Meldon Aplite Quarries, Devon

[SX 567 920]

Introduction

The Meldon Aplite intrudes Lower Carboniferous rocks on the north-west flank of Dartmoor. It contains a diverse range of accessory minerals including petalite, topaz, fluorite, bavenite, pollucite, spodumene and a variety of beryllium minerals.

The Meldon Aplite Quarries GCR site (originally known as the 'Graunulite Quarry') comprises two adjoining quarries, one each side of the Red-a-Ven Brook (host to the Red-a-Ven Mine GCR site) (see (Figure 7.6)), which worked the so-called 'Meldon Aplite'. The 'aplite' is essentially a dyke, some 3.5 km in length and up to 20 m wide, of mineralogically banded, medium-to fine-grained granite with some localized pegmatitic segregations. This dyke appears to be unique to South-west England, and is an unusual lepidolite-soda microgranite which has been intruded into tuffs and sedimentary rocks of Lower Carboniferous age. These comprise the Meldon Chert Formation (principally shales and impure limestones), as well as rocks of the older Meldon Shales and Quartzite Formation, which includes volcanic agglomerates and tuffs. These rocks have been much folded, faulted and overturned before intrusion of the granite, which has also metamorphosed them. The sequence now dips steeply to the north-west. As the Meldon Aplite intrudes metamorphosed country rocks, its relationship to the adjacent Dartmoor Granite is problematical, especially as it is richer in plagioclase feldspar and contains Li-micas, typical of E-type granites of Exley *et al.* (1983), which are otherwise Unknown in the Dartmoor Granite. Of great mineralogical importance is the diverse array of accessory minerals and abundant topaz and fluorite associated with the aplite. The aplite shows an appreciable enrichment in Rb, Cs, F, B, Be and Nb, interestingly with almost no trace of Sn, W or sulphide mineralization. This directly contrasts with the St Austell Granite where this pattern of element enrichment is clearly related to mineralizing events.

The geological literature on the Meldon Aplite Quarries GCR site chiefly considers mineralogical aspects of the site. The aplite was mentioned by De la Beche (1839), Reid (1912), and Worth (1920), while Kingsbury (1970) listed and described many of the rare mineral species known from this locality. Other studies of note include those of Dearman and Claringbull (1960), who described bavenite, and several studies by Chaudhry and Howie (1970a, 1973, 1976), who noted the presence of topaz, lithium micas and lithium tourmalines. Subsequently, Von Knorring and Condliffe (1984) reported the occurrence of columbite-tantalite-microlite, while Drysdale (1985) described the occurrence of petalite, spodumene and pollucite. Many of the rare accessory minerals are often found as well-formed crystals in druses throughout the aplitic rock-masses. Chaudhry and Howie (1970b) reported the presence of axinite from skarns adjacent to the aplite.

Description

The area around the Meldon Aplite Quarries is one of considerable geological and mineralogical interest. To the immediate west are exposures within the sedimentary sequence displaying fine folded structures, whilst to the north are the vast and active Meldon quarries (originally BR ballast quarries). In these deep quarries the working faces are worked on several levels. They afford magnificent sections of altered Lower Carboniferous sedimentary rocks, tuffs and two major basic dykes, all of which have been thermally and metasomatically altered by the Dartmoor Granite. The Meldon (British Rail) quarries are important mineralogically for the range of calcium and skarn manganese silicate minerals present. To the east of the Meldon Aplite Quarries, and closer to the Dartmoor Granite, are the mineral workings of the Red-a-Ven Mine (described in the Red-a-Ven Mine GCR site report, this chapter). It is believed that the aplite can be traced as a body for some 3.5 km from Sourton Tors to the main Meldon Quarries.

The aplite is a white to pale-grey, fine-grained, holocrystalline rock, but patches and lenses of pegmatite (some coarse-grained) occur within the body. In many places it is altered by the introduction of late-stage minerals. It also contains xenoliths of country rock, but these are also altered.

In the southern quarry, the aplite, which is in contact with hornfelsed shales and tuffs, is about 20 m thick. In the upper levels of the quarry it splits into several smaller intrusions. Local pegmatitic segregations contain a range of accessory minerals of international importance. In the northern quarry the aplite has offshoots into cherts and shales. At these contacts mineralization has often been developed. The aplite is lithium-and beryllium-rich. Petalite occurs in perthite veins, sometimes forming up to 30% volume.

The aplite consists of albite, quartz and orthoclase-perthite with micas and accessory topaz and tourmaline. The tourmaline occurs in a range of colours from pink to green, and rarely blue. Lepidolite mica from the aplite has been found by K-Ar determinations to have an age of approximately 254 Ma (Miller and Mohr, 1964), but some doubt has been raised as to the accuracy of this age due to argon leakage from the mica (see Edmonds *et al.,* 1975).

Various authors have recognized up to three different types of aplite forming the rock mass, namely:

1. a chilled facies consisting of fine-grained albite and quartz with mica, and apatite and lepidolite mica;
2. a light-grey variety containing albite, quartz and pinkish lithian mica; and
3. a coarse-grained variety, with quartz, brownish lepidolite, tourmaline, topaz and fluorite.

Also some mineralogical variation can be seen in the pegmatitic segregations (Chaudhry and Howie, 1973).

Where the aplite veins pass into the country rocks, the borosilicate minerals axinite and datolite are sometimes abundant. Many of the joints in the aplite are lined by a coating of blue fluorite. From some of the pegmatitic areas native arsenic and löllingite have been recorded.

Interpretation

The Meldon Aplite appears to be unique in Britain. A large number of factors need to be taken into account to provide a model for its genesis. In interpreting its formation it is necessary to account for the overall fine grain-size and its unusual composition when compared with granite differentiates elsewhere in Britain, and also in comparison to other Variscan granites in Southwest England. Other aplites and pegmatites do occur in the area, but discussion has mostly centred on comparisons with the crystallization of the quartz porphyry ('elvan') dykes.

Considering the rock-forming minerals present, the feldspars present are found to be polymorphs of higher-temperature, volatile-poor environments (Chaudhry and Howie, 1973), which also applies to the nature and formation of the Li-micas (lepidolites). The presence of orthoclase rather than microcline in most of the rocks is also significant. The presence of the lithium-bearing minerals petalite and spodumene has been discussed along with comparisons to the paragenesis of lithium minerals in pegmatites from Zimbabwe, especially those at Bikita (L. Haynes, pers. comm.).

The extent of petalite- and spodumene-replacement by Li-mica depends on the fluorine content of the late-stage fluids. At Meldon, Drysdale (1985) suggested that petalite and spodumene do not occur together. Chaudhry and Mahmood (1979) regarded the petalite as a late metasomatic replacement of other minerals, notably orthoclase, its irregular distribution indicating that metasomatic action was preferential, affecting only certain areas.

The Dartmoor Granite crystallized as a plagioclase-quartz-biotite rock, which subsequently reacted with a volatile K-rich fluid phase to provide megacrystic K-rich granites characteristic of the Cornubian Batholith.

On the basis of experimental work, it has been argued that the Meldon Aplite is similar to type-E granites, with a magmatic origin in which either in-situ crystal separation or later metasomatism resulted in compositional inhomogeneities. It is considered that in peraluminous magmas, high fluorine contents could initiate early topaz crystallization. L. Haynes (pers. comm.) has made the following points considering the genesis of the aplite, namely:

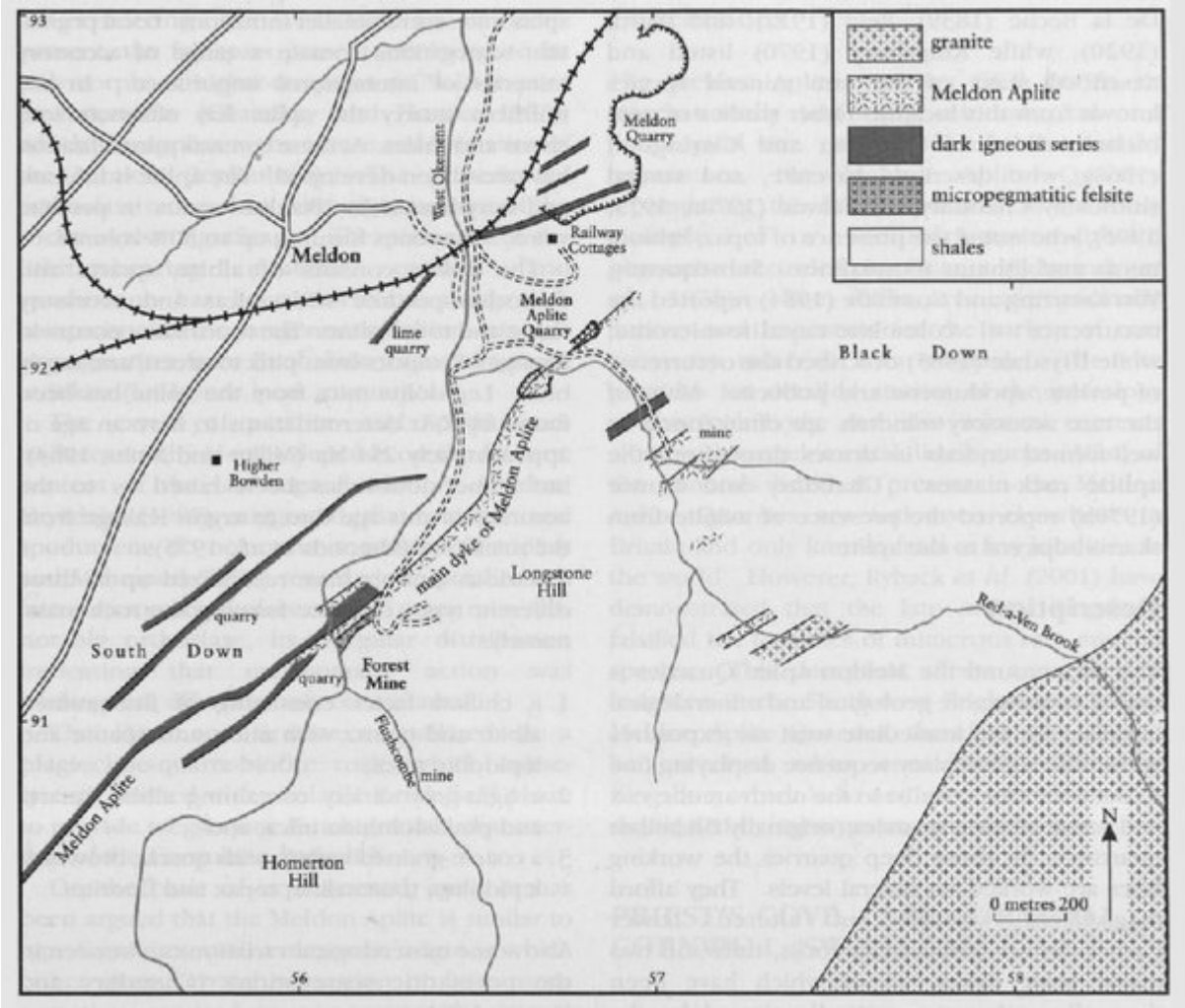
1. the structure of the Meldon Aplite is similar to that of South-west England elvans, which crystallized in an opening fissure environment. Metasomatic replacement of an initial magma by a later fluid-rich magma could be the cause of some of the alteration features seen in Meldon;

2. chemical zonation and mineralogy is similar to that of Bikita-type pegmatites;
3. the crystallization history of the feldspars is similar to that of type-B Cornubian Batholith granites. The early crystallization of topaz and Li-mica may have been important; and
4. the later magma (forming the pegmatitic pods) may have been a late-stage type-E granite.

Conclusions

The Meldon Aplite Quarries GCR site is an internationally important mineralogical and petrological site. It is a remarkable 'granitic' occurrence, the Meldon Aplite Quarries representing the best exposures of the only example of a sodium-potassium-lithium pegmatite recorded in Britain (Edmonds *et al.,* 1975). The rocks are internationally famous and important for the variety of rare accessory minerals they contain. The site provides for detailed studies of the petrology of the rock body, and also mineral contents along with rare elemental distributions. Many of the minerals listed as present in the Meldon Aplite Quarries are unknown elsewhere in Britain and only known from a few localities in the world. However, Ryback *et al.* (2001) have demonstrated that the late A.W.G. Kingsbury falsified the localities of numerous rare mineral species. This deception affects a number of locations in the South-west England, including Meldon Aplite Quarries, therefore care should be exercised when considering claims by Kingsbury which have not been substantiated or duplicated by subsequent collectors.

References



(Figure 7.6) Map showing the location of the Meldon Aplite Quarries GCR site (shown on old maps as the 'Granulite Quarry'), and the Meldon Aplite.