Information Sheet 1E: The Dartmoor granite and associated igneous rocks

General description

By around 300-290 million years ago, the crustal thickening associated with the rise of the Variscan Mountains and consequent heating of deeper levels, led to the production of granitic magma. As the magma developed in a thrust terrain, its intrusion appears to have been as a series of sheets rather than as a single mass, as continued tectonic activity created opportunities for it to be intruded into higher levels in the crust. This sheet-like internal structure has been elegantly demonstrated along coastal exposures of the Land's End granite in west Cornwall – part of the westward continuation of the same Variscan granite complex as Dartmoor. Although there are no contemporary studies, it is highly likely that a similar internal structure exists within the Dartmoor granite and historical observations such as the presence of megacrystic granite primarily only in high tors (including in Yes Tor, Locality G2, and West Mill Tor, Locality G3; Edmonds *et al.* 1968) adds circumstantial evidence to such a scenario (i.e. this granite represents a single sheet or layer high in a composite intrusion and therefore now only outcropping, or surviviving, in the highest areas of the moor, the tors). Additional evidence of this model of intrusion may also come from the structure within the Carboniferous nappes to the north of the granite, the 'Meldon Anticline' being part of an accommodation structure allowing the emplacement of a sheeted intrusion (see Sheet 1G).

East Mill Tor – a typical outcrop of granite on the high moor (Photo: Kevin Page 2005)

The Dartmoor granite is the classic igneous rock, composed of interlocking crystals of white orthoclase

feldspar, clear quartz and shiny black flakes of biotite mica. The feldspar crystals, whether exceptionally large (e.g. megacrystic), or not, are commonly well formed and frequently alligned parallel with the flow of the crystallising magma. As cooling continued, quartz and biotite mica grew in the spaces between the large feldspars. Unusually for granites on a global scale, the Variscan granites of south-west England are relatively rich in boron, and as a result the final stages of crystallisation often includes the growth of small clusters of black tourmaline crystals, a boron-containing mineral. Around the edge of the intrusion, veins, or dykes, of relatively fine-grained granite locally penetrate the surrounding Bealsmill Formation, as in Red-a-ven Brook (Locality BF4) and in the East Okement (Locality BF8). Such veins may be locally relatively rich in biotite or tourmaline and the influence of the boron may extend into the Bealsmill Formation beyond which may also be locally tourmalinised (Edmonds *et al.* 1968).

Meldon Aplite Quarry (north), showing aplite veins crossing banded cherts.
Photograph taken in 1999, view now obscured by vegetation (Photo: © Kevin Page)

Occasionally discrete veins of microgranite – or aplite – may also be present, as also at Yes Tor and West Mill Tor, and are probably relatively late intrusions. The most famous of these is the 'Meldon Aplite' although mineralogically it is quite different, representing a remarkable late-stage distilation of unusual elements such as lithium, fluorine, phosphorous and possibly beryllium, within the granitic magma. As a result, a unique range of rare and unusual minerals developed, especially in relatively coarse 'pegmatitic' lenses.

Whereas the main granite contains orthoclase and black biotite, along with the ubiquitous quartz, feldspars in the aplite are dominated by albite – with minor orthoclase - and micas by lilac coloured lithium-containing lepidolite. Minor topaz and elbaite are also present. The aplite has also yielded a unique range of accessory

minerals including lithium-containing petalite and pink and green tourmalines, also apatite (calcium phosphate), pollucite (containing caesium), fluorite (calcium fluoride), the clay montmorillonite, boron-containing datolite, the zeolites heulandite and stilbite, also prehnite, axinite, cordierite, bavenite (containing beryllium), palygorskite, columbite (contining niobium) and spodumene (Chaudry and Howie 1973, 1976; Dearman and Claringbull 1960; Edmonds et al. 1968; Floyd et al. 1993; Knorring 1951; Knorring and Condliffe 1984, Mackenzie 1972; McLintock 1923). Records of the beryllium mineral amblygonite-montebrasite, beryl, beryllonite, chrysoberyl, eudidymite, milarite and rhodizite by Kingsbury (1961, 1964 and 1970) however, need re-confirmation as the author is now known to have fabricated at least some of his results…

Massive white aplite in the southern and larger Aplite Quarry (Locality A1) (Photo: Kevin Page 2005)

With such a rich and varied mineralogy, it is not surprising therefore, that the outcrops of the Meldon Aplite have for many years been the focus of intense mineral collecting activity and despite being protected by national law within the Meldon Aplite Quarries Site of Special Scientific Interest, are still attacked regularly by rogue collectors…

The Aplite forms a dyke like body which crosses the Red-a-ven Brook and has been worked in two quarries, a small northern quarry (Locality LC21/A1) and a larger southern quarry (Locality LC5/A2). In the former the dyke splits into several smaller bands and is well seen at the back of the quarry cutting banded cherts. In the latter, the body is much thicker but surviviving wall rocks, where it has been removed, show thin seems and veins penetrating cracks in the surrounding hornfels. Beyond this quarry, to the west, there has been much debate as to whether the dyke continues, some believe it crosses the West Okement valley, others believe it peters out very quickly.

The northern margin of the aplite dyke in southern Aplite Quarry (Locality A1), showing white aplite penetrating cracks in the adjacent Lower Culm Group hornfels (Photo: Kevin Page 2005)

The relatively low iron content of the Aplite meant it was briefly exploited for glass making in the 1920s, and piles of broken class were once visible near the former site of the works, immediately to the north – these have now been 'tidied up', however, so very little trace of this activity survives. The buildings which are present therefore represent a later phase of working, for aggregate from the 1940s to the early 1970s (Fletcher et al. 1997).

Representative exposures in the Meldon area

LOCALITY	NGR	DESCRIPTION	REFERENCES
G1: High Willhays	58038921	Granite Tor with both megacrystic and poorly megacrystic granite.	Edmonds *et al.* (1968, pp.97-99, 104, 105, 120).
G2: Yes Tor	58089016	Granite Tor with megacrystic granite, also fine grained granite, including a posible microgranite dyke in the east face of the tor, around '40 ft' long and at least 2.5m thick, showing possible chilled margins with a finer grained texture than interior of body.	Edmonds *et al.* (1968, pp.98, 99, 109, 110, 120).
G3: West Mill Tor	58769097	Granite Tor with megacrystic granite and a possible small microgranite dyke in its northern part (with a 1.2-1.8 m lower portion, apparently spreading horizontally above)	Dearman (1959), Edmonds *et al.* (1968, pp.99, 110, 121).
G6: Black Tor	56828924-56628954	Granite Tor with megacrystic granite, also fine grained granite.	Edmonds *et al.* (1968, pp.99, 109, 120).
G7: West Okement River	56028984 area	Large boulders of megacrystic granite present in river near a weir (G7a), with exposures of similar granite in the river at Vellake Corner (G7b).	Edmonds *et al.* (1968, pp.120, 178).
G8: Meldon Reservoir	557908 and 560910	Relatively fine-grained biotite-tourmaline granite dykes were formally seen crossing the West Okement River but are now submerged. An island towards the SW end of the reservoir may, however, include exposures of one of these dykes.	Edmonds *et al.* (1968, pp.120).
A1/A2: Meldon Aplite Quarries (south and north respectively) / Meldon Aplite Quarries SSSI (part).		Aplite dyke up to 18m thick, dipping 50o SE exposed in two quarries – the only example of a sodium-potassium-lithium pegmatite in the Britain, enriched with lithium, beryllium, rubidium, boron, fluorine and several rare earth elements. The dyke is dominated by albite, orthoclase, quartz and lepidolite mica, with minor topaz and elbaite. It has yielded a unique range of accessory minerals (see above). The Aplite is dominantly fine-grained (0.15-0.3 mm crystals) but includes relatively coarse grained 'pegmatitic' seams with feldspar crystals several cm long. In such bands lilac-coloured lithium mica-lepidolite, pink and green zoned tourmalines and pink-coloured petalite wer formerly locally conspicuous. The dyke is cut by frequent small veins with minerals such as axinite and joint surfaces often show blue and purple fluorite. The margins of the dyke in the western quarry commonly show thin veins of aplitic material penetrating the country rock and in the eastern quarry the dyke splits and penetrates banded Firebeacon Chert Formation as several subparallel sheets. In the former site the body is around 18m wide but splits at higher levels and in the latter area the parallel dykes are up to 2.5m wide. The Aplite was initially worked for glass making, including in the 1920s, but latterly, until the late 1960s at least, it was worked primarily for aggregate. Exposures of the Aplite are of at least national importance and protected within the Meldon Aplite Quarries SSSI.	Beer and Fenning (1976, p.2), Chaudry and Howie (1973, 1976), Darbyshire and Shepherd (1985), Dearman (1959), Dearman and Claringbull (1960), Edmonds *et al.* (1968, pp.111, 112, 120), Fletcher *et al.* (1997), Floyd *et al.* (1993), Kingsbury (1961, 1964, 1970), von Knorring (1951), von Knorring and Condliffe (1984), Mackenzie (1972), McLintock (1923), Page (1999a), Worth (1920).

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