C14 Roche Rock

[SW 991 596]

Highlights

Roche Rock is a unique site within an intrusion of quartz–tourmaline rock which was formed either from a boron-rich differentiated magmatic fluid or from a complex late-magmatic hydrothermal process.

Introduction

Roche Rock (Figure 5.10) is a lenticular, craggy outcrop, rising to a height of 20 m above its lower slopes and surmounted by a ruined chapel (Figure 5.17). It is on the southern outskirts of the village of Roche, about 8 km NNW of St Austell. The rock itself is entirely made up of quartz and black tourmaline (schorl) in varying proportions, is generally rather friable and sometimes distinctly vuggy. Its origin has been ascribed variously to magmatic (Power, 1968; Charoy, 1981, 1982) and hydrothermal/metasomatic (Flett, *in Ussher et al.,* 1909; Wells, 1946) processes. Manning (1981) regarded it as probably being due to the latter, but as a result of much more complex reactions than previously recognized. It is likely that these are related to those responsible for breccia formation and mineralization in other places and they are associated with the 270 Ma BP intrusive phase (Chapter 2; Allman-Ward *et al.,* 1982; Bromley and Holl, 1986; Halls, 1987; Bromley, 1989; Bristow *et al,* in press).

Description

There is nothing to add to the simple field observations noted above, beyond saying that in hand specimen most of the tourmaline is in short prisms, although some is acicular, with needles up to 40 mm long, and radiating 'suns' are not uncommon. Although the total outcrop has been mapped as an elliptical area about 600 m by 300 m, an area of about 250 m by 100 m is fully exposed at this site.

The average grain size is seen to be 1–2 mm and both quartz and tourmaline are usually sub■ to anhedral, with sutured or indented margins, and the tourmaline is yellow brown with patches and zones of blue.

Interpretation

The school of thought favouring hydrothermal origin, based its conclusions primarily on textural evidence (Flett, *in* Ussher *et al.,* 1909; Wells, 1946), apparent replacement of one mineral by another being common and tourmaline often being found in veins and other obviously post-magmatic situations. Hence the Roche Rock tourmalinite came to be regarded as the tourmalinized end-member in a sequence, starting with granite and in which luxullianite was an intermediate stage. Power (1968), however, in a general study of south-west England tourmaline, discovered clear differences between blue-green acicular tourmaline of the kind usually found in veins, and regarded as hydrothermal, and the brown prismatic tourmaline found in the body of the granites and considered to be primary and, at latest, late magmatic. This established the Roche Rock tourmalinite as magmatic.

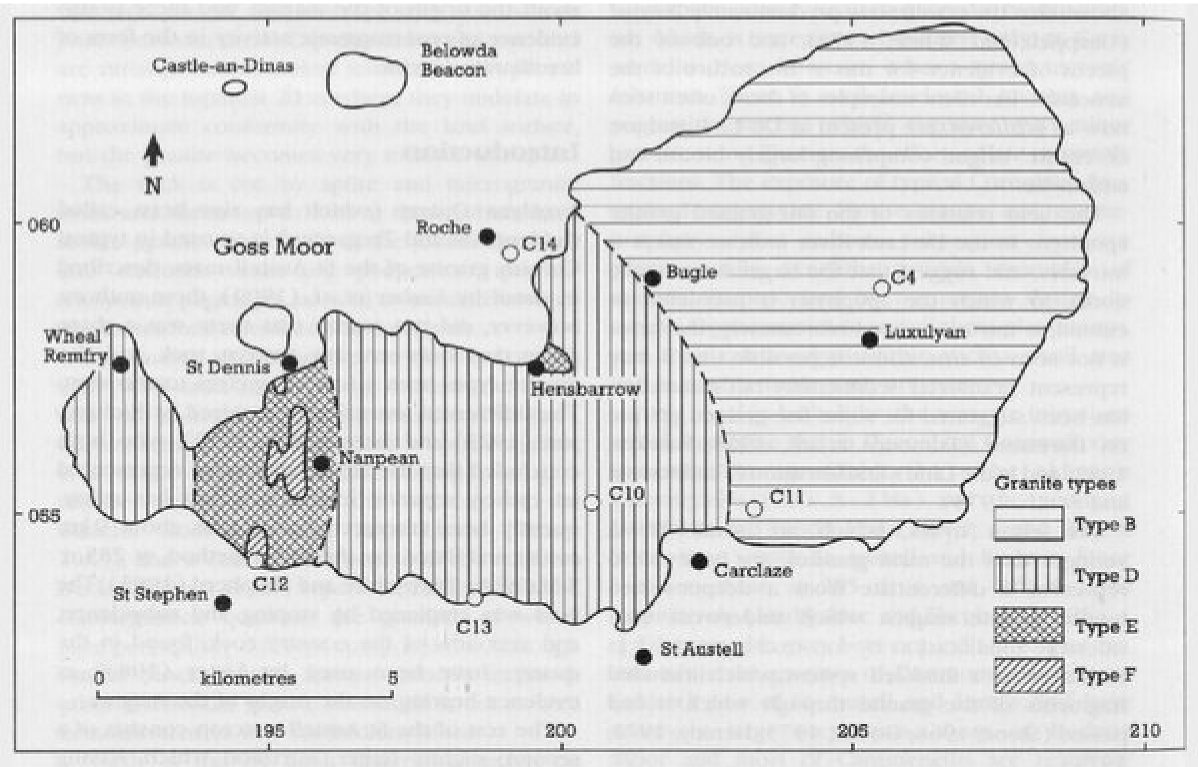
Quartz–tourmaline rocks and tourmalinites are not rare in Cornwall; in addition to the Roche Rock (which is outstanding), there is an example at Porth Ledden, and such rocks are often uncovered in china-clay workings and mines. Charoy (1981, 1982), noting the experimental work of Pichavant (1979), ascribed all these to the separation of immiscible boron- and fluorine-rich magmatic fluid, accompanied by alkalis and silicon, in the late stages of Cornubian granite crystallization (see 'Petrogenesis' section above). Bearing in mind the results of other laboratory experiments on relatively simple granite systems incorporating boron and fluorine, Manning (1981) suspected that the process was more complex than this, especially in view of a tendency towards highly saline fluid inclusions in the minerals, and that the process may be multistage. Like quartz–topaz–tourmaline rocks such as that at St Mewan Beacon, with which he associated them, Manning thought that tourmalinite might have followed closely on magmatic crystallization, but saw a need for more experimental work, particularly on stability relations in systems with high salinity and containing B, F and OH. Some preliminary results of such work are reported by Pichavant and Manning (1984); these suggest that B and F can depress the magmatic freezing temperature of the granite system to 650°C at 1 kbar, and that the effect of F is greater than that of B in altering minimum melt compositions.

The second intrusive phase of the batholith at about 270 Ma BP (see Chapter 2) brought with it much boron and resulting tourmalinization. Frequently, this produced both explosive and implosive reactions which caused extensive brecciation by building up high internal pressure, which was suddenly released by fracturing to the surface, as at Wheal Remfry in the west of the St Austell mass (Allman-Ward *et al.,* 1982; Bromley and Holl, 1986; Halls, 1987; Bromley, 1989). It seems probable, however, that where violent rupturing of the rocks did not occur, intense tourmalinization, with both primary and secondary generations of tourmaline, took place in areas of high boron concentration. Roche Rock could well be an example of this (Bristow *et al., in* press).

Conclusions

Roche Rock is probably the largest and certainly the best exposed quartz–tourmaline rock in Cornwall and perhaps in the country. It affords a unique site for the examination of this late granitic facies *in situ.* The origin of this distinctive rock has been variously attributed to its being the last product of the magma crystallized from a residual granite melt, particularly rich in boron to form so much of the mineral tourmaline, or, alternatively, as the product of changes wrought by hot solutions charged with boron left over from the magmatic phase during which the granites of Cornwall were formed (see St Mewan Beacon).

[References](#)



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