
**ABSTRACTS OF OTHER PAPERS/POSTERS PRESENTED AT THE
ANNUAL CONFERENCE, JANUARY 2012**



**SARSENS FROM DEVON AND WEST SOMERSET:
TOWARDS AN UNDERSTANDING OF THEIR ORIGIN
AND IMPLICATIONS FOR LANDSCAPE EVOLUTION**

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Indurated silcretes, commonly known as sarsens, have surprising geological and archaeological significance. Their distribution in the British Isles is generally associated with the crop of the Chalk but extends to the west into Somerset and Devon. This paper reports sarsens from the Axe and Creedy river valley terraces, with studies of their petrography and geomorphological setting. The geomorphological contexts of these finds strongly suggest movement of the blocks from an original position by solifluction-related debris flow processes, under conditions of de-periglaciation. Petrography reveals subangular quartz grains in a matrix of cryptocrystalline silica. Along with other studies and hydrogeological considerations a hypothesis is proposed for early Palaeogene cementation from Si charged groundwater closely related to the residual weathering of the former more widespread extent of the Chalk.

**VOLCANICLASTIC RED BEDS FROM THE CORBYN'S
HEAD MEMBER, TORQUAY, SOUTH DEVON**

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The Corbyn's Head Member of the Torbay Breccia Formation (Permian) includes some 15 m thickness of sandstone passing upwards into clast-supported conglomerate. It includes thin (<0.5 m) beds of sandstone with ash, granules of igneous debris and, in places, abundant subhedral biotite flakes. This presentation will describe the sedimentology and petrography of these rocks, together with the results of preliminary probe analyses of the included biotite. The origin of the igneous debris in the CHM will be discussed, and its significance in terms of the chronology of the red beds will be assessed.

**GEOLOGISTS IN SOUTH-WEST ENGLAND –
WHAT HAVE THEY BEEN UP TO?**

Norman Butcher

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Attending the 1st (1956) and 2nd (1958) Conferences of Geologists and Geomorphologists in the South-West of England, both held in Exeter, and out of which The Ussher Society grew, as well as many annual meetings of the Society since, an attempt will be made to review the contribution of many geologists to understanding this tricky part of Britain.

**I HAVE SEEN THE FUTURE - AND IT MIGHT WORK -
HEMERDON AND METAL MINING IN THE UK**

John Cowley

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There is a current fascination with how Europe will ensure access to a range of critical minerals. The question is how we are going to solve this access problem. The underlying concept is to: (i) improve, by negotiation, access to resources in other countries, (ii) reducing demand, by design changes and recycling, and (iii) access our own resources. There is no doubt that the first two pillars can make a contribution. However, the issue is that they may be too little, too complex and too late. Accessing our own resources may be the solution. The problem is that we have not, as a UK society, really accepted the concept of a metal mining industry within our borders and our future. But is that the correct view of the future? If metal mining can be consistent with other objectives then, in the interests of our whole economy, should we not grasp the potential? Might the future work? Hemerdon could be the key to that acceptance, and the presentation will deal with that concept and give an update on the project.

**THE OCCURRENCE OF PIGOTITE
IN CORNWALL RE-EXAMINED**

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Pigotite speleothems are being increasingly recognised in granite and quartzite terrains in various parts of the world such as NW Spain, Australia, and South America. Since pigotite (an

alumina organic compound) was first reported from granite caves of Cornwall in 1840 by J.F.W Johnston, its occurrence in Cornwall is re-examined. The Reverend M. Pigot who guided Johnston in the field and after whom the mineral was named, was almost certainly in fact the Reverend George Pigott. The key exposures lie in deep narrow caves/zawns (geos) eroded into megacrystic granite on either side of Porthcurno on the south coast of the Land's End Peninsula. These caves/zawns contain a complex record of raised beaches, not previously recognised. The speleothems comprise draperies and flowstones with microgours, remarkable for their fine detail. A probable new occurrence has been identified at Porthmeor on the north coast of the peninsula as well as an inland occurrence at Condurrow mine in the granite south of Redruth. The growing recognition of pigotite and carbonate speleothems places Cornwall firmly on the map as a significant area for non-karstic cave deposits.

UNUSUAL FAILURE IN WAVE CUT PLATFORMS, MONMOUTH BEACH, LYME REGIS

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Typical failures along the exposed edges of wave cut platforms have been observed and recorded on Monmouth Beach, west of Lyme Regis since 2003, most notably in Bed 29 (Lang), the Ammonite Pavement. The mechanism is simple to explain in that thinning of the hard limestone, particularly along the jointing, has weakened the beds to the point where the sea can displace them. A much more untypical failure was first seen in Bed 19 (Lang), the Specketty, in 2007 and observed failing in the summer months of 2010 and 2011. Both involved upward displacement of the hard limestone during calm weather. This is a very rare event. It is controlled by lateral variation in the geology of the bed and is therefore complex. A second, strange failure is described from Bed 31, the Third Quick, also in the summer of 2011. Further ledge edge failures in other beds were observed in October 2011 but they do not appear to be related to any significant storm event, although a swell wave, recorded on the Plymouth Coastal Observatory wave rider buoy off West Bay, may have been the culprit. That said; these ledges have been exposed too much worse weather in previous winters and it is suggested that whatever is causing the observable uplift in Bed 19 or 31 may also be at work on these ledges but to a lesser degree. A novel photographic survey technique has been applied to record the major failure event. Suggested mechanisms for failure are discussed and recommendations for further work are suggested.

COASTAL EROSION AT SIDMOUTH, DEVON: IF YOU'RE IN A HOLE, STOP DIGGING

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Like many small coastal towns, Sidmouth was founded on the valley sides adjacent to a river outfall that provided a natural harbour. Subsequent expansion of the town in the late 18th and early 19th Centuries, when living by or visiting the sea became popular for health reasons, involved the entrainment of the river and building on land that was subject to marine

flooding. Engineering works in the 19th and 20th Centuries designed to protect the low-lying parts of the town included the construction of sea walls, and groynes and offshore bunds to protect a ridge of storm-beach gravels that acts as a natural sea defence. Other works designed to enhance the leisure facilities, for example piers for pleasure-boats and improved beach access, reduced the effectiveness of the sea defences. A succession of breaches in the 20th Century was followed by increasingly elaborate remedial works. Few of these took account of the geology or the processes that influence the evolution of this part of the coast. One result of this is a proposal to extend the sea defences eastwards into the World Heritage Site that is based on poorly researched rates of erosion.

HOW UNCONVENTIONAL IS THE NORTH TORRIDGE COAST?

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Recently to promote Britain's onshore basins, in particular with regards their potential to hold unconventional hydrocarbons DECC (2010) produced the following report: *"The Unconventional Hydrocarbon Resources of Britain's Onshore Basins – Shale Gas"*.

Within this report along with the Americans EIA's assessment in 2011, no mention was given to any significant unconventional potential being present in the South West and especially not on the North Torridge Coast (Fig. 1).

This talk thus presents, with the aid of data from two previous Ussher Society meeting talks (Cornford *et al.* 1987 and Burley & Cornford 1998):

- 1) An introduction into unconventional resources while also defining their success criteria.
- 2) Attempts to draw comparisons between these defined criteria and the geology and geochemical data available for the North Torridge Coast to better understand the areas unconventional prospectivity.



Figure 1. DECC (2010) distribution map for potential unconventional formations.

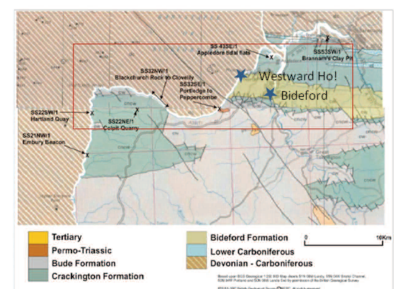


Figure 2. Geological map of the North Torridge Coast: http://www.northdevon-aonb.org.uk/geology_reports/south/summy_rigs.pdf.

MICROFOSSILS ASSOCIATED WITH THE DORSET PLIOSAUR

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The discovery of a skull and part-skeleton of a new species of pliosaur in Dorset has provided the opportunity to see if the microfossils in the enclosing clays are normal or different from comparable samples collected away from the vertebrate remains. To date the assemblage of foraminifera, ostracoda, holothurians sclerites, etc., appears to be as expected with the assemblage of foraminifera dominated by nodosariids and epistominids. Recent research on samples collected near whale-fall occurrences (most notably on the California coast) indicates that an opportunist assemblage of foraminifera can be present but this has not been recorded in our material. This is probably the result of sediment burial by 'normal' Jurassic clays following the initial stripping of the carcass.

SUMMARIES OF EVIDENCE FOR CHANGING PLEISTOCENE SEA-LEVELS AND ENVIRONMENTS IN SW ENGLAND AND THE CHANNEL ISLANDS

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Early work on Pleistocene sea-level change concentrated initially upon locating and mapping both the Quaternary marine sediments and their underlying shore (wave-cut) platforms. Attempts were made to try and relate such features to past sea-levels relative to current High Water Mark (HWM) or Mean Sea Level (MSL) as well as their morphological and sedimentological position within the surviving seaward extent of the underlying shore platform. Careful examination and analysis of the range of sediments overlying the raised beach material enabled subsequent challenging discussion as to the relative age of these raised beaches, namely that they antedated the Last Cold Stage of the Late Quaternary at the very least but could be much older. The development of geochronological dating techniques gradually enabled more specific relative and absolute dates to become available with contrasts being made over much wider areas. Increasing sophistication of measurements of former sea levels extending to high level platforms has led to current work associated with their uplift history.

PROMOTING GEOSCIENCE IN SOUTH-WEST ENGLAND - 50 YEARS OF THE USSHER SOCIETY

John Mather

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In January 1956 a group of geologists and geomorphologists working in South-West England met at the University of Exeter. The ensuing conference was a success and subsequent gatherings were held in 1958, 1960 and 1961. The conferences were held with a minimum of formality and from 1958 abstracts of the papers presented were published by the Royal Geological Society of Cornwall (RGSC). By the time of the 5th conference in 1962 it was recognised that a more formal arrangement would be needed if the by now annual conferences were to continue. The RGSC, the Geologists' Association and the Geological Society of London all rejected approaches to become an umbrella organisation for the conferences or to commit to publishing the abstracts. At a business meeting held on Thursday 11th January, 1962 it was decided to form a new society to provide an assured income for future conferences and a mechanism for the election of officers; thus the *5th Conference of Geologists and Geomorphologists working in the South-West of England* became the 1st conference of the new society. The name Ussher Society was adopted to commemorate the work of W.A.E. Ussher (1849-1920), an officer of the Geological Survey, who was considered to have made the most significant single contribution to understanding the stratigraphical succession in the Devonian and Carboniferous of South-West England. Annual conferences have been held ever since and although we are celebrating the 50th anniversary of the foundation of the Society, this Exmouth meeting is in fact the 51st such event. This paper traces the further growth and development of the Society and highlights the contributions of some of the key personnel involved.

GEOLOGICAL INVESTIGATIONS IN GLASTONBURY

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Geological investigations in support of the revised mapping for sheet 296 Glastonbury. This poster illustrates a 3D model of the area and presents the results of a drilling programme focussed on characterising the Quaternary sequence. Core material from the drilling shows a variable sequence of Holocene silt and clay with occasional peat, Pleistocene sands and gravels overlying the Mercia Mudstone Group. Of particular interest are the Burtle Beds – a shelly, sandy marine beach deposit with calcite concretions, presumably dating to the Ipswichian transgression. A till was found at one location, providing evidence of glaciation in the area.

NEW PALAEOMAGNETIC RESULTS FROM THE LIZARD OPHIOLITE, CORNWALL, UK

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The Lizard complex of Cornwall represents a fragment of oceanic lithosphere that has been thrust (obducted) northwards on to continental crust of SW England in the Devonian during the Variscan orogeny. Palaeomagnetic results from 11 sites at three localities from dykes and gabbros along the east coast of the Lizard ophiolite are presented, along with anisotropy of magnetic susceptibility (AMS) data. All the rock samples from the dykes showed intermediate to high bulk susceptibility within a range 4.9×10^{-4} to $7.9 \text{ SI} \times 10^{-3} \text{ SI}$. Various fabric relationships were found in dyke samples ranging from good to poor agreement with the measured dyke orientations, suggesting that the controls of AMS may vary between dykes. Host gabbros showed random fabrics, reflecting lack of preferred orientation of crystals in these rocks. Both dykes and gabbros showed a mixture of oblate and prolate magnetic fabric shapes.

Palaeomagnetic analysis of demagnetization data showed two magnetization components. Most gabbro sites showed high unblocking temperature components with shallow to intermediate positive inclinations and ESE declinations. These are considered to be the original magnetization acquired during formation of the complex by sea floor spreading at a mid-oceanic ridge. In contrast, the majority of samples from dyke sites are dominated by SSW-directed components with shallow negative inclinations, isolated at intermediate to high unblocking temperatures. The mean magnetization of these sites is $D=191.3^\circ$, $I=-18.8^\circ$ ($k=113.4$, $\omega_s=8.1^\circ$, $N=6$). This direction is identical to the Permian geomagnetic field direction in SW England, suggesting that the dykes were largely remagnetized in the Permian, most likely due to fluid flow associated with intrusion of the Cornubian batholith.

NEW STUDIES ON THE TAXONOMY, STRATIGRAPHY AND BIOGEOGRAPHY OF BRACHIOPOD FAUNAS FROM THE MARINE LOWER DEVONIAN OF SOUTH WEST ENGLAND: PRELIMINARY RESULTS

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Although the marine faunas of the Devonian System in SW England are famous for their historical contribution to the initial characterisation of the Devonian System, there has been remarkably little recent study and their significance remains obscured. In particular, many open questions remain concerning the age of the earliest marine shelly faunas in the region and their true taxonomical and biogeographical significance. Initial studies by MSG and KNP have focussed on new material collected from the Torquay area, which has been studied in conjunction with material in public and private collections. These faunas have been compared with coeval assemblages from the Rheinisches Schiefergebirge (RSG), northern Gondwana terranes, and from the Eastern Americas Realm. Initial results indicate that faunas from S. Devon range

from late Pragian to Emsian and show close affinities to those from the RSG and some taxa represent the ancestors of forms from the Eastern Americas Realm - confirming that there was faunal exchange in the latest Emsian. Study of early Devonian brachiopods from N Devon, has also been commenced, including an assessment of their biogeographical and taxonomic affinities in relation to those from S. Devon - potentially helping to resolve a number of outstanding questions concerning the Variscan evolution of SW England, including the claimed presence of displaced terranes.

THE MINERALOGICAL AND GEOCHEMICAL LEGACY OF HISTORICAL MINING IN SW ENGLAND

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Devon and Cornwall are very attractive counties in the UK, with apparently unspoilt coastal and inland landscapes, with commonly only the presence of the iconic images of abandoned engine houses to remind visitors and residents alike of an industrial past. However, the legacy of, in particular, hard rock mining, is such that large areas of both land and coastal sediments can be demonstrated to be heavily contaminated if we measure the abundance of elements such as arsenic, lead, copper, zinc, cadmium, etc. During the peak of hard rock mining and mineral processing in the mid to late 1800s waste streams were released directly into the environment, with for example, the release of mine tailings into river courses. Mine drainage would also have had a significant effect on water quality. Whilst the release of contaminated water with metals in solution would have been a transient environmental impact, the release of particulate waste has a much longer residence time, and resulted in sedimentation along floodplains and in our typically narrow ria estuaries. Although today the estuaries in SW England have varying levels of environmental designations, including areas of outstanding natural beauty (AONB), special areas for conservation (SACs) and SSSIs (Sites of Special Scientific Interest), they should really be viewed as unlined, unmanaged tailings ponds!

In this talk the impact of mining and mineral processing on the environment in SW England will be reviewed. In particular, we will examine the evidence for the impact of mining on the estuaries in Cornwall, and consider whether or not the estuarine sediments are potential diffuse sources for ongoing contamination. In addition we will consider how mineral processing, through the use of arsenic calciners has resulted in localized point sources with extremely high levels of contamination. Ignorance of the risks to the environment posed by both these diffuse and point sources will be considered, through two case studies; (1) an example of what can happen if contaminated sediments are physically disturbed and (2) two recent cases in which animal morbidity can be directly linked to arsenic exposure around calciner buildings.

ACKNOWLEDGEMENTS

In the preparation of this review I am drawing on the work of many colleagues who have worked with me on (or in!) the estuaries of Cornwall. I would particularly like to acknowledge the contributions made by Matthew Power, Gavyn Rollinson, Simon Camm, Robin Shail, Andy Cundy, Sue Hughes, Varyl Thorndycraft, Bethany Simons, Heidi Buck, David Watkins and Paul Wheeler.

**ASPECTS OF COASTAL CLIFF AND SLOPE
MODIFICATION IN THE CHANNEL ISLANDS DURING
THE PAST HALF MILLION YEARS**

John Renouf

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Composite coastal slopes and cliffs define the form and outline of the Channel Islands; they separate the high island plateaux from the expanse of low lying land and shallow sea bottom that lie between the islands. Putting aside the question of the remoter origins of this geomorphology, the focus here is on the past 500 k years. A land rise of some 40 m minimum over this period has caused the sequence of past high interglacial sea-levels to be found at successively lower levels of the coastal slopes and finally at heights that overlapped with the low lying platform. The complex interplay between rising land and sea-levels at varying heights has brought about the formation of a number of different erosional and depositional features. These are expressed in a variety of ways and a number of them, such as flats cut into hillsides, cave formation and the erosion caused by the Holocene sea-level rise, can be linked to consequences for archaeology and often have implications for present coastal behaviours.

**PALAEO-DRAINAGE OF LYNTON AND
VALLEY OF ROCKS, DEVON**

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Lynton and the Valley of Rocks is a dry valley running east-west parallel to the coast of north Devon. Since the early 20th Century the origin of the Valley of Rocks and the 'hanging valley' at Lynton have been debated. The established view is that the valley owes its existence to a former westwards extension of the East Lyn River, which today meets the sea at Lynmouth (Simpson, 1953). In 1983 a resistivity survey was undertaken by Dalzell and Durrance which supported the idea of an extension of the East Lyn River, with the additional concept that the Lee Stream was an eastward flowing tributary of the East Lyn River. By using Clast Lithological Analysis (CLA) on borehole samples obtained from Lynton and performing the first Ground Penetrating Radar survey of the area, Rolfe *et al.* propose the palaeo-drainage of Lynton and the Valley of Rocks was in fact an extension of the West Lyn River and not that of the East Lyn River as previously thought.

A combination of fault-controlled river diversion and ice damming are proposed for the capture of the West Lyn River by the East Lyn River. The long-established view is that any glaciation this far south must belong to the Anglian/Elsterian Stage (MIS12) (c. 480-420 ka). The first Optically Stimulated Luminescence (OSL) dates ever obtained for the Lynton and Valley of Rocks area suggest capture and infilling during the Devensian/Weichselian (MIS3) (c.58 ka). Recent work by Rolfe *et al.* (2012) suggests that ice was in the Bristol Channel and covering Lundy during the Devensian/Weichselian. The results provide crucial new evidence in the interpretation and understanding of the Pleistocene history of southwest Britain.

REFERENCES

- Dalzell, D. and Durrance, E.M. 1980. The Evolution of the Valley of Rocks, North Devon. *Transactions of the Institute of British Geographers*, **5**, 66-79.
- Rolfe, C.J., Hughes, P.D., Fenton, C.R., Schnabel, C., Xu, S., and Brown, A.G. 2012. Paired ¹⁰Be and ²⁶Al exposure ages from Lundy: new evidence for the extent and timing of Devensian glaciation in the southern British Isles. *Quaternary Science Reviews*, **43**, 61-73.
- Simpson, S. 1953. The development of the Lyn drainage system and its relation to the origin of the coast between Combe Martin and Porlock. *Proceedings of the Geologists' Association*, **64**, 14-23.

**SOME OBSERVATIONS ON TUNGSTEN
MINERALISATION IN SW ENGLAND**

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This presentation will review the geology, setting and chronology of the larger tungsten deposits in the province. Differences and similarities will be highlighted, and attention drawn to the association of some tungsten deposits with N-S trending lineaments. The development of such lineaments at an early stage in the post-orogenic history of the province will be discussed. The extent to which the various factors might provide guidance for future exploration will be explored and suggestions made for the improvement and wider availability of geophysical and geochemical data to that end.

GRANITES AND MINERALISATION IN SW ENGLAND

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The Cornubian Batholith and orefield is amongst the most intensively investigated in the world and many of the developments of the last 50 years have first been reported at Ussher Society meetings or in its journals. The principal drivers for research activity during this period have been the mining of metals, industrial minerals and aggregates, the evaluation of 'Hot Dry Rock' geothermal energy, re-surveys and mineral reconnaissance studies by the British Geological Survey and PhD investigations in many UK and overseas universities. The dimensions of the Cornubian Batholith are reasonably constrained, but is probably thinner in most locations than most gravity surveys suggest - perhaps 6-8 km. Its location in the lower plate of the Rheohercynian / Rhoic suture, and relations with host rock structures, indicate that lithospheric thickening *and* thinning controlled the thermal evolution of the lithosphere and generation of extraordinary melt volumes. Whilst predominantly crustally-sourced there is a minor direct contribution from mantle-derived melts and there was an enormous heat input into the lower crust. The granites are located above their source zones. Emplacement of the batholith occurred over a 20 Ma period in the Early Permian, by a combination of roof lifting and, probably, floor depression, and has resulted in a markedly composite body in comprising sheet-like bodies at a variety of scales. NW-SE faults controlled magma transport from the lower crustal source regions. Earlier granites (Scilly, Carnmenellis, Bodmin Moor) are mineralogically, texturally and geochemically distinctive and display localized solid-state fabrics. Alkali feldspars are overwhelmingly magmatic rather than metasomatic and some may have a very complex crystallisation history. More generally, magmatic state fabrics are complex but frequently indicate NNW-SSE stretch of the magma during emplacement.

Some enclaves represent host rock, others hybridised melts formed by magma mixing and there is some restite. Biotite and tourmaline granites are cogenetic but the topaz granites may represent separate source / melting events. Rhyolite / microgranite ('elvan') dykes correspond to the range of pluton compositions and at least locally had an eruptive expression.

W-Sn-Cu-As mineralisation associated with the granites primarily reflects the structurally-controlled flow of magmatic-hydrothermal fluids from crystallising magmas and variable mixing with meteoric and, to a lesser extent metamorphic and basinal fluids. Fracture systems hosting mineralisation are controlled by Early- and Mid-Permian regional tectonic deformation of crystallising magmas and their host rocks; changes in stress regime result in variable vein / lode orientations across the province. Reactivation of fracture systems is commonplace, both during the availability of magmatic-hydrothermal fluids and subsequently. 'Cross-course' mineralisation is controlled by the fault-controlled Triassic migration of basinal fluids from Permo-Triassic successions into the sub/adjacent basement. Subsequent regional inversion episodes in the Late Jurassic / Early Cretaceous resulted in migration of hydrocarbons into plutons in west Cornwall and are associated with kaolinite/pyrite assemblages in reactivated veins. Palaeogene uplift also caused some reactivation and secondary U-Co-Ni-Ag mineralisation. Mineralisation is related to magmatic/tectonic episodes rather than long-lived granite-induced convective hydrothermal circulation.

50 YEARS OF TECTONICS AND STRUCTURAL GEOLOGY IN SW ENGLAND

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² *British Geological Survey (HRA)*

In the early Ussher Society years, structural investigations primarily addressed the occurrence, nature and relative chronology of small-scale geological structures in Devonian and Carboniferous rocks that were generally considered to reflect deformation associated with the Variscan orogen. The description of 'tergiversate' folds in the Proceedings was one of the earliest analyses, worldwide, of sheath fold geometries. Seismic reflection profiling in the late 1970s and early 1980s revealed the widespread occurrence across the province of thrust faults in the upper and middle crust and a late Palaeozoic suture to the south. These were accompanied by influential field-based studies in the early 1980s that re-emphasised the role of thrust tectonics promulgated 50 years earlier by Eileen Hendriks. A 40-year programme of remapping by the British Geological Survey has resulted in major advances of understanding of stratigraphy and structure and their mutual dependency. The Upper Palaeozoic tectonic evolution is consistent with the development of a Devonian-Early Carboniferous passive margin that was subsequently strongly inverted during Variscan convergence. A series of six major sedimentary basins have been defined and many of the earlier structural complexities such as 'facing confrontations' can be explained by inversion geometries across variably orientated rift-related basement fault zones.

The stratigraphical and structural/tectonic similarities between SW England successions and those in Germany (in particular) have been repeatedly noted at Society meetings and SW England is an integral part of the European Rhenohercynian Zone, albeit with further complexity introduced by the Bristol Channel Bray Fault Zone. Plate tectonic models of the 1970s and 1980s have invariably involved the Lizard ophiolite, which has an international significance, but whose affinity is unclear. It probably formed, during the Early Devonian, in a marginal

basin to the north of the closing Rheic Ocean. Some of the structures in basement rocks post-date deformation associated with Variscan convergence. A late Carboniferous-Early Permian extensional regime is indicated by a variety of folds, cleavages and faults whose kinematics are typically associated with a top-sense-of-shear to the south. At the largest scale, this is manifested by folding and steepening of earlier D2 thrust-related fabrics to give the km-wide Start-Perranporth Zone. Early Permian magmatism, mineralization and sedimentary basin development were all controlled by post-Variscan extension that gave way to Mid-Permian strike-slip tectonic regimes. Post-Variscan tectonic evolution has been strongly influenced by the repeated but variable reactivation of Variscan thrust and NW-SE transfer faults. The latter are optimally orientated for strike-slip reactivation in the contemporary stress regime and are associated with infrequent $\leq M4$ earthquakes.

FROM SIDMOUTH TO THE SURVEY: THE EARLY LIFE OF HENRY DE LA BECHE

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The British Geological Survey grew out of the mapping carried out by Henry Thomas De la Beche (1796-1855) in Devon in the early 1830s. Although born in London, De la Beche spent a somewhat peripatetic childhood in the West Country, finally settling in Lyme Regis when he was sixteen. It has long been thought that it was there, through his friendship with the fossilist Mary Anning (1799-1847), that he developed his interest in geology. The discovery of a new journal, written by De la Beche on his 50th birthday, sheds much new light on his eventful early life (including surviving a shipwreck in the Bahamas) and on the origins of his geological interests.

UPPER PALAEOZOIC SEDIMENTATION IN SW ENGLAND

Maurice Tucker

Universities of Durham and Bristol

Upper Palaeozoic sedimentary rocks in the Southwest are beautifully exposed along many parts of the coast and they themselves reveal many interesting stories. The Devonian was a time of tropical seas with reefs full of marine life and terrigenous sediments advancing and retreating from the north. Deeper water basins received pelagic limestones and turbidites, as well as much mud. Carboniferous sedimentation generally continued the deeper water clastic theme with classic turbidites, but also cherts, with the basin closing in the later Carboniferous and then becoming more non-marine. After late Carboniferous-early Permian exposure, erosion and karstification of Devonian limestones, desert conditions were established with aeolian, wadi and fluvial facies, and palaeosoils. This talk will illustrate the diverse nature of the Upper Palaeozoic strata and their depositional environments.

NOTE

The Scott Simpson Lecture on "*Resolving Long-Standing Tectonic Enigmas in the Wessex Basin - New insights from the integration of Field Observations with the Subsurface Database*" was presented by John Underhill, *Grant Institute of Earth Science, School of Geosciences, The University of Edinburgh*.