# C15 Megiliggar Rocks

[SW 609 266]

## Highlights

This is the only well-exposed site which shows contacts between lithium-mica granite and pelitic hornfels, sheets of leucogranite, aplite and peg matite developed from a late-stage granitic roof complex, and unusual minerals.

## Introduction

This site (Figure 5.12) includes both cliffs and foreshore over a length of about 1 km below Tremearne Farm, just over 2 km north-west of Porthleven. Within it are the eastern contact of the Tregonning part of the Tregonning–Godolphin Granite with its country rocks and a series of granitic sheets developed from the intrusion as an extension of its roof complex.

The mixed sediments of the Mylor Slate Formation are strongly folded, cleaved and veined in a manner typical of the Cornish links% the local structures have been discussed by Stone and Lambert (1956) and Stone (1966, 1975) and the regional setting of the Mylor Slate Formation by Holder and Leveridge (1986). The sediments have been thermally metamorphosed into cordierite- and andalusite-hornfelses near the granite.

The granite (Type E, (Table 5.1); Exley and Stone, 1982) is thought to have originated at depth by a complex exchange process. As described earlier ('Petrogenesis' section), this was facilitated by an F-rich phase and involved the replacement of Fe–Mg in biotite by Li–Al to produce zinnwaldite, and the albitization of plagioclase. In the opinion of Stone (1975 *et seq.*), this occurred in solid biotite granite, which was then remobilized as Type-E magma, while Manning (1982) considers that it could have been part of a process of magmatic differentiation (Stone, 1975, 1984; Manning, 1982; Exley and Stone, 1982; Exley *et al.,* 1983; Manning and Exley, 1984; Pichavant and Manning, 1984). Either way, this variety of granite is exposed elsewhere only in the St Austell outcrop.

From the eastern contact, a series of sheets of pegmatite, aplite and leucrogranite, changing from one to another both vertically and laterally, cuts through the cliffs and along the beach (Figure 5.18). Stone (1969, 1975) and Exley and Stone (1982) have ascribed the varied rock types to the contrasted partioning of elements between discrete liquid and vapour phases, but Bromley and Holl (1986) have suggested that these phases themselves arose from pressure variations triggered by the opening of cavities by subsidence of country rock. Badham (1980) argued that temperature variation controlled the development of the various rock types. The sheets are characteristically lithium rich, and Stone (1984) and Stone *et al.* (1988) believe that some of the lepidolite in these late rocks may have been magmatic, rather than metasomatic like most of the Li-mica in the region. Many unusual minerals occur here, among them amblygonite (Stone and George, 1979) and triplite (George *et al.,* 1981).

## Description

The country rocks at Megiliggar Rocks are banded, light and dark grey and buff psammites, semipelites and pelites of the Mylor Slate Formation which have been deformed twice (first into minor upright and overturned folds and then into major recumbent folds) and cleaved, as has been explained in the account of the nearby Rinsey Cove site. These features are typical of the killas of Cornwall and are particularly well seen in these cliffs. Close to the granite, the metasediments have been baked and are now spotted hornfelses with cordierite and andalusite. Corundum, however, has not been reported as it has at Priest's Cove.

The neighbouring granite intrusion consists of a northern, fine-grained, megacrystic biotite granite (Dangerfield and Hawkes, 1981; Type C, (Table 5.1), Exley and Stone, 1982), which is called the Godolphin Granite (after Godolphin Hill), and a southern, medium-grained, non-megacrystic lithium-mica- and topaz-bearing granite (Type E, (Table 5.1)) named

after Tregonning Hill. The latter component is exposed in the cliffs.

Its eastern contact with the Mylor Slate Formations can be seen at the eastern end of Trequean Cliff, especially on the shore, and across the head of Legereath Zawn. In both localities it is sharp and without significant marginal change in the texture of the granite. It is almost vertical, although tourmalinization streaks ('*schlieren*') and a thin pegmatite occur within the granite at the first locality and there are sheets and veins of granites of different types at the base of the cliffs and in stacks at the second.

Presumably owing to the steepness of the contact, a sheeted roof complex is not well-developed here, but from Legereath Zawn eastwards there is a series of granitic sheets of similar compositions to those found in the roof complex above the eastern end of Rinsey Cove. These sheets dip gently towards the south-east, vary in thickness from 0.10 m to 3 m approximately, and both coalesce and split on occasion. They cut across the cleavage in the Mylor metasediments.

The chief rock types in the sheets are pegma-tites (Figure 5.19), aplites and lithium-mica leucogranites, and these types change from one to another with distance from the main granite. Pegmatites are especially well developed under pelite 'roofs', even where these are provided by xenoliths, of which there are many in various stages of detachment, disorientation and digestion. The most-complicated single outcrop is that forming Megiliggar Rocks and, here and nearby, all variations of texture are present, from narrowly banded 'line rocks' to pegmatites 0.10–0.15 m thick, together with a wide range of compositions. Some rocks are 'graded' in respect of grain size and/or tourmaline content, and have uneven bases. Many quasi-sedimentary features occur (Figure 5.20).

The occurrence at Megiliggar of blue-green apatite crystals up to 30 mm long is well known (although they are far from common); that of other unusual phosphate minerals such as amblygonite (Stone and George, 1979) and triplite (George *et al.,* 1981) less so.

## Interpretation

The Tregonning Granite is believed to have derived from biotite granite at depth, by the separation of a fluorine- and water-rich fraction of the magma as described earlier for Rinsey Cove and in the 'Petrogenesis' section. The origin of the pegmatite–aplite–leucogranite sheets lay in the high volatile concentrations in this new magmatic fraction, which contained high concentrations of such elements as Mn, P, Sn, Ga and Ge along with the OH, F and B. The Li-mica leucogranite would seem to have been the direct continuation of the magmatic process, but the eventual partitioning of Na into the silicate melt and K into aqueous vapour, gave rise to aplite, and by reaction with the aplite, metasomatic pegmatite respectively (Stone, 1969; Exley and Stone, 1982). The development of the vapour phase could have resulted from sudden pressure changes as blocks of country rock subsided to make way for the magma; repetition of such movements would produce alternating aplite and pegmatite (Bromley and Holt, 1986). Badham (1980) did not distinguish between vapour and liquid phases, but argued that the separation and crystallization of leucogranite at higher temperatures was followed by the separation and crystallization of distinct aplite and pegmatite fluids at lower temperatures and subsequent diffusive alteration.

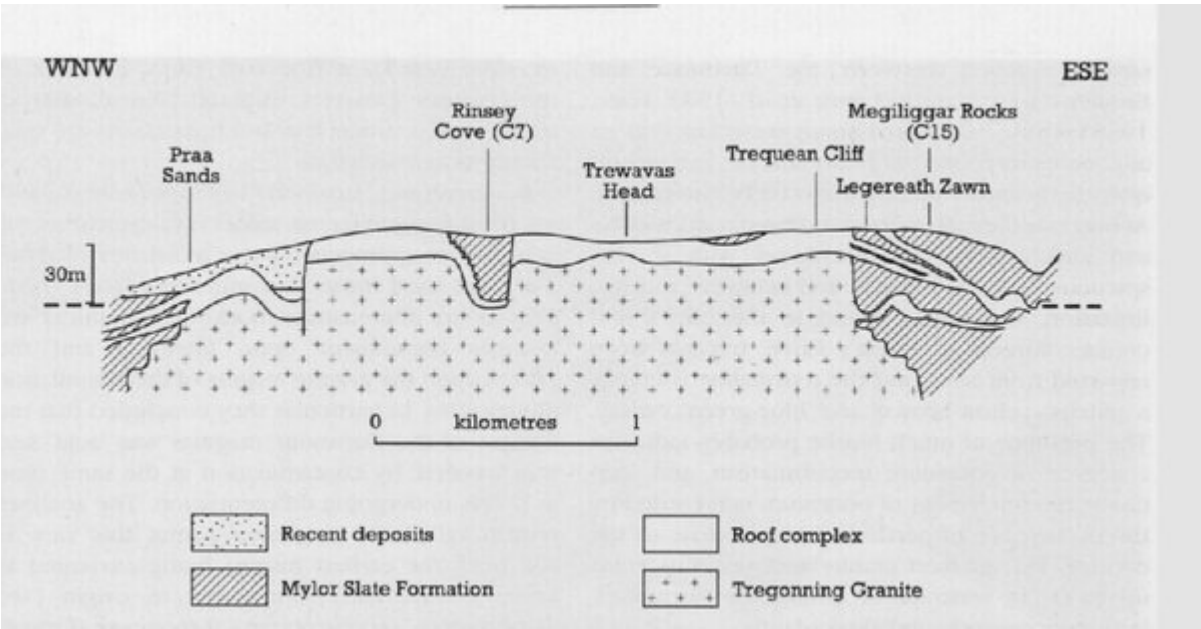
The rock types and mineralogies of the sheets in this complex are much more varied than those found at other places, such as Porthmeor Cove, because of the presence of Li, P and F in the Li-mica granite magma.

The Megiliggar Rocks section exhibits the only well-exposed series of leucogranite–aplite–pegmatite sheets developed from a lithium-mica granite, and allows detailed examination of these unusual late-stage facies and their relationships with each other, their parent granite and their host metasediments. They have developed as a result of the concentration of volatile constituents under an impermeable roof of metasediment and the partitioning of elements from residual magma between liquid and vapour phases. In the only other exposures of Type-E granite, the contacts are with other granites and the roof complexes are relatively poorly developed.

## Conclusions

The Megilligar Rocks section exhibits the only well-exposed series of sheets of aplite, pegmatite and leucogranite developed from a lithium-mica granite. They comprise sheet-like offshoot intrusions from the main granite mass, are the last representatives of igneous activity locally, and are among the last products of the declining igneous activity that had formed the massive granite masses of Devon and Cornwall. The emplacement of this main body of magma had already folded and baked the surrounding (older) sedimentary rocks. The site allows detailed examination of these unusual late-stage granitic facies and their relationships with each other, their parent granite and their host, metamorphosed, sedimentary rocks.

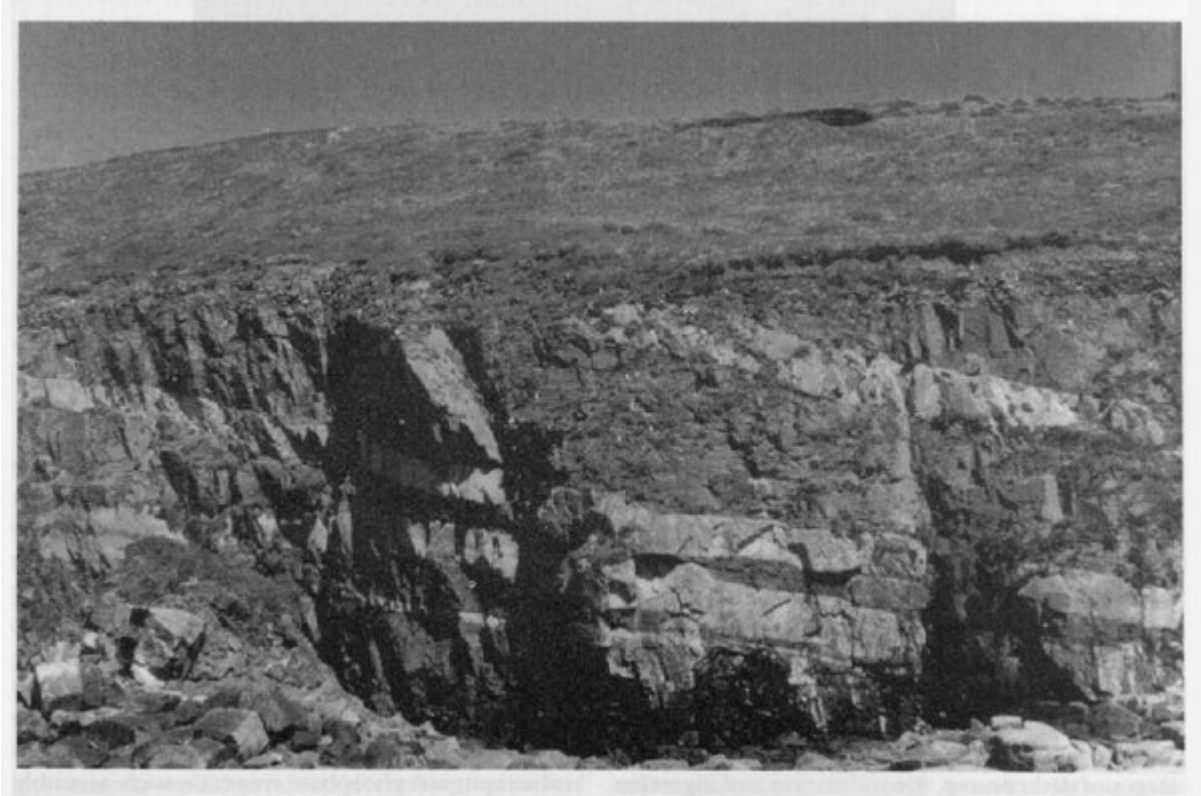
**References**



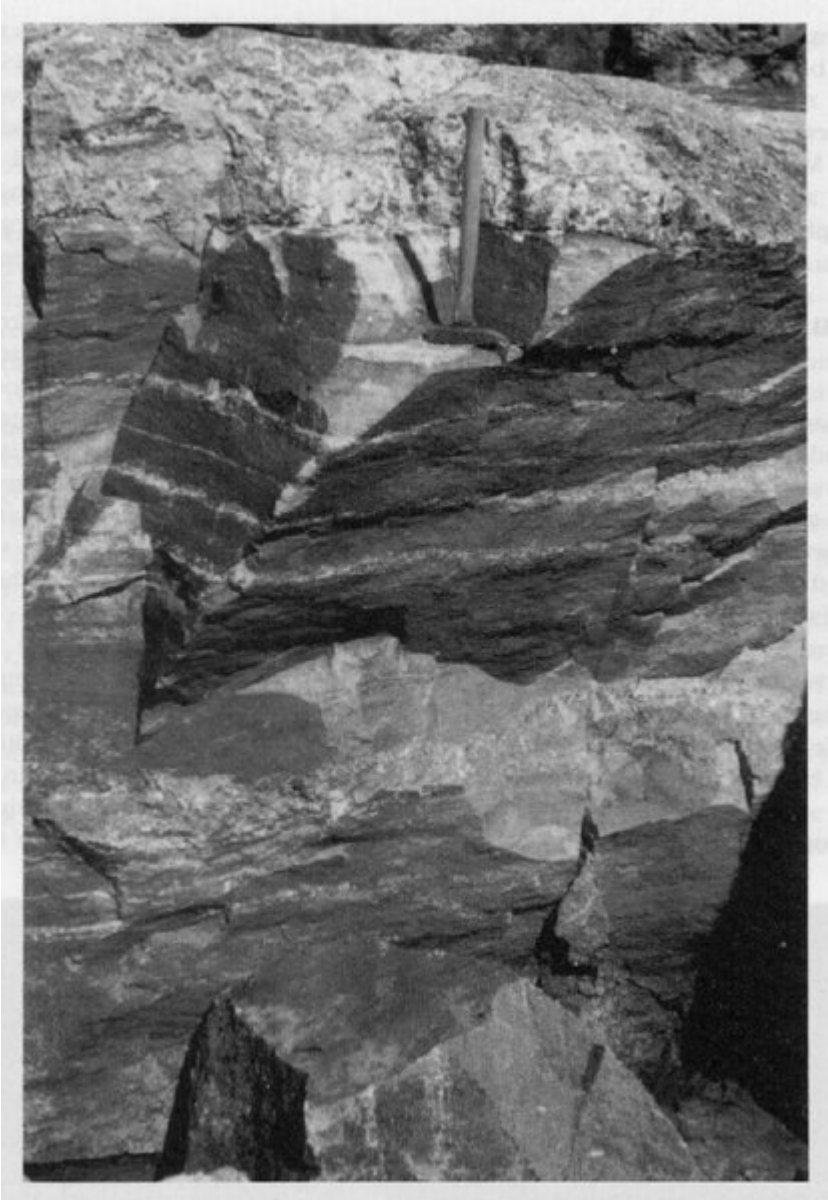

*(Figure 5.12) Diagrammatic section across the Tregonning Granite, based on coastal exposures, showing the location of sites at Rinsey Cove (C7) and Megiliggar Rocks (C15) (after Exley and Stone, 1982, figure 21.2).*

| Type | Description | Texture | Minerals (approximate mean modal amounts in parentheses) | | | | | | Other names in literature |
|---|---|---|---|---|---|---|---|---|---|
| | | | K-feldspar | Plagioclase | Quartz | Micas | Tourmaline | Other | |
| 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 | Subhedral to subhedral; microperthitic (32%) | Subhedral to subhedral. Often zoned: cores $An_{25}$-$An_{20}$, rims $An_{9}$-$An_{15}$ (22%) | Irregular (34%) | Biotite, often in clusters (6%); muscovite (4%) | Subhedral 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, 1913; 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%) | Subhedral to subhedral. Often zoned: cores $An_{17}$-$An_{13}$ (28%) | Irregular (33%) | Biotite 3%; muscovite (7%) | Subhedral 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 | Subhedral to subhedral; microperthitic (27%) | Subhedral to subhedral. Unzoned, $An_{7}$ (26%) | Irregular; some aggregates (36%) | Lithium-mica (6%) | Subhedral 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%) | Subhedral. Unzoned, $An_{4}$ (32%) | Irregular; some aggregates (30%) | Lithium-mica (9%) | Subhedral 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%) | Subhedral. 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)*



*(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.)*



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

*(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.)*