REPORT

Vein cavities on Dirtlow Rake

In the Carboniferous Limestone south of Castleton, Dirtlow Rake is a classic vein system with a long history of productive mining. This included a large open pit that was developed in the 1980s and now lies close to the high point on the new road skirting the much larger limestone quarry.

Fluorspar mining completed

The open pit was originally worked by a contractor for Laporte Minerals, after the orebody adjacent to the main rake was discovered in 1984. Mineral extraction continued under a series of planning permissions until the contractor went into receivership in 1996. In the following year a planning permission was issued which consolidated Dirtlow Rake with the adjacent Hollandtwine and Hazard Mine workings. With its prominent position on Bradwell Moor, in the centre of the Peak District National Park, controlling the impact of this mineral working on the landscape was always problematical. The approved working scheme was never carried out to its full extent and the proposed final restoration plan to achieve a long valley feature connecting all three sites could not be implemented.

Laporte ceased operations in 1999, and responsibility for restoration of the site could not easily be resolved among the various parties that had been involved. Eventually, after several years of negotiations, funds were provided for restoration work and a scheme was agreed with the landowner. Begun in late 2006, this involved backfilling the open pits with the remaining overburden material to leave a regraded landform sympathetic to the surrounding landscape with its history of mineral working along the rake over three to four centuries. The scheme maximises the area of restored grazing land available to the current landowner, while preserving for open view the geological features on the northern quarry face. The earthmoving work is due for completion by the summer of 2007, and the site will then begin to blend into the landscape as the field boundaries are rebuilt and the grass cover gradually returns.

This is a good example of geo-conservation and is consistent with the principles outlined in the recently-published geo-diversity guidelines (ODPM, 2005; Scott et al, 2007). It is hoped that the final dressing of topsoil will have a tolerably low concentration of lead, though retaining isolated areas of galena-contaminated soil that will encourage the development of metallophyte plant communities, adding to the local biodiversity.

The orebody, now completely removed from the pit, was a dome-shaped mass about 100 m in diameter and 30 m deep. It was roofed by limestone that was almost entirely un-mineralised, and its floor was on the Upper Miller's Dale Lava. It was slightly elongate with its south-eastern margin edge against Dirtlow Rake. A lower zone of altered limestone was capped by a breccia pile that appeared to represent extensive collapse of a Carboniferous cave chamber (Butcher and Hedges, 1987). It is unclear whether the dissolution and subsequent roof failure, by progressive stoping, of this chamber, pre-dated the mineralisation. Alternatively, both its enlargement and collapse may have been by the same hydrothermal activity that introduced the minerals. The main mineral of the domed orebody was fluorite, though the adjacent rake carries largely calcite and barite with lesser quantities of galena.

The two large pipe-shaped vein cavities exposed on the north wall of the Dirtlow workings, with remnants of smaller cavities recognisable by the ribs on their walls.

Backfilling the open pit in summer 2007. The tipper is on the fill at its intended level, which will finally reach a slope down to the foot of the face with the solution features.

Solution features preserved

With the orebody now removed, solution features are now exposed on the open north-western face. Most notable are the surviving halves of two large vertical pipe-shaped vein cavities, along with remnants of at least six more, smaller cavities. All lie within a zone of jointing, though they are not on a single well-defined joint. The two large features are each about 20 m high and 7 m wide. Their walls are stepped by sub-horizontal ribs. These could relate to variable dissolution on beds of contrasting lithologies; alternatively they could have been etched into the walls beside the tops of sediment banks that accumulated in stages while the roof migrated upward by stoping collapse. Scallops are large and poorly defined, and there is no vertical fluting that would indicate vadose origins by cave waterfalls.

Morphologies of these features are all consistent with a phreatic origin, by slowly moving water well below the contemporary water table. They are vein cavities comparable with many others known in the Castleton limestone (Ford, 1986, 2000). These by the Dirtlow Rake are shaped more like vertical shafts than many of the other features - which are more extensive in two dimensions along the planes of single rakes or joints; these could possibly have been linked by openings removed by mining where they lay in front of the plane of the cut face. Of the two large vertical features, that to the west is capped by a half-roof, while that to the east is now open to the sky above where it splits into two (only since a sediment plug fell out from each when it was all breached by the pit face). A low cave along a bedding plane, with its roof pitted by small phreatic domes, links the bases of the shafts. Like at most other nearby vein cavities, there are no large open cave passages leading in or out.

These vein cavities beside Dirtlow Rake are not mineralised. They are therefore much younger than the earlier stage of dissolution when the broad dome structure was formed, then partially collapsed during or before receiving its late Carboniferous

The eastern vein cavity with its ribbed wall.

The undercut bedding plane across the base of the vein cavities, with its roof pitted by phreatic domes.

hydrothermal mineralisation. They are probably roughly contemporary with the many other vein cavities in the area, including the nearby Titan Shaft (Waltham, 2000). Though initiation of the cavities may relate to early circulation by warm waters, their main enlargement dates from the mid-Tertiary, soon after the Upper Carboniferous cover was removed, thereby allowing accelerated groundwater circulation and dissolution (Ford, 1986). All these old phreatic cavities were drained when the Hope Valley was cut to levels beneath them. While most of these distinctive solution features lie far underground and are accessible only to cavers, these beside Dirtlow Rake are now available for all to see.

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A new book, *The Rise and Fall of the Ediacaran Biota*, edited by P. Vickers-Rich and P. Komarower is published in October 2007 as Special Publication of the Geological Society of London, Number 286, with 464 pages (ISBN 978-1-86239-233-5).