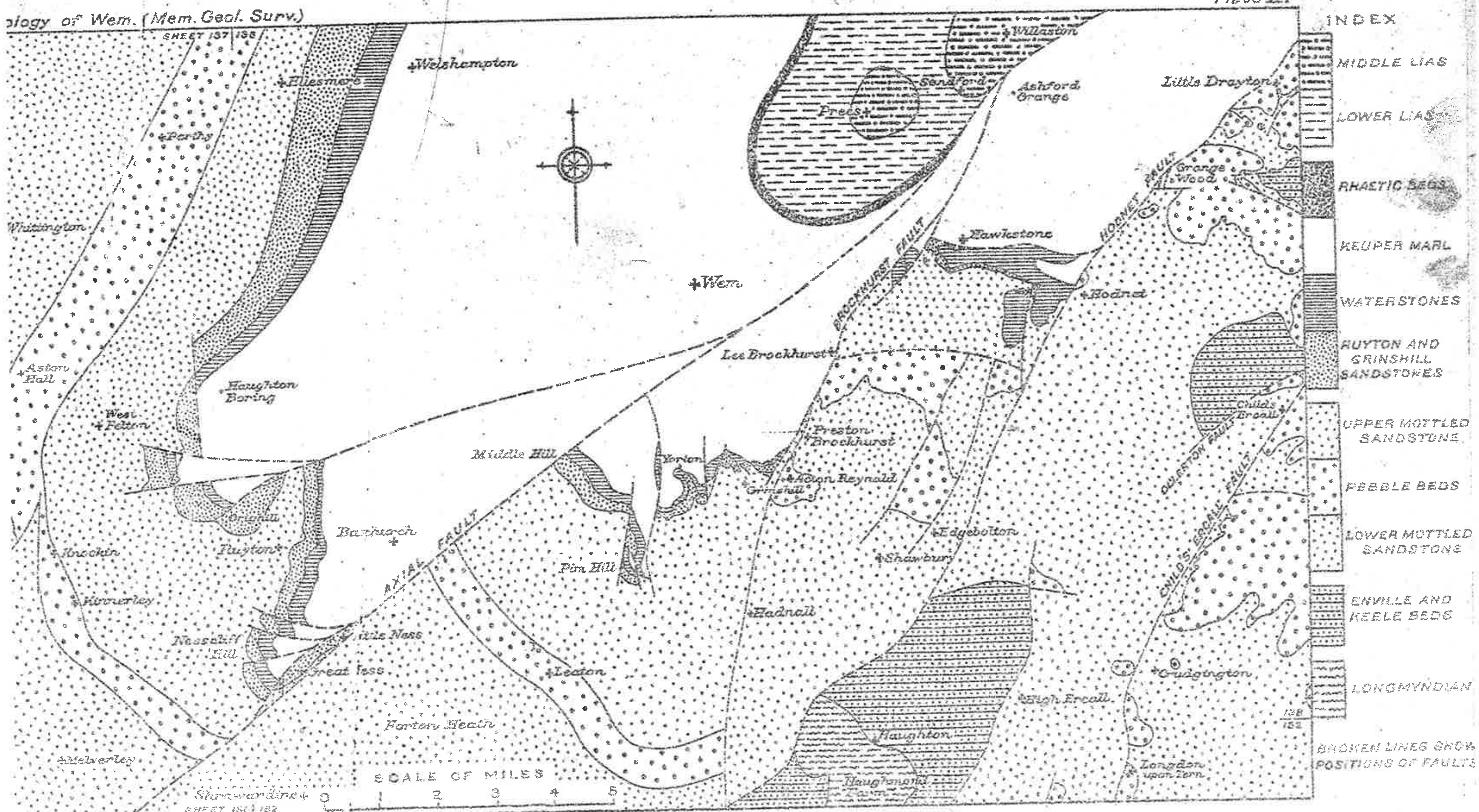
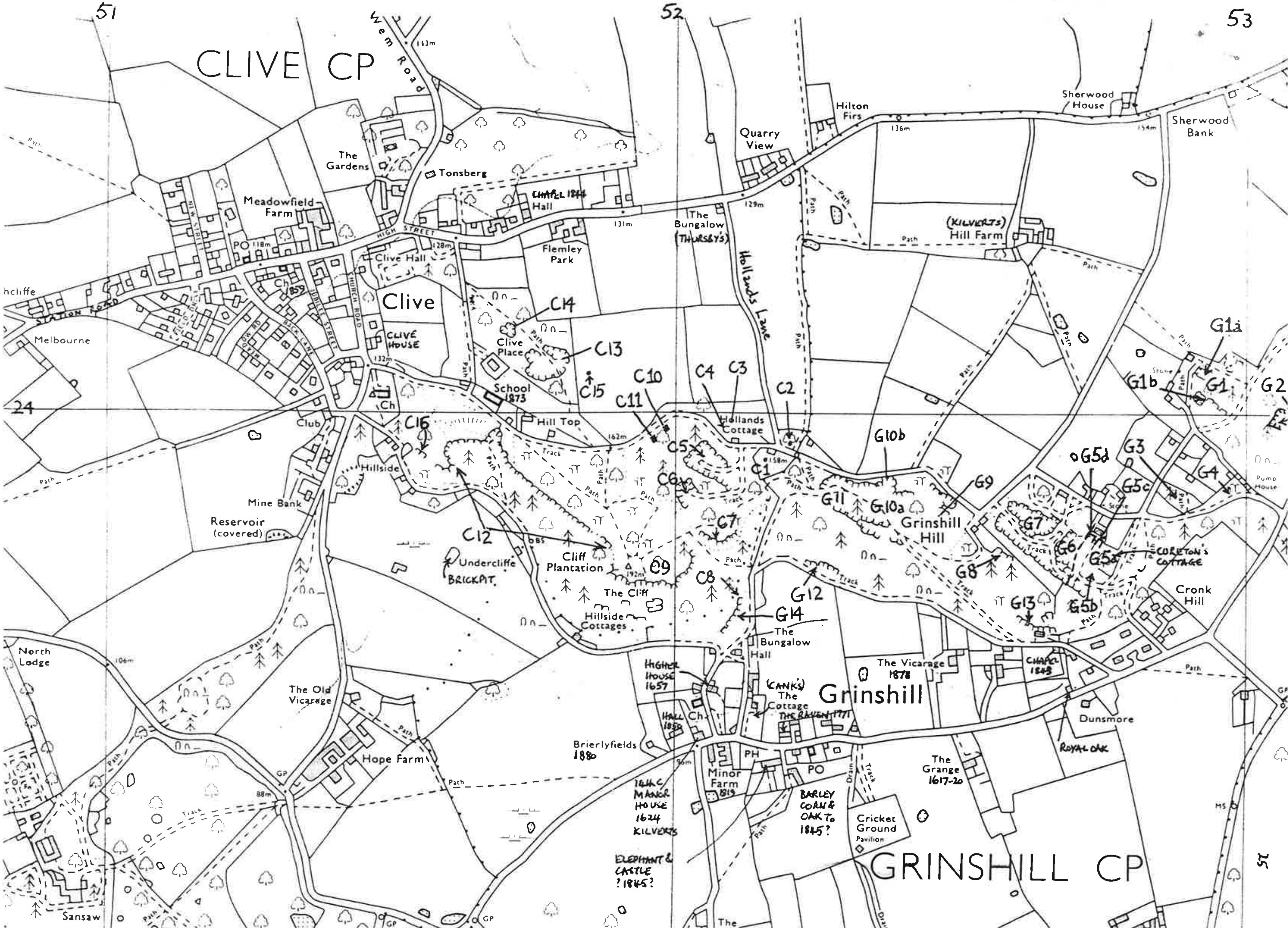
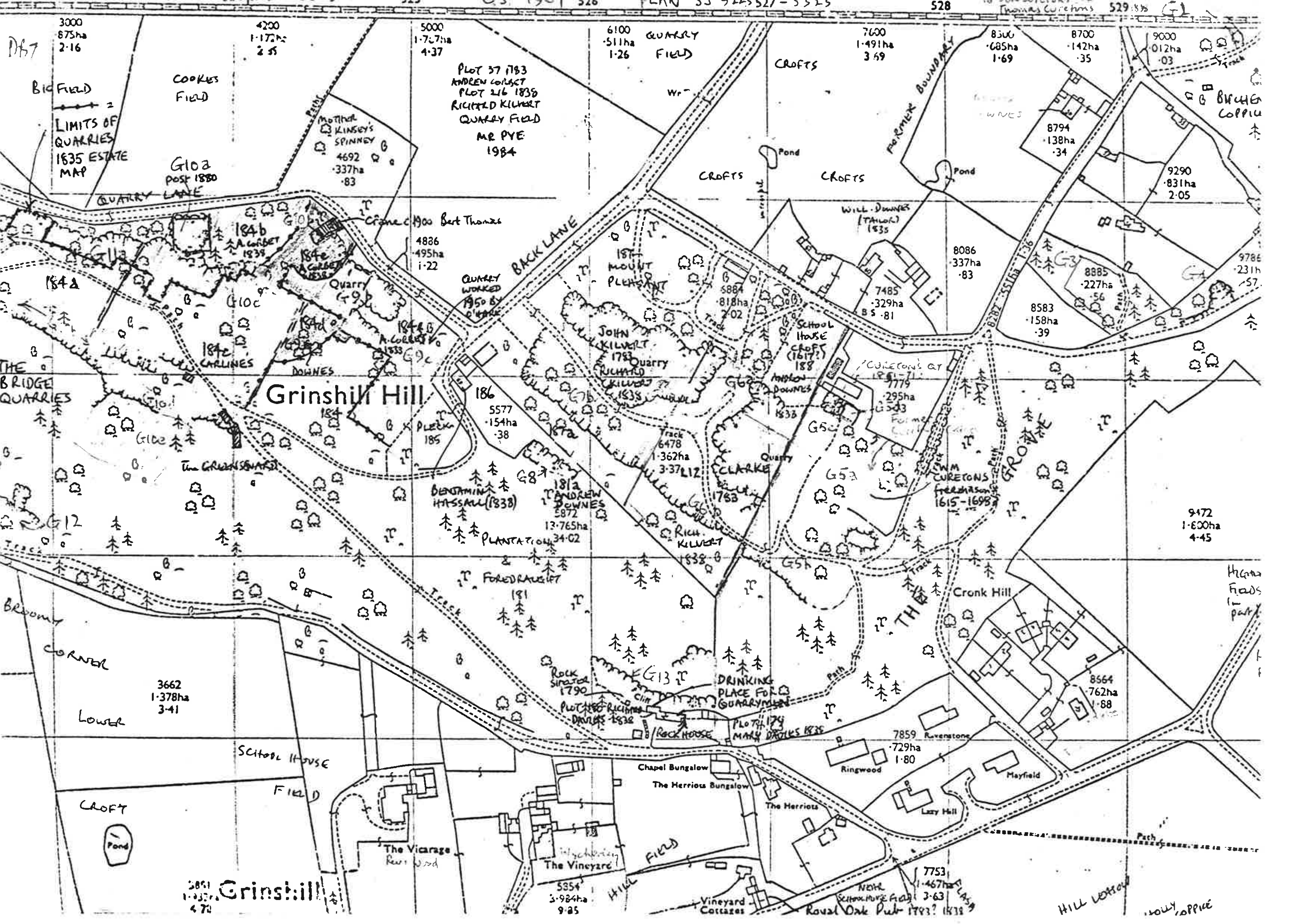


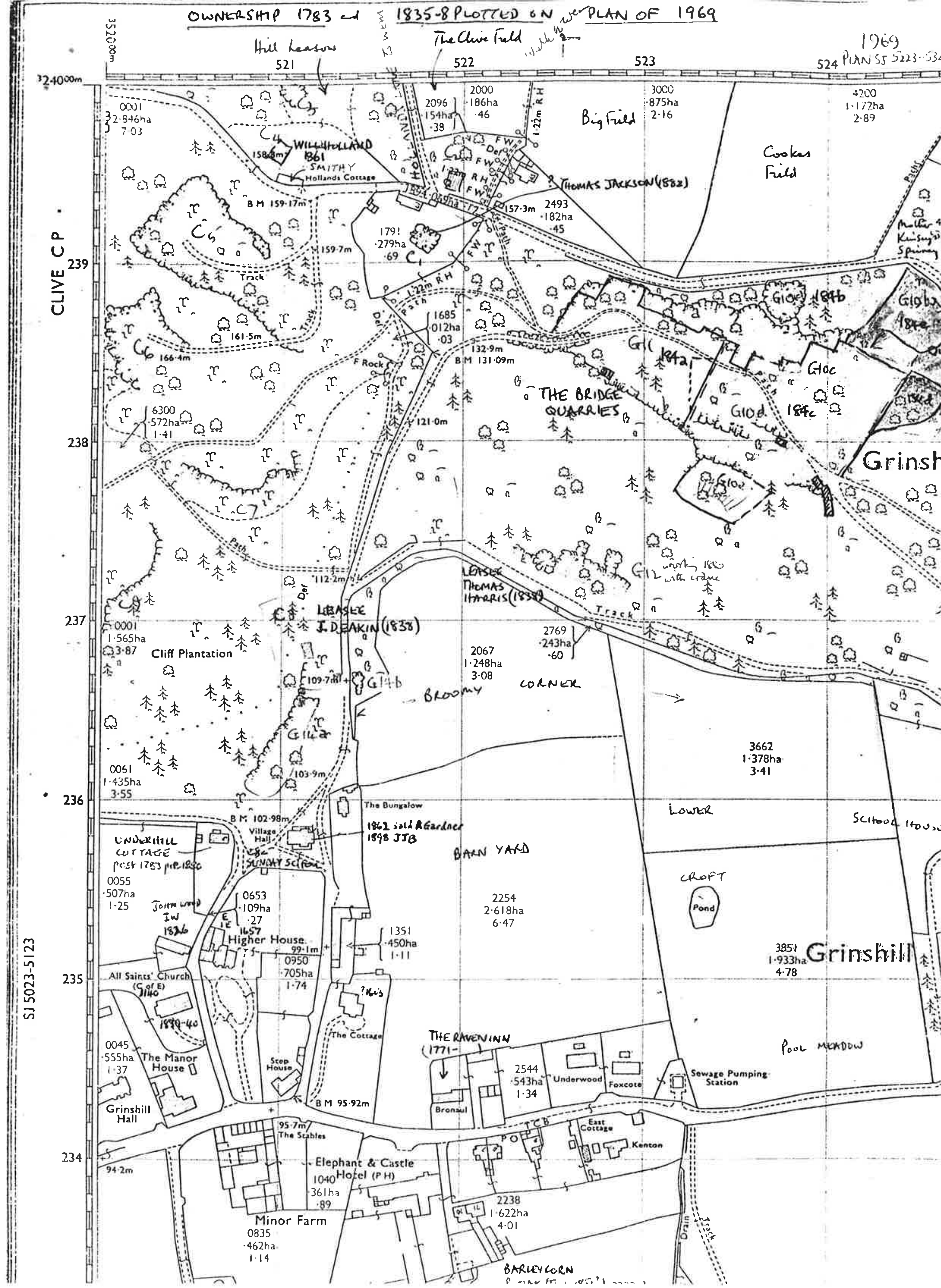
TECTONIC MAP OF THE TRIASSIC BASIN OF NORTH SHROPSHIRE


CLIVE CP
GRINSHILL CP
Clive
Grinshill
51
52
53
24
Wem Road
High Street
Church Road
Jubilee Street
Back Lane
New Street
Station Road
Hollands Lane
The Gardens
Tonsberg
Meadowfield Farm
Clive Hall
Clive House
CHAPEL 1844
Hall
Flemley Park
The Bungalow (THURSBYS)
Quarry View
Hilton Firs
(KILVERTS) Hill Farm
Sherwood House
Sherwood Bank
Ch 1859
PO
Club
Ch
School 1873
Hill Top
Clive Place
Hollands Cottage
Hillside
Mine Bank
Reservoir (covered)
Undercliffe BRICKPIT
Cliff Plantation
The Cliff
Hillside Cottages
Grinshill Hill
The Bungalow
Hall
HIGHER HOUSE 1657
HALL 1850
Ch
(CANKS) The Cottage
THE RAVEN 1771
The Vicarage 1878
CHAPEL 1843
Dunsmore
ROYAL OAK
Cronk Hill
CORETON'S COTTAGE
Pump House
Brierlyfields 1880
PH
Minor Farm 1819
PO
14thC MANOR HOUSE 1624 KILVERTS
BARLEY CORN & OAK TO 1845?
ELEPHANT & CASTLE ?1845?
The Grange 1617-20
Cricket Ground
Pavilion
The Old Vicarage
Hope Farm
North Lodge
Sansaw
Melbourne
Path
Track
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
G1
G1a
G1b
G2
G3
G4
G5a
G5b
G5c
G5d
G6
G7
G8
G9
G10a
G10b
G11
G12
G13
G14


RED MARL WITH THIN PATCHES OF DRIFT
SHAWBURY
Det. No. 2
10 FT SECTION RED MARL
MORETON
Preston Hall
Post Office
Sherwood
Hill Farm
Marlpit
Windpump
DYKE IN SITU
DYKE SEEN IN DITCH
1499·667
2242
Acres
SANDSTONE WITH PEBBLES
FRAGMENTS OF DYKE ROCK
BLOCKS OF DYKE ROCK
BLOCKS OF DYKE ROCK IN SITU
FLAG ROCK OR FREESTONE
6 FT MARL ON FLAG ROCK
RED MARL 6 FT FLAG ROCK 20 FT
Birch Coppice
WHITE FREESTONE
Old Quarry
Old Sand Pit
DARK CHOCOLATE BOULDER-CLAY ON SOFT RED SANDSTONE
CONJECTURAL
SANDSTONE WITH FEW PEBBLES
FAULT ROCK
DEEP DIPPING DECK-RED SANDSTONE
SOFT RED SANDSTONE
FLAGGY SANDSTONE
CHURCH
Sunday School
All Saints' Church
Grinshill
Vicarage
Hope Farm
Brierly Cottage
REDDISH SAND
Whitchurch Shrewsbury
BROCKHURST FAULT
PROBABLE LINE OF DYKE
Apollo's Coppice
Acton Reynald
Obelisk
GRINSHILL

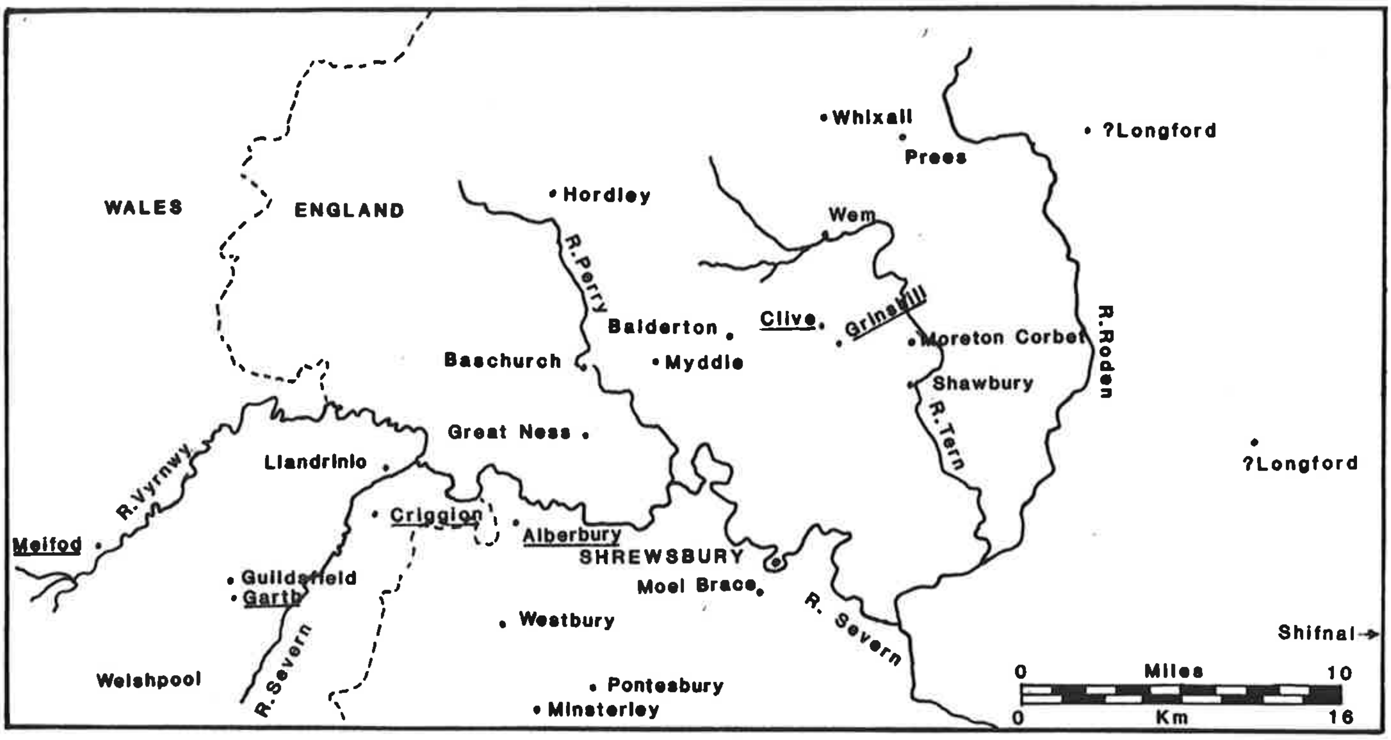


Grinshill Hill
Grinshill
BACK LANE
QUARRY LANE
LIMITS OF QUARRIES 1835 ESTATE MAP
BIG FIELD
COOKES FIELD
QUARRY FIELD
CROFTS
FORMER BOUNDARY
Pond
Mother Kinsey's Spinney
PLOT 37 1783 ANDREW CORBET PLOT 216 1838 RICHARD KILVERT QUARRY FIELD MR PYE 1984
Crane c1900 Bert Thomas
QUARRY WORKED 1950 BY O'HARE
MOUNT PLEASANT
JOHN KILVERT 1783 Quarry RICHARD KILVERT 1838
SCHOOL HOUSE CROFT
ANDREW DOWNES 1838
WILL DOWNES (TAILOR) 1835
CLARKE 1783
RICH KILVERT 1838
BENJAMIN HASSALL (1838)
ANDREW DOWNES
PLANTATION & FOREDRAUGHT
WM CURETONS FREEHOLD 1615-1698
THE GROVE
Cronk Hill
DRINKING PLACE FOR QUARRYMEN
ROCK SHELTER 1790
ROCK HOUSE
MARY DAVIES 1835
The GREENSWARD
THE BRIDGE QUARRIES
CARLINES
DOWNES
Track
Path
Cliff
BROOMY CORNER
LOWER SCHOOL HOUSE FIELD
CROFT
HILL FIELD
Chapel Bungalow
The Herrions Bungalow
The Herrions
Ravenstone
Ringwood
Mayfield
Lazy Hill
The Vicarage
The Vineyard
Vineyard Cottages
Royal Oak Pub
HIGHER FIELDS
HILL LOTHOW
BIRCHEN COPPICE
HOLLY COPPICE

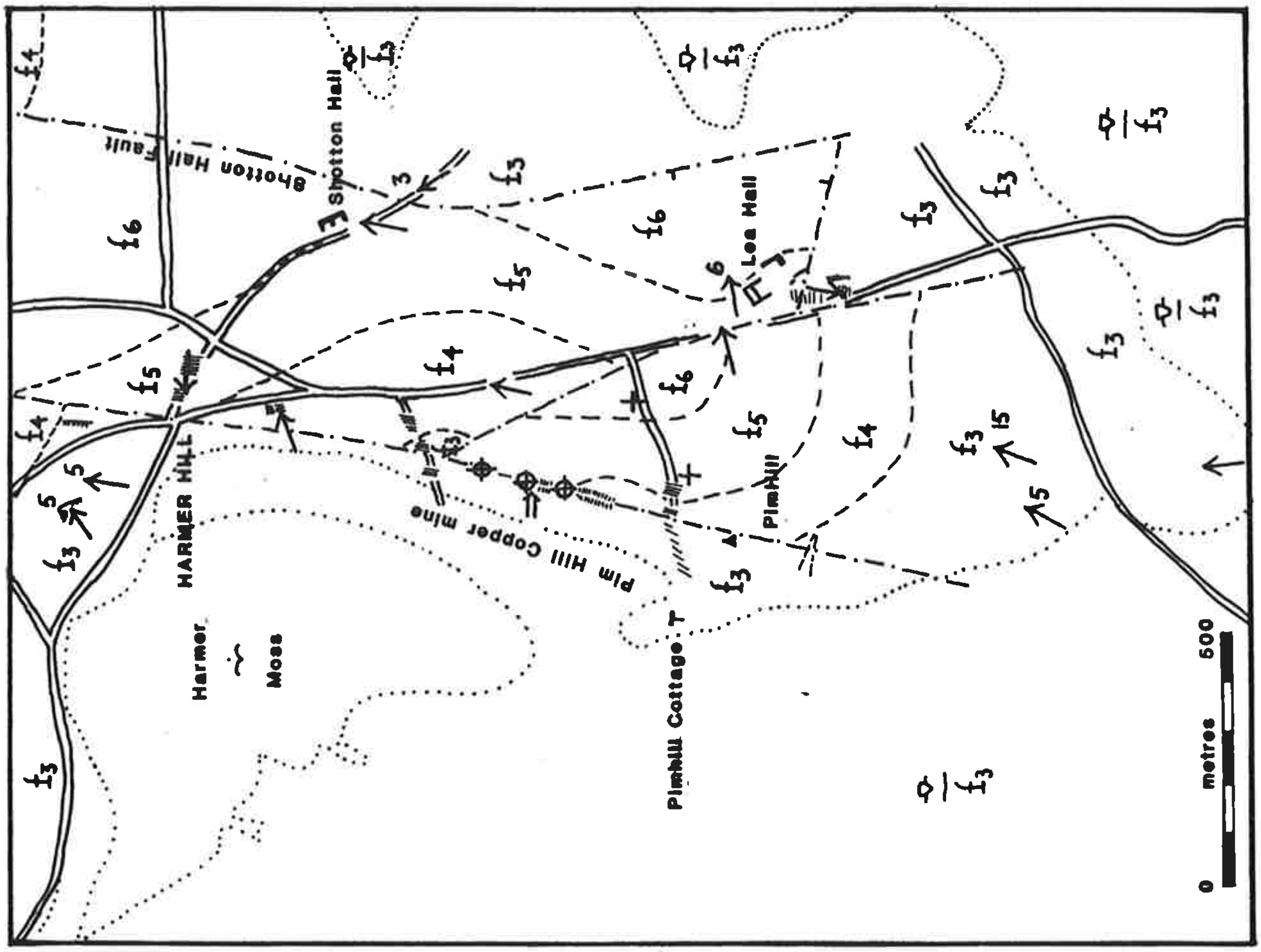

OWNERSHIP 1783 and 1835-8 PLOTTED ON PLAN OF 1969
1969 PLAN SJ 5223-53
Hill Leasow
The Clive Field
521
522
523
524
CLIVE C P
SJ 5023-5123
0001
2·846ha
7·03
WILLHOLLAND 1861
SMITHY
Hollands Cottage
BM 159·17m
C5
159·7m
Track
161·5m
C6
166·4m
6300
·572ha
1·41
C7
Path
2096
·154ha
·38
2000
·186ha
·46
1·22m RH
FW
Def
1791
·279ha
·69
C1
157·3m
2493
·182ha
·45
THOMAS JACKSON (1882)
3000
·875ha
2·16
Big Field
Cookes Field
4200
1·172ha
2·89
1·22m RH
Path
1685
·012ha
·03
132·9m
BM 131·09m
F Rock
121·0m
THE BRIDGE QUARRIES
G11 1842
G10c
G10d 184c
G10e 1846
Grinsh
G12 working 1880 with crane
112·2m
LEASEE THOMAS HARRIS (1838)
LEASEE J DEAKIN (1838)
0001
1·565ha
3·87
Cliff Plantation
2769
·243ha
·60
2067
1·248ha
3·08
109·7m
G14b
BROOMY CORNER
G14a
Track
0061
1·435ha
3·55
103·9m
3662
1·378ha
3·41
The Bungalow
BM 102·98m
Village Hall
1862 sold A Gardner
1898 JJB
UNDERHILL COTTAGE
post 1783 pre 1836
SUNDAY SCHOOL
LOWER
SCHOOL HOUSE
BARN YARD
0055
·507ha
1·25
0653
·109ha
·27
1657
2254
2·618ha
6·47
CROFT
Pond
John Wood
JW
1836
Higher House
99·1m
1351
·450ha
1·11
0950
·705ha
1·74
3851
1·933ha
4·78
Grinshill
All Saints' Church (C of E)
1840
1839-40
The Cottage
THE RAVEN INN (1771-
POOL MEADOW
0045
·555ha
1·37
The Manor House
Step House
2544
·543ha
1·34
Underwood
Foxcote
Sewage Pumping Station
Grinshill Hall
BM 95·92m
Bronsul
95·7m
The Stables
TCB
PO
East Cottage
Kenton
94·2m
Elephant & Castle Hotel (PH)
1040
·361ha
·89
2238
1·622ha
4·01
Minor Farm
0835
·462ha
1·14
Drain
Track
BARLEYCORN

THE ROCK SUCCESSION AROUND GRINSHILL (SALOP).

GROUP	VISUAL LOG	DIVISIONS	LITHOLOGIES	FOSSILS	ENVIRONMENT	THE DYKES
?LADINIAN MERCIA MUDSTONE GROUP ← Passage →		↑NORTHWICH HALITE FORMATION UNAMED MUDSTONE FORMATION	Red & green interbedded siltstones and mudstones NaCl pseudomorphs, suncracks, ripple marks. Thin sandstones (skerries) more common at base. Adhesion ripple bedding in thin siltstones	Fragmentary plants – unidentified. Trace fossils – burrows	TRANQUIL & LOWER LOW FLOW REGIME DEPOSITS ? LAKE & LAKE MARGINAL ? INTERTIDAL (MID- TO UPPER FLATS) SURFACES SUBJECT TO AEOLIAN PROCESSES	Discovered by Murchison (1835, 1839) at Acton Reynald. Extended distribution Geol. Survey of 1920 (Pocock & Wray 1925). In two places the dyke trend is ?shifted by N-S faults. Dykes cut through WSF, HSF, TSF, MMG. Some end in TSF, MMG. Description by Dr Flett: A decomposed porphyritic dolerite, fine grained towards its margin, with small porphyritic felspars in a microcrystalline groundmass. Marginal areas are vesicular and always much decomposed: Central portions are dark grey, with white feldspar phenocrysts up to 5mm. Rock is not well preserved: pyroxene entirely replaced by secondary products, not possible to discern whether olivine present originally. Feldspar (labradorite) with complex twinning and slight zoned structure: albitized in places. Feldspar in groundmass is labradorite. Magnetite, ilmenite frequent: leucoxene, apatite, pyrite, common. chlorite, ~~kaolinite~~, calcite, quartz (secondary) abundant. MAY HAVE BEEN A THOLEIITIC DOLERITE. REGARDED IN 1930'S AS PROBABLY TERTIARY IN AGE and ASSOCIATED WITH BRITO-ICELANDIC (THULEAN) IGNEOUS PROVINCE. ISOTOPIC AGE DATE 51-52 my (EOCENE) (FITCH & MILLER) (1960'S) ? THE DATE OF ALTERATION & MINERALIZATION NOW THOUGHT TO BE ASSOCIATED WITH THE OPENING OF THE NORTHERNMOST ATLANTIC BY PLATE TECTONIC SEPARATION OF GREENLAND FROM EURASIA.
ANISIAN		TARPORLEY SILTSTONE FORMATION 3 – 13m mean 6.5m	Grey, light yellow, occ. green or pink fine grained flat bedded, thin bedded ssts interbedded with very thin green micaceous siltstone - mudstone laminae. Sole structures (prod, bounce, flute marks; load & flame casts); clay galls (intraformational); flat lamination with current lineation; cross lamination; asymmetric ripple marks of transverse straight and linguoid types; symmetric ripple marks; flat topped ripple marks; halite pseudomorphs; wrinkle marks; rill marks on crests of ripples. Mud laminae drape structures. Mudcracks! Pinhole cavities after gypsum - anhydrite.	Bones of Rhynchosaurus articeps Owen (Ward 1839) Suite of trace fossils including Rhynchosauroides articeps Maidwell = Footprint D1 of Beasley	ALTERNATIONS OF LATERAL & VERTICAL ACCRETION DEPOSITS LOWER LOW FLOW REGIME ALTERNATES WITH DEPOSITION FROM SUSPENSION. QUIET ? FLUVIAL REGIME ? LAKE DEPOSITS INTERTIDAL DEPOSITS (LOWER SAND FLATS)	
240 my		'ESK' BED 15cm - 45cm	Yellow grey sand and sst, incoherent, with some harder patches: speckled with MnO_2: Sometimes barytic cement.		? SUPRATIDAL DEPOSIT ? CAVITIES AFTER EVAPORITES	
SCYTHIAN SHERWOOD SANDSTONE GROUP		RUYTON & GRINSHILL SANDSTONE MEMBER 16m – 45m HELSBY SANDSTONE FORMATION	Yellow, white, light red, generally dull red. Massive, thick beds of even grain – hence a freestone. Hard or soft, hardening on exposure. Some v. large sets of cross bedding, with some troughs and some signs of reactivation. In east silicified joints: nodular barytes in the western parts near Clive. One clay horizon for a short distance. Palaeocurrent to WNW. Basal parts cross-bedded at Glat near Clive School	? Bones of Rhynchosaurus articeps Owen a rhynchocephalian forerunner of the Tuatara Lizard (Sphenodon) in New Zealand. See papers of A.D. Walker 1969 Geol. Mag. 1970 QJGS	? FLUVIAL (IGS) DOMINANTLY LATERAL ACCRETION DEPOSITS OR MOST LIKELY AEOLIAN (THOMPSON 1970) PALAEOCURRENT FROM EAST = TRADE WIND (PALAEOMAGNETISM SHOWS 19°N OF EQUATOR ELSEWHERE AT THIS HORIZON)	
← Passage →		PASSAGE BEDS 5m	Red and yellow freestones			
SCYTHIAN		WILMSLOW SANDSTONE FORMATION	Bright, deep-red, soft fine-grained x-bedded ssts. Palaeocurrent to WNW.		? FLUVIAL BRAIDED RIVER FROM SE LATERAL ACCRETION DEPOSITS ? AEOLIAN EPISODES	
245 my		CHESTER PEBBLE BEDS FORMATION AT DEPTH				



Locations named Quarries underlined.



THE GEOLOGY OF THE GRINSHILL AREA (see Fig 1 and the succession of rocks in this area)

• The Grinshill area lies in the southern part of the South Lancashire, Cheshire, North Shropshire Basin (Fig.1). This basin was initiated after the deposition, uplift and erosion of the Pennine Carboniferous Basin somewhere between 300 and 270 million years ago. The North American-Eurasian plate, recently enlarged by the collision of the African plate and subject to east-west wrenching, became relatively stable and affected by east-west tension, so that elongate basins (or half-rifts) developed. Deposition of the Sherwood Sandstone Group and the later Mercia Mudstone Group took place over a period ?270-213 million years, sedimentation roughly keeping pace with subsidence. Some of the details of the rock succession in the local area are given in diagrammatic form. The area was folded and faulted at a much later date, the earth movements being sustained episodically over long periods. The area was intruded by basic magma ?50 million years ago as the northern North Atlantic Ocean opened, was mineralised, and was covered (in the period 24000-13000 yrs) by the last advance of the last ice sheet (the Devensian ice).

The minerals and their distribution

The Triassic rocks within the Basin are essentially silica rich sediments cemented by silica (SiO_2), calcite ($CaCO_3$) and iron oxides/hydroxides, the latter imparting the characteristic red colouration. A considerable number of other minerals occur in the rocks including feldspars and clay minerals, but the ones of interest in the mining areas were compounds containing copper, lead, cobalt or silver. All of these elements were mined at one time or another in the region.

The principal minerals are malachite, azurite and chysocolla (copper); galena, pyromorphite and cerussite (lead); asbolite (cobalt, nickel and manganese); wad (manganese) and barite (barium sulphate). Occurring with these metals are arsenic, silver, vanadium, and molybdenum. A list of minerals so far recorded from the region is presented in Table 1.

TABLE 1. Minerals recorded or reported from the metalliferous deposits of the Cheshire-Shropshire Basin. Dominant species * (As known in 1979).

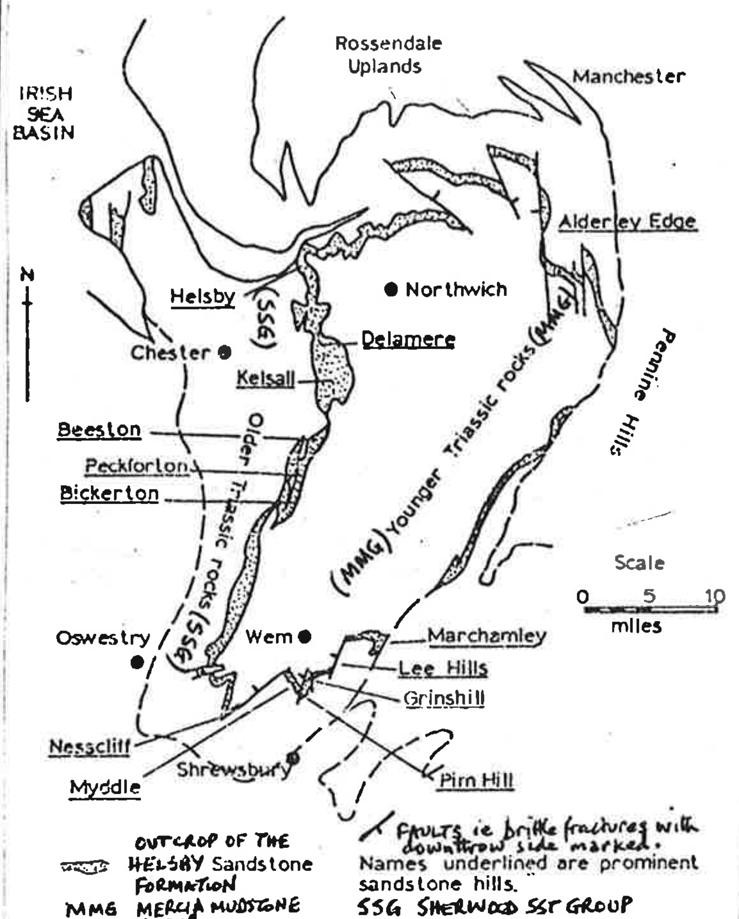
COPPER	Native Copper	LEAD *	*Galena	IRON	Pyrite
	Chalocite		Massicote		Haematite
	Chalopyrite		Minium		Goethite
	Bornite		*Cerussite		Limonite
	Enargite		*Pyromorphite		Turgite
	Cuprite		Arsenical pyromorphite		Pisanite
	*Malachite		Anglesite		Scorodite
	*Azurite				Beudantite
	Chysocolla	MANGANESE			
	Tyrolite		Pyrolusite	ZINC	Sphalerite
	Plancheite		*Wad		
	Olivenite			MOLYBDENUM	
	Brochantite	COBALT	*Asbolite		Wulfenite
	Libethanite		Erythrite		
	Liroconite		Bravoite	BARIUM	*Barite
	Caledonite		Cobaltite 42		Witherite
	Langite	VANADIUM	Roscoelite	NICKEL	
	Covellite 42		Vanadinite		Bravoite 42
	Djurleite		Mottramite		Gersdorffite
				SILVER	Tetrahedrite

The metallic minerals occur with a barite 'gangue' as disseminations within the sandy and pebbly Triassic rocks, coating sand grains, infilling pore-spaces and forming a patchy rock cement. The mineralised rock often has ill-defined contacts and varies foot by foot in metal grade, thickness and width, forming lenses, streaks and irregular patches of mineralised ground. In detail the distribution and association of the minerals is complex but essentially follows a pattern which can be summarised thus :–

1. The mineralisation is predominantly copper-cobalt-manganese-barite. Only at Alderley Edge and Mottram Mine was lead present in economic quantities.

2. Barite and wad (manganese) have a wide geographic distribution around the Basin, while copper-cobalt-(lead) minerals are more restricted to areas proximal to faults.

3. The minerals occur through a vertical range of some 6,000 feet of Triassic rock but are most abundant within the top of the Mottled Sandstone Formation and particularly in the overlying Keuper Sandstone Formation immediately below the regional 'seal' of the Waterstones. In addition Keuper Sandstone or Mottled Sandstone [illegible]



THE CHESHIRE-SHROPSHIRE BASIN

FIG 1

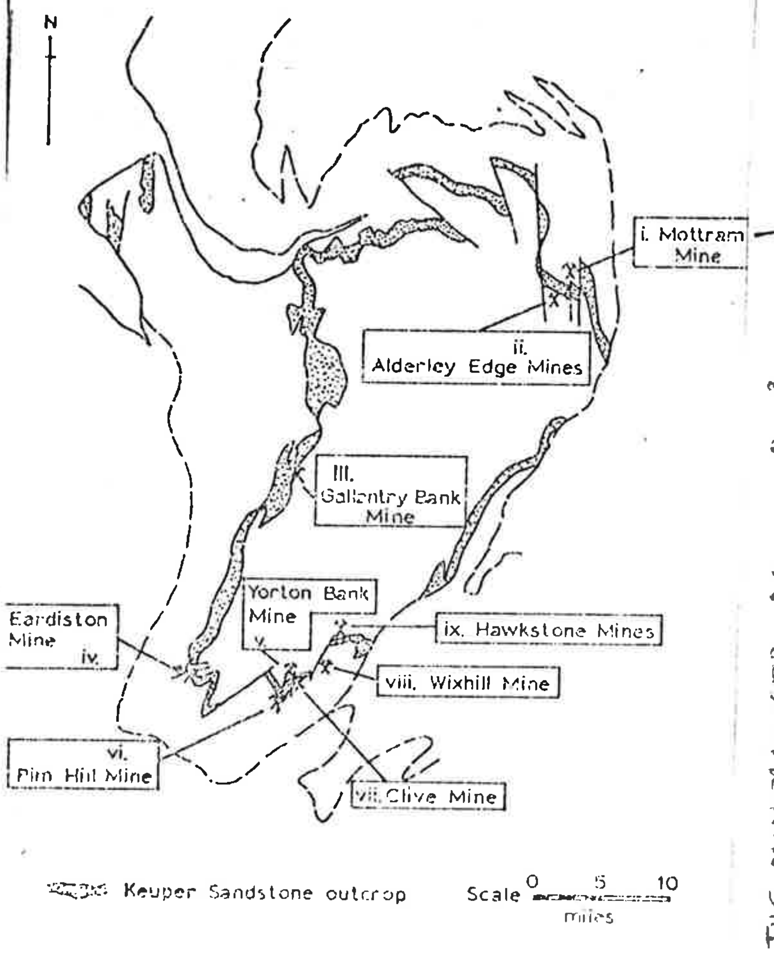
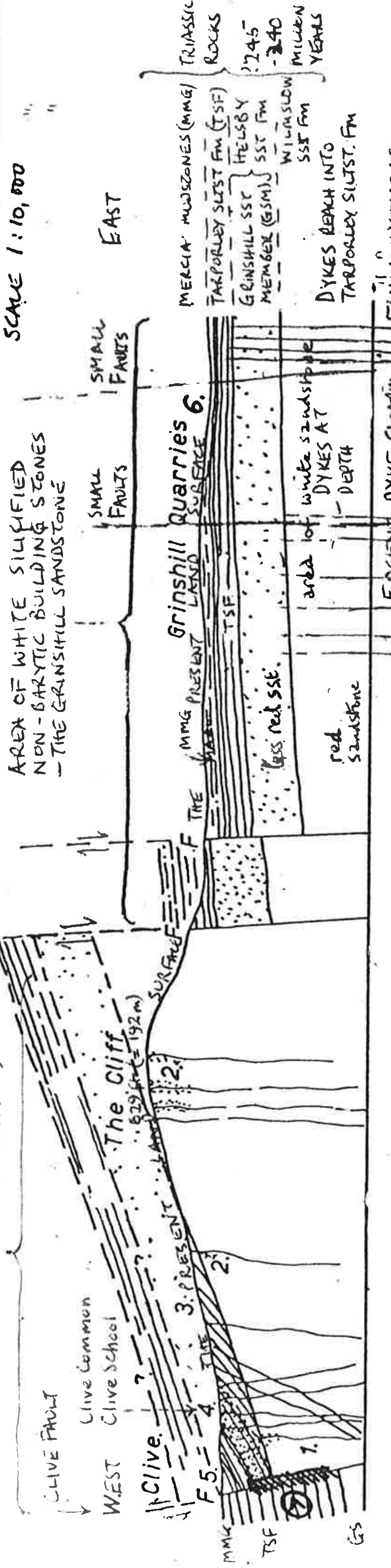


FIG 2. MINES IN THE CHESHIRE-SHROPSHIRE BASIN



1. Barite veins. 2. Barite concretions associated with veins in the top of the Wilmslow Sandstone.
3. Non-baritic rocks towards the base of the Grinshill Sandstone, away from the fault.
4. Barite increasing up cross-beds. 5. Higher cross-beds non-baritic; as are rocks eastwards (6).
7. MALACHITE-ASBOLITE-BARITE, MINE BANK

A GEOLOGICAL CROSS-SECTION ACROSS GRINSHILL FROM CLIVE TO CRONK HILL

The Mines

There are nine principal mining sites in the Cheshire-Shropshire Basin. All of them worked copper ores which were associated principally with cobalt at Eardiston and Clive; cobalt and silver at Bickerton and cobalt, lead and silver at Alderley Edge and Mottram St. Andrew. All sites had associated barite and wad. Little is known of the ores at Yorton, Pim Hill, Wixhill and Hawkstone, but they are likely to have been copper-cobalt in character. Vanadium was recorded at Pim Hill.

The regional setting of these mining sites is shown in Figure 2. At Alderley Edge and Mottram St. Andrew the ores were dispersed through faulted ground; at Eardiston, Bickerton, Clive, Pim Hill, Yorton and Wixhill the ores were mined from rocks adjacent to one principal fault, while at Hawkstone Park, the trial mines are in ground not adjacent to faults.

The date of first discovery of these mineral deposits is unknown, but they are likely to have attracted early attention by virtue of the brightly coloured copper compounds or the sterility of the ground around the mineral occurrence.

Mining by the Romans has been postulated for the Alderley Edge Mines (Roeder 1901)[3], (Roeder and Graves 1905)[4]; for the Mottram Mine (Roeder 1901)[3]; and for the Clive and Hawkstone Mines (Wood in Watkin 1879)[5]. Stone artifacts discovered at Alderley Edge and Mottram Mine have led to the conclusion that mining began prior to the Roman Occupation (Boyd-Dawkins 1875)[6].

It is likely that mining had taken place at all the sites prior to the latter half of the 1700s, with the possible exception of Eardiston Mine (Carlon In Press)[2]. By the late 1700s the region was supporting a flourishing copper mining and smelting industry, though the most productive period of mining was undoubtedly the thirty years period 1850-1880 when the mines at Mottram, Alderley Edge, Bickerton, Eardiston, Clive, Pim Hill and Wixhill were worked. West and Wood Mines, Alderley Edge were worked intermittently in the early years of the 1900s and leases were sought or obtained for the Bickerton and Eardiston Mines. Various individuals and companies have shown a passing interest in the Alderley Edge, Bickerton, Eardiston and Clive Mines in recent years but it is most unlikely that any of them will be reopened.

All the mines seem to have been worked by initial open pitting and trenching, followed by shaft or adit access to underground mining where the ore was removed in the normal way by picking or later using drilled shot holes and gunpowder. The stopes produced were either linear or irregular, depending upon the form and nature of the orebody. In most of the mines timber props were used sparingly or not at all, the rocks standing without the need for artificial support.

Only the Alderley Edge Mines appear to have been dry workings, although the Hawkstone trial mines were probably dry also. All the other mines were wet, some alarmingly so, and required the use of steam power to dewater them. Clive, Bickerton and Eardiston all had, at sometime or other, engine houses and steam engines, and some form of motive power may have been used at Yorton and Wixhill for pumping and hoisting.

The copper ores were initially treated on site or nearby by smelting, however by the early 1800s the ores were too low grade to be treated economically by direct smelting. In 1857 William Henderson, company chemist for the Alderley Edge Mining Company, patented a process for copper extraction from poor copper ores using an acid leaching technique (Henderson 1857)[7]. This method was later adopted at Bickerton, Eardiston and Clive.

The following review of the Cheshire-Shropshire Basin mines is based on archival, field and verbal researches and is intended to shed new light on these old mines. For each mining site the location is given with the National Grid Reference. The present (1980) surface features and remains are described and a brief outline of the mining history, geology and related features given. References for each locality are given, where these are generally available.

Commencing in the north-east corner of the basin, the mines are described in anticlockwise order around the region, as numbered in Figure 2.

vii. CLIVE (GRINSHILL) MINE

Location: On the south and south-east sides of Clive village, north Shropshire. The workings extend from NGR SJ5150.2425 to SJ5130.2363.

Geology: The Clive Fault runs under Clive village throwing Marls and Waterstones to the west into contact with Grinshill Sandstone (Keuper Sandstone) and Mottled Sandstone to the east, the two latter units being mineralised. The fault dips steeply westwards, being almost vertical. The ore was found in rocks leached of their iron oxide-hydroxide content, this material forming an 'iron-pan' adjacent to the main orebody. The ore was a mixture of malachite with azurite and asbolite in a baritic sandstone adjacent to the Clive Fault. The mineral impregnation pinched and swelled, the average stoping width in the 1860s being 15-20 feet, and was tested over a lateral distance of some 600 yards to a maximum depth of 240 feet. The ore grade and volume decreased dramatically below 180 feet.
The granular, grey-white host rock was in places speckled with abundant asbolite (cobaltian wad) an occurrence termed 'pepper and salt rock'.
In 1862 ore raised averaged 3½% copper.

Mining: At least six shafts, numerous surface excavations and an adit were sunk and driven to test and exploit the orebody at Clive. Ore was stoped and trammed to the hoisting shaft, which in the early years of mining was at the north end of the sett. Worked to a depth of 240 feet, the levels below 180 feet were used for haulage only. A 6 feet by 9 feet shaft was sunk to a depth of approximately 160 feet at SJ5139. 2386 in the hangingwall of the deposit. Originally a hoisting shaft adjacent to the mine plant area of the 1860s, this shaft was deepened in the early 1900s and is still used as a source of water, being equipped with pumps.

History: Clive Mine is yet another working in part attributed to the Romans. First mooted by Samuel Wood in 1879 (in Watkin 1879)[5], the evidence is very shaky and hinges on the similarity between certain levels at Clive and those of proven Roman origin on Llanymynech Hill near Oswestry. As at Pim Hill, Wixhill and Hawkstone Park, the presence of copper at Clive was well known by the late 1600s. A considerable portion of the Clive Mine may have been excavated in the 1600s, and 17th century tools and artifacts have been discovered in the mine.
The mine lease was held by John Payne of Droitwich in 1739, and over the next 120 years several interested individuals and companies sought to reopen and mine the Clive orebody.
A prosperous episode of mining activity took place between 1862-1869. During this period the Clive Mining Company came into being after obtaining a lease to work the orebody from the landowner, Mr. Gardner. Some 30-40 men were employed at the mine, some of them Cornishmen and others experienced copper-sandstone miners who had worked in the Alderly Edge Mines.
They greatly extended Clive Mines; ore was raised, crushed between cogs and acid leached in 24 large stone tanks. Copper was precipitated from the solution in wooden troughs using scrap iron.

The Clive Mining Company, initially under the care of mine manager J. T. Harris who also briefly took charge of the Rednal (Eardiston) Mine about this time (Carlon in press)[2], constructed workshops and an engine house at the Clive Mine. The present Mine Cottage at Clive is one of the original mine buildings. On closure in 1869 the stone leaching tanks were sold to the Bryntail Mine near Llanidloes, Powys, Central Wales. Here they were used in the dressing of barytes. Restored some years ago by the Department of the Environment, the Bryntail Mine still possesses 8 of the Clive tanks, which can be seen, in various stages of restoration at NGR SN915869. The site is described by Bick (1977)[19].

Output: The total output of ore from the Clive Mine is unknown.

Surface: There is little to see on site at Clive. The best tangible mining relics are at Bryntail Mine some 60 miles away! The deepened hoisting shaft is still accessible, within a building adjacent to Mine Cottage on private property. Due south of Mine Cottage in a plantation a fence marks the position of a 'shaft that appeared in the 1950s due to subsidence of its infill, and 200 feet further south are two recent 'holes' where the ore was stoped to surface.

References:
Bick (1977)[19] page 37.
Victoria County History (1908)[20] pages 266 and 417.
Pocock and Wray (1925)[16] pages 90 and 99.
Hunt (1884)[21] page 259.
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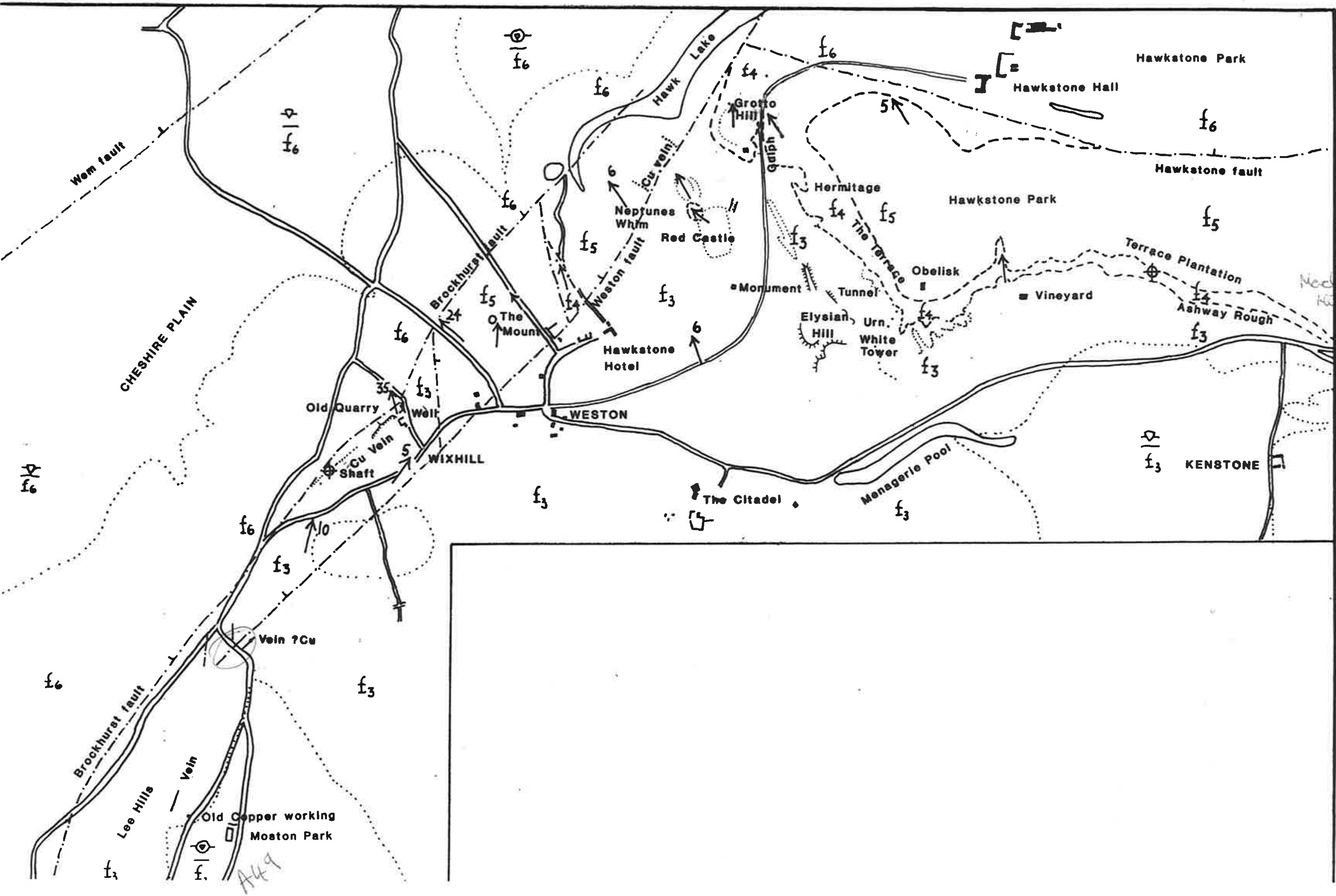
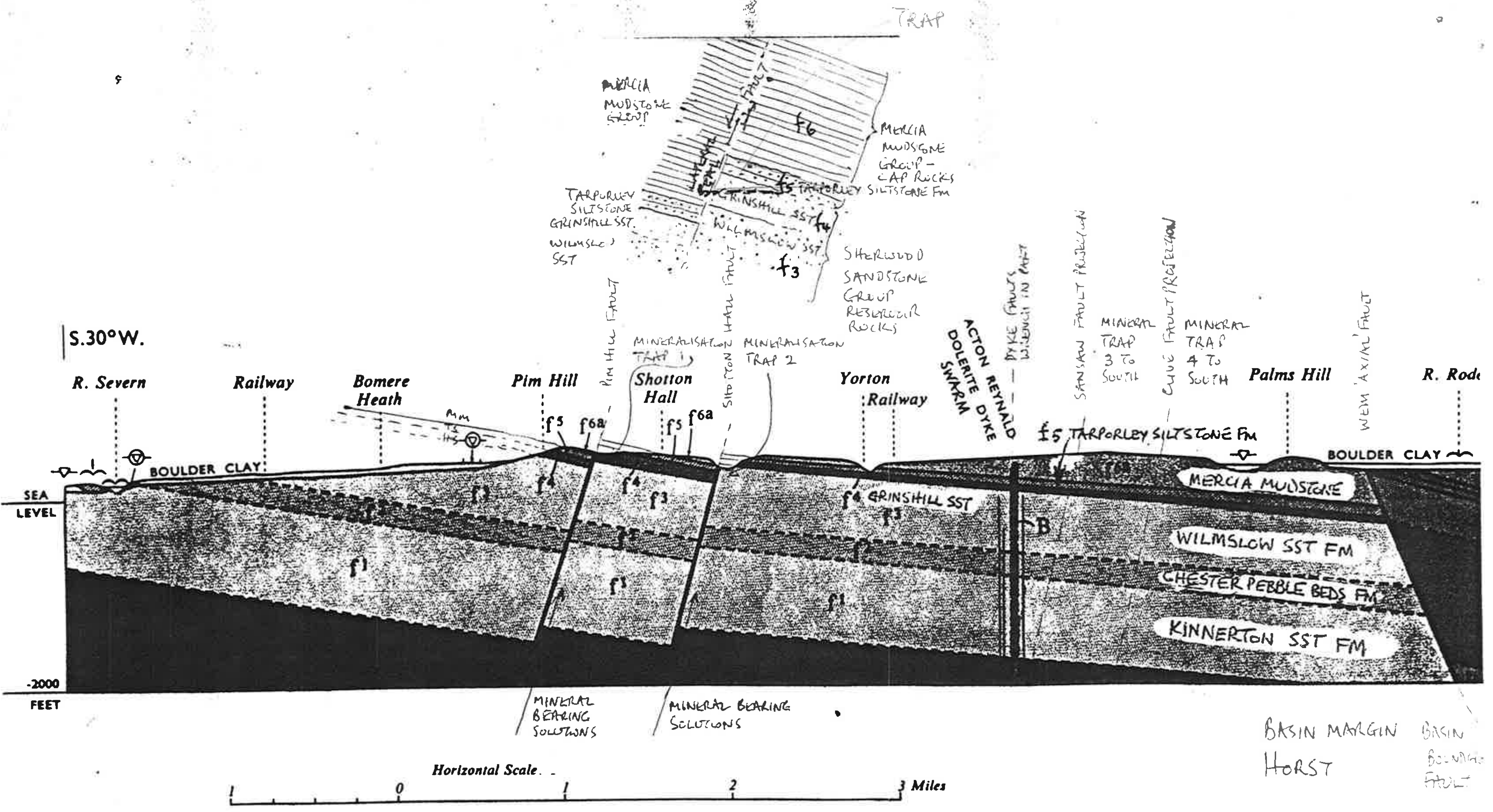
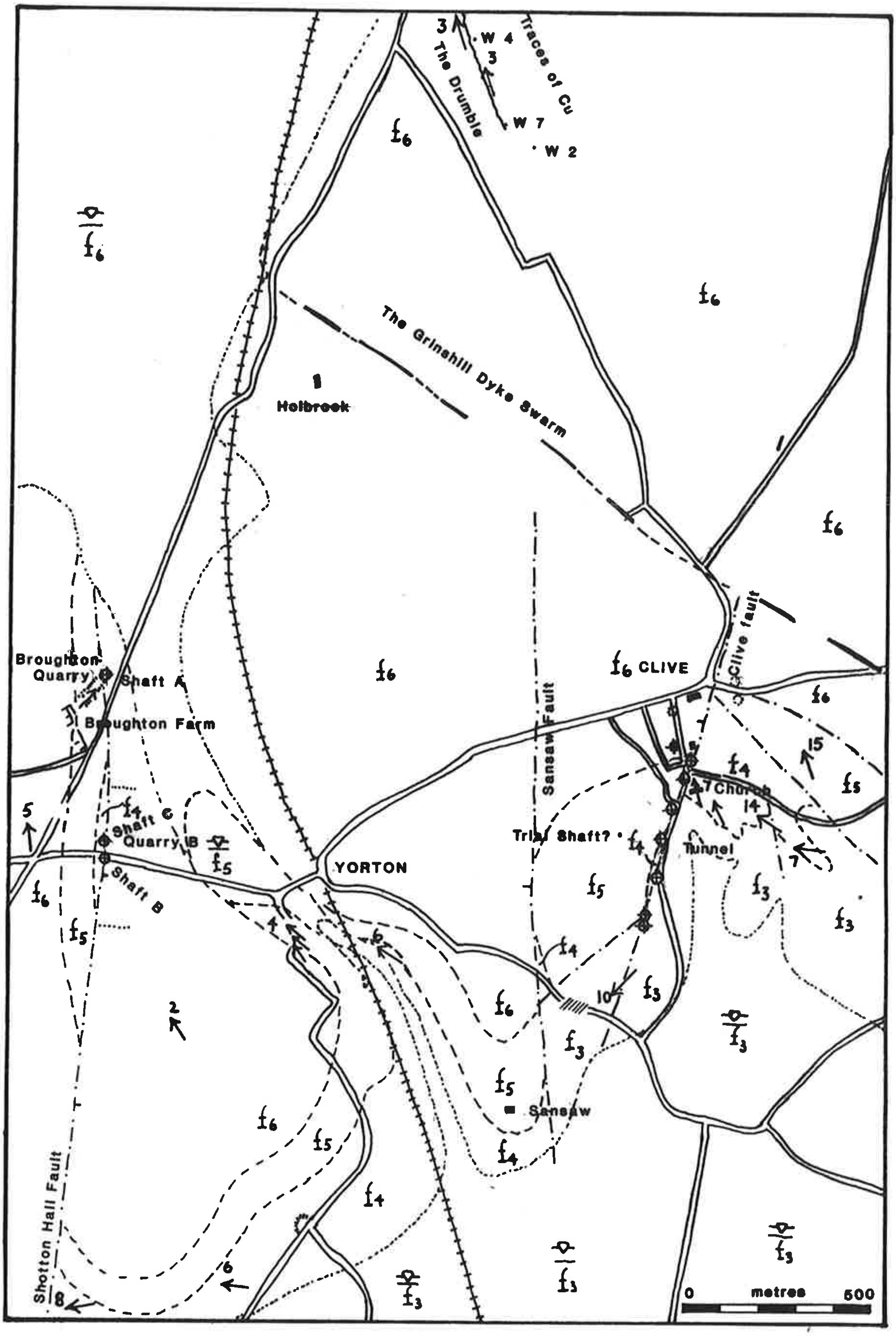


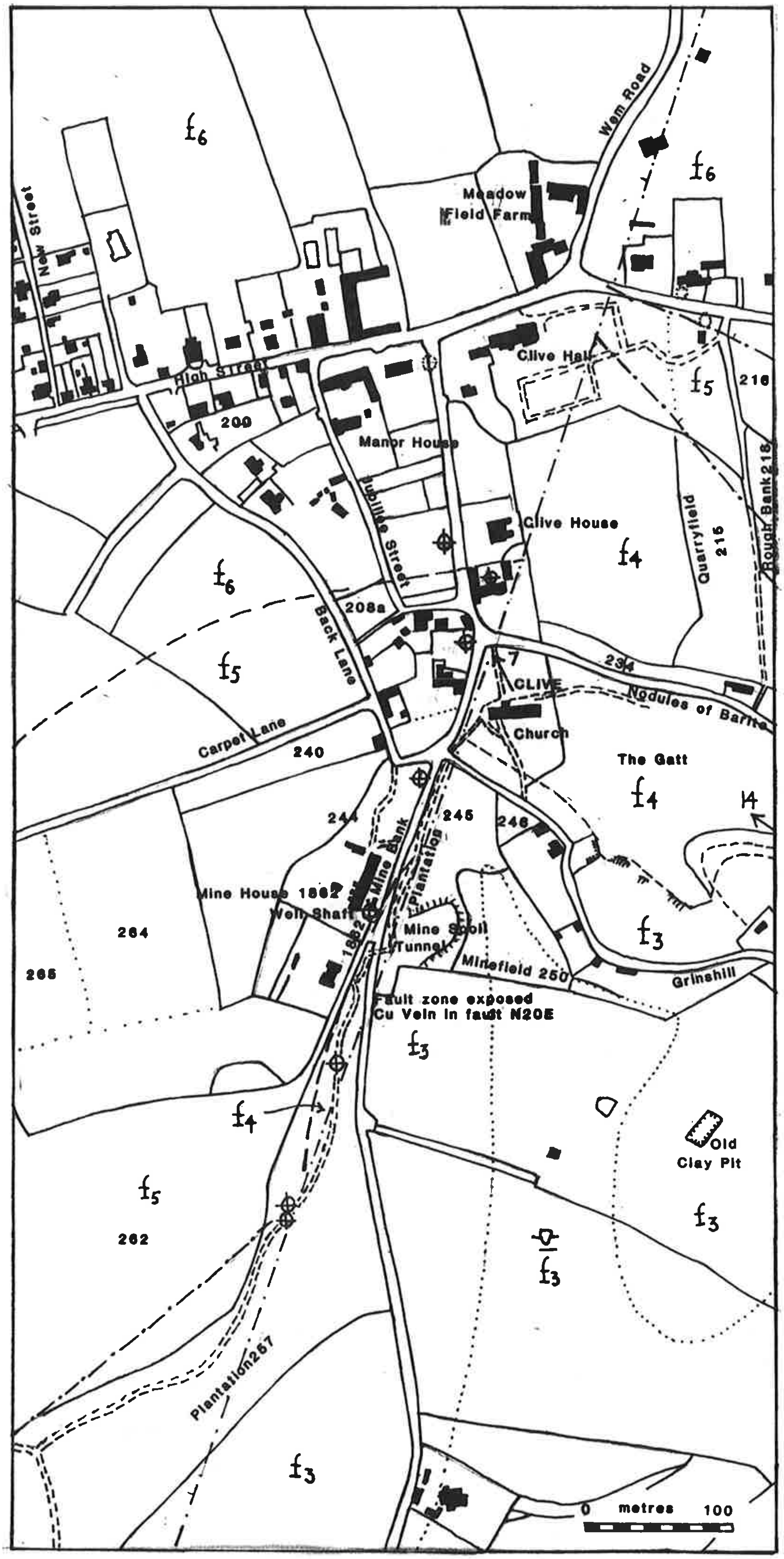
Hawkstone Park
Hawkstone Hall
Hawkstone fault
Hawkstone Park
Hawk Lake
Grotto Hill
Gaiph
Hermitage
The Terrace
Obelisk
Terrace Plantation
Vineyard
Ashway Rough
Cu vein
Neptunes Whim
Red Castle
Monument
Tunnel
Elysian Hill
Urn
White Tower
Weston fault
Brockhurst fault
The Mount
Hawkstone Hotel
WESTON
Old Quarry
Well
Cu Vein
Cu Shaft
WIXHILL
The Citadel
Menagerie Pool
KENSTONE
CHESHIRE PLAIN
Wem fault
Vein ?Cu
Brockhurst fault
Lee Hills
Vein
Old Copper working
Moston Park



S.30°W.
R. Severn
Railway
Bomere Heath
Pim Hill
Shotton Hall
Yorton
Railway
Palms Hill
R. Rode
BOULDER CLAY
SEA LEVEL
-2000 FEET
ACTON REYNALD DOLERITE DYKE SWARM
MERCIA MUDSTONE
WILMSLOW SST FM
CHESTER PEBBLE BEDS FM
KINNERTON SST FM
GRINSHILL SST
TARPORLEY SILTSTONE FM
TRAP
MERCIA MUDSTONE GROUP
MERCIA MUDSTONE GROUP - CAP ROCKS
TARPORLEY SILTSTONE FM
TARPORLEY SILTSTONE
GRINSHILL SST.
WILMSLOW SST
SHERWOOD SANDSTONE GROUP RESERVOIR ROCKS
PIM HILL FAULT
SHOTTON HALL FAULT
MINERALISATION TRAP 1
MINERALISATION TRAP 2
DYKE FAULTS WRENCH IN PART
SANSAW FAULT PROJECTION
CLIVE FAULT PROJECTION
MINERAL TRAP 3 TO SOUTH
MINERAL TRAP 4 TO SOUTH
WEM 'AXIAL' FAULT
MINERAL BEARING SOLUTIONS
MINERAL BEARING SOLUTIONS
BASIN MARGIN HORST
BASIN BOUNDARY FAULT
Horizontal Scale
1 0 1 2 3 Miles



Traces of Cu
The Drumble
W 4
W 7
W 2
The Grinshill Dyke Swarm
Holbrook
Broughton Quarry
Shaft A
Broughton Farm
Shaft C
Quarry B
Shaft B
YORTON
Sansaw Fault
Trial Shaft?
CLIVE
Clive fault
Church
Tunnel
Sansaw
Shotton Hall Fault
0 metres 500



f6
Wem Road
f6
Meadow
Field Farm
New Street
High Street
Clive Hall
f5
216
200
Manor House
Jubilee Street
Clive House
f4
Quarryfield
215
Rough Bank 218
f6
208a
Back Lane
f5
234
CLIVE
Nodules of Barite
Church
Carpet Lane
240
The Gatt
f4
14
244
245
246
Mine Bank
Plantation
Mine House 1862
Well Shaft
1862
Mine Spoil
Tunnel
f3
Minefield 250
Grinshill
264
265
Fault zone exposed
Cu Vein in fault N20E
f3
f4
Old
Clay Pit
f5
262
f3
f3
Plantation267
f3
0 metres 100

GEOCHEMISTRY OF THE GRINSHILL DYKE SWARM

D.B. THOMPSON & J.A. WINCHESTER
(UNIV. KEELE)

	A			B		C			B/C MORGING
Sample	8509	8510	8511	8512	8513	8514	8515	8516	8517
CODE	1 Dyke ? NE margin	1 Cureton Dyke A middle	1 Cureton Dyke A SW margin	Dyke B middle	Dyke B SW edge	1 ? Dyke C N margin	Dyke C middle	Dyke C S side	1 Dykes B/C N. side
SIO2 %	51.68	53	53	50.85	53.01	52.1	52.39	52.73	53.36
TIO2	3.57	2.8	3.08	3	3.5	3.69	3.15	3.01	2.84
AL2O3	29.66	24.71	26.8	23.56	24.37	28.15	27.62	24.31	20.17
FE2O3	.98	5.16	1.95	8.62	4.91	1.43	2.55	5.13	8.92
FEO	0	0	0	0	0	0	0	0	0
MNO	.05	.08	.06	.05	.05	.06	.1	.05	.11
MGO	.51	1.29	.54	1.87	.92	.39	.6	1.23	1.81
CAO	1.02	.99	.9	.95	.92	.96	.92	1.45	1.7
NA2O	.13	.11	.17	.09	.15	.19	.14	.17	1.27
K2O	4.06	3.68	5.54	1.93	4.8	4.21	4.42	3.51	2.67
P2O5	.53	.44	.49	.39	.46	.5	.41	.39	.34
H2O+	8.73	7.88	7.41	9.09	7.64	8.53	8.54	8.88	6.63
S	.02	.01	.02	.02	.02	.02	.02	.01	.01
BA ppm	317	412	493	745	355	361	398	322	979
CE	86	77	114	81	112	100	91	52	55
CL	387	59	90	348	1331	863	1286	4306	136
CR	54	18	39	26	45	77	60	52	11
CU	1	36	17	47	43	20	19	19	29
GA	16	24	18	21	20	17	20	18	23
LA	51	41	57	49	24	44	43	30	11
NB	15	12	15	12	13	14	10	9	10
ND	58	43	64	40	76	54	66	76	43
NI	11	22	12	61	20	8	21	23	60
PB	59	129	101	222	194	116	133	134	59
RB	41	70	62	47	60	44	55	73	35
SR	38	66	54	65	75	44	41	50	81
TH	5	6	9	0	5	4	2	3	3
V	406	345	392	490	498	546	464	439	420
Y	92	96	109	103	104	99	85	81	63
ZN	83	150	97	213	166	85	81	96	40
ZR	376	290	337	253	307	319	265	249	238

	B/C	D=C'		E=B'			CHARES		
Sample	8518	8519	8520	8521	8522	8523	8524	8525	8526
CODE	Dyke B/C middle	1 Dyke D N. side	1 Dyke D middle	1 Dyke E N. side	1 Dyke E middle	Dyke E middle-south	2 middle	2 E margin	2 West margin
SIO2 %	49.42	52.89	45.97	44.34	45.99	47.23	53.04	56.71	56.81
TIO2	2.32	3.24	2.79	2.63	2.4	2.18	2.65	2.68	2.73
AL2O3	17.09	21.09	19.41	18.52	16.22	14.46	21.66	18.84	20.06
FE2O3	9.4	5.11	7.46	6.64	8.7	9.33	7.96	7.24	6.01
FEO	0	0	0	0	0	0	0	0	0
MNO	.08	.05	.11	.08	.1	.11	.16	.09	.08
MGO	2.26	1.99	1.66	2.24	3.54	3.42	.94	1.61	1.27
CAO	7.72	2.6	6.53	8.92	8.78	9.12	4.43	.83	.87
NA2O	2.21	.33	.61	.27	.62	1.5	3.02	.27	.19
K2O	1.53	3.88	2.93	2.07	1.63	1.15	2.28	4.48	4.97
P2O5	.28	.41	.38	.36	.39	.41	.78	.63	.73
H2O+	7.46	8.19	10.55	12.97	9.87	9.58	4	6.34	6.5
S	.03	.01	.01	.02	.11	.07	.02	.01	.01
BA ppm	3329	135	288	1719	512	1739	1497	659	503
CE	50	71	51	55	53	23	59	135	118
CL	324	96	67	73	59	69	94	67	74
CR	1	50	8	4	1	1	28	1	1
CU	62	90	100	94	83	74	35	31	16
GA	20	28	29	23	26	20	21	20	17
LA	8	26	17	22	5	10	19	38	33
NB	10	14	12	12	15	14	12	19	21
ND	37	34	44	38	44	23	18	64	82
NI	37	32	49	35	11	10	37	14	26
PB	27	2342	1077	1521	662	307	78	65	78
RB	24	49	50	28	24	20	27	64	61
SR	189	34	45	87	80	123	228	35	41
TH	3	25	9	12	6	4	2	5	9
V	380	501	409	407	344	273	436	284	242
Y	54	85	87	76	75	81	66	108	127
ZN	34	5424	9933	5627	4823	1617	42	27	21
ZR	203	296	263	258	261	279	232	409	461