Tremearne Par, Cornwall

[SW 610 266]

Introduction

This classic coastal locality magnificently exposes the near-horizontal sheeted pegmatitic-aplitic complex developed in the roof zone of the lithium-mica Tregonning Granite, which extends into country rocks (killas) belonging to the Mylor Slate Formation of Devonian age. Tremearne Par to Megilligar Rocks forms a continuous coastal section (see (Figure 7.12)a), which lies some 1.5 km north-west of Porthleven.

The pegmatitic sheets relate to the nearby Godolphin Granite pluton, the Tregonning Granite being the Li-mica variety of the Godolphin Granite. Good exposures of the Tregonning–Godolphin Granite can be studied from the coastal cliff-path.

The granitic sheets rise from the roof zone of the Tregonning Granite at Legereath Zawn and descend to the beach section at Megilligar Rocks. This continuous coastal section provides remarkable exposures for chemical and mineralogical studies of a granite pluton roof-zone complex. Megilligar Rocks are mainly pegmatitic- and aplitic-facies rocks associated with subordinate granite.

The contact between the granite and the country rocks at Megilligar Rocks is remarkably clearly exposed (see (Figure 7.12)b). Complete sections occur of the aplitic- and pegmatitic-facies rocks, with the spectacular growth of feldspar, apatite and tourmaline perpendicular to the contact.

Various authors, for example Hall (1930), and Stone (1975), have provided detailed field relationships for the full section, while Exley *et al.* (1983), and Floyd *et al.* (1993) presented detailed discussions on the Cornubian Batholith and associated igneous rocks.

Description

The Godolphin Granite was first described in Geological Survey memoirs and so-called by Flett and Hill (1912), and was characterized by its uniformity of mineralogy and texture. Stone (1969, 1975) recognized and described the two main granite types and the pluton was renamed the 'Tregonning–Godolphin Granite' (see (Figure 7.13)). Stone (1975) described the coastal section containing the roof complex and outward extending sheets of granitic material. The granite forming Godolphin Hill is a type-C granite, based on the classification of Exley *et al.* (1983); however the main part of the granite area is a type-E lithium-mica granite carrying zinnwaldite or lepidolite mica.

The granitic sheets at Megilligar Rocks originate from the layered roof-zone of the Tregonning Granite and form part of the roof complex. They are composed of leucogranite with pegmatitic stringers close to the Tregonning Granite, but pass laterally from this body into dominantly layered pegmatitic-aplitic bodies. These are associated with some leucogranite and tourmaline granite. The sheets are emplaced into the pelitic country rocks of the Mylor Slate Formation, which are contact metamorphosed to spotted slates.

On the west side of Legereath Zawn the granite-killas contact in the cliff is seen to be nearly vertical, and a roof complex is developed above the normal Li-mica granite. The granite sheets dip gently to the south-east away from the granite. The granitic sheets vary in thickness from a few centimetres to 2–3 m, the thicker units being a complex mixture of pegmatite and aplite, at times showing merging of two or more sheets, then diverging. Some of the thinner bodies are concordant to the foliation. Stone (1969, 1975) described textures of the sheets in detail, the most spectacular textural structure being the perpendicular growth of the large K-feldspar, tourmaline and apatite crystals.

Disorientated xenoliths occur within the sheets and in the roof pegmatites. Some of the xenoliths are commonly enriched in tourmaline. In the pegmatitic areas brown-black-blue tourmaline prisms reach several centimetres in length, while

light-green apatites also grow up to several centimetres. The Li-mica occurs as a pale-brown lepidolite, zinnwaldite and/or muscovite ('gilbertite'). Fluorite, killingite, triplite and amblygonite are also present, while topaz is an early mineral in the paragenetic sequence. The phosphate minerals and ore minerals appear to have formed late in the magmatic or immediate post-magmatic crystallization sequence.

The granitic rocks are enriched in elements such as F, Li, Rb and Cs, together with Sn, P and B (Exley *et al.,* 1983). The rocks therefore contain lithium micas, albite and topaz. The granitic rocks (especially leucogranite) appear to have many similarities to the microgranites and aplites at the Meldon Aplite Quarries GCR site, including mineralogical similarities with a range of contained rare mineral species, including amblygonite (Stone and George, 1978).

Fine crystals, up to several centimetres in length, of K-feldspar, twinned on Carlsbad, Baveno and Manebach laws, occur in the pegmatitic rocks. A dark-brown, irregularly shaped mass (5 cm x 2 cm) of triplite, and some smaller crystals closely associated with löllingite have been described from the pegmatites and leucogranites at the top of the main granite sheets at Megilligar Rocks (George *et al.,* 1981). These triplite crystals may be coated with a blue mineral, believed to be vivianite.

Interpretation

The sheets at Megilligar Rocks and their relationship to the granite of the roof complex have been discussed in detail by Stone (1969) and provide an insight into the relationships between mineralization and magmatic differentiation In Li-mica granites. Stone (1975) presented the general sequence of crystallization for the Tregonning–Godolphin Granite as:

1. fine- to medium-grained biotite granite with megacrysts of K-feldspar not larger than 4 cm (Godolphin Granite). Crystallization of plagioclase and quartz;
2. metasomatism of areas of the biotite granite by volatile components from a deep source leading to some ion exchange, for example K and Na, and the subsequent development of Li-mica granite magma, with volatiles being located in Li-mica, topaz and tourmaline;
3. as the Li-mica granite crystallized, volatiles accumulated under the roof, producing the layered leucogranite, aplite and pegmatitic complex of the roof zone, probably with several phases of re-melting, fluid metasomatism and crystallization;
4. build-up of pressure causing lifting of the roof and horizontal fractures in the country rocks at or near roof level, magma movement from roof zone into fractures and differentiation into the Megilligar Rock sheets;
5. late-stage alteration and mineralization similar to that found elsewhere in the Comubian Batholith, including mineralization, greisenization, tourmalinization and kaolinization. Localized at the highest part of the Tregonning Granite were some very rich tin veins, worked at Wheal Vor, to the east of the Tregonning Granite, while Great Work Mine worked tin and copper veins, and Rinsey and Trewavas Head worked copper veins;
6. emplacement of the quartz-feldspar porphyry ('elvan') dykes, and further mineralized greisening and kaolinization.

All the above features may be seen in the surrounding area of Tremearne Par. The model proposed invokes metasomatization and ion exchange as the most important mechanisms for producing compositions suitable for melting and production of Li-mica granites.

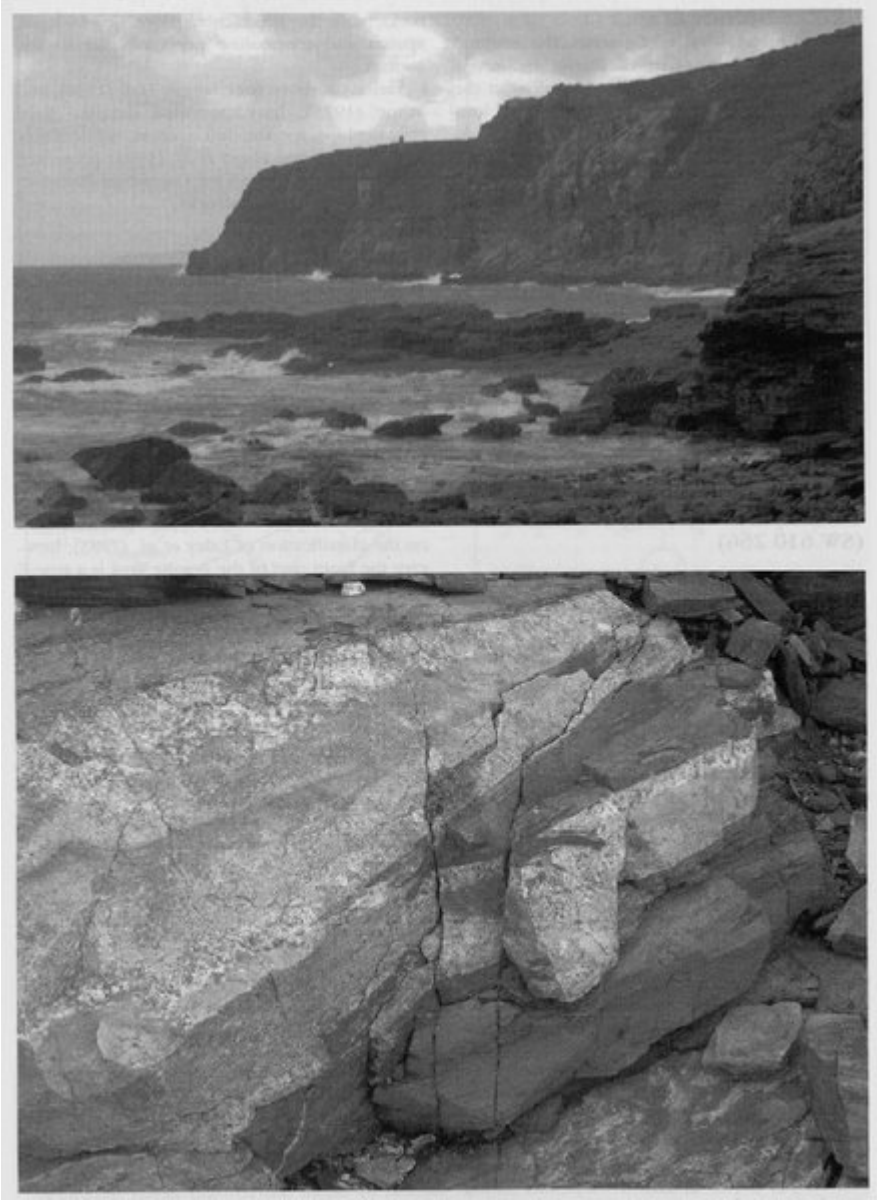
The geochemical and mineralogical relationships present at Megilligar Rocks in the Li-mica granite and its differentiates are of fundamental importance to understanding the relationship between magmatic and ore-forming processes in the Cornubian Batholith.

Conclusions

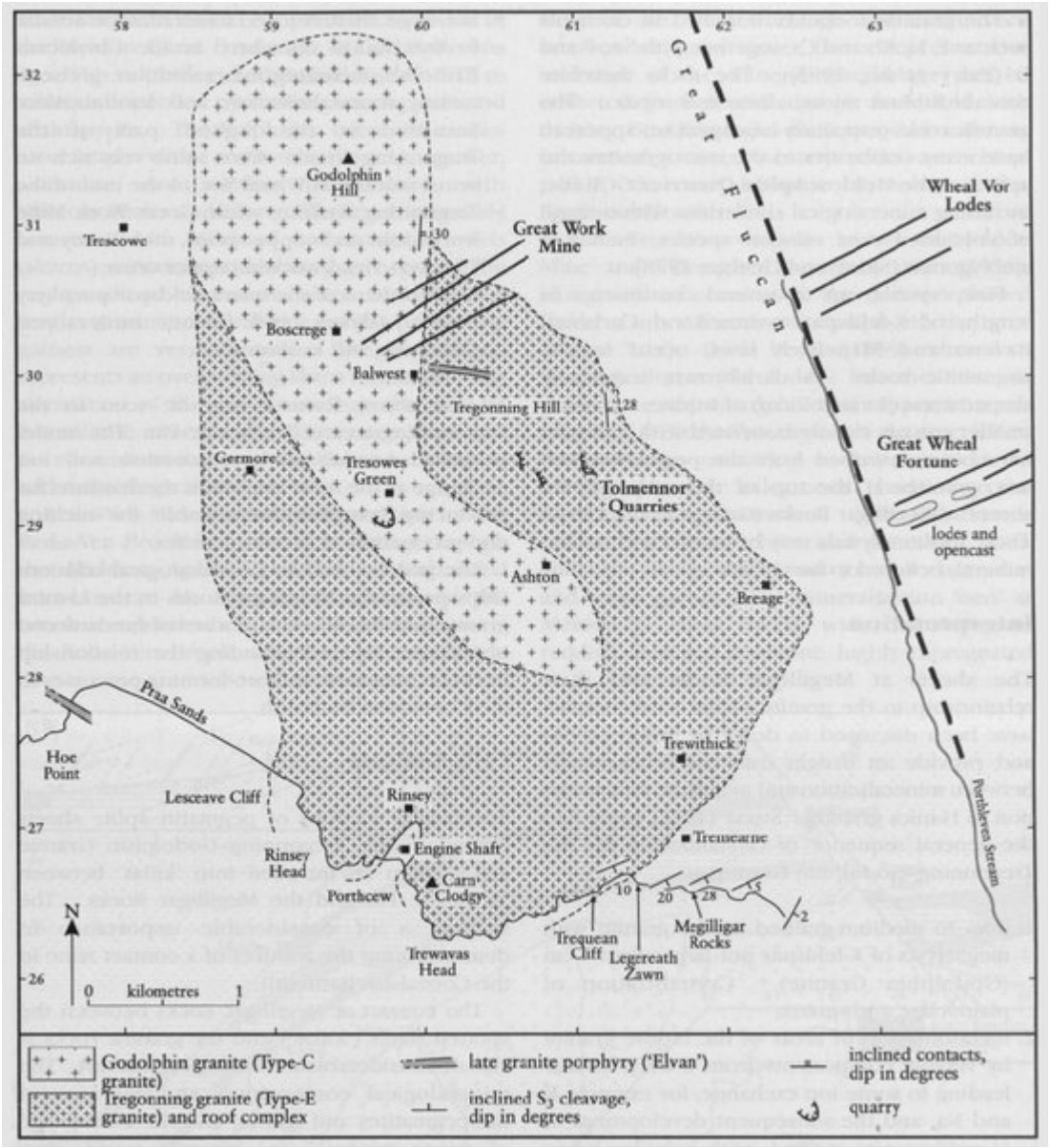
Spectacular sections of pegmatite-aplite sheets related to the Tregonning–Godolphin Granite are seen to be intruded into 'killas' between Tremeane Par and the Megilligar Rocks. The section is of considerable importance in demonstrating the features of a contact zone in the Cornubian Batholith.

The contact at Megilligar Rocks between the spotted slates ('killas') and the granitic rocks is also of considerable mineralogical interest. The mineralogical composition and textures of the pegmatites and aplites, and the assemblage of minor minerals, for example triplite, are important to fuller understanding of the section.

References



(Figure 7.12) (a) View across Tremearne Par and Megilligar Rocks towards Wheal Trewavas copper mine. (b) The contact between the pegmatite and the killas, Tremearne Par. (Photos: H. Townley, Natural England.)



(Figure 7.13) Geological sketch map of the Tregonning–Godolphin Granite. The area without ornament is composed of the Mylor Slate Formation. Solid lines mark exposed boundaries; dashed lines mark inferred boundaries. After Stone (1969). Granite boundaries modified by Taylor and Wilson (1975).