



NORTH EASTERN GEOLOGICAL SOCIETY

Newsletter November 2014

<http://www.northeast-geolsoc.50megs.com>

1. NEGS SPRING/SUMMER FIELD MEETING PROGRAMME

GEOLOGY & MINERALISATION AT NENTHEAD

Sunday 12th October 2014

Report of the field meeting led by **Brian Young** (*Honorary Research Fellow, Department of Earth Sciences, University of Durham: (Retired British Geological Survey District Geologist for Northern England)*) and **Peter Jackson** (*Chairman: Nenthead Mines Conservation Society*)

Well-nigh perfect autumn weather greeted members who had travelled to the Cumbrian high Pennine resort of Nenthead for an exploration of the local geology and mineralisation. Having welcomed members and congratulated ourselves on choosing such a fine day the leaders introduced the programme by suggesting that we spend the first part of the day underground in total darkness!

The Nenthead area is one of the most intensely mineralised parts of the Northern Pennine Orefield. The village was a major centre of lead mining, especially during the heyday of the industry in the 18th and 19th centuries under the tenure of the Quaker London Lead Company. It was this company who built the village and operated most of the local mines and the large Nenthead Smelt Mill. With this company's departure, precipitated by the almost total collapse of local lead mining at the turn of the 19th and 20th centuries, other companies, notably the Belgian Vieille Montagne Zinc Company, acquired many of the mining leases, but with zinc rather than lead as their main target. Although mining disappeared from the neighbourhood many years ago, large spoil heaps and opencast mining operations (hushes), together with a wealth of former mine and smelt mill buildings in varying states of dilapidation, attest to the huge importance of this formerly great industry. Mining remains are not confined to the surface. More extensive, and generally much better preserved, are the miles of underground workings, many of which remain accessible and are the regular haunts of mine explorers and mine historians. Our subject for the first part of our visit was one of these workings.

Through the generosity and courtesy of the Nenthead Mines Conservation society, members were equipped with hard hats and lamps in readiness for our traverse of parts of the workings of Carr's Mine. This is one of a number of workings, a short distance upstream from the village that was reconditioned for tourist access and interpretation during the 1990s and is now in the care of the Conservation Society. Before going underground, Brian

Young gave a short introduction to the geological setting of Nenthead within the broader context of the Northern Pennines. An important feature of the veins and associated flat deposits at Nenthead is the abundance of mineralisation in veins of several orientations, most notably the NNW-SSE trending 'cross veins' which elsewhere in the orefield are usually barren. Carr's Mine exploited deposits with Carr's Vein, one of these cross veins. The Nenthead deposits are also unusual for their very high levels of zinc mineralisation in association with lead, as well as for the virtual absence from many of the deposits of the area's normal gangue minerals such as fluorite or barium minerals.

Peter Jackson, the Conservation Society Chairman, then outlined something of the history of the mine and highlighted some of the geological features to be seen on our traverse.

Unusually for the Northern Pennines, the Carr's Mine adit is driven on a gentle downward gradient into the workings: most other local adits were driven on a slight uphill inclination to effect drainage of the workings. Here at Carr's Mine, underlying underground workings allow drainage into those deeper levels. Fine sections through the mudstones and siltstones beneath the Great Limestone were examined along the adit walls and roof as we progressed inbye. The miners' practice of driving such crosscut levels within the more readily excavated shale and siltstone beds, with the base of the overlying Tuft Sandstone serving as a sound roof were noted. The abrupt passage through the Carr's Cross Vein into the Great Limestone, here extensively altered by metasomatism to horizontally extensive bodies, known as 'flats', composed predominantly of ankerite ($\text{Ca}(\text{Fe}^{2+}, \text{Mg}, \text{Mn})(\text{CO}_3)_2$) in which pockets and veinlets of galena (PbS) and sphalerite ($(\text{Zn}, \text{Fe})\text{S}$) are conspicuous, were examined and discussed. The hardness of the rock, and the effort required to penetrate it in the days of hand drilling were clearly demonstrated. So too were some of the difficulties of making detailed observations of individual lithologies in comparatively fresh, unweathered underground exposures where the rocks assume a remarkable degree of similarity in poor lighting. Some very clear sections through faults both mineralised and un-mineralised were seen *en route* to the sizeable stopes in sphalerite-rich replacement mineralisation. Distinctive post-mining encrustations of white hydrozincite ($\text{Zn}_3(\text{CO}_3)_2(\text{OH})_6$) on the stope walls were pointed out. The darkness of the large stope enabled the leaders to demonstrate the spectacular fluorescence in ultra violet light exhibited by a number of local minerals, notably fluorite (CaF_2), calcite (CaCO_3) and witherite (BaCO_3), though these minerals are not present within the Carr's Mine workings. Emerging from the mine's tourist exit, and pleased to find that the fine weather was still with us, the group delayed examination of the fine surface exposures of mineralisation here until after lunch.

Through the hospitality of the Nenthead Mines Conservation Society, their visitor centre in one of the old Smelt Mill buildings was at our disposal, offering hot drinks and a chance to see the society's fine collection of local minerals and mining artefacts.

The afternoon was spent on a leisurely traverse of the sections through the beds of exposures of the Alston Formation in the banks of the River Nent upstream from the Smelt Mill. The position of the Iron Post Limestone, a thin, impersistent and unusually fossiliferous limestone, was pointed out in the river banks, though its almost complete concealment by river-borne debris in recent years was outlined as a good example of the importance of observing and recording such transient geological sections.

The vast amounts of mineralised rock, derived from adjoining spoil heaps, that litter the river bed here, provided members with good examples of all of the locally important minerals, together with opportunities to examine textural features in veinstone and metasomatised limestones.

A clear section through the lowest few metres of the Great Limestone and the underlying sandstone at the top of the Iron Post cyclothem, in the right bank of the river, was examined in some detail. It was this sandstone, the curiously, and inexplicably, named 'Tuft', that we had previously seen in the roof of Carr's Level. Abundant evidence of numerous palaeosol horizons with abundant carbonised rootlet traces were seen with, at the very top of the sandstone, a few centimetres of highly carbonaceous material that was discussed as the local equivalent of the Townhead Coal of south Northumberland. The very sharp base of the overlying Great Limestone marks a major marine flooding surface at the base of the Great Limestone cyclothem. This horizon is today conventionally adopted in this area as the mappable base of the Namurian succession.

About a metre above the limestone's base, a very prominent roughly metre thick bed of limestone composed almost entirely of encrusting sponges and colonial corals, with associated brachiopods, bivalves etc., all beautifully preserved in life position, was demonstrated. Taking its name from the encrusting sponge *Chaetetes depressus*, the Chaetetes band is a prominent stratigraphical marker in the Great Limestone across much of the Northern Pennines. It is especially well developed here where weathering has accentuated the mildly siliceous preservation of the fine cellular detail of the sponges and corals.

The Chaetetes Band near the base of the Great Limestone.

Undulating layers of Chaetetes depressus in life position, accentuated by weathering. Right bank of River Nent, downstream from the waterfall.



A well-preserved large colonial coral (Siphonodendron sp.), overgrown by layers of Chaetetes depressus in the Chaetetes Band near the base of the Great Limestone. Right bank of River Nent, downstream from the waterfall.

Between this point and the waterfall, brown weathering adjacent to joints in the limestone betrays the presence of iron metasomatism as the Carr's Cross Vein is approached. Although Carr's vein is not exposed at surface, the metasomatism associated with it culminates in the conspicuously brown-weathering limestone at the waterfall. Here the limestone is almost completely altered to an ankerite-rich rock though original features such as bedding planes, stylolites etc remain conspicuously preserved.



GREAT LIMESTONE AT THE WATERFALL, NENTHEAD

Conspicuous brown weathering marks the extent of ankerite-rich Metasomatism in the limestone close to Carr's Vein. Although almost completely altered to ankerite-rich rock, original features such as bedding are clearly preserved. The steel walkway is the tourist exit from Carr's Mine.

Numerous cavities and veinlets within the metasomatised rock, resulting from the volume reduction associated with the alteration, contain fillings of galena and locally sphalerite. Being close to the water table in the valley bottom these sulphides are here comparatively fresh and unaltered.



Veinlets of galena in ankeritised Great Limestone. Waterfall on River Nent.

A short walk took us to the dumps from old underground workings in the Cowlitts Veins, a little further up the valley. Characteristically brown-weathered metasomatised limestone comprises most of the spoil but is accompanied by abundant evidence of zinc mineralisation. However, the zinc is typically present here as the zinc carbonate mineral smithsonite (ZnCO_3), which here as in most parts of Alston Moor is in the form known as 'dry bone' ore from its distinctive brown cellular texture, resembling the inside of a dried bone. Smithsonite results from the near-surface supergene alteration of primary sphalerite. A feature of these dumps is the common occurrence of smithsonite pseudomorphs which retain the shape of the original sphalerite crystals. It is likely that these early workings raised smithsonite, known in earlier centuries as 'calamine' for the making of brass.

Discussion of the origins of the local mineralisation provided an opportunity to outline the exploration for new base metal deposits at depth, currently under way in the area immediately north of Nenthead and clearly visible from this vantage point.

En route to our starting point a short detour gave us views of the enormous wheel pit that once housed a huge waterwheel employed to drive a set of condensers used to capture lead fumes from the adjoining smelt mill.

Back at the Conservation Trust's visitor centre, to the accompaniment of more hot drinks and cakes, the leaders were thanked for a memorable day out that marked NEG's first recorded underground field meeting.

Report by Brian Young and all photos © B.Young

Secretary:

I make no apologies for printing the report from Brian in full. **Brian supplied a list of references which I have attached to the report on the Website.**

I also received a message from Peter Jackson who thanked us for bringing NEGS to Nenthead and hoped that members enjoyed the day. He suggested that a further underground field meeting may be possible next year (if appropriate), perhaps into the more interesting parts of Smallcleugh mine. Also see **3. NEWS**

Many thanks to both Brian and Peter (and Mrs Jackson) for an excellent Field Meeting from all of those that attended this interesting day.

The Field Meetings for the 2015 season are being planned. If anyone would like to lead a field trip, or knows of potential leaders/locations, please contact Field Trip Secretary - Eric Johnson: eric_w.johnson@btinternet.com

2. NEGS AUTUMN/WINTER LECTURE PROGRAMME.

The first lecture of the 2014-2015 NEGS programme enjoyed an excellent audience and a stimulating speaker.

Report from Lecture presented to the North East Geological Society on 17th October 2014 by Professor Andy Aplin, Durham University

Gas, Oil and Carbon Dioxide: Is Cinderella shale now Belle of the Ball?

Professor Aplin started his presentation with an overview of the globally accelerating demand for energy coupled with population increase, emphasising that our society is facing a new scenario in terms of energy usage. The integration of horizontal drilling and fracking has enabled very large new hydrocarbon resources to be exploited. This is also a challenge

as burning more hydrocarbons will create more carbon dioxide pollution, causing more global warming. One reaction could be the development of many large carbon sequestration reservoirs.

It is estimated that very large shale basins holding a store of partly recoverable hydrocarbons occur all over the world. China has potentially the largest resource followed by the USA and Argentina. Marine resources have not yet been quantified.

Organic material deposited with the inorganic shale material makes up approximately 10% of shale. To form hydrocarbons this material has to experience a raised temperature in excess of 150 degrees centigrade, this equates with burial to a depth of 5 Kms. Much of the hydrocarbon material formed is lost to conventional reservoirs but a significant % remains trapped in very small pore spaces. These deposits are termed unconventional hydrocarbon resources.

Fracking is a well established process, exerting stress on the shale with high pressure fluids and chemicals (typically detergent materials), horizontal drilling is a much newer technique, the combination of both techniques started commercially 15 years ago with some startling economic results in the USA. Shale rock has a very low permeability, fracking enhances it allowing the trapped hydrocarbon to escape. This typically amounts to about 15% of the hydrocarbons present.

Commercial exploitation today involves the creation of a pad, about the size of a football pitch. Several wells (possibly 20) are developed from one pad. The process can take 18 months and production quantities quite rapidly fall - requiring new pads to be constructed. Output typically falls by 80 - 85 % in three years. The environmental and resource needs of this type of development are quite substantial albeit short lived.

The USA has drilled 40,000 wells in 10 years. In the same period the UK has drilled 3. The USA has huge areas, often thinly populated, that are being exploited. The Eagle Ford shale in southern Texas for example has drilled 7000 wells in 5 years with 5500 more approved. This allows very cheap fuel to be supplied to industry providing a competitive advantage in addition to political aspects of such developments.

The UK has not got similar resources or the experience that is present in the USA; it does however have an advanced, integrated infrastructure that may well reduce the impact of the drilling process. It may be that we could recover oil and gas over a period of about ten years that would economically help the country in the short term. It is estimated that by 2020 the UK will be dependent on overseas sources of energy for 80% of our needs. In 2004 we were just about self sufficient. Norway, for example, is a major supplier as is Qatar.

Issues associated with such developments would include transport, water supply - use and cleaning, aquifer contamination, seismic activity, leakage and the consequential climate change. Present thinking feels that the UK would be able to cope well with these areas but the associated costs would be significant.

Climate change would be a serious issue however. Several sequestration options have been identified, our politicians have identified the storage to be reliable for 2000 years, this is a new dimension in terms of forward planning. A very real issue is the size of the problem if

global warming is to be kept below 2 degrees centigrade. There are facilities to store 0.3% of the Carbon dioxide today, it is estimated that 27% needs to be stored. This would need about 4000 sites. This is possible but reducing the output of carbon dioxide is seen as a more realistic solution.

The visual support for the lecture was excellent with links from our biblical past to graphical projections.

Andy welcomed questions from the audience which were, as usual, perceptive and dealt with rigour. The lecture was very warmly received by the audience who thanked Andy for the presentation

Report by Gordon Liddle.

Suggestions (with names, contact if possible) for speakers would be appreciated by Prof. G. Foulger. : Email: g.r.foulger@durham.ac.uk

3. NEWS

“National Association of Mining History Organisations Conference 2015”

This conference will be hosted by the Nenthead Mines Conservation Society (NMCS) at Nenthead. **22 to 25th May 2015.**

The programme includes lectures themed on recent mining history research in the North Pennines, and the influence of war on the UK mining industry. There will also be a programme of surface and underground excursions. Details of the programme will be published on the internet in December 2014 at www.namho.org

NMCS welcomes any offers of lectures and excursions. Prospective writers and leaders should contact NMCS Chair, Peter Jackson, via either e-mail admin@nentheadmines.com or phone 07718385646.

NMCS also runs a programme of open days at Nenthead. Information is published at www.nentheadmines.com

Earlier this year Prof. Gillian Foulger informed NEGS Committee about a 4th year module 'Earth Sciences into Society' in which students complete projects in companies and organisations. We submitted a proposal for students to complete a project for (and with) NEGS and awaited the new academic year and a response. The response, in October, was positive and we have a group of 4th year (MSci) students, Stef Boughey, Rosie Robson and Alexia Santamas, who are working very enthusiastically towards increasing membership, publicising and revitalising the society.

Over the next 6 months, the Students are planning to create a promotional leaflet, promote individual lectures, create a new website template, revitalise the society's logo and form a 3 year plan to encourage progress within the society. The overarching aim will be to double membership over the next 3 years.

NEGS is on Facebook

www.facebook.com/northeasterngeolsoc, insert North Eastern Geological Society in search bar on your Facebook page, and 'Like' the page.

The page is hosted by the new **Student Representative** to your NEGS Committee, who is already doing some great ambassadorial work. Rosie (Kincaid) is a 3rd year geology student.



or
the

4. INFORMATION

Do have a look at this site, some wonderful pictures:-

100 Great Geosites: The Final List

The UK and Ireland feature some of the most diverse and beautiful geology in the world, spanning most of geological time, from the oldest Pre-Cambrian rocks to the youngest Quaternary sediments. As part of **Earth Science Week 2014**, The Geological Society and partner organisations are celebrating this unique geo-heritage by launching a list of 100 Great Geosites across the UK and Ireland.

<http://www.geolsoc.org.uk/100geosites>

From the Geologists Association

Ladies & Gentlemen,

Please find attached two links concerning the Geological Conservation Review publications. Each volume addresses a part of the stratigraphical column (eg Marine Devonian), provides an exceptional review of current knowledge, and a series of geological site descriptions (extremely useful to assist your field excursions).

Please could you circulate them to all your geological friends and colleagues to whom, I trust, they will be of considerable benefit.

https://gallery.mailchimp.com/b3ea23a6951bcf5950bddd925/files/b_PGA_GCR_flyer.pdf

https://gallery.mailchimp.com/b3ea23a6951bcf5950bddd925/files/a_GCR_Document.doc

**Best wishes, Graham
Dr Graham M Williams,
Honorary Treasurer,
Geologists' Association**

5. MEMBER PROFILE – on last page

6. ADMINISTRATION

If you receive this newsletter by post and have an email address, then please let me have it.
negsec@gmail.com Best Wishes, Chris Burrige (Secretary) Tel: 01915289707

5. MEMBER PROFILE

Our profile for this edition is of a very long-standing NEGS member, who has served on Committee; has led, and as Field Meeting Secretary, organised many field visits for NEGS over the years. Currently **JOHN WARING** is the NEGS Webmaster.



**"The result, therefore, of our present enquiry is that we find no vestige of a beginning, –no prospect of an end."
("Theory of the Earth" pub. 1788
James Hutton 1726-1797)**

It was when I came to work as a school teacher in the North East in 1974 that I first became interested in geology, quite distinct academically from my early education mainly in the classics and music. Until then, a rock was a rock, nothing more!

One evening I accidentally started watching an OU programme showing a lecturer perched on the side of a cliff casually picking up an ammonite and demonstrating its zonal significance. I was overcome with curiosity and subsequently enrolled with the OU to study the science foundation course (S101) followed by courses in the Earth Sciences, a programme which, coupled with full time teaching in Primary Education as well as helping to bring up 3 teenage daughters left little time for leisure. After completing my OU degree, c. 1983 I became a member of the Y.G.S. and also of N.E.G.S. then led by John Senior of Durham Univ. Department of Adult Education.

My interest in thin section making is due to the influence of Alex Herriot, one of the leaders of a Y.G.S. residential weekend in 1986 on the Isle of Arran. His contribution to the island geology is acknowledged in the 1987 edition of the map. During his lifetime he made over 5000 thin sections which are now housed in the Hunterian Museum, Glasgow and can be viewed on the website.

On retirement, 1995, I taught part time adult education classes in geology at the local Adult Education Centre. At present I am a member of an active RIGS Group associated with the Tees Valley Wildlife Trust. Being a church organist and sea fishing (e.g. 28lb ling caught 3 miles off Saltburn) are among my other interests. My favourite exposures are the Carboniferous/Permian unconformity and Tertiary Dyke both immediately north of Tynemouth North Pier.

Grass patches mark line of Upper Carboniferous-Lower Permian Unconformity on cliff face below Tynemouth Priory (Photograph from NEGS Website – Field Trip May 8th 2011)

