristol over the past few years. Two significant conclusions are drawn from the new data:

(1) The sandstones of the Redcliffe Sandstone Member do not rest directly on Coal Measures under central and southern Bristol, but are underlain by as much as 20–25 m of red mudstones; for example beneath the type locality at Redcliffe. The mudstones contain discrete, thin, graded sandstone beds towards the top, and a thin sandstone and/or breccia at the base resting on highly weathered Coal Measures. They contrast with the mudstones higher in the sequence in beings sandier, weaker, and lacking in gypsum veining. The unit only outcrops in the floor of the tidal New Cut, and is informally referred to as the New Cut Mudstone.

(2) The east–west Yanley Fault which is mapped to the south-west of Bristol continues for several kilometres further east across southern Bristol, with a down-throw of 40 m or more to the south. It juxtaposes 'normal' facies Sidmouth Mudstone to the south against Redcliff Sandstone or New Cut Mudstone. It also controls the northern boundary of the Avon flood plain at St Philips.

A new geological map of the area was presented.

MINATURA2020 – Mineral Deposits of Public Importance

John Cowley

Mineral & Resource Planning Associates Ltd, 23 Bayfran Way, Blandford Forum, Dorset, DT11 7RZ

The exploitation of minerals in Europe is essential to ensure that the present and future needs of European society can be met. Both for sustainability objectives, and the maintenance of the existing manufacturing industry across Europe, access to a wide range of minerals is required. The potential of EU mineral resources, therefore, needs to be protected and enabled. However, such actions must take account of other land use considerations, such as agriculture, forestry, habitats for fauna and flora, other environmental concerns, priorities for settlements and infrastructure, etc., all of which are currently affecting/restricting mineral development options.

MINATURA2020, a new EU project funded within the scope of the European Commission's Horizon 2020 Programme for Research & Innovation (R&I), was launched in February 2015 to address these issues via a pan-European approach so as to provide a policy and planning framework for mineral extraction

across Europe. Evidence will be drawn from selective case studies across Europe, which studies include onshore minerals in SW England (particularly metal and industrial minerals) and offshore minerals in the Celtic and Irish seas. John is a partner in the project and described some of the issues involved and arising.

De La Beche's 1839 'head' sections in south Cornwall revisited

Peter Ealey

8 Minster Fields, Manaccan, Helston, Cornwall, TR12 6JG

De La Beche (1839) used two Quaternary coastal sections south and north of the mouth of the Helford Estuary to illustrate his concept of 'head'. Although 'head' is now thought of almost universally as a periglacial deposit, De La Beche himself envisaged colluvial processes as the dominant mechanism. Surprisingly these sections and underlying shore platforms have received little attention in the 175 years since, despite the fact they are essentially the type sections of 'head'.

Investigation of the relatively extensive raised shore platforms and overlying Quaternary sequences indicates that those south of the Helford are noticeably higher (8.5 m. O.D.) than those farther north (4.73 m O.D.), suggesting differences in their age of formation. Contemporary platform development is confined noticeably to localised areas (Nelly's and Sunny coves). The lower units of the 'head' overlying the raised beaches are almost certainly colluvial as De La Beche himself envisaged. Periglacial solifluction and loess deposits are restricted to the upper part of the 'head' sequences.

The Quaternary evolution of the coastline, with its associated shore platforms, 'head' deposits and ria embayments, sheltered from the dominant South-West wind and wave direction, was then outlined.

Key issues in the management of the Jurassic Coast World Heritage Site, fossil acquisition, and the role that Jurassica has to play

Richard Edmonds

1 Cuckoo Hill Cottages, Cuckoo Lane, Uplyme, Lyme Regis, Dorset DT7 3SS

Fossils form a key strand in the Dorset and East Devon Coast's status as a World Heritage Site and collectors, have, since the days of Mary Anning, demonstrated their essential role in the recovery of specimens of great scientific value. Without their efforts, fossils will be lost to the sea. The World Heritage Site Management Plan recognises the importance of collecting but also encompass initiatives such as the West Dorset fossil code which allows everyone access to information about what is being found and requires that important specimens are offered to accredited museums in the first instance, should they be sold or donated. The issue for the Site management is that collectors are holding onto their best finds in expectation that a World Class fossil museum or display will be built to house them. The local museums, even with current extension plans, do not have the capacity to house and display these specimens. Jurassica is a major proposal to be located in a quarry on Portland and the intention is to create an immersive experience by recreating the environments of the past. It will acquire the important collections so that they can be described and displayed for educational benefit.

Communicating the invisible: public perceptions of the geological subsurface

Hazel Gibson[1], Iain Stewart[1], Sabine Pahl[2], Alison Stokes[1] and Mark Anderson[1]

[1] School of Geography, Earth & Environmental Sciences, Plymouth University, Drake Circus, Plymouth, PL4 8AA

[2] School of Psychology, Plymouth University, Drake Circus, Plymouth, PL4 8AA

Geoscience operates at the boundary between two worlds: the visible and the invisible. Increasingly new geological technologies, such as hydraulic fracturing, carbon capture and storage (CCS) and radioactive waste disposal are drawing the public's attention to the 'invisible' world of the geological subsurface. This presents unique communication challenges because these technologies exist in a realm that can never be physically seen.

To address this issue, a study examined the psychological perceptions of residents in three villages in the south west of England. Using Morgan *et al.*'s 'mental models' technique (2002), a broad sample from each village was qualitatively interviewed and mental models were constructed from the resultant data. The mental models were then quantitatively tested using a questionnaire to assess the perceptions that the residents hold towards the geological subsurface. The results from the mental models assessment show the principal perceptions held by the majority of the public, in particular the connection between the visible surface and the invisible subsurface. The work will provide an important empirical baseline from which to develop a science-led strategy to engage the general public with new technologies and to increase our understanding of the more broadly held conceptions of the invisible subsurface.

MORGAN, M.G., FISCHOFF, B., BOSTROM, A. and ATMAN, C. 2002. Risk communication: *A mental models approach*. Cambridge, Cambridge University Press.

Foraminifera of the Fal Estuary (Cornwall), including the taxa associated with the maerl beds

M. B. Hart[1,2], K. Cartwright[3], B. Fisk[3], C.W. Smart[1,2], C. Consolaro[1,2] and J.M. Hall-Spencer[2,4]

[1] School of Geography, Earth & Environmental Sciences, Plymouth University, Drake Circus, Plymouth PL4 8AA

[2] Marine Institute, Plymouth University, Drake Circus, Plymouth PL4 8AA

[3] Exeter College, Hele Road, Exeter EX4 4JS, Devon

[4] School of Marine Science & Engineering, Plymouth University, Drake Circus, Plymouth PL4 8AA

St Mawes Bank in the Fal Estuary (Cornwall) contains a nationally important accumulation of calcareous red seaweed often referred to as maerl. Maerl beds are often associated with high benthic diversity and this investigation has studied the foraminifera that are found within samples of the maerl and the adjacent sediments. Our samples were preserved and then stained with rose Bengal, in order to ascertain the 'living' (stained) assemblage of foraminifera associated with the maerl. Only <1% of the taxa associated with the maerl appear to be living at the time of collection in September 2012, and the assemblage is a mixture of open marine taxa and those characteristic of estuarine and sea grass communities. The presence of pelagic ostracods and centric diatoms supports the suggestion that at least some of the high foraminiferan diversity

reported from maerl assemblages is the result of transported material trapped within the intricate meshwork of the maerl. Foraminifera from other areas of the Fal Estuary are typical of saltmarsh, estuarine and near-shore marine assemblages reported elsewhere in South-West England.

Contrasting Holocene coastal palaeoforest vestiges of Mount's Bay and Daymer Bay, Cornwall

Frank Howie

Cornwall Geoconservation Group, Cornwall Wildlife Trust, Five Acres, Allet, Truro, Cornwall, TR4 9DJ

Atlantic storms sweeping the coastlines of western England over the past five years have resulted in temporary exposures of Holocene palaeosols and palaeoforest vestiges in bays and estuaries. In Cornwall opportunities arose to re-examine and sample the historically significant Mount's Bay and Daymer Bay 'submerged forests' deposits which reveal evidence of contrasting depositional environments linked to the distinctive Holocene geology of the southwest and north Cornish coastlines.

New exposures of the Mount's Bay palaeoforest and associated silt and sands are tentatively correlated with known organic-rich sediments reported in logs from a number of boreholes in the area. The acidic peat sediments preserve a flora that flourished in an embayed back-barrier environment which was eventually drowned by episodic storm events and moderate rates of sea-level rise.

In contrast, in Daymer Bay, palaeosols with well-defined macro and micro-flora and faunal elements are associated with shell-rich dune development and estuarine encroachment. This assemblage of sub-fossil terrestrial gastropods, plant and vertebrate remains is a consequence of burial in anorganic-rich calcic sediment – a rare phenomenon in deposits associated with UK coastal palaeoforests.

The Northern Contact Zone of the Land's End Granite - Late-Variscan Tectonic Evolution and Granite Emplacement

Samuel P. Hughes and Robin K. Shail

Camborne School of Mines, College of Engineering, Mathematics and Physical Sciences, University of Exeter, Penryn Campus, Penryn, TR10 9FE

The contact zone between the late Devonian Mylor Slate Formation and the Land's End Granite crops out along the north coast of the Penwith Peninsula in West Cornwall. A structural study has demonstrated the existence of late Palaeozoic deformation that has been correlated with the regional deformation chronology in South Cornwall away from effects of granite emplacement. D1 is represented by a ubiquitous S1 cleavage that is generally bedding-parallel. D2 structures are partitioned and rare, and include open folds with a weak axial planar cleavage that can be seen to crenulate S1. Early-D3 structures include folds and an axial planar cleavage that are associated with low-angle detachments and re-activated thrust faults. S1 and S2 cleavages have in places been refolded by F3 folds, and S3 cleavage can be seen to crenulate previous fabrics. High-angle extensional faults striking ENE-WSW crosscut ductile D3 deformation, but would have formed under the same NNW-SSE extensional regime. This transition to brittle D3 structures was caused by continued crustal thinning. Granite sheets are seen to crosscut ductile D3 structures and are hosted by late-D3 faults. Granite-related mineral veins are also hosted by late-D3 faults which correlates the timing of granite emplacement with late-D3 deformation. Internal granite structures along with host rock contact relations shows sheet-like emplacement with minor stoping around pre-existing fault zones. Pre-granite structures have been reoriented to the north and west, suggesting inflation of the host rock accommodated the pluton. The reorientation of D1-D3 structures around large-scale NW-SE faults demonstrates that there must have been movement on these structures during granite emplacement. Reactivation of these structures during granite emplacement may have played a major role during pluton construction and the emplacement of more evolved melts in to the roof zone.

Cliff erosion to the east of Sidmouth and the role of groundwater

John Mather

4 Crockernwell Court, Crockernwell, Exeter, EX6 6NA and Department of Earth Sciences, Royal Holloway, University of London, Staines, TW20 0EX

Most predictions of cliff top retreat to the east of the River Sid outfall at Sidmouth have assumed that the rate is controlled by erosion at the cliff foot. This view was challenged by Ramues Gallois in 2011 in a paper to the Ussher Society. He suggested that larger landslides were initiated by the collapse of head deposits and deeply weathered mudstones towards the top of the cliff, which triggered secondary joint-bounded failures lower down. Observations suggest a further mechanism whereby groundwater issuing from bedding planes in the mudstone/siltstone sequence causes softening and collapse of mudstones, followed by eventual failure of overlying sediments now left overhanging. Collapse occurs either through softening or lubrication of joints parallel to the cliff line. The result is that the cliff is gradually eaten away by a series of small rock falls.

GALLOIS, R. 2011. Natural and artificial influences on coastal erosion at Sidmouth, Devon, UK. *Geoscience in South-West England,* **12**(4), 304–312.

Newly Discovered Antimony Occurrences in SE Devon- Hot Spring Deposits?

Charlie Moon

Rose Cottage, Church Hill, Calstock PL18 9QQ (cjm@moongeology.co.uk) and Camborne School of Mines, College of Engineering, Mathematics and Physical Sciences, University of Exeter, Penryn Campus, Penryn, TR10 9FE

Follow up of the Tellus SW geochemistry anomalies has located significant volumes of oxide antimony mineralization (identified as romeite group minerals). This style has not been previously detected as no sulphides are present at surface and antimony oxides/hyroxides are not easy to detect visually. *In-situ* (pXRF) assays indicate grades from 0.1%–2% Sb which have been confirmed by conventional ICP-MS analysis.

Mapping and sampling by Pearson (2015) showed the deposits are associated with previously mapped faults. Host rocks are very siliceous, isolated, blocks as well as travertines in Devonian limestones, and Permian red beds. The elemental association of Sb-As-Pb-Cs (no Au) and travertine-tufa occurrence suggest a Permian hot-spring origin. The heat source may have been distal volcanic, basinal or granitic.

PEARSON, R. 2015. *Exploration for Antimony in South Devon.* Unpublished MSc Dissertation, Camborne School of Mines, Exeter University.

Ammonite-based correlation of the Lower Toarcian (Lower Jurassic): from the Portuguese GSSP to Somerset, UK

Kevin N. Page

School of Geography, Earth & Environmental Sciences, Plymouth University, Drake Circus, Plymouth, PL4 8AA

The Toarcian is reputed to be a time of great upheaval in the Jurassic World with global warming, black shale deposition, massive methane release and a 'mass extinction' event. All these phenomena have varying degrees of global evidence but, crucially, it is the ammonite correlation that underpins many of the proposed explanatory models. Due to a significant degree of biogeographical provincialism, however, it can appear that regional, let alone, global correlations are not well established for the Lower Toarcian in particular, and ammonite-based correlations have even been 're-written' to suit certain geochemical models. Recent work in Portugal, however, which appears to show a different ammonite sequence to that in northern Europe, including the UK (according to various published works), has revealed that exactly the same zonal terminology is applicable, despite traditional assignment to a different faunal bioprovince (see Page, 2003). In addition, this work has demonstrated that historical work in the UK has overlooked some of these similarities and differences have, therefore, been emphasised. This paper will present a proposal for a standardisation of Lower Toarcian zonations across Europe, including a re-interpretation of the succession of Lower Toarcian ammonite faunas in south-west England.

PAGE, K.N. 2003. The Lower Jurassic of Europe - its subdivision and correlation. *In*: SURLYK, F., DYBKJAER, K., INESON, J., NIELSEN, L.H. and POULSEN, N.E. (eds). The Jurassic of Denmark and adjacent areas. *Special volume of the Geological Survey of Denmark,* **1**, 23–59.

Fossils and Heritage: Conserving a unique resource for future generations

Kevin N. Page[1] and William A. P. Wimbledon[2]

[1] *School of Geography, Earth & Environmental Sciences, Plymouth University, Drake Circus, Plymouth, PL4 8AA*

[2] *School of Earth Sciences, University of Bristol, Queen's Road, Bristol BS81RJ, UK*

Conserving palaeontological heritage is a complex matter, reflecting national laws mixed with considerations which are often more philosophical than objective. In some countries only the source localities are formally protected but in others only the ('moveable') heritage itself is protected. Both extremes create their own problems including significant losses due over exploitation in the first instance and non-recovery for the second extreme. Most national approaches also naturally emphasise the protection of a national heritage which can make international studies difficult or impossible. However, illegal movement for sale often still occurs, sometimes even to supply less scrupulous institutions. Some attempts to reach international agreement on guiding principles for safeguarding geological heritage have been achieved in recent years including the Council of Europe's 'Recommendation (2004)3' the IUCN's 'Motion CGR4. MOT055' (2008), although these only briefly consider moveable heritage. The issue is nevertheless of great concern to many palaeontologists and heritage managers alike and a few attempts to establish scientific guiding principles for the management of palaeontological heritage do exist. The philosophy and principles behind these developments will be discussed. Crucially, adopting more scientifically informed approaches will also help ensure that the role of that rarest of geological commodities – the palaeontologist – remains available internationally to help document and describe a unique, shared heritage that we still know so little about.

PAGE, K. N., HENRIQUES, M. –H., MELÉNDEZ, G., and WIMBLEDON, W. A. 2015, Towards a European agreement on the use and movement of palaeontological heritage for scientific and educational purpose. *In*: Programme and Abstracts, Geoconservation strategies in a changing world VIII International ProGEO Symposium 2015 (8 -12 September 2015), Reykjavík, Iceland.

The occurrence of echinoderms in Blue Lias Formation of Devon and Dorset

Chris Paul

Lyme Regis Philpot Museum, Lyme Regis, Dorset, DT7 3QA

Referring fossil occurrences to zones or stages automatically extends known stratigraphic ranges and produces false patterns of biotic turnover concentrated at zonal or stage boundaries. Recording occurrences bed by bed demonstrates the evidence on which stratigraphic ranges are based and allows confidence intervals on known ranges to be estimated. Furthermore it reveals real patterns of occurrence. The Blue Lias Formation (Lower Jurassic) is ideal for such recording having a detailed lithostratigraphy with established bed terminology. Echinoderms are ideal to illustrate this survey having complex skeletons that disintegrate rapidly after death, thus providing taphonomic and palaeoecological as well as occurrence data.

Historically four species of echinoid and one crinoid have long been known from the Blue Lias. This survey shows that echinoids and crinoids are almost mutually exclusive, probably reflecting increasing water depth through time. Echinoid test and jaw elements only occur in Bed H1, the probabl source of articulated museum specimens. Spines are locally common and randomly orientated up to Bed H75, but rare above. Crinoid columnals and pluri-columnals occur sporadically below Bed 19 (Specketty), but are more consistently present above, where arm ossicles also occur. Rare sub-circular patches of crinoid ossicles represent post-mortem disarticulation without subsequent disturbance.

Micaceous haematite from north-east Dartmoor: 'Devonshire Shining Ore'

Richard C. Scrivener

Demmits Farm, Posbury, Crediton, Devon, EX17 3QE

Micaceous haematite is a soft grey variety of that mineral used in the manufacture of anti-corrosion paints for metal structures. It was formerly worked from a number of east-west trending veins in the north-eastern lobe of the Dartmoor Granite, to the east of the Sticklepath-Lustleigh Fault. This presentation will describe the geology and mineralogy of these veins and discuss their metallogenesis in the wider context of the Dartmoor Granite.

The stratigraphy and structure of the host rocks to the Hemerdon W-Sn deposit - a preliminary view from the periphery

Robin Shail[1], Tom Stock[1], Mark Smethurst[1,2], James McFarlane[3], Laurie Hassall[3], Richard Scrivener[4] and Brian Leveridge[5]

[1] *Camborne School of Mines, College of Engineering, Mathematics and Physical Sciences, University of Exeter, Penryn Campus, Penryn, TR10 9FE*

[2] *Avalonia Geophysics (http://www.avaloniageophysics.co.uk/)*

[3] *Wolf Minerals UK Ltd, Drakelands Mine, Drakelands, Plymouth, PL7 5BS*

[4] *Demmitts Farm, Posbury, Crediton, Devon, EX17 3QE*

[5] *Willand Old Village, Cullompton, Devon, EX15 2SG*

The Hemerdon W-Sn deposit, being worked at Drakelands Mine near Plympton by Wolf Minerals, is a world-class ore body. It is hosted by a steeply inclined NE-SW striking 100+ m wide subvertical granite dyke in which mineralisation is primarily associated with moderately- to steeply NW dipping greisen-bordered quartz-wolframite ± cassiterite sheeted veins. The lithostratigraphical units hosting the Hemerdon Dyke are poorly defined and there has been no systematic geological survey of the Ivybridge Sheet since that of Ussher in the late 1890s. Mapping and sampling of new exposures created during site preparation in summer 2015 has been compared with drill core data and a revised lithostratigraphy for the mine site developed. The wider near mine-site geology has been re-evaluated using Tellus South West radiometric, LiDAR and magnetic data and compared with the recently resurveyed Plymouth Sheet to the west. These data suggest that the host rocks were deposited close to the Landulph High, the boundary between the South Devon and Tavy basins. The Early Permian post-Variscan geological evolution of the immediate mine site area has been influenced by both NW dipping extensional faults and NW-SE strike-slip faults that may have influenced both granite emplacement and fracture-controlled mineralisation.

William Smith from Fullers Earth to Google

Peter Wigley

Lynx Information Systems Ltd, 93-99 Upper Richmond Road, London, SW15 2TG, United Kingdom
pwigley@atlas.co.uk

William Smith's maps have been studied in detail by many researchers interested in Smith's place in the history of geology but few have looked at the maps in the context of modern geological information. The author has been interested in Smith's maps for the past decade and during that time has digitised a number of his maps and incorporated them into a Geographic Information System (GIS).

A major problem in transforming Smith's maps into a GIS is that there is no indication of the projection used on his maps. There are marginal graticules showing latitude and longitude, but no internal lines and although the coastline is recognisable, it does contain positional errors. However, Smith was fortunate to have the talented John Cary as his map maker. Cary's local surveying of town and village positions was excellent and he used much of this information on the elegant base map he produced for Smith's 1815 map.

In order to discover the projection used, a series of iterative tests were undertaken on the map graticules using projections in common use during the early 19th century. Overall the best fit was the Cassini projection. Using this projection, the Smith maps were georeferenced to real world co-ordinates based on the positions of Cary's towns and villages.

The base map prepared by Cary for the 1815 map essentially predates the 1st Principal Triangulation. However, some of the Smith-Cary county maps were concurrent with early phases of the triangulation and in several cases include information derived from the triangulation.

Once in real world coordinates, Smith's maps can be compared with modern geological mapping. This comparison shows that for much of the Cenozoic and Mesozoic of England Smith's mapping was remarkably good. Modern technology makes it possible to drape Smith's maps on a digital terrain model and view them in 3D. These visualisations dramatically illustrate Smith's complete understanding of the principles of stratigraphy.

Smith's wonderful panoramic cross-sections have been located on his maps as have fossils from his Strata Identified publication. These studies have been incorporated into a new website, William Smith's Maps-Interactive. This is a free educational resource which can be found at http://www.strata-smith.com

Portland, Purbeck and Wealden beds: but where is the Jurassic/Cretaceous boundary?

William A.P Wimbledon[1], G. Li[2], P. Pruner[3] and P. Schnabl[3]

[1] *School of Earth Sciences, University of Bristol, Queen's Road, Bristol BS81RJ, UK*

[2] *Nanjing Institute of Geology and Palaeontology Chinese Academy of Sciences, 39 East Beijing Road, Nanjing 210008, China*

[3] *Institute of Geology of the CAS, v. v. i., Rozvojová 269, 165 00 Prague, Czech Republic*

In the mid-nineteenth century, the Purbeck Limestone Formation was put into the Jurassic following the lead of Edward Forbes, who regarded its rare echinoids and marine molluscs as typically Jurassic. Brongniart had already included the 'Purbeckien' as the top stage of the Jurassic: though d'Orbigny (for no obvious reason) later relegated it to the Cretaceous, and concluded the Jurassic with the Portlandian (= upper Tithonian). Then there was no radiometric dating, no geochemistry, no palynology, and only macrofossils were widely used to suggest relative ages. Forbes had also noted minute non-marine ostracods (and gastropods) as useful biostratigraphic tools; and these were later used to correlate around the globe. Some species are reliable Purbeck stratigraphic markers, but others are facies/salinity controlled: lower faunas disappearing and then reappearing when the facies changes. Up to the 1990s statements about stages and placing a J/K boundary could be as imaginative as writings about early Purbeck 'tropical forests' of 'cycads and 'monkey puzzle trees'. There was only an approximate idea of where the Purbeck beds lay relative to a global timescale and standard stages - Tithonian, Berriasian, Valanginian, etc. In the last few years, our ability to correlate non-marine strata with marine sequences has greatly improved, largely due to the wide application of magnetostratigraphy.

Re-mapping the composite granite batholith of South West England using Tellus radiometric data

Chris M. Yeomans[1,2], Robin K. Shail[1], Paul A.J. Lusty[2], Stephen Grebby[3], Mark A. Smethurst[4] and David Beamish[2]

[1] *Camborne School of Mines, College of Engineering, Mathematics and Physical Sciences, University of Exeter, Penryn Campus, Penryn, TR10 9FE*

[2] *British Geological Survey, Environmental Science Centre, Keyworth, NG12 5GG*

[3] *The University of Nottingham, Nottingham Geospatial Institute, Innovation Park, Nottingham, NG7 2TU*

[4] *Avalonia Geophysics (http://www.avaloniageophysics.co.uk/)*

The granites of the South West England Batholith have been previously categorised using a range of textural, mineralogical and geochemical criteria. These classifications have been based on point samples and field observations and have defined a series of granite facies across the composite batholith.

In contrast, high resolution airborne radiometric data from the Tellus South West survey provides continuous sampling across the entire surface crop of the granites. Variable concentrations of the radioelements potassium, thorium and uranium provide a new opportunity to delineate granite facies. Whilst high concentrations of uranium are known, the principal mineralogical host is uraninite, which is largely weathered out at surface. Furthermore, uranium is mobile at surface and concentrations should be interpreted with care. Therefore, potassium and thorium are the most robust radioelements for classification purposes.

We incorporate ratios and relative abundances of the radiometric data into an objective image classification. Some areas of peat caused spurious pixels which were removed prior to classification. The 'unsupervised' classification algorithm enables a classification scheme which defines classes based on clustering within the dataset. This is the first attempt at granite classification in South West England using continuous batholith-wide data and delineates previously unknown geochemical variations within the granites.