JULY 10th 2018 Tuesday Dinantian Igneous Rocks of the Derbyshire Peak District
with Adrian Legg (Member).

Industrial Theme – lime, roadstone and railway ballast

12 of us met Adrian at the Peak District National Park car park in Tideswell Dale, on one of our rare meetings out of the county, on a beautiful July day. For those of us travelling over Holme Moss, the journey itself was a worthwhile day out whilst looking forward to seeing igneous rocks which are so rare in Yorkshire. Although the Derbyshire Peak District is known for its classic Carboniferous limestone scenery, Adrian had spent time researching dolerite, lava and volcanic ash outcrops in the scenic area of Tideswell Dale and Miller’s Dale and very ably explained and demonstrated these to us. We started with a dolerite boulder in the car park, which itself sits on dolerite within an old quarry with a substantial dolerite sill in the trees above us and then by ascending a short way we approached the huge Tideswell Dale Quarry with its 30m deep sill face to be examined. All this material was excavated and used for rail ballast and roadstone. We continued down the Dale and alongside the River Wye to Miller’s Dale and ascended to the Station on the abandoned railway now used by walkers and cyclists being on the Monsal Trail where we had lunch in whatever shade we could find. Adrian showed us a further quarry just west of the station before heading across the major viaduct and past an industrial lime kiln beside the railway, being another industrial use of the geology of the area, before reaching our final point of geological interest in a railway cutting before Litton Mill. At this location a lava flow entered a lagoon causing the lava to harden quickly into features like pillow lava. An explanation board had been erected to explain this to the public. A thoroughly interesting day in this new area to us and “accessible” igneous rocks.

Dinantian igneous rocks of the Peak District

Dinantian rocks are found in the southern part of the Peak District, from Castleton in the north to Ashbourne in the south. To the east, they extend as far as Matlock, and in the west, to just to the west of Buxton. The Dinantian rocks of the Peak District are predominantly limestones. They were laid down in two different depositional environments. Most of them were deposited in a shallow water platform known as the Derbyshire Platform, which was situated north of the Wales-Brabant High. The area in between, the Widmerpool Gulf, formed a deeper water off-shelf basin, in which the limestones of the south-western part of the Peak District, primarily around Dovedale, were deposited.

Northern area (north of Monyash)

South eastern area (west of a line from Matlock to Wirksworth)
Small central area, around Southern area, just east of Tissington (near Dovedale Bakewell)

Figure 1: Distribution of igneous rocks in the Peak District Dinantian outcrop (Figure 15 from Aitkenhead et al., 2002).
This excursion focuses on the igneous rocks of the northern area, and specifically focusses on a number of closely spaced sites in Tideswell Dale and Miller’s Dale, which best display some important features of these rocks. Within the Dinantian rocks, igneous rocks are found in four geographical areas, as shown in figure 1.

Stratigraphy

All carbonate rocks in the Derbyshire High province of the Peak District belong to Peak Limestone Group. They are classified into four formations (from oldest to youngest):

- Woo Dale Limestone Formation (Chadian to Holkerian)
- Bee Low Limestone Formation (Holkerian to Asbian)
- Monsal Dale Limestone Formation (Brigantian)
- Eyam Limestone Formation (Late Brigantian)

These are contemporary with the Great Scar Limestone Group (Chadian to Asbian) and the Yoredale Group (Brigantian) found in the Yorkshire Dales.

Within these carbonate rocks, there is a wide variety of igneous rock units. Walters and Ineson (1981) recognised 30 distinct extrusive horizons, either tuffs (volcanic ash) or lava flows, many of which are afforded member status within the BGS lithostratigraphic framework for the Carboniferous Period (Waters et al., 2007 & 2009). Intrusive igneous rocks are also known, comprising vents, dykes and sills.

In the northern area, all the igneous rocks found at outcrop occur within Bee Low Limestones of Asbian age and Monsal Dale Limestones of Brigantian age. This excursion focusses on the two most significant lava flows in the area, the Lower and Upper Miller’s Dale Lavas, and the intrusive Tideswell Sill. Inevitably, we will also see the carbonate rocks within which they are found.

Some details of the main rock units are provided here.

Bee Low Limestone Formation

Pale grey, or sometimes brownish-grey, fine to medium grained calcarenite (i.e. sometimes sandy), thickly bedded limestone, with scattered crinoid debris. Palaeokarst features are common on many bedding planes, and are often overlain by red-brown or grey-green volcanic clays (i.e. volcanic ash layers which have been turned into clays by weathering and alteration) up to 0.5m thick.

In the Miller’s Dale area, the Bee Low Limestone is intruded by the Lower Miller’s Dale Lava, which is afforded member status. There are sufficient differences in lithology between the limestones above and below the lava for them to be afforded separate member status.

Chee Tor Limestone Member

Found below the Lower Miller’s Dale Lava Member. A homogeneous, pale grey to grey, massive or thickly bedded calcarenite (i.e. sandy) limestone. Bed boundaries are typically demarcated by clay partings.

Lower Miller’s Dale Lava Member

Olivine-basalt, normally containing vesicles filled with calcite, zeolite or chlorite. Less vesicular in central parts. Up to maximum thickness of 30m. Typically very weathered.

In southern areas, including Miller’s Dale and the Tideswell area, outcrops are often lenticular in shape, suggesting emplacement as a series of tongue-like flows. Further north, outcrops are more continuous, suggesting sheet-like flows.
**Miller’s Dale Limestone Member**

Found above the Lower Miller’s Dale Lava Member. A pale grey to grey, occasionally pure white, fine grained limestone, with common fossils, including crinoids, corals and brachiopods. The middle part occasionally contains cherts, and there are occasional local ooidal beds.

**Monsal Dale Limestone Formation**

A pale to medium grey, thickly bedded and bio-turbated limestone, containing sporadic chert nodules.

**Station Quarry Beds**

Described by Cope (1936), although they are not formally recognised as a subdivision in the BGS lithostratigraphic framework.

Thinly bedded grey to black fine grained limestones, containing chert, especially towards the top. Contains dark clay partings. Crinoid fragments can be found in places. Max thickness is 17m, but only 12m at the type location, where they are directly overlain by the Upper Miller’s Dale Lava.

**Upper Miller’s Dale Lava Member**

Amygdaloidal olivine-basalt, with calcite and chlorite infilling vesicles. Flow banding visible in places. Max thickness of 35m, decreasing eastwards to the type location in the railway cutting at Litton Mill.

**Geological Conservation Review Sites**

Two of the sites that we will visit are Geological Conservation Review sites. Across the UK, there are over 3000 of these sites, identified as the best examples of particular aspects and periods of the geological history of the United Kingdom.

**Tideswell Dale**

A dolerite sill intruding Asbian (Visean) limestones at or around the planar contact between limestones and the Lower Miller’s Dale lava (Waters, 2003b).
Litton Mill Railway Cutting

At this location, the Upper Miller’s Dale Lava has flowed across an eroded limestone surface and was terminated as it flowed into a lagoon. The flow front is shattered and brecciated as it came into contact with the water of the lagoon (Waters, 2003a).

More information about these two sites are available online (Ctrl + Click), as shown in the reference list below.

References


**BGS Report** on the geology of the Peak District around Tideswell Available on-line [Ctrl + Click]  [https://www.bgs.ac.uk/downloads/start.cfm?id=2811](https://www.bgs.ac.uk/downloads/start.cfm?id=2811)  (93 Pages)