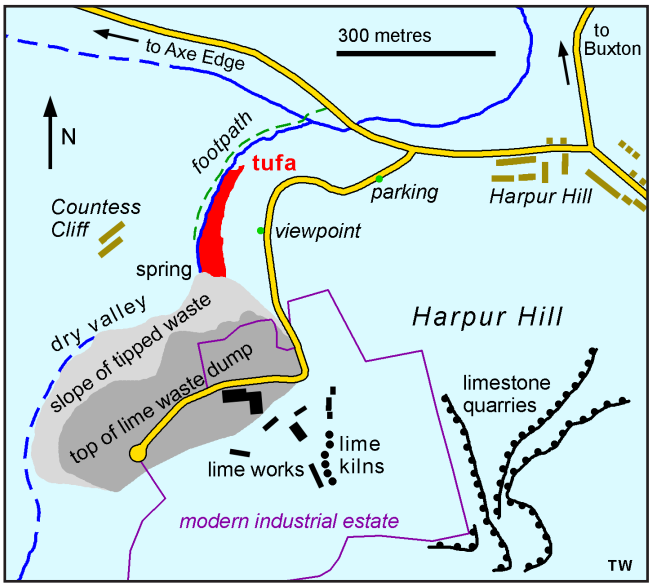
REPORT

Harpur Hill tufa

Among the many splendid karst features to be seen within the White Peak of Derbyshire, one of the less well known sites is tucked away beside an industrial estate at Harpur Hill, south of Buxton. A deep grassy valley containing the Brook Bottom Springs is cut into the Carboniferous limestone, although there is almost no exposure of bedrock. Instead, its floor is a great sheet of tufa that is more than 200 metres long.

Much of this tufa appears gleaming white in sunshine and its terraces retain dozens of shallow pools. It can be seen from the industrial estate road on its eastern side, but it is also well worth a short walk up the footpath that is adjacent on the western side. From the footpath the mini-terraces and their rimstone dams can be appreciated; they are nearly all still active with films of water flowing over the dams. Don't even think of walking on the tufa, because it is soft and far from lithified, besides which, footprints would be as unwelcome as the car tyres and junk that are already there. Deposition of tufa can also be seen along many sections of the main stream. A dry-stone wall has been overrun by the tufa, and ponding behind it contributes to parts of the tufa reaching a thickness of nearly three metres.

Tufa and travertine are almost interchangeable terms. Both are made of calcium carbonate, and softer varieties are often known as tufa, whereas travertine is the harder, more lithified form. Both are natural features of many karst terrains, but the Harpur Hill site is not entirely natural, unless you accept mankind as natural within the current environment of the Anthropocene. This tufa deposit has been deposited after dissolution of lime and not of limestone, because Harpur Hill was the site of a great lime works in the past.



Selected features around the tufa deposits of Harpur Hill, with the lime works as they were in 1900, and the quarry faces and giant tip heap now largely blended into the landscape.

Lime burning was a very inefficient process within the simple lime kilns of past centuries, and it produced huge amounts of waste. This consisted of a rubbly mixture of partially calcined limestone, glassy clinker, lime and coal ash, and it was simply dumped on the hillsides in large quantities. Groundwater draining though this lime rubble directly dissolves the reactive calcium oxide, thereby producing calcium and hydroxyl ions in hyperalkaline solutions (with pH of 9 to 13). When these waters emerge into open air, they absorb atmospheric carbon dioxide, to cause precipitation of calcium carbonate. The end result is the same as from deposition by natural limestone waters, except that the role of carbon dioxide is reversed in the final precipitation. Most importantly, this precipitation of calcite can take place at rates around 100 times faster than that caused by loss of carbon dioxide that prompts deposition from bicarbonate in solution.

Upper end of the tufa terraces of Harpur Hill; the grass slopes behind are natural on the left, and are the front slope of the lime waste tip on the right.

Endless patterns within the terracettes that are each a few centimetres high on the tufa

At Harpur Hill the great lime works with its row of kilns was active between 1835 and 1952. During that time, thousands of tonnes of waste were dumped on tips that extended out towards the Brook Bottom valley. Tramways were laid across the flat top to the sites for end-tipping. The whole flat area is now occupied by the industrial estate, which also extends eastwards onto the backfilled quarry floors behind the sites of the long-demolished kilns. The tips reached the streambed along the valley floor around 1890, and most of the tipping was during the subsequent thirty years or so, with the stream from the natural spring flowing through a brick-built culvert that was eventually buried. Rainwater drains through the tip to seep out at the foot of the slope or leak into the culvert, and from either route deposits the tufa soon after emerging into daylight.

Drainage through the tip continues, so the tufa is still expanding, but it appears that it has all been deposited within about 150 years. This rapid deposition of carbonate from alkaline solutions accounts for the calcite straw stalactites that are commonly seen inside brick tunnels or wet basements, where the source is the lime in mortar, cement or concrete. Less than two kilometres from Harpur Hill, Poole's Cavern is famed for its stalagmites, some of which stand more than ten centimetres tall on top of pipes that were installed for Victorian gas lighting. Unlike the other, very much older, calcite deposits in the cave, these were formed by drainage from the waste heaps of the Grin Low lime works that were active on the hillsides above the cave from the mid-1600s for more than 200 years.

Active deposition at downstream end of the tufa terraces.

The huge travertine terraces at Pamukkale, Turkey, with the girl standing on a concrete dam completely encased in calcite within the last 20 years, since it was built on the old road that is now also covered with calcite in the foreground.

Large and natural deposits of travertine do occur at well-known karst sites such as Plitvice and Krka in Croatia, and Dunn's River Falls in Jamaica. Tufa cascades also occur in many other places, though mainly in tropical regions where rates of dissolution and deposition are higher. Even there, most of the major sites of tufa and travertine rely on chemical processes that are enhanced in warm and acidic waters emerging from geothermal sources. Steam can usually be seen rising from the travertine terraces at Yellowstone's Mammoth Springs. On a smaller scale, the Peak District's largest natural tufa deposits, at Matlock, were formed by spring waters that are geothermally warmed.

The magnificent calcite terraces at Pamukkale, in Turkey, are fed by spring water at a temperature of 35°C. They have taken at least 55,000 years to reach their present size, but still achieve spectacular rates of deposition. An old road across the site is now buried beneath tufa deposited within only twenty years; concrete dams were built on the road and are now coated with calcite, so that many tourists think that they and their welcoming warm pools are natural features. But even this rate of deposition cannot match precipitation from hyperalkaline waters draining out of lime tips, such as at Harpur Hill with its spectacular addition to the youngest features of the Peak District karst.

References

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Tony Waltham
tony@geophotos.co.uk