Re-evaulation of flat-style mineralisation in the Northern Pennines

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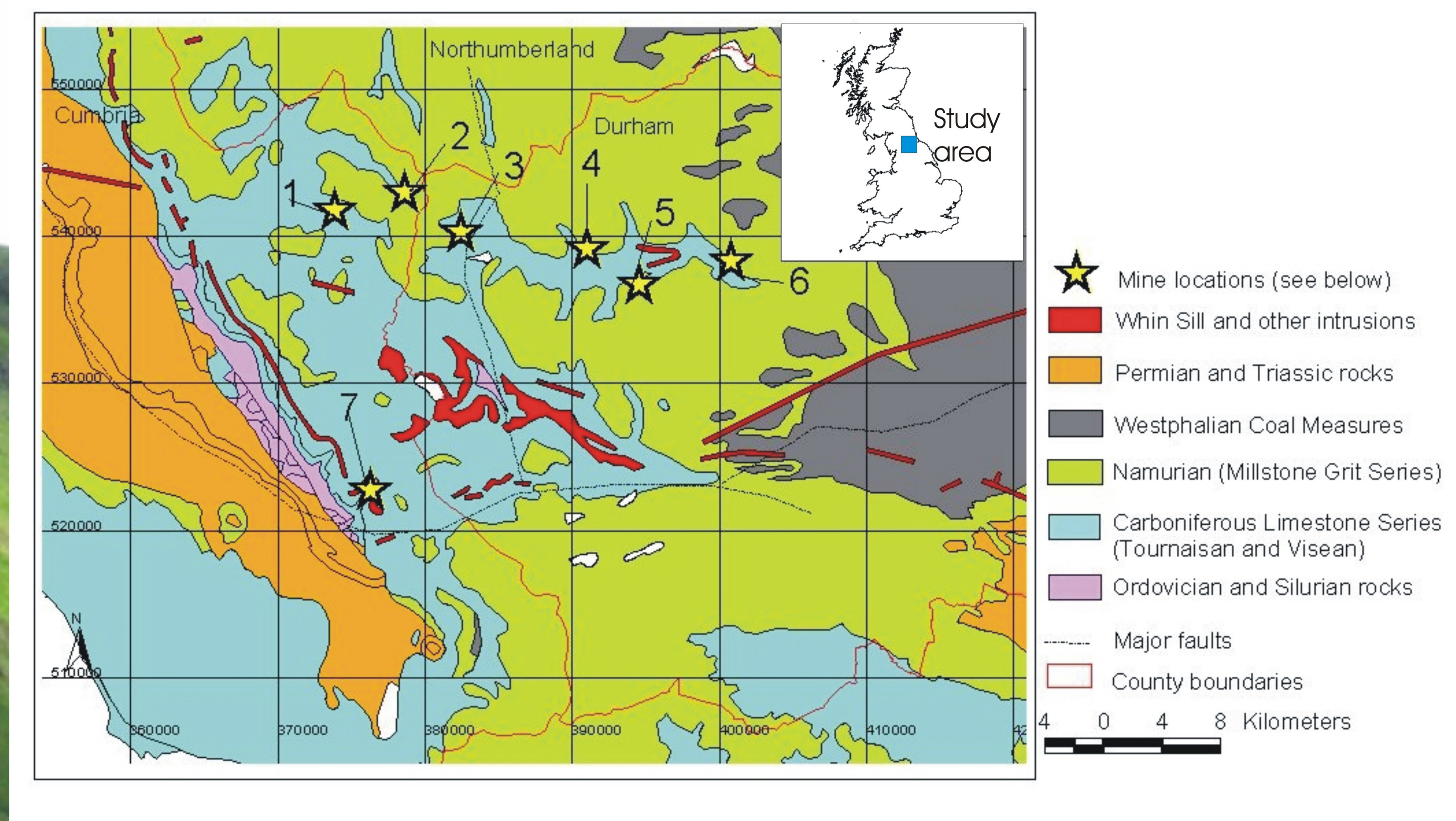


Figure 1. Simplified geological map of the Alston Block in the Northern Pennines showing localities studied (1. Tynebottom Mine; 2. Smallcleugh Mine; 3. Wellheads Hush; 4. West Rigg open-cut; 5. Eastgate Cement Works quarry; 6. Rogerley Mine; 7. Scordale (Hilton and Merton Mines)).

Introduction

During its lifetime, the North Pennine Orefield (NPO) produced over 4 million tons of lead as well as significant amounts of zinc, fluorite, barite and witherite (Dunham, 1990). Production was not just from sub-vertical veins, which have the most obvious surface expression, but also from stratabound, sub-horizontal orebodies known as flats.

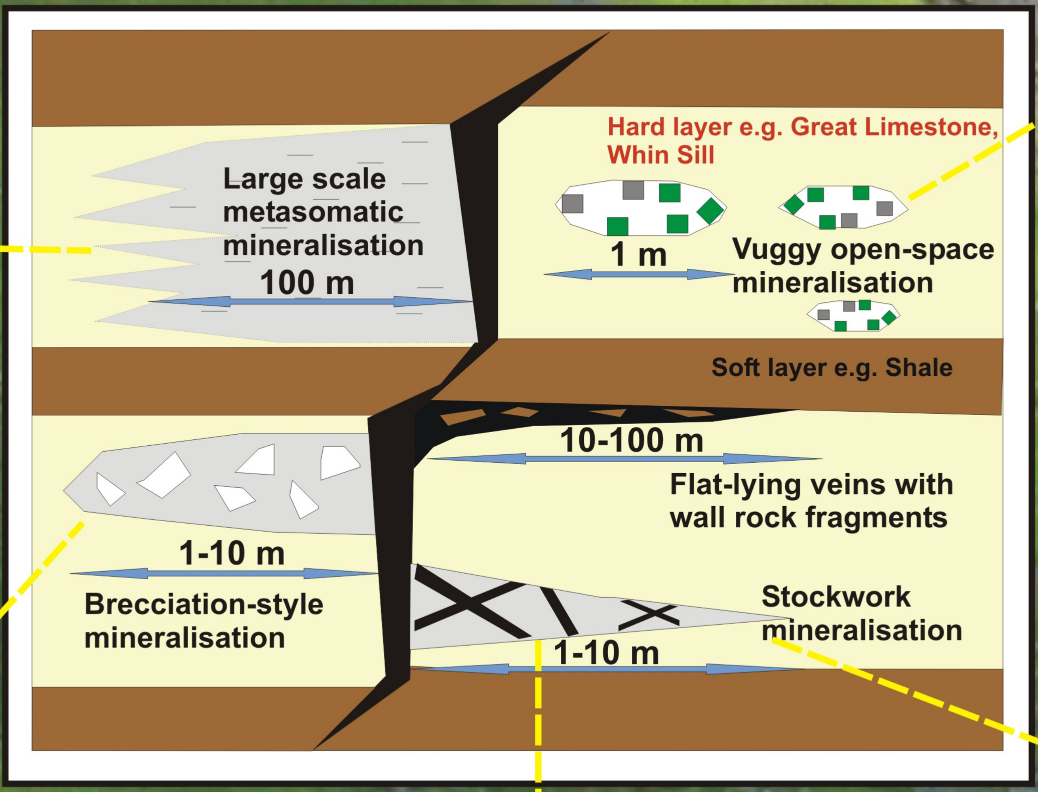
Flats have a very limited surface outcrop but some made a significant contribution towards mine output. For example, at Boltsburn Mine rich galena-bearing flats discovered in the late 19th Century yielded almost 100,000 t of lead concentrates and formed the majority of the mines production until its closure in 1931.

The BGS is investigating flat-style mineralisation to understand the factors that control its distribution, such as limestone diagenesis, ground preparation and host rock permeability-porosity. Flats have the best potential for new resources, an understanding of their genesis is critical in delineating further mineralised areas.

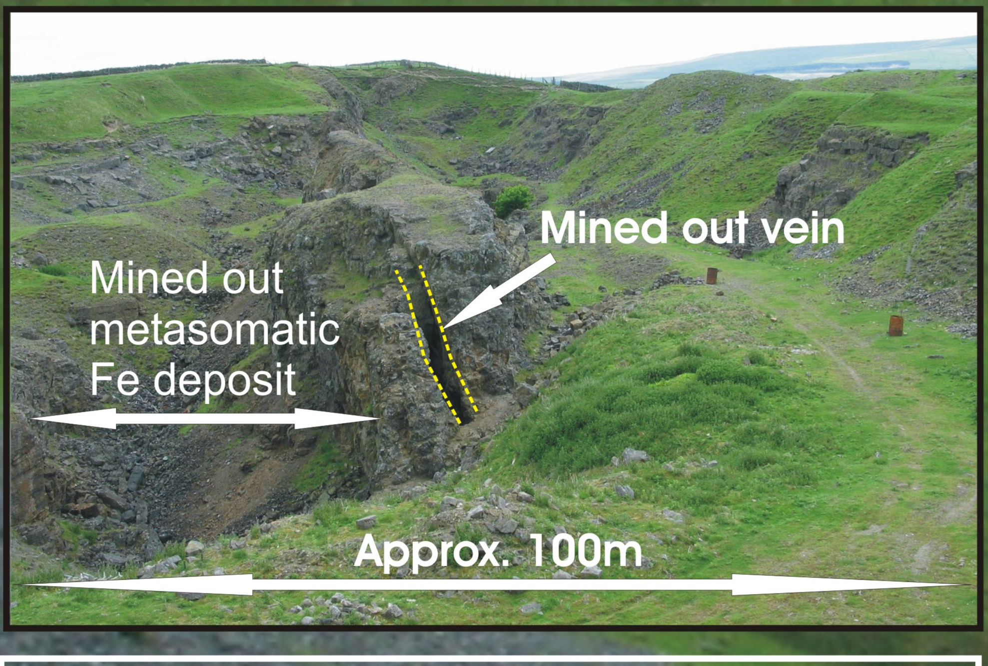
Types of flat mineralisation styles in the North Pennine Orefield

Flat-style mineralisation

Currently, flat-style mineralisation is thought to result from the metasomatic replacement of limestone. Disseminated sulphide minerals along with barite and fluorite are important components of the metasomatism, however, the main effect is widespread ankeritisation and sideritisation, which locally forms economic iron deposits (e.g. Carricks Mine and West Rigg Opencut).

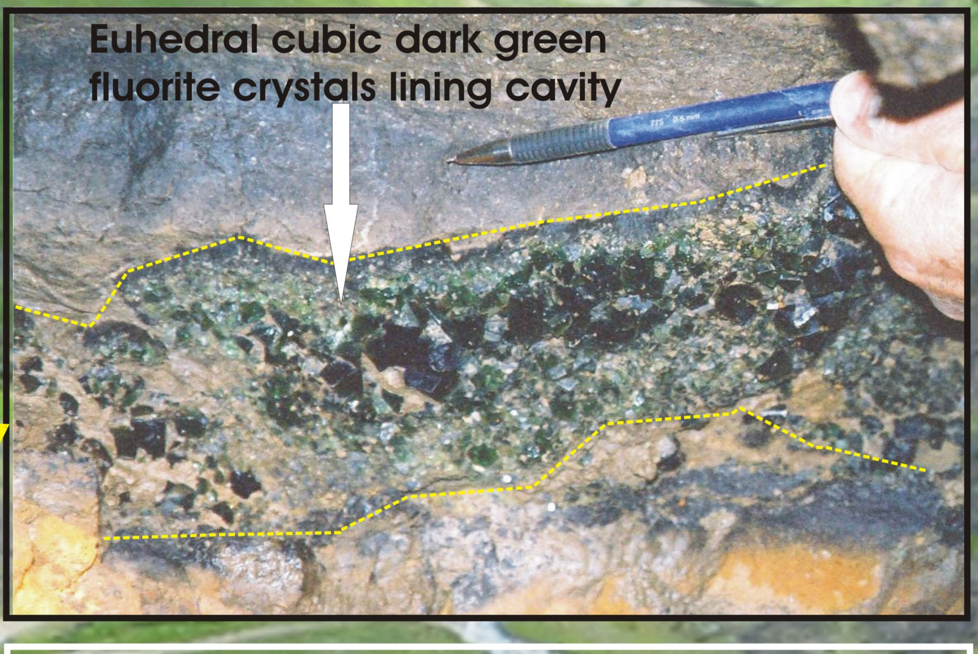


Widespread metasomatic replacement - West Rigg Opencut



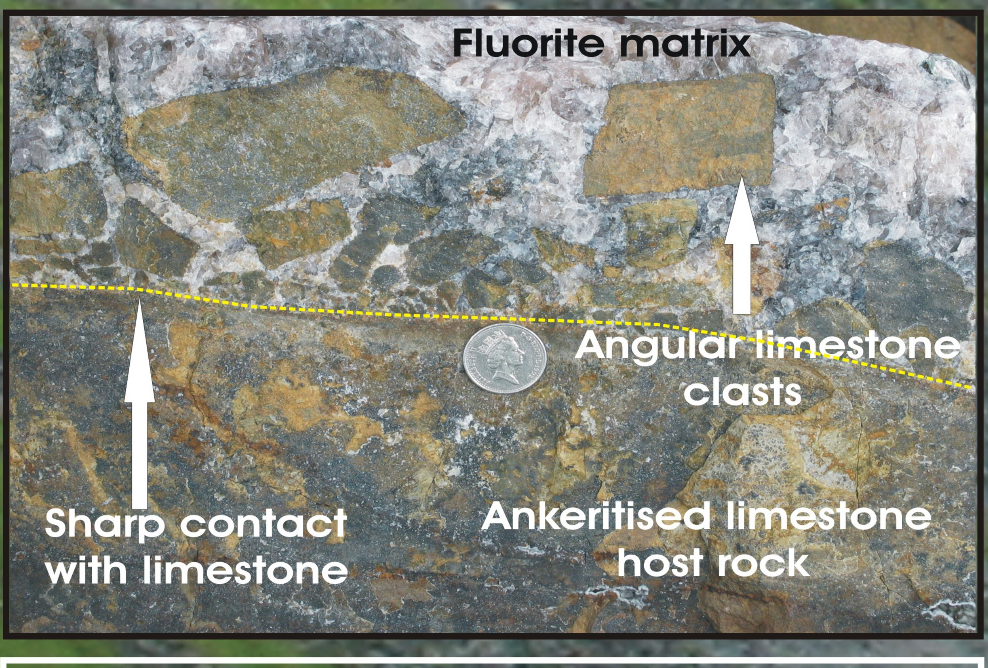
The most widespread form of flat-style mineralisation involves metasomatism of the host rock (usually limestone). The replacement of existing textures and features is common, including exceptional replacement of fossils with galena. At West Rigg Opencut extensive oxidised ankerite/siderite replacement of limestone was worked as iron ore.

Open filling mineralisation - Rogerley Mine



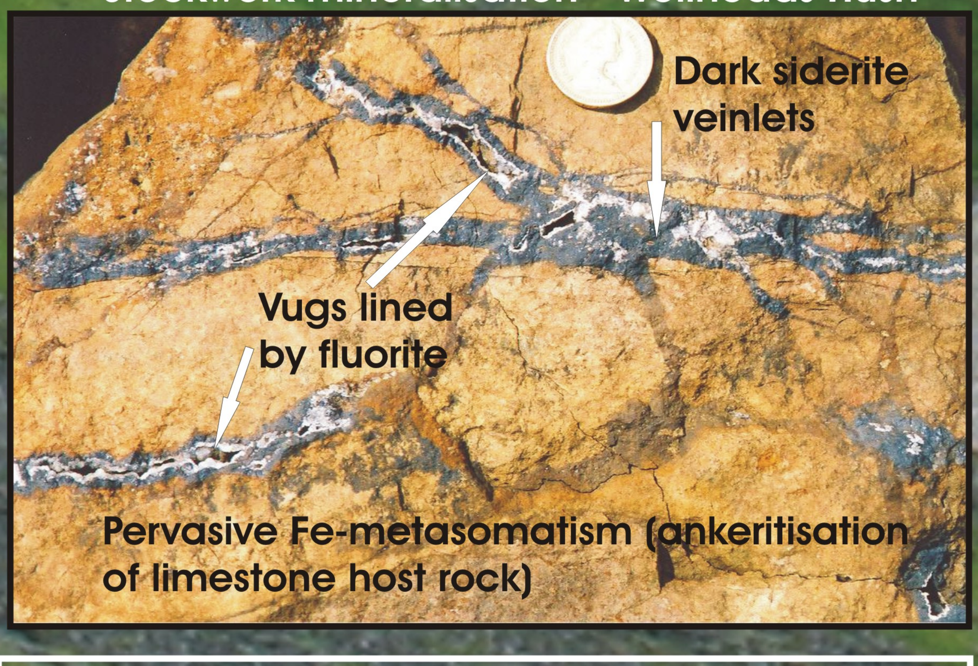
In a number of cases, Pb-Zn-Ba-mineralisation lines voids in ankeritised limestone. These vary from a few cm to over one metre in length. Good examples are seen at Rogerley Mine where centimetre scale euhedral green fluorite cubes have formed in sub-horizontal voids.

Brecciation mineralisation - Eastgate Cement Works quarry



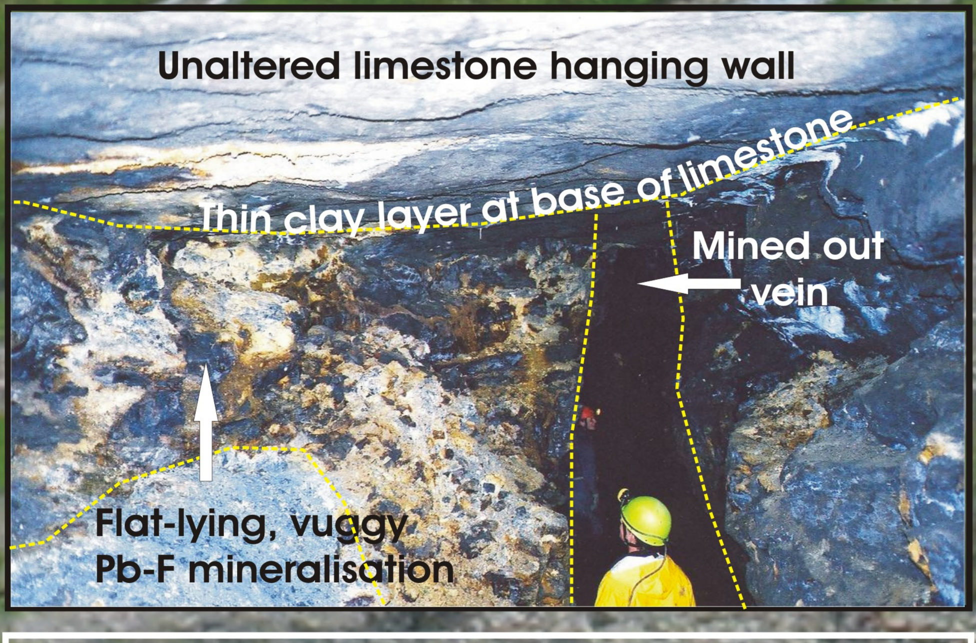
Hosted within ankeritised limestone is breccia-style mineralisation. Here, angular limestone clasts occur within a fluorite vein with sharp contacts against the limestone. These may be formed by overpressured mineralising fluids against an impermeable horizon, such as a clay band.

Stockwork mineralisation - Wellheads Hush



Some localities (e.g. Wellheads Hush) show pervasively ankeritised limestone intruded by centimetre-scale anastomosing siderite veinlets. These often contain crystalline fluorite within vugs indicating a void present during vein intrusion.

Flat-vein style mineralisation - Tynebottom Mine



Where veins (conduits) halt against impermeable horizons such as clay bands (e.g. Tynebottom mine seen above), mineralisation penetrates several metres into the underlying host rock limestone as sub-horizontal veins, which can include rafts of wallrock material.

Preliminary conclusions

Field studies show that processes in addition to metasomatic replacement operated and that these resulted in two distinct types of non-metasomatic flat mineralisation.

The relationship between pervasive ankeritisation and sideritisation of the limestones and Pb-Zn-Ba-F mineralisation is not yet clear. Fe-metasomatism may however play a key ground preparation role by increasing limestone porosity and permeability.

Flat-lying impermeable layers probably played a role (i) directing mineralising fluids laterally, and (ii) causing the localised fluid overpressures responsible for breccia and horizontal vein mineralisation.

Future work

Detailed petrological and mineralogical study of rocks will be used to improve understanding and importance of the different mineralisation processes involved in the NPO e.g. Limestone diagenesis.

Fluid inclusions from a range of diagenetic, gangue and ore minerals will be studied to determine fluid evolution, timing and the temperature of the mineralising fluids. This will help to clarify relationships between Fe-metasomatism and ore mineralisation.

New geological data from surface mapping will be used to produce a comprehensive map of vein and flat occurrences. This will be integrated with existing data to highlight areas of potential for flat-style mineralisation.

Reference

Dunham, K. C. (1990) Geology of the Northern Pennine Orefield. Volume 1:Tyne to Stainmore. Economic Memoir Covering the Areas of 1:50,000 and One-inch Geological Sheets 19 and 25 and Parts of 13, 24, 26, 31, 32 (England and Wales). British Geological Survey: HMSO, London

Background picture: View south from Scordale Mine