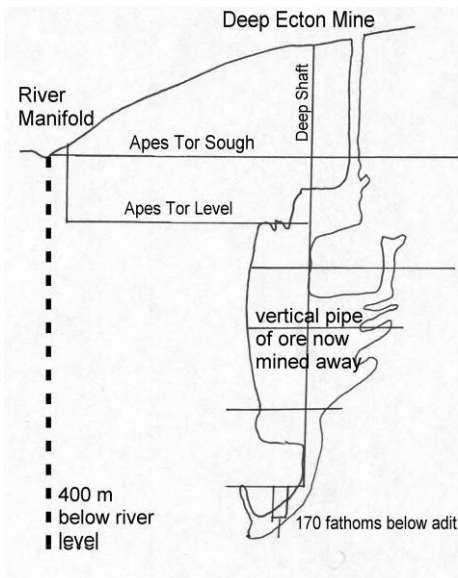


APES TOR: EARTH SCIENCE BRIEFING FOR THE SITE

EARTH SCIENCE BACKGROUND

The geological and geomorphological story of the Apes Tor, Ecton Hill area is based on the interpretation of evidence from the rocks and from the landscape, some of which may not be visible in this area. Here is the story and the evidence for it.

Figure 1. The Deep Ecton Mine (After Robey and Porter 1972 *The Copper & Lead Mines of Ecton Hill*)



The rocks of Ecton Hill are shales and muddy limestones containing a few fossil brachiopods and crinoid fragments from the Carboniferous period (beginning 354 million years ago). These indicate deposition in a warm marine environment.

These layers of limestone, originally horizontal, are now folded into anticlines and synclines, which trend (run) in a north-south direction. The rocks were broken by a series of faults running in two major directions: NE to SW, and NNW to SSE. These folds and faults suggest compressive forces from a roughly east-west direction, during later Carboniferous times (295 million years ago), since younger rocks are not affected.

These limestones were buried during the Permian and Triassic periods (between 290 and 205 million years ago), and during this time it is probable that circulating ground waters, with metals in solution, deposited minerals in spaces and fractures in the limestone of Ecton Hill.

Unusually for mineralisation in the Derbyshire / Staffordshire area, these deposits contained copper deposited as chalcopyrite (CuFeS_2 , which is 34.5% copper). Other minerals deposited include sphalerite (ZnS); calcite (CaCO_3); and barite (BaSO_4).

The two major ore bodies at Ecton (The Deep Ecton Pipe and Clayton Pipe) are vertical (See **Figure 1**) and may be associated with the near vertical fractures caused by the meeting of the two fault directions in the rocks.

The rocks, which once buried the area, have now been eroded away. Although there is no direct evidence of glacial erosion, the area would have been covered during the Ice Age.

At the end of the last Ice Age (10 000 years ago) frost shattering produced large amounts of angular scree material at the foot of slopes. Surface water carrying dissolved calcium carbonate has cemented these angular fragments together in many places forming a breccia. Meltwater rivers swept through the valleys of the area. Subsequent weathering and erosion of the limestones formed the present day thin covering of soil over the hillsides.

Chemical weathering also attacked the original minerals in the ore bodies, dissolving and re-depositing the original copper sulphide minerals as hydrated copper carbonates (malachite, green, and azurite, blue) making the ore body richer, lower down.

There is evidence of copper mining in the Bronze Age. Documented mining of the copper deposits began in 1760, peaking at over 4000 tons per annum in 1785, and declined steadily through the 19th century until about 1888. Remnants of mine buildings, and the "soughs" which carried vast amounts of water pumped from the deep mines, 400 metres below the valley floor, can still be seen. (See **Figure 1**).

EARTH SCIENCE PRINCIPLES

In this area it is possible to demonstrate the following Earth Science principles.

- 1) **The Principle of Original Horizontality:** Originally horizontal bedding surfaces now indicate the amount of tilting that has affected the rocks since deposition.
- 2) **The Principle of Superposition:** in a bedded sequence of strata, the oldest layers were deposited first, and are found below the younger layers, which were deposited later.
- 3) **The Principle of Cross-Cutting Relationships:** Structures, like faults and joints, which cut through rocks must be later, and therefore, younger than the structures they cross cut. They must also be older than the ones that cut across them.

NATIONAL CURRICULUM LINKS

In this area it is possible to:

Use instruments in the field to collect data: tape measure, compass, clinometer, and plot results on maps. [Science]

Explore the ideas of sustainable development explored through environmental and resource issues [Geography].

A four minute animation with narration - A short history of Apes Tor quarries - is available as file APESTOR04.exe