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MINERAL VEINS IN BANNERDALE CRAGS

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The glacial corrie known as Bannerdale, 2 miles SSW of Mungrisdale village near Keswick in Cumbria, contains a number of high and low temperature veins. The former show signs of being granite derived and one vein carries small quantities of graphite. The low temperature veins show a quartz and barytes mineralisation, two veins carrying quantities of galena, with one having been mined.

SITE DESCRIPTION

The crags and surrounding local area are composed of Skiddaw Slates metamorphosed by the underlying Skiddaw granite. A complete petrological description of this strata is contained in the area Geological Memoir, published by the Geological Survey. Infrequent dykes out the crags and are of interest as in two cases mineral veins follow their lines of weakness in part. Glacial effects are very prominent, the crags being an ice eroded corrie, and two easily recognized overflow channels are present on 'The Tongue'. As a consequence of this erosion, the mineral veins are exposed to view. In common with other glacial valleys of gentle inclination, Bannerdale is very wet underfoot.

A sketch map together with explanatory views is utilised for reference as grid references without a topographical description are insufficient. Most of the veins are situated in areas easily accessible by scrambling. The ground south of the east ridge has not been examined in connection with this investigation.

VIEWPOINTS

As one approaches along the track from Mungrisedale it is best to pause where a path leads down to a sheepfold on the valley floor, at point X on the map. On the opposite side of the valley the entrance of the graphite mine is prominent at the foot of a wide green band - the 'Green Avenue'. A shadowy line above the level mouth marks the course of the vein. Situated at the head of this avenue is a deep rift and a prominence bearing a small barytes vein. This rift marks one branch of the beck bearing barytes in its bed. Between this beck and the lead mine a smaller unmineralised beck is evident. A most conspicuous channel marks the course of the lead workings with a higher trial along the line of the vein. The andesite vein is not very obvious but is marked by a white, quartz rib near the rim of the crags. At the extreme right hand edge, [41] two gullies are evident, one an eroded elongated channel, the other a wide shallow rift. The latter carries the 'treble vein' area at the junction of the green moorland with the higher, rocky ground. Better viewed from the glacial overflow channel just below the path at the viewpoint. The general area is covered by '6' Map.

MINERAL VEINS

The veins are divided into two categories based on their mineral content,, origin, and their effects on the country rock. The veins are not completely exposed, but conclusions can be safely drawn from the exposures along their course. Apart from the veins described. there are also large numbers of quartz veins present within the area which have not been examined at any length.

The High Temperature Veins are of a texture very similar to those at the Carrock Mine. Alteration of included slate and the slate wall rock for a short distance is intense. These veins are usually restricted to a few inches in width. The included slate is often converted to an aggregate of white and dark micas with chlorite. Fluorine from consolidating granite intrusions can give rise to abundant development of white mica in the vicinity of a granite when veined into metamorphosed clay-slate.[1] In Bannerdale, the white mica is apparently more prominent in the more strongly metamorphosed areas. Chlorite is usually derived from the alteration of silicate minerals containing iron, alumina and magnesia, and in this case the chlorite can arise from fluorine liquids reacting with the cordierite and biotite in the slate. These processes, yielding white mica or chlorite, can occur simultaneously, thus shown by the intimate intergrowths visible. The presence of independent white mica, chlorite/white mica, Chlorite/dark mica areas may correspond to localized variations in the slate composition or perhaps some introduction of iron in the latter case. These changes have been observed as incomplete, where the mica-chlorite is in discrete layers conforming with the visible structure of adjacent unaltered slate. Reaction here has either not proceeded as vigorously, or has been restricted to the available metamorphic minerals.

These alterations are consistent with a granitic source for these veins - tending to be confirmed by the observed presence, albeit sparse, of apatite, tourmaline and primary rutile.

It is of interest to note that similar changes have taken place associated with undisputedly granite - derived veins emitted from a hidden granite mass situated between Keswick and West Cumberland. It has been postulated this is an underground extension of the Skiddaw Granite. [42]

The Low Temperature Veins are commonly composed of milky quartz which may be massive, granular, loughy; and may show selvage consisting of a comb-like growth of anhedral quartz crystals. Texturally, the quartz is noticeably very different to the previous vein type. Alteration of slate wall-rock and inclusions is very slight, or perhaps non-existent in some cases. Maximum effects appear to be a paler slate resulting, with some slight development of sericite at the slate/quartz margins.

The barytes/sulphide veins all fall into this grade.

Age determinations on galena and galena-barite veins NW of the area demonstrated an emplacement age of post-Triassic. The Skiddaw Granite, however, has a Lower Devonian age. These lead veins are thus circa ½ the age of the granite. It is suggested the lead/barium mineralisation at Bannerdale belongs to the same group.

DETAILS OF THE VEINS

TREBLE-VEIN JUNCTION (TJ)

In 1972 the author noticed the presence of apparently three veins within a distance of 10 yards. Since this observation a run of scree has nearly covered the area, only one vein being reasonably visible at present.

a) The presently visible vein consists of a rib of barytes, up to two inch width, enclosed in a much wider quartz vein composed of various textures. It appears that two ages of quartz veining are present here, the younger barytes apparently following the line of the older hi-temperature type. Only about 15 foot along the strike is visible, the lower portion disappearing under soil cover - above the barytes either dies out or is disguised among the scree and soil, and rough ground. Direction roughly E - W; dip 70º to the south.

Going west, following the line of the gully up the crags, some quantity of loose quartz containing much altered slate and the odd area of in-situ veining is noticeable. One sample of primary rutile displaying a sageritic texture was obtained from here.

Records made in the cursory examination of 1972 indicate two different veins hidden under the scree: b) a lead-quartz vein and c) a quartz-white-mica vein.

b) This vein contained spots and patches of weathered galena in a sugary-quartz gangue, probably running to a few percent lead. The strike was slightly E of N. While the visible length at that time was only a [43] few feet, extending this line northwards it intersects the western edge of Bowscale Tarn Crags. Galena in small quantities has been reported from this area - the author has not yet examined this ground.

c) No minerals or items of interest were noted at the time in the quartz-mica vein.

The gully containing the above veins is well eroded and scree choked - making further investigation difficult. However, the lead vein could probably be re-exposed without extreme effort.

THE ANDESITE VEIN (AV)

A few hundred feet south of the above veins a roughly NW/SE quartz vein is evident. Near the rim of the corrie, a white rib is visible as a visual guide.

At this location a width of several feet of lo-temp. quartz in slate can be seen; some cavities contain poorly developed quartz crystals. Traces of barytes were evident. Slate wall-rock here has been little metamorphosed, in contrast to the abundant chiastolite of the triple junction area.

Following the vein downhill it is found that a large andesite dyke running roughly E - W in the crags is present. The vein tends to follow the southern edge of this intrusion, a blocky fracture, and different weathering from the slate, makes the course of the dyke evident in the field. At the downhill end of the dyke some pockets of platy barytes in quartz are visible. These pockets extend over a length of about six feet with a maximum width of 12 inches, and may represent a N/S vein rather than a part of the NW/SE vein. Small quantities of iron-pyrites have been introduced into the dyke from this vein. Unluckily, ground to the N, S and E of this area is very poorly exposed.

A large, square-cut, gully south of the dyke foot is well drift covered but appears unconnected with any mineralised vein.

AREA ADJACENT TO THE RUINED HUT

The slate, in-situ and as loose blocks, shows numerous signs of high-temp. quartz veins several inches in width. In addition to the mica-chlorite the Geological Survey have noted the presence of tourmaline. Near the hut the author noted the occurrence of a vein carrying felspar crystals up to one inch in length. A lump of quartz-mica-chlorite veinstuff contained apatites up to half an inch in length. After noting the apatite, an ultraviolet examination of various samples of veins was undertaken. No further apatite was noted - the one example fluorescing orange - and no scheelite was found.

These veins can be taken as representing a slight development of [44] granite pegmatites.

OLD LEAD MINE VEIN (BV)

The trials classed as ‘Bannerdale Lead Mine’ are on this vein and consist of three workings. The main, and middle, working consist of some openwork and a short level with stoping to a maximum of 15 feet height. Commonly, the vein here consists of a few inches of barytes with patches of galena and minor sphalerite/chalcopyrite; some quartz is present. Approaching the forehead the vein splits and thins, becoming quite unpromising.

A short distance below this level a lower level has tried the vein but found very little. Zinc is apparently more abundant here as a number of oxidation-flows are in evidence - even so, the quantity of ore must have been very small, if any.

Following the vein to the valley bottom, below this latter trial, the presence of a basic dyke adjacent to the vein is again noticeable.

On the northern edge of the openwork the rocky ground contains a series of acutely-curved and folded quartz veins. These presumably fill stress cracks in the slate and are unmineralised, and of academic interest only.

Continuing along the course of the vein above the main working a trial is reached after a few hundred feet. Being only a few feet in length it is really only a scratching on the vein. Approximately two feet of quartz is visible with a slight showing of barytes and some well oxidized iron-pyrites in cavernous quartz. Tracing the vein further up the steep ground intermittent pockets of barytes a few inches in width are noticeable. Eventually thins to a tiny quartz vein lost under cover near the rim of the crags.

The vein maintains an E-W direction throughout and shows a dip of about 70° south in the main working. Economic sulphide mineralisation is probably absent through the height of the crags, the old lead working representing a minor pocket that most likely did not show a profit.

Oxidation of sulphides in the two trials is very limited and predominantly post-mine. Large amounts of hydrous iron-oxides present in the levels is derived from iron pyrites in the slate and does not represent a hidden sulphide mass.

MINERALS PRESENT IN THE TWO LEVELS

Galena - PbS - occurs as coarse spots and the occasional patch a few [45] inches across.

Sphalerite - ZnS - present sparingly as small patches associated with the galena. Some is very low in iron showing a deep red to transparent yellow-brown when viewed with a strong lens.

Chalcopyrite - $CuFeS_2$ - as small patches with the previous minerals.

Cerussite - $PbCO_3$ - as tiny crystals in a small oxidised area in the main working.

Malachite - $Cu_2(OH)_2CO_3$ - small amounts of botryoidal material present with the chalcopyrite.

Linarite - $PbCu(OH)_2(SO_4)$ - traces as micro-crystals in oxidized galena/ chalcopyrite patches in the main level.

Smithsonite - $ZnCO_3$ - present as a white to very pale blue coating in the main working; and as botryoidal patches in the lowest level.

Jarosite - $(Fe_2O_3)_3.K_2O.(SO_3)_4.6H_2O$ - in the main level, which is fairly dry, numerous pieces of slate can be found with yellow to brown powdery coatings. Much is apparently what is commonly termed ‘limonite’, but some

of the coarser material is present as crystals that have tentatively been identified as jarosite. This latter mineral is not uncommon in small amounts in fairly dry environments associated with oxidizing iron sulphides.

Barytes - $BaSO_4$ - present in the vein mainly as massive buff-coloured material; maybe fine-grained or platey in texture.

Additional minerals, mentioned in various older publications, are: Greenockite - CdS; Witherite - $BaCO_3$, and Stibnite - Sb_2S_3. Without viewing actual specimens any comments on these are purely speculative. None of the three were noted in the present investigation, but it is of course not possible to view the material that was removed from the stope. The present in-situ-vein and tips may not represent some minor occurrences that could have been found during mining. Levels of cadmium in the sphalerite, and antimony in galena have not been determined, to perhaps make a case one way or the other. Mr W.T. Shaw has noted minor amounts of witherite in the Caldbeck barytes mines, however, this was invisible to the naked eye. Mis-identification of these minerals a century ago must be borne in mind. [46]

STREAM VEIN (SV)

Parallel to, and slightly SE of, the beck adjacent to the Lead Mine, another beck occurs that has proven to carry barytes mineralisation. The lower portion contains much loose slate, making observation of the in-situ rock difficult; however, at approximately the height of the hi-lead mine trial the beck enters rough ground and exposure is continuous. Starting at the foot of this area and continuing up the beck for as far as is practical the vein shows up to six inches of barytes, though an average of two inches is more representative. Quartz is again ever-present, with only minor traces of iron-pyrites. The vein follows the curving course of the beck - or more properly, vice versa; the general trend overall being roughly E-W. Eventually the vein is lost under cover very near the rim of the bowl - with occasional pockets of platey barytes in quartz six to twelve inches in diameter being noted in the upper reaches. Comparing this vein with the lead mine vein it is very noticeable that the former contains more barytes than the latter at similar heights. Taking the exposures of both above the high lead mine trial, the Stream Vein would have appeared worthy of a trial by the ‘Old Men’ as it is much stronger. However, the lack of economic sulphides would undoubtedly account for the lack of interest. Whether one can draw parallels with the lead mine and suggest lead and zinc my occur between the rough ground and the valley bottom is open to conjecture. In any case, the deposits in this area appear very limited and pockety, and were probably subject to fairly localised controls during deposition.

PROMINENCE VEIN

The book containing the Stream Vein divides into two min channels near the head of the crags - the southern fork containing a deep rift, and an obvious rocky bump termed for convenience ‘The Prominence’. This rocky outcrop

contains a small vein carrying up to two inch pockets of barytes in quartz. Exposure is poor and the vein appears unconnected with any other barytes-containing veins in the area. Strike is roughly E-W to ENE - WSW. It is not convenient to explore this vein further due to ground cover.

GRAPHITE VEIN

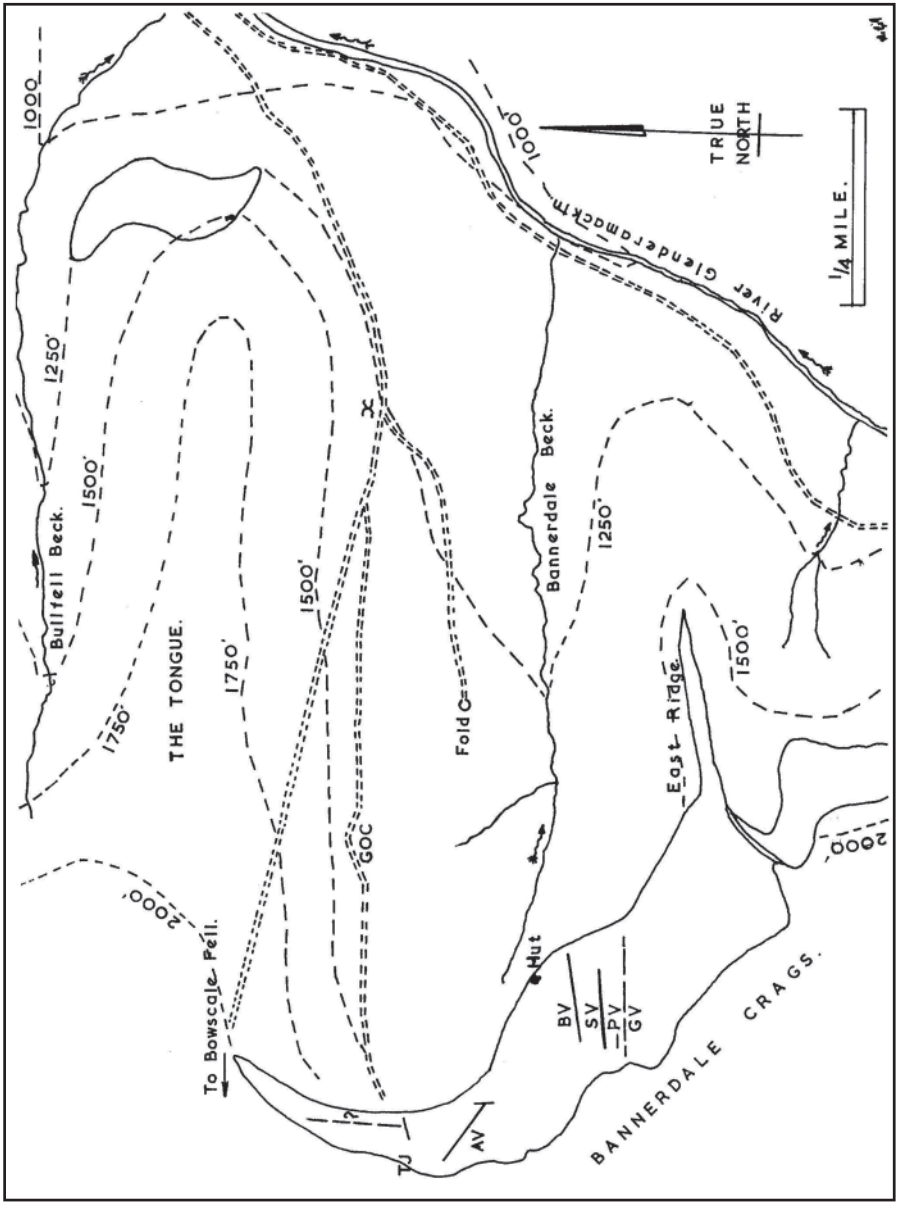
The occurrence of graphite was mentioned in T.M. Hall's manual in 1868, and the confirmation of this mineral was one reason for initiating work in the area. Interest in this mineral was shown by the 'Old Men', who drove a level ca.25 feet in length on the vein. This level is approximately 100 yards south of the lead mine workings, at the foot of the rough ground; most easily viewed from the opposite side of the valley.

This vein pursues an approximate E-W course and dips steeply to the [47] south. Examination at the level entrance shows clots of graphite to one inch, though the majority is much smaller. Graphite is concentrated on the edges of a medium-sized quartz vein accompanied by chlorite rosettes, muscovite mica, small amounts of manganite and traces of iron sulphides. Graphite has also been injected for a short distance along the cleavage of the slate wall rock. Away from the level mouth very little mineralisation in the quartz is visible. Care must be taken not to confuse dark, soft, sheared slate with the graphite. Above the level the vein is traceable as a shallow channel - though exposure is fairly poor. The vein follows the foot of a large grassy shelf - 'Green Avenue' - and soil cover is quite common.

When first examined by the author in 1972 a prominent quartz vein high up the crags, on the line of the graphite vein, was assumed to be the continuation above the level. The recent, more thorough, work does not confirm this - however it appears likely. This vein eventually disappears under cover near the rim of the crags, about 100 feet south of the Prominence Vein. No graphite has been noted above the level, and this may represent the only pocket of the mineral.

The author does not feel qualified to make comments on the ultimate source of the graphite. However, consulting the paper by R.G.J. Strens on the Borrowdale graphite, it is possible to draw parallels without having to resort to a vivid imagination.

The Bannerdale Lead Mine is mentioned on p.22 of the 1916 copy of *Special Report of the mineral Resources of Great Britain - Vol 11 Barytes and Witherite*. It is suggested here that the Bannerdale Graphite originated from the lead workings - an opinion the author has met in a number of circumstances. No accurate locality data appears to have been published by anyone who has actually found graphite at Bannerdale, it has been a matter of convenience to assume the old lead workings were the source. Additionally, even recent descriptions of this area by several groups have neglected to mention the graphite level, in spite of its prominence when viewing this area from 'The Tongue'.



Slate gouge in some of the faults yields a rather deceptive appearance, and graphite in minute quantities is a product of the metamorphism of the Skiddaw Slates (ref. c) Harker). While retaining an open mind, the author considers the majority, if not all, of the graphite from Bannerdale will have originated from the 'Graphite Vein' and consequent level. If this mineral occurs

elsewhere in the area, high-temperature veins in ground adjacent to and of the ruined hut would be the most likely places. This suggestion utilises the magmatic-source theory - i.e. - supplying suitable conditions for transport and deposition but not necessarily the graphite's actual primary source. [48]

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REFERENCES

a) One Inch Sheet Memoir No 23 - Cockermouth. Institute of Geological Sciences.

b) Postlethwaite, J. *Mines and Mining in the Lake District*, 1877.

c) Harker, A. *Metamorphism*

d) Sterling Gleason *Ultraviolet Guide to Minerals*

e) Bateman, A.M. *Economic Mineral Deposits*

f) Hall, T.M. *Mineralogists Directory*, 1868.

g) Shaw, W.T. *Mining in the Lake Counties* (Clapham: Dalesman, 1972).

h) Strens, R.G.J. "The Graphite, Deposit of Seathwaite in Borrowdale" *Geological Magazine*, (102) No.5.

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