

# 9:Copper

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## 9.1 Introduction

Copper was probably being mined in Britain from at least 2200BC but the first workings in England, at Ecton in Staffordshire and Alderley Edge in Cheshire, appear to be a little later in the 2nd millennium BC (*see Prehistoric Assessment*). Although there is currently little evidence for copper extraction in the period following the Bronze Age in England, it was again being mined during the Romano-British period. Similarly, the current level of evidence suggests that there was little extraction of copper in post Roman Britain and through the early medieval period. Although bells were being cast in bronze (*see below*) from the 12<sup>th</sup> century, in Exeter (Blaylock 2000, 4), the source of the copper is not known. Attempts to work the metal in the north-west (centred on Keswick) and at Ecton in Staffordshire in the early post medieval period proved unviable and it was not until the late 17<sup>th</sup> century that copper was extracted on a large scale in Britain, with mines in the south-west of England and Wales at the forefront of production.

Copper has been used since its earliest discovery either in its own right as the pure metal or more commonly until modern times combined with other metals to form alloys. The pure metal is ductile with high thermal and electrical conductivity and is resistant to corrosion. The latter property makes copper an ideal material for the manufacture of water piping and roofing sheets and as a component of chemical manufacturing plant. Copper bottoming using massive sheets of copper was used in the 18<sup>th</sup> and 19<sup>th</sup> centuries to protect wooden hulled ships from boring worms in warm, tropical waters. The introduction of copper coins in the 18<sup>th</sup> century accounted for large quantities of the metal and copper goods were also a significant element in the slave trade well into the 19<sup>th</sup> century. The property of electrical conductivity enables its use in electric motors, cabling and electronics.

Copper is alloyed with tin to form bronze, an alloy which is easily cast and is hardwearing and was the first metal to widely be used in the prehistoric period to fashion weapons and personal ornament. Later, bronze would create a demand for copper in the production of cannon, bells and ship propellers. Its hard-wearing properties make it ideal for bearings. The alloy of zinc and copper is brass. Although brass has origins in the Roman period, the late development of techniques to produce zinc as a usable metal (*see Lead/Silver/Zinc assessment*) explain why brass production in England relied on imports until the 16<sup>th</sup> century, after which it was adopted for many uses both as a functional and a decorative material.

## 9.2 Geology

The geology of copper mineralisation is relatively complex because the orebodies often contain different types of ores. Copper is usually found as sulphide, sulphate and oxidised minerals.

Unlike other non-ferrous metals, the range of ores present and exploited within England is wide, the most important primary ores being chalcopyrite ( $\text{CuFeS}_2$ ), bornite or 'peacock ore' ( $\text{Cu}_5\text{FeS}_4$ ), chalcocite ( $\text{Cu}_2\text{S}$ ),

and tennantite ((CuFe)  $12\text{As}_4\text{S}_{13}$ ). Chalcocite and tennantite are often referred to as 'grey copper ore'. Towards the surface, these ores have been altered by weathering and oxidation, producing orebodies of cuprite known as 'red copper ore' ( $\text{Cu}_2\text{O}$ ), malachite ( $\text{Cu}_2\text{CO}_3(\text{OH})_2$ ), azurite ( $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$ ), chrysocolla ( $\text{CuSiO}_3 \cdot 2\text{H}_2\text{O}$ ) and other oxidized copper minerals (Read 1962).

Copper ores are therefore more complex chemically than the main ores of tin and lead and contain a lower proportion of elemental copper. A typical copper ore may only contain 6% copper. They are also less dense, and therefore harder to separate by gravity methods from the country rock and other minerals.

Notwithstanding the variety of ores, the bulk of the production in England has been as chalcopyrite.

### **9.3 Distribution of Copper Ore in England - (BGS 1998).**

Sediment hosted copper deposits are found in the Midlands, principally at Alderley Edge, where they occur in sandstones of Triassic age. In this type of ore body, the copper ores form cement between the sandstone grains. The ore body is often horizontal or near horizontal and relatively near to the surface. Vein style deposits are common in parts of England but do not usually have economic significance except in Cornwall, Devon and Cumbria. Vein style ore bodies occupy vertical, or near vertical, fissures and can extend up to 300m below the surface. There are also, in North Devon on the southern borders of Exmoor, lenticular deposits which probably have a syngenetic origin and are confined to particular strata in the sedimentary, Devonian, rocks (Beer & Scrivener 1982, 125-26).

Epigenetic deposits in limestone are to be found in Stafford at Ecton and North Yorkshire at Middleton Tyas. This type of ore body tends to occupy irregular cavities and is usually sub-vertical. The occurrence is often near surface but may extend for 300m below the surface.

A Skarn type copper deposit, where the copper ore occurs in a zone mixed with other rocks and minerals, was mined in South West England at Belstone, but they are otherwise rare.

In Cornwall the occurrence of copper ores is closely associated with those of tin, which may occur at greater depth below the copper deposits. Many copper mines in Cornwall had exhausted their reserves of copper ore by the mid 19<sup>th</sup> century but continued to raise tin. The surface expression of such mines, including waste materials and evidence of dressing may appear as a tin mine; evidence of a copper phase may be less obvious.

Copper ores have been noted in many mines in England but usually not in an economically significant quantity. The occurrence may only be of mineralogical interest but considerable efforts may have been made to search for the ore.

### **9.4 Copper Mining Localities**

Copper ores have been produced in England principally in Cheshire, Cornwall, Cumbria, Devon and Staffordshire. The UK contributed more than half the world's output of ore in the early 19<sup>th</sup> century with the bulk of the production in the period coming from South West England. The peak year for production was 1856 (Schmitz 1979) but thereafter fell rapidly as exhaustion of ore bodies and cheaper imported ore caused the closure of most English copper mines by the end of the 19<sup>th</sup> century. The last exclusively copper mine to close in England is believed to be Ramsley in Devon in 1909 (Hamilton Jenkin 1981, 76).

Cornwall and west Devon was the major producing area from the late 18<sup>th</sup> to the middle of the 19<sup>th</sup> century. For example, in the period between 1845 and 1913 Cornwall produced 65% of the UK output and in some years produced over 80% of the annual UK output (Burt et al 1987). Ecton in Staffordshire was another significant producer in the 1750s-80s, although never rivalling the output from Cornwall and other major UK mines. Devon became a major producer in the second half of the 19<sup>th</sup> century (Burt et al 1987) providing up to 50% of the UK output, a single mine, Devon Great Consols, contributing a significant percentage of that output..

Within Cumbria, copper mining took place in the 16<sup>th</sup> and 17<sup>th</sup> centuries around Keswick and Coniston. Production at Coniston peaked in the 19<sup>th</sup> century with annual figures for several years of up to 3000 tons, which represented around 2% of the UK annual output (REF ###).

The Alderley Edge Mines in Cheshire had a relatively small production of around 3500 tons of ore in the early 19<sup>th</sup> century (REF ###). There is good evidence to show that mining at this site took place in the Bronze Age (*see* prehistoric assessment).

Many mines in England produced very small quantities of ore and are probably not typical of the development of the industry. The high value of copper ores influenced continuing attempts to mine copper in England into the mid-20<sup>th</sup> century, although the output was very small as a proportion of world production.

## 9.5 Historical Context

*(nb Prehistoric copper mining is discussed in the Prehistoric Assessment)*

Very little historical documentation is known for copper mining in England until the late 16<sup>th</sup> century, although copper was included in Crown prerogative from the mid-13<sup>th</sup> century and frequently included in Crown mining grants (Claughton 2010, 163). Cranstone remarked that 'Copper mining in the periods from the Iron Age to the 16<sup>th</sup> century has received little attention' (Cranstone 1993). This probably reflects the relative status of the industry before the 16<sup>th</sup> century, when compared with other non-ferrous mining such as tin and lead. There were, however, occasional attempts during the late medieval period to work copper bearing-ores including the reworking of residues from earlier working (Rippon et al 2009, 24-7), but it was not until the post-medieval period that there was a sustained attempt to work copper ores in England.

Sixteenth century documents featuring aspects of the north Cumbrian mines have survived and have been examined in detail and this research has informed the field study of the mines in that area. The Company (or Society) of Mines Royal was mining in Cumbria from 1568 into the early 17<sup>th</sup> century, under Letters Patent granted by the crown and providing the company with monopoly rights to copper and other ores bearing precious metals in certain counties of England and Wales, jointly funded from England and Augsburg (Donald 1994). Similar rights in other counties were taken up by the Company of Mineral and Battery Works (Donald 1961). The Cumbrian copper production was not a success and the mines appear to have been sustained by silver production as there was no market for the copper produced, which could not compete economically with imports from Sweden (Hammersley 1973). Some of the mines in Cumbria were revisited after 1693 but with only limited success (Grant 1985).

Richard Carew commented in 1601 that copper could be found in Cornwall 'but with no gain to its searchers' (Carew 1602, C2) and the Company of Mines Royal also unsuccessfully searched for workable copper in Cornwall during their period of operation. It was not until the last decade of the 17<sup>th</sup> century that English copper mining developed as a major producer, coincidental with the removal of Crown prerogative and the loss of monopolistic rights to 'Mines Royal' (Claughton 2010, 164). Mines in North Devon, where mining and smelting had been attempted in the late Medieval period, grew rapidly exploiting rich deposits, up to 50% copper, but could not be sustained as the mineralisation was of limited lateral extent (Dixon 1997). The Cornish mines and, later, those in West Devon although not as rich, were capable of far greater production. It was ore from these mines exported to south Wales for smelting that led to the establishment of the world's leading copper production centre in and around Swansea (Hughes 2005, 16-55). The re-discovery and exploitation of large low grade deposits on Anglesey in the second half of the 18<sup>th</sup> century, and the establishment of large scale copper smelting on Merseyside, challenged the dominance of mines in south-west England and, to a lesser extent, Swansea smelting interests (Harris 1964).

The rapid growth of copper production at the end of the 17<sup>th</sup> and through the 18<sup>th</sup> century attracted the attention of engineers, particularly from Sweden which, up until that time, had been the leading European producer. Published, and unpublished, reports by the likes of Cletchers (Liverpool University, Harold Cohen Library, MS 7.1, 21), Kalmeter (Brooke 2001), Angerstein (Berge & Berge 2001) and, to a less extent, Svedenstierna (Dellow 1973) have added significantly to our knowledge of the development of copper mining in the United Kingdom during that period.

With significant new discoveries, particularly in west Devon, copper mining in the south-west of England recovered to become the dominant copper producing region in the 19<sup>th</sup> century where Devon Great Consols on the River Tamar, became the leading world copper producer by mid-century (Goodridge 1964). The history of copper mining in Cornwall and West Devon was summarised by Barton in 1968 but has been partially added to since that date, particularly by the work leading up to this district's inscription on the list of UNESCO World Heritage sites.

There were, however, many other mines across England which contributed to overall production from the last decade of the 17<sup>th</sup> through to the early years of the 20<sup>th</sup> century. Unlike the lead industry, where Burt (1984) provided an overall assessment in *The British Lead Mining Industry*, a similar study of British copper mining from the 17<sup>th</sup> century onwards is still lacking. Harris (1964) went some way to providing a balanced view of the early development in relation to the rapid expansion of production from the Parys Mountain mines on Anglesey, but most work has been of a parochial nature with little reference to a national context.

The mines of Alderley Edge and the rim of the Cheshire Basin, stretching into north Shropshire, have received considerable attention and a new book on the former is just published (Carlton & Dibben 2012; *see also* Carlton 1981a and b). Copper mining in the West Shropshire ore-field is covered by Shaw (2009) and many of the sites are described by Pearce (1994 & 1997). The working of the Ecton Mines, in Staffordshire, in the 18<sup>th</sup> and 19<sup>th</sup> centuries has been subject to several detailed studies of historical sources and these have attempted to link the documentary evidence to the archaeology of the sites (Porter 2004; Porter & Robey 1972 and 2000). Other minor sources of copper have been covered - Middleton Tyas, in north Yorkshire, by Raistrick (1936) and Hornshaw (1975), Doddington, in west Somerset, by Hamilton & Lawrence (2008).

Copper mining in what is now Cumbria is to some extent dominated by the activity of the Mines Royal Company but later mining attracted interest amongst local historians from a very early date (Postlethwaite 1877) and followed up in the second half of the 20<sup>th</sup> century by various authors (for example Shaw 1983 with earlier editions going back to 1970). The history of some mines has been described in detail - for example *The Coniston Copper Mines* (Holland 1986), Eskdale (Austin 1991) or Goldscope and the Calbeck Fells (Tyler 2005 & 2009) although the latter's work is not well referenced.

The south-western counties of England, Devon and Cornwall, as noted above have, however, provided the principal focus for research into the history of copper mining. Barton (1968) provided an early overview which has been expanded, into north Devon by Dixon (1983 & 1997) and Claughton (1989 & 1997), and across west Devon and Cornwall. The focus has been on individual or small groups of mines - Devon Great Consols, in the Tamar Valley (Goodridge 1964); Shambrook (1982) on the mines of Caradon Hill; Dolcoath, perhaps Cornwall's premier mine and continually worked in some form from the 16<sup>th</sup> through to the 20<sup>th</sup> century (Buckley 2010); to mention but a few. The level of archaeological investigation (below) does, on the whole, reflect the domination of the south-west counties although there are some notable exceptions, particularly for post-medieval copper mining in what is now Cumbria. Many Cornish mines worked both tin and copper during their lifetimes and the published histories of such mines include both in their narrative, including Levant (Corin 1992), Botallack (Noal 1972) and East Pool (Heffer 1985).

## 9.6 Technology

### 9.6.1 Mining

There is no evidence that mining for copper employed methods different to those used for mining other non-ferrous minerals in England. Early mining was by the quarrying of the ore by opencast methods, both laterally and vertically, perhaps starting with small trenches and shallow quarries. When the depth below surface became too great for opencast working, mining would commence via small vertical shafts with horizontal tunnels driven from shaft bottoms. The need for drainage was met by either driving sub-horizontal tunnels known as adits or by using human or animal power to raise buckets and, when the technology became available by pumping in larger vertical shafts using water, atmospheric or steam power.

The method of drainage was considerably influenced by the topography of the mine site. A mine on a mountain could be readily drained by adits, whereas a mine on level land would require the lifting of water by buckets, barrels or pumps powered by waterwheels and, later, by steam engines. Most mines required continuous drainage activity and successful 18<sup>th</sup> and 19<sup>th</sup> century copper mines, particularly in Cornwall and Devon, became dependent upon the development of atmospheric and steam pressure engines. The Cornish Copper mine owners were important early users of atmospheric and steam pumping engines and influenced the development of these machines with the need to work at far greater depths than the tin miners had hitherto achieved. The technology used for haulage of the ore to surface followed the same progression and used similar power sources as for pumping.

Rock breaking underground involved the use of hammers, wedges, fire-setting, hand drills, gunpowder and high explosives as each method was developed. Although it can be argued that central European involvement in the 16<sup>th</sup> century brought with it no techniques new to mining in England, copper mining was at the

forefront in the use of explosives when they were introduced from Europe in the mid to late 17<sup>th</sup> century. Mechanized drilling powered by compressed air became widely used from late in the 19<sup>th</sup> century.

### **9.6.2 Ore preparation**

Material brought to the surface of the mine usually contained a considerable amount of the host rock and this as well as other minerals had to be separated from the copper ore. Mechanisation of the ore preparation processes came relatively late to copper mining and was never adopted by some small 19<sup>th</sup>-century operations. The ore was broken or 'ragged' manually using hand hammers and it was then hand-picked. In Cornwall particularly this was the work of women, children and older men unable to work underground (Mayers 2004). Even after the introduction of mechanised crushing in other non-ferrous metal mining operations, using water and steam power, some copper ore preparation continued to be carried out by hand and indeed copper ores were often of a sufficient purity not to require further treatment and could be sent directly for smelting following the ragging and picking processes. Water-powered crushing rollers were introduced in around 1806 to deal with more disseminated forms of copper ore (Ferguson 1873) and developed into the main form of mechanised crushing, though stamping mills and, later, ball mills were also used to reduce copper ores.

The crushed material was then separated in water using gravity methods. Initially, this would be in wood trunks and metal sieves but water and steam power was later applied to sieves shaken in water. Material illustrating the processes used at a major late 19<sup>th</sup> century copper mine, Devon Great Consols in west Devon, has been published by Stewart (2005).

Crushed ore from mines in the sandstones of the Cheshire Basin, at Alderley Edge and the Clive Mine in north Shropshire, were subject to treatment using hydrochloric acid to leach out the copper, which was then recovered by precipitation using scrap iron. The stone precipitation tanks used at the Clive Mine until the late 1860s were moved to Bryntail, Montgomeryshire in mid-wales, where they survive (Shaw 2009, 248-49).

Ore dressing technology began to develop towards the end of the 19<sup>th</sup> century and various experimental methods were applied. Electrolytic processes were used at Coniston mine in Cumbria, and precipitation on to scrap iron was used at Caradon and Devon Great Consols mines. Flotation processes were developed in the early 20<sup>th</sup> century and were applied to copper ores, increasingly in conjunction with the processing of other non-ferrous minerals. There were early flotation mills in Cornwall and Devon that were constructed to process copper and tin ores together, and by the mid-20<sup>th</sup> century, processing plants were built to handle mixed ores including copper, tin, lead and zinc.

In Cornwall and west Devon particularly, copper ores were roasted to remove contaminants such as arsenic. By the early 19<sup>th</sup> century arsenic was becoming of value in its own right and by the third quarter of the century many mines were making special provision for its recovery (see the assessment for Arsenic).

### **9.6.3 Smelting**

Some copper smelting is known to have been carried out close to the ore sources prior to the late 17<sup>th</sup> century. An example is that at North Molton (close to the Bampfylde Mine) where copper slags found near the mine have been dated to the late 15<sup>th</sup> century (Rippon et al 2009, 26). However, the introduction of coal as the fuel used in the reverberatory furnace necessary to smelt copper resulted in a concentration of smelting activity close to the coalfields, predominantly in South Wales (Hughes 2000) but also the Wye Valley, Bristol and

Merseyside. Smelting on the coalfields is outside the remit of this assessment but we should consider the small smelters found close to the mines from the post-medieval period onwards. A smelter was established at Keswick for the Cumbria ores in the 16<sup>th</sup> century and continued working until the early 17<sup>th</sup> century, using locally prepared charcoal along with coal, from the west Cumberland field, for ancillary processes. In the late 18<sup>th</sup> century the Duke of Devonshire was smelting copper at Whiston, close to his Ecton mines (Porter 2004, 124-45) and, for a short period in the late 18<sup>th</sup> and early 19<sup>th</sup> centuries, copper was smelted at Hayle in Cornwall by the Cornish Copper Company using coal shipped from South Wales (Pascoe 1981; Ferguson 1996 104-8).

#### **9.6.4 Movement of materials**

Prior to the early 19<sup>th</sup> century most mines relied on pack horses to carry their ore to the nearest coastal or river port for shipment to the smelters and coastal shipping was a key element in the transport of copper ores. Statistical evidence for the latter, extracted primarily from the Exchequer portbooks, has in some cases been examined (for example Hussey 2000, 116-19) but the former is a poorly researched form of transport.

Early railways and plateways were constructed in Cornwall and Devon in order to link the mines to small shipping ports (*see tin assessment*). These lines provided a means of transporting the copper concentrates to the port for export and for importing timber and coal for the mine operations. The Portreath Tramroad, and the Redruth and Chacewater railway were examples of railways constructed to serve copper mines. Some of the shipping ports were built and developed as part of the transport link from line to smelter and worked in conjunction with the tin mining industry.

The need to move copper, along with lead and tin, lay behind the construction of the Tavistock canal in Devon serving the mines in the Upper Tamar Valley and West Devon and as far east as Wheal Friendship at Mary Tavy. The canal, completed in 1817, and a series of inclines delivered the ores to Morwellham Quay on the banks of the River Tamar from where sea-going ships could transport the ores, including after 1844, those of Devon Great Consols (Booker 1974, 31). Growth of the copper industry in the Tamar valley during the mid-19<sup>th</sup> century resulted in an expansion of port facilities along the Tamar at Newquay and Gawton, and at existing quays such as Calstock on the Cornish side of the river.

Hayle Harbour in western Cornwall and the town that surrounds it was created and evolved largely around the Cornish Copper Company which began smelting copper there in the 1750s. Quays were built in the natural harbour for shipment of coal and other industries such as Harvey's foundry built up their bases from Hayle (Todd & Laws 1972, 86-102).

### **9.7 Archaeology**

The pattern for the archaeological investigation of copper mining and associated processes is uneven across England. As stated above, it is dominated by work carried out in West Devon and Cornwall, and although much was commissioned in connection with its World Heritage status, it does reflect the position of those counties as the major copper producing region of the country. Some of the investigations are assessments of the archaeological assets, as with Devon Great Consols and other Tamar Valley mines (Buck 1998; 2001a & 2001b), but others are comprehensive surveys. Copper mining on and around Caradon Hill in East Cornwall,

centred on Minions, was a major part of one of the first comprehensive landscape surveys carried out by the Cornwall Archaeological Unit, now part of Cornwall Historic Environment Services (HES), and included detailed surveys of many mining features (Sharpe 1993a).

In addition to those mentioned above, copper mines in Cornwall and west Devon which have been the subject of archaeological investigation at some level include Tresavean (Sharpe 1989), Dolcoath (Sharpe 1993b; Buck 2001c), Buller (Lawson-Jones 1998), United (Reynolds 2000), Bedford United (Buck 2003), West Basset (Palmer & Neaverson 1987; Sharpe 2007a & b) and Consolidated (Sharpe 2009) but this list is by no means exhaustive. The Tamar Valley has an active industrial archaeological group (TVIA) and as part of their investigations they have researched copper mines around Morwellham and the Tavistock Canal (Anon 2012). Some of their findings are published on the web ([www.tvia.org.uk](http://www.tvia.org.uk)) and a publication is imminent.

In Devon outside the Tamar Valley, and the area defined in the World Heritage inscription, the mines on the periphery of Dartmoor have been surveyed in some detail, primarily the work of the RCHME (later English Heritage) survey team formerly based in Exeter; these include: Ausewell Wood Mine (Newman 1998b; 2004a), Druid Mine (Newman 2003a), Brookwood and Wheal Emma (Newman 2005; 2006b). Ausewell Wood has also been subject to geochemical (Carey 2000) and geophysical (Dean & Faxon 2000) survey. The Bampfylde Mine at North Molton was also the subject of survey by the RCHME and was interpreted in *The Field Archaeology of Exmoor* (Riley & Wilson-North 2001, 148-51). Evidence for late medieval smelting has been identified at Bampfylde (Rippon et al 2009, 26), although the site of the furnaces themselves has not been located. At Doddington, in West Somerset, the history of which was covered by Hamilton & Lawrence (2008), the surviving features were re-surveyed by English Heritage in 2003 (Newman 2003b).

Little, if any, archaeological work appears to have been carried out on the small copper mines in west Shropshire but those in the north of the county, on the rim of the Cheshire Basin, have been the subject of limited investigation (Ove Arup 1993). The accessible workings of most of the mines in the county have been surveyed by the Shropshire Caving and Mining Club. At Alderley Edge, on the northern edge of the Cheshire Basin, extensive investigation has focused primarily on the Roman and prehistoric workings (Timberlake & Prag 2005) but the accessible workings of all periods have been recorded by the Derbyshire Caving Club (Carlon & Dibben 2012).

The Ecton mines in Staffordshire have been subject to detailed archaeological investigation. Again there is significant interest in the evidence for prehistory activity (*see Prehistoric Assessment*) but the medieval and later workings are well served by the work carried out to date (Barnatt in prep; 2002; Barnatt et al 1997). Barnatt and his colleagues have evaluated the subterranean and surface archaeology combined with a reassessment of the documentary evidence, helping to identify the extent and dating for the accessible workings.

In the north of England the archaeological investigation does to some extent mirror the interest amongst some mining historians in the post-medieval workings, particularly the activities of the Mines Royal Company. The workings at Middleton Tyas, in the north of Yorkshire, appear to have attracted no archaeological interest beyond the identification of key features (Hornshaw 1975, Map 3). In the north-west, in what is now Cumbria, copper mining has been a focus of investigation since at least the 1980s when a survey was carried out of features on and around the dressing floors in the Coppermines Valley at Coniston (Middleton 1985). Other copper mining features around Coniston have subsequently been investigated in



some detail, including the Paddy End dressing floors (Anon 2007), the Greenburn Mine (Oswald et al 2001) and potential post-medieval workings close to Leverswater were recently the focus of investigations by Time Team (*CAT* **109**, 7-18).

In the Caldbeck Fells the Silvergill and Roughtengill mines, which produced some copper in addition to lead and silver, were surveyed at surface by English Heritage (Jecock et al. 2001) producing evidence for working from the post-medieval period through to the 19<sup>th</sup> century. Subterranean investigations, focusing primarily on the former period, are on-going but some work has been reported by Allison & Murphy (2010). Most, if not all, of the accessible subterranean workings mentioned above have been explored and surveyed by mine exploration groups in the Lake District. Much of that material is archived by the Cumbria Amenity Trust Mining History Society (CATMHS - <http://www.catmhs.org.uk/archive.php> )

A few smaller mines have also been subject to some investigation, for example Potts Valley (Anon 2004) and Browns Crag (Anon 1997). It is also understood that some archaeological investigation has been carried out at surface and underground on the mines in the Newland Valley, particularly Goldscope which is known to have been worked in the 16<sup>th</sup> century, but no records are available.

## 9.8 Historic Environment Records

Records for copper mining sites exist in the Cheshire, Cornwall, Cumbria, Devon, Shropshire, Somerset, Staffordshire, North Yorkshire and the Yorkshire Dales NP HERs. The Devon and Cornwall HERs have evidence developed as a result of the WHS bid, Staffordshire has records generated by the research at Ecton and there are some surveys in Cumbria.

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