C11 Carn Grey Rock and Quarry

[SX 033 551]

Highlights

This site is one of the few showing granite intermediate in character between that of the two main St Austell intrusions.

Introduction

Carn Grey Rock and its adjacent quarry lie 3.5 km to the north-east of St Austell, beside the road to Trethurgy. They lie in the contact zone between the first and second intrusions of the St Austell mass (Figure 5.10). The more western of these, much of which is now characterized by Li-mica, cuts the eastern biotite granite along a zone extending roughly between Carclaze and Bugle and in the direction of Roche. It has been thought, variously, that this rock is of direct magmatic origin or to have been metasomatically produced from biotite granite (Richardson, 1923; Exley, 1959; Hawkes and Dangerfield, 1978; Dangerfield *et al.,* 1980; Manning and Exley, 1984; Hawkes *et al.,* 1987; and also the 'Petrogenesis' section above). The western intrusion does contain some biotite granite, however, and is variable in texture, suggesting that its origins are not simple (Hill and Manning, 1987; Bristow *et al.,* in press). Some biotite granite is found close to the presumed intrusive contact, indicating a degree of complexity there (discussed below). Although situated on the eastern side of this contact, Carn Grey Rock resembles the western types of (Li-mica) granite in respect of its texture, sodic plagioclase, high tourmaline content and low biotite content.

Description

The granite at Carn Grey Rock is medium- to coarse-grained and rather poorly megacrystic, with megacrysts up to 40 mm in length, and quartz in rounded aggregate grains. In thin section it shows many features indicative of recrystallization, such as strain, zoning and intergrowth in minerals. Its composition is that of biotite granite from the eastern intrusion, except that it has less biotite and calcic plagioclase and more tourmaline. The biotite is very pale, and Richardson (1923) believed that both biotite and lithionite' (zinnwaldite) were present; the optical properties of these micas are similar, however, and they are unlikely to coexist as discrete phases. Indeed, Leech (1929) disagreed with Richardson and considered the Carn Grey Granite to be a distinct type, comparing it with that of Merrivale on Dartmoor. Carn Grey Rock is a rather 'flat' tor, about 4 m high, with well-developed subhorizontal jointing which is also seen in the quarry below, where it shows an antiformal structure. It is believed that this site was the source of many standing stones and menhirs in the St Austell district.

Interpretation

The first of the St Austell intrusions, which has a centre near Luxulyan and a diameter of about 9 km, is made up of coarse-grained granite with biotite, zoned oligoclase ($An_{25–30}$) and potash feldspar megacrysts (Type B, (Table 5.1); Exley and Stone, 1982). The second, which was intruded across the western edge of the first, is centred near St Dennis, and is about 11 km in diameter.

Most of it contains zinnwaldite (Stone *et al.,* 1988), albite (An_7) and potassium feldspar megacrysts, but is generally not as strikingly megacrystic as the first intrusion and has a variable texture which includes some fine-grained rock and, in addition, pockets of biotite granite (Manning and Exley, 1984; Hill and Manning, 1987; Bristow, in press; Bristow *et al.,* in press). The zinnwaldite-bearing rock is Type-D granite ((Table 5.1); Exley and Stone, 1982). Originally thought to be a member of a differentiated magmatic sequence (Richardson, 1923; Exley, 1959), much of this rock is now considered to be the result of metasomatism of biotite granite by the intrusion of a late-magmatic differentiate from biotite granite magma. This brought in lithium and sodium, and the resultant rock can be seen in its solid state in the Nanpean area and near Hensbarrow Beacon as a non-megacrystic Li-mica granite with albite (Any) and topaz (Type E, (Table 5.1)). Its

origins are discussed in the 'Petrogenesis' section above and in relation to Tregargus Quarries.

In most of the western area (see (Figure 5.4) and (Figure 5.10), an aqueous, F-rich fluid exchanged Li and Na for Fe in biotite and Ca in oligoclase. The Fe not used in the resulting zinnwaldite, combined with B to form tourmaline, and Ca not retained in albite combined with B to form fluorite. Fluorite granite (Type F, (Table 5.1)) occurs in pockets within the Type-E granite in the Nanpean area (Manning, 1982; Exley and Stone, 1982; Exley *et al.,* 1983; Manning and Exley, 1984; Hawkes *et al.,* 1987).

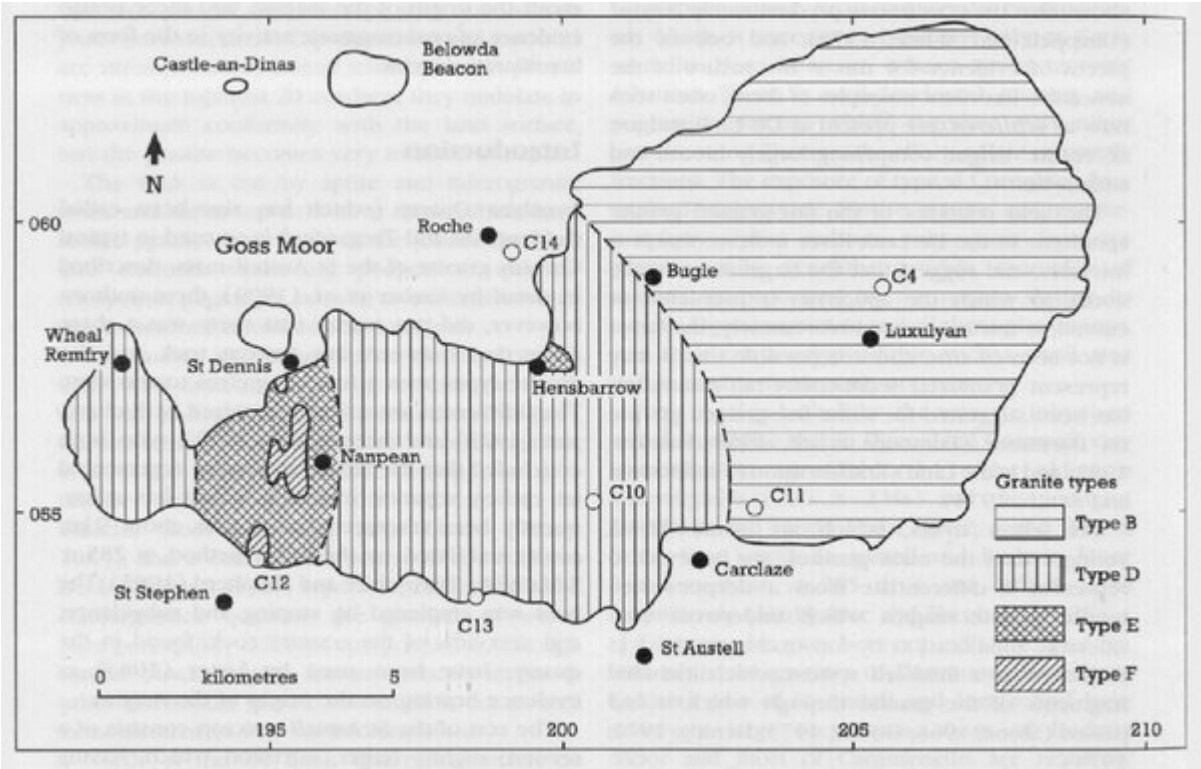
The contact between the two main intrusions is not exposed, and severe kaolinization makes field relations difficult to interpret, but biotite granite has been reported from several localities in the western area (Richardson, 1923; Bray, 1980; Allman-Ward *et al.,* 1982; Hill and Manning, 1987), and the evidence seen so far suggests that the contact is an irregular zone rather than a plane. Although the texture of the Carn Grey Rock is typical of the western intrusion, its composition is intermediate between the eastern (Type B) and the western (Type-D) granites, and it seems to represent the easternmost point to which the metasomatism penetrated and a case where the changes were not complete.

Carn Grey is an important site, providing one of the fresh exposures in the south-west of the eastern St Austell intrusion. It has textural and compositional characteristics and a geographical position which suggest that it provides a link between the main original rock types of the eastern and western intrusions, where partial alteration by Li, Na and F, brought in by the youngest intrusion, can be seen. Successive intrusions and subsequent Li metasomatism do not occur in any of the other Cornubian granite masses.

Conclusions

Carn Grey is an important site, providing one of the rare fresh exposures in the south-west of the eastern St Austell granite intrusion. The site lies in the contact area of the first and second granite intrusions which make up the St Austell mass. Texturally, the granite here has the characteristics of the medium- to coarse-grained megacrystic (with larger crystals, to 40 mm) western granite, but the chemical/mineral composition approaches that of the eastern granite. It therefore has characteristics and a position which suggest that it might provide a link between the chief rocks of the eastern and western intrusions.

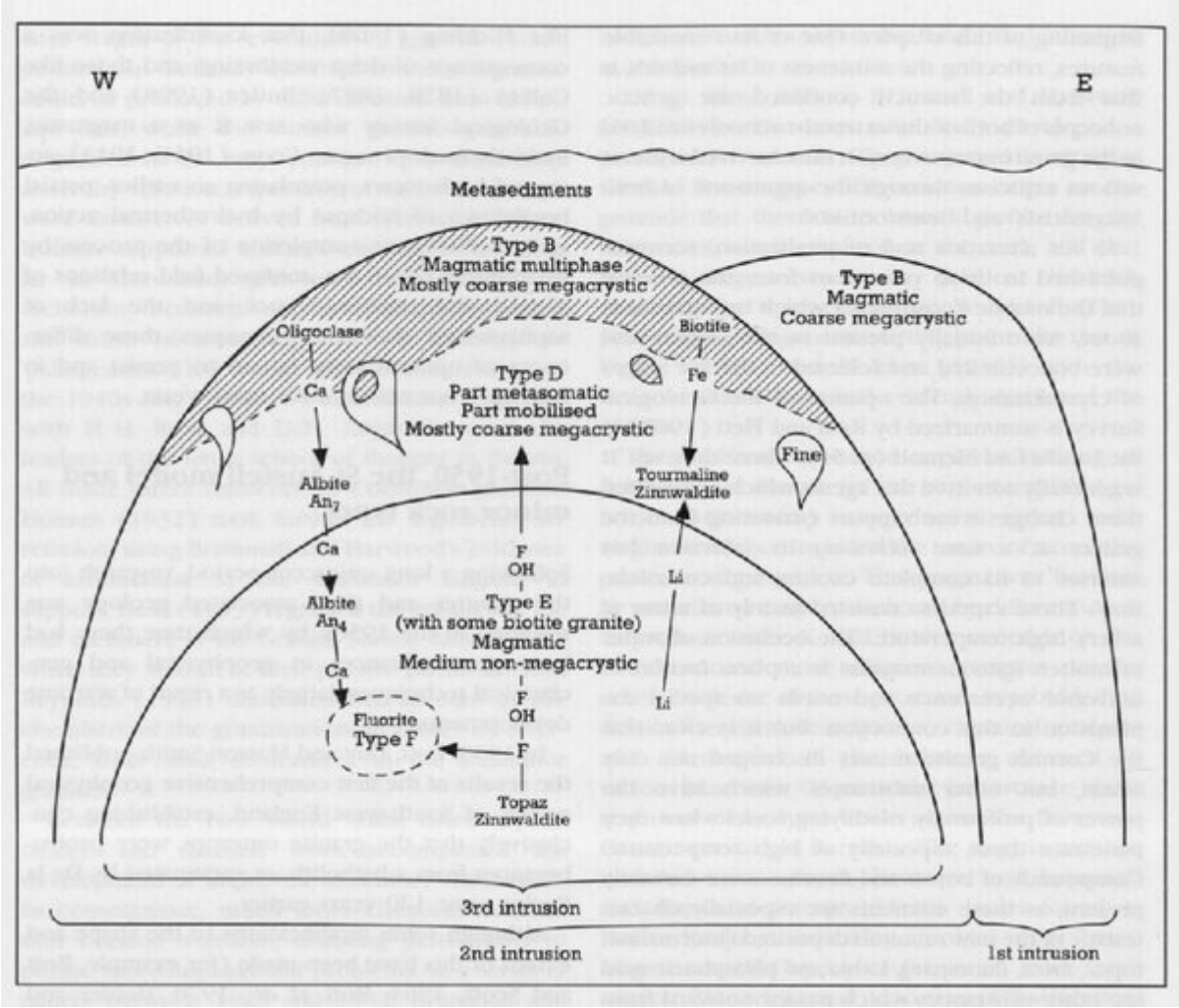
References



(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.

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 5-11 cm maximum, mean about 2 cm. Hypidiomorphic, granular	Euhedral to subhedral; microperthitic (32%)	Euhedral to subhedral. Often zoned: cores An_{25}-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 ior granite (Brammall, 1926; Brammall and Harwood, 1923, 1632) = 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_{13} (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)



(Figure 5.4) The St Austell model. Diagram showing the first intrusion of Type-B granite (Table 5.1) cut by multiphase second intrusion of biotite granite, with metasomatic aureole of Type D caused by intrusion of Type E.