



Geology of: HEALEY DELL

Valley of the River Spodden

ROCHDALE

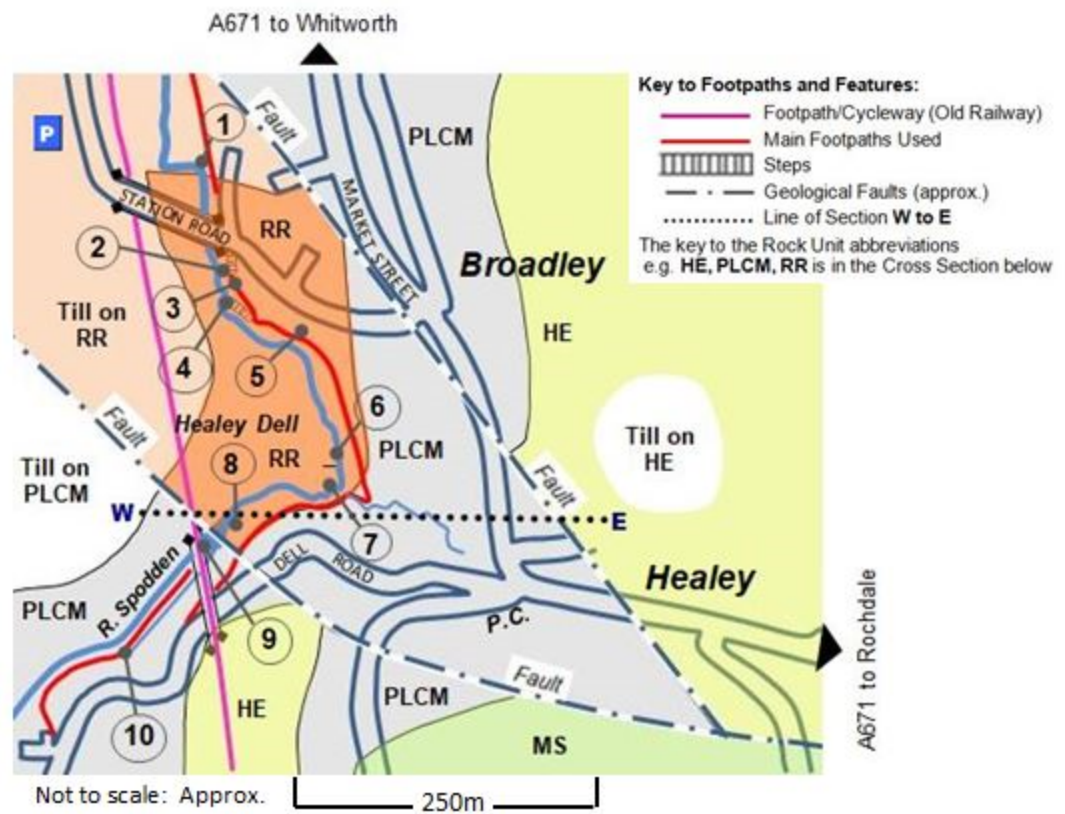
and Rossendale



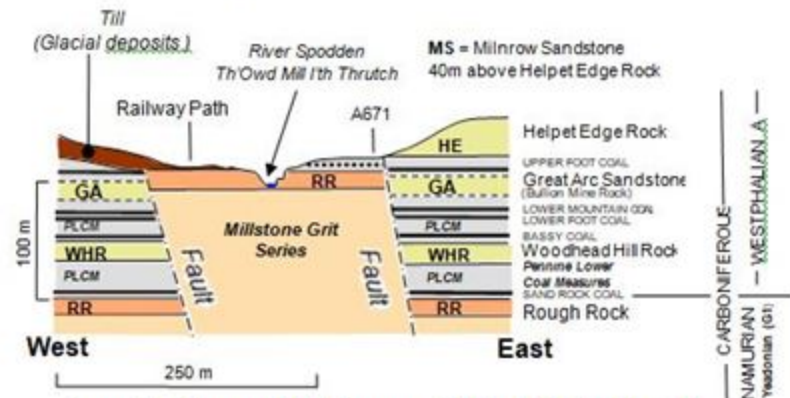
Fairies' Chapel

The story of an ancient river delta,
ice-age torrents and
industrial heritage.

The area is now a nature reserve
open to the public.



Simplified Geological Sketch Diagram of Healey Dell Area



Cross Section on W to E across Th'Owd Mill l'th Thrutch showing Rock Units and Fault displacement



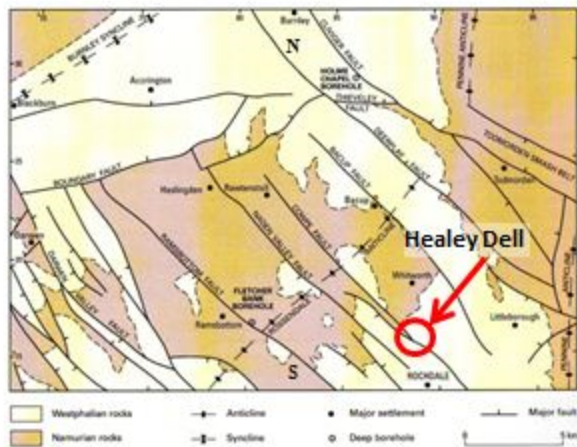


Figure 2 Geology of the Rochdale district.



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Healey Dell lies on the Southern limb of the Rossendale Anticline (a structural arch) which rises in the vicinity of Burnley and has a crest, as a broad plateau in the Bacup area before sloping gently down South-South-East toward Rochdale. The axis of the anticline runs roughly from Chorley in the West to Todmorden in the East and is in rocks of Carboniferous age (about 320 million years old)

The rocks were laid down in an immense equatorial river delta, developing southward over millennia with braided rivers and coal forming forested swamps developing in slack water far behind any ocean tide-line. Varying flow rates of river water and lagoons gave rise to sands (fast flow), muds and silts (slower flows) which eventually became rock.

The anticline has been heavily affected by many North West to South East trending faults and by glacial erosion which has removed most of the younger coal measures from the top of the anticline. As the ice melted, glacial deposits ('till') and torrential water resulted.

At Healey Dell this has led to a steep, narrow and deep gorge exposing some of the structure and erosional forms in the rocks where the River Spodden cuts down this limb of the anticline and on towards the River Roch. The water power and coal have been heavily exploited locally throughout the industrial revolution.

The river passes over several faults. Two of the more prominent faults converge under Gandy Lane, Healey. The river passes over the Northerly fault near Broadley Station. The Southerly fault runs from the North side of the old railway viaduct, crossing the river close to Th'Owd Mill l'th Thrutch. These two faults bring a thin wedge of a much older rock at the top of the Millstone Grit Series, the aptly named **Rough Rock**, into what are otherwise **Pennine Lower Coal Measures (PLCM)** rocks. The Rough Rock passes out of sequence into the bottom of the PLCM below the Woodhead Hill Rock. The Woodhead Hill Rock, Helpet Edge Rock and other sandstone are units within the PLCM. Much of the surrounding bedrock in this area is hidden under glacial deposits ('till'), including the Northern limb of the fault.

The positions of the two faults are not easily seen but have led to local features in the landscape. Faulting brings a shatter zone of broken rock to either side and the forces have helped to widen existing joints and weaknesses in the rocks which the River Spodden has exploited in its course.



Cross-bedding: Is the result of the deposition and erosion of large ripples in river beds or an advancing delta front. These

move down-current in the same way that desert dunes move downwind. Look in two planes where possible. These are dynamic, three-dimensional systems especially where there are braided delta streams (distributaries) involved. The crests of ripples and the troughs between them will wave about, across current and there may be smaller ripples on larger ripples. Where the top surface is concave (see left) these are the usual lee or down-current ripple surfaces (bottom sets), a delta front or, sometimes, there are similar structures arising from the migrating edges of delta distributary channels in cross-section.

Where the top is convex that's what is left of the top-sets. These are more unusual as they tended to wash away in the frequent flash floods of the time. They are only preserved where the crests were building much faster than the crests were eroding.

Load structures:

(see right) result from the various forms of river bars or a fresh heavy flood in distributary river channel deposits which might at different times, overflow and run in different directions perhaps settling into troughs between other large ripples or abandoned stream beds.





1: North of the remains of Broadley station the river crosses the Northerly of the two converging faults onto the older Rough Rock. This is a limb of the Cowpe fault system. From the footpath to the North of Station Road bridge, you

can observe how the River Spodden makes two abrupt turns under rock bluffs as if seeking a line of weakness in the Rough Rock. The symbols show the relative movement of the rock, younger rocks dropping to the North (to right of picture) and the current direction of river flow.

2: Cross Station Road and descend the stone steps on the East side. Looking over and down into a narrow gorge. (below left).

Except when in flood, the River runs both sides of a prominent water-worn slab of bedrock. Numerous swirl-holes or 'mills' can be seen which are worn by pebbles lodging into crevices and then being driven round and round by the force of the water, wearing these deep circular depressions



3: From a little further down the wide path, you can look over to the opposite side of gorge (see above) and see the sheer sides. This is a clear sign of rapid down cut into a weak rock joint system caused by torrents of melt water starting at the end of the last ice-age, 10,000 years ago. Above there is a series of convex surfaces which descend to the footpath. These follow eroded top-set cross-beds showing that the ripples were rapidly building their crests.

4: Where safe to do so, descend the steep, uneven steps to the '**Fairies' Chapel**' platform (see cover image). This is often off-limits due to erosion caused by falling trees. From this platform there are spectacular views of waterfalls and chutes. There are plenty of examples of cross-bedding, clay partings between rock beds and swirl-holes abandoned as the river cut further down into the rock bed.



(see left).



5: Climb back up to the main path and continue down to the long rock face on the left. There are good examples of cross-bedding, (see **cross-bedding** panel) erosion surfaces, thin mudstone horizons between beds and load structures (see **load structures** panel) where the soft sediments below have deformed under subsequent deposits. Under some overhangs you can see deep ripples running across the under-surface. You might spot a fossil imprint of a very small piece of an ancient tree on a rock edge above head height.

6: Toward the bottom of the long face, viewed over the rail and down into the gorge, there is a stone-built weir built onto a prominent water-worn bed of rock. This weir used to feed water via a wooden laund or masonry leat to the old 'Th'Owd Mill I'th Thrutch' around the next bend in the river.





7: At the abrupt bend in the river, looking back up the gorge. (See above). Several further waterfalls follow-on from the weir, the final and largest forming the acute bend. Perhaps the line of the lower valley was already set against the wedge of Rough-Rock by a 'shatter-zone' around the fault when the ice-age torrents came through. There is also a prominent stream descending steeply from Healey Corner, high up on the right. When there are no leaves on the trees, you can see an unusual laminated spherical concretion set into a cleft high on a bluff opposite (binoculars may be needed to see this). This is thought to be a relict piece of cross-bedded sediment, which, if in situ, has been left when less-well cemented sediment around it has weathered away.

8: The path now rises toward Dell Road. On the right of the path is a board showing features of the old felt mill. The waterwheel pit, treatment tanks, sulphur ovens and a single arch (of original 2) across the narrowest, deepest stretch of the river ('The Thrutch') are all that now remains. The arches once supported a mill building,



9: If conditions allow the nimble can make a steep, winding descent to the concrete weir at the riverside on the upstream side of the disused railway viaduct (which now carries recreational users). Otherwise a 240 metre detour is required down Dell Road to find a narrow level path at the right of garages for the first terraced houses on the right. Follow this to the water-gate allowing water into the leat. The southern limb of the fault system shows in the far river bank by the last arch of the viaduct as older solid Rough Rock wall above the weir and younger shales below. These have 'draped' at an angle, as they faulted downward. The down-throw on both faults is roughly 100 metres. A short distance, (20m) downstream, i.e. south, above the leat, these shales show to be almost horizontal. The viaduct and most local buildings are believed to have been built with local stone.



10. South along the leat path for 100m, the water enters a tunnel (danger – do not enter). Here you can make a close inspection of the shales. When you

disturb the algae you can see the shales here are made of very fine sand in wavy beds with lenses of mud in the troughs. This is 'laminar lenticular shale' and is unusual. It can be formed by alternating currents in shallow and slack water, tidal flats, floodplains, subtidal etc.



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To the memory of Marjorie Mosley

