The Legacy of Mining at Alderley Edge

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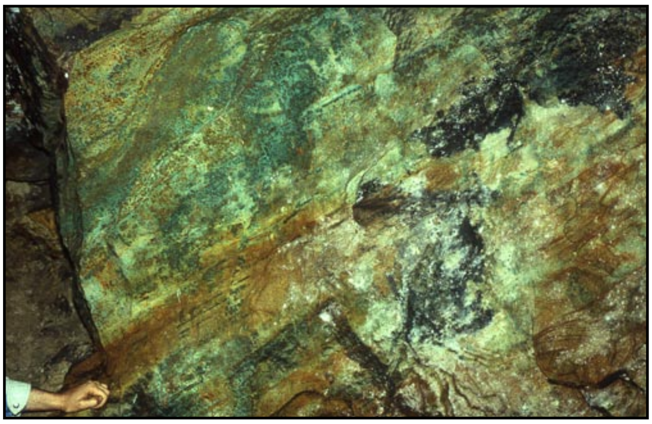
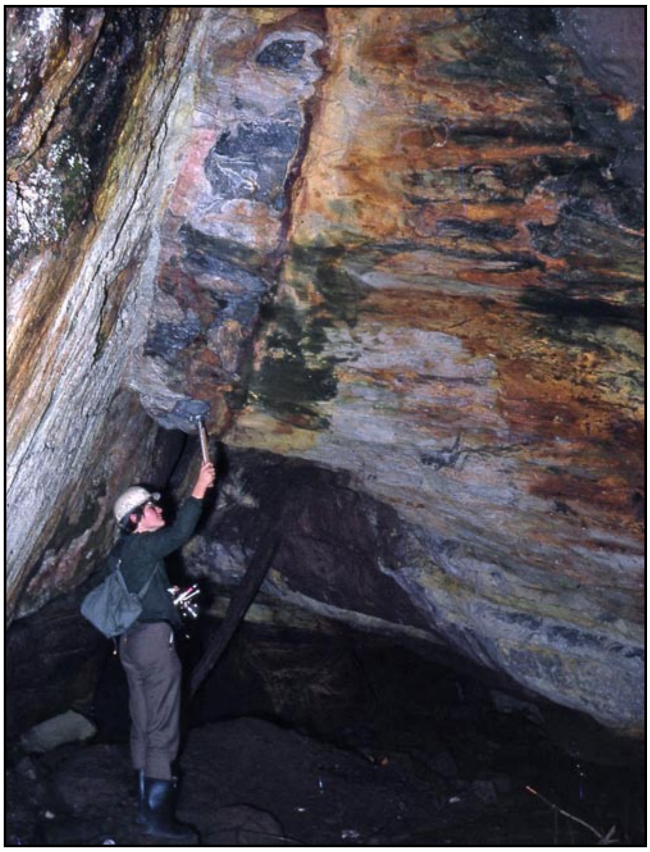
The Cheshire Basin is an asymmetric, north-south-trending, post-Variscan graben structure that accommodates a thick succession of Permian, Triassic and lower Jurassic sediments. The Triassic sequence includes arenaceous formations of the Sherwood Sandstone Group, overlain by argillaceous and evaporitic units of the Mercia Mudstone Group. Barite mineralization and, at scattered localities, small metallic ore deposits, principally of copper, but including lead and smaller amounts of cobalt, manganese, nickel, vanadium, zinc and other elements, occur in the sandstone. The main site where these ores were mined is Alderley Edge, in the northeast of the basin, 15 km south of Manchester (Warrington, 1965, 2010).

The Alderley ore deposits were originally considered to be syngenetic but have, for the last 50 years, been regarded as epigenetic. Alderley Edge is a 3km-wide horst that lies between major N-S-trending faults. Formations of the Sherwood Sandstone are now exposed in the horst but were formerly covered by a seal of Mercia Mudstone and the structure was, therefore, a potential trap for migrating fluids. In lectures in Manchester in 1977 the writer proposed that the mineralizing fluids were low-temperature, intrastratal basinal brines that migrated into this trap where the ores were deposited under reducing conditions, possibly created by hydrocarbons that accumulated in the same structure (Warrington, 1980). This basic model has since been substantiated and refined by others. The primary mineralization is now considered to have occurred in late Triassic to early Jurassic times, as part of the diagenesis of the host-rocks (Plant *et al.*, 1999). Extensive alteration occurred in the Cenozoic, and over sixty mineral species, mostly secondary, have been recorded from the locality (Braithwaite, 1994; Warrington, 2010).

The sandstone sequence exposed at Alderley Edge comprises the Wilmslow Sandstone and overlying Helsby Sandstone formations. These dip SW at 10-15º and successively higher units in the Helsby Sandstone crop out across the horst. Metallic ores occur almost exclusively in the c.100m-thick Helsby Sandstone that includes members of both fluvial and aeolian origin and is succeeded by the lowest (Tarporley Siltstone) formation of the Mercia Mudstone.



Disseminated copper ore (malachite and other secondary minerals) in aeolian sandstone in West Mine.



Fault zone with associated barite (pink) and massive galena (grey) in the Engine Vein mine; a stoped-out area extends into sandstones in the footwall to the right.

Over 15 km of disused mine workings at this site afford a unique opportunity for the study of the mineralization and sedimentary features in the red-bed host rocks in an unweathered state and in 3D. The mine workings comprise three units that, from east to west, give access to three successively higher ore-bearing levels in the succession, and to host rocks and structural situations of different character at each level. In the east, in the Stormy Point and Engine Vein mines, mineralization occurs in the topmost Wilmslow Sandstone and the basal Helsby Sandstone; fluids were trapped in footwall sandstones adjacent to faults, and below mudstone beds that form aquicludes in the Helsby Sandstone. The ore bodies here were narrow, linear, and strongly fault-controlled. In the central area, in a member higher in the Helsby Sandstone and seen in Wood Mine, mineralization occurs in a succession of eight or nine fining-upward, fluvial sedimentary cycles. Mudstone beds in these cycles, and others containing debris from the erosion of such beds, formed complete and partial aquicludes respectively, and resulted in irregular and discontinuous, but more extensive, ore bodies. Farther west, in West Mine, an aeolian sandstone higher in the Helsby Sandstone contained very large,

Part of a stope in West Mine left after the extraction of a large body of copper ore hosted by aeolian sandstone.

more continuous, ore bodies, reflecting the relatively homogeneous nature of the host rock at that level.

The open stopes left by mining reflect the size, form and disposition of the ore bodies and offer a unique opportunity to observe the influence of structure and host-rock facies on the migration of the mineralizing fluids. They can, by analogy, aid visualization of the influence of those factors on the migration of other fluids, such as hydrocarbons, and afford the opportunity to 'step inside a reservoir'.

References

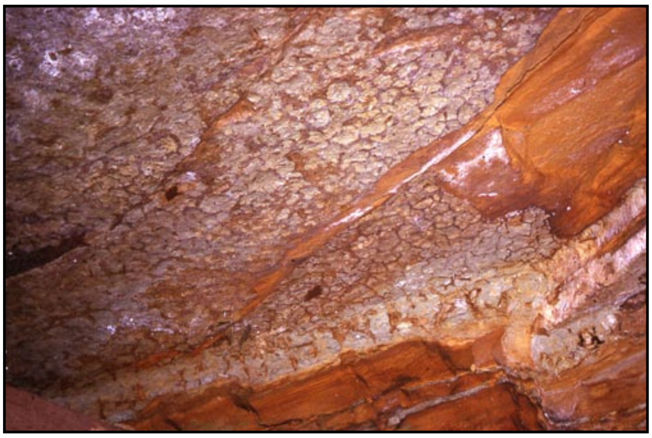
Braithwaite, R.S.W., 1994. Mineralogy of the Alderley Edge – Mottram St Andrew area, Cheshire. *J. Russell Soc.*, **5**, 91-102.

Plant, J.A., Jones, D.G. & Haslam, H.W., (eds)., 1999. *The Cheshire Basin; basin evolution, fluid movement and mineral resources in a Permo-Triassic rift setting*. British Geological Survey.

Warrington, G., 1965. The metalliferous mining district of Alderley Edge, Cheshire. *Merc. Geol.*, **1**, 111-129.

Warrington, G., 1980. The Alderley Edge mining district. *Amateur Geol.*, **8**, 4-13.

Warrington, G., 2010. Alderley Edge district, Cheshire. 182-190 in Bevins, R.E. *et al.*. (eds), *Mineralization of England and Wales*. Geological Conservation Review Series **36**. Peterborough: Joint Nature Conservation Committee.



Mudstone bed with mudcracks seen in section and from the underside, in the roof of a stope in the Engine Vein mine.

REVIEW

Scottish Agates by Nick Crawford and David Anderson, 2010. Lapidary Stone Publications, 978-0-9558106-1-9, 208 pages, 800 colour illustrations, £14.99.

This splendid book is accurately summarised by the back cover description: 'Scottish Agates provides a comprehensive account of the agates of Scotland including more than 800 full colour images, an in-depth exploration of where these beautiful stones can be found, a description of techniques for their preparation with information on their history and use in jewellery'

Scottish agates are generally restricted to areas underlain by basaltic lava flows, especially in the Midland Valley. The book is written by two enthusiastic collectors and is illustrated by the hundreds of excellent colour images of sawn and polished specimens, together with numerous locality photographs and small-scale colour maps of the six main areas where they may be found. The first 7 pages describe the geology of Scotland followed by a somewhat unnecessary (though interesting) 16-page summary of Earth's history, with world maps of continental reconstructions, followed by 12 pages of how Scottish agates are formed. The bulk of the book contains details of the sources (quarries, streams and fields) of the agates found in each of the principal areas, illustrated with dozens of images of specimens and landscape photographs for each area.

The book is completed by brief descriptions of collecting, cutting, polishing and imaging techniques, Scottish agate jewellery and artefacts, collectors and their specimens and a comprehensive bibliography and useful index

If there is any criticism it would be that there are too many images of the agates: to cram them all in they are mainly necessarily small (5x4cm). A reduced number of larger images of the most important specimens would be an improvement; the larger half-page images scattered through the book attest to this. Excellent landscape photographs of agate-bearing areas are also too small and could usefully be enlarged. There are no Grid References to quarries or other localities. This may be deliberate, to discourage casual collection, and is difficult where areas or lengths of rivers are involved.

This book is certainly comprehensive in its coverage of the subject and is abundantly illustrated with high-quality photographs. The heavy-weight paper feels good and helps the quality of the photographs and illustrations. It can be recommended as an excellent technical and visual source of information on this somewhat esoteric subject.

Tim Colman