## **Figures and tables**

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(Table 1.1) List of GCR igneous rock sites in south-west England. See (Figure 1.1) for locations.

(Table 2.1) Ages and initial Sr isotopic ratios of granitic rocks from the Cornubian batholith (data from Darbyshire and Shepherd, 1985, 1987)

(Table 2.2) Main evolution and alteration stages of the St Austell Granite (after Bristow et al., in press)

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(Table 5.3) Pearson product moment correlation coefficients for major and minor elements (after Exley and Stone, 1982, Table 23.1) \* Based upon 26 'average' analyses used and described in Stone and Exley (1978). Highly significant correlations have asterisks: these are values for which the Null hypothesis is rejected at the 0.01 significance level.

Boxed values are those belonging to the ferric element association.

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Group A sites:	Group B sites:	Group C sites:	Group D sites:
Lizard ophiolite and mélange	Pre-orogenic volcanics	Cornubian granite batholith	Post-orogenic volcanics
<ul> <li>Al Lésard Point (SW 696116 - SW 706115)</li> <li>Az Kennack Sands (SW 734166)</li> <li>Az Polbarrow-The Balk (SW 717136 - SW 715128)</li> <li>AK Kynance Cove (SW 684133)</li> <li>Coverack Cove-Dolor Point (SW 784187 - SW 788181)</li> <li>Porthoustock Point (SW 810217)</li> <li>Portholow Cove-Porthkerris Cove (SW 7961232 - SW 806226)</li> <li>Lankidden (SW 796164)</li> <li>Mullion Island (SW 690178)</li> <li>Alo Elender Cove-Black Cove, Prawle Point (SX 769353 - SX 769356)</li> </ul>	<ul> <li>B1 Porthleven (SW 658284 - SW 634250)</li> <li>B2 Cuddon Point-Prunsia Cove (SW 848275 - SW 555278)</li> <li>B3 Penlee Point (SW 474269)</li> <li>B4 Carrick Du-Clodgy Point (SW 67414 - SW 512410)</li> <li>B5 Carnards Head (SW 452387)</li> <li>B6 Botallack Head-Porth Ledden (SW 462303 - SW 355322)</li> <li>B7 Tator-da (SW 440230)</li> <li>B7 Pentire Point-Rumps Point (SW 92806 - SW 935812)</li> <li>B9 Chipley Ouarries (3X 807712)</li> <li>B10 Dinas Head-Trevose Head (SW 847781 - SW 830766)</li> <li>B11 Trevone Bay (SW 90762)</li> <li>B12 Glicker Tor Quarry (SX 263823)</li> <li>B14 Tintagei Head-Bossiney Haven (SX 047892 - SX 096895)</li> <li>B15 Brent Tor (SX 471804)</li> <li>B16 Greystone Quarry (SX 304807)</li> <li>B17 Pitts Cleave Quarry (SX 501781)</li> <li>B18 Trusham Quarry (SX 501781)</li> <li>B18 Trusham Quarry (SX 848807)</li> <li>B19 Kyecroft Quarry</li> <li>(SX 848807)</li> <li>B19 Kyecroft Quarry</li> <li>(SX 843847)</li> </ul>	C1 Haytor Rocks area (SX 788773) C3 Birch Tor (SX 688814) C3 De Lank Quarries (SX 101755) C4 Luxulyan (Goldenpoint, Tregarden) Quarry (SW 064891) C3 Leuadon Common (SX 704728) C6 Burrator Quarries (SX 546677) C7 Rinsey Core (Porthcew) (SW 68389) C3 Cape Corewall area (SW 68389) C1 Can Grey Rock and Quarry (SX 033551) C12 Tregargus Quarries (SW 948941) C13 St Mewan Beacon (SW 948941) C13 St Mewan Beacon (SW 98389) C15 Megiliggar Rocks (SW 991896) C16 Meldon Apilte Quarries (SW 69286) C16 Meldon Apilte Quarries (SW 69286) C17 Praa Sands (Folly Rocks) (SW 573320) C18 Cameron (Beacon) Quarry (SW 738386)	<ul> <li>D1 Kingsand Beach (SX 438506)</li> <li>D2 Webberton Cross Quarry (SX 878671)</li> <li>D3 Poshury Clump Quarry (SX 818973)</li> <li>D4 Hannaborough Quarry (SS 829028)</li> <li>D5 Killerton Park (SS 971005)</li> </ul>

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(Figure 2.6) Correlation of observed Devonian lithostratigraphy across Devon (after Durrance and Laming, 1982).



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(Figure 2.9) Distribution of the two main magmatic groups within the Exeter Volcanic 'Series', mid-Devon (after Edmonds et al., 1969).



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(Figure 3.6) Lithological borehole logs for the Traboe ultramafic—mafic cumulate complex at Traboe, Lizard area (data from Leake and Styles, 1984).



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(Figure 3.10) Banded gneiss, Kennack Sands. (Photo: M.T. Styles.)



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(Figure 3.23) Shear zones developed in gabbro, Carrick Luz, Lankidden. (Photo: M.T. Styles.)



(Figure 3.24) A spectacular development of pillow lavas, of Frasnian age, on Mullion Island. (Photo: P.A. Floyd.)



(Figure 3.25) Photomicrograph of pillow lava from Mullion Island. Primary plagioclase, zoned clinopyroxene and ilmenite are set in a secondary pumpellyite-facies mineral matrix. (Photo: P.A. Floyd.)



(Figure 3.26) The rocky cliffs of Elender Cove expose metavolcanic greenschists of the Start Complex. Elender Cove, near Prawle Point, Devon. (Photo: David Noton Photography.)





(Figure 4.1) Outline map of south-west England showing the location of Group B sites.

(Figure 4.2) Variation of Zr and Nb in Upper Devonian (small dots and crosses) and Lower Carboniferous (large dots) basaltic lavas relative to different geographical regions. Data largely from Floyd et al. (1983) and unpublished.



(Figure 4.3) Th—Hf—Ta variation in Devonian and Carboniferous basaltic rocks from different tectonic units and regions in south-west England. Tectonic discrimination fields from Wood (1980).



(Figure 4.4) Distribution of Ni and Cr in Variscan ultramafic bodies associated with dolerites and pillow lavas relative to ophiolitic and stratiform cumulates (boundaries from Figure 3.3).



(Figure 4.5) Apparently discordant relationship between a basic intrusive body (on the right) and adjacent foliated sediments of Lower Devonian age (on the left). Porthleven, Cornwall. (Photo: P.A. Floyd.)


(Figure 4.6) Simplified map of the Cudden Point greenstone body.



(Figure 4.7) Photomicrograph of the coarser facies of the Cudden Point greenstone showing primary augite partly replaced by a fringe of actinolite (cross polars). (Photo: P.A. Floyd.)



(Figure 4.8) Geological map of the Mousehole—Newlyn section of the Land's End Granite aureole, showing the distribution of the dolerite sills around Penlee Point (after Floyd, 1966a).



(Figure 4.9) Photomicrograph showing late zoned tourmaline replacing chloritic matrix of contact metamorphosed Penlee dolerite (cross polars). (Photo: P.A. Floyd.)



(Figure 4.10) View of the pillow-lava sequence at Clodgy Point, Penwith, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.11) Relationship between Upper Devonian pillow lavas and interlayered pelitic sediment, Clodgy Point, Penwith Peninsula.



(Figure 4.12) Polygonal cooling cracks on pillow-lava sequence at Clodgy Point, Penwith, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.13) Sketch of the tectonized contact between adinolized sediments and greenstone, Clodgy Point, Penwith Peninsula.



(Figure 4.14) Photomicrograph of mineral relationships in late amphibole-rich hydrothermal veins, near Clodgy Point, Penwith Peninsula (cross polars). (Photo: P.A. Floyd.)



(Figure 4.15) The two greenstone masses of Gurnard's Head. The intervening hollow is underlain by metasediments. Gurnard's Head, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.16) Sheared and flattened L. per Devonian pillow lavas associated with the massive greenstone body at Gurnard's Head, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.17) Geological map of the Botallack—Cape Cornwall section of the Land's End aureole, Penwith Peninsula (after Goode and Merriman, 1987).



(Figure 4.18) Section through the Botallack Mine, showing the sub-sea-floor workings and famous diagonal shaft, near St Just, Penwith Peninsula (after Embrey and Symes, 1987).



(Figure 4.19) Line drawing of the cliff-edge engine-houses of the Botallack Mine and the beginning of the diagonal shaft at The Crowns, near St Just, Penwith Peninsula (reproduced from Barton, 1965).



(Figure 4.20) Composite drawing of mineral relationships in the biotite—cordierite—anthophyllite assemblage, based on exotic hornfelses from the Zawn a Bal to Kenidjack area, Land's End aureole, Penwith Peninsula.



(Figure 4.21) Massive cliff section composed of various banded, amphibole-hearing, basic hornfelses of volcanic origin. In, the foreground is a small irregular raft of metasediment caught up during the emplacement of the basalts. Tater-du. Cornwall. (Photo: P.A. Floyd.)



(Figure 4.22) Typical, banded, basic hornfels of volcanic origin, composed of dark layers of hornblende and biotite, with light-coloured, segregation lenses of diopside. Tater-du, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.23) View of Pentire Point cliffs showing Upper Devonian pillow-lava mounds. (Photo: P.A. Floyd.)



(Figure 4.24) Pillow-lava breccia formed by fragmentation on cooling soon after submarine extrusion. Pentire Point, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.25) In situ autobrecciation of a lava pillow. Pentire Point, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.26) Upper Devonian pillow lavas of alkali-basalt composition. Chipley Quarries, Devon. (Photo: PA. Floyd.)



(Figure 4.27) Cross-section through two pillows showing the high degree of vesicularity and its concentric disposition. Chipley Quarries, Devon. (Photo: P.A. Floyd.)



(Figure 4.28) (Opposite) Wedge of argillite (pale-coloured cliffs) resting on dark intrusive dolerite near sea-level. Trevose Head, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.29) Photomicrograph of a hydrous dolerite showing large irregular crystal of dark, primary, kaersutitic amphibole replacing colourless clinopyroxene (bottom right); long needle-like apatite crystal traverses the amphibole unaltered (top). Trevone Bay, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.30) Photomicrograph of a hydrous dolerite showing the fan-like growth of secondary Al-rich pumpellyite that replaced the original plagioclase. Trevone Bay, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.31) Geological map of the area to the south of Liskeard showing the location of the Clicker Tor ultramafic body (after Burton and Tanner, 1986).



(Figure 4.32) Photomicrograph of partly altered olivine crystals (with veins) and intercumulus pyroxene in the ultramafic body at Clicker Tor, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.33) Weathering of the Polyphant ultramafic body (hydrous picrite) showing a core boulder of serpentinite within a highly oxidized, degraded matrix. Polyphant, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.34) Photomicrograph of the Polyphant hydrous picrite, showing serpentinized olivine crystals, pyroxene and dark kaersutitic amphibole (top left). Polyphant, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.35) (Opposite) Map and section of north Cornwall, showing the distribution and relationship of the major nappes (after Selwood and Thomas, 1986a). The Tintagel Volcanic Formation occurs in the Tredorn Nappe.



(Figure 4.36) Contorted greenschists belonging to the Tintagel Volcanic Formation at Gullastem, north of Tintagel, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.37) Distribution of the Tintagel Volcanic Formation between Bossiney Bay and Trebarwith Strand, north Cornwall (after Freshney and McKeown, in Dearman et al., 1970).



(Figure 4.38) Sketch and section of Tintagel headland, north Cornwall, showing the thin upper slice of the Tintagel Volcanic Formation truncated by thrusts and cut by later normal faults (after McKeown. in Dearman et al., 1970).



(Figure 4.39) The conical knoll of Brent Tor is composed of Lower Carboniferous basaltic pillow lavas and hyaloclastites which formed a near-emergent seamount with a reworked volcaniclastic apron. Brent Tor, Devon. (Photo: P.A. Floyd.)



(Figure 4.40) Map and cross-sections of Greystone Quarry, showing the development of undulating thrust surfaces cutting dolerite and the transportation of Upper Devonian sediments over Lower Carboniferous volcanics by the major Greystone Thrust (after Turner, 1982).



(Figure 4.41) Diagrammatic sketch of intrusive dolerite bodies in the Pitts Cleave Quarry, near Tavistock (after Dearman and Butcher, 1959). A) main face (c. 230 m long) and B) southern face (c. 85 m long).



(Figure 4.42) Well-developed columnar jointing in dolerite. Pius Cleave Quarry, Tavistock, Devon. (Photo: P.A. Floyd.)



(Figure 4.43) Modal and chemical variation in thu• upper part of the Ryecroft dolerite sill, Teign Valley, east Devon (data from Morton and Smith, 1971).



(Figure 5.1) Outline map of south-west England showing the location of Group C sites.



(Figure 5.2) Normative quartz-albite-orthoclase (Q-Ab-Or) diagram (after Exley and Stone, 1982, Figure 23.2).



(Figure 5.3) Variation diagrams for Zr—K/Rb, Zr/TiO<sub>2</sub>—K/Rb, Nb—Y and Zr—TiO<sub>2</sub> in south-west England granite types and different plutons (after Exley et al., 1983).



(Figure 5.4) The St Austell model. Diagram showing the first intrusion of Type-B granite (Table 5.1) cut by multiphase second intrusion of biotite granite, with metasomatic aureole of Type D caused by intrusion of Type E.

Type	Description	Texture	Minerals (approximate mean modal amounts in parentheses) K-feldsnar Planioclase Quartz Micas Tourmaline Other						Other names in literature
A	Basic microgranite	Medium to fine; ophitic to hypidiomorphic	(Amounts vary)	Olipoclase- andesine (amounts vary)	(Amounts vary)	Biotite predominant; some muscovite	Othen present	Hornblende, apatite, zircon, ore, gazzet	Basic segregations (Reid et al., 1912); Basic inclusions (Brammall and Harwood, 1923, 1926)
B	Coarse-grained megacrystic biodie granite	Medium to coarse; negacrysts 6-17 cm maximum, mean about 1 cm. Nypriormorphic, granular	Euhedral to subbedral; microperibile (32%)	Eubedral to subbedral. Oben atned. cores Progr-Ange. time Ang-Ange. (22%)	irregular (34%)	Biotite, often in chanters (5%); mancovite (4%)	Exhedral to ashedral. Often socied. Primary' (1%)	Zirron, ere, spatier, undabasto, etc. (total, 1%)	Includes: Giant or tor grazzie (Brammall, 1826; Brammall and Barwood, 1023; 1853) = big is foldspar grazine (Edmonds et al., 1863), coarse megacrystic grazite (Brawnall, 1866; Brammall and Barwood, 1863; 1853) = poorly megacrystic grazzie (Giamonds et al., 1986; coarse megacrystic grazzie (mesocrystic type) (Barwall megacrystic trained (Damperfold and Reviews, 1991). Alar medium-grazzie (Giamonds, 1992) (Barwall megacrystic trained (Damperfold and Reviews, 1991). Alar medium-grazzie (Barwise and Damperfold, 1978), medium-grazzie (Barwise, 1981). Barwise, 1991). Mar- medium-grazzie (Barwise, 1981). Barwise, 1991). Mar- medium-grazzie (Barwise, 1981). Barwise, 1991), marc (Damperfold and Braines, 1981). Barwise, 1991), diotic grazzie, and globular quarts grazzie (Pill and Marssing, 1987).
c	Pine-grained biotite granite	Mediam to fine, sometimes megacrystic, hypidiomorphic to splitic	Subhedral to anhedral; sometimos microperthitic (30%)	Bahedral to subbedral. Often aoned: cores An <sub>10</sub> -An <sub>13</sub> (26%)	hrægslær (33%)	Biotite 3%; muscovite (7%)	Exhedral to anhedral. Primary' (1%)	Ore, andalusite, fluorite (total, <1%)	Pine granite, megaceyat-rich and megaceyat-poor types (Hewlees and Dangerfield, 1978; Dangerfield and Hawkee, 1991)
D	Megacrystic lithurs-mica granite	Medium to coarse; menucrysta 1-8.5 cm, mean about 2 cm. Hypidiomorphic, granular	Euhedral to subhedral; microperthitic (87%)	Enhedral to subbedral. Unaoned, Any (26%)	hrregular; some aggregates (36%)	Lithiurs-mica (6%)	Eubodral to anhedral "Primary" (4%)	Pluorite, ore, apatite, topaz (total, 0.5%)	Lithionite gnanite (Pichardson, 1923), Early lithionite gnanite (Earley, 1969), Porphyritic ithionite gnanite (Earley and Stone, 1964), Mogacrystic lithium-mics gnanite (Earley and Stone, 1982)
E	Equigramlar lithium-mica granite	Medium grained; hypidiomorphie, granular	Anhodral to intentitia'; microperthitic (24%)	Enhodral. Unzoned, An <sub>4</sub> (32%)	hrregular; some aggregates (30%)	Lithium mica (9%)	Euhedral to anhedral (1%)	Phonete, apartice (total, 2%); topaz (3%)	Late lithiosite grazite (Edey, 1989). Nos-porphytic lithiosite grazite (Edey and Stone, 1946). Median-grained. non-meso-projectic lithium-mics grazite (Edewises and Dangerfield 1978; Equipramile lithium-mics grazite (Edey and Stone, 1962; Topagrazite (Hand Manning, 1967)
r	Pluorite granite	Medium-grained; hypidiomorphic, granular	Sub-anhedral; microperthitic (27%)	Eshedral. Unsoned, An <sub>4</sub> (34%)	hregular (30%)	Muscovite (6%)	Abeent	Phoorite (2%), topaz (1%), apatite (<1%)	Gulbertite granice (Richardson, 1923)

(Table 5.1) Petrographic summary of main granite types (based on Exley et al., 1983)



(Figure 5.5) Chondrite-normalized REE profiles for Corinthian granites. Data for Land's End, Carnmenellis, Bodmin Moor and Dartmoor from Darbyshire and Shepherd (1985).



(Figure 5.6) The 1980s model. Granitic magma generated in the lower crust (but with mantle components) and evolving both by assimilating upper-crustal constituents and differentiating Li-mica granite magma. Magma becomes increasingly hydrated by drawing in increasing quantities of meteoric water during ascent.



(Figure 5.7) Schematic representation of fluid evolution in the eastern sector of the Cornubian metallogenic province showing the importance of 'immiscibility events' and mixing (after Shepherd et al., 1985).



(Figure 5.8) Diagrammatic representation of water circulation in Cornubian granite. Areas of low heat flow, U and <sup>222</sup>Rn concentration are associated with china clay and indicate draw-down; areas of high heat flow, U and <sup>222</sup>R11 concentration indicate uprise (based on Durrance et al., 1982).



(Figure 5.9) Haytor Rocks, exposing the coarse megacrystic granite of Dartmoor. The megacrystic character of the granite is visible in the foreground exposure. (Photo: S. Campbell.)



(Figure 5.10) Map of the St Austell Granite outcrop, showing the chief granite types, localities mentioned in the text (filled circles) and the following sites: C4 = Luxulyan Quarry; C10 = Wheal Martyn; C11 = Cam Grey Rock; C12 = Tregargus Quarries; C13 = St Mewan Beacon; and C14 = Roche Rock.



(Figure 5.11) Contact between Dartmoor Granite and Devonian slates, re-exposed after face cleaning by the Nature Conservancy Council in 1980. (Photo: Mj. Harley.)



(Figure 5.12) Diagrammatic section across the Tregonning Granite, based on coastal exposures, showing the location of sites at Rinsey Cove (C7) and Megiliggar Rocks (C15) (after Exley and Stone, 1982, figure 21.2).



(Figure 5.13) The headland of Cape Cornwall which exposes contacts between Land's End Granite and adjacent metasediments. (Photo: S. Campbell.)



(Figure 5.14) Geological sketch map of the Cape Cornwall area (site (:8).



(Figure 5.15) Small granite cupola emplaced in pelitic hornfelses of the Mylor Slate Formation. Porthmeor Cove, Cornwall. (Photo: K.A. Cottle.)


(Figure 5.16) Later dyke of megacrystic granite cutting and displacing an earlier leucogranite dyke. Porthmeor Cove, Cornwall. (Photo: R.A. Cottle.)



(Figure 5.17) The craggy outcrop of Roche Rock consists of quartz—tourmaline (schorl) rock. Roche Rock, Cornwall. (Photo: R.A. Cottle.)



(Figure 5.18) Pegmatite—aplite—granite sheets cutting Mylor Slate Formation metasediments in the cliffs at Legereath Zawn, near Tremearne Par. Megiliggar Rocks, Cornwall. (Photo: C.S. Exley.)

![](_page_74_Picture_0.jpeg)

(Figure 5.19) Pegmatite—aplite—granite layering in one of the granitic sheets. Megiliggar Rocks, Cornwall. (Photo: C.S. Exley.)

![](_page_75_Picture_0.jpeg)

(Figure 5.20) Pegmatite—aplite—granite boulder on Tremearne Beach, demonstrating the quasi-sedimentary character of the igneous layering. Megiliggar Rocks, Cornwall. (Photo: C.S. Exley.)

![](_page_76_Figure_0.jpeg)

(Figure 5.21) (Opposite) Detailed map of Cameron Quarry (after Hosking and Camm, 1985).

![](_page_77_Figure_0.jpeg)

(Figure 5.22) Coastal section of the Cligga Head Granite, site C19 (after Moore and Jackson, 1977).

![](_page_77_Figure_2.jpeg)

(Figure 6.1) Outline map of south-west England, showing the location of Group-D sites.

![](_page_78_Figure_1.jpeg)

(Figure 6.2) Chondrite-normalized multi-element patterns for the A) basaltic and B) lamprophyric suites of the Exeter Volcanic 'Series' (data from Leat et al., 1987).

![](_page_79_Figure_0.jpeg)

(Figure 6.3) Chondrite-normalized REE patterns for Permian rhyolites (from Floyd, unpublished) and south-west England granites (data from Alderton et al., 1980).

![](_page_79_Picture_2.jpeg)

(Figure 6.4) Flow-banded rhyolite lava of Permian age that may have formed part of the volcanic field developed above the Cornubian granite batholith. Kingsand, Devon. (Photo: P.A. Floyd.)

![](_page_80_Picture_0.jpeg)

(Figure 6.5) Silica phenocrysts in the flow-banded, partly devitrified matrix of the Permian rhyolite lava. Kingsand, Devon. (Photo: P.A. Floyd.)

![](_page_80_Figure_2.jpeg)

(Figure 6.6) Sketch of the lava—sediment relationship at the base of a late Stephanian basalt lava flow of the Exeter Volcanic 'Series', Webberton Cross Quarry, near Exeter.

![](_page_81_Picture_0.jpeg)

(Figure 6.7) Highly amygdaloidal (vesicles infilled with white zeolites and/or clays) and oxidized subaerial basalt lava flow. Webberton Cross Quarry, Devon. (Photo: P.A. Floyd.)

![](_page_81_Figure_2.jpeg)

Intrusive phase	Outcrop and granite type	Rb-Sr age (Ma)	Initial <sup>87</sup> Sr/ <sup>86</sup> Sr ratio	Comments
Major	Dartmoor (B)	280 ± 1	0.7101 ± 0.0004	
Chevrolet de	Bodmin Moor (B)	$287 \pm 2$	0.7140 ± 0.0002	Mineral age
difference of	St Austell (B)	$285 \pm 4$	0.7095 ± 0.0009	
	Carnmenellis (B)	$290 \pm 2$	0.7130 ± 0.0020	Mineral age
	Tregonning (E)	280 ± 4	$0.71498 \pm 0.00381$	Highly evolved, lithium-rich
atomic of	Land's End (B)	268 ± 2	0.7133 ± 0.0006	Mineralization re-set age
Minor	Hemerdon Ball	304 ± 23	$0.70719 \pm 0.01025$	Heavily mineralized
1000	Kit Hill	$290 \pm 7$	$0.70936 \pm 0.00228$	( serve preserves) ten states?)
agerback3e	Hingston Down	282 ± 8	$0.71050 \pm 0.00119$	and the state of the second
and so the second	Castle-an-Dinas	$270 \pm 2$	$0.71358 \pm 0.00122$	Later intrusion re-set age
1000000	Carn Marth	298± 6	$0.70693 \pm 0.00207$	ero and the bas out the basis
Dykes	Meldon 'Aplite'	279 ± 2	0.7098 ± 0.0017	Dig Trent view
and a second	Brannel Elvan	270 ± 9	0.7149 ± 0.0031	Re-analysed
1001.000	Wherry Elvan	282 ± 6	$0.7120 \pm 0.0025$	Re-analysed
Mineral	South Crofty	269 ± 4		en later
veins	Geevor	$270 \pm 15$	0.7122 ± 0.0012	the sea in the local diversion of the second s

(Table 2.1) Ages and initial Sr isotopic ratios of granitic rocks from the Cornubian batholith (data from Darbyshire and Shepherd, 1985, 1987)

		Age					Direction	Main chang	pes in mineralogy		Associated	
S:age	Process	(millons of years) *	Depth (km)	(°C)	Salinity of Buids	Source of heat	stress	Feldspar	Quarta	Mica	mineralization	Comments
1	Emplacement of biorite graxite, ferming main batholith	290-265	73	500-800		Magnatic	Varisoan (E-W)					Biotite granite which now forms eastern part of the St Asseed granite
п	First phase of post-magmatic aberation and mineralization	285-225	2-3	500-1200	Moderate	Magnatic	Initially E - W, then N - 5	Limited creasenination alongside veins	112		Sn, W	Early greisenization and superalization e.g. Castle-an-Dinas (W
Ша	Emplacement of evolved lithium rich gratines and biotite gratines in western part of St Austell gratite	239-230	2-3	500-600		Magmaric	N - 5					Goazites belonging to this phase may underlie much of the batholith. Goazites hydraulically fractured
шь	First part of second phase of post-magmatic alteration and mineralization	875-870	72	650-380	Moderate	Mainly migmatic, some radiogenic	N - 5 or NW - SE	Guinensiation converted to quarts, mice and topas by F-rich Buda, mice of gilbertite type. Desenationetice: reglaced by tournaline	Repeatedly Inscruzed and Discruzes annealed by Deals growths of quarts	Some re-crystallisation, biotite loses iron which is taken up by loaznalize growth	Bn, W, Cu	Main phase of metalliferous mineralization
IIIe	Emplacement of felaitic olvun dylena	278-270	72	600-500	Moderate	Magmatic	N - S				Sn. W. Cu	Further input of magnatic heat
IV	First phase of argilic alteration and NW-SE or N-S quarth-bernatile veine and faulting	276-280	71.2	350-300	Moderate to high	Mainly radiogenic, possebly some magmatic or mantle basi	E.W	Na isidamar altered to emeethe like assemblage, little kaolutie K foldspur, sittered to tilles, maybe some smeethe	Press siliers released by argillation, forms overgrowths on quarts and now ioon-stained non-tournaline bearing lodes (NW - SE and N - S)	Mach iron liberated from biotize which is carried out of the grashe to form iron locks. Some mice hydrated to gilbertibe	Fe/U/Pb/Za	Note: Salinity, lack of kaolinite and change in stress direction. Low imperature mataliflarous minecalization
				2223		Quier	cent period?					110
v	Second phase of angilic alteration. Main period of kaolinisation Rosep Measure apergene aberation?	260 to present	02-1.5	50-150	Low	Radiogenic	Variable E - W or N - S, later becoming vertical	Na heldsping: alwayd roadily to kaolinito <u>K feldspig:</u> silvered less readily to kaolinite <u>Smertine</u> alwayd readily to kaolinite	Preve silica released by argillation, forms overgrowths on quark and some minor quarks veine	Same iror. Eberated from botto, not carried out of grazite so colouri matrix, la areas of intense kaolinization moca/line alternd to kaolinite	Pe/U (minor)	Note: Fresh water and main opiacds of keolin formation. Isostatic uplift may have played a pan
VI	Early Teetiary chemical weathering (also Mosconic?)	25-60	0.0-0.3	20-50	Low	High surface temperature	Vertical	Alternet isaointile, is b-axis disordered in Eccene-Oligocene weathering	Some solution of allice from quarts grains	Some iron liberated from bostne, not carried out of the graulie no colours matrix. In areas of intense keedinization wrica/films alterned to kaolimite		Tertiary weathering manfle is source of material for hall clays and associated sediments

(Table 2.2) Main evolution and alteration stages of the St Austell Granite (after Bristow et al., in press)

		Type B		Typ	pe C	Ty	pe D	Type E	Type F	Granite porphyry	Microgranite
	Bodmin Moor	Carnmenellis	Geevor Mine	Geevor Mine	Bodmin Moor	St Austell*	Cligga Head	Tregonning -Godolphin	St Austell*	Tregonning -Godolphin	Meldon micro -granite dyke NW Dartmoor
	(N = 10)	(N = 12)	(N = 7)	(N = 1)	(N = 3)	(N = 8)	(N =2)	(N = 10)	(N = 5)	(N = 2)	(N =1)
50.	72.43	72.63	71.20	73.70	74.00	73.01	78.73	71.10	74.00	72.60	72.80
TIO,	0.21	0.28	0.35	0.06	0.07	0.14	0.13	0.06	0.07	0.20	0.04
Al.O.	15.03	14.68	14.20	14.10	14.78	14.72	14.85	16.11	15.81	14.50	16.40
Fe <sub>2</sub> O <sub>1</sub>	0.32	0.50	0.80	0.60	0.10	0.47	0.34	0.35	0.08	1.88	
FeO	1.48	1.24	1.38	0.44	0.85	0.74	0.94	0.81	0.17	1.21	0.84
MnO	0.04	0.05	0.03	0.03	0.03	0.03	0.05	0.07	0.01	0.05	0.09
MgO	0.44	0.48	0.60	0.05	0.18	0.14	0.33	0.09	0.08	0.26	0.05
CaO	0.84	1.12	1.12	0.56	0.44	0.44	0.41	0.59	1.31	0.28	1.28
Na <sub>2</sub> O	3.11	3.11	2.82	2.86	2.74	3.42	3.21	3.73	4.06	0.12	2.77
E.O	8.06	4.36	5.11	4.77	6.73	5.36	5.05	4.84	4.66	7.66	3.95
14,0	0.06	0.07	0.08	0.07	0.04	0.18	0.11	0.87	0.01	0.03	0.94
PrO.	0.25	0.18	0.24	0.32	0.25	0.53	0.15	0.50	0.46	0.26	0.48
1,0,			0.41	0.47			0.27	0.14			
F						(0.58)	0.38	1.22	(1.36)	12000	1.40
H <sub>2</sub> O	1.01		0.73	1.38	0.88		1.13				
Nb	0.0	17	30	40		57		93	81	21	67
21	121	137	185	40	34	(90)	65	46	0.0	94	38
Y	41	48	30	20	40			10	-	18	
Se .	94	92	95	23	43	41	178	61	. 64	34	47
Eb	419	462	480	760	444	982	695	1218	615	814	2293
Ia	196	397	230	15	102	(83)	150	204	(43)	699	197
La	31	10			12	8		-3		14	15
Ce	38		-		2	34	95	36	19	68	27
U								19		20	24
Th		*	-					23		31	
Fb	46	47	15	10	42		-	16		0	6
Ga		40	30	30			40	40		20	38
Zn	62	72	45	35	48		103	48		45	31
Ge	-		-		-			11		4	11
Sn	23	14	19	17	29		40	.36		71	14
Cs	28	34		-	48			127		33	223
-	100	78	88	62	107	45	60	33	63	78	14

(Table 5.2) Average analyses of granites from the Cornubian batholith (after Exley et al. 1983)

	Р	K	Na	Ca	Mg	Mn	Fen	Fem	Al	Ti
Si	- 0.45	+0.11	- 0.05	- 0.26	- 0.29	- 0.26	- 0.36	- 0.28	- 0.61	0.33
Ti	- 0.48	+0.07	- 0.21	+0.75*	+0.90*	- 0.27	+0.77*	+0.40	- 0.35	
A	+0.72*	- 0.28	+0.33	- 0.24	- 0.33	+0.43	- 0.23	- 0.16		
Fe	- 0.20	+0.61*	- 0.69*	- 0.13	+0.34	- 0.16	+0.21			
Fe	- 0.09	- 0.04	- 0.01	+0.60*	+0.76*	- 0.04				
M	+0.61*	- 0.29	+0.23	- 0.20	- 0.34					
M	- 0.46	+0.02	- 0.11	+0.67*						
Ca	- 0.40	- 0.37	+0.24							
Na	+0.33	- 0.92								

\* Based upon 26 'average' analyses used and described in Stone and Exley (1978). Highly significant correlations have asterisks: these are values for which the Null hypothesis is rejected at the 0.01 significance level. Boxed values are those belonging to the femic element association.

(Table 5.3) Pearson product moment correlation coefficients for major and minor elements (after Exley and Stone, 1982, Table 23.1) \* Based upon 26 average analyses used and described in Stone and Exley (1978). Highly significant correlations have asterisks: these are values for which the Null hypothesis is rejected at the 0.01 significance level. Boxed values are those belonging to the ferric element association.