

Abstracts of other papers read at the Annual Conference, January 1989

Morphometric analysis of the Lizard. *A.R. Cartwright, Bosillack, Silverdale Road, Falmouth TR11 4HP.*

The Lizard Peninsula is an area of geological complexity, the surface expression of which is to some extent masked by marine planation (Pliocene?). Depiction of the area's relief by contours is not wholly satisfactory: the use of data from OS 1:25000 sheets results in either a large and cumbersome map with clearly spaced contours or a compact map in which contours on steep slopes tend to merge. If the number of contours mapped is reduced, significant detail may be overlooked. A further disadvantage of contoured maps is that the perception of large tracts of barely dissected but gently sloping ground is impaired by the presence of contours crossing such areas. To try to overcome these various problems inherent in conventional methods of showing relief the author resorted to a technique of contour counting which he developed for Norfolk, where similar problems of relief representation exist (unpublished M.Phil. Thesis 'An analysis of landscape types and a re-evaluation of traditional regional sub-divisions of Norfolk', University of East Anglia, 1973). The resultant map is presented alongside others showing geological formations, structures and drainage of the Lizard Peninsula.

Landfill gas migration characterisation. *R. G. Gregory, Electrowatt Engineering Services (UK) Ltd, Grandford House, 16 Carfax, Horsham RH12 1UP and M.J. Tomlinson, Department of Geology, University of Exeter, North Park Road, Exeter EX4 4QE.*

Measurements of the compositional variation between oxygen, carbon dioxide and methane in the soil or overburden gas on and surrounding landfill sites can yield information on the extent of landfill material and on gas migration outside the landfill site boundary.

The landfill site near Bodmin was typical in that, at the heart of the landfill, approximately 60% methane and 40% carbon dioxide (v/v) were observed when shallow probes penetrated the clay/rubble cap. As the landfill thinned methane levels dropped, until at 10% methane, concentrations dropped by up to three orders of magnitude between adjacent samples sites. 10% methane was adopted here as the concentration which determined the edge of the landfill site.

Gas migration outside the landfill site was shown as three distinct regions of elevated methane concentrations, relative to ambient. Zones of strong contamination were defined as areas with >0.1% methane. The carbon dioxide/methane ratio confirmed that these zones were due to landfill gas migration. However, where aerobic gases had been able to react with the raw landfill gas, this ratio was disturbed. Areas of aerobic soil gas interaction can be deduced by the combined observation of the carbon dioxide and oxygen results with methane concentrations.

Gas measurements at a control station show variations due to barometric pressure, but do not indicate that correction of the data was warranted, because the changes observed above were so clearly defined.

An atheloptic trilobite fauna from the Upper Devonian of South Devon. *C.J. Burton, Department of Geology, University of Glasgow and S.B. Leman, Department of Geology, University of Durham.*

Faunal assemblages containing sighted, atheloptic (reduced-eyed) and blind phacopid trilobites are found in the upper Famennian Rora Slate of the Ilington area of South Devon. The assemblages range in age from the *sphaeroides* zone to the *euryomphala* zone.

These assemblages approximate to biocoenoses, in which the mobile benthonic, nektonic and planktonic forms outnumber the fixed benthos. The biocoenoses were investigated at two clusters of localities, a stratigraphically lower cluster (*sphaeroides* zone) at Lounston (SX 79087515) and an upper cluster (*euryomphala* zone) at Combe (SX 79057400). Ecologically the Lounston cluster contained a diverse equilibrium fauna, although with a reduced fixed-benthic element. The Combe cluster contained a highly specialised and much less diverse fauna, dominated by one, blind phacopid species and with minor nektonic and planktonic elements.

Within the phacopid element the diversity decrease is mirrored by changes in vision. In the Lounston cluster the basal community is

dominated by atheloptic forms, with equally subordinate sighted and blind forms. Going up succession blind forms become dominant, with subordinate atheloptic forms and the complete loss of sighted forms. At Combe the process is completed with the total and exclusive dominance of blind forms.

These factors, taken together with water depths, estimated from trilobite eye function, and the ecological characteristics of the faunas, suggest that the faunal changes indicate the drowning of an outer shelf, with depths increasing from c.200m to c.600m. The timing of the changes correlates closely with the onset and maximum stages of the eustatic sea-level rise of the Hangenberg Event, and suggests that this event was signalled by the faunal changes noted.

Devonian palynomorphs recovered from the sediments S.E. of Loe Bar, south Cornwall - preliminary results and implications. *R. Knight and J. Wilkinson, Department of Geology, University of Southampton.*

Diverse, prolific palynomorph assemblages have been recovered from "Mylor-type" horizons SE of Loe Bar. Miospores form the predominant component and acritarchs comprise less than 3% of the total microflora. Rare fragmented chitinozoa have been recorded. The assemblages are Late Devonian (Famennian) in character, and contain no exclusively Carboniferous taxa. Any assignment to the miospore biozonation scheme of Street *et al.* (1987) is contentious. The absence of *Retispora lepidophyta* and its association, coupled with the occurrence of *Rugospora flexuosa* and *Retusotriletes phillipsii*, intimates a Mid-Famennian (*pre-lepidophyta*) age for the "anomalous" occurrence of the taxon *Grandispora echinata* challenges this interpretation, suggesting a Latest Famennian age.

Taxa indicative of the Lower/Middle Devonian were recorded and are considered reworked. Reworking may account for this confusing mixture of Famennian/Strunian index miospores. Previous structural models for this section are considered questionable.

The Permo-Triassic in Devon. *G. Warrington, British Geological Survey, Keyworth, Nottingham NG12 5GG.*

The south Devon coast, from Torbay eastwards to Pinhay Bay near Lyme Regis, provides the most continuously exposed and accessible section of a Permo-Triassic succession in Britain. The sequence preserved there formed between c.260 and 205Ma. Continental environments characterised the region during most of that time but were replaced by marine conditions before the end of the Triassic period. Late Permian pollen from the lowest beds at Exeter are the oldest indigenous fossils known from the succession and form the first clear biostratigraphic evidence for the presence of Permian deposits in the region. These beds rest unconformably upon rocks affected by the Variscan orogeny or, locally, upon weathered rocks of the Exeter Volcanic Series. An interval of up to 40Ma separates the late Permian deposits at Exeter from the youngest sediments (Westphalian C: Carboniferous) affected by Variscan folding in Devon. This interval forms a geochronological envelope that accommodates the intrusion of the Cornubian granite batholith and related events, including extrusion of the Exeter Volcanics. The position of the Permian-Triassic boundary in Devon is constrained within the sequence between the Dawlish Sandstone and the vertebrate-bearing middle Triassic Otter Sandstone. Late Triassic pollen occur in the Mercia Mudstone Group and, with macrofossils, in the Penarth Group and lowest beds of the Lias. The boundary with Jurassic deposits, within the Lias at the appearance of *Psiloceras*, is conformable. The Devon coast section is at the western side of the Wessex Basin in which an analogous sequence is known, from borehole and geophysical evidence, to be present beneath younger deposits; the section is, therefore, the "tip of the iceberg" that provides an insight into the nature of the largely concealed development of Permo-Triassic rocks in southern England.

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The Fal Valley lineament. *C.M. Bristow, ECC International Ltd., St. Austell, Cornwall PL25 4DJ.*

This paper describes all the phenomena associated with a lineament which traverses the western lobe of the St. Austell granite in the vicinity of the Fal Valley. Pre-granite dextral movement appears likely, but

although there is no evidence of iron and uranium mineralisation and extensive movement post-granite, there is little evidence of dextral movement after emplacement. The lineament is in fact composed of two elements, one NS and the other NW-SE.

Stratiform and related mineralisation in SW England. *R.C. Scrivener, R.C. Leake, B.E. Leveridge and T.J. Shepherd, British Geological Survey, St Just, 30 Pennsylvania Road, Exeter.*

The Variscan fold belt of SW England has in the past been exclusively associated with the tin-tungsten-base metal vein deposits of the Variscan granitoid intrusions and their envelopes. Recent mapping and geochemical programmes have led to the identification of stratiform syn-sedimentary concentrations of metals, associated with episodes of volcanism, in sedimentary and volcanoclastic strata ranging from Lower Devonian through Lower Carboniferous in age.

Though commonly reworked by late hydrothermal events, these originally volcanic-exhalative and diagenetic metal concentrations occur in well-defined assemblages within recognised stratigraphical units. These assemblages include manganese-iron minerals associated with cherts and basic volcanic rocks and lead-zinc-silver-barite ores associated with black shales, both of Lower Carboniferous age, lead-zinc-antimony-silver minerals from slates and associated basic volcanic rocks of the Middle/Upper Devonian, and heterogeneous metal concentrations in the Lower Devonian continental sediments which occur with basic and acidic volcanic rocks. An attempt will be made to place the various occurrences of metalliferous mineralisation in a regional geological setting.

Intrusive subdivisions and hydrothermal phenomena at Priest's Cove, Penrith, Cornwall. *Lin Yucheng and C. Halls, Department of Geology, Royal School of Mines, Imperial College, London SW7 2BP.*

Detailed studies of field relations at Priest's Cove, supported by chemical, petrographical and mineralogical observations provide new evidence to demonstrate the composite nature of the Land's End granite and some critical aspects of the transition from the pegmatitic to hydrothermal state which led to mineralisation. Evidence for at least three substages of granite emplacement exists; these correspond in part to textural facies identified by previous investigators. The pegmatitic stage of evolution is represented by

- (1) unidirectional "stockscheider" pegmatites at internal contacts;
- (2) pegmatite pods and miarolytic cavities;
- (3) aplite-pegmatite dykes with comb-layering;
- (4) "hybrid" pneumatolytic veins with pegmatite borders.

In addition there is local strong development of K-feldspar metasomatism in the hornfels adjacent to veins near the granite contact. The pneumatolytic stage of hydrothermal evolution is marked by the formation of several intersecting sets of extensional fractures, the borders of which show tourmaline, hematite and chlorite alteration; hydrothermal breccia has formed locally. The later stages of mineralisation were located in a large, northeasterly-trending composite fault lode by which the granite contact is downthrown to the northeast.

Sn and Ti oxides from Mousehole, Cornwall -evidence from trace element substitutions. *C.J. Lister, Department of Earth Sciences, Parks Road, Oxford OX1 3PR.*

Tin and titanium oxide minerals occur in different host rocks within the Land's End granite aureole at Mousehole. Electron microprobe analyses reveal compositional differences between cassiterite occurrences, as well as between co-existing Ti oxide species. The evidence from trace element substitutions can be used to assess the roles of host rocks and mineralising fluids in the formation of such minerals.

The trace fossils of the Upper Carboniferous Bideford Formation of North Devon, England. *Xu Li, Department of Earth Sciences, Parks Road, Oxford OX1 3PR.*

The Bideford Formation contains nine coarsening upwards deltaic cycles, in which five trace fossil associations are distinguished. The turbidite association contains *Asteriacites* and *Planolites Ophthalmoides* which represent a marine water incursion in the fresh or brackish water basin. The delta front association consists of *Kouphichnium*, ? *Zoophycus* and *Palaeophycus* in un-slumped areas. The mouth bar association is characterised by *Pelecypodichnus*, *Susteraichnus* and *Trichichnus*. The inter-distributary bay association has the greatest diversity and mainly contains *Cochlichnus*, *Treptichnus*, *Torrowangea*, *Curvolithnus*, *Didymaulichnus*, *Acanthorhapse* and a Tetrapod footprint, and the delta top association is characterised by *Arenicolites* and *Teichichnus*.

The distribution of trace fossils is mostly controlled by sedimentary microfacies and salinity rather than bathymetry alone. Some abundantly burrowed mouth bars show that from distal deeper water to proximal shallow water, the burrows changed from horizontal to vertical and became shorter without change in diameter.

Dating the age of fault activity in North Somerset. *J.C. Gutmanis and R.H. Maddock, GeoScience Ltd., Silwood Park, Buckhurst Rd., Ascot, SL5 7QW; C. Vita-Finzi, Department of Geology, University College London, Gower St., London WC1E 6BT and E.A. Hailwood, Department of Oceanography, Southampton University, Southampton S09 5NH.*

Attempts have been made to obtain minimum absolute dates for the last activity of two faults in the North Somerset Coastal Fault Belt. Radiometric (uranium series, ¹⁴C) and palaeomagnetic dating techniques were applied to calcites from undeformed vein systems cross-cutting the Hinkley Point Fault; and ¹⁴C dating was applied to bone material from undeformed Quaternary gravel deposits overlying a fault zone in Liassic bedrock at Helwell Bay. Detailed field mapping and microscopy was used to show that the samples chosen for dating had not undergone any significant fault-related deformation. Dates obtained from the radiometric techniques ranged from c.33ka to greater than 300ka, believed to reflect the influences of isotopic exchange and contamination, and the inherent age limits of the techniques. Palaeomagnetic dating techniques identified reverse polarisation in a calcite sample from the Hinkley Point Fault, proving an age greater than 730ka (the time of the last field reversal). Palaeomagnetic vectors suggested a pre-Pliocene (possibly early Jurassic age) for the calcite vein emplacement. The dating results make a contribution to the problem of assessing seismic hazard in the North Somerset region.

The work described was carried out by the Seismic Hazard Working Party of the Central Electricity Generating Board. The abstract is published by permission of the Board.

Ab initio studies of minor mineral-filled fractures at Mousehole, Cornwall. *ME. Durkin, Department of Earth Sciences, Oxford and LA. Saville, Department of Geology, University of Sheffield.*

A thin veneer of a few metres of deformed metasediments and metabasites penetrated by late multi-phase, mm scale, mineral filled fractures overlie mesocrystic granite at Mousehole (Cornwall). Field relationships demonstrate that these sub-parallel, steeply dipping mode 1 fractures are pre-intrusive but with mineral fill that may in part derive from thermal reworking on granite emplacement. In-plane shear fractures (Mode 2) seem limited to localities where minor re-activation of former shear sites has occurred.

Vein morphology, mineralisation and propagation mechanisms are discussed.