CASHWELL HUSH AND UPPER SLATESIKE: Geology and mineralogy

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INTRODUCTION

The areas designated as Scheduled Monuments here comprise two small areas on the remote moorland on the north east shoulder of Cross Fell. The northernmost comprises a XXX m length of the old opencast trench known as Cashwell Hush, the southernmost coincides with the area of spoil heaps and related features at the site of the Slatesike Mine (Figure 1). Both worked sections of the NE-SW trending West Cross Fell – Doukburn Vein.

However, in order to understand fully the nature of these workings and the materials extracted from them, the area covered by this report has been extended to include the surface workings at deeper levels on the same vein system, approximately 0.75 km NE of the designated sites, together with a small cluster of long-abandoned workings on two parallel veins from which copper ores appear to have been the principal mineral raised. The boundary of the area described here is depicted on Figure 4. As will be outlined below, in line with this project’s declared objective of attempting to identify sites of very early mining, the copper workings at Cornriggs and Cashburn are considered to offer one of the most likely locations within this orefield at which such early, perhaps Bronze Age, mining may have taken place.

OREsome PROJECT: SURVEY HISTORY & PERSONNEL

Geological examinations of the site were undertaken by Brian Young and the following OREsome volunteers: Peter Jackson, Graham Brooks, Andy Hopkirk.
PREVIOUS DESCRIPTIONS
Geological mapping of the site and its neighbourhood was undertaken on the 1: 10560 scale by the Geological Survey between 1875 and 1877 and published on Geological Survey 1:10 560 scale County Sheets Cumberland 51NE, 52NW. An abridged version of this mapping was published on British Geological Survey 1:63 360 scale Sheet 25 (Alston) in 1883. Revisions to the geology, mainly derived from mineral investigations undertaken during World War II led to a revised 1:63 360 scale sheet published in 1965. This mapping was re-issued at the 1:50 000 scale in 1973.

Under the heading of Cross Fell Mines, Smith (1923, p. 98) gave very brief comments on the workings on the West Cross Fell – Doukburn Vein, though with few remarks on the geology. In a review of British fluorspar resources Dunham (1952, p. 62) made a brief reference to the abundance of fluorite at Cashwell and to the potential of this vein as a commercial source of this mineral. More recently, the same author (Dunham 1990, p. 132) provided comments which focussed mainly on the geology of the orebodies in the underground workings on the vein, together with very brief remarks on the copper-rich veins of Cornriggs and Cashburn. In their review of the supergene minerals of the Northern Pennine Orefield, Bridges and Young (1998) discussed the minerals then known from the Cornriggs and Cashburn workings.

GEOLOGY AND MINERALISATION

As depicted on Figure 2 the sites designated as Scheduled Monuments lie on the outcrop of beds between the Great and Little limestones, termed the Coal Sills. In this part of Alston Moor these beds are composed predominantly of sandstone (Dunham, 1952, p. 62), though with some interbedded shales and siltstones. The extended site area, as described here, embraces the outcrop of beds extending downwards to include in descending order the Four Fathom, Three Yard, Five Yard and Scar Limestone: beds between these limestones comprise shales, siltstones and sandstones.
The main veins present on this site comprise:

- The West Cross Fell – Doukburn Vein
- The Cornriggs Vein
- The Cashburn Vein

**West Cross Fell – Doukburn Vein:**
Where it crosses the site this is a strongly mineralised vein that has been extensively worked both in the conspicuous opencuts collectively known as Cashwell Hush, on the ridge that extends NE from Fallow Hill, and in extensive underground workings accessed by a number of shafts and levels. As reported in existing published descriptions, apart from galena the predominant minerals present are fluorite, quartz, carbonates (assumed to include calcite, ankerite and/or siderite), and sphalerite. Dunham (1952, p. 62) drew attention to the abundance of good quality massive fluorite on the dumps from Cashwell Mine, suggesting that, but for its remote location, the site may be an attractive commercial fluorspar prospect. He further recorded that small quantities of this mineral were obtained here “...by Mr H.Millican some years ago...”.

Whereas Dunham (1990, p. 132) recognised that the old surface excavations must indicate the former presence of workable orebodies at this level, neither he nor any of the other references cited above offer any further information on the nature of the vein here.

**Cornriggs and Cashburn veins:**
Dunham (1990, p132) briefly comments on these small parallel veins which crop out on the east side of Cash Burn in strata between the Four Fathom and Scar limestones. They are of particular interest in carrying copper as their main metalliferous constituent. Galena was noted during the present investigation though only in subordinate quantities.

**MINING HISTORY AND OUTPUT**
Summaries of the history and extent of workings on the West Cross Fell - Doukburn Vein have been given by Smith (1923, p. 98) and Dunham (1990, p. 132). The latter author reports that between 1811 and 1870 Slatesike Mine yielded 5172 tons of lead concentrates, with a further 83 tons recorded jointly from Slatesike and Katelock mines between 1871 and 1880. An output of 7700 tons of lead concentrates is also recorded jointly between the Cashwell and Doukburn workings, for the period 1848 – 1911. According to Dunham (loc. cit.) Cashwell Mine remained in operation until about 1921, though he quotes no production figures for the period since 1911. Lead was smelted in a mill at the head of Cash Burn, though the dates of its operation are not known. According to Dunham (loc. cit.) silver recoveries for the period 1856 - 1865, were 9.0 ozs per ton of lead from Slatesike with 6.4 ozs for the combined Cashwell – Doukburn ores. Some fluorspar was recovered from the Cashwell dumps, though the amounts are not recorded.

No dates of working are known for the Cornriggs and Cashburn veins and no separate production figures are known for the amounts or nature of any ores raised here. It is significant that careful examination of the spoil remaining from the dressing of these ores has revealed only very small amounts of galena, in marked contrast to the overwhelming abundance of copper mineralisation. The field evidence strongly suggests that copper ores were the main, if not only, minerals worked from them: any significant production of lead ores seems unlikely.
DESCRIPTIONS OF INDIVIDUAL GEOLOGICAL FEATURES
Sites of geological interest which lie within the boundary of the Scheduled Ancient Monument are shown on Figure 3. Sites described here which lie outwith this boundary are shown on Figure 4.

Fig. 3 Features within Monument boundary
Location 1.
The outcrop of the West Cross Fell – Doukburn Vein along the crest of the ridge extending NE from Fallow Hill is readily traced through a series of opencast trenches. Sandstones clearly comprise a significant proportion of the Coal Sills here, as reported by Dunham, (1952, p. 62) and appear to have provided wallrock conditions conducive to hosting workable mineralisation. The remaining opencasts suggest that vein widths may have been between 1 and 2 m wide.
Looking SW along opencast workings in the West Cross Fell – Doukburn Vein in Coal Sills sandstone wall rocks. Mineralised material comprising quartz, fluorite and a few galena fragments are abundant to the right of the excavation. Lumps of coronadite are also locally common here.

Photo: Brian Young.

Although no mineralisation is today exposed in situ, an abundance of mineralised spoil flanks the opencasts. Within this the most obvious gangue minerals are quartz and fluorite. Fragments of galena, typically with a thin superficial coating of pale grey to white cerussite are comparatively common.

Also present locally are concentrations of a dark grey to black mineral in the form of massive to cellular masses up to 10 cms across in which scattered irregular cavities mainly > 1 cm across locally exhibit botryoidal surfaces. These masses commonly enclose fragments of brecciated quartz and more rarely fluorite. Analysis of samples of this mineral by Dr Tom Cotterell at the National Museum of Wales reveals this to be the uncommon lead manganese oxide mineral coronadite (Pb(Mn$^{4+}$:Mn$^{2+}$)$_8$O$_{16}$).

First recorded from the Northern Pennines at High Sedling Mine, Weardale, in 1996 (Young et al. 1996), it has since been reported from Skears Mine, Teedale (Moreton and Lawson, 2013) and Grasshill Mines also in Teesdale (Cotterell et al, 2016). Although until recently regarded as a rather rare mineral, coronadite is almost certainly much more common than published reports of its occurrence might suggest: as a dull black and uninteresting looking mineral it is easily overlooked and in common with other manganese oxide minerals its identification requires relatively sophisticated analytical techniques. Its identification at Cashwell Hush is a significant addition to the range of minerals reliably reported from this orefield.

The coronadite at all of its reported occurrences in the orefield is clearly of supergene origin and is almost certainly the product of an interaction between lead- and manganese-rich groundwaters within the near-surface oxidation zone of the host deposits. The necessary manganese almost certainly originated through oxidation of siderite and/or ankerite in which manganese is almost invariably present: the lead to intense alteration of galena. Although no primary manganese minerals are known from the orefield, analyses of several examples of siderite and ankerite reveal manganese contents of up to 3.5% (Smythe and Dunham, 1947; Dunham, 1990). Oxidation of these minerals has created locally extensive deposits of supergene limonite’ (goethite) ores in which manganese contents of 3 – 5 % are common with up to 13.6% manganese recorded from one such deposit in Weardale (Dunham, loc. cit.).
A specimen of dark grey to black massive to cellular coronadite in white are embedded fragments of white quartz.  
*Photo: Andy Hopkirk.*

**Location 2.**

A single loose block of sandstone found in the spoil from these opencast workings exhibits fine trace fossils of wide diameter burrows (Figure 7).

*Figure 7.*  
Fossilised burrows in block of Coal Sills sandstone.  
*Photo: Brian Young.*

**Location 3.**
The writer was unable to visit the spoil heaps of Slatesike Mine (hopefully some details will be provided by volunteers).

Dunham (1990, p. 132) notes the presence of fluorite, quartz, siderite and limonite (goethite), together with traces of galena on the dumps.  In addition, he records a comment made by C.E.De Rance on a map held by BGS stating that “...brown hematite... 4 feet (1.2 m) thick was found when Slatesike Mine was last worked...”.  This must be a reference to goethite, though whether this was present within the vein, or in a flat deposit which may have been hosted in either the Great or Little Limestone is not stated.
Location 4.
Substantial dumps remain here from the Cashwell Level [NY7170 3674], although it is clear that material from here is used periodically to surface estate tracks on the adjoining grouse moor. This level provided access to deep levels within the West Cross Fell – Doukburn Vein within the lowest strata explored within the mine in beds below the Four Fathom Limestone. Vein minerals present on these dumps include fluorite, quartz, calcite and locally siderite and/or ankerite. In addition, a few blocks of quartz veinstone containing pyrite, marcasite and rarely a little pyrrhotite were seen. This assemblage is of interest in suggesting the possibility of a genetic connection between this vein and the Great Sulphur Vein, which crops out about 3 kms N of the Cashwell Mines. This letter vein is one of the orefield’s largest mineralised structures and is characterised by carrying a pronounced zone in which all three of these iron sulphide minerals are dominant. The significance of this is discussed further below. The abundant veinstuff present on these dumps is substantially unoxidised and thus offers a useful insight into the likely nature of the vein filling worked in the higher levels of the mine, including the opencast trenches on the hilltop.

Location 5.
A straight gully-like feature up to around 30 m wide extends from approximately NY7168 3722 to 7188 3730. This coincides precisely with the mapped outcrop of the Cornriggs Vein. The feature is generally covered with short grassy vegetation and there are no exposures of mineralised ground. However, small areas of apparently barren and un-vegetated spoil, comprising both coarse mineralised rock and gravel to sand grade tailings are conspicuous in two areas (described below) close to the extremities of the trench-like feature.

Location 6.
At the foot (SW end) of the gully is a conspicuous cluster of small spoil heaps composed both of coarse veinstone and substantial amounts of gravel sized tailings, almost certainly derived from hand-dressing operations. A shaft, apparently sunk on the south side of the vein, and identified as S21 on the Alston Moor Capping and Gating Plan, lies within wire fencing at this point.

According to information provided by D. Borthwick (personal communication, 2017) this shaft was descended by members of the Cumbria Amenity Trust mine exploration society in 1992. Although details of this exploration are sketchy, it seems that levels were found to run in both directions, presumably on vein, from the foot of the shaft, though its depth seems not to have been recorded. Further shafts were found to have been sunk from a side tunnel within these workings. This same plan of Alston Moor shafts depicts a second shaft, identified as S22, a few metres of this.

The mineralised spoil here is composed mainly of white to colourless medium to coarse grained quartz in which patchy concentrations of chalcopyrite are common. Dark grey silicified shale is also present, commonly in the form of a quartz-cemented mineralised breccia, and a few fragments of massive white to very pale purple fluorite were also noted. Perhaps the most conspicuous feature of this mineralised material is the common presence of crusts of green and blue supergene copper minerals. Most abundant is malachite, which most commonly occurs as thin (≤1 mm) earthy to crystalline coatings on quartz, silicified shale, and more rarely fluorite, though cellular crystalline crusts up to several mm thick are also seen locally. A few specimens exhibit delicate euhedral acicular crystals of malachite up to 2 mm long, in cavities in quartz veinstone. Less abundant, though common, are vivid deep bright blue coatings of azurite. As with malachite, azurite most commonly occurs here as thin (≤ 1 mm thick) coatings on quartz, silicified shale or fluorite. Thicker
compact crystalline crusts of azurite up to 2 – 3 mm thick, in places exhibiting subhedral crystals up to 3 mm long, are also sparingly present.

Dark brown ‘limonitic’ staining is common.

Galena appears to be extremely rare in this material. No obvious zinc primary or supergene minerals were seen.

Although appearing to be mainly barren and un-vegetated these concentrations of richly mineralised veinstone may host a significant bryophyte and lichen flora.

Location 7.
Near the head of the south side of the gully occurs a cluster of small spoil heaps composed both of coarse mineralised veinstuff and spreads of gravel tailings. In overall composition and mineral content these heaps appear to resemble those already described at location 6. It is, however, worth recording that during a previous investigation of this site the writer obtained a very few specimens of quartz veinstone in which small masses of chalcocite up to 5 mm across were accompanied locally by irregular masses of native copper up to 2 mm across (Bridges and Young, 1998, p. 4). It is likely that chalcocite and native copper found here are of supergene origin.

A shaft, apparently sunk on this vein, adjoining the Pennine Way and recorded as S5 on the Alston Moor Capping and Gating Plan, was found to be blocked with rubbish at a depth of 95 feet (D. Borthwick, personal communication, 2017)

Location 8.
Approximately 500 m north of, and parallel with, the Cornriggs Vein, a similar shallow trench-like feature coincides with the outcrop of the Cashburn Vein. This too is almost completely vegetated, though a small area of un-vegetated spoil at its SW extremity, adjoin the footpath along the Cash Burn, marks the site of an old shaft sunk either directly into the in or the wall-rocks on its immediately southern side.

The small spoil heap at this site, derived either from a small shaft or adit, contains limestone fragments and a substantial amount of vein quartz in which scattered concentrations of chalcopyrite may be seen. Some of the quartz is well crystallised as pyramidal white crystals up to over 1 cm across.

The presence of abundant copper mineralisation is revealed by the conspicuous scattering of small malachite fragments and coatings on quartz and limestone fragments. As with the spoil from the Cornriggs workings, malachite here commonly occurs as coatings (≤ 1 mm thick) and as patchy cellular crystalline crusts up to 3 mm thick on quartz-chalcopyrite veinstone. Azurite was not seen here. A few fragments of galena were also seen.

In the side of the gully, immediately south of these spoil heaps, a small exposure of the Scar Limestone exhibits a number of parallel strings of quartz and calcite up to around 2 cms wide over an overall width of about 20 cms. This is likely to be an exposure of the Cashburn Vein, though it is barren of sulphides at this point.
As with Location 7, these apparently barren and un-vegetated concentrations of richly mineralised veinstone may host a significant bryophyte and lichen flora.

**NOTABLE GEOLOGICAL AND MINERALOGICAL FEATURES**
The discovery of the uncommon manganese mineral coronadite in some abundance at the surface workings on the West Cross Fell – Doukburn Vein is a notable outcome of the present investigations. As well as expanding and adding to the understanding of the inventory of minerals known from the orefield, this discovery offers significant insights into the geochemistry of manganese within these deposits and the role of supergene processes in its mobility in the near-surface environment. The serendipitous discovery of coronadite here invites careful examination of similar locations for evidence of further discoveries of this inconspicuous but unusual mineral.

When viewed alongside the primary mineral assemblages available for study from the deeper levels of this vein, the Cashwell Mines offer a rare opportunity within this orefield to study the profile of a major North Pennine vein from its deeply oxidised surface outcrop into its largely unaltered primary condition at depth.

Despite limited time, investigations of the mineralisation of the Cornriggs and Cashwell veins, confirms previously held views that the composition of these veins is unusual within the overall context of the orefield. Whereas veins in which copper is the dominant metal component are known elsewhere in the field, they are rare and, confined to the portion of the orefield that can be genetically related to the Tynedale cupola of the concealed North Pennine granite batholith. Considerable scope thus remains to undertake further investigations into the mineralisation at these, and comparable veins elsewhere in the orefield, with the prospect of revealing important new evidence on the metallogenic processes responsible for creating these deposits and their place within the metallogenic models of this and similar orefield.

**EXISTING CONSERVATION STATUS FOR GEOLOGICAL INTERESTS**
No part of the site or any of its adjoining areas currently enjoy any statutory protection for features of geological interest. The Cornriggs workings were recommended for recognition as a North Pennine geodiversity Site in the North Pennine geodiversity Audit and Action Plan of 2004, though no precise site boundary was proposed.

It is recommended here that such recognition should be accorded to all of the features described here from Cashwell, Slatesike, Cornriggs and Cash Burn.

**THREATS**
The remote situation of the features of interest at these sites might be seen as offering them some protection.

Unlike several other sites studied in this investigation, Scheduled Monument status applies only to an insignificant part of the site and thus this ‘protection’ cannot therefore be seen as a potential threat to the geological or ecological interest.
Whereas Dunham’s (1952, p.62) suggestion of the fluorspar resource potential of the Cashwell Mines remains valid, even supposing commercial fluorspar mining or exploration were to return to the orefield, the industry would almost certainly view a number of more accessible sites as more attractive options. Any resumption of commercial mining or exploration at this site therefore seems unlikely.