

**ABSTRACTS OF OTHER PAPERS/POSTERS PRESENTED AT THE  
ANNUAL CONFERENCE, JANUARY 2013**



**THE SCOTT SIMPSON LECTURE**

**ICE AND TIDES: THE EVOLUTION OF THE  
CELTIC SHELF AND CELTIC SEA FROM THE  
LAST GLACIAL MAXIMUM TO THE PRESENT**

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During the Last Glacial Maximum (LGM; 24 ka BP) the Irish Sea Ice Stream (ISIS) of the British-Irish Ice Sheet advanced as far as the Isles of Scilly and terminated in a glacial margin in the central Celtic Sea. Deep-sea sediment cores from the continental slope register the imprint of this event as a pulse of lithologically-distinctive ice-rafted detritus (IRD). Independent dating of this IRD pulse corroborates geochronological evidence from onshore sequences for the timing of this advance. Recent Bayesian analysis of the geochronological data from the Irish Sea indicates very rapid retreat (collapse) of the ISIS northwards during Greenland Interstadial 2 (23 ka BP). Retreat was a function of rising sea-level and rapid warming, and may have been accentuated by megatidal amplitudes as suggested by palaeotidal (PTM) simulations. The moribund linear tidal sand ridges of the Celtic Sea formed as paraglacial subtidal bedforms at the glacial margin as a function of high bed shear stress during lower sea level. Glacial isostatic adjustment (GIA) simulations constrained by sea-level observations provide the evolving palaeotopography that controlled the postglacial tide and tide-dependent changes simulated by observation-constrained PTM; these include amplitude, dissipation, bed stress (hence sediment transport) and seasonal stratification (hence primary productivity).

**UNDERSTANDING THE CONTROLS ON  
IRON CONCENTRATIONS OBSERVED IN  
GROUNDWATER ABSTRACTED FOR  
PUBLIC SUPPLY IN EAST DEVON**

Marcus Adams

*South West Water*

Groundwater from the Otter Sandstone and Budleigh Salterton Pebble Beds Formations (Triassic) in the Otter Valley makes a significant contribution to the water supply of East Devon. Although raw water quality is generally excellent some boreholes abstract water with levels of dissolved and total iron which are problematic. Concentrations of iron  $>50 \mu\text{g l}^{-1}$ , albeit well within the public supply limit of  $200 \mu\text{g l}^{-1}$ , can over time

lead to significant levels of deposition/encrustation affecting boreholes, pumps, treatment facilities and pipe networks. Careful management is required to prevent potential problems at customers' taps. Preference is always given to addressing quality problems at source rather than through treatment options and this presentation describes how the drilling of a new borehole, adding to an existing wellfield at Ottery St Mary, was undertaken specifically to meet water quality objectives. Data gathered from studying the performance of this new source provided a valuable insight into how groundwater chemistry evolves at this location and builds on the existing conceptual model of rock-water interaction processes originally put forward in the 1980s. Subsequently this new understanding has been used to guide the remediation of an existing Ottery borehole that now abstracts water with a much lower iron content.

**ENGINEERING GEOLOGY  
OF THE SOLENT GROUP**

Alan Cattell

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The Eocene to Oligocene age Solent Group outcrops on the Isle of Wight and in the New Forest. It consists predominantly of clays deposited in fresh and brackish water, and colour-mottling at some levels indicates sub-aerial exposure. The Group has been intensely studied and described because of the abundant fossil remains, but there is virtually no published information on its engineering properties. The unit is geoethnically important as it underlies the northern coast of the Isle Wight, where there are infrastructure connections to the mainland and extensive areas of ancient landslip. Data from investigations at some 30 sites have been compiled and correlated with the stratigraphy, making use of recent cored boreholes. The plasticity is highly variable and correlates with smectite abundance, controlled at least in part by syn-depositional weathering, and some smectite-rich clays are extremely plastic, particularly in the upper parts of the Group. Peak and residual drained strengths are consequently low but variable, with implications for slope stability assessment. The undrained strength of the clays is low compared with other UK Palaeogene non-marine clays, such as those of the Reading Formation and particularly the Bovey Formation.

## **INTERTIDAL SHORE PLATFORMS OF THE SOUTH COAST OF WEST CORNWALL**

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The spatial distribution of the intertidal shore platforms, often rocky, of Cornwall are well documented and extend up to 500 m offshore. However there have been few detailed geomorphological/geological studies of individual platforms or processes active in the intertidal zone. This contribution focuses on intertidal platforms of the south coast of West Cornwall. Despite their common occurrence in the intertidal zone, their surface texture (washboard-like relief, corrosion surfaces, potholing) is diverse reflecting the heterogeneous geology of the area. The majority of current platforms are backed by palaeo-cliffs often with fossil caves and emerged platforms overlain by raised beaches. These modern platforms have been formed by either lowering or even landward incision of the emerged platforms during the post-glacial rise in sea-level. The sedimentology of raised beaches and their contemporary seaward intertidal deposits can be directly compared, leading to a better understanding of the depositional setting of the former. Other platforms were formed during older sea-levels in the infratidal to intertidal zones, subsequently covered by prograding head terraces, and are now being exhumed by coastal erosion. In areas dominated by igneous terrain, the modern shore platforms are littered with boulders derived from the landward head terraces, forming a natural rock armour.

## **MIAROLITIC TEXTURES IN BORON-RICH FRACTIONS OF THE ST AUSTELL GRANITE AND OTHER EVOLVED FRACTIONS OF CORNISH GRANITES RELATING TO THE DYNAMIC SEPARATION OF A TRANSITIONAL 'VAPOUR' PHASE**

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Different parts of the boron-enriched fractions of the granite have been progressively exposed by the extractive operations in the Wheal Remfry china clay pit in the western lobe of the St Austell granite. These exposures provide evidence of the way that the borosilicate fraction separated from the boron- and water-saturated fraction of the granite magma at the transitional stages of magmato-hydrothermal evolution in this granite system. Because of the close spatial and genetic association of the boron-rich granite magma and the hydrothermal breccia in that area, intuitive conclusions about the way that the system evolved can be drawn. The processes of segregation are illustrated and discussed in relation to the observations of London (1992) and Candela (1997).

## **THE HOLOCENE SEPARATION OF JERSEY FROM MAINLAND EUROPE**

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The island of Jersey receives most of its electrical power from France via two submarine cables. These are now nearing a time when replacement must be considered and a new cable is now planned. More than 50 marine boreholes have been drilled into the seabed between France and the east coast of Jersey and these have been used to plan the route of the new cable by contractors. The cores have now been released to the Soci t  Jersiaise for research and core OVC-18 is being used as a pilot for the micropalaeontological analysis. This core has 100% recovery, with the transition from woodland, with peats and plant beds, to inter-tidal mud flats and, eventually, marine sediments with abundant marine fossils and highly significant occurrences of the calcareous alga known as maerl. This core, therefore, contains a near-complete record of Holocene sea level rise through to the invasion of the slipper limpet *Crepidula* in 1962. Many of the samples contain well-preserved assemblages of foraminifera and ostracods that allow the reconstruction of a range of sub-environments through to fully marine. Below the terrestrial sediments in core OVC-18 is a thickness of carbonate-rich sands that may be of Eocene age or derived from pre-existing Eocene sediments.

## **CLEMENT REID: ALL BUT FORGOTTEN? HIS LIFE AND DEATH IN MILFORD**

Roger Hedge

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This poster display owes its origin to the coincidence of an Ussher Society member living in the Hampshire village where Reid and his wife had a home and where they are buried in the village churchyard. The sorry state of his grave marker is shown, along with pictures of him, one on the beach with William Ussher. His wife outlived him by several decades and wrote some memories of him and his work. These show he had wider interests than just geology. Richard Scrivener has provided some other memories of Reid and his wife, while Reid was with the BGS.

## **FRAMBOIDAL PYRITE IN DEVONIAN ARGILLITES OF NORTH CORNWALL - ORIGIN AND SIGNIFICANCE**

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The Middle Devonian argillites west of Trevone near Padstow contain abundant microcrystalline pyrite, disseminated as individual grains, framboids and polyframboidal aggregates. The formation of framboidal pyrite in otherwise unfossiliferous, sedimentary carbonate-poor mudstones and siltstones is considered in the light of data on depositional and tectonic setting (availability of organic material and sulphate), early authigenic diagenetic processes (indicative of dysaerobic or euxinic environments), possible reworking of sediments and later regional metamorphism (up to anchizonal grade) and deformation (fault and shear zone mineralisation).

## THE APPLICATION OF TITANIUM-IN-QUARTZ GEOTHERMOMETRY TO THE LAND'S END GRANITE AND ASSOCIATED MINERALISATION

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Temperature estimates of the Land's End Granite and associated mineralisation in West Cornwall have been restricted in the past due to the availability of applicable techniques and the precision and accuracy of the results. This study sets out to apply the titanium-in-quartz geothermometer (Wark and Watson, 2006) to samples of different varieties of granite, quartz-tourmaline rock and mineralised veins from the NW margins of the pluton. The titanium in quartz thermometer uses the formula:

$$T (^{\circ}\text{C}) = (-3765 / (\log (X^{\text{qtz-Ti}}) - 5.69)) - 273$$

where T is the temperature and  $X^{\text{qtz-Ti}}$  is the level of Ti in ppm. Titanium increases exponentially with increasing temperature. Temperatures of  $691 \pm 31^{\circ}\text{C}$  and  $645 \pm 115^{\circ}\text{C}$  were determined for the granites;  $600 \pm 67^{\circ}\text{C}$  for the quartz-tourmaline rock;  $537 \pm 74^{\circ}\text{C}$  for greisen quartz; and  $547 \pm 66^{\circ}\text{C}$ , and  $559 \pm 82^{\circ}\text{C}$  and  $544 \pm 66^{\circ}\text{C}$  for quartz from mainstage polymetallic veins. Precision was found to decrease with decreasing titanium levels. Previous techniques have been reviewed, including fluid inclusion studies and temperature estimates from zircon saturation levels, and their results compared to those from this study. The resulting temperature estimates have also been applied to the interpretation of the geology in the region.

### REFERENCE

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## FAULTING IN PERMO-TRIASSIC STRATA AND BURIED CHANNELS REVEALED BY EXCAVATION OF THE LYPSTONE-POWDERHAM PIPELINE TUNNEL, EXE ESTUARY, DEVON

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A tunnel for a gas pipeline was driven beneath the Exe Estuary from Lypstone to Powderham, 6 km southeast of Exeter. Permian breccia, sandstone and Triassic mudstone were penetrated, lying beneath Pleistocene and Recent gravels, sands and muds of the River Exe flood-plain complex. The mudstone layers were attributed to the Exmouth Mudstone and Sandstone Formation, probably Triassic in age, while the sands and breccia were identified as belonging to the Dawlish Sandstone and Exe Breccia formations, both of Permian age. The latter was mostly recognised as the Langstone Breccia Member which is defined herein as an upper subdivision of the Exe Breccia. The tunnel was driven between vertical shafts, most of it within bedrock at -20 m O.D. Mudstone occurred at five points in the tunnel route and its adjacent surface exposures, interpreted as being due to step-fault displacement of the Permian-Triassic boundary. The fault planes were apparently oriented parallel to the estuary trend, and probably of Cretaceous date. The strata dip eastward up to about  $10^{\circ}$ . Fault duplication increased the apparent thickness of the Permian section in the tunnel by

162 m. The Pleistocene river deposits consisted of basal gravels overlain by sand, silt and mud of estuarine origin. The gravels were encountered in the tunnel drive where a buried channel complex was penetrated beneath the western flank of the flood-plain. Pebbles in the gravels indicated a post-Cretaceous age and a likely source area in Exmoor. A much smaller channel was encountered on the eastern side, beneath the present-day river channel, containing probable Jurassic shale pebbles, fractured by the tunnelling process; these may have been derived from an outcrop south of Taunton.

## THE CHEESEWRING: GEOTOURISM, GEOCONSERVATION AND GEO-EDUCATION. A CORNISH ICON AND A NEOLOGISM HOTSPOT

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The Cheesewring granite tor on the eastern edge of Bodmin Moor is recorded on Norden's map of Cornwall dating from c. 1584 and described as "*a heape of stones, admirably depending, wherein nature bath done more at aduerture (if a man may so speake) than arte or force can doe by greateste deliberation*". With a range of names such as the Cheesewring, Cheese-rings, Wring-cheese the tor has been described by travellers and guidebooks to the present day with many describing it as one of the pre-eminent, if not the pre-eminent, natural wonder in Cornwall. The tor was saved from the destruction which befell many other natural granite features at the hands of quarrymen by restrictive clauses in the 1845 and 1865 leases issued by the Duchy of Cornwall, the owners, so giving it probably the longest history of geoconservation in the UK. The 'cheese' in the tor's name almost certainly refers to the cheeses in pressing juice out of pulped apples in cider-making, rather than to any milk product, and the Cheesewring is itself the type 'Cheesewring' tor in several dictionaries and encyclopaedias of geomorphology and geography. No name in Cornish has been found for the tor.

## TRACE ELEMENT GEOCHEMISTRY OF THE CARMENELLIS GRANITE: EVIDENCE OF LOW ABUNDANCE ELEMENTS

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The composite Carnmenellis Granite intrusion is host to the most significant Sn mineralisation in SW England. However exposure is often poor and the area has been little studied recently. This study aimed at establishing the trace element distribution of the intrusive by updating the survey of Hosking (1965, 1967) which was reported but never published, and the original data of which are believed partly lost. Stream sediments were collected at approximately 500 m intervals, over the intrusive and immediately surrounding metasediment, and analysed using ICP-MS after an aqua regia digestion. This allows very low detection limits for many elements (e.g. Cs, In, Nb, Ta) that were previously not determinable precisely. Copper data confirm the reproducibility of previous surveys with the detections of a high amplitude unmined copper anomaly at Stithians associated with an elvan dyke (Bradshaw and Stoyel, 1968). Tin, W, In and Bi are strongly enriched at discrete locations at the granite-metasediment contact reflecting known mineralisation and contamination as well as areas for

further investigation. In contrast As enrichment is restricted to the metasediment. The south-centre part of the pluton is enriched in Li-Cs-Nb-Ta detecting the known rare metal pegmatites at Halvasso but also indicating a wider influence, perhaps of Li-enriched granite phases.

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### MORPHODYNAMICS OF THE GANNEL ESTUARY, SOUTH-WEST ENGLAND

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The Gannel Estuary that is situated in southwest of Newquay between Pentire Point East and Pentire Point West on the north coast of Cornwall, southwest UK is a small estuary with a narrow inlet that connects the sandy Newquay Bay with the inner estuary. The bay is considered to be a closed sediment cell, suggesting that over the mesoscale, the sediment budget is balanced by morphodynamic adjustment across the estuary, inlet, beaches and bay. The historical evolution and temporal morphological dynamism of the Gannel Estuary and adjacent beach are examined to evaluate spatial connectivity of morphodynamic behaviour. The main objective of the analysis is to evaluate historic/temporal trends and variability of the sub-systems. Changes in the shoreline and channel positions are dominated by a quasi-annual signal that reflected cross-shore sand transport forced most likely by hydro-dynamic processes. Geological configuration and past anthropogenic activities (mining, harbouring, dredging, etc.) at the study site also affected the spatial extent and morphodynamic evolution of the estuary.

### THE GEOCHEMISTRY OF OYSTER SHELLS

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The analysis of shell material has been shown to be valuable in terms of biomonitoring of pollution as shells integrate pollutant levels over time, thereby providing a realistic indication of the pollution status of the environment. This research examines the petrography and geochemistry of oysters (*Crassostrea gigas*, the Pacific oyster and *Ostrea edulis*, the European flat oyster) derived from a number of study sites within Devon and Cornwall. The oysters sampled are composed of foliated calcite and a chalk microstructure. In particular those sites that have been affected by mine drainage are compared to more pristine environments. The geochemical analyses also provide an opportunity for establishing a base line of other trace elements.

### RHENIUM - OSMIUM DATING OF MOLYBDENITE FROM SOUTH-WEST ENGLAND

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Molybdenite is a minor mineral phase present in a number of localities in the South-West England orefield. It is commonly associated with the early stages of granite-related mineralization such as pegmatites and greisen-bordered Sn-W systems. Recent studies at Durham University have investigated the potential for Rhenium-osmium dating of molybdenite, including a suite of samples from localities in Cornwall. The results of this work will be presented and the data will be interpreted in relation to earlier geochronological investigations using other methods.

### HAS THE KENNET VALLEY BEEN THE SITE OF REPEATED FAULT REACTIVATION?

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The geology of the North Wessex Downs is usually described as a simple 'layer cake' of Chalk overlaid by Tertiary sands and clays followed by a capping of superficial Quaternary gravels and lowland peat. Closer inspection shows a more complex and interesting history. I want to argue that a very large range of phenomena ranging from sedimentation patterns, deformation history, river and valley development, ground water flow and river terraces can be explained by a simple model. This involves repeated reactivation of basement faults in response to a changing tectonic stress-field. Due to the almost complete absence of outcrops, evidence is indirect and open to diverse interpretations. Nevertheless, the present model, which is consistent with the findings of the London Basin Forum and the Petroleum Geology of the Wessex Basin, provides a united synthesis of the geology of the region and suggests a number of directions for further study.

### GRANITE RELATED INDIUM MINERALISATION IN SOUTH-WEST ENGLAND

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Indium is consistently mentioned in metal supply risk lists because of a rapidly growing demand and limited production. The metal is critical in the production of photovoltaic cells and colour liquid crystal displays, and is considered to be of strategic significance to technological developments within the EU and UK. Historical mining in SW England has ignored a wide range of metals that are currently topical for technological developments. Indium occurs widespread in granite related mineral deposits across South-West England. Significant concentrations are found in sulphide-bearing skarns from the northern margin of Dartmoor (the Red-a-Ven mine), the greisen vein systems at Redmoor and Cligga Head, and more than 20 main stage mineral vein systems across the region. The richest occurrences have been identified at Botallack (St Just district); Dolcoath, Wheal Concord and Nangiles (Camborne-Redruth-St Day district), and Wheal Charlotte (St Agnes). Electron-probe



microanalysis and QEMSCAN techniques were used to characterize more than 90 samples from South-West England. Total indium concentrations are very variable within and between the individual deposits. Calculated whole-rock concentrations locally reach 420 ppm, equivalent to 800 ppm in 100% sulphide + oxide. The indium is distributed between sphalerite (up to 1.2 wt%), chalcopyrite (up to 2200 ppm), stannite (up to 6700 ppm) and cassiterite (up to 1800 ppm). Vein systems that are particularly rich in indium also carry rare, minute grains of roquesite ( $\text{CuInS}_2$ ) that are commonly found in bornite and chalcocite. While the mineralogical distribution of indium is variable, there is commonly a broad correlation between the concentrations within coexisting host minerals. Although indium concentrations are highest in sphalerite and stannite, chalcopyrite is the dominant mineral host throughout the area. While indium may never become a main commodity for targeted exploration and extraction in the region, the metal has significant potential to add value to the extraction of tungsten, tin, copper and zinc. Although the metal is considered as a potential by-product by Western United Mines, much more detailed investigations are required to fully understand the timing and nature of indium mineralisation within individual mineral vein systems.

**THE TECTONICS OF EARLY STAGE CORNUBIAN BATHOLITH CONSTRUCTION AND MINERALISATION AS VIEWED FROM THE NW MARGIN OF THE ISLES OF SCILLY PLUTON**

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The Isles of Scilly Granite, together with the Carnmenellis and Bodmin Moor granites represent, at their current exposure level, the oldest plutons within the Cornubian Batholith and comprise predominantly coarse-grained smaller phenocryst biotite granite. Detailed mapping of the NW margins of the pluton, exposed at the northern ends of St Martins, Tresco and Bryher, together with an evaluation of the relative chronology and kinematics of granite emplacement and mineralisation has provided an insight into the interplay between tectonics and magmatism that may be applicable to all these 'early' plutons. The coarse-grained biotite granite is composite and locally exhibits biotite-rich schlieren with variable tube, rhythmic-graded and trough morphologies in the vicinity of internal contacts. These are interpreted to have formed during magma flow. A more extensive area of biotite-rich schlieren on the northern end of White Island (St Martins), previously interpreted as an inclusion of host rock / metamorphic basement / greisenized sheared granite, possibly represents hybrid magma. The coarse-grained biotite granite possesses a steeply NW-dipping magmatic state foliation that, in the northern extremities of the study area, is replaced by a similar orientated solid state foliation characterised by the plastic deformation of quartz. The associated magmatic / solid state lineation is typically steeply pitching within the foliation. Occasional kinematic indicators such as tilting of feldspar phenocrysts suggest these fabrics developed during a top sense-of shear to the SE. Gently SE-dipping extensional ductile shear zones are common and exhibit kinematic indicators such as marker deflection, foliation curvature, C-S and C'-S fabrics, mantled feldspar porphyroclasts and mica fish that are usually consistent with a top-sense-of-shear to the SE. NW-SE striking, steeply inclined, oblique- and strike-slip ductile shear zones are less frequent. The ductile shear zones have locally controlled the emplacement of porphyritic fine-grained granite and aplite-pegmatite sheets that were the source for magmatic-

hydrothermal fluids associated with greisen and quartz-tourmaline mineralisation and wallrock alteration. In some instances, quartz-tourmaline mineralisation in steeply inclined brittle faults is sourced from underlying gently inclined shear zones. Quartz-tourmaline veins hosted by shear zones were deformed during continued extension on SE-dipping shear zones and accompanying oblique- and strike-slip on NW-SE shear zones. The NW margin of the Isles of Scilly Granite preserves evidence for the emplacement of granite magma batches during a NW-SE extensional regime characterised by a top sense-of-shear to the SE (accompanied by oblique- and strike-slip movements on NW-SE transfer faults). The kinematics are compatible with the regional D3 tectonic episode associated with the extensional reactivation of the Rheohercynian Suture and other major thrusts. The 'early' granites are the only ones to display solid-state fabrics and ductile shear zones. Our data are in permissive agreement with earlier fabric studies, that lack shear sense criteria, from the Carnmenellis and Bodmin Moor granites. The style of quartz-tourmaline mineralisation on Scilly is similar to early mineralisation, such as 'Quartz Floors' within South Crofty Mine and elsewhere in the Carnmenellis and Bodmin Moor granites, that may be shear zone controlled.

**TRELIVER MINERALS LTD - EXPLORING FOR ECONOMIC TIN DEPOSITS IN THE NORTH ST AUSTELL GRANITE AREA**

Mark Thompson and Alex King

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Treliver Minerals has a number of target areas that it will investigate for economic mining potential by geophysics and diamond core drilling in early 2013, building on work undertaken in the early 1980s by Billiton Exploration UK Ltd. Target lithologies include replacement style mineralisation in calc-silicates and breccia pipes.

**SUSTAINABLE AND ENVIRONMENTAL TREATMENT AND RE-USE OF MARINE SEDIMENTS (SETARMS)**

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SETARMS is a European INTERREG funded project established with the intention of identifying treatment and re-use options for difficult to dispose of dredged harbour sediments. The University of Exeter is one of twelve UK and French partners working on the project that is currently entering its third year. Project partners have undertaken geochemical and geotechnical characterisation on sediment from 13 ports located on the French and English side of the Channel, including two ports in Cornwall. Quantitative mineralogical characterisation of the sediment samples was achieved using the QEMSCAN analytical system, which provided rapid determination and quantification of the mineralogy, chemical composition and grain size of the samples. The results of the mineralogical characterisation of sediment from the 13 SETARMS ports are presented. Examples of changes in the mineralogy of selected samples that have been treated with lime and cement prior to possible re-use in road construction are discussed.

## **TALE OF A BOUNDARY**

Geoffrey Warrington

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In 1994 the St Audrie's Bay section, Somerset, was proposed as a candidate Global Stratigraphic Section and Point (GSSP) for the base of the Hettangian Stage. In 1997 other candidates based on ammonites in successions in Peru and Nevada, USA, were proposed, followed, in 1999, by one from Canada, based on radiolarians. That in Peru was later withdrawn, leaving three for consideration by the Triassic-Jurassic Boundary Working Group (TJBWG) of the International Subcommittee on Jurassic Stratigraphy (ISJS). However, in 2007, three new proposals, from Austria and Northern Ireland (based on ammonites), and Nevada (using carbon isotopes), were published. A vote by the TJBWG for a preferred marker from what had now become six candidates favoured the appearance of a new species of *Psiloceras* in Austria or in Nevada. In a vote to choose between these sites the former was preferred, but with <60% of the votes. A vote on that outcome resulted in the TJBWG approving proposal of the Austrian candidate to the ISJS. The ISJS and the International Commission on Stratigraphy voted in favour of this result, which was ratified by the International Union of Geological Sciences in April 2010. The GSSP was formally inaugurated in August 2011.

## **INSIDE A MID TRIASSIC FLUVIAL DEPOSIT IN CHESHIRE**

Geoffrey Warrington

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University of Leicester*

The Mid-Triassic Helsby Sandstone Formation of Cheshire includes fluvial and aeolian members. Sedimentological details are usually poorly seen at surface but are visible in unweathered sections in disused mine workings at the Alderley Edge Geological SSSI, 20 km south of Manchester. Here, fluvial and aeolian members both hosted ores deposited from migrating intrastratal brines. In part of the mines ore was worked in a c. 33 m-thick succession of fining-upward fluvial cycles. In these a basal erosion surface is overlain by conglomerate that is succeeded by progressively finer river channel deposits and finally by overbank mudstones that underwent erosion during subsequent channel migration. One mudstone occurs throughout the workings, but most were completely eroded and are represented only by clasts in the basal unit of a succeeding cycle. These differences influenced subsequent fluid migration, with the mudstone bed and those with mudstone clasts forming complete and partial aquicludes respectively. This is reflected in the irregular nature of the voids that now represent the ore bodies hosted by this facies. In contrast, an aeolian unit higher in the Helsby Sandstone at Alderley hosted much larger and more continuous ore bodies.