# C7 Rinsey Cove (Porthcew)

[SW 593 269]

## Highlights

This site has a unique section through a pelitic roof pendant in a granite pluton. Its late-stage and metasomatic minerals and textures in the granite and country rock, reflect the influence of magmatic volatile constituents.

Introduction

There are several places where contacts between Cornubian granites and their country rocks can be seen, but this section (Figure 5.12) through a roof pendant is unique. Not only do its margins show stepped contacts, xenoliths and granite apophyses, demonstrating the emplacement of the Tregonning Granite by stoping, but the granite itself, a lithium-mica-bearing variety, has developed a roof complex of leucogranite, pegmatite and aplite associated with a coarse-grained facies at the contact. Together with extensive tourmalinization, these features demonstrate the effects of volatiles such as OH, F and B during crystallization as they became progressively concentrated close to a nearby impermeable envelope.

A detailed field description and petrography was given by Hall (1930), general accounts of the petrogenesis are included in Exley and Stone (1982) and Exley *et al.* (1983), and details of the origin of the Li- and F-rich granite come from Stone (1975, 1979, 1984). The origin of the roof complex has been explained by Stone (1969), Bromley and Holl (1986) and Badham (1980).

## Description

Rinsey Cove, or Porthcew, is on the south coast of Cornwall immediately to the east of Rinsey Head and about 4 km north-west of Porthleven. The Tregonning–Godolphin Granite pluton, which meets the coast here, is composed of two variants; the more northerly Godolphin facies consisting of fine-grained, megacrystic biotite granite (Type C, (Table 5.1); Exley and Stone, 1982), while the southern Tregonning facies, exposed in the coast section, is made up of medium-grained, non-megacrystic lithium-mica–albite–topaz granite (Type E, (Table 5.1); Stone, 1975; Stone and Exley, 1982). This has developed a local megacrystic facies and banding which, unlike that in western parts of the Bodmin Moor Granite, is not tectonic in origin, and which is parallel with the contact with the roof, visible on the west side of Rinsey Head and in the cliffs on both sides of the cove. This contact is sharp and dips seaward at about 30°, the granite immediately beneath it being somewhat coarser than average and having a sheet complex of lithium-mica leucogranite–aplite–pegmatite just below.

Tourmalinization is common in xenoliths which are found in all stages of assimilation, and acicular tourmaline appears on the underside of the country rocks near the cliff top at the eastern side of Rinsey Cove.

The rocks which make up the roof and pendant, which occupy most of the Cove, are Mylor Slate Formation metasediments which, although predominantly dark and pelitic, contain semipelite and psammite and thus have a striped or banded appearance. The place of the Mylor Slate Formation in a wider context of stratigraphy and structure has been discussed by Leveridge *et al.* (1984) and Leveridge and Holder (1985). The rocks also contain numerous quartz veins, both contorted and cross-cutting, much of the silica for which seems to have been derived from the mobilization of quartz within the rocks by the compression and heat of metamorphism. The local structure, better seen here than at many contacts, consists of recumbent folds, on the limbs of which are minor folds resulting from an earlier deformation. There are two cleavages, of which the more striking (originally termed $S_2$ but now redesignated $S_3$ to correspond with the regional chronology) is subhorizontal and undisturbed by the granite (Stone and Lambert, 1956; Stone, 1966).

In addition to being folded, the metasediments have been thermally metamorphosed to spotted hornfelses, with the development of cordierite, andalusite (locally chiastolite) and, through metasomatism, tourmaline. Corundum, present in the Land's End metasediments at Priest's Cove, has not been found, and migmatization, like that associated with the Dartmoor Granite at Burrator and Leusdon Common, is absent.

On the west side of Rinsey Cove, the contact dips towards the Cove at 20–30°, cutting across the flat-lying cleavage, but is 'stepped' along joints in units from 0.5 to 4 m high, demonstrating emplacement of the granite by stoping and subsidence; disorientated xenoliths and apophyses of granite show how the magma penetrated the killas and prised blocks away. Coarse granite and aplite–pegmatite layers up to 3-m-thick are present. At the head of the cove, a cave has been eroded along the contact which here shows evidence of having been faulted and mineralized. The eastern contact is nearly vertical and may be either intrusive or faulted. The main body of the granite has a medium-grained texture almost up to the contact where there are 1-m-thick pegmatite and pegmatitic patches nearby. A smaller, elliptical pendant or large xenolith about 15 m across and also accompanied by pegmatitic patches is exposed between tide marks on the shore a few metres to the south.

## Interpretation

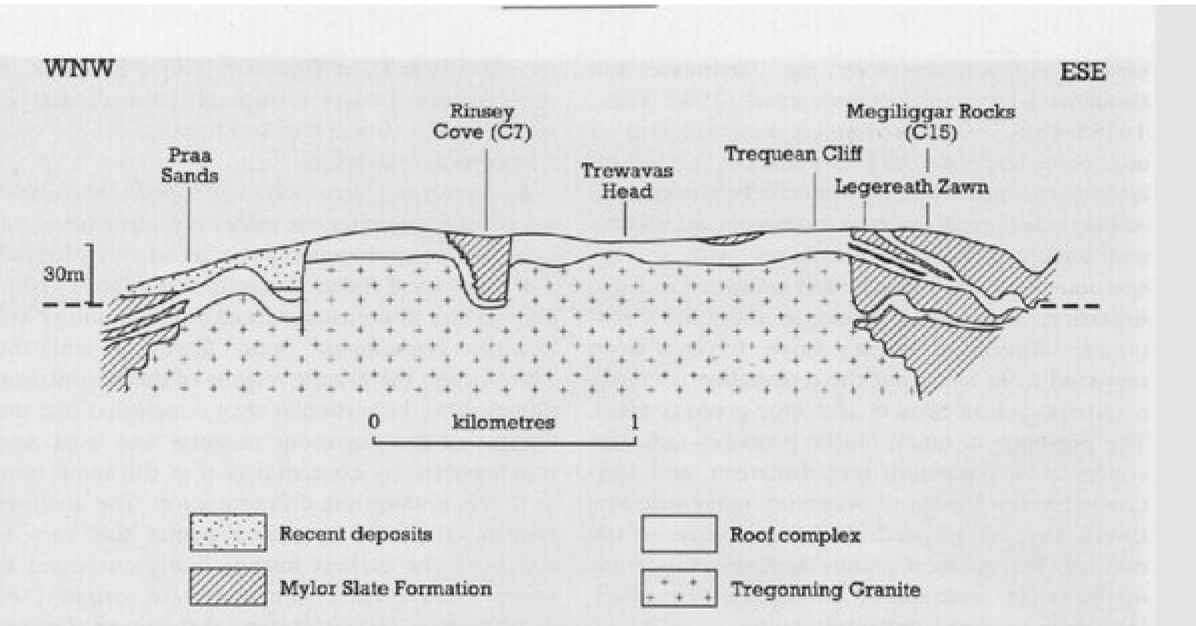
It is considered that the magma producing the Tregonning Granite evolved from the Godolphin magma as a consequence of the deep-seated separation of a fluorine- and OH-rich fraction and ion exchange to enrich the Tregonning magma in Li, Na and Al at the expense of Fe, Ca and Mg. Biotite was thus replaced by zinnwaldite, and plagioclase became more albitic. This process is demonstrated elsewhere in the St Austell mass (discussed below, Tregargus Quarries). The sheets of the roof complex at Rinsey indicate the building up of a later, volatile-rich residuum under a relatively impermeable roof. The lithium-mica leucogranite represents a direct continuation of magmatic melt evolution, whereas the aplite represents a crystallized silicate liquid, and the pegmatite replaces aplite which was metasomatized by a K-rich aqueous fluid (Stone, 1969; Manning, 1982; Exley and Stone, 1982; Exley *et al.,* 1983; Manning and Exley, 1984; Pichavant and Manning, 1984). The roof complexes of other granites, for instance Land's End (seen near Cape Cornwall and Porthmeor Cove), are much simpler because of the absence of the lithium-mica granite component, while the related sheets of Megiliggar Rocks, a short distance to the southeast, are both thicker and more complex. The difference between aplitic and pegmatitic textures could, however, equally be a result of pressure variations following successive openings of the rock initiated by the movement of foundering blocks, as suggested by Bromley and Holl (1986). Badham (1980) combined features of both these explanations, accepting the variations in fluid compositions but emphasizing the importance of physical conditions in determining textures. The lithium-bearing micas from the Tregonning Granite and its leucogranite sheets, whose exact compositions were uncertain for many years, have now been identified as zinnwaldite and lepidolite respectively (Stone *et al.,* 1988).

The only other exposures of this type of granite are found in the western part of the St Austell mass, but in this case they are intruded into granite. Moreover, the roof complex, seen only in china clay pits in the vicinity of Hensbarrow Beacon, has not developed as distinctive a display of leucogranite, aplite and pegmatite as that at Rinsey Cove.

## Conclusions

This site shows outstanding sections through the upper part of one of the plutons of the Cornubian Granite mass and its junction with the older sedimentary rocks which it has intruded, baked and altered. Here may be seen evidence of how the granite was emplaced when still molten rock, by the undermining and dislodgement of blocks of the surrounding rocks by forcefully penetrating joints and fissures (a process called stoping), followed by subsidence of blocks into the magma. Blocks thus prised off from the country-rock walls and a possible hanging mass of baked sediments are seen to be surrounded by granite. In time, the molten granite would have assimilated the blocks, but here they have survived because the granite cooled and solidified before this could happen. The site has a well-developed roof complex, the upper-formed product of the granite magma. Although still of granite composition, the component pegmatite, aplite and leucogranite of the complex differ in detail from one another and from the earlier-crystallized granite as a result of losing some constituents of early crystals, increased concentration of volatiles, and interactions between the constituents.

**References**




*(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).*

| Type | Description | Texture | Minerals (approximate mean modal amounts in parentheses) K-feldspar | Plagioclase | Quartz | Micas | Tourmaline | Other | Other names in literature |
|---|---|---|---|---|---|---|---|---|---|
| A | Basic microgranite | Medium to fine; ophitic to hypidiomorphic | (Amounts vary) | Oligoclase-andesine (amounts vary) | (Amounts vary) | Biotite predominant; some muscovite | Often present | Hornblende, apatite, zircon, ore, garnet | Basic segregations (Reid et al., 1912); Basic inclusions (Brammall and Harwood, 1923, 1926) |
| B | Coarse-grained megacrystic biotite granite | Medium to coarse; megacrysts 5-17 cm maximum, mean about 2 cm. Hypidiomorphic, granular | Euhedral to subhedral; microperthitic (32%) | Euhedral to subhedral. Often zoned: cores $An_{35}$-$An_{30}$, rims $An_8$-$An_{15}$ (22%) | Irregular (34%) | Biotite, often in clusters (6%); muscovite (4%) | Euhedral to anhedral. Often zoned. 'Primary' (1%) | Zircon, ore, apatite, andalusite, etc. (total, 1%) | Includes: Giant or tor granite (Brammall, 1926; Brammall and Harwood, 1923, 1932) = big feldspar granite (Edmonds et al., 1968), coarse megacrystic granite (Hawkes and Dangerfield, 1978). Also blue or quarry granite (Brammall, 1926; Brammall and Harwood, 1923, 1932) = poorly megacrystic granite (Edmonds et al., 1968), coarse megacrystic granite (mesocrystic type) (Hawkes and Dangerfield, 1978), coarse megacrystic granite (small megacryst variant) (Dangerfield and Hawkes, 1981). Also medium-grained granite (Hawkes and Dangerfield, 1978), medium granites with few megacrysts and megacrysts very rare (Dangerfield and Hawkes, 1981). Biotite-muscovite granite (Richardson, 1923; Exley, 1959). Biotite granite, equigranular biotite granite, and globular quartz granite (Hill and Manning, 1987). |
| C | Fine-grained biotite granite | Medium to fine, sometimes megacrystic; hypidiomorphic to aplitic | Subhedral to anhedral; sometimes microperthitic (30%) | Euhedral to subhedral. Often zoned: cores $An_{10}$-$An_{15}$ (26%) | Irregular (33%) | Biotite 3%; muscovite (7%) | Euhedral to anhedral. 'Primary' (1%) | Ore, andalusite, fluorite (total, <1%) | Fine granite, megacryst-rich and megacryst-poor types (Hawkes and Dangerfield, 1978; Dangerfield and Hawkes, 1981) |
| D | Megacrystic lithium-mica granite | Medium to coarse; megacrysts 1-8.5 cm, mean about 2 cm. Hypidiomorphic, granular | Euhedral to subhedral; microperthitic (27%) | Euhedral to subhedral. Unzoned, $An_7$ (26%) | Irregular; some aggregates (36%) | Lithium-mica (6%) | Euhedral to anhedral 'Primary' (4%) | Fluorite, ore, apatite, topaz (total, 0.5%) | Lithionite granite (Richardson, 1923). Early lithionite granite (Exley, 1959). Porphyritic lithionite granite (Exley and Stone, 1964). Megacrystic lithium-mica granite (Exley and Stone, 1982) |
| E | Equigranular lithium-mica granite | Medium-grained; hypidiomorphic, granular | Anhedral to interstitial; microperthitic (24%) | Euhedral. Unzoned, $An_4$ (32%) | Irregular; some aggregates (30%) | Lithium-mica (9%) | Euhedral to anhedral (1%) | Fluorite, apatite (total, 2%); topaz (3%) | Late lithionite granite (Exley, 1959). Non-porphyritic lithionite granite (Exley and Stone, 1964). Medium-grained, non-megacrystic lithium-mica granite (Hawkes and Dangerfield, 1978). Equigranular lithium-mica granite (Exley and Stone, 1982). Topaz granite (Hill and Manning, 1987) |
| F | Fluorite granite | Medium-grained; hypidiomorphic, granular | Sub-anhedral; microperthitic (27%) | Euhedral. Unzoned, $An_4$ (34%) | Irregular (30%) | Muscovite (6%) | Absent | Fluorite (2%), topaz (1%), apatite (<1%) | Gilbertite granite (Richardson, 1923) |

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