A VISIT TO THE FORMER COPPER - LEAD - COBALT WORKINGS AT ALDERLEY EDGE, CHESHIRE (INCLUDING A VISIT UNDERGROUND TO THE WEST MINE) BY THE NORTH STAFFS GROUP OF THE GEOLOGISTS' ASSOCIATION OF LONDON, WEDNESDAY 26TH JUNE 1991, 5.30 - 10.00 PM.

The visit will benefit immeasurably from the knowledge of mining and underground expertise of Stephen Mills of the Derbyshire Caving Club (DCC) to whom the leader and NSGGA offers its profound thanks.

Introduction

The purposes of the trip are:

1. To introduce NSGGA members to a geological and mining environment which has much to offer visitors in terms of understanding the general geology of the area, the controls and possible origins of mineralisation, the history of mining and the applications of science.

2. To discuss problems of access and conservation, for this mine has been the subject of a very heated controversy and a protracted public enquiry; the owner wishing to open the mine in a limited way to the general public to promote research on the origins of the mine and its geology; the local houseowners vehemently averse to a major tourist attraction being set up in a 'stockbroker' belt.

A general introduction to the Alderley Edge area (Fig.1), its geological succession (Fig.2), structure (Fig.3), mineralisation (Figs. 3, 4, 9) and mining history will be found in the accompanying diagrams which detail the outcrops, localities and discussion points which will be encountered on the excursion.

The Route

Start at the National Trust Car park immediately east of the Wizard Restaurant (SJ860772) marked A on Fig.7.

The first, overland, part of the excursion is designed to introduce visitors to the geological succession of the Wilmslow Sandstone Formation (WSF) and the Helsby Sandstone Formation (HSF) (see Thompson 1970a) both lower Triassic, Scythian in age, c. 240 million years old on the Harland time-scale (1982).

1. Visit the Information Centre and the small Museum of the Derbyshire Caving Club (marked B on Fig.7), adjacent to the Wizard Restaurant, which both display fine hand specimens of variedly mineralised sandstones, archaeological items (e.g. stone hammers) and mining artefacts which are unlikely to be found on a single visit such as this.

2. Walk northeastwards along the lane past the National Trust warden's house, Forester's Lodge, past mine spoil in Thieves Hollow (which has recently been excavated from Engine Vein Mine and dumped by members of the DCC) until Engine Vein SJ860775 is reached (Figs 6,7,10) (marked C on Fig.7).

Establish the succession; WSF, fine to medium-grained reddish mottled sandstones (aeolian and fluvial) are overlain by pebbly sandstones and conglomerates of the type area of the Engine Vein Conglomerate Member (EVCM) of the HSF which is c. 15m (50ft) thick hereabouts (Thompson 1970 a,c). The latter beds are interpreted as a low-sinuosity, somewhat emphemeral, river deposit (Thompson 1970 b). The overlying Hayman's Farm Member (HFM) 14m (44ft) thick consists of interbedded sandstones and mudstones with the former frequently injecting the latter especially in the type locality of the Hayman's Farm borehole, SJ857763. The mudstones have yielded spores of late Scythian age (Warrington 1967) and continental waterfleas, i.e. branchiopods, of Euestheria type (Warrington 1963). The HFM is interpreted as an abandoned channel and/or riverplain overbank area wherein discharges varied from low (mudstones) to very-high (sandstones injecting mudstones). Observe a single orangey sandstone unit, possibly a migrating aeolian dune, and the irregularly-curved, slickensided, mineralised, normal, i.e. tensional, Engine Vein fault zone aligned WNW-ESE, with a c. 7m (23ft) throw to the north (Figs. 10, 11).

This is the site of the former Engine Vein Mine, which may be visited underground by prior arrangement with the DCC. Investigate evidence of human habitation and mining which occurs on the surface: the sites of former stone pits where stone hammers of ? Bronze Age type have been found (see Gale 1989); the sites of deep shafts (now capped by the DCC) at the east and west ends, the latter connecting with the Hough level - the long tunnel which runs under the Edge from northeast to southwest and connects many of the mines (Fig.6); the former 'opencast'area of the mine. Imagine the headgear of the mine in its hey-day; where would the engine be sited? Consult the diagram of the section of the mine (Fig. 10) and observe the relationships of the succession, the lithofacies and palaeoenvironments, the structure, the porosity - permeability characteristics, and the distribution of ore and gangue minerals in relation to potential trap structures - the WSF and EVCM hosting the ores, local mudstone bands and the HFM generally, providing the local impervious upward barriers (see Figs. 3,4). Fluvial palaeocurrents in the EVCM are directed to the NW over the whole of the Alderley Edge area.

3. Walk WNW along the trace of the Engine Vein fault until the path from Beacon Lodge ENE to Stormy Point is reached (SJ858775), marked D on Fig 7. The fault is here mineralised only by baritic veins which cross the path but the remains of a mineral trial adit can just be seen extending towards the northeast. These red-orangey sandstones, c. 12m (40ft) thick, overlie the EVCM and HFM, are fluvial and aeolian and belong to the Beacon Lodge Sandstone Member (BLSM) of the HSF.

4. Track southwards through the wood and locate a capped shaft beside the path at the back of the Wizard Restaurant, at SJ859774, marked E on Fig.7. This lies along a hitherto unsuspected north-south double normal fault zone which throws the BLSM, interbedded red sandstones and thin mudstones, on the east, against the lowest fluvial cycles of the Wood Mine Pebbly Sandstone Member (WMPSM) of the HSF on the west. The Wizard's (Restaurant) Well was first descended by Stan Gee and Stephen Mills of DCC in August 1977, but deep water was met at c.15m depth. Nevertheless 20 metres of workings of a mine were explored. The present entrance shaft was discovered by dowsing by Stephen Mills in 1984 (Johnson 1984), briefly explored and, by brilliant deduction and insight, related to the Cobalt Mine, which existed first between 1807 and 1811 and then perhaps extended to 1820. This mine was described by Robert Bakewell (1811, 1813). It is now known as the Wizard's (Restaurant) Well Cobalt Mine. It probably extends as far as the Engine Vein fault on the north but is certainly present under the entrance to the National Trust Car Park and has been explored southward through Finlow Hill Wood - a total of 0.8km of working. It was first worked by a Mr. Plowes of Pontefract till 1810, and later by the Stockport Company of Ashton, Bury, Dodge, Horne, Stackhouse and Dr. Jarrold, a group of Derbyshire miners, after that time.

5. Walk into Church Quarry (SJ858774) marked F on Fig.7 and observe several cycles of pebbly sandstones of the WMPSM, the blind adit in the northwest corner, and the eastern face, from which an adit marked on the 1:2500 Ordanance Survey Map of 1872 once went eastwards into the Wizard's Well Cobalt Mine. Check that the dip of the strata hereabouts is still to the southwest. This quarry was the home of Evans the Hermit, the man who is reputed to have known most about the Alderley Mines, especially the underground parts. In the WMPSM of the Haymans Farm Borehole, an interbedded sandstone and mudstone unit at 391ft yielded footprint tracks of Rhynchosauroides rectipes (Beasley MS in Maidwell 1914, p. 143); (see Thompson 1966, pp. 185-193) - the small lizard-like reptile.

6. Return to the B5087 road, noting the Surgery across the road (marked G on Fig.7), the headquarters of the Derbyshire Caving Club on the Edge. Walk northwards before crossing the road and turning into Windmill Wood at a stile. Carry on forwards to the west and realise that one is crossing cycle after cycle, 10 in all, of the WMPSM, each of which is greatly mineralised with Cu, Pb and Co in Wood Mine, which lies directly beneath your feet. Locate the metal capped shaft of Wood Mine Entrance. This mine (see Fig.6) may be visited underground if prior arrangement is made with DCC.

Many shaft heads may be located by their tell-tale piles of mine spoil, now vegetated, degraded and subdued. Its northern boundary fault, particularly rich in galena, is the continuation of the Engine Vein Fault; its southern boundary fault, parallel but 0.5km to the south, can be located just south of the Brynlow Valley at SJ856773. A description of Wood Mine will be found in Carlon (1979, pp. 82-90).

7. Walk westwards from Wood Mine entrance (H on Fig.7) to see the drainage sough, now filled with 2m depth of peat, and look westwards to overlook the flat ground upon which the mine spoil, the ore treatment plant, the processing works and the offices of the Alderley Edge Mining Company were once sited. A good imagination will be needed to reconstruct the activities of this area in 1872 (see Fig.12) and to look WNW and see in the mind's eye the awesome gash in the surface of the earth which once marked the 100m - long, 30m - wide, 20 metre - deep, opencast approach to the famous West Mine. The bare ground to the south is where the treated, spent sand, still rich in arsenic, was stockpiled. It has gradually been sold off or taken away often by gardeners wishing to clear weeds from their paths. Some went to floor the runway extension at Ringway Airport in the 1970.

8. The visit underground to West Mine, via its metal capped entrance shaft (SJ851776), is by kind permission of the owner of the land, Paul Sorenson, and through the agency of the Derbyshire Caving Club which is represented by one of its senior members, Stephen Mills. Costs relating to insurance, the hiring of hard hats and the servicing of lamps are inevitable should you wish to undertake this trip with a school party.

The strata formerly exposed in the opencast, but now only seen underground, are of the West Mine Sandstone Member (WMSM) of the HSF. The beds are likely to correlate across the country with the Weir Sandstones at Styal and generally with the aeolian Frodsham Soft Sandstone Member of the HSF (Thompson 1970 a,b). In a total thickness of 18m (60ft), there is a simple stratgraphy: three large cosets of cross-bedded sandstones (Bottom, Middle and Upper Beds, 6m, 3m and 3m thick, respectively) are likely to be aeolian, and are interbedded with flat- bedded, interbedded fine sandstones, sandy siltstones and mudstones bearing mica, aqueous, current ripple marks, mud drapes, mudstone lenses, mudcurls and dessication cracks, and therefore likely to be interdune, river floodplain deposits. A single specimen of the plant fossil Equisetales is to be seen in the southwest part of the mine where the flat-bedded sandstones may also display high-index, very-low amplitude, aeolian ripple marks.

Descriptions of West Mine are to be found in Dewey and Eastwood (1925), from which the plan of the mine is taken (Fig. 13), Carlon (1979, pp. 55-82) and Warrington (1980) best chronicle the formation and development of the Alderley Edge Mining Company Limited (AEMCL) under James Michell (from 1857 to 1862, but extending to 1877 under other managers), William Henderson (Company Analyst and Chemist) and Francis Phillips (underground "captain" of the mines). Dr. H. G. Harwood (personal communication 1970) reported that Henry (later Professor Sir Henry) Roscoe worked on highly vanadiferous sandstones from here (1868, 1869, 1875).

Amongst the features to be seen in West Mine are the following:

geology: dip to southwest: north-south faults; one through Whitebarn Farm (with a 18m (60ft) throw to the east), another cited as the Chain Shaft Fault, another known as the West Mine Boundary fault with a 35m (120ft) throw to the east; finely interlaminated foresets of differing porosity-permeability characteristics which are likely to be largely ripple-drift aeolian pseudolaminae. Palaeocurrents are inferred to have flowed from ESE-WNW, a direction typical of sub-tropical (20°) palaeolatitudes and Triassic trade winds c. 240 million years ago. Mica-rich horizons are found in the bottomsets of the fluvial crossbeds and in the interbedded low-energy, flat-bedded, cross-laminated strata of the WMPSM.

minerals: See the chart of mineral occurences recorded in the mines (Fig.9) and note the presence of Vanadium-bearing species, Cobalt workings in the Middle Chambers; azurite spheres in sandstone (rather than mudstone as at Engine Vein Mine); liesegange rings in several areas; calcite and secondary "flowstone" carbonates on the Chain Shaft Fault:

mining: north mine: south mine: lower, middle and upper passages set respectively in the productive bottom, middle and top cosets of the WMSM: a railway level forms the deepest part of the mine and traverses upslope via the opencast to the treatment works; immense stopes 25m high at maximum; largely unsupported roofs but the occasional pillar, some vandalised by explosives; coal-fired ventilation shafts; black powder (gunpowder) surface coatings to the walls (not to be confused with asbolite, the Co-Ni bearing Mn-hydroxide); shafts in abundance; artefacts (spades, bars, boots, etc); ore collection shoots in the floors of a stope; spent, processed, sand backfilled into passages underground, still weakly acidic with HCl.

ecology: a dark-purple fungus ecosystem, with 22 species, some only found here and in the Bahamas (personal communication to S. Mills 1977 by Professor Beck, Manchester University).

9. Return, if time permits, to see the West Mine Sandstones outcropping in the Brynlow Valley (see Johnson 1984) above the Brynlow Mines, centered on SJ856772. Locate the southern boundary fault of Wood Mine by a series of shafts and former opencast pits as one walks to the Southeast.

10. Walk on to Artists' Lane to see the top of the WMSM (aeolian) and its contact with the overlying Nether Alderley Sandstone Member of the HSF (Thompson 1970b), beginning with the Brynlow Pebbly Sandstone Bed, a fluvial cycle of c. 3m thickness.

11. Return via Artists' Lane to the National Trust Car Park, passing the Surgery and the Wizard Restaurant and walking over the former workings of the Wizard's (Restaurant) Well Cobalt Mine.

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D.B. Thompson, Department of Education, University of Keele, Staffs ST5 5BG.

C. **References**

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D. Figures

A list of figures appropriate to this excursion will be found appended to the previous article in this volume of the journal. Should members have difficulty locating these sources they should write to the author enclosing an A4 stamped addressed envelope for 30p.

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D.B.Thompson, Department of Education, University of Keele, Staffs, ST5 5BG.

NSGGA EXCURSION TO ALDERLEY EDGE 26th JUNE 1991

DIAGRAMS TO ACCOMPANY THE FIELD EXCURSION TO ALDERLEY EDGE, NORTHEAST CHESHIRE.

- ARCHAEOLOGY
- CHEMISTRY OF MINERAL PROCESSING
- CONSERVATION
- ECOLOGY
- GEOLOGY
- HISTORY OF MINING
- LAW
- LITERATURE
- TECHNOLOGY
- WATER SUPPLY
- PROBLEM RECOGNITION & SOLVING
- SCIENTIFIC METHODOLOGY

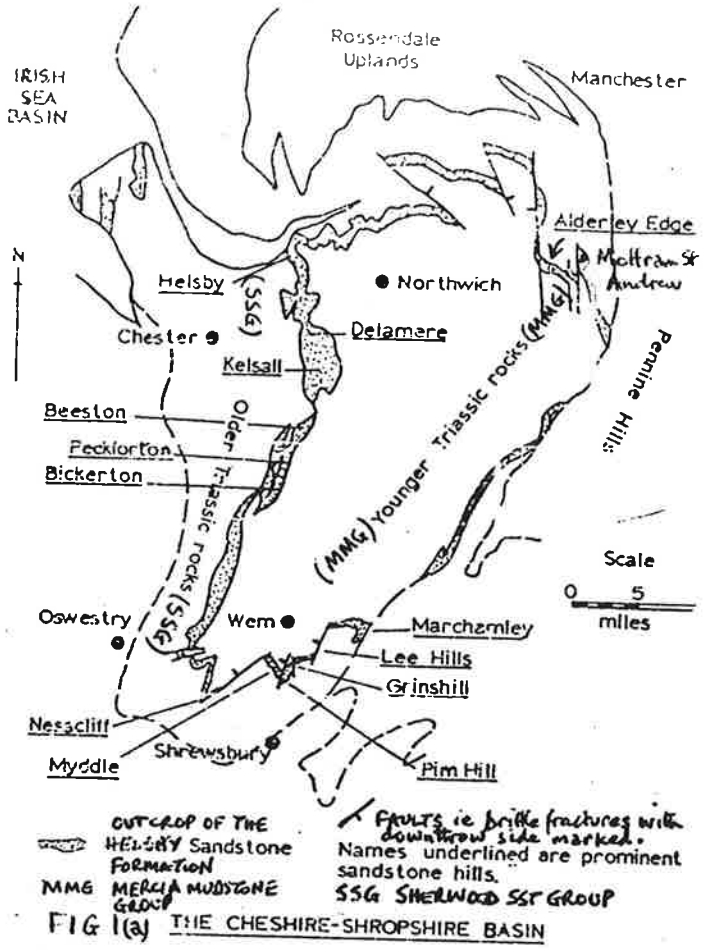


FIG 1(a) THE CHESHIRE-SHROPSHIRE BASIN

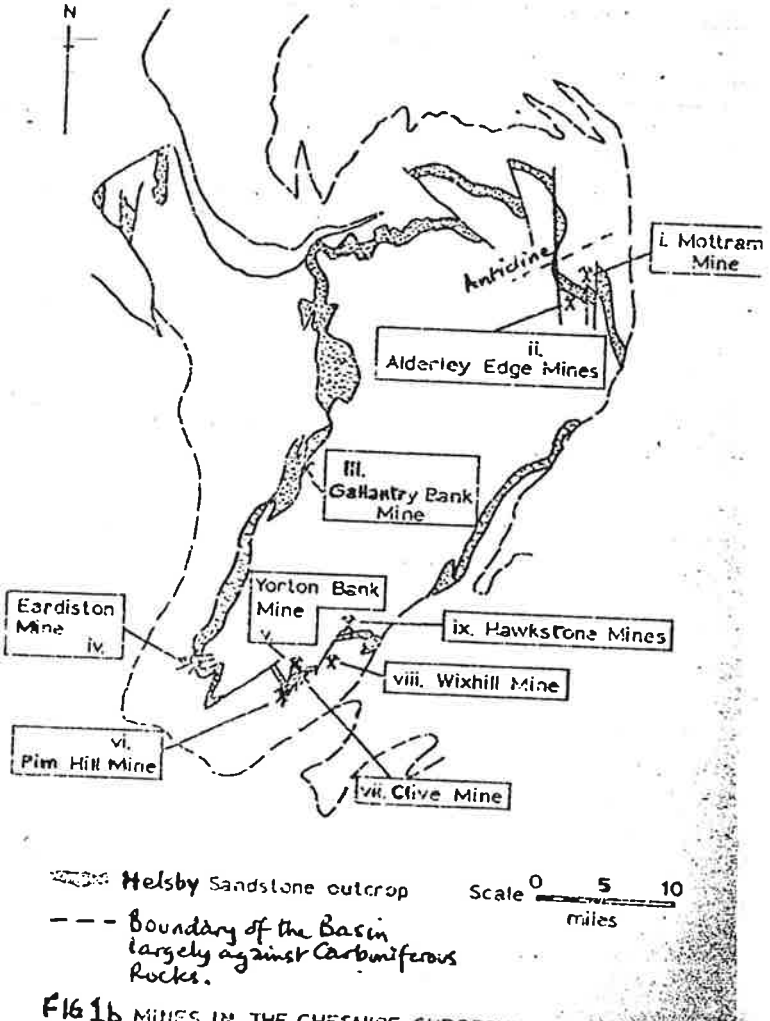


FIG 1b MINES IN THE CHESHIRE-SHROPSHIRE BASIN

FIG 2A THE STRATIGRAPHIC NOMENCLATURE OF THE CHESHIRE BASIN BASED ON WARRINGTON & THOMPSON (1970) WARRINGTON et al (1980); THOMPSON (1970a).

	Stage	Group	Former nomenclature 1860 – 1980		Formations and members with thicknesses & abbreviations used in the text: Cheshire Basin generally	Alderley – Styal area	Sedimentology and palaeoenvironment
JURASSIC					LOWER & MIDDLE LIASSIC-Jur. c.600 m		
TRIASSIC	Rhaetian	Penarth	RHAETIC BEDS				Shallow marine
	LADINIAN NORIAN ANISIAN CARNIAN	MERCIA MUDST. GROUP MMG	UPPER KEUPER MARL	KEUPER	UNNAMED MUDSTONE FM c.300 m	Eroded	Shallow marine, evaporitic in part
			UPPER KEUPER Saliferous Beds		WILKESLEY HALITE FM c.400 m		Hypersaline, lagoonal, Sabka, continental
			MIDDLE KEUPER MARL		UNNAMED MUDSTONE FM c.400 m		Salinas with marine feed
			LOWER KEUPER Saliferous Beds		NORTHWICH HALITE FM c.300 m	? Solution breccia	Hypersaline, lagoonal, continental
			LOWER KEUPER MARL		UNNAMED MUDSTONE FM c.300 m	UNNAMED MUDSTONE FM	Salinas with marine feed
			WATERSTONES		TARPORLEY SILTSTONE FM, TSF c.120 m	TARPORLEY SILTSTONE FM, TSF c.120 m	Hypersaline, lagoonal, continental
	SCYTHIAN	THE SHER-WOOD SAND-STONE GROUP	LOWER KEUPER SANDSTONE		HELSBY SANDSTONE FM, HSF 100 – 150 m Frodsham Soft Sst. Mbr FSSM c. 30 m Delamere Pebbly Sandstone Member, DPSM c. 30 m Thurstaston Soft Sst. Mbr, TSSM c. 30 m with Thurstaston Hard Sst at base c. 3 m	HELSBY SANDSTONE FM HSF c. 132 m Nether Alderley Sst. Mbr NASM c. 38 m with Brynlow Conglom. at base c. 3 m West Mine Sandstone Mbr, WMSM c. 17 m Wood Mine Conglom. Mbr. WMCM c 40 m Beacon Lodge Sst. Mbr. 12 m Engine Vein Conglom. Mbr, EVCM 30 m	Fluvial, moderate sinuosity Aeolian dominates fluvial Fluvial, low sinuosity Aeolian dominates fluvial Fluvial; low-sinuosity, ephemeral
			BUNTER UPPER MOTTLED SANDSTONE	BUNTER	WILMSLOW SST. FM WSF c.300 m	WILMSLOW SST. FM WSF c.300 m	Aeolian dominates fluvial at top Aeolian-fluvial Fluvial dominates aeolian at base
			BUNTER PEBBLE BEDS		CHESTER PEBBLE BED FM, CPBF c.200 m	CHESTER PEBBLE BED FM CPBF c.200 m	Fluvial, low-sinuosity, braided, very high discharges
PERMIAN Upper	ZECHSTEIN 1 & ?2		MANCHESTER MARL		MANCHESTER MARL FM in the north 0-100 m; KINNERTON AND COLLYHURST SANDSTONE FM IN THE NORTH = BRIDGNORTH SST. IN THE SOUTH c.350 m	STOCKPORT & MANCHESTER MARLS 40-100 m	Marine with dwarfed restricted fauna, salinas with marine feed, some intertidal; Aeolian inland sand
Lower			BUNTER LOWER MOTTLED SANDSTONE FM			COLLYHURST SANDSTONE FM 150-275 m	Sand-sea with dunes, draa and dry interdunes

Figure 28 Generalised stratigraphic succession and environments of deposition.
A. Possible environments. B. Lithology. C. Stratigraphic divisions, units (old terminology in brackets) D. Units in the Alderley Area

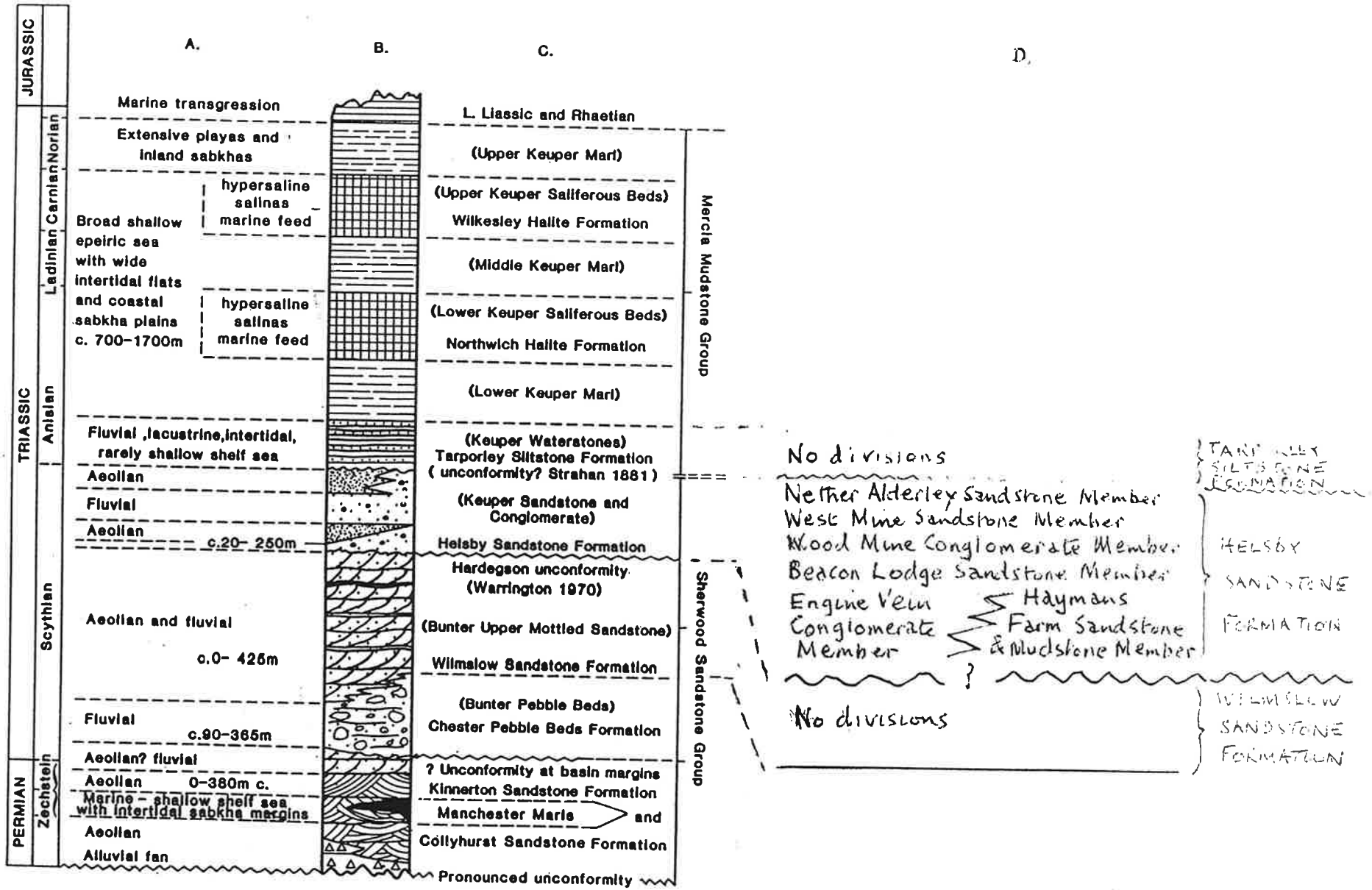
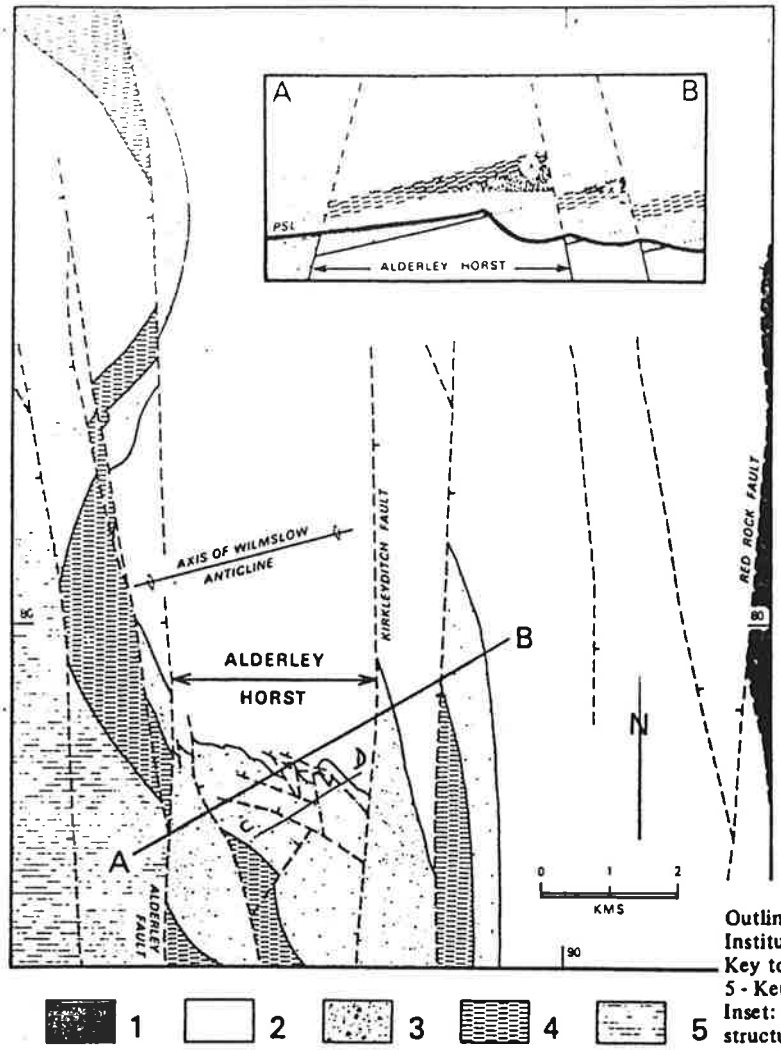
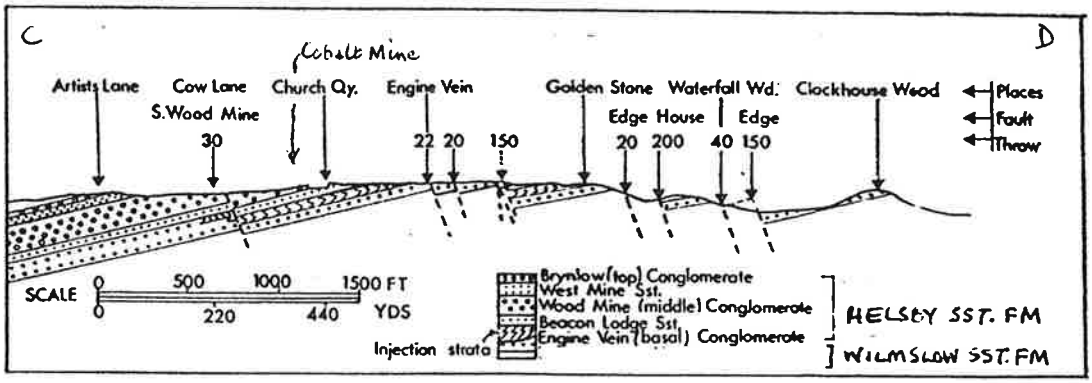


FIG. 3a



Outline structure and solid geology of the Alderley area (based, with permission, upon Institute of Geological Sciences 1:50000 Sheet 98, Stockport; 1977).
Key to ornament: 1 - Carboniferous, 2 - Bunter, 3 - Keuper Sandstone, 4-Waterstones. 5 - Keuper Marl.
Inset: schematic section, on line A - B on the geological map, showing potential structural traps for hydrocarbons and other fluids beneath a cap-rock of Keuper Marl (See appendix 1 for recent changes in the names of 2 to 5) in the Alderley horst (X) and an adjacent faulted block (x^1); PSL - present surface level (shown by thick line), all features in the section above that level have been removed by erosion and are projected from the geological map. After Warrington 1980

FIG 3b



After Thompson (1966 unpublished)

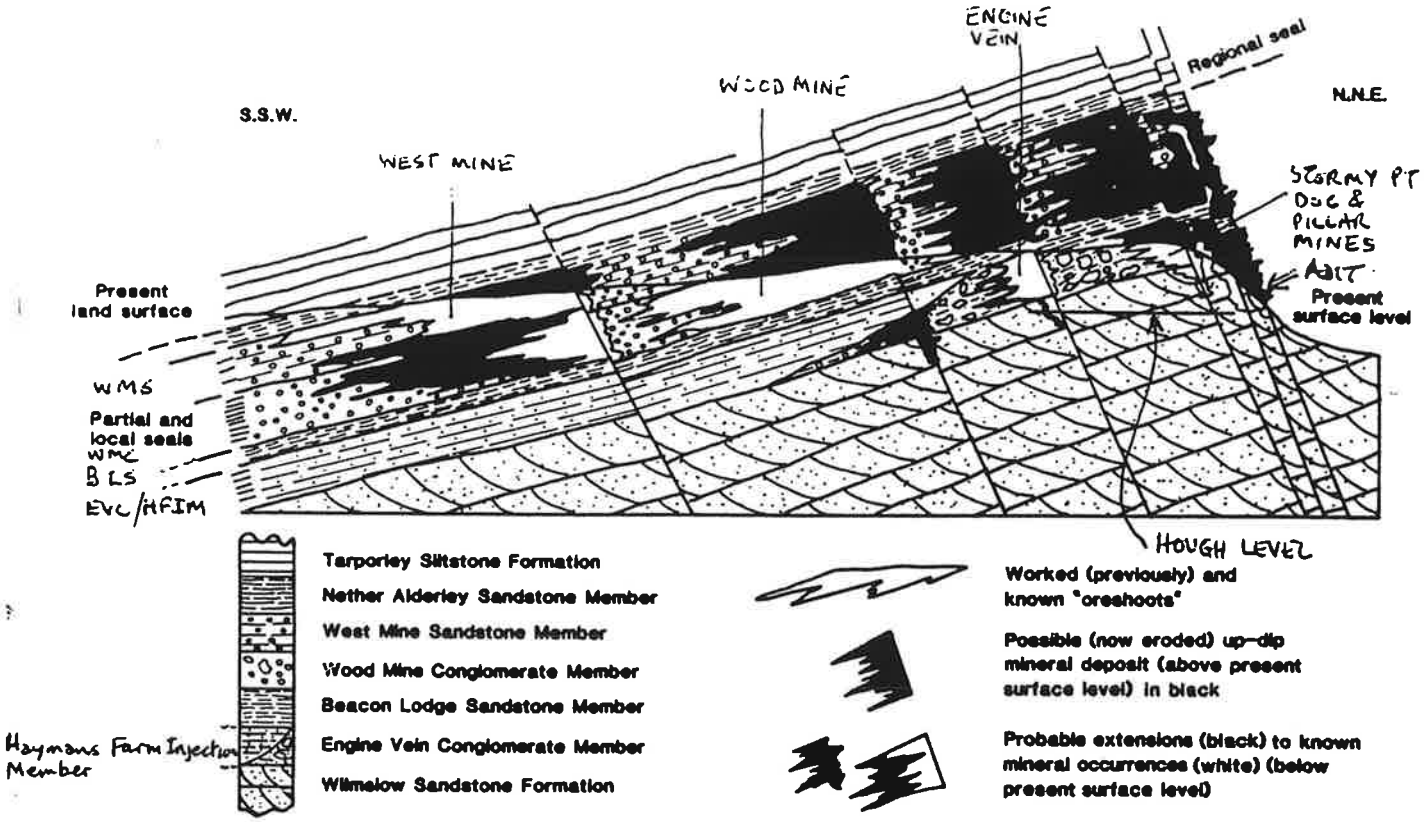


FIG 4 Diagrammatic section showing relationships between structure, stratigraphy and mineralisation in the Wilmslow and Helsby Sandstone Formations at Alderley Edge. (in part with courtesy of Dr. C.J. Carlon)

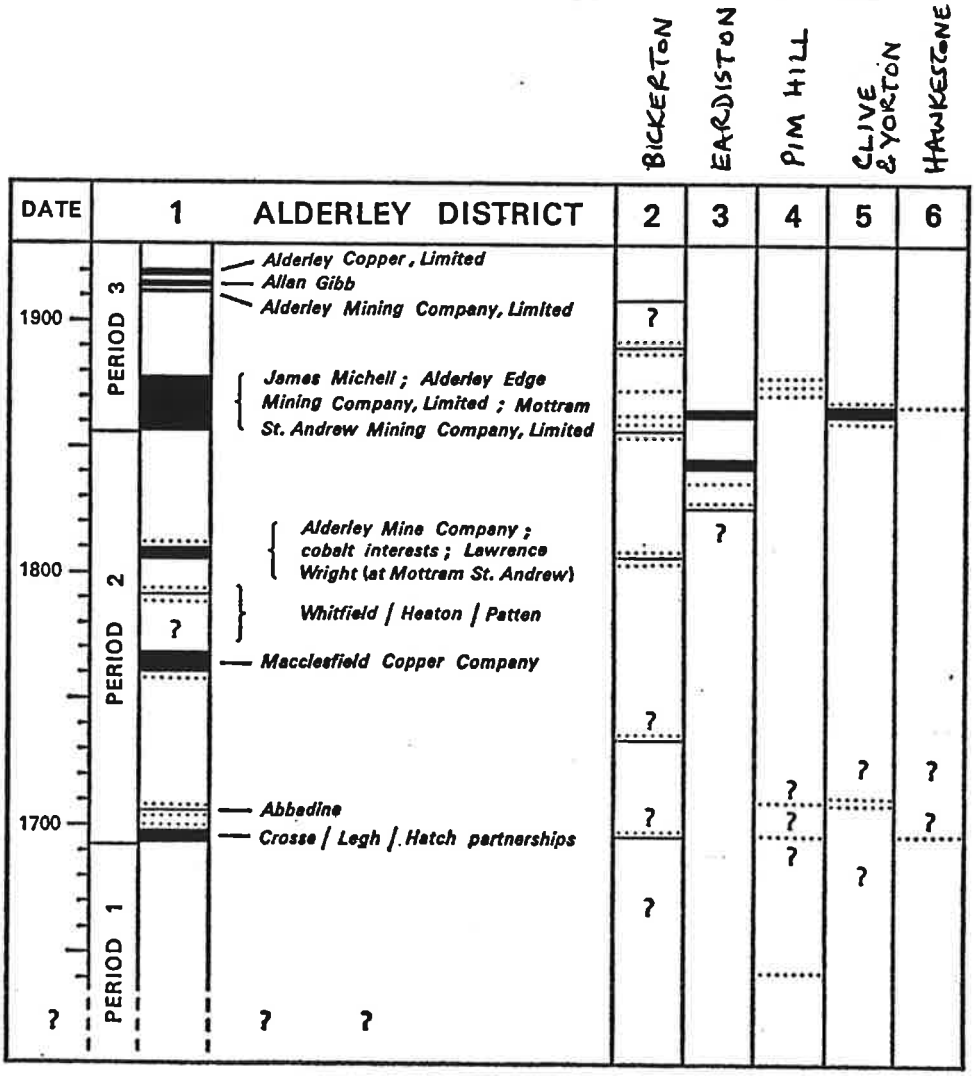


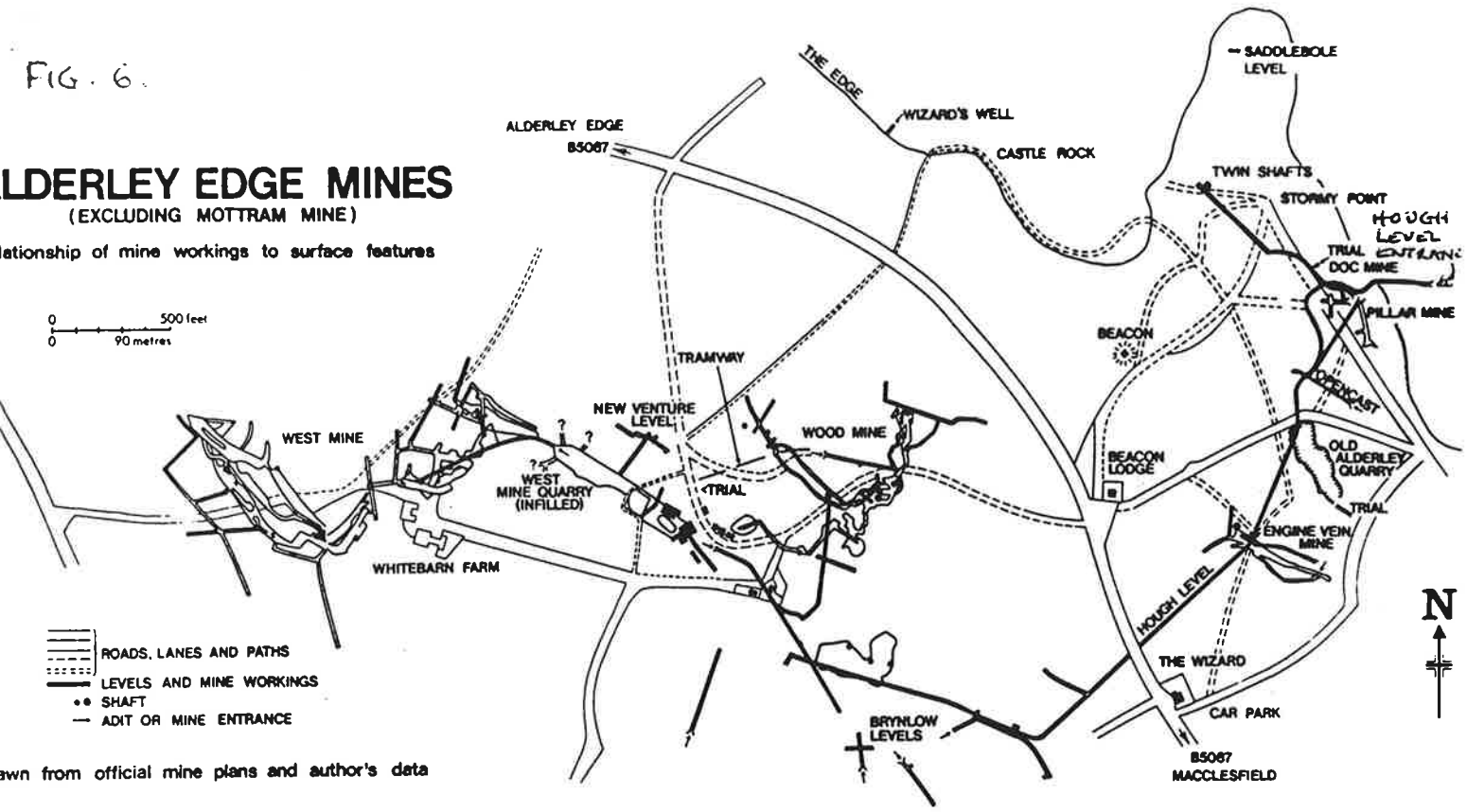
FIG. 5 – Chronology of mining activity in the Alderley district (1), with comparative summaries of activity in other non ferrous mining districts (2-6) in Cheshire and northern Salop (localities as in Figure 1). (Based upon Warrington, 1980b, Fig. 1, p. 10, and *J. Shrops. Caving Min. Club* (for 1980), 1981, p. 13)
Full black — periods of documented activity. Stipple — periods (approximate) of inadequately documented activity. ? — periods during which mining may have taken place.

FIG. 6.

LDERLEY EDGE MINES

(EXCLUDING MOTTRAM MINE)

lationship of mine workings to surface features



awn from official mine plans and author's data

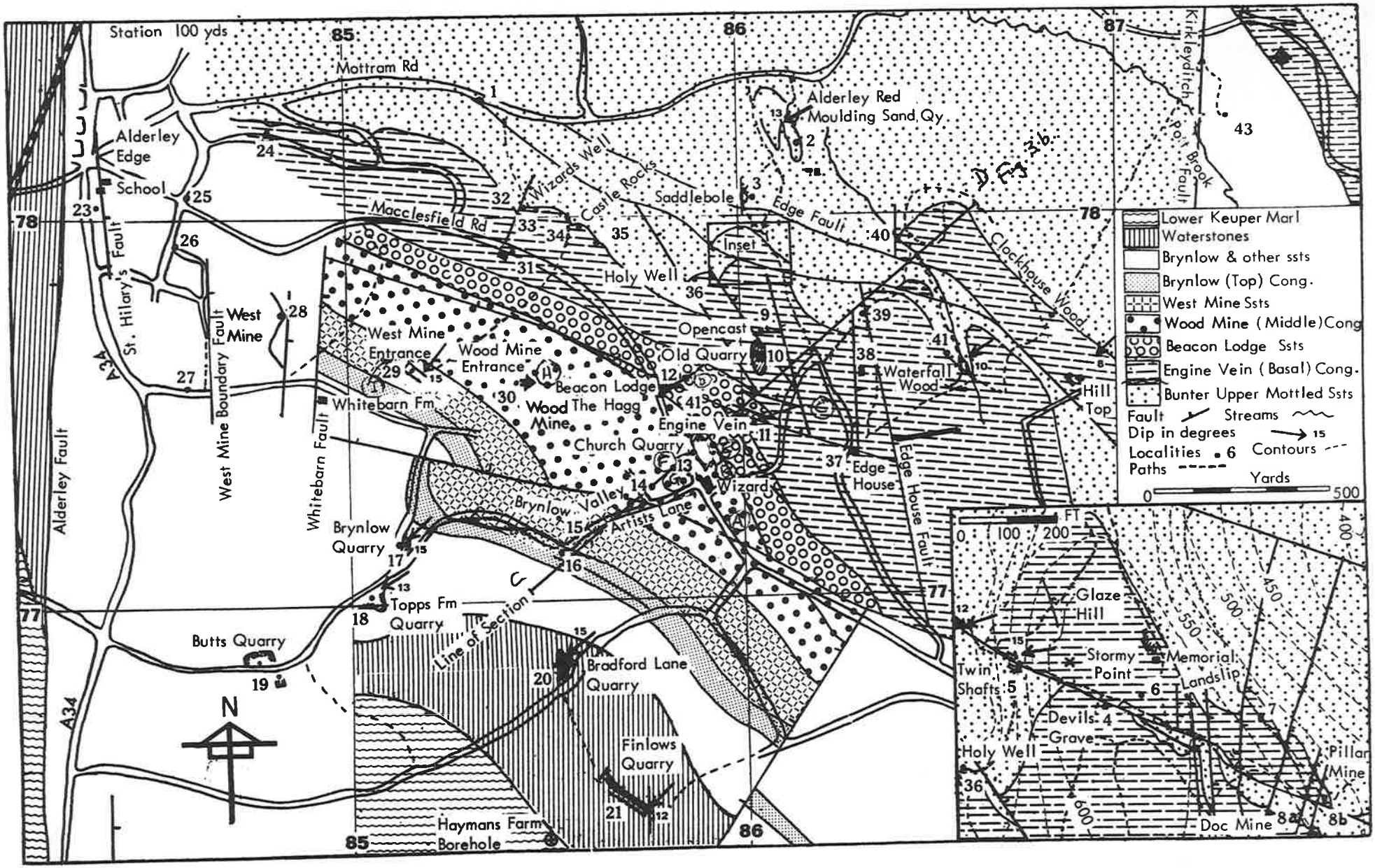
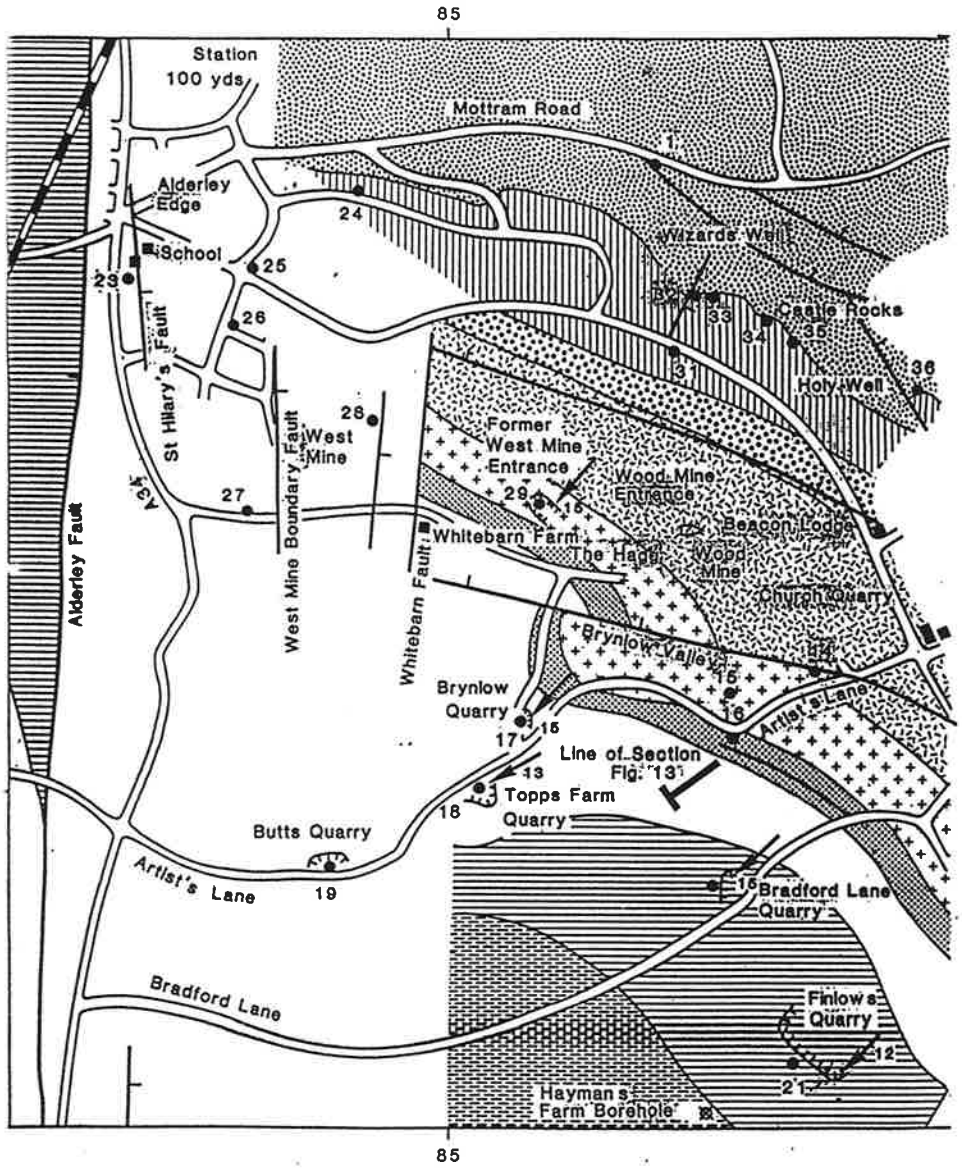
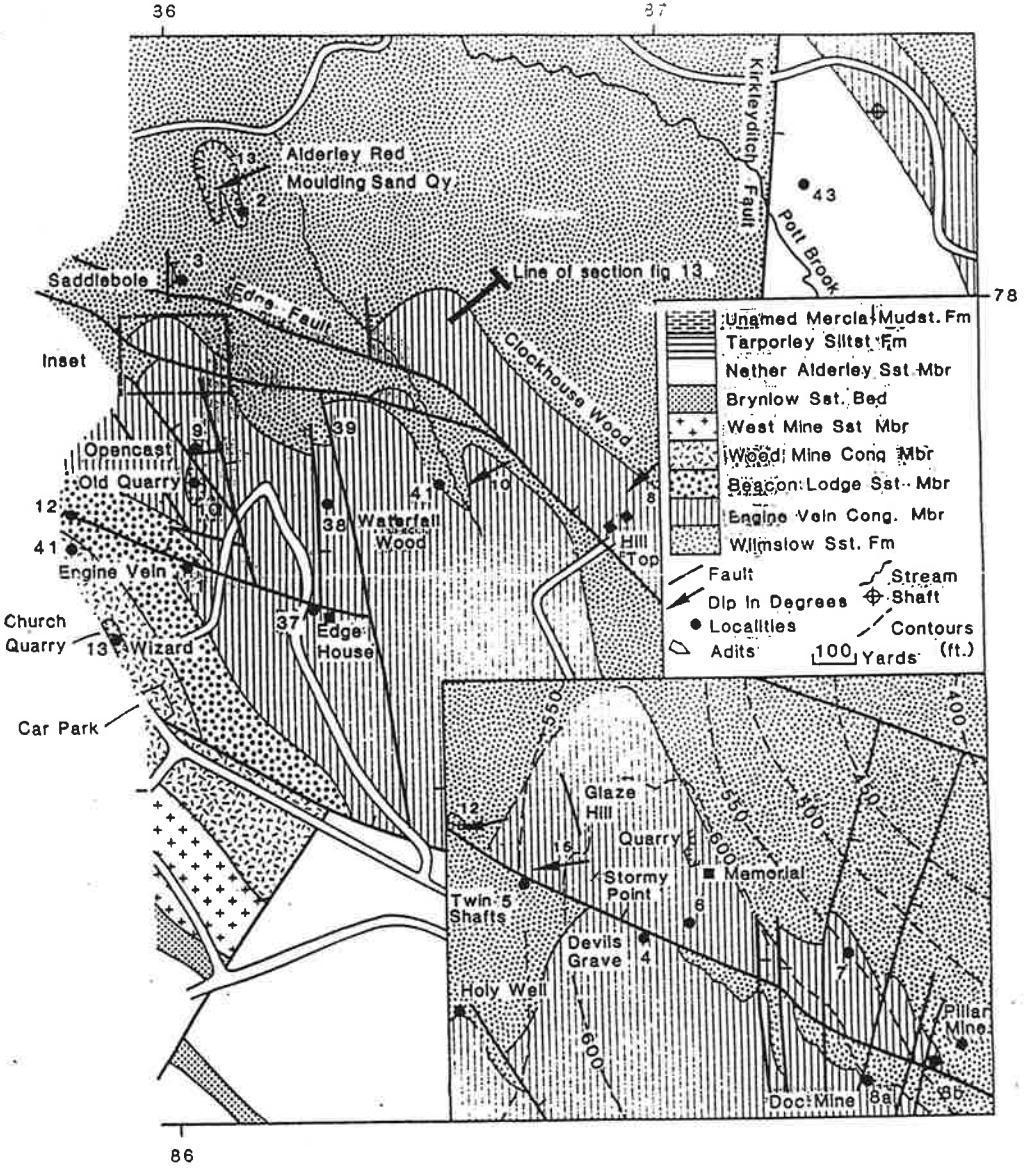


FIG. 7. A GEOLOGICAL EXCURSION MAP BASED ON THE INSTITUTE OF GEOLOGICAL SCIENCES 1:10 560 MAP (TROTTER 1963)
INSET: GEOLOGICAL MAP OF THE STORMY POINT AREA BASED ON THE AUTHORS OWN MAP AT 1:2500 (1966)
LOCATIONS (A) — (I) RELATE TO THE NSGGA TRIP OF 26.6.91

FIG 7 A GEOLOGICAL EXCURSION MAP BASED ON THE INSTITUTE OF GEOLOGICAL SCIENCES 1:10 560 MAP (TROTTER 1963). INSET: GEOLOGICAL MAP OF THE STORMY POINT AREA BASED ON THE AUTHOR'S OWN MAP AT 1:2500 (1966).





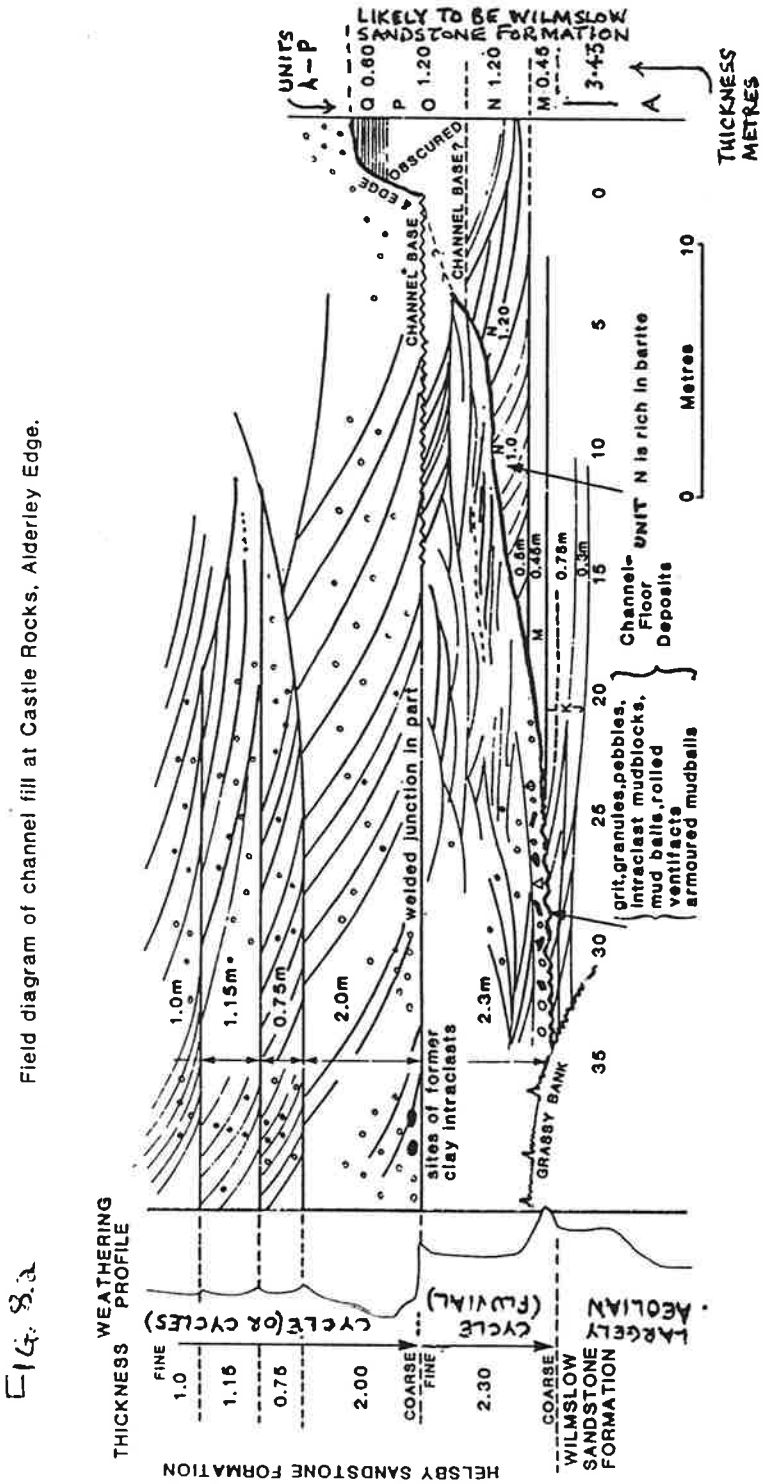
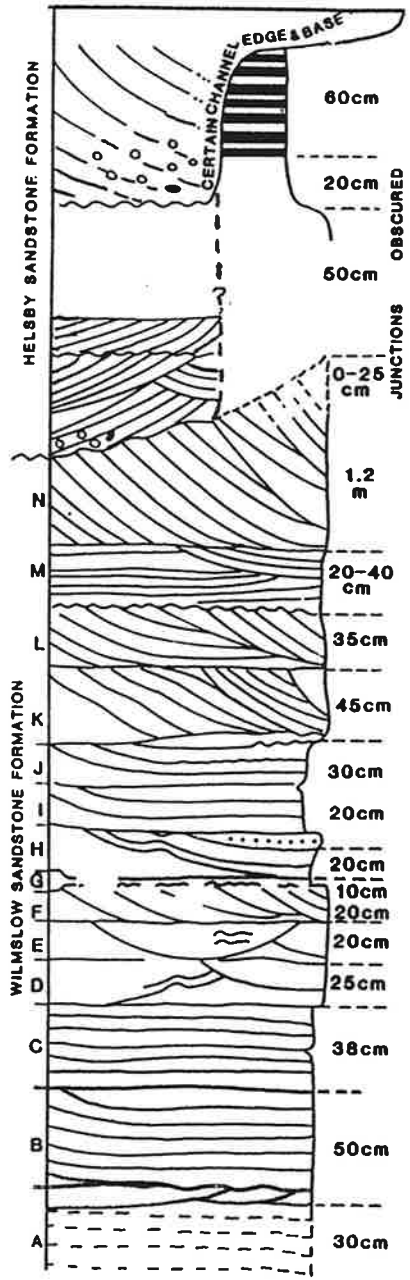


Fig 8a Field diagram of channel fill at Castle Rocks, Alderley Edge.

Fig 8b. Graphic log of Wilmslow Sandstone and Helsby Sandstone junction at Castle Rocks, Alderley Edge.



Red mudstone-shale

Mud intraclasts with pebbles in channel fill

Trough-crossbedded sandstone: clay galls

Red, mottled white, crossbedded sandstone: reactivation surfaces, heterogeneous foresets with coarser laminae in places.

Red, mottled off-white, flat-bedded sandstone

White to pink medium-grained sandstone: reactivation.

White medium-grained sandstone: reactivated.

Channel cuts down to here in east

Red, fine- to medium-grained flat- to wavy-bedded sandstones - ?bottomsets
Slightly deformed, possible sandflow unit at base

Wavy-bedded medium to fine-grained sandstone

White medium-grained cross-bedded sandstone: pink-coloured near base

Pink, flat-bedded sandstones; may be bottomsets of crossbedding

Irregular bedding or small troughs

Flat-bedded sandstone

MINERAL SPECIES REPORTED FROM ALDERLEY EDGE & MOTTRAM ST. ANDREWS MINES UP TO END OF 1987

RB = DR R.S.W. BRAITHWAITE
I&V = DR ROB IXER & PROF D. VAUGHAN
AK = ARTHUR KINGSBURY
PR = PETER ROBINSON
GH = DR G. HARWOOD
RI = DR ROB IXER
JRK = J. R. KNIGHT
N = NAYLOR et al (1989)

COPPER MINERALS Cu+

PLACES	CHALCOPYRITE	BORNITE	CHALCOCITE	COVELLITE	BLAUBLEIBENDER COVELLITE	ATURLEITE	IDAITITE	TENNANTITE	MALACHITE	AZURITE	CHRYSOCOLLA	PLANCHEITE	ENARGITE	POSNJAKITE	LIROCONITE	OLIVENITE	TYROLITE	ANTLERITE	BROCHANTITE	LANGITE	CALEDONITE	LINARITE	PISANITE	LIBETHENITE	CUPRITE	NATIVE COPPER	MOTTRAMITE	AURICHALCITE
WEST MINE	• RB								•	•	• RB						• RB											
NEW VENTURE LEVEL									•	•																		
WOOD MINE	•	? ? ? ? ? ? ? (see I&V p. 489)							•	•	•					•	• RB		• RB						?			• RB
ENGINE VEIN	•	•	•	•	•	?	•		•	•	•	• AR	•	•	?	•		• RB	• RB	• RB	?	•	•	•	• PR	• PR		
OPENCAST									•	•																		
DOC AND PILLAR MINE									•	•								• RB										
STORMY POINT	•	? ? ? ? ? ? ? (see I&V p. 489)							•	•															?			
TWIN SHAFTS																												
KIRKLEY-DITCH									•	•																	•	
UNSPECIFIED LOCALITIES							•																				•	

LEAD MINERALS Pb+

PLACES	GALENA	CERUSSITE	LEADHILLITE	ANGLESITE	MINIUM	MASSICOT	PYROMORPHITE	As-PYROMORPHITE	WULFENITE	VANADINITE
WEST MINE	•	•							• RB	• * GH
NEW VENTURE LEVEL	•	•								
WOOD MINE	•	•		? I&V			•	• RB	• RB	
ENGINE VEIN	•	•	• RB	•	•	•	•	• RB	• RB	
OPENCAST	•	•								
DOC AND PILLAR MINE	•						•			
STORMY POINT	•			? I&V						
TWIN SHAFTS	•									
KIRKLEY-DITCH	•	•					•			•
UNSPECIFIED LOCALITIES	N									? N

Zn+

PLACES	SPHALERITE	HEMIMORPHITE	SMITHSONITE
WEST MINE			
NEW VENTURE LEVEL			
WOOD MINE		• RB	? I&V
ENGINE VEIN	•	• RB	• RI
OPENCAST			
DOC AND PILLAR MINE			
STORMY POINT	•		? I&V
TWIN SHAFTS			
KIRKLEY-DITCH			
UNSPECIFIED LOCALITIES	N		

Fe+

PLACES	MARCASITE	PYRITE	BRAVOITE	(Ni-Co-Fe SULPHO-ARSENIDE)	PHARMACOSIDERITE	LIMONITE	SCORODITE
WEST MINE						•	
NEW VENTURE LEVEL						•	
WOOD MINE	•	•				•	
ENGINE VEIN	•	•	•	•	• RB	•	•
OPENCAST						•	
DOC AND PILLAR MINE						•	
STORMY POINT	•	•	•	•		•	
TWIN SHAFTS						•	
KIRKLEY-DITCH						•	
UNSPECIFIED LOCALITIES							

Ag

PLACES	ARGENTITE/ACANTHITE	NATIVE SILVER
WEST MINE		
NEW VENTURE LEVEL		
WOOD MINE	? I&V	
ENGINE VEIN	• RI	• JRK
OPENCAST		
DOC AND PILLAR MINE		
STORMY POINT	•	
TWIN SHAFTS		
KIRKLEY-DITCH		
UNSPECIFIED LOCALITIES		

Mn. Ni Co+

PLACES	WAD	ASBOLITE	ERYTHRITE	NICKEL ARSENIDES
WEST MINE	•	•		
NEW VENTURE LEVEL	•	•		
WOOD MINE	•	•	• RB	
ENGINE VEIN	•	•	•	• RI
OPENCAST	•	•		
DOC AND PILLAR MINE				
STORMY POINT				
TWIN SHAFTS				
KIRKLEY-DITCH	•	•		
UNSPECIFIED LOCALITIES				

OTHER MINERALS including GANGUE

PLACES	BARITE	WITHERITE	GYPSUM	CALCITE	JAROSITE	NATIVE SULPHUR	HYDROCARBONS
WEST MINE	•						
NEW VENTURE LEVEL	•						
WOOD MINE	•						
ENGINE VEIN	•	•	•	•	• RB	• RB	
OPENCAST	•						
DOC AND PILLAR MINE	•						
STORMY POINT	•						
TWIN SHAFTS	•						
KIRKLEY-DITCH	•						?
UNSPECIFIED LOCALITIES			N				

FIG. 9.

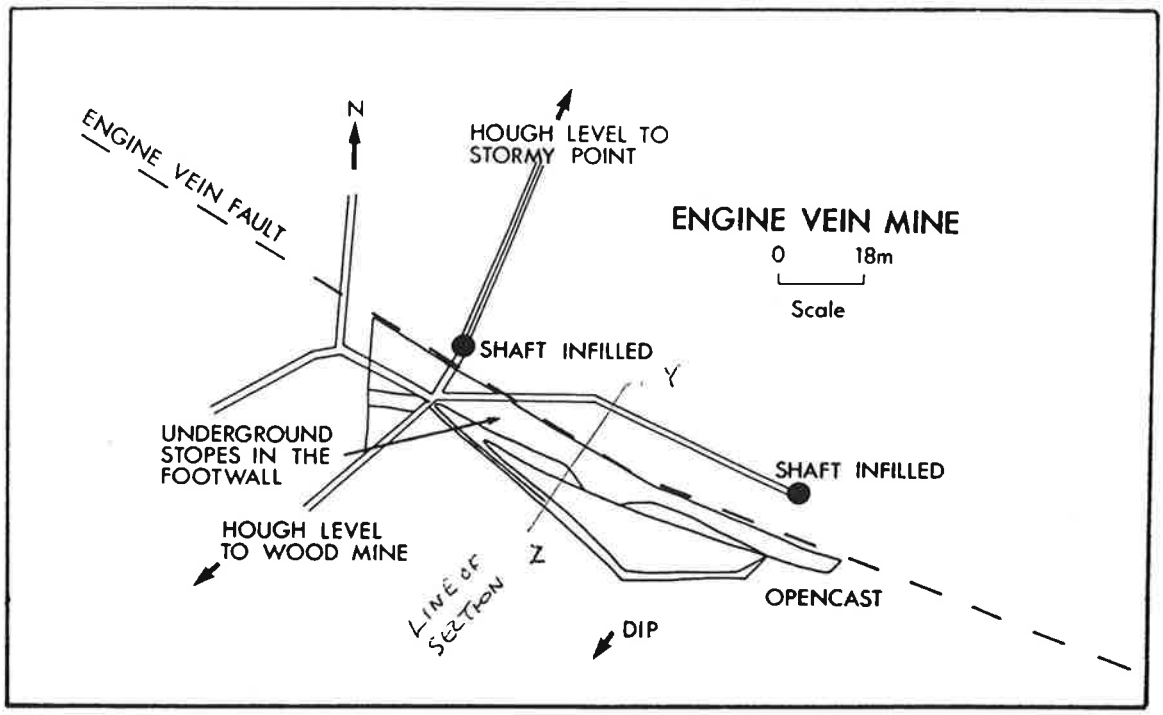


FIG.10 Plan of Engine Vein Mine.
From a plan c. 1878. Reproduced by kind permission of Mr. A. Lowndes.
After CARLON (1979) Fig 12.

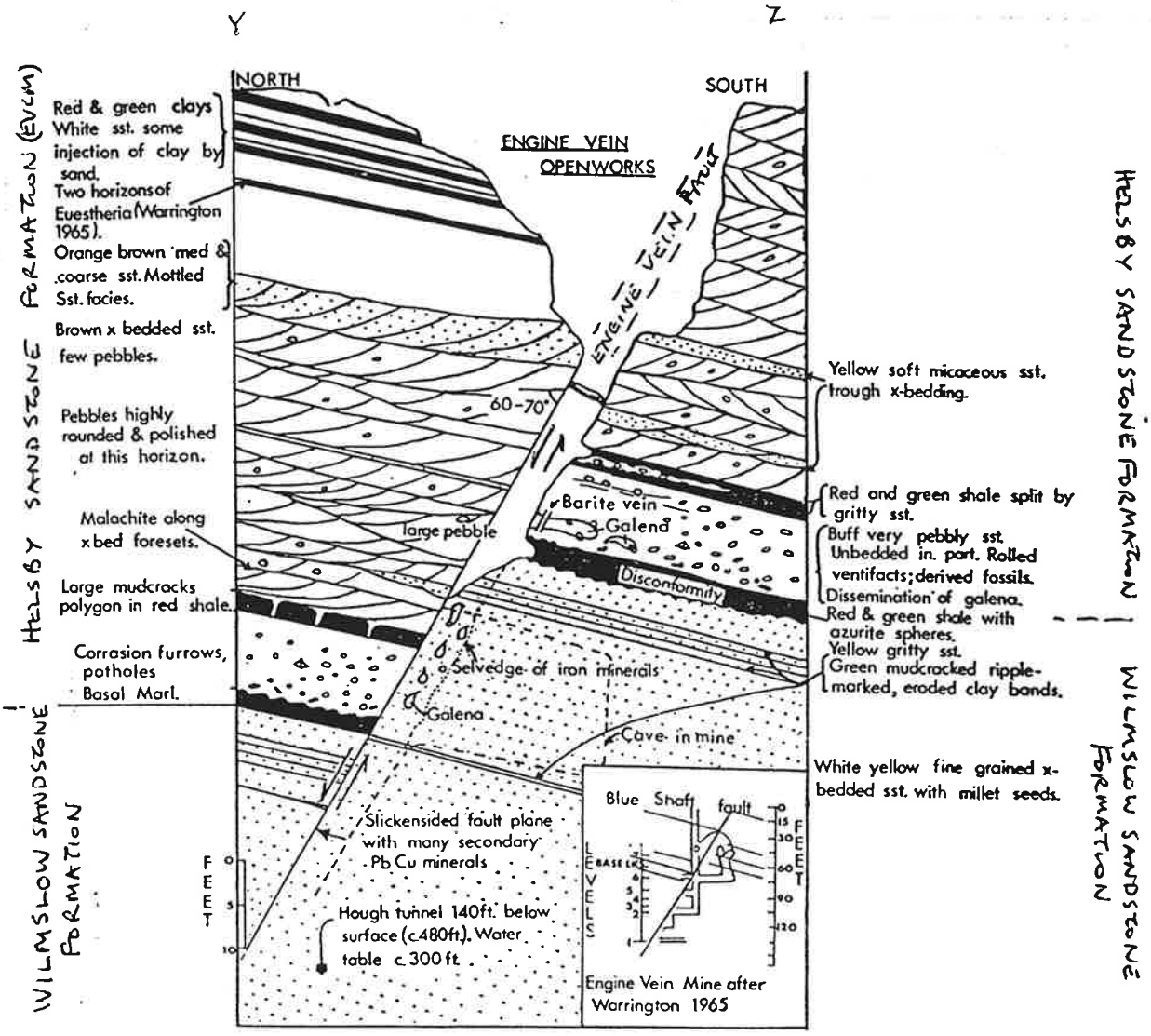


Fig. 11 Diagrammatic section across Engine Vein, (After Thompson 1970 c)

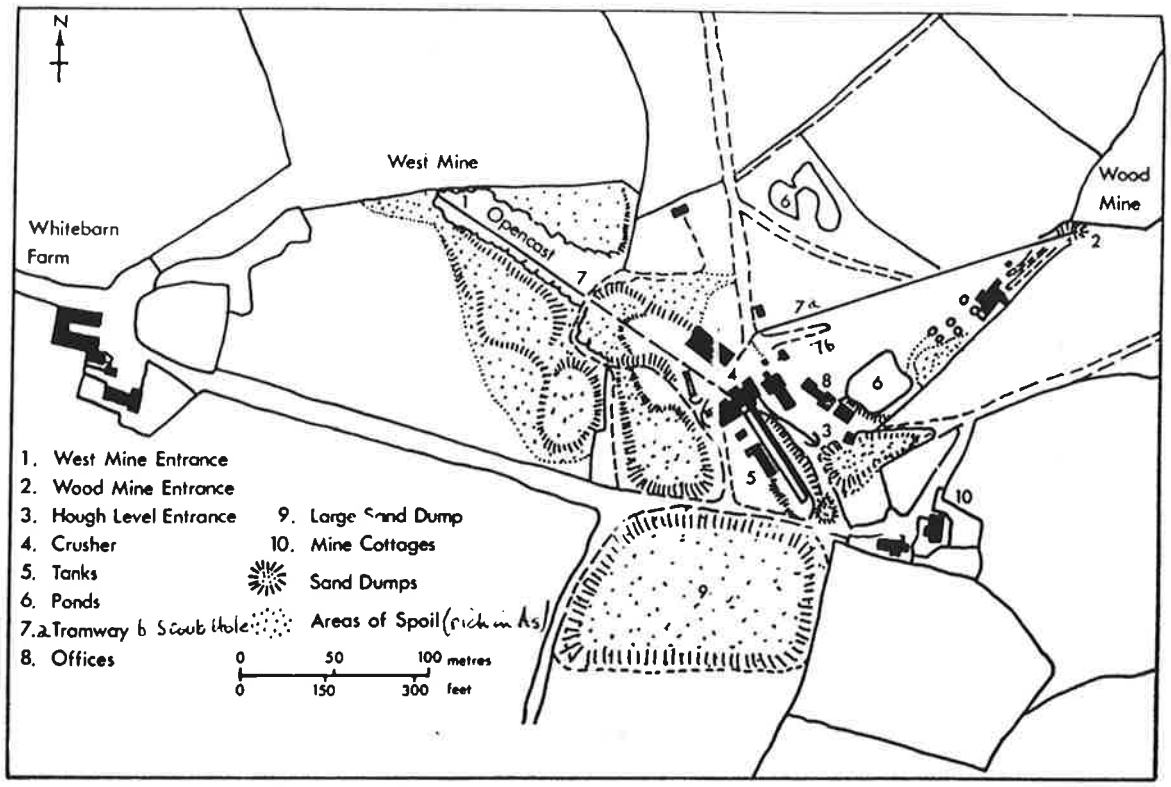


FIG. 12. The Ore Treatment Works and the offices of The Alderley Edge Mining Company Limited c. 1872

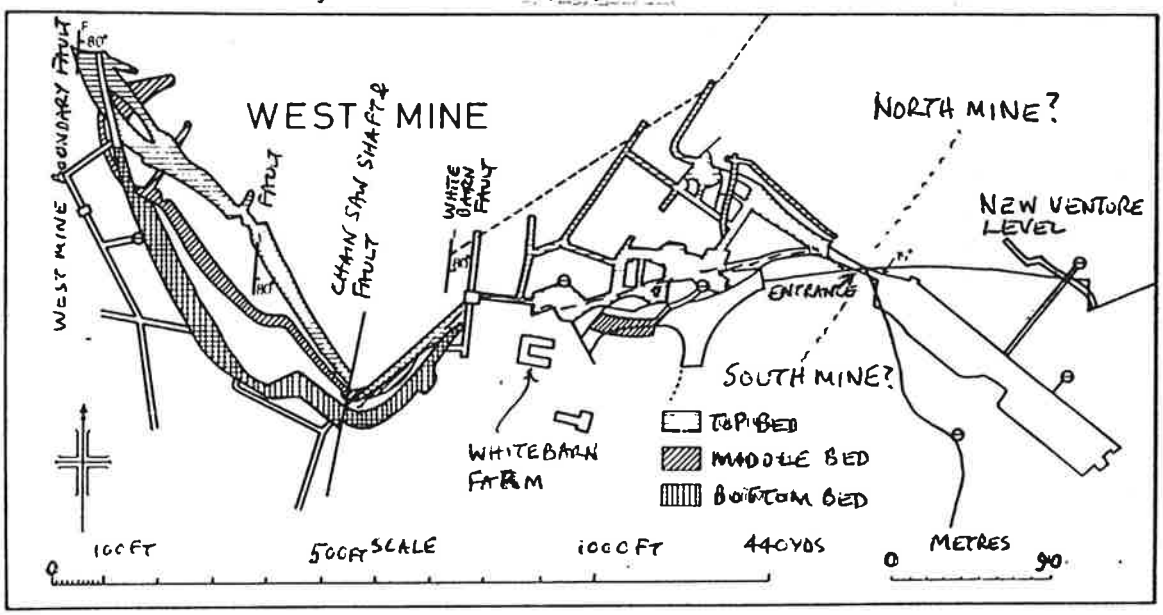


FIG. 13. Plan of West Mine. (After Dewey and Eastwood, 1925)

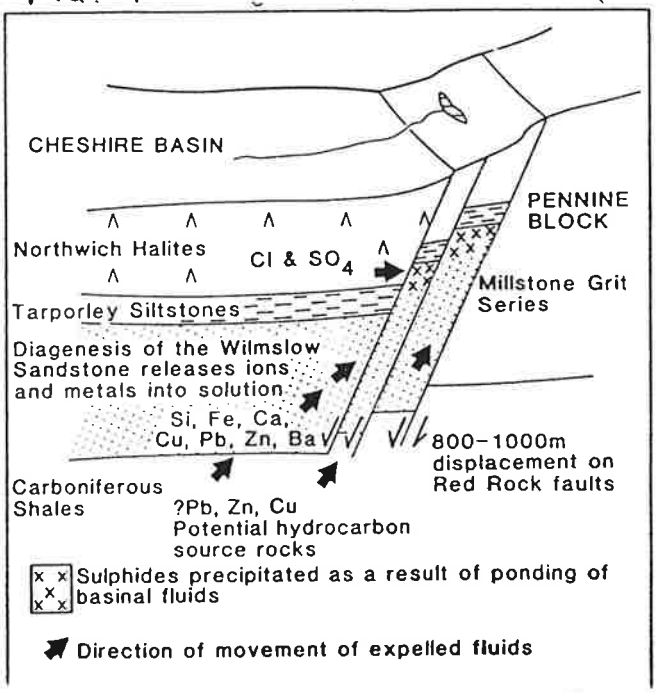


Fig. (b) Summary diagram to show possible origins of mineralization around the margins of the Cheshire Basin. Potential sources of metals and sulphur exist in the underlying Carboniferous and in the basin itself where diagenesis of the Lower Triassic and Upper Permian sandstones may have resulted in the release of trace metals into solution. The traps around the basin margins are topographically higher than the rich Cl^- and SO_4^{2-} source in the form of the evaporites due to basin inversion during the Tertiary. (NAYLOR et al 1989 fig 10.)

MINERAL SPECIES REPORTED FROM ALDERLEY EDGE & MOTTRAM ST. ANDREW'S MINES UP TO END OF 1987

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GH = DR G. HARWOOD
RI = DR ROB IXER
JRK = J. R. KNIGHT
N = NAYLOR et al (1989) IN PRESS

COPPER MINERALS Cu+

PLACES	CHALCOPYRITE	BORNITE	CHALCOCITE	COVELLITE	BLAUBLEIBENDER COVELLITE	DJURLEITE	IDAITE	TENNANTITE	MALACHITE	AZURITE	CHRYSOCOLLA	PLANCHEITE	ENARGITE	POSNJAKITE	LIROCONITE	OLIVENITE	TYROLITE	ANTLERITE	BROCHANTITE	LANGITE	CALEDONITE	LINARITE	PISANITE	LIBETHENITE	CUPRITE	NATIVE COPPER	MOTTRAMITE	AURICHALCITE
WEST MINE	• RB								•	•	• RB						• RB											
NEW VENTURE LEVEL									•	•																		
WOOD MINE	•	? ? ? ? ? ? ? (see I&V p.489)							•	•	•					•	• RB		• RB						?			• RB
ENGINE VEIN	•	•	•	•	•	?	•		•	•	•	• AK	•	•	?	•		• RB	• RB	• RB	?	•	•	•	• PR	• PR		
OPENCAST									•	•																		
DOG AND PILLAR MINE									•	•									• RB									
STORMY POINT	•	? ? ? ? ? ? ? (see I&V p.489)							•	•															?			
TWIN SHAFTS																												
KIRKLEY-DITCH									•	•																	•	
UNSPECIFIED LOCALITIES							•																				•	

LEAD MINERALS Pb+

PLACES	GALENA	CERUSSITE	LEADHILLITE	ANGLESITE	MINIUM	MASSICOT	PYROMORPHITE	AS-PYROMORPHITE	WULFENITE	VANADINITE
WEST MINE	•	•							• RB	• * GH
NEW VENTURE LEVEL	•	•								
WOOD MINE	•	•		? I&V			•	• RB	• RB	
ENGINE VEIN	•	•	• RB	•	•	•	•	• RB	• RB	
OPENCAST	•	•								
DOG AND PILLAR MINE	•						•			
STORMY POINT	•			? I&V						
TWIN SHAFTS	•									
KIRKLEY-DITCH	•	•					•			•
UNSPECIFIED LOCALITIES	• N									?

Zn+

PLACES	SPHALERITE	HEMIMORPHITE	SMITHSONITE
WEST MINE			
NEW VENTURE LEVEL			
WOOD MINE	• RB	? I&V	
ENGINE VEIN	• RB	• RI	
OPENCAST			
DOG AND PILLAR MINE			
STORMY POINT	•	? I&V	
TWIN SHAFTS			
KIRKLEY-DITCH			
UNSPECIFIED LOCALITIES	• N		

Fe+

PLACES	MARCASITE	PYRITE	BRAVOITE	Ni-Co-Fe SULPHARSENIDES *	PHARMACOSIDERITE	LIMONITE	SCORODITE
WEST MINE						•	
NEW VENTURE LEVEL						•	
WOOD MINE		•	•			•	
ENGINE VEIN	•	•	•	•	• RB	•	•
OPENCAST						•	
DOG AND PILLAR MINE						•	
STORMY POINT	•	•	•	•		•	•
TWIN SHAFTS						•	
KIRKLEY-DITCH						•	
UNSPECIFIED LOCALITIES							

Ag

PLACES	ARGENTIAN TETRAHEDRITE	NATIVE SILVER
WEST MINE		
NEW VENTURE LEVEL		
WOOD MINE	? I&V	
ENGINE VEIN	• RI	• JRK
OPENCAST		
DOG AND PILLAR MINE		
STORMY POINT	•	
TWIN SHAFTS		
KIRKLEY-DITCH		
UNSPECIFIED LOCALITIES		

Mn Ni Co+

PLACES	WAD	ASBOLITE	ERYTHRITE	NICKEL ARSENIDES
WEST MINE	•	•		
NEW VENTURE LEVEL	•	•		
WOOD MINE	•	•	• RB	
ENGINE VEIN	•	•	•	• RI
OPENCAST	•	•		
DOG AND PILLAR MINE				
STORMY POINT				
TWIN SHAFTS				
KIRKLEY-DITCH	•	•		
UNSPECIFIED LOCALITIES				

OTHER MINERALS including GANGUE

PLACES	BARITE	WITHERITE	GYPSUM	CALCITE	JAROSITE	NATIVE SULPHUR	HYDROCARBONS
WEST MINE	•						
NEW VENTURE LEVEL	•						
WOOD MINE	•						
ENGINE VEIN	•	•	•	•	• RB	• RB	
OPENCAST	•				RB	RB	
DOG AND PILLAR MINE	•						
STORMY POINT	•						
TWIN SHAFTS	•						
KIRKLEY-DITCH	•						?
UNSPECIFIED LOCALITIES	•		• N				