C18 Cameron (Beacon) Quarry

[SW 704 506]

Highlights

This quarry contains the only surface exposure of the St Agnes Granite contact, with rare pervasive greisening, which is possibly unique in Britain. There is also replacement and telescoped ore mineral paragenesis.

Introduction

Cameron (or Beacon) Quarry is situated about 800 m WNW of St Agnes Beacon on the north coast of Cornwall, and is the only place where the St Agnes Granite contact, with the country rock of Upper Devonian hornfels, is exposed at the surface. Together with the Cligga Head Granite, 5 km to the north-east, this granite forms a small cusp on a northerly prolongation of the Cornubian batholith (Bott *et al.,* 1958; Tombs, 1977).

At the contact between the sedimentary rocks and the biotite granite, the pelites have been metamorphosed to spotted hornfelses, and the granite has a fine-grained margin with some pegmatitic patches.

The main interest in the quarry lies in the widespread, pervasive greisening, which is very rare; silicification; the development of disseminated cassiterite and sulphide mineralization. Reid and Scrivenor (1906) described some of the replacement phenomena, and Hosking (1964) and Hosking and Camm (1985), who give a full description of the quarry (Figure 5.21), proposed a complex paragenesis in which the relations between greisening and mineralization are examined in detail. They ascribe these features to permeation of the granite by fluids moving through it along a network of 'knife-edge' and microscopic fissures. Bromley and Holl (1986) consider the fracture system to be unrelated to the greisening, the impermeable cover of the granite cusp being more important in giving rise to a Vonding' effect.

Description

The country rocks round Cameron Quarry are the semipelitic and psammitic Porthtowan Formation (formerly the Ladock Beds, a subdivision of the more extensive Upper Devonian Gramscatho Group), and although the psammites at the contact show little obvious signs of alteration, loose fragments on the ground surface show that thermal metamorphism has caused spotting of the hornfelses, with andalusite developed in pelitic bands. These features are additional to tourmalinization caused by the underlying granite and which preceded greisening. The contact with the granite is seen at the northern end of the quarry (Figure 5.21), and within a metre or two of the igneous rock, which is normally a medium- to coarse-grained, poorly megacrystic biotite granite with megacrysts up to 20 mm long (Dangerfield and Hawkes, 1981; Type B, (Table 5.1); Exley and Stone, 1982) has a chilled, fine-grained texture. Fine-grained contacts are not common in Cornwall, as is demonstrated at the contacts at Rinsey Cove and Porth Ledden for example. There is also a pegmatitic facies visible at the contact in places.

Massive and pervasive greisening and silicification give much of the granite an abnormally dark colour, fine grain size and glassy appearance. There has been extensive alteration of feldspar megacrysts to greisen locally, and although some have been eroded to leave hollow moulds, others, near post-greisen fractures, have been replaced by aggregates of minerals which conspicuously include cassiterite. Mineralization, in the form of disseminated copper sulphides, is best seen in the north-east and south-west corners of the quarry.

Interpretation

Almost always in south-west England (and generally elsewhere in Britain), greisening is very obviously related to a joint or fracture system. This is not the case in Cameron Quarry where, although varying in intensity, nearly all the granite has been altered, first by greisening and then by silicification. Hosking and Camm (1985) believe this permeation to have been achieved as a result of the development of a complex network of fine fractures due partly 'to contraction and partly ... to the pressure exerted by residual fractions in the magma'. Bromley and Holl (1986), on the other hand, state specifically that the quarry contains 'massive greisen not related to penecontemporaneous fractures' and presume that 'the greisening solutions were ponded beneath the impermeable carapace of tourmalinized hornfelses'. There seems to be no reason why both should not be right if the 'network of fine fractures' is on a scale approaching the microscopic and regarded as distinct from the usual type of megascopic joint system. It is certain, however, that mineralization took place in a series of steps following the influx of pulses of fluid as suggested by Halls (1987), and that it varied in degree over very short distances.

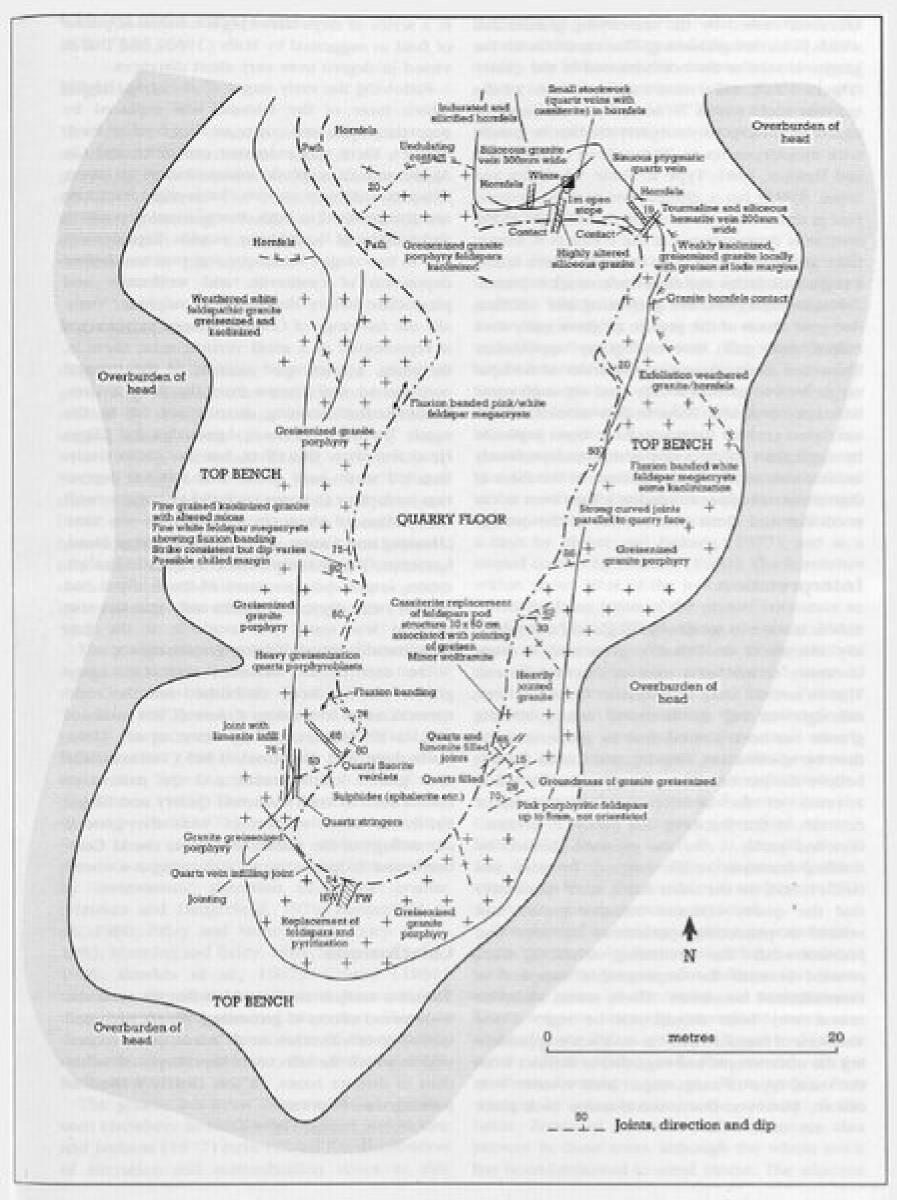
Following the early stages of alteration, during which most of the feldspar was replaced by secondary mica and quartz or dissolved to leave cavities, there was extensive cassiterite and Cu, As, Fe and Zn sulphide mineralization via open, although still very narrow, 'knife-edge' fractures, and this resulted in both disseminated deposition and infilling of the feldspar moulds. Replacement was in two stages: K-feldspar was removed before deposition of cassiterite, and wolframite and plagioclase before deposition of sulphide. Virtually the full range of Cornish mineral parageneses is represented in a small vertical span; there is, therefore, a telescoped version of the mineral zonation so well known from the famous Camborne–Redruth mining district not far to the south. The mines of the St Agnes area and Cligga Head also show this effect, but less distinctively. Detailed study here shows that mineral deposition took place in stages, as it did elsewhere, with reactivation of channelways from time to time (Hosking and Camm, 1985). Unlike Cligga Head, Cameron Quarry rocks exhibit very little kaolinization, largely because most of the feldspar had already been altered to quartz and mica, but also because less water was available at the low temperature stage following greisening.

The date of the intrusion of the St Agnes granite has not been established but the main mineralization in western Cornwall was at about 270 Ma BP (for example, Jackson *et al.,* 1982; Darbyshire and Shepherd, 1985), substantially after granite emplacement; and the pattern of events seen at both Cameron Quarry and Cligga Head has close similarities with the general chronology of the mineralized areas round Camborne and St Just.

Conclusions

This is a unique site in which can be seen the widespread effects of greisening, silicification and intense mineralization in a 'telescoped' succession in which the effects are superimposed rather than in distinct zones, all less closely related to jointing than is normal.

References



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

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_{50}, 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)