Excursion 18 Loanhead Quarry

Key details

Author	C. D. Gribble
Themes	Clyde Plateau Lavas; a Permo-Carboniferous dyke; minerals and their occurrence.
Features	Lava flow characters, red boles, rock joints, vesicular and amygdaloidal texture, porphyritic texture.
Maps	O.S. 1: 50 000 Sheet 63 Firth of Clyde. B.G.S. 1: 63 360 Sheet 30 Glasgow
Terrain	Quarry floor and rock faces.
Distance	Loanhead Quarry [NS 365 555] is situated near the A737 road, about 2 km (over 1 mile) north of the village of Beith, which is about 20 km (12.5 miles) from central Glasgow.
Time	About 45 minutes travelling time, and about 3 hours in the quarry (about a half day).
Access	The quarry is operated by Tarmac Roadstone (Scotland) Ltd., at 134 Nithsdale Drive, Glasgow (041) 423 6611: for permission telephone the Quarry Manager direct at Loanhead Quarry (041) 234. 2534 or 3758 . There is ample car parking space at the quarry offices, but first obtain permission from the Manager. This is a working quarry. Hard hats must be worn. Beware of heavy vehicles which are continually moving around. There is a regular bus service from Buchanan Bus Station in Glasgow, taking about 1 hour and 40 minutes to Beith; the driver may be willing to stop near the quarry.

Introduction

In Lower Carboniferous times (about 360 million years ago), the Glasgow area was subjected to intense and widespread volcanic activity. Basic lava flows and volcanic ash were poured out over an area of more than 2500 km' reaching a maximum thickness of 800 m, and these are known as the Clyde Plateau Lavas. They now form the flat-topped Campsie Fells, Kilpatrick Hills and Renfrew Heights lying to the north, west and south of Glasgow respectively. Loanhead Quarry is excavated in the basalts which form the high ground to the SW of the city.

Three successive lava flows can be seen in the quarry, although the continuous removal of rock from the faces may make them difficult to identify from time to time.

Locality 1

(Figure 18.1). In the long south face in the Upper Quarry two layers of red bole are observed which separate the basalt flows. Judging from the position of the boles, the uppermost lava flow is more than 10 m thick, the lower one at least 15 m thick, and the middle lava flow about 8 m thick. The high face is benched, i.e. it is split into an upper and lower face; the top two flows can be seen in the upper face, with the lower red bole running along the bench between the two faces. The lowermost flow occupies the complete lower face. These lava flows tend to undulate but, in general, dip at a shallow angle towards the north west. Examination of the basaltic rock shows that the lava is vesicular; that is it contains vesicles, which are gas holes in the rock formed by dissolved gases being released under reduced pressure when the original molten lava was erupted on to the land surface. These vesicles are often empty, but sometimes may be filled with minerals formed by the deposition of various salts from solutions in which they had been dissolved. When this occurs, the lava is said to be amygdaloidal, and the mineral-filled cavities are called amygdales. Individual lava flows tend to have vesicles and amygdales near the top and bottom surfaces. When lava was first erupted gas bubbles formed and tried to escape from the molten rock. However the top of a lava flow would have congealed quickly, preventing the escape of these gas bubbles; and therefore a concentration of these would occur near the top. The movement of the lava flow over the land surface dragged the upper surface down at the front of the flow, so that concentrations of vesicles (or amygdales) occur at both the top and bottom of the flow.

Close inspection of the more non-vesicular blocks of lava occasionally reveals the presence of minerals which show good crystal faces, and are conspicuously bigger than the surrounding matrix. Such minerals are called phenocrysts, and the lava containing them is said to be porphyritic. This type of rock occurs when the molten lava has remained for some time in the magma chamber at depth, so that early formed minerals have had time to develop and grow to an appreciable size before the molten magma (containing both crystals and melt) is finally erupted on to the land surface. In the basalts at Loanhead the phenocrysts were originally olivine, but this has since been altered and replaced by an aggregate of iddingsite (a hydrated silicate of iron and magnesium) and iron oxide. A microscope examination of the basalt shows that it contains both fresh and altered olivine phenocrysts, in a matrix of feldspar laths and augite, together with some minute magnetite granules. The feldspar laths show a poor flow texture, being roughly aligned by the flow of the lava before it consolidated.

The lava flows in this quarry were originally erupted sub-aerially: i.e. poured on to a land surface. The presence of red boles shows that the top surface of each lava flow has been weathered in the presence of oxygen with the ferrous iron (Fe^{2+}) contained in the basalt being oxidised to ferric iron (Fe'), which reaction involves a colour change to red-brown (the colour of ferric iron); the thickness of the red bole gives an estimate of the length of time over which weathering took place. These weak, weathered surfaces or red boles have been preserved by the protection offered from the overlying lava flows.

Locality 2

An extremely fine example of a red bole can be observed on the small rock face to the east of the road leading away from the primary crusher towards the Upper Quarry (Figure 18.1). The bole is up to half a metre thick and rests on top of a chloritised zone in which the principal mineral chlorite, a greenish, secondary mineral, was formed from the original ferromagnesian minerals in the basalt, either by late stage hydrothermal processes or by sub-horizontal shearing in the lava pile.

Joints occur throughout the quarry, appearing as vertical cracks running through the basalts. Crystallisation took place at point centres during the cooling of the basalt, and, as these cooling centres grew in size, thermal contraction of the igneous body also occurred which produced small gaps between adjacent cooling centres. A series of polygonal joints developed which grew in towards the centre of the igneous body; these joints developed at right angles to the margins of the cooling body. At Loanhead the joints are usually vertical since the lava flows are horizontal or sub-horizontal, although a few flat-lying joints may be seen on the extreme east face of the upper quarry near the very fine grained 'scree falls'. The basalt jointing should be compared with that of the dolerite dyke described below.

Locality 3

A dolerite dyke is seen in the south east face of the Upper Quarry near the corner, where it exhibits superb polygonal jointing over the entire face. The dolerite dyke is a thin igneous sheet (5 m thick here) intruded vertically, and, since cooling takes place from the margins inwards, the joints affecting the dyke are horizontal. A dark green, soapy mineral known as bowlingite (a variety of saponite) frequently coats joint surfaces, often in association with a finely divided red heulandite. Native copper may also occur in the joint planes, but is more common as small flakes widely disseminated through the basalt.

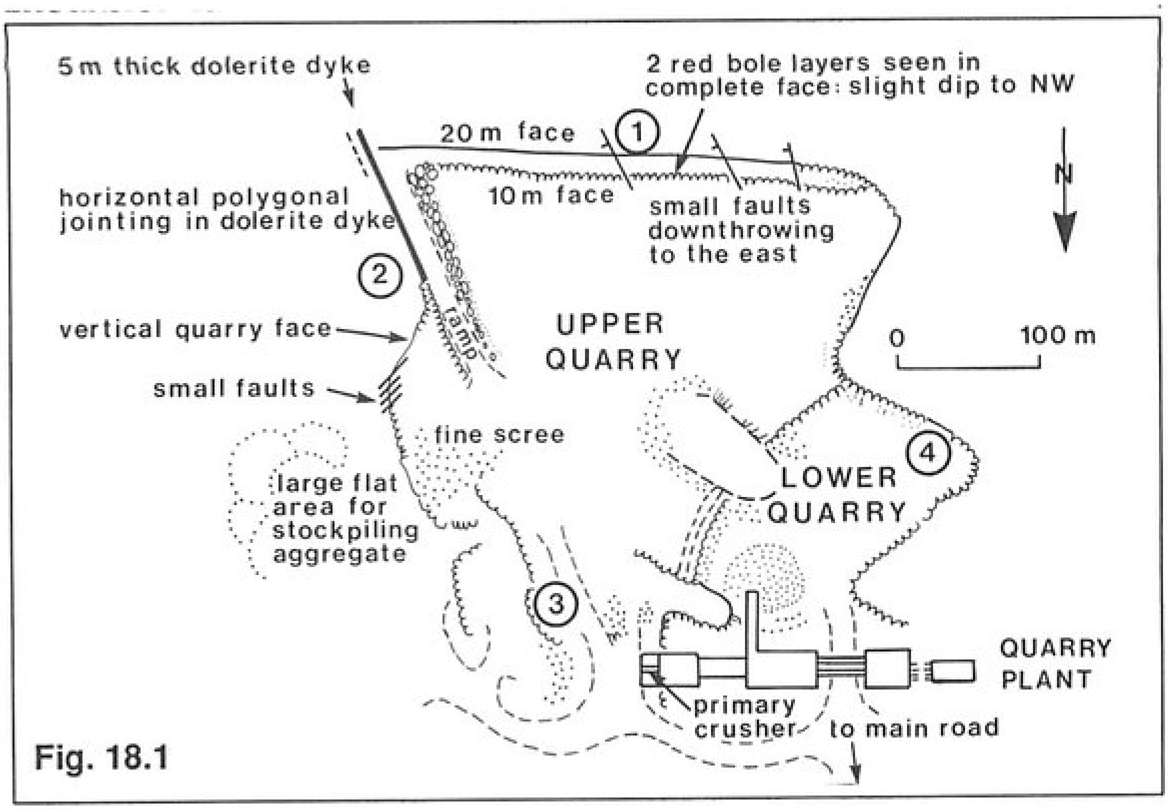
Locality 4

In a few places in the upper quarry, especially on the west side of the lower face, a thin layer of volcanic ash or tuff may be seen. These ash bands are discontinuous and it is impossible to tell if they were deposited in water.

Mineralisation in the rocks at Loanhead Quarry

Most of the interesting minerals in the basalt lavas are not primary minerals, originally crystallising as an integral part of the rock, but secondary minerals formed in the vesicles and joints of the basalt after it had consolidated. The most common mineral is calcite, found as 'dog-tooth' crystals, cleavage rhombs and as massive aggregates. Pale green, botryoidal (grape-like) masses of prehnite are common, and also snow-white crystals of analcime. Copper may be found native on joint surfaces and also as the hydrated carbonate malachite, and the oxide cuprite. Zeolites are present though rather rare, especially red heulandite, and the white fibrous minerals thomsonite and natrolite. An important collection of the zeolite minerals of the Glasgow district can be seen in the Hunterian Museum of Glasgow University.

As regional vulcanicity waned, hot waters, perhaps bearing carbon dioxide, percolated through the consolidated lava pile. The existing primary minerals (olivine, feldspar, augite) were altered, and elements released during this episode contributed to the formation of low-temperature secondary minerals such as calcite and zeolites in the cavities and fissures of the basalts. Either copper was magmatic in origin, or it was formed by the percolating waters concentrating the minute quantities of copper originally found in the basalt.



(Figure 18.1) Plan of Loanhead Quarry.