ABSTRACTS OF OTHER PAPERS READ AT THE ANNUAL CONFERENCE, JANUARY 1994

REFINEMENT OF THE TIME/SPACE RELATIONSHIPS OF INTRUSION AND HYDROTHERMAL ACTIVITY IN THE CORNUBIAN BATHOLITH

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Continued geochronological research on Cornubian granitoid rocks and associated "main-stage" mineralisation confirms, but considerably refines the model presented at the 1993 Ussher Conference (1), viz. the biotite (-muscovite) monzogranites which dominate the batholith and the major Sn-Cu (-W, As, Zn, fluorite) lode systems were generated over a period of ca. 30 m.y., from 293-4 to at least 269 Ma, and are distributed in a large number of sub-provinces which experienced essentially independent histories of intrusion, cooling to subsolidus temperatures, and vein and lode development, extending over intervals of up to, exceptionally, ca. 25 m.y. (1).

Among the new geochronological date are concordant $^{207}Pb/^{235}U$ age determinations for magmatic monazites from the Land's End and Dartmoor Granites. The coarsely megacrystic (Crippleseae) and fine (Castle an Dinas) facies exposed in the NE area of the Land's End Granite were emplaced at, respectively, 277.1 ± 0.4 (2σ), and 276.7 ± 0.4 Ma, clearly antedating intrusion of both coarse (Lamorna: 274.7 ± 0,4 Ma) and fine (Polgigga: 274.4 ±0.4 Ma) units of the southern part of the pluton. $^{40}Ar/^{39}Ar$ cooling dates for muscovites (Tc ca. 3200 C) in the southern area are similarly 2-3 m.y. younger than in the NE. We propose that these data reveal two distinct, albeit composite, elliptical intrusive centres which we term the Zennor and St. Buryan lobes. The latter, essentially barren, represents the youngest major plutonic event of the batholith. The richly mineralised, weakly megacrystic coarse granites of the St Just area, as yet undated, may constitute a third intrusive domain, but $^{40}Ar/^{39}Ar$ age data imply that this domain constitutes part of the Zennor lobe.

Resolution of the emplacement history of the Dartmoor Granite is less advanced. A new U-Pb monazite date of 286.2 ± 1.0 Ma for fine-grained granite from Moor Farm, Throwleigh Common, in conjunction with published dates (1,2) for the Haytor coarse-grained weakly megacrystic granite (285.2 ± 0.6 Ma) and Pewtor coarse-grained megacrystic granite (281.0 ± 0.6 Ma), implies the occurrence of at least three plutonic episodes; these may not, however, be universally correlated with the three textural variants, each of which may have been emplaced in several stages. $^{40}Ar/^{39}Ar$ incremental-heating age spectra for hydrothermal muscovite from Hemerdon Ball confirm that hydrothermal activity occurred *before* 290 Ma, in agreement with the proposal of Darbyshire and Shepherd (3) that this small satellitic body was emplaced before the main Dartmoor Granite (see also 4)

The expanding $^{40}Ar/^{39}Ar$ database for mineralised bodies in the province as a whole supports the diachronous development of both "greisen-bordered", generally W-rich vein swarms and the productive Sn-Cu lodes (1,2, but cf. 4), although some of the determined ages pose intriguing problems. Thus, hydrothermal muscovite from the Great Work-Wheal Reeth lode system of the Breage district yields a *minimum* age of 285 Ma, with evidence of resetting after 282 Ma; this is significantly older than cooling dates of 281.5 ± 1.6 and 281.0 ± 1.3 Ma determined for, respectively, magmatic muscovite from the Godolphin Granite and zinnwaldite from the Tregonning Granite. We infer that the Great Work-Wheal Reeth-Lady Gwendolyn mineralisation is hosted by an unrecognised granite older than the contiguous Godolphin and Tregonning plutons. Sn-Cu lode development here, and perhaps also in the major Wheal Vor-Wheal Metal camp, was therefore coeval with that in the Camborne-Redruth district (280-287 Ma; 1,2) and may similarly have been related to an apophysis of the Carnmenellis Granite. The sensibly contemporaneous cooling ages of the Tregonning Li-mica alkali feldspar granite and Godolphin biotite monzogranite (similar relationships are found in the St Austell Granite) have implications for petrogenetic modelling.

Present knowledge of the earlier stages in the time/space evolution of the batholith and its associated lithophile/chalcophile mineralisation is illustrated by a series of 12 "time-lapse photographs" taken at ca. 2 m.y. intervals, distinguishing: (i) defined and inferred granite intrusion ages; (ii) emplacement of vein systems plausibly related to second-boiling processes in apical magma bodies; and (iii) development of the productive SnCu (-As, Zn, F) lodes.

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PLAGIOCLASE IN THE CORNUBIAN GRANITES: A NOMARSKI DIFFERENTIAL INTERFERENCE CONTRAST AND ELECTRON MICROPROBE RECONNAISSANCE

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Reflected-light Nomarski DIC imaging of etched polished thin sections has provided unique insights into the internal zoning and hence evolution of mineral grams (1,2,3) and overall textural relationships (4) in volcanic rocks, but applications to granitoids are few. We present the initial results of a study of plagioclase phenocryst systematics in the biotite monzogranites of the Cornubian batholith (particularly the Land's End and Carnmenellis plutons) and their mesocratic microgranitic enclaves, largely granodioritic to tonalitic in composition and interpreted as hybridised melt "pillows" (5).

Two widespread morphologica/compositional populations, Types A and B, are distinguished. The more abundant Type A grains are subhedral with: well-defined core zones, generally strongly sericitised, but preserving evidence of the partial conversion of oscillatory-zoned plagioclase to "fretted" material; wide mantles exhibiting finely-oscillatory zoning, and narrow-to-wide rims lacking oscillatory zoning.

These grains are normally zoned overall from ca. An_{24}, to An_{25} or, in some examples, An_0. Whereas the rims are sensibly concordant with the mantles, the core-mantle interface is discordant and therefore records an episode of dissolution. Type A grains have not been confirmed in enclaves with granodioritic or more basic compositions. Type B grains, less abundant overall, are characterised by euhedral to subhedral forms in the granite, but display ovoid, "resorbed" outlines in the enclaves. Whereas core and mantle domains may be distinguished, Na-rich rims are narrow and clearly replacive. These crystals exhibit fine-oscillatory zoning throughout cores and mantles, and several episodes of dissolution are evident, some of which generated fretted or patchy zones. However, Type B plagioclases show no gross zonation, oscillating between ca. An_{24} and An_{30} across both cores and mantles. In addition to the above populations, some plagioclase phenocrysts in tonalitic microgranular enclaves have core compositions as calcic as An_{60} (5).

We infer that the more calcic Type B grains record an early period of crystal migration in a magma chamber experiencing convective overturn: the oscillatory zonation reflects crystallisation at sensibly constant temperature, while the periodic dissolution events are ascribed to migration into slightly hotter environments. The more abundant type A crystals formed subsequently, and record cooling of the magmas to the solidus, the "free" growth recorded by oscillatory zoning giving way to crystallisation under conditions of extreme melt viscosity. The apparent absence of Type A plagioclase in the less silicic igneous enclaves implies that the latter had largely crystallised prior to the initial development of this generation of phenocrysts. However, Type A crystals probably developed around partially melted Type B nuclei following an episode of temperature increase tentatively ascribed to commingling with more mafic magma.

The recognition of complex "stratigraphic" relationships in the plagioclase of the monzogranites provides for the first time a framework for the clarification of the overall crystallisation history of these otherwise petrographically refractory rocks.

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LITHOSTRATIGRAPHY OF THE PURBECK LIMESTONE GROUP IN DORSET

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The existing classification of the Purbeck Limestone Group in Dorset divides the sequence into two Formations (Durlston overlying Lulworth), and 15 or so Beds. The latter have recently been given Member status. The traditional lower', 'Middle' and 'Upper' divisions of the Group are now largely redundant. Recent BGS mapping in the Upwey area, in the west of the Isle of Purbeck, and work currently under way on the coastal sections, shows that many of the newly promoted Members are poorly defined lithostratigraphically, and are, therefore, of limited use for lateral correlation and sedimentary analysis. It has been found that the Group can be divided more usefully into five new lithostratigraphical units, which can be readily mapped inland and correlated laterally, and have potential for palaeogeographic analysis. The new units are given Member status and will be formally defined in the coastal sections in a forthcoming publication. They represent a level of classification which is meant to complement, not supersede, the existing classification, although it is necessary to return the existing Members to their original Bed status.

Provisional lateral correlation using the new classification shows that the higher part of the sequence, representing the Durlston Formation, is best developed and exposed in the stratotype section of the Purbeck Limestone Group at Durlston Bay, in the east of the Isle of Purbeck. However, it can be demonstrated that the underlying Lulworth Formation, although thicker in the east, shows greater lithological and sedimentary variety in the west of the Isle of Purbeck. It is suggested, therefore, that whilst the stratotype section of the Durlston Formation should be Durlston Bay, that for the Lulworth Formation should be selected from one of the superbly exposed sections between Lulworth Cove and Worbarrow Tout.

THE WORK OF ENGLISH NATURE IN SOMERSET

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Within the County of Somerset there are currently 107 Sites of Special Scientific Interest. Of these SSSIs 55 are of biological interest, 8 have both a biological and a geological interest, and 28 are of geological interest only. The sites range in size from less than a quarter of an acre to several hundred acres in the case of geomorphological notifications.

A wide range of problems are encountered in the protection and management of these sites, and a number of these are outlined. The sites referred to include Cheddar Gorge, Thrupe Lane Swallet, Brean Down and St Dunstan's Well Catchment.

OBSERVATIONS ON A PROBABLE PALAEOSURFACE NEAR CAWSAND, CORNWALL

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The largest existing remnant of the 'Dartmoor' rhyolite may be seen just north of Cawsand/Kingsand along the shore of Plymouth Sound. A small exposure of Permo-Triassic conglomerate (or breccia), hereafter called 'redbeds' at Sandways is separated from the rhyolite by a biotite-bearing kaolinite bed approximately 0.5 m thick. The origin of the kaolinite is not yet known, but the purple-greenish colour near its base suggests that it may be an altered volcanic ash. The redbeds contain rounded rhyolite boulders up to 1 m in size, silt beds showing desiccation tracks, and annelid tracks. The exposed redbeds are about 7 m thick and represent a remnant of a much larger mass resting unconformably on Devonian sandstones and slaty shales. The exposures of Devonian rocks near the redbeds may be eroded remnants of a deep soil and weathered zone originally more than 2 m thick. This surface had already been eroded to form gullies when the redbeds were deposited on it. The rhyolite boulders in the redbeds are clearly older than the bulk of the exposed rhyolite flows and appear to be similar to fine-grained rhyolite intruded into the Devonian rocks before the formation of the weathered surface, since these intrusions form part of the surface. An isolated boulder appears to be a silcrete remnant.

IGNEOUS EVENTS IN THE LATE CARBONIFEROUS AND EARLY PERMIAN OF SOUTH-WEST ENGLAND

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New Ar-Ar isotope analyses of micas provide evidence for the age of the lamprophyric members of the post-Variscan Exeter Volcanic Rocks, These geochronological data are presented in the context of the stratigraphy of the New Red Sandstone of the Exeter district. The extrusion ages of the Exeter Volcanic Rocks are related to the geochronology of the emplacement and cooling of the Cornubian granite batholith. Sm-Nd isotope data for igneous clasts within the New Red Sandstone breccias are presented and used to elucidate the timing of uplift and unroofing of components of the batholith. The age of the lower part of the New Red Sandstone succession is discussed in relation to recent work on the timing of the Permian/Carboniferous boundary.