The explosion crater at Fauld

While in no way a natural feature, the huge crater above the Fauld gypsum mine, 8 km northwest of Burton upon Trent, is one of the more bizarre components of the East Midlands landscape. It originated in one of the world's largest explosions of wartime munitions, which were being stored in the old mine. The site has changed little since then, and still warrants a visit; there is nothing else like it in Britain.

Gypsum, alabaster and anhydrite

The Tutbury gypsum is the lower of the two major gypsum horizons within the Mercia Mudstone that have been exploited in the Trent Valley region. It lies about 35 m below the Newark gypsum, and 75 m below the Rhaetic Blue Anchor Formation, the marker horizon by which the two gypsums are always traced within the monotonous sequence of red mudstones. Both beds consist of anhydrite ($CaSO_4$, anhydrous calcium sulphate) at depth.

The original gypsum ($Ca_2SO_4.2H_2O$) was deposited by incomplete evaporation of shallow saline waters in bays temporarily cut off from the sea along the desert shorelines of Triassic Britain. Conversion of the gypsum to anhydrite occurs when the increased pressures and temperatures of burial cause dehydration during the lithification process, generally at depths of around 400 m. Re-conversion, from anhydrite back to gypsum, requires only the addition of water within the deep weathering process, and generally starts when denudation lowers the surface to within about 100 m of the mineral. Both these depth figures vary with local conditions of geothermal gradient, groundwater availability and geochemistry, and it is considered that alabaster, instead of normal gypsum, was produced by rapid, cold hydration at shallow depths in a periglacial environment (Mossop and Shearman, 1973).

Today the anhydrite survives at depth, but the outcrop along the southern slope of the Dove valley, west of Tutbury (Fig. 1), is of gypsum. This forms a variable and discontinuous bed of mineral lenses that reach up to 6 m thick. Though much of the gypsum is soft, featureless and almost chalky in structure, some of it is of the stronger, crystalline, translucent variety known as alabaster (Firman, 1984). This is highly valued as an attractive and easily carved ornamental stone. The Fauld material can provide very large blocks and is notably pure and clean, with less of the red streaking that

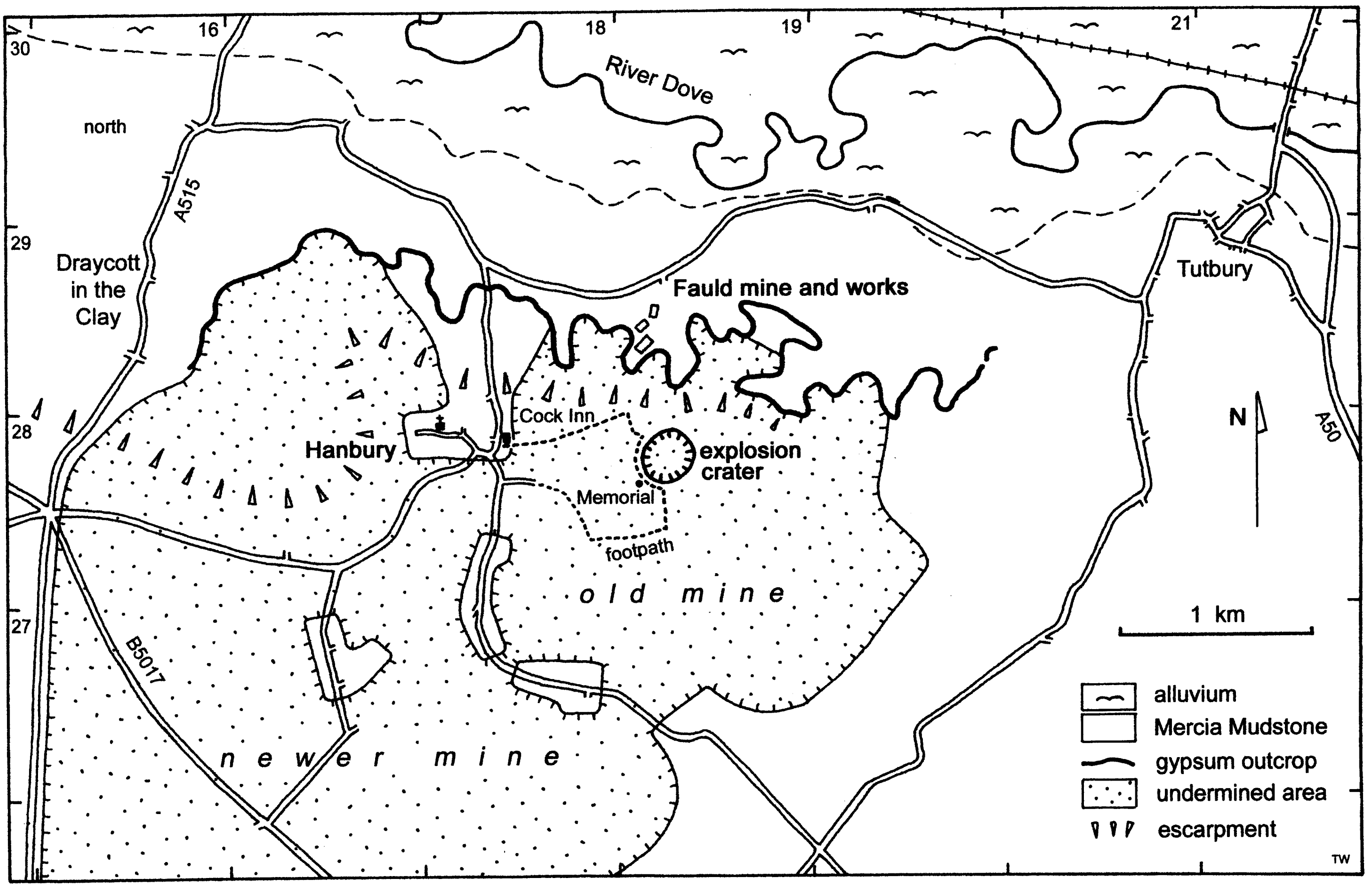

Figure 1. The area around Fauld and Hanbury.

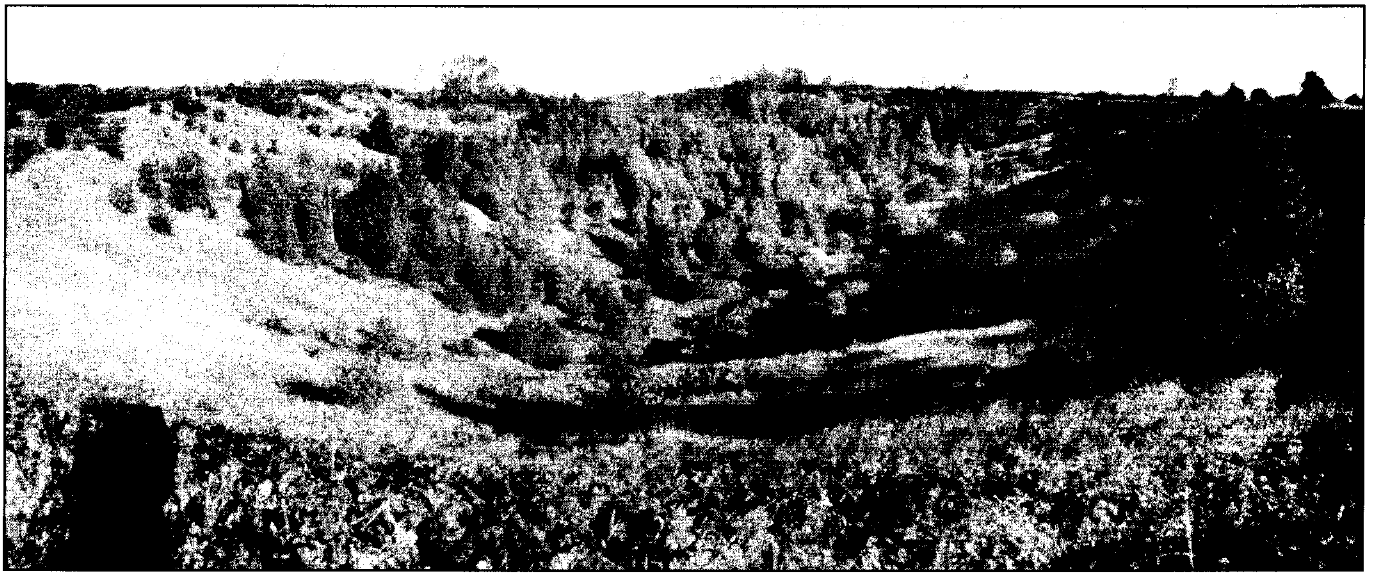

Figure 2. The explosion crater seen from its southern rim.

characterises the locally well-known alabaster from Chellaston. At Fauld, the best alabaster was found in lenses 5-12 m across, randomly distributed within the chalky gypsum.

The gypsum dips very gently to the south, and passes under the rise of a very gentle escarpment, so that its mudstone cover is up to 90 m thick a few kilometres south of the outcrop. The hills also have a thin veneer of glacial till. As the cover increases, the gypsum progressively gives way to its ancestral anhydrite. There is no clear demarcation, but an intermediate zone has a remnant core of anhydrite with gypsum at both base and top in contact with the mudstone. Joint lines also have vertical sheets of gypsum through the anhydrite, and neatly demonstrate the gradual conversion where water can reach the mineral.

Mines and mining

Alabaster was used as long ago as 1080 to build the archway over the western door of Tutbury church. The early sources were small open quarries and short drift mines along the outcrop between Tutbury and Draycott-in-the-Clay, but these are no longer recognisable. The contorted outcrop of the gypsum (Fig. 1) winds round the old quarries, with the modern and disused mine entrances at their southern ends. Further east and west the mineral bed is too thin for economic working. As time went by the mines had to extend further into the hill, and were amalgamated into fewer, larger operations. The Fauld mine dates from before 1800, when it was one of three almost horizontal drift mines into the hillside at the back of the old quarries.

All the mines are pillar-and-stall operations, whereby about 25% of the mineral was left in place to support the roof and ground above. The early workings were all for ornamental stone, and have no regular pattern, as the galleries (or stalls) followed the best quality of alabaster. The miners used blasting to excavate their headings, until they found a lens of good alabaster. Then all blasting stopped, and the stone was cut out by hand (Trafford Wynne, 1907). The roof was undercut as a "topping" slice a metre high was dug out of the poor quality upper stone. Working in this, the miners advanced until they were about 1.5 m in from the face, and then dug a gutter down to the base of the bed. They also dug out side slots. Normally the bed was about 2 m thick, and would be split free at the floor and mid-height, by hammering steel feathers and wedges into horizontal auger-drilled holes. Blocks 1 m thick, 1.5 m wide and up to 6 m long were thereby extracted intact, and hand-sawn to size, or to cut out poor stone, before being carted to daylight.

Plaster was produced by roasting gypsum and inferior alabaster, and its production overtook that of alabaster before 1900. The mines all became one and were modernised by British Gypsum, as they were extended to the southwest in a regular square grid of excavated stalls each 6 m wide between square pillars 6 m across. Production was gypsum for a plaster factory at the mine entrance, together with increasing amounts of anhydrite, which is used in cement. Small amounts of alabaster were extracted almost on demand from remaining ground in the old mine, until resources were exhausted in the early 1990s. One of the larger blocks produced in the later years was carved into a bath as a wedding present for Princess Margaret in 1960.

Today, Fauld is Britain's leading source of anhydrite, and produces no gypsum at all. The workings extend more than 6 km to the south (well off the map in figure 1), in a belt 2-4 km wide. At depths of 60-90 m the mineral is pure anhydrite. The depth also aids mine stability, as the totally unweathered roof mudstone is a strong material. Only at shallow depths, in workings many years ago,