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THE STRUCTURE AND EVOLUTION OF THE  
WESSEX BASIN

by

STUART DAVID LAKE B.Sc.

VOL II

A thesis submitted to the University of Durham  
for the degree of Doctor of Philosophy.

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Department of Geological Sciences, December 1985.



15. APR. 1986



NORTH  
COOLES FARM

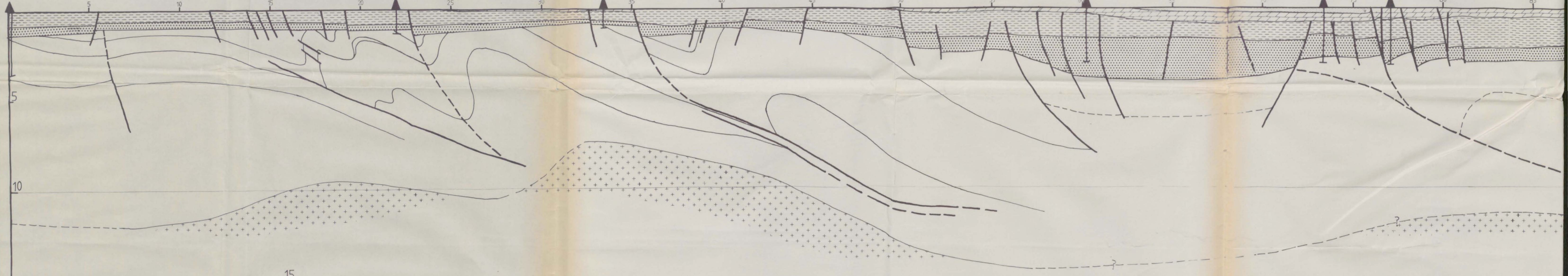
DEVIZES

BRUTON (10Km to west)


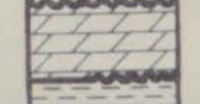

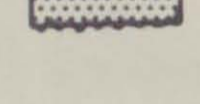
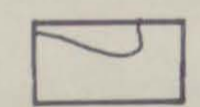
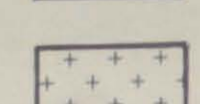
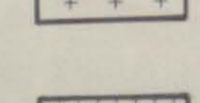
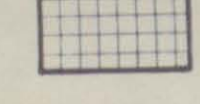
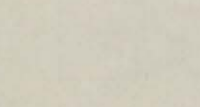
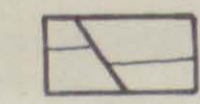

WINTERBORNE KINGSTON

WYTCH FARM

ARRETON (50Km to east)



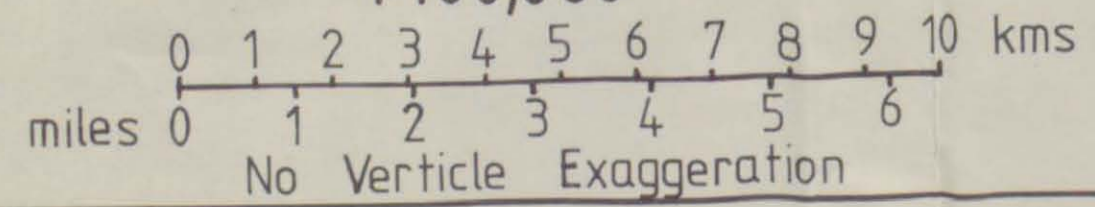
KEY

-  TERTIARY SEDIMENTS
-  infill
-  Basin
-  CRETACEOUS SEDIMENTS
-  JURASSIC SEDIMENTS
-  PERMO-TRIAS SEDIMENTS
-  UPPER CARBONIFEROUS TO PROTEROZOIC VOLCANICS AND SEDS
-  OLDER PRECAMBRIAN BASEMENT
-  MOHO (Max and Min depth)
-  FAULT
-  BOREHOLE CONTROL

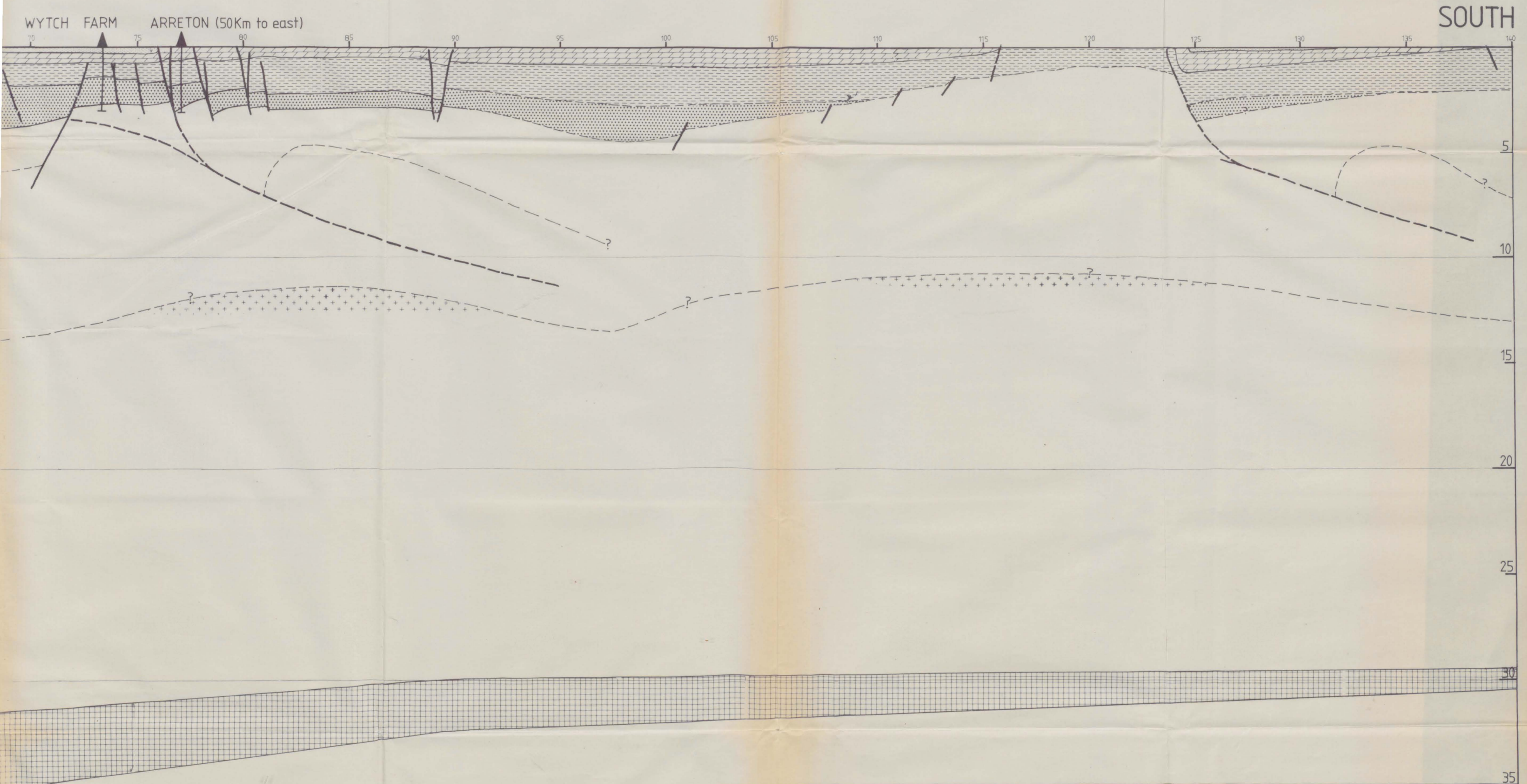
Durham University NERC

SCALE

1:100,000



15  
20  
25  
30  
35  
40

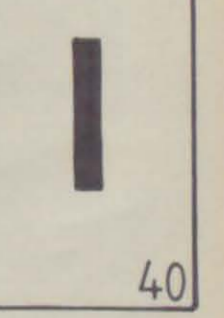


WYTCH FARM      ARRETON (50Km to east)

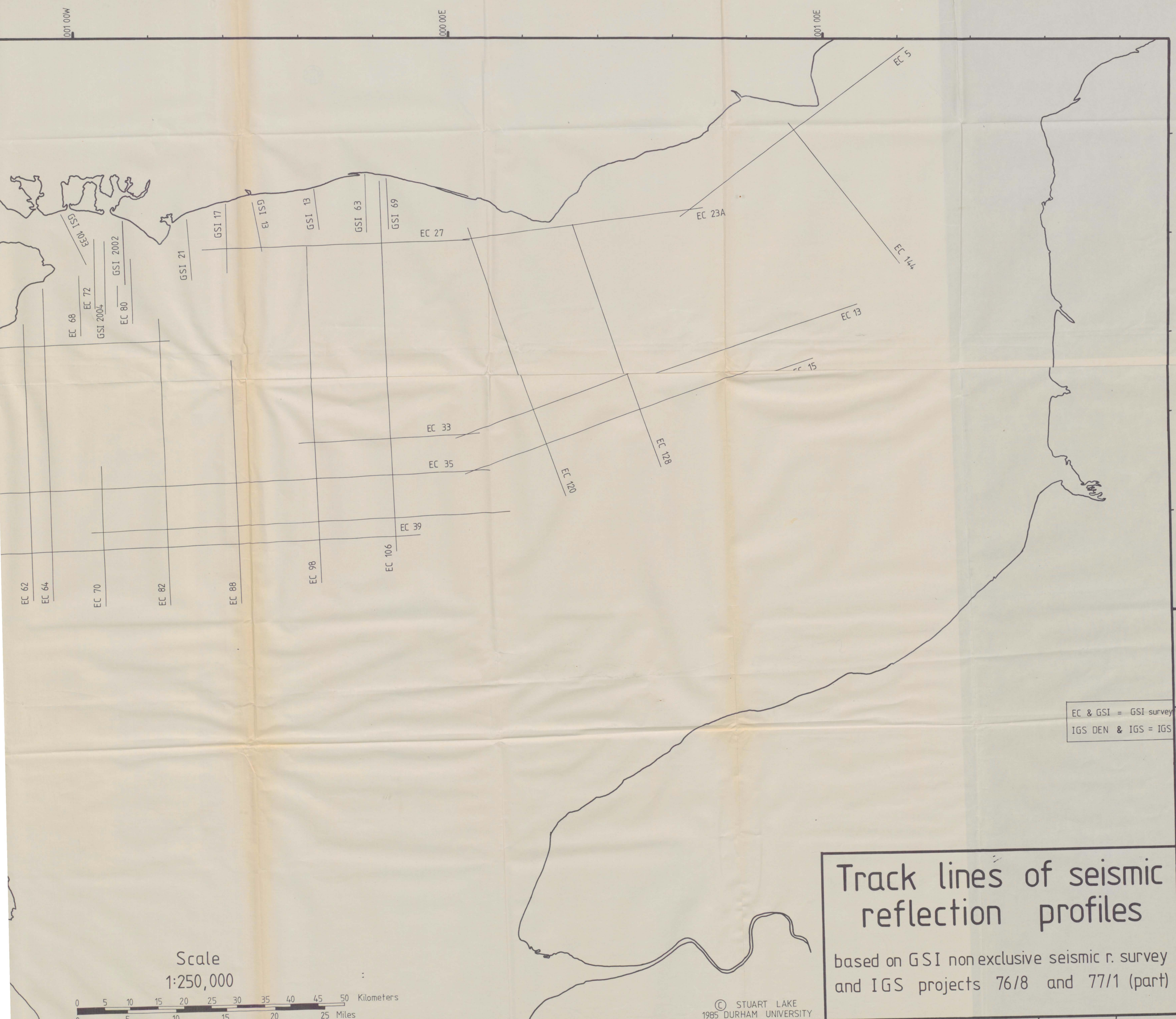
SOUTH

STUART LAKE  
 Sources:-  
 CHADWICK et al 1983  
 COLTER & HARVARD 1981  
 DINGWALL 1971  
 BAMFORD et al 1976  
 etc

STRUCTURAL PROFILE ACROSS THE  
WESSEX BASIN



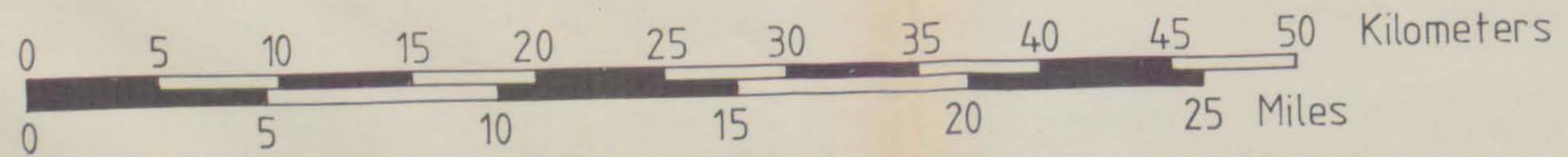


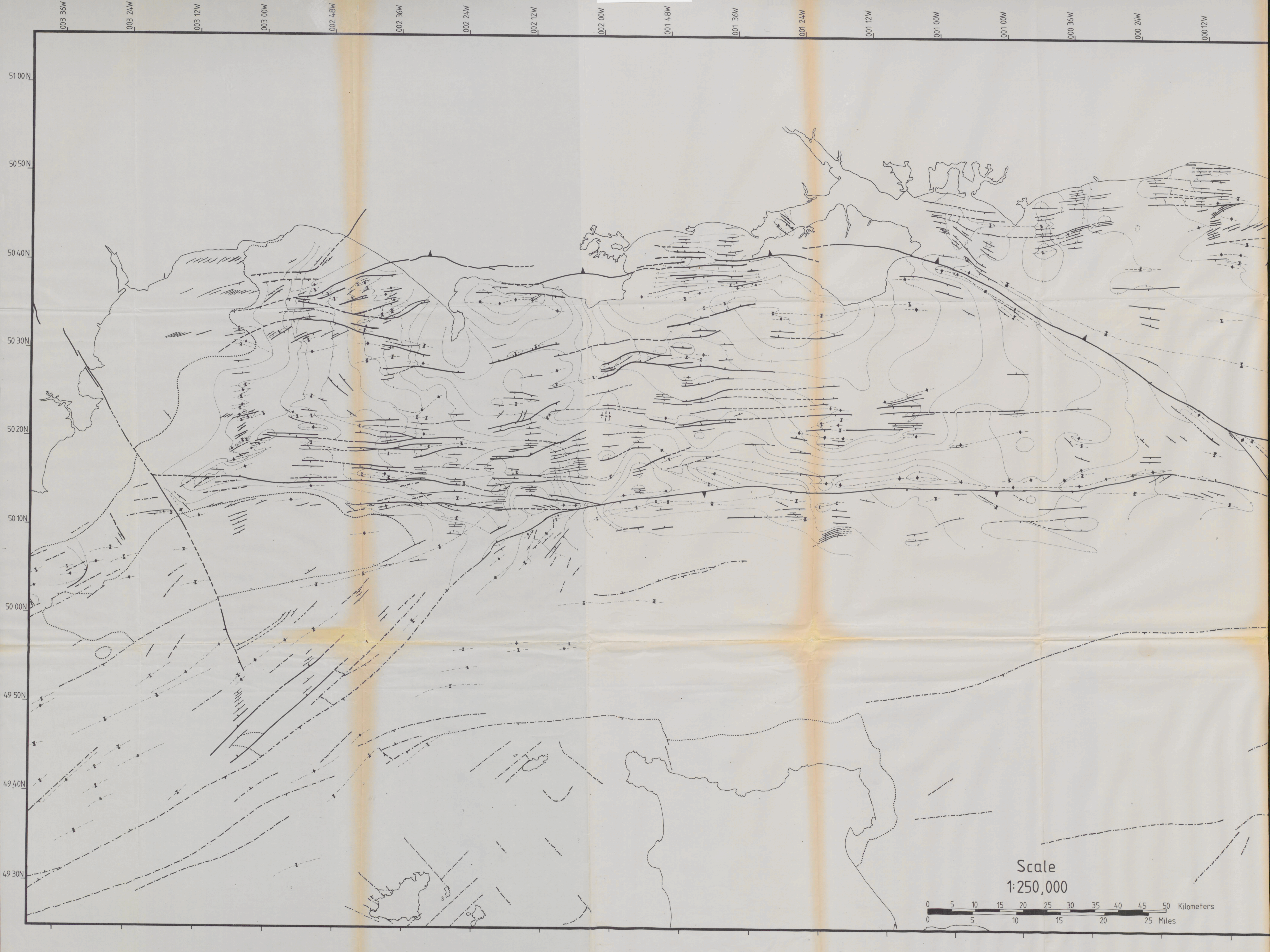


EC & GSI = GSI survey  
 IGS DEN & IGS = IGS

**Track lines of seismic reflection profiles**  
 based on GSI non exclusive seismic r. survey and IGS projects 76/8 and 77/1 (part)

Scale  
 1:250,000

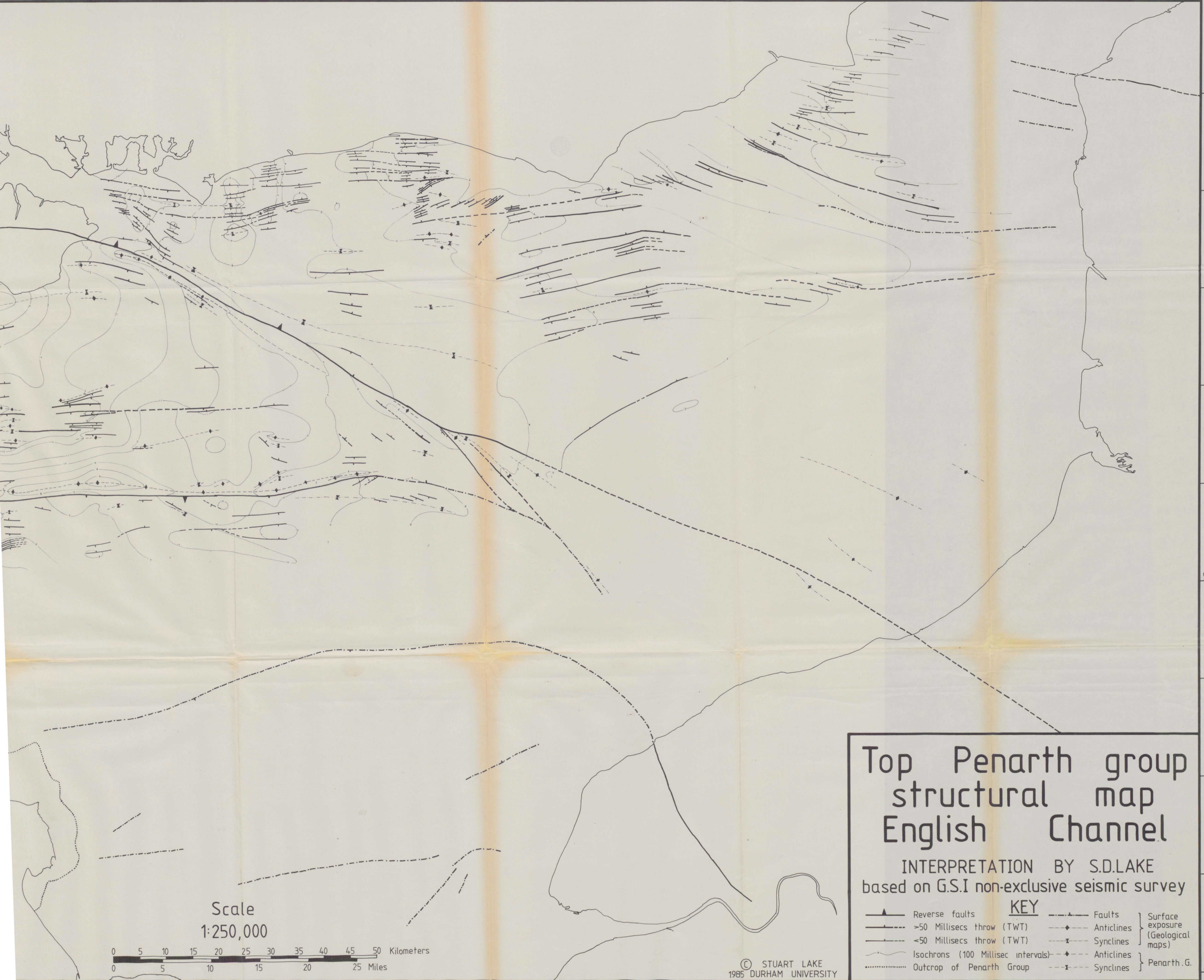




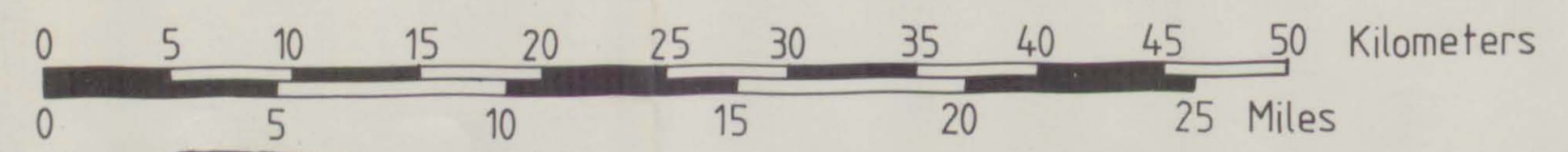


001 12W 001 00W 001 00W 000 36W 000 24W 000 12W 000 00E 000 12E 000 24E 000 36E 000 48E 001 00E 001 12E 001 24E 001 36E 001 48E

1123



Scale  
1:250,000



# Top Penarth group structural map English Channel

INTERPRETATION BY S.D.LAKE  
based on G.S.I non-exclusive seismic survey

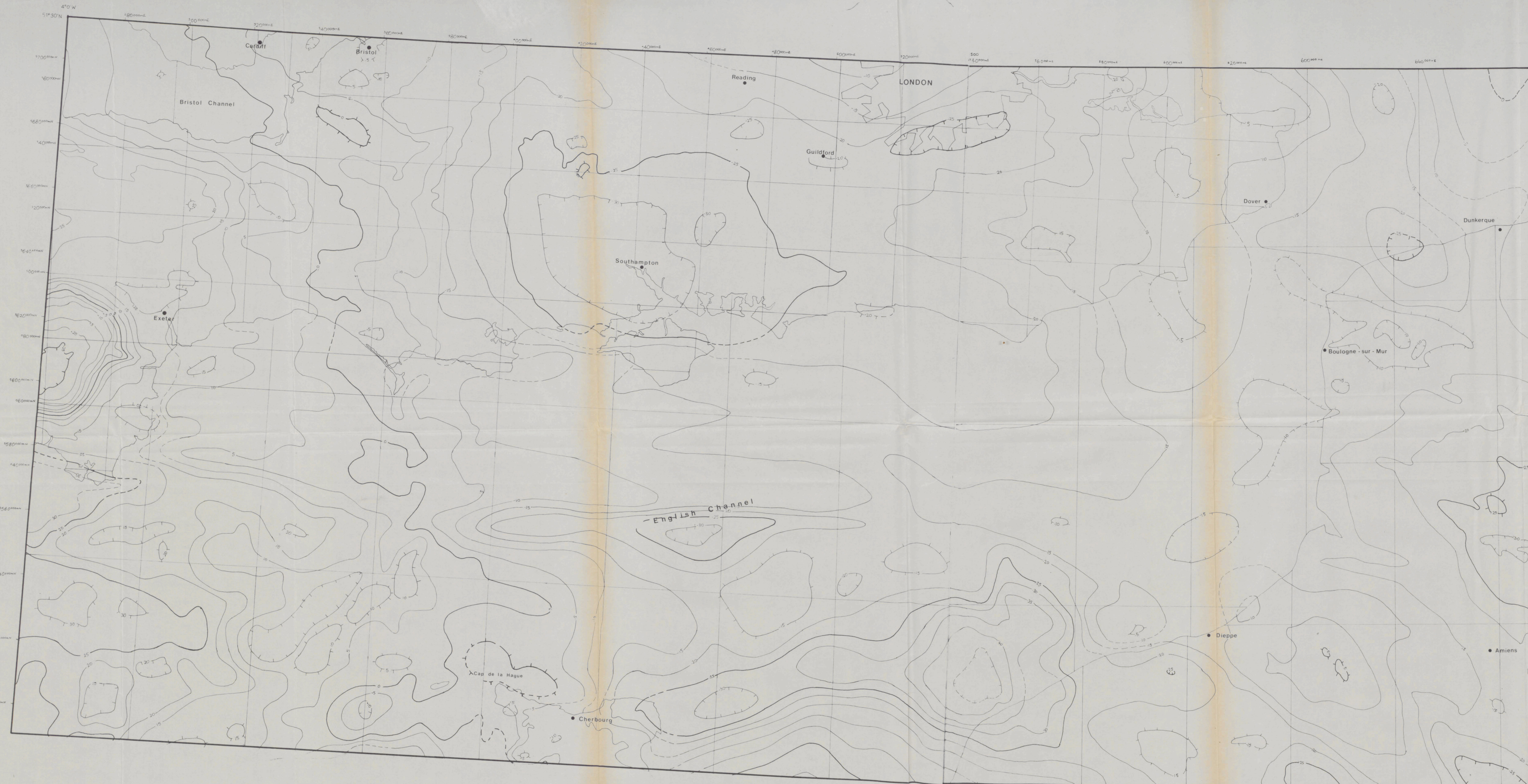
### KEY

- |       |                                    |     |            |                                      |
|-------|------------------------------------|-----|------------|--------------------------------------|
| ▲     | Reverse faults                     | —◆— | Faults     | } Surface exposure (Geological maps) |
| —◆—   | >50 Millisecs throw (TWT)          | —x— | Anticlines |                                      |
| —x—   | <50 Millisecs throw (TWT)          | —◆— | Synclines  | } Penarth.G.                         |
| —     | Isochrons (100 Millisec intervals) | —x— | Anticlines |                                      |
| ..... | Outcrop of Penarth Group           | —x— | Synclines  |                                      |

© STUART LAKE  
1985 DURHAM UNIVERSITY

50 00N

000 00E



COMPOSITE BOUGUER  
GRAVITY ANOMALY  
MAP, WESSEX BASIN

1:500,000

REDRAWN FROM B.G.S SOURCES

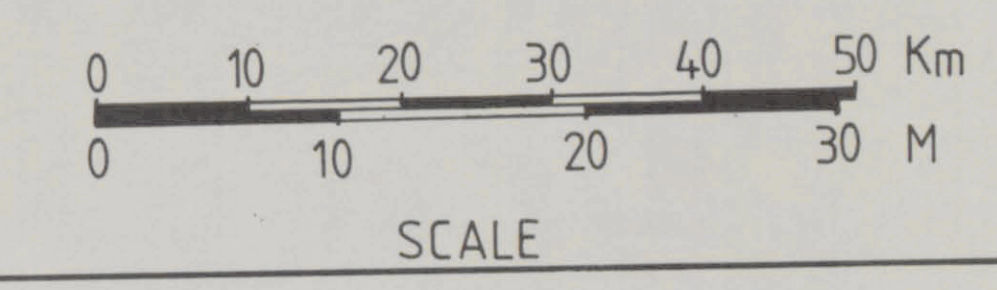
KEY

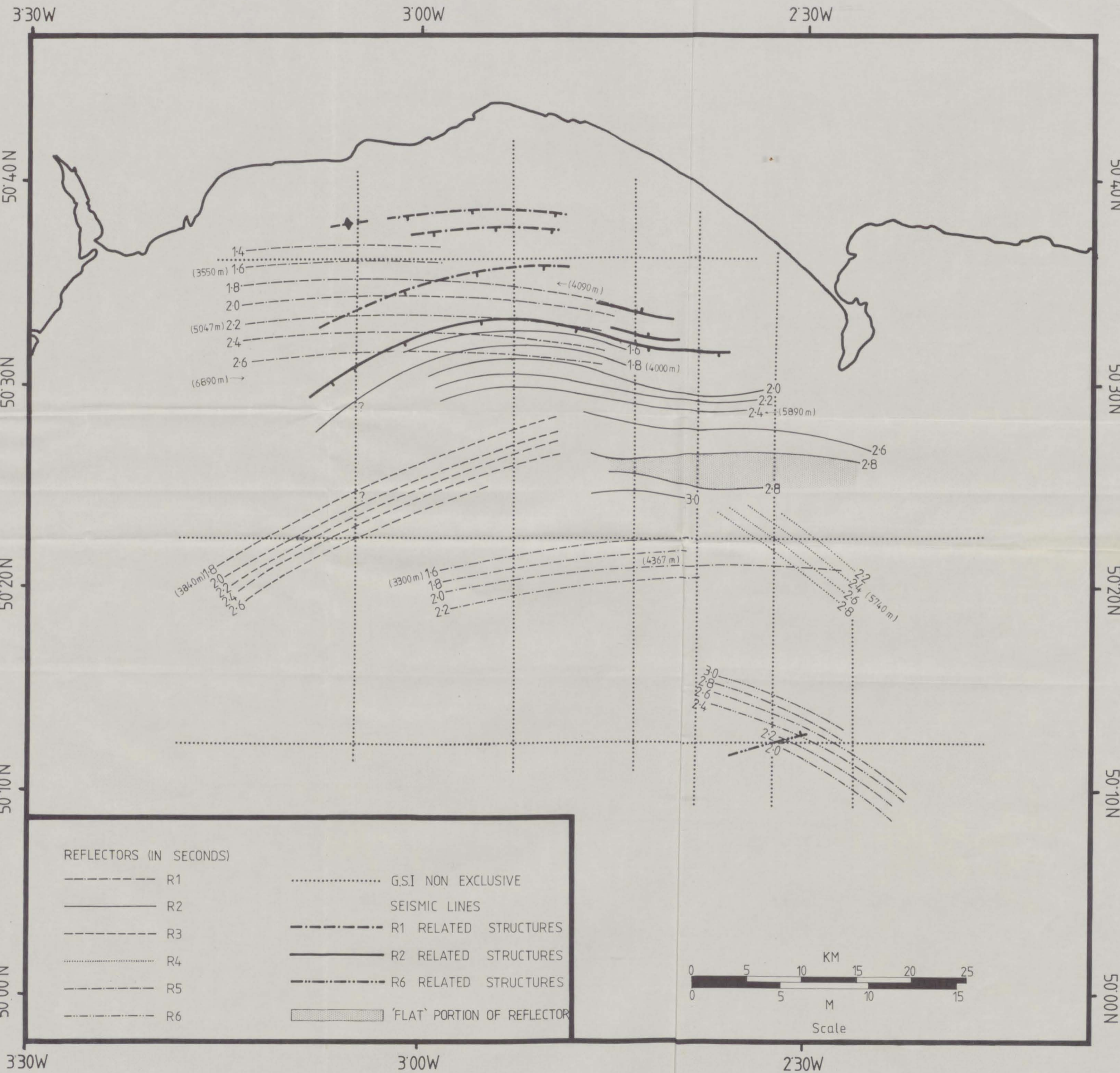
- ISOGAL VALUES IN MILLIGAL  
LINES AT 5mGal INTERVALS
- ANOMALY HIGH
- ANOMALY LOW

SOURCES

- U.K. DATA
- IGS 1:250,000 BOUGUER GRAVITY  
ADDITIONAL UNPUBLISHED DATA
- FRENCH DATA
- B.R.G.M 1:80,000 CARTES  
GRAVIMÉTRIQUES DE LA FRANCE

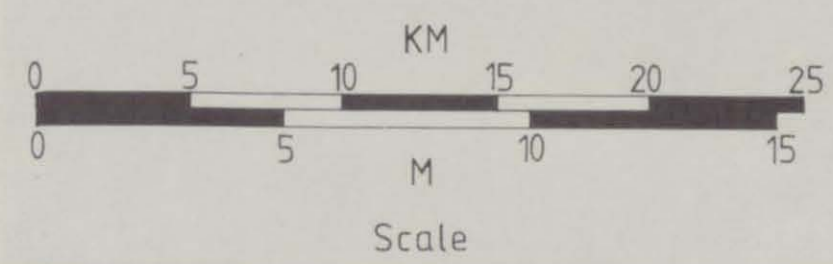
International Gravity Formula 1967  
-5mGal applied to B.R.G.M data to  
convert to I.G.F 1967 and N.G.R.N 1973





REFLECTORS (IN SECONDS)

- |              |                                 |
|--------------|---------------------------------|
| ----- R1     | ..... G.S.I NON EXCLUSIVE       |
| ———— R2      | SEISMIC LINES                   |
| - · - · - R3 | - · - · - R1 RELATED STRUCTURES |
| ..... R4     | ———— R2 RELATED STRUCTURES      |
| ----- R5     | - · - · - R6 RELATED STRUCTURES |
| - · - · - R6 | ▨ 'FLAT' PORTION OF REFLECTOR   |



# PRE APTIAN SUBCROP MAP

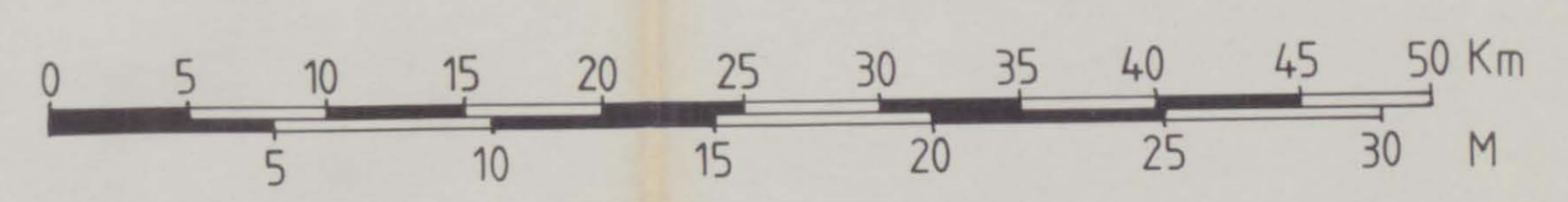
- LITHOLOGICAL BOUNDARIES
- - - - WESTWARD EROSIONAL LIMIT OF LOWER GREENSAND
- · - · - WESTWARD LIMIT OF GAULT
- - - - FAULTS

H1	WEALDEN
G14	PURBECK
G13	PORTLAND
G12	KIMMERIDGE CLAY
G9-11	CORNBRASH TO CORALLIAN
G5-8	INFERIOR OOLITE TO FOREST MARBLE
G1-4	LOWER JURASSIC
F	TRIASSIC
E	PERMIAN
B	BASEMENT

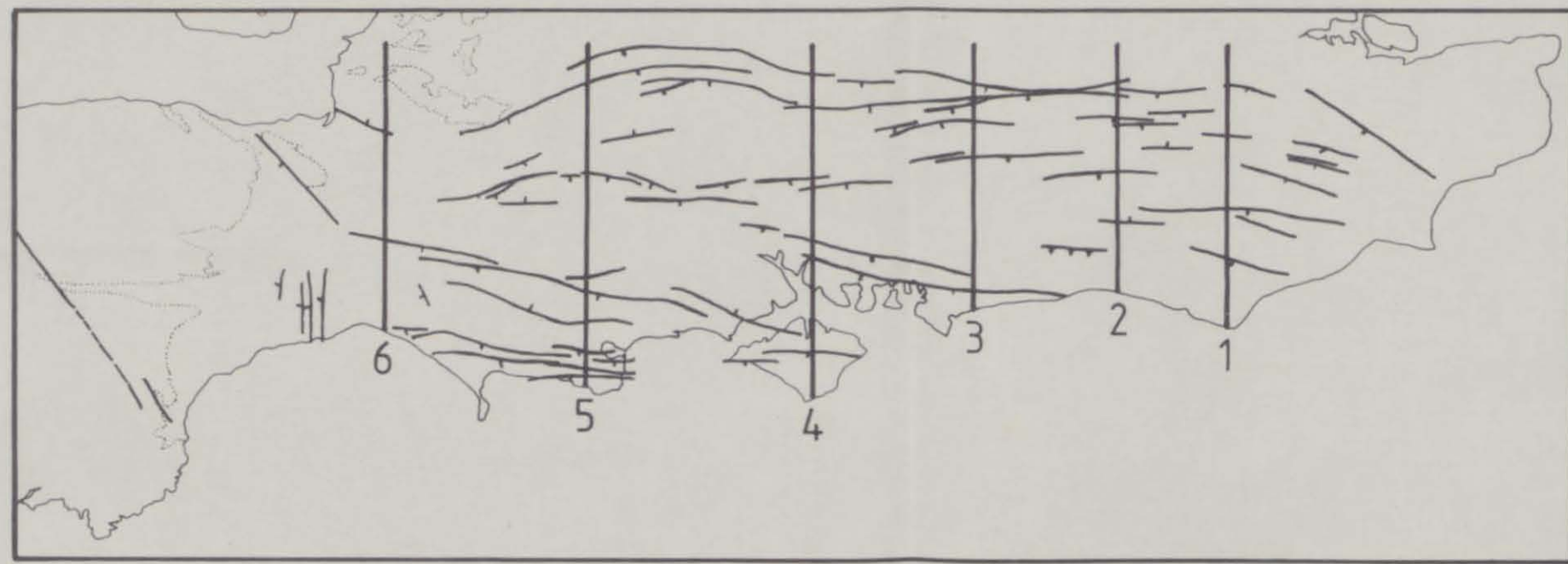
LAKE 1985



Grid N



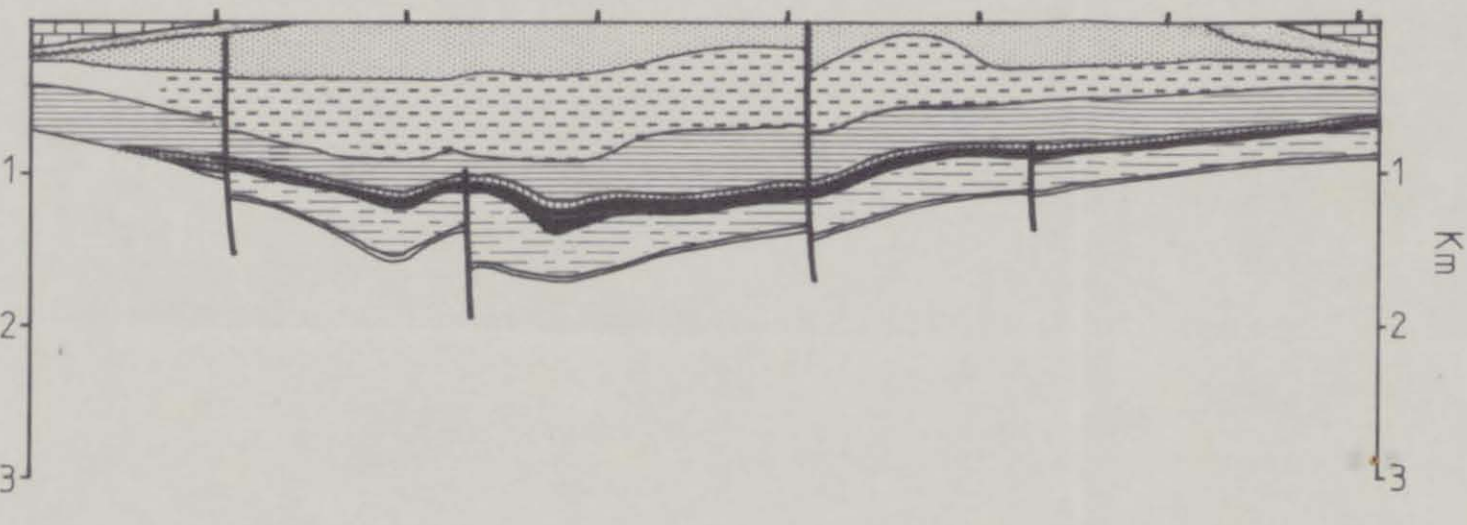
Scale



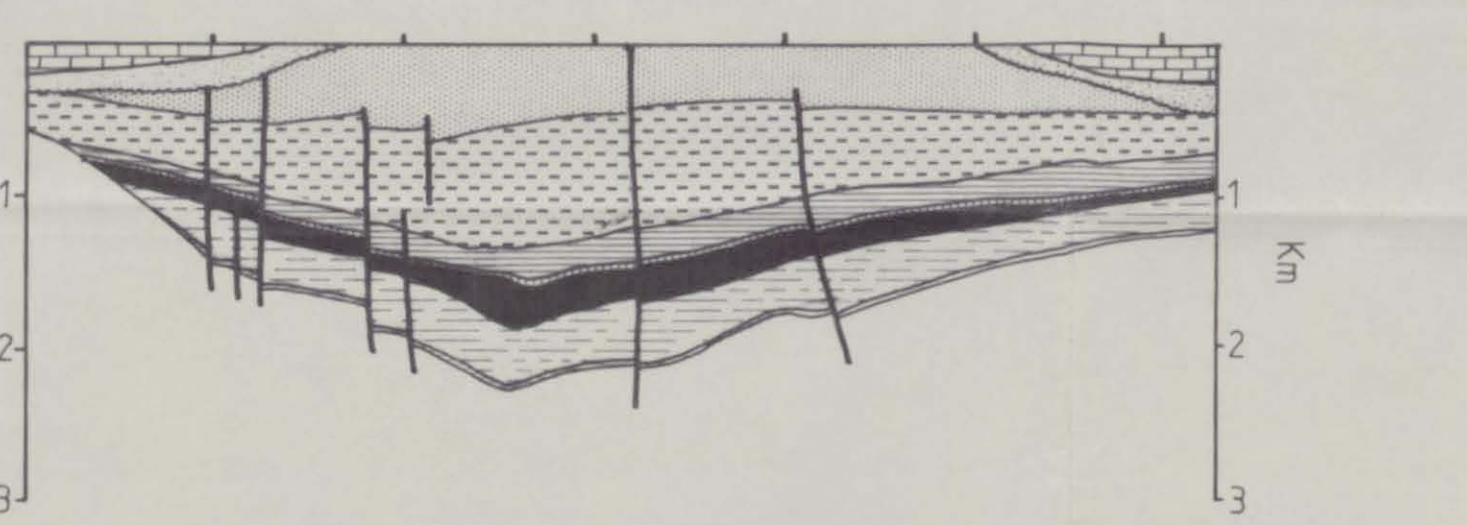
North

South

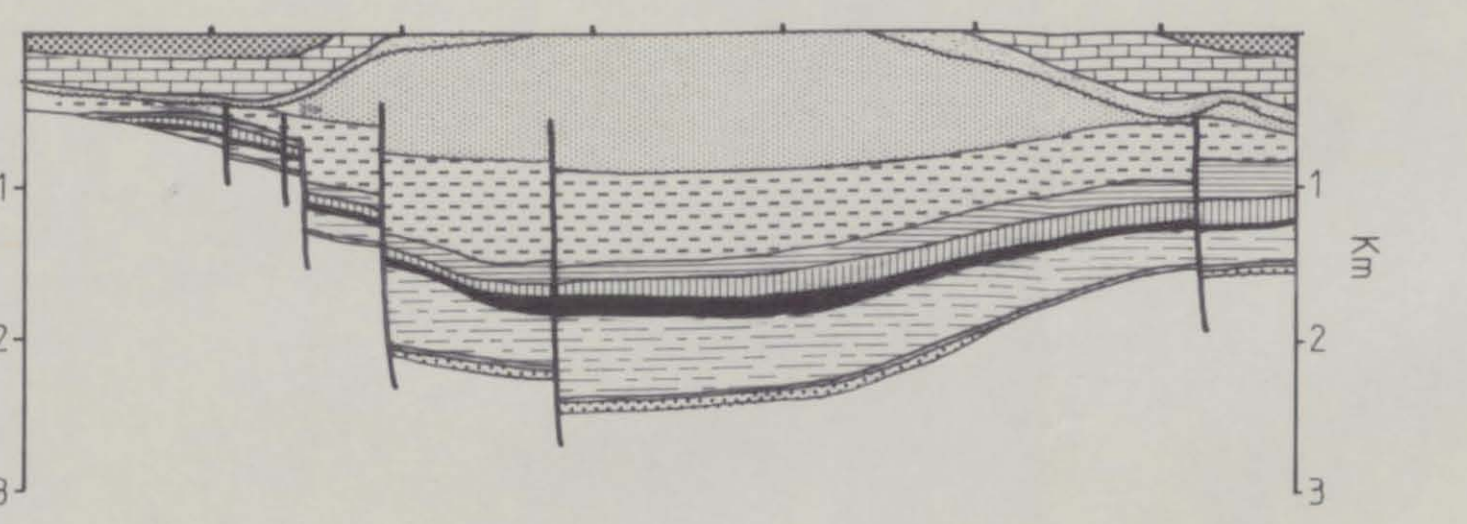
①



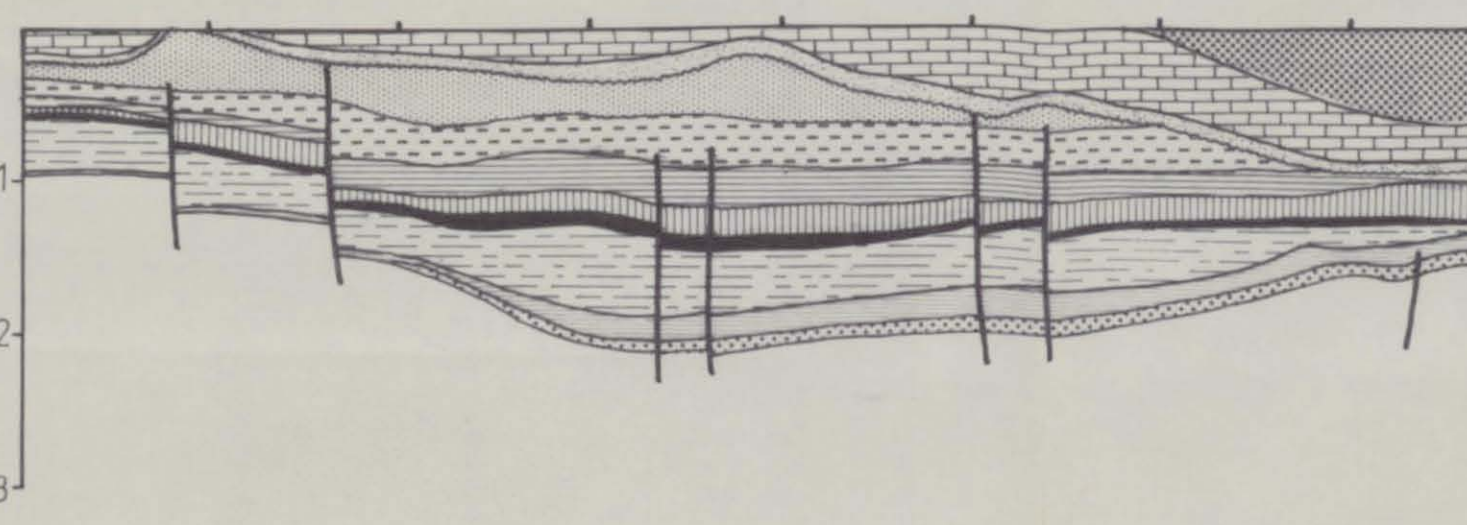
②



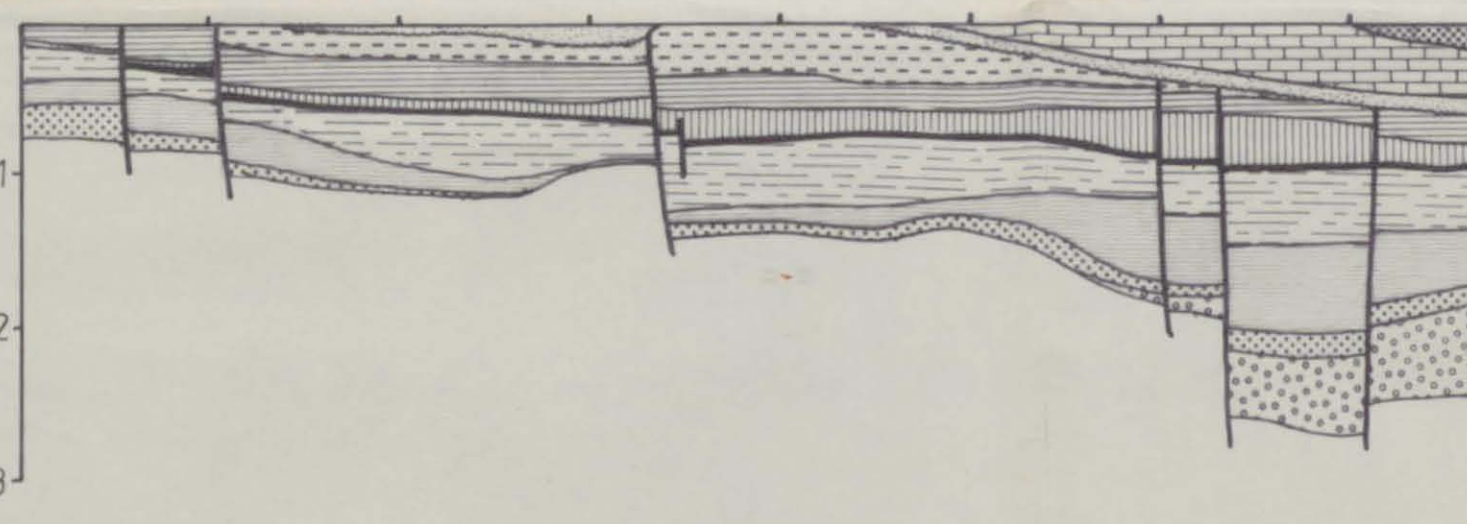
③



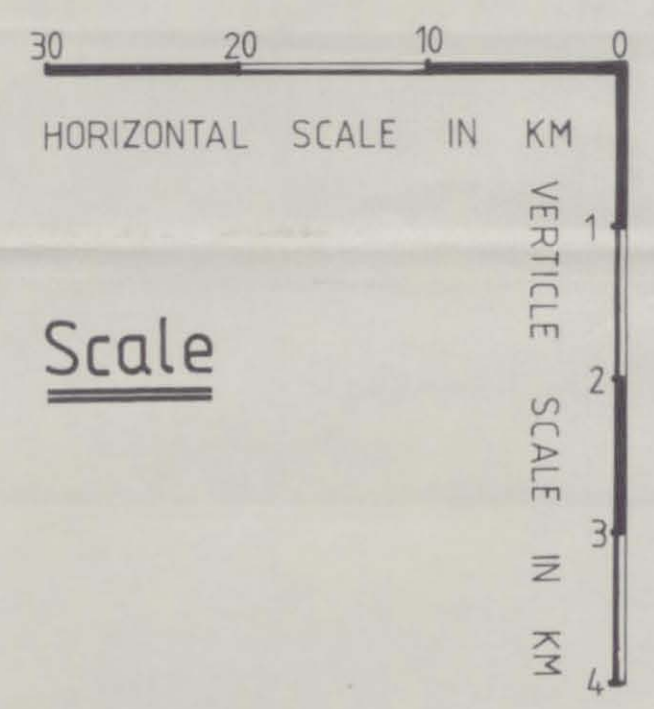
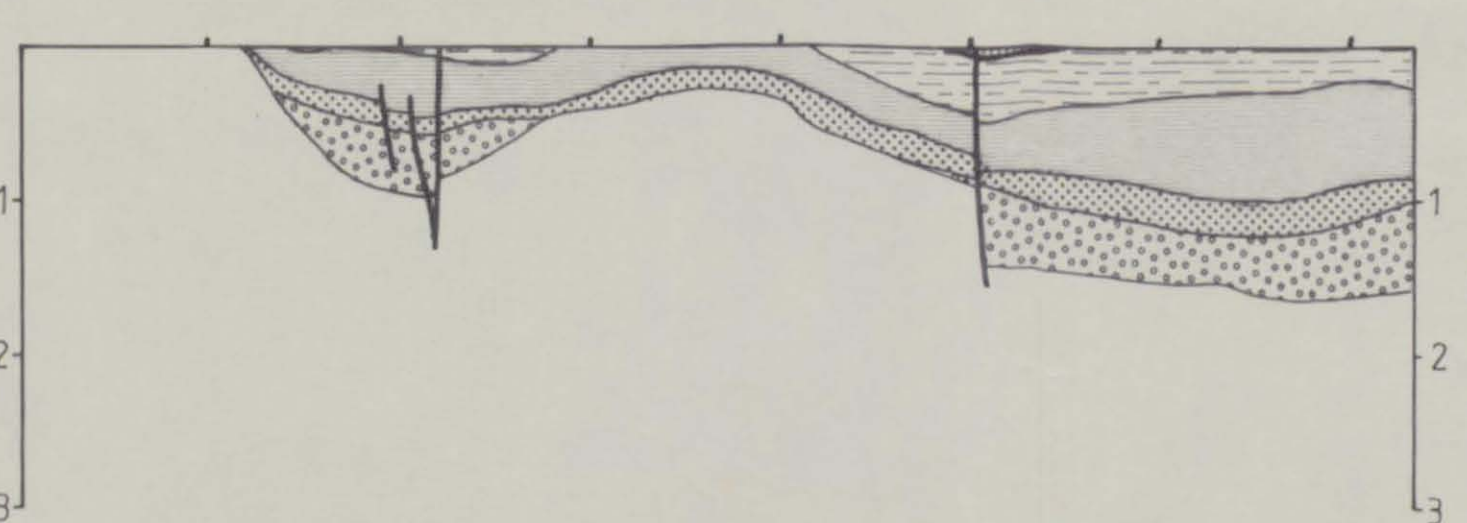
④



⑤

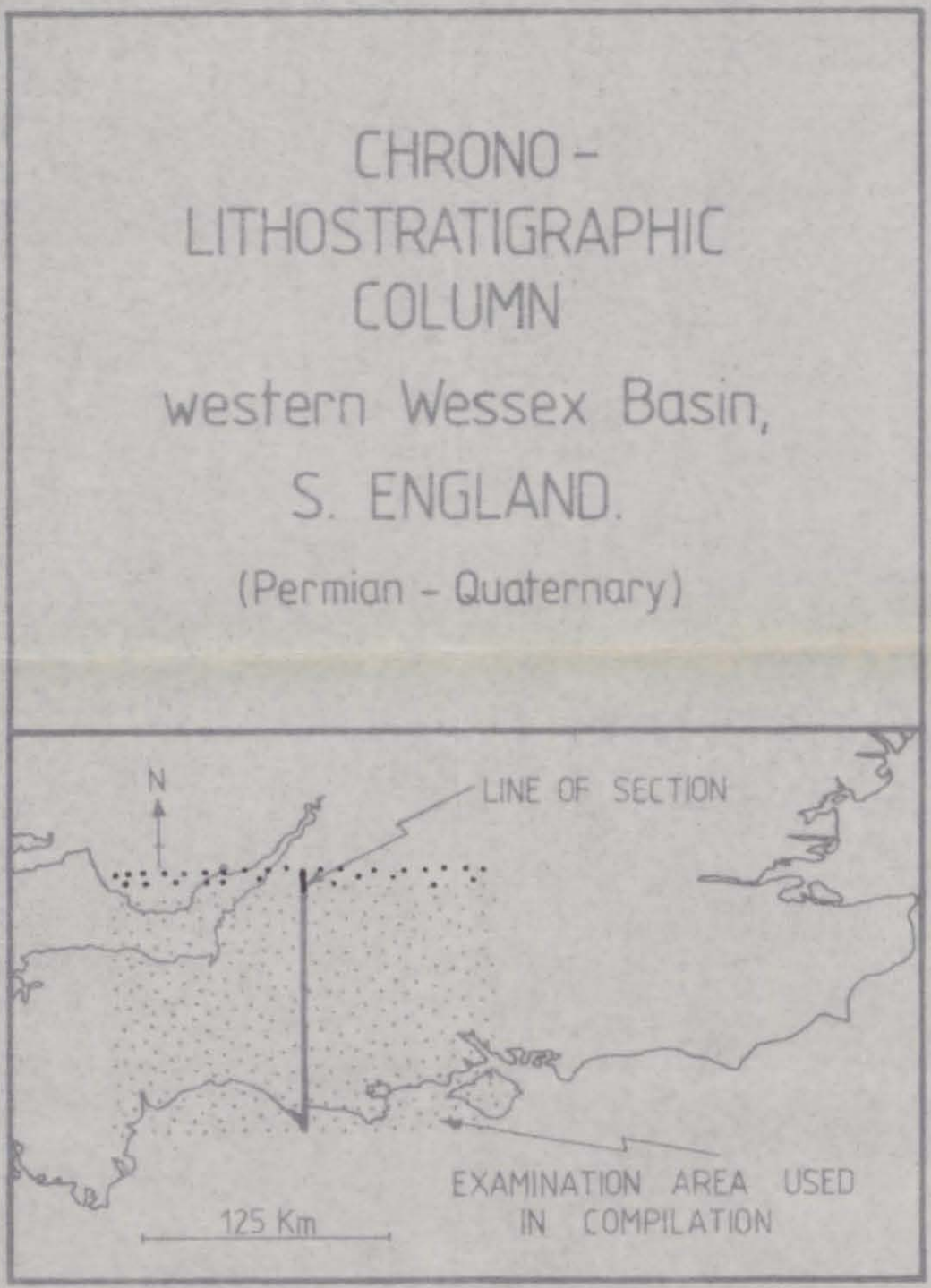


⑥

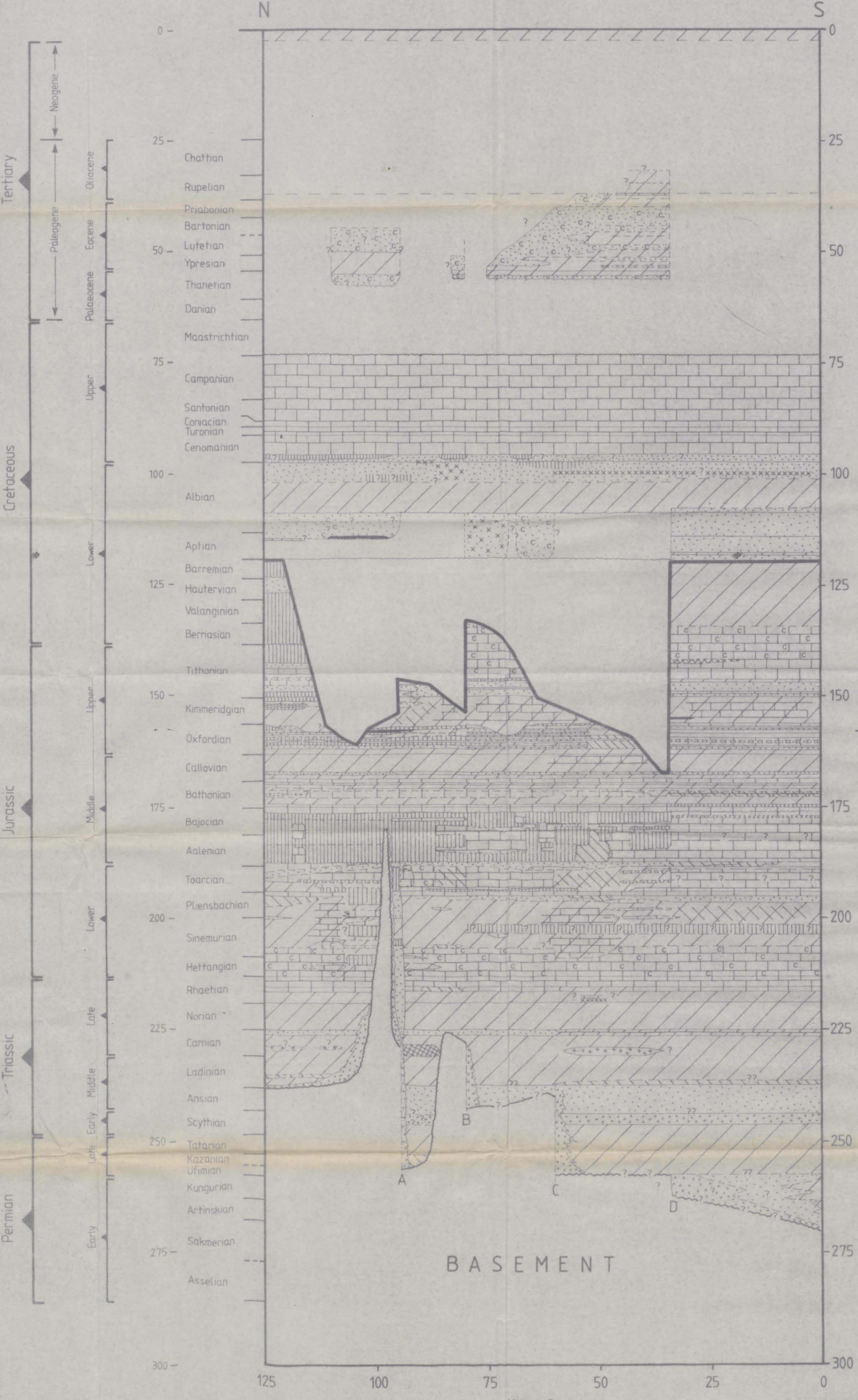


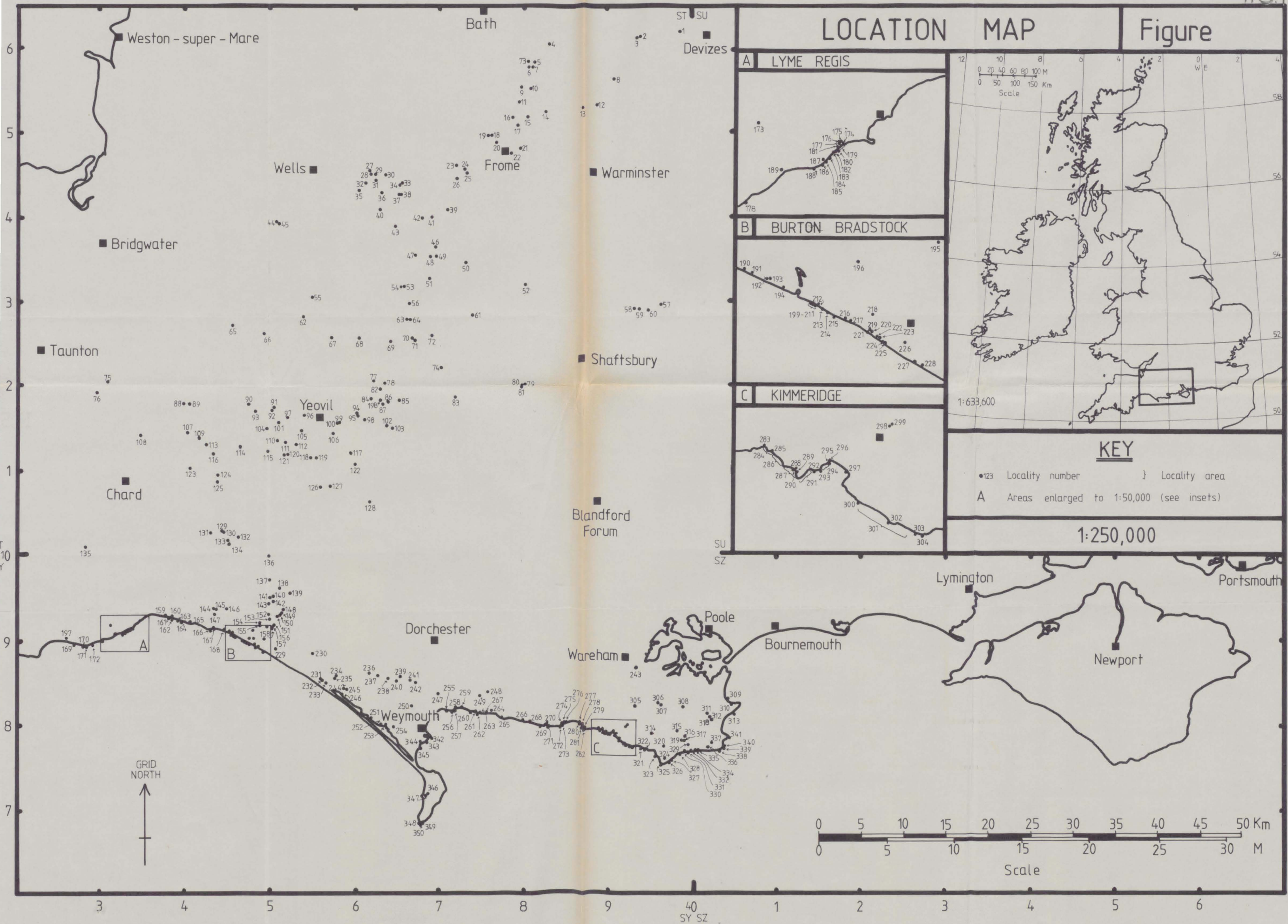
KEY

	TERTIARY FORMATIONS		PORTLAND, KIMMERIDGE, CORALLIAN		LIAS
	CHALK		CORALLIAN (part), OXFORD CLAY, KELLAWAYS		PENARTH GROUP, MERCIA MUDSTONE GROUP
	UPPER GREENSAND, GAULT, LOWER GREENSAND		GREAT OOLITE GROUP		SHERWOOD SANDSTONE GROUP
	WEALDEN, PURBECK		INFERIOR OOLITE		PERMIAN



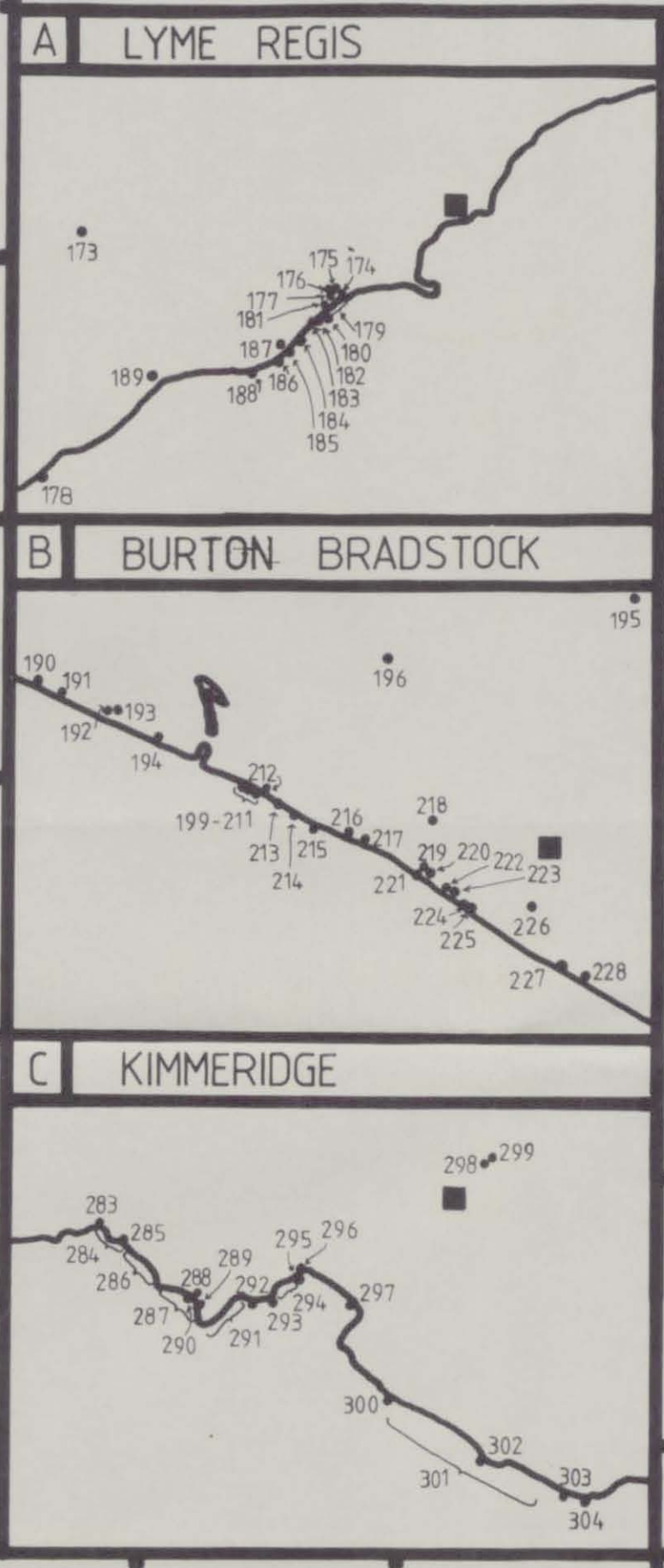
- KEY**
- major growth faults
  - Aptian/Albian unconformity
  - unconformity
- LITHOGRAPHY**
- Absent
  - mudstone/shale/marl
  - sandstone/clay alternating
  - limestone
  - sandstone
  - limestone/clay
  - shale predominant - limestone local
  - siltstone
  - silty mudstone
  - non sequence
  - silty limestone
  - conglomerates & marginal deposits
  - halite
  - anhydrite
  - dolomite
  - possibly diachronous boundary
  - chert
  - iron ore





# LOCATION MAP

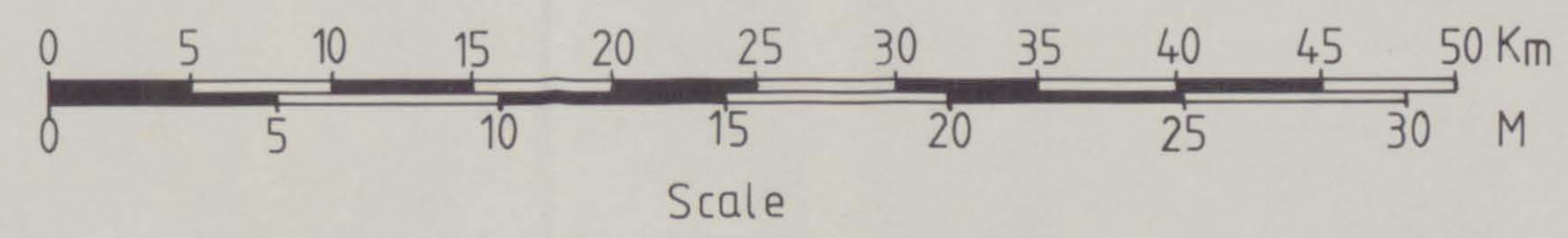
# Figure



## KEY

- 123 Locality number
- } Locality area
- A Areas enlarged to 1:50,000 (see insets)

1:250,000



GRID NORTH

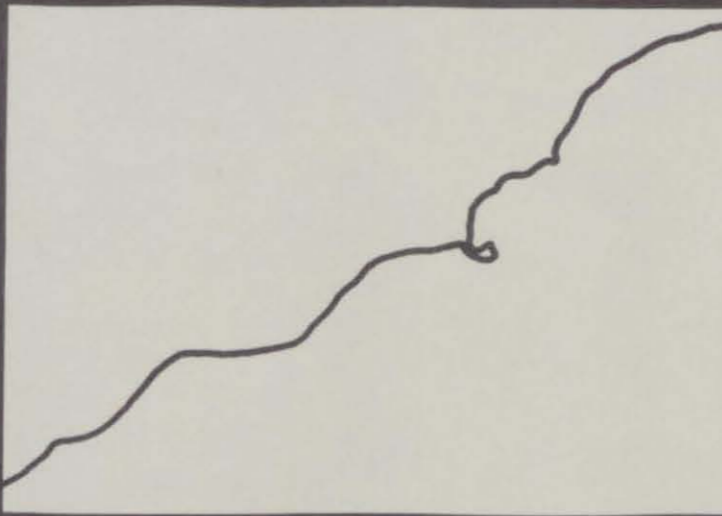


SY SZ

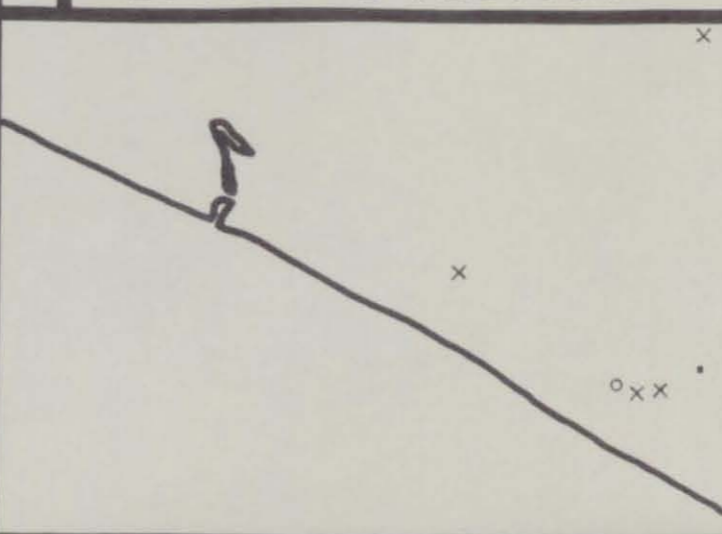


### ADDITIONAL JURASSIC LOCALITIES

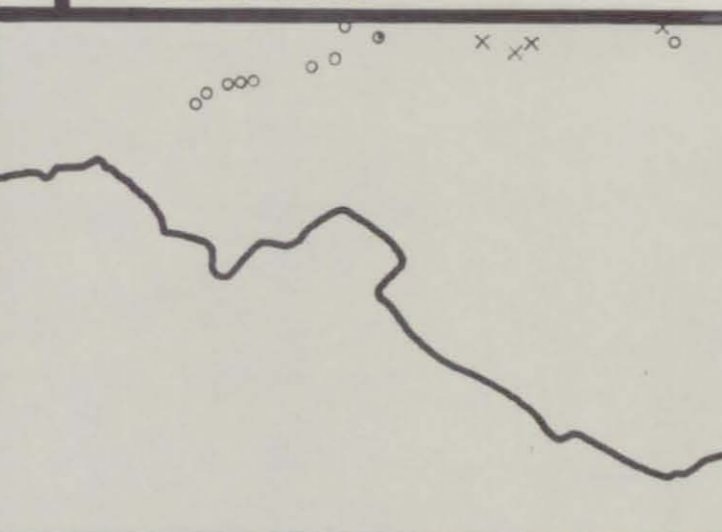
A LYME REGIS



B BURTON BRADSTOCK



C KIMMERIDGE

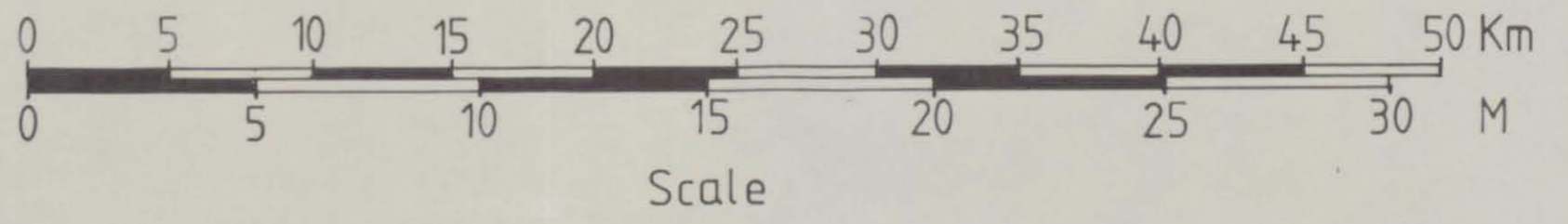


#### KEY

- x NO EXPOSURE
- o SMALL EXPOSURE
- UNVISITED
- NO SIGNIFICANT KINEMATIC INDICATORS

1:250,000

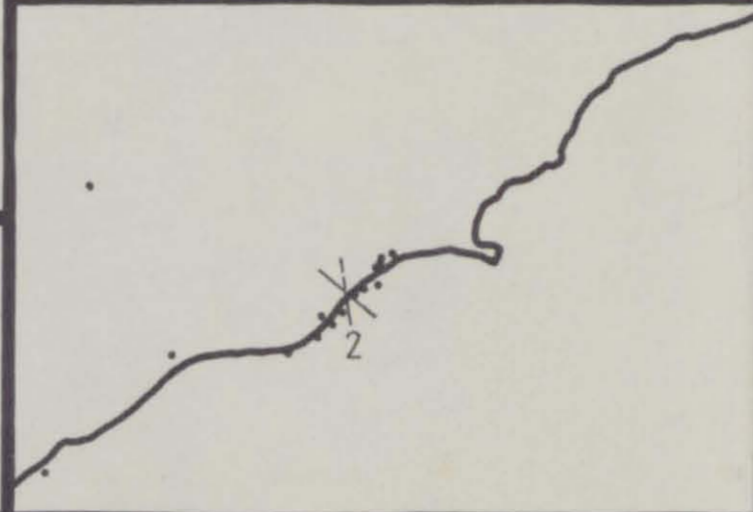
GRID NORTH  
↑



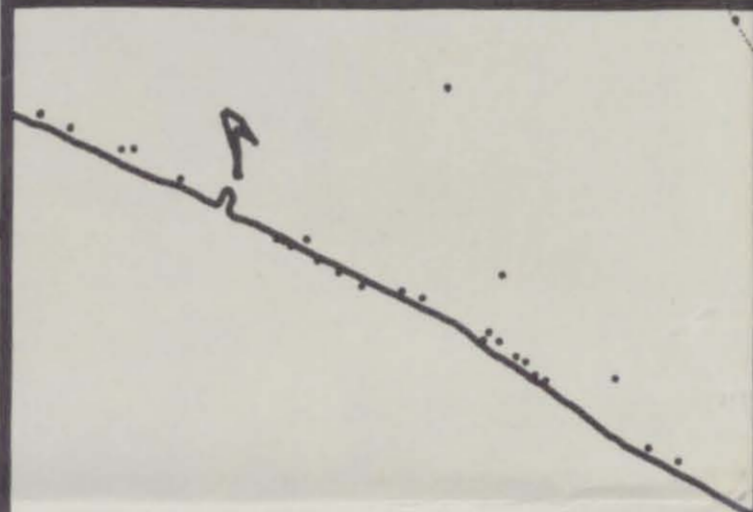


# SHEAR SENSE INDICATORS

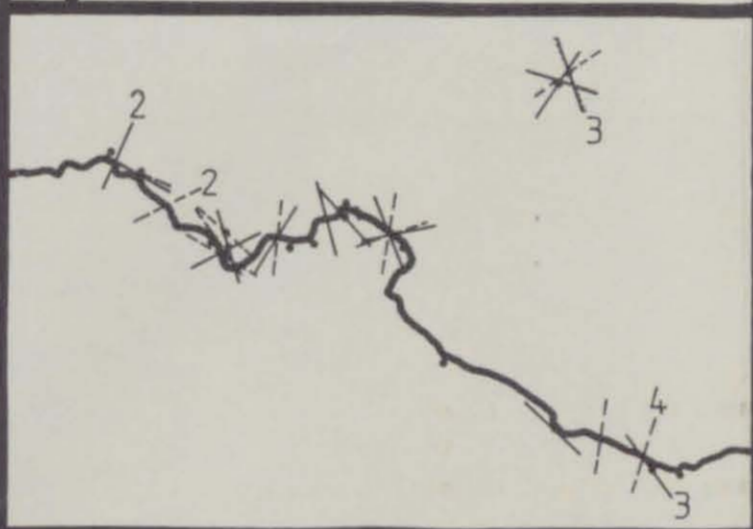
A LYME REGIS



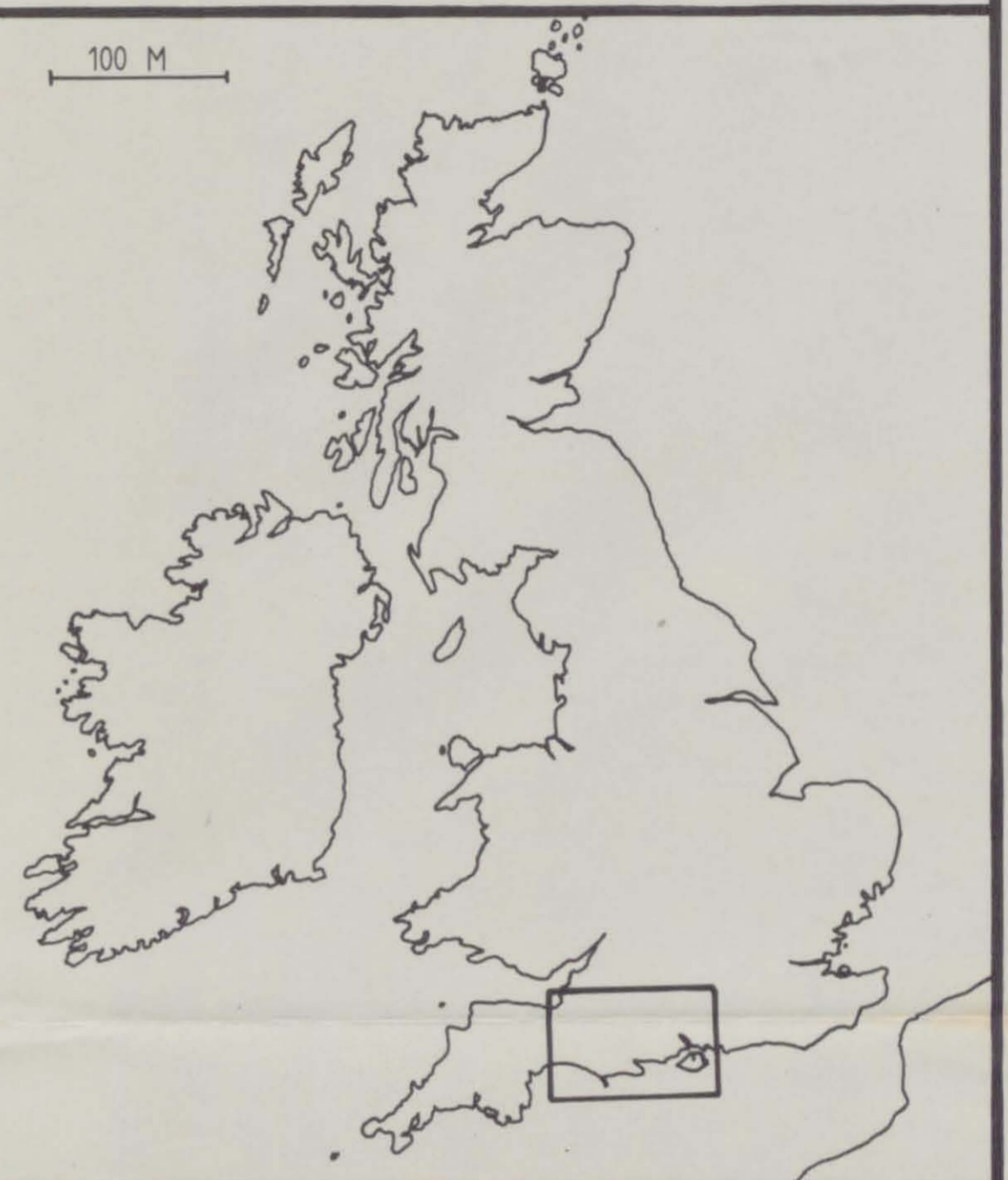
B BURTON BRADSTOCK



C KIMMERIDGE



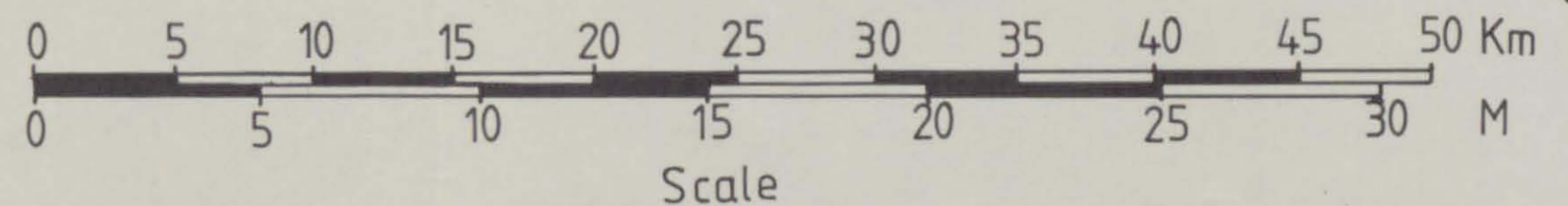
100 M



## KEY

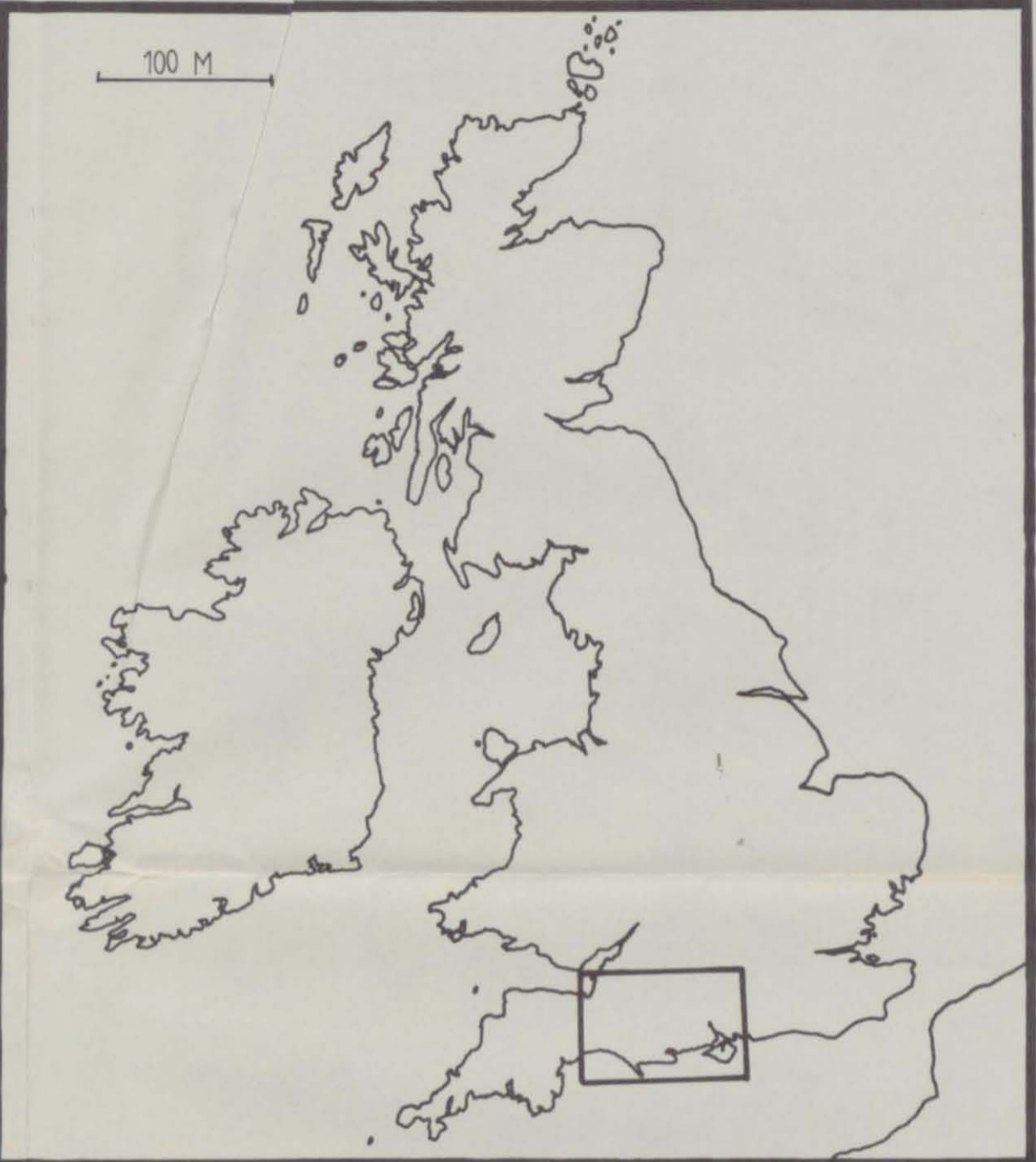
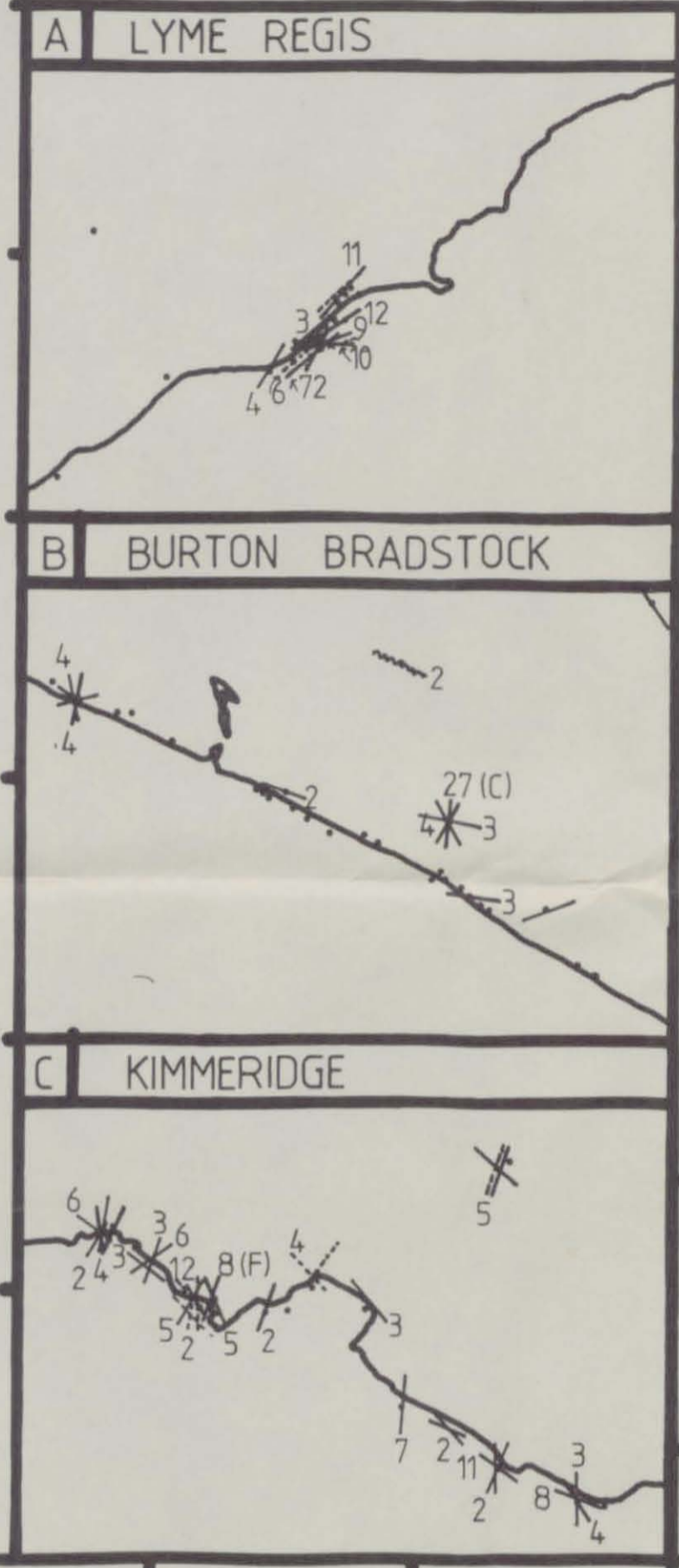
- LOCALITY
- DEXTRAL
- - - SINISTRAL
- ⋯ UNKNOWN OFFSET

1:250,000





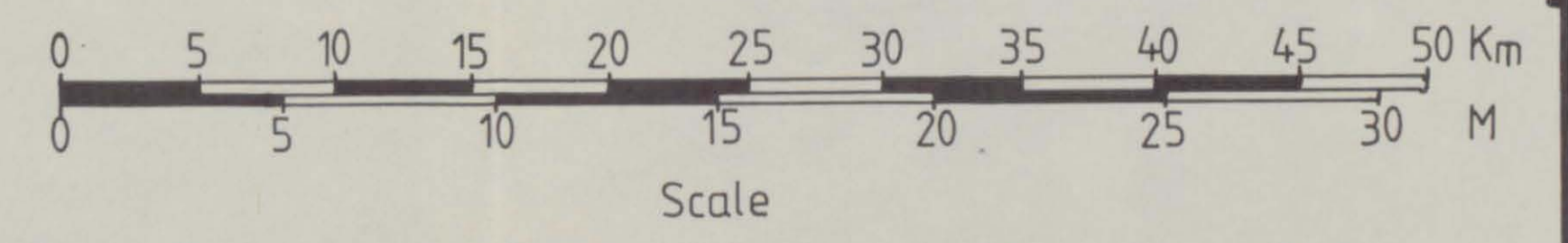
### ADDITIONAL KINEMATIC INDICATORS



### KEY

- LOCALITY
- CALCITE VIENS
- - - PYRITE VIENS
- ~ STYOLITE
- (F) FAULT RELATED
- (S) SELENITE COVERED

1:250,000




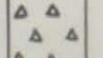


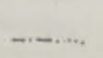


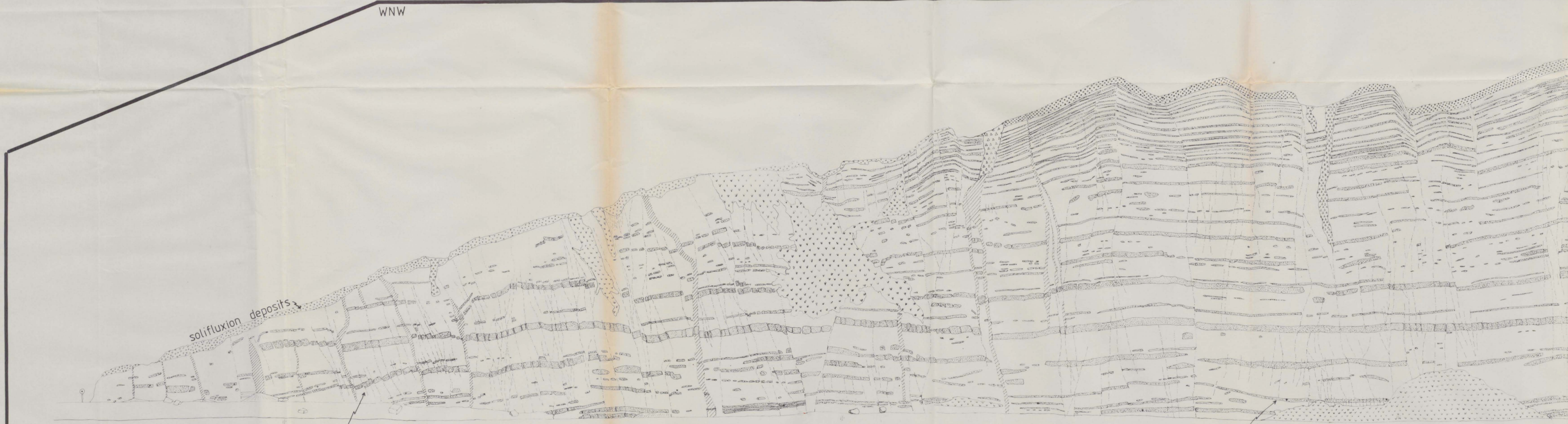
WNW

solifluxion deposits

Loc A

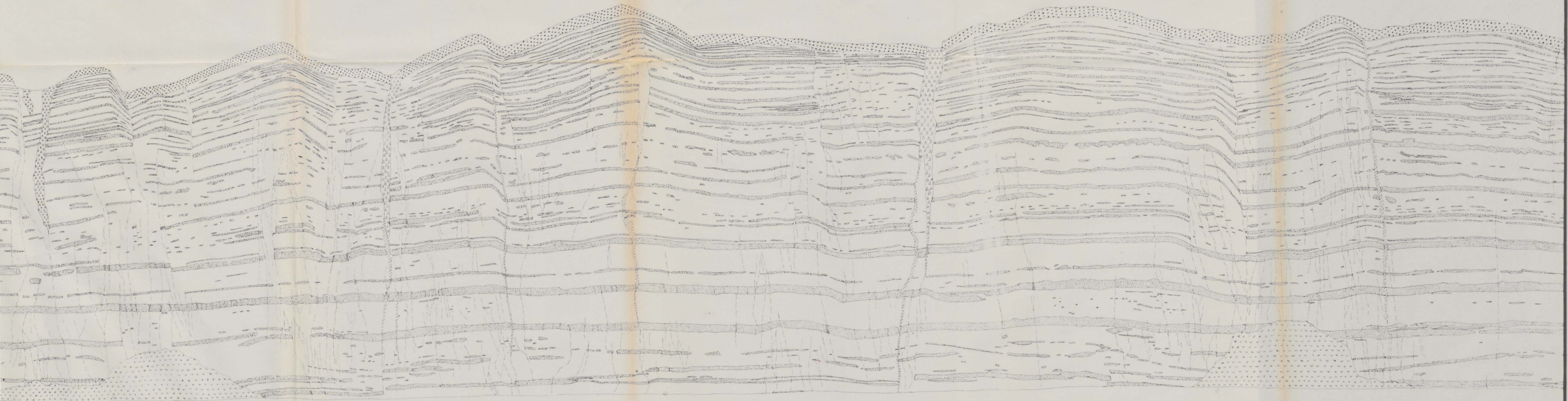
Channels

-  INFERIOR OOLITE
-  FRIABLE SANDSTONE
-  CEMENTED SANDSTONE
-  QUATERNARY INFILL
-  FRACTURE SOLUTION PIPES
-  VEGETATION
-  JOINTS

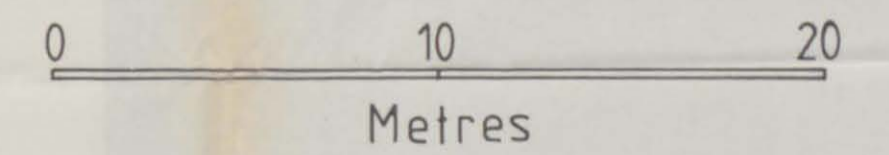


11.55

ESE



STRUCTURES IN THE BRIDPORT SANDS. EAST CLIFF, BRIDPORT



S.D.LAKE

1985



### PRIMARY JOINTS

**A** LYME REGIS

**B** BURTON BRADSTOCK

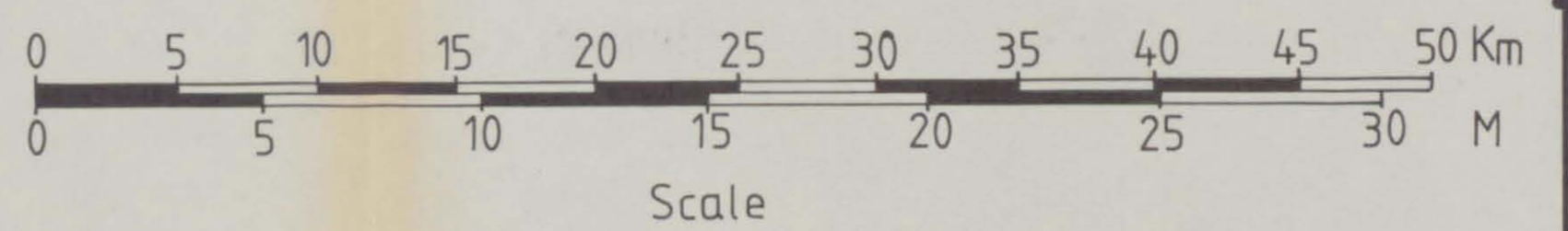
**C** KIMMERIDGE

100 M

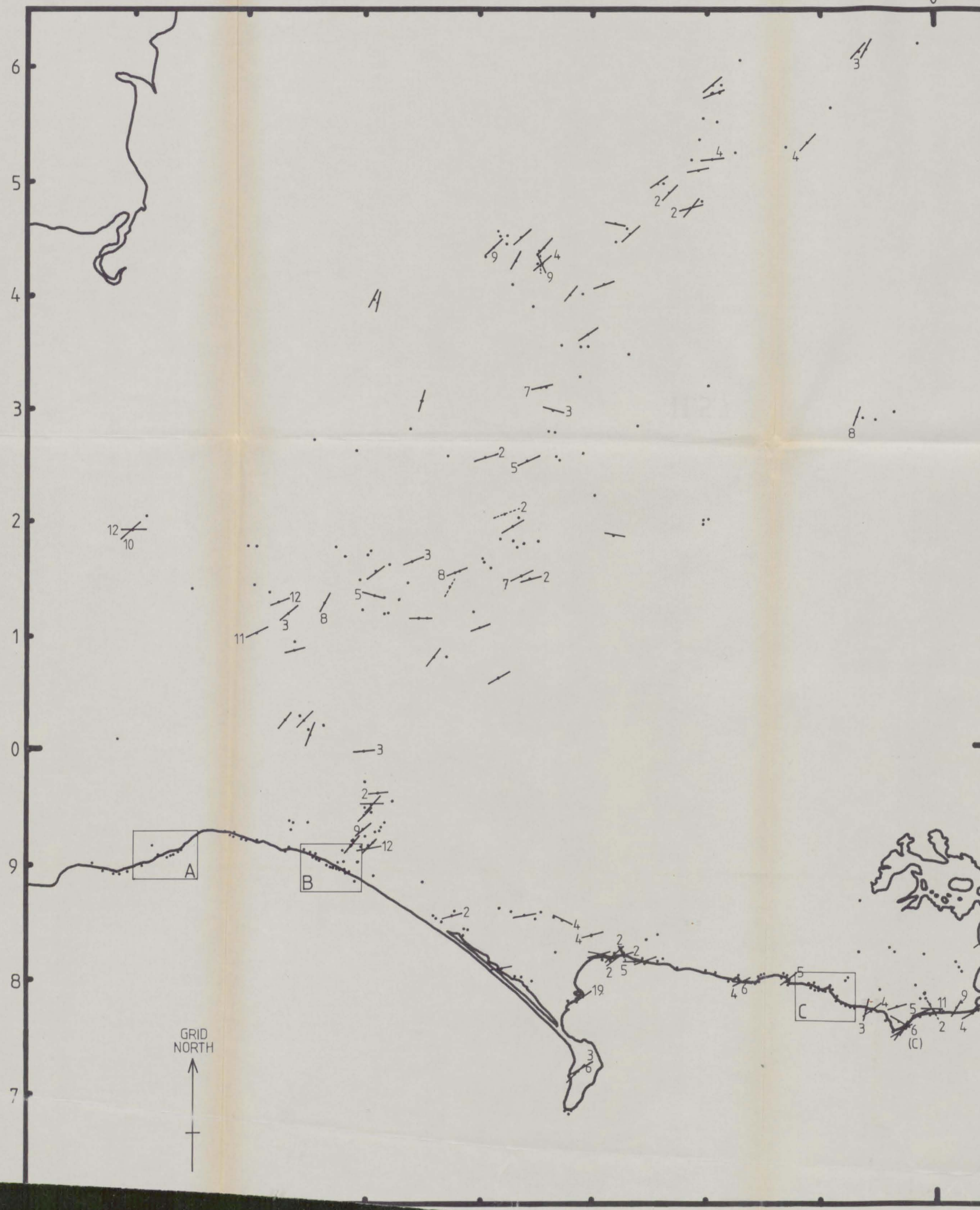
**KEY**

- LOCALITY
- (C) CLAY INFILL
- JOINT TREND AND NUMBER

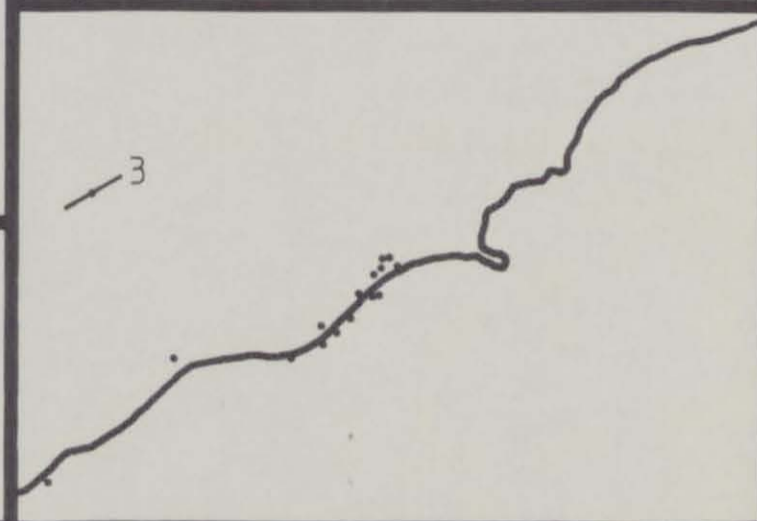
1:250,000



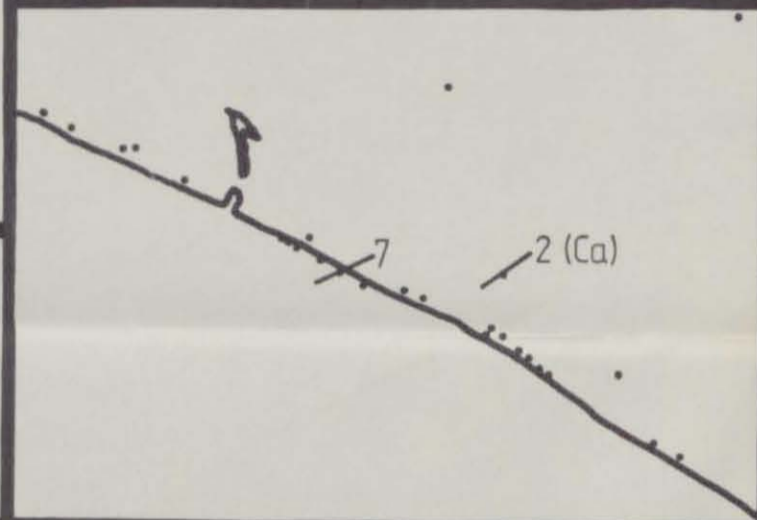
# SECONDARY AND TERTIARY JOINTS



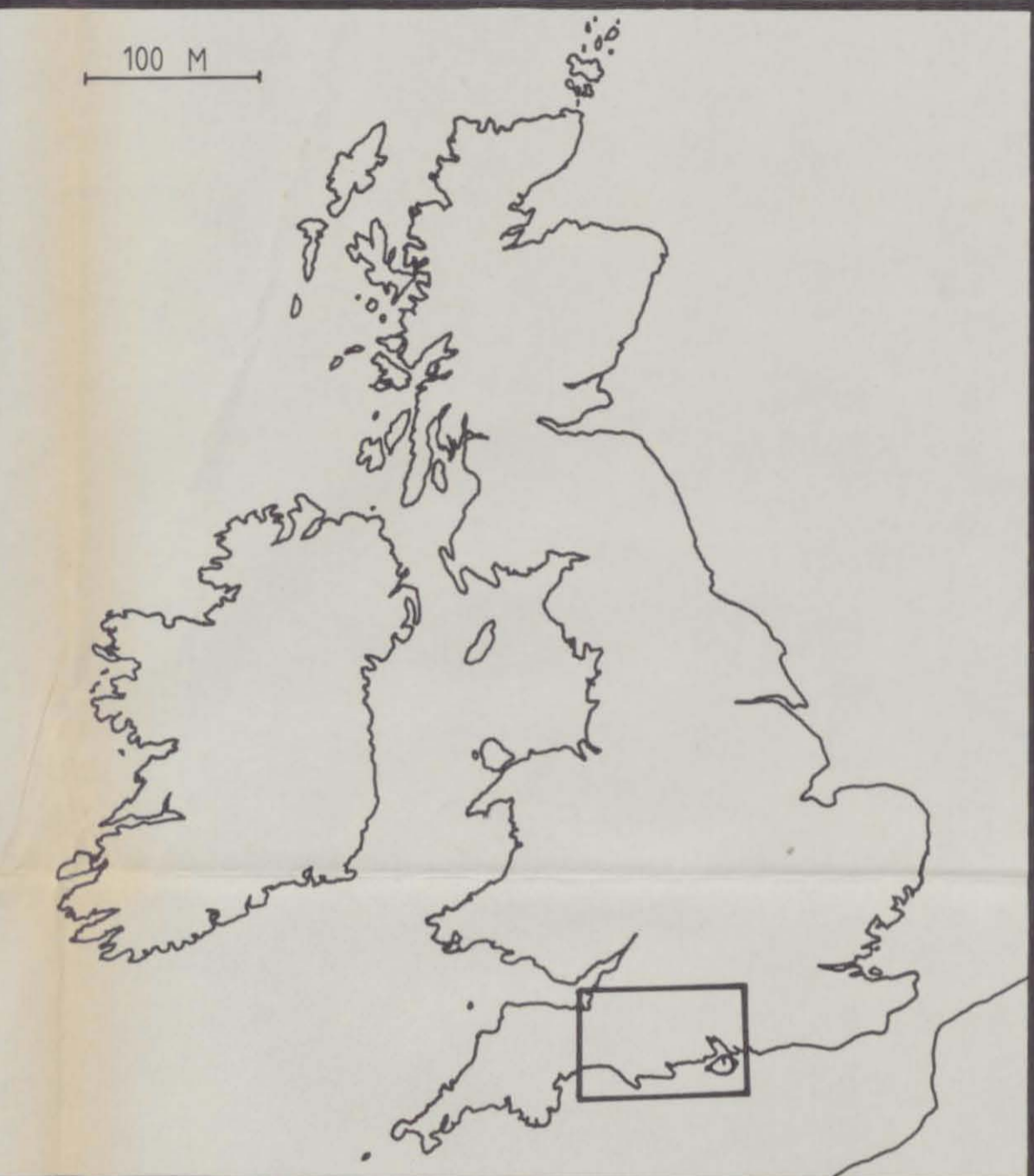
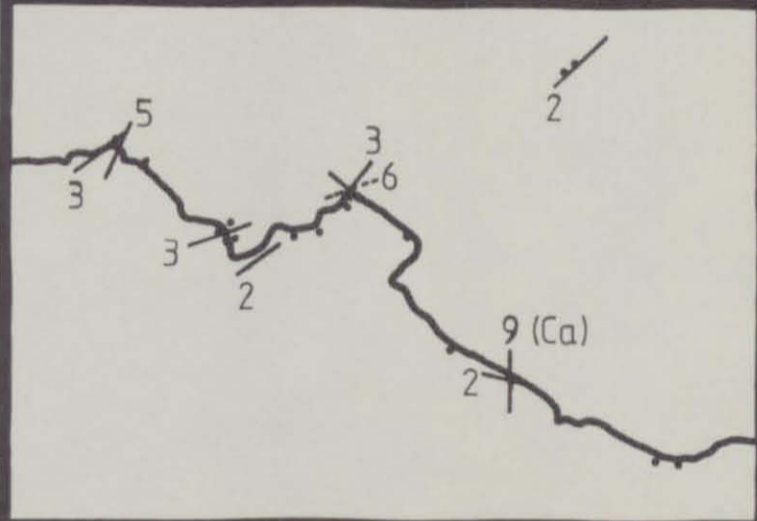
A LYME REGIS



B BURTON BRADSTOCK



C KIMMERIDGE

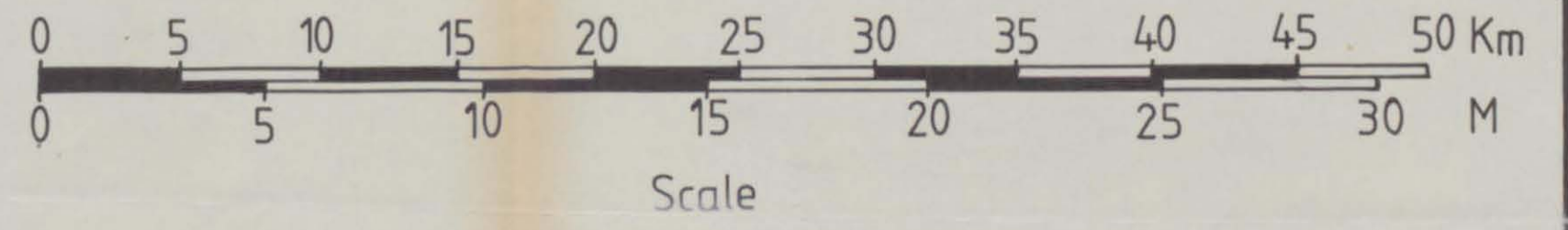


## KEY

- LOCALITY
- SECONDARY JOINT TRENDS
- - - TERTIARY JOINT TRENDS
- (C) CLAY INFILL
- (Ca) CALCITE INFILL

1:250,000

GRID NORTH  
↑

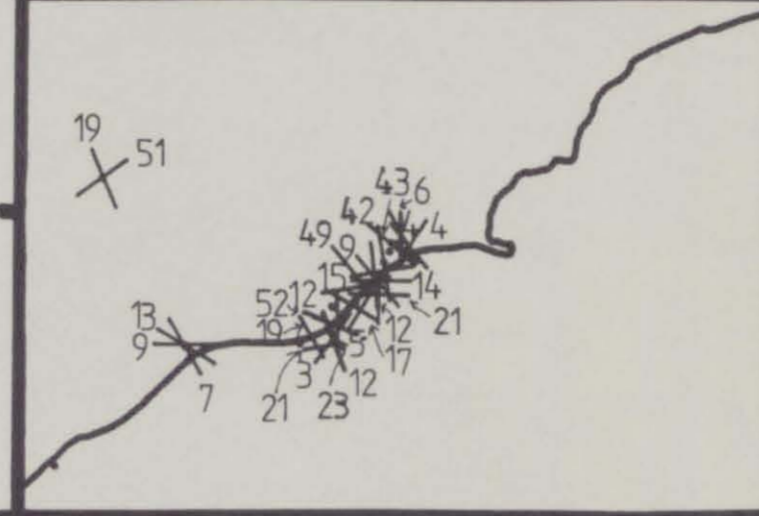


Scale

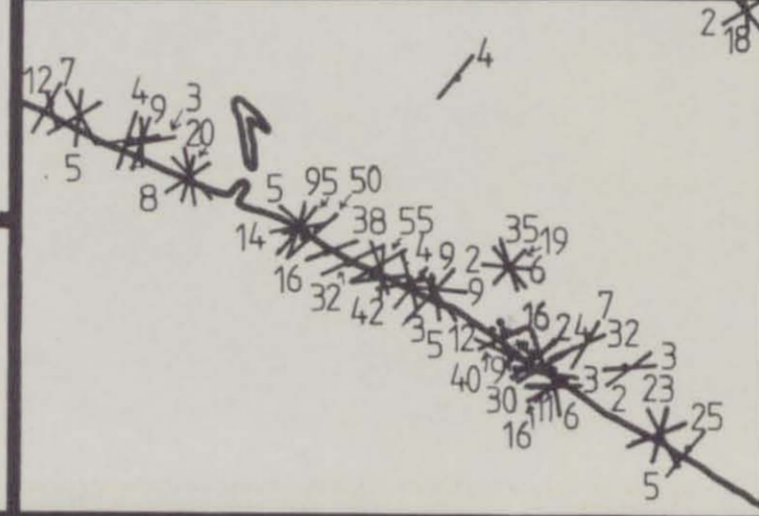
# JOINTS ALL ORIENTATIONS UNDEFINED



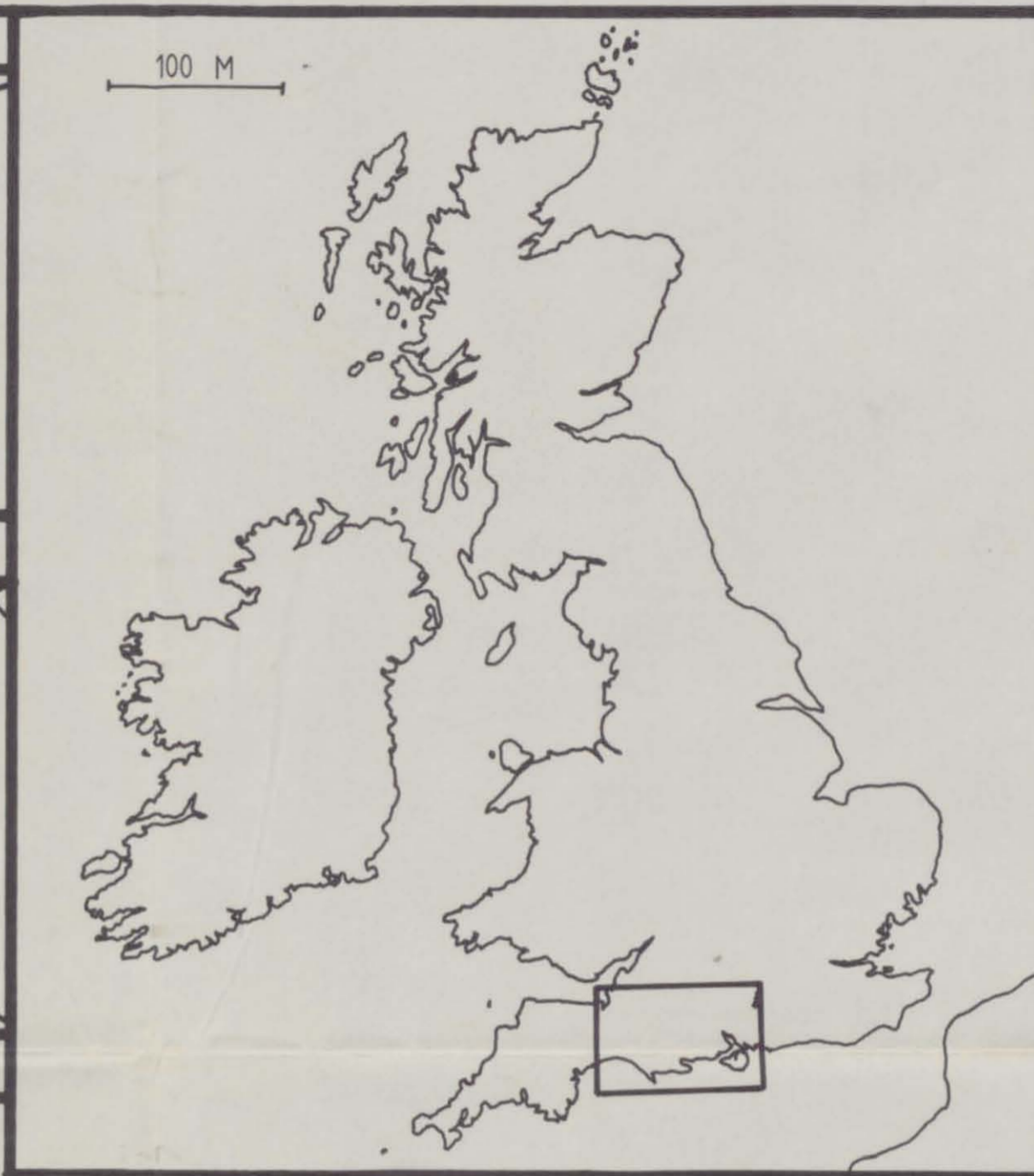
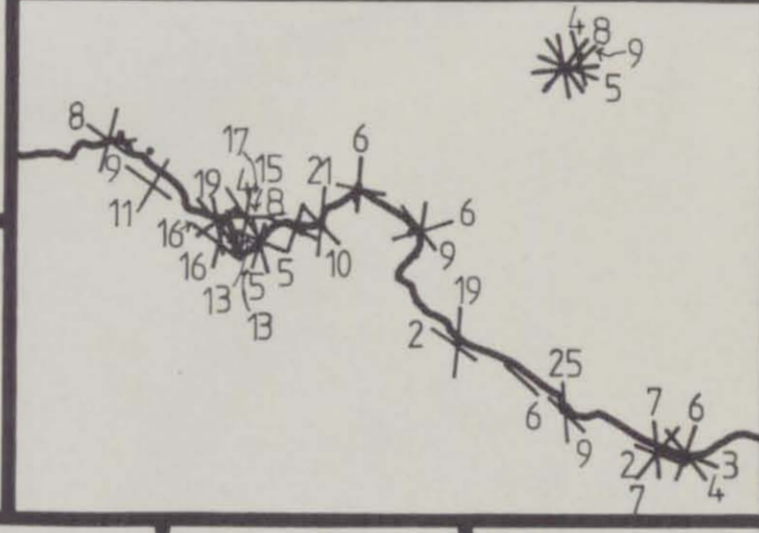
## A LYME REGIS



## B BURTON BRADSTOCK



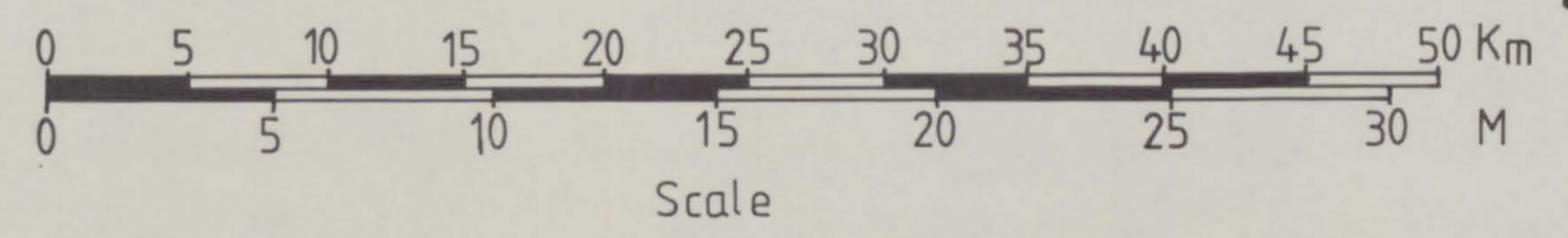
## C KIMMERIDGE



**KEY**

- LOCALITY (Ca) CALCITE ON SURFACE
- JOINT TREND AND NUMBER (F) FISSURES

1:250,000



SS ST

ST 3 4 5

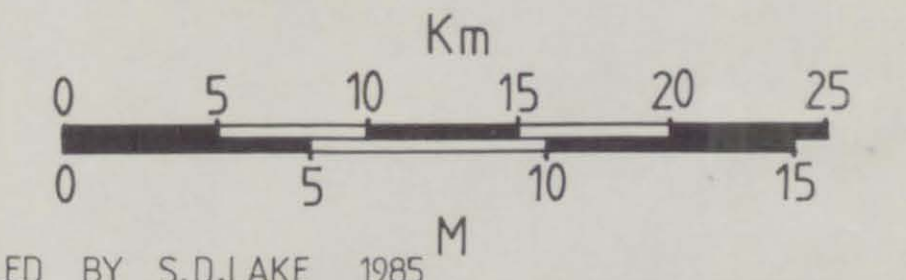
11A1

# BOREHOLES AND WELLS IN THE WESTERN WESSEX BASIN

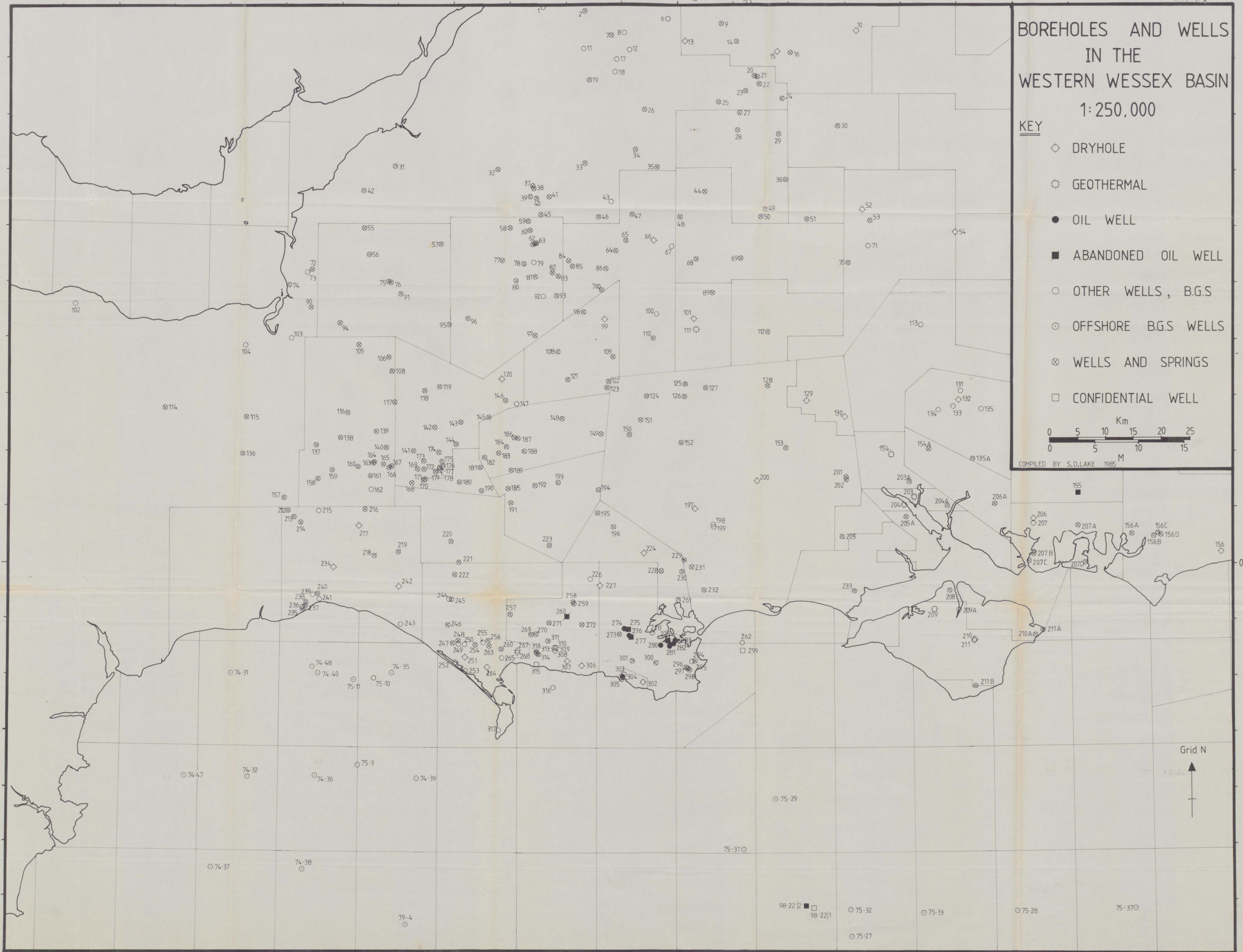
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## KEY

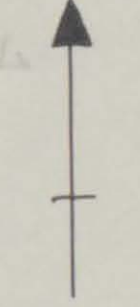
- DRYHOLE
- ☼ GEOTHERMAL
- OIL WELL
- ABANDONED OIL WELL
- OTHER WELLS, B.G.S
- OFFSHORE B.G.S WELLS
- ⊗ WELLS AND SPRINGS
- CONFIDENTIAL WELL



COMPILED BY S.D.LAKE 1985



Grid N



SX SY

SY SZ

SU SZ



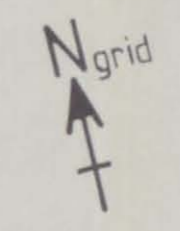
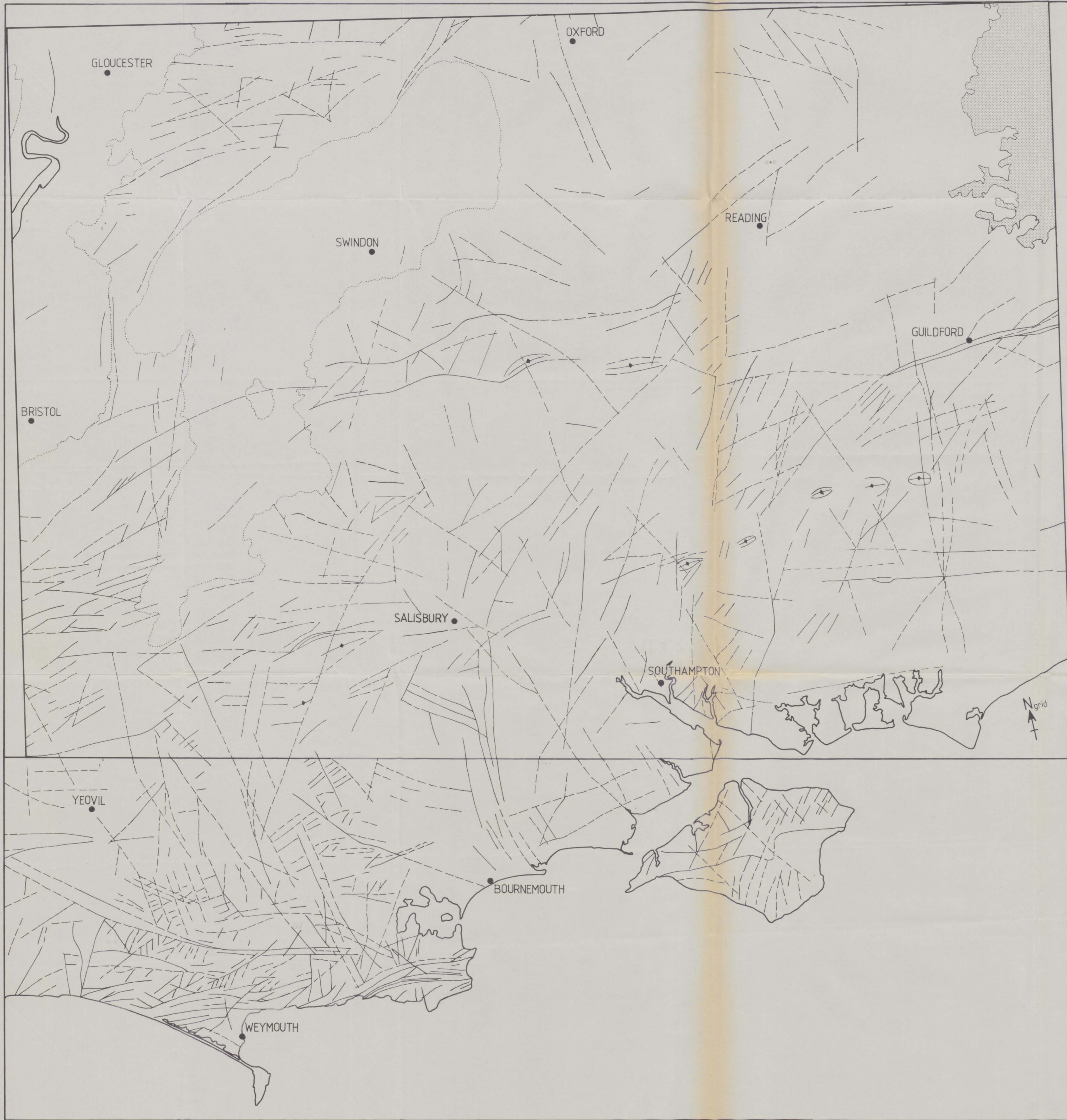
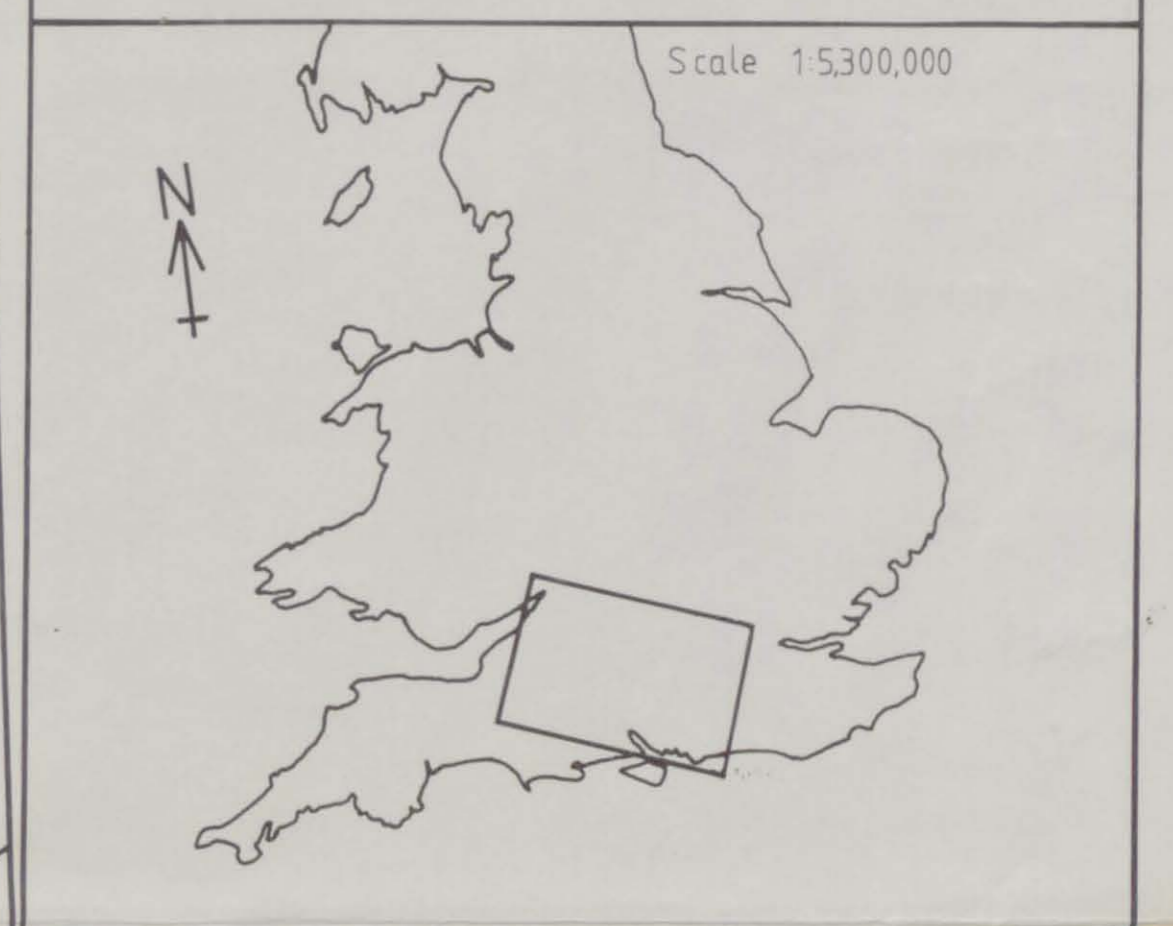
# LANDSAT MSS lineament map path 216:row 24 path 217:row 24 1:250,000

BAND 7 (0.8-1.10 μm NEAR INFRARED)  
WINTER IMAGERY  
MOSAIC COMPILED by G.S.L  
Interpretation by Stuart Lake

DURHAM UNIVERSITY NERC FEB 1984

**KEY**

- CLEAR LINEAMENTS
- - - - - SUBTLE LINEAMENTS
- LIMIT OF CLOUD COVER
- ANTICLINAL AXIS
- SU BURBAN LONDON

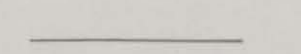
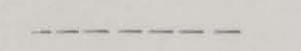

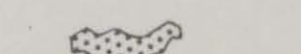


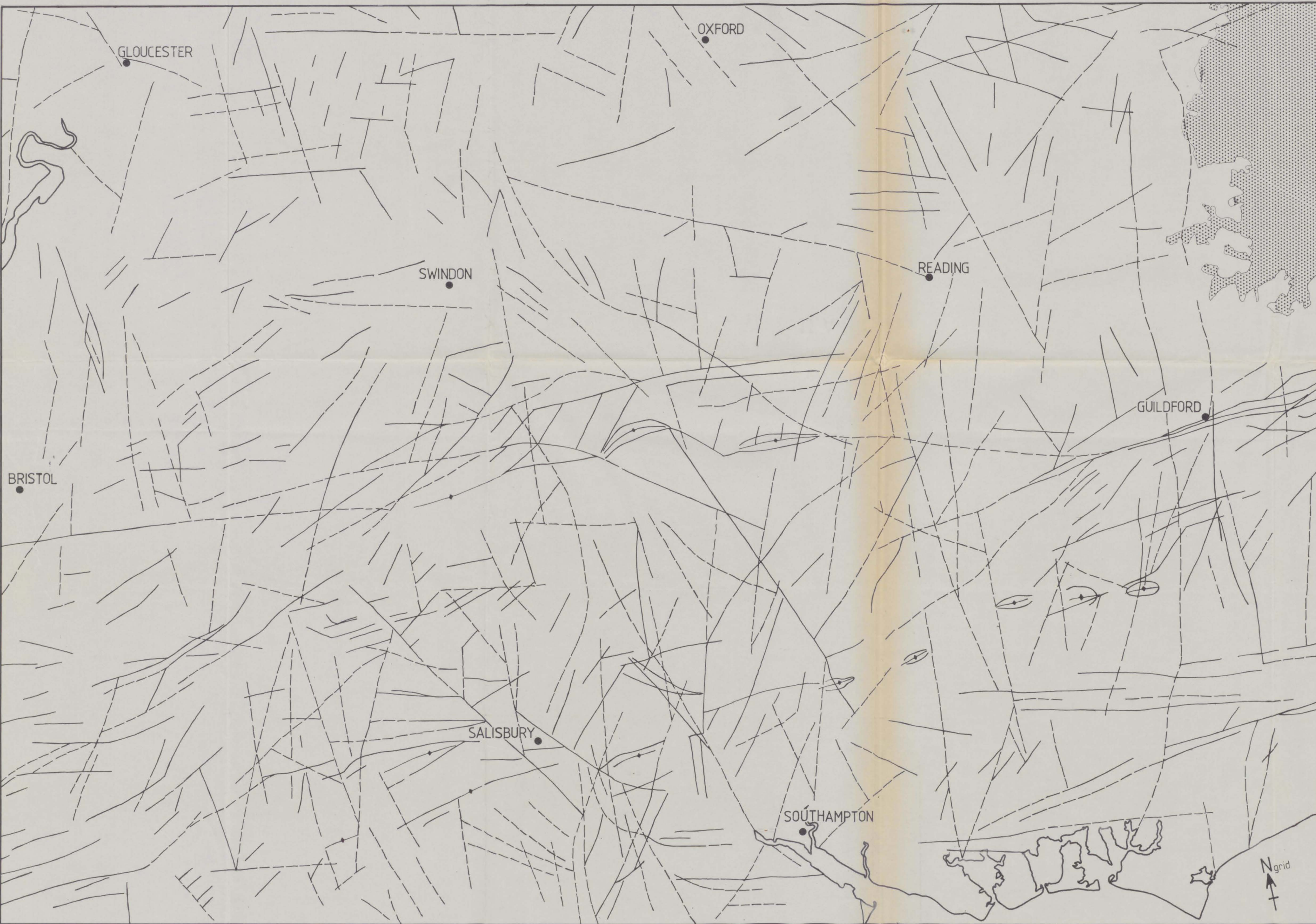
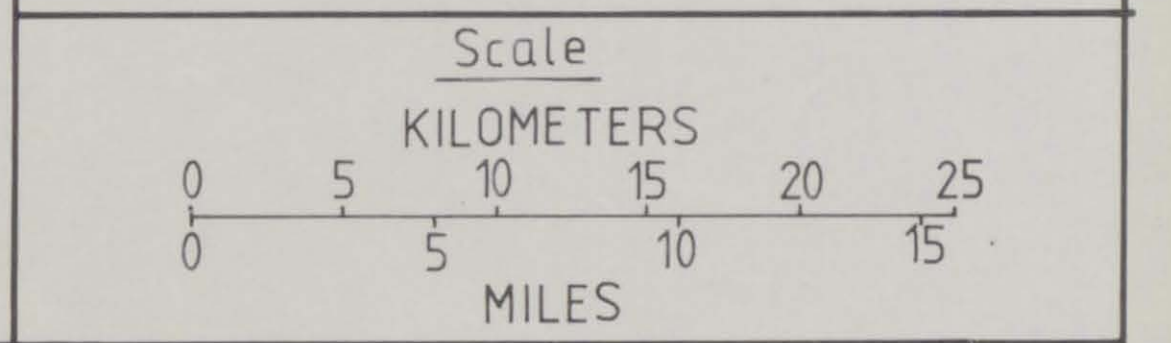
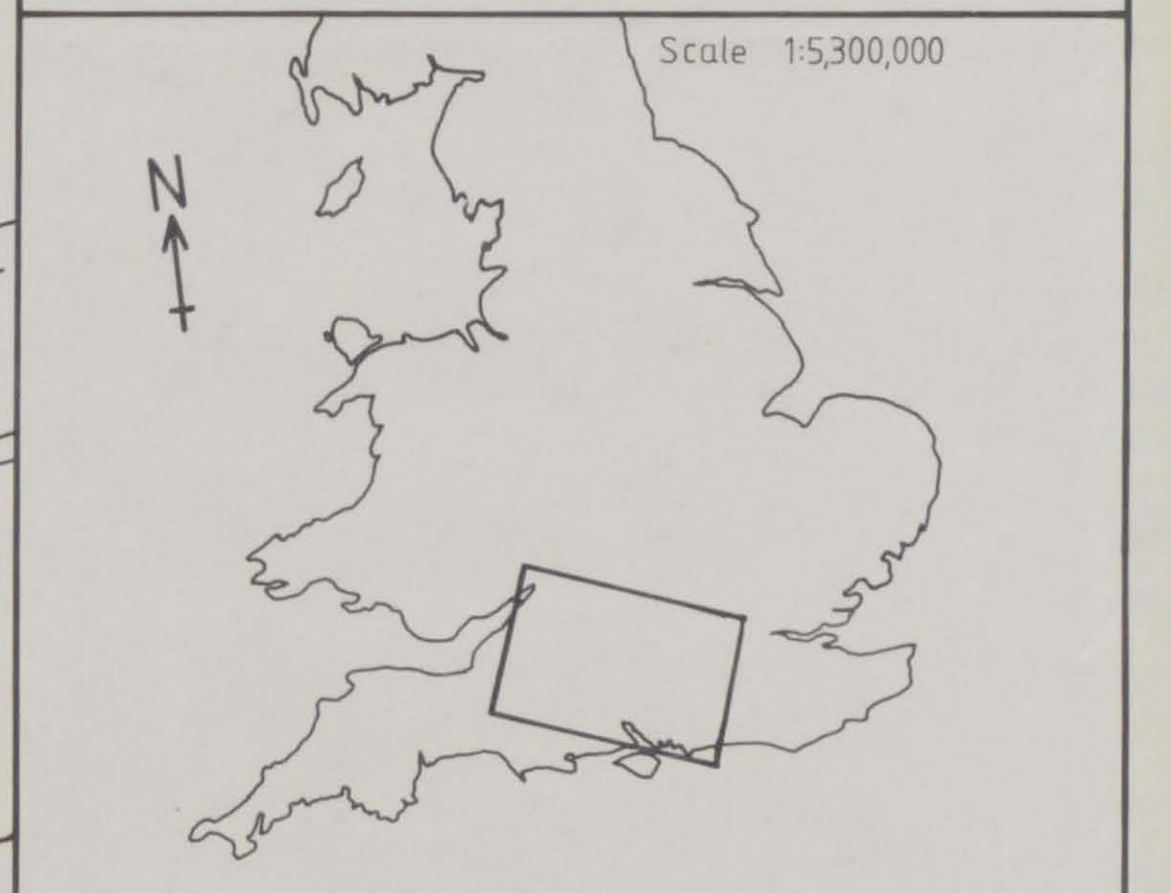
# LANDSAT TM lineament map path 202:row 24 1:250,000

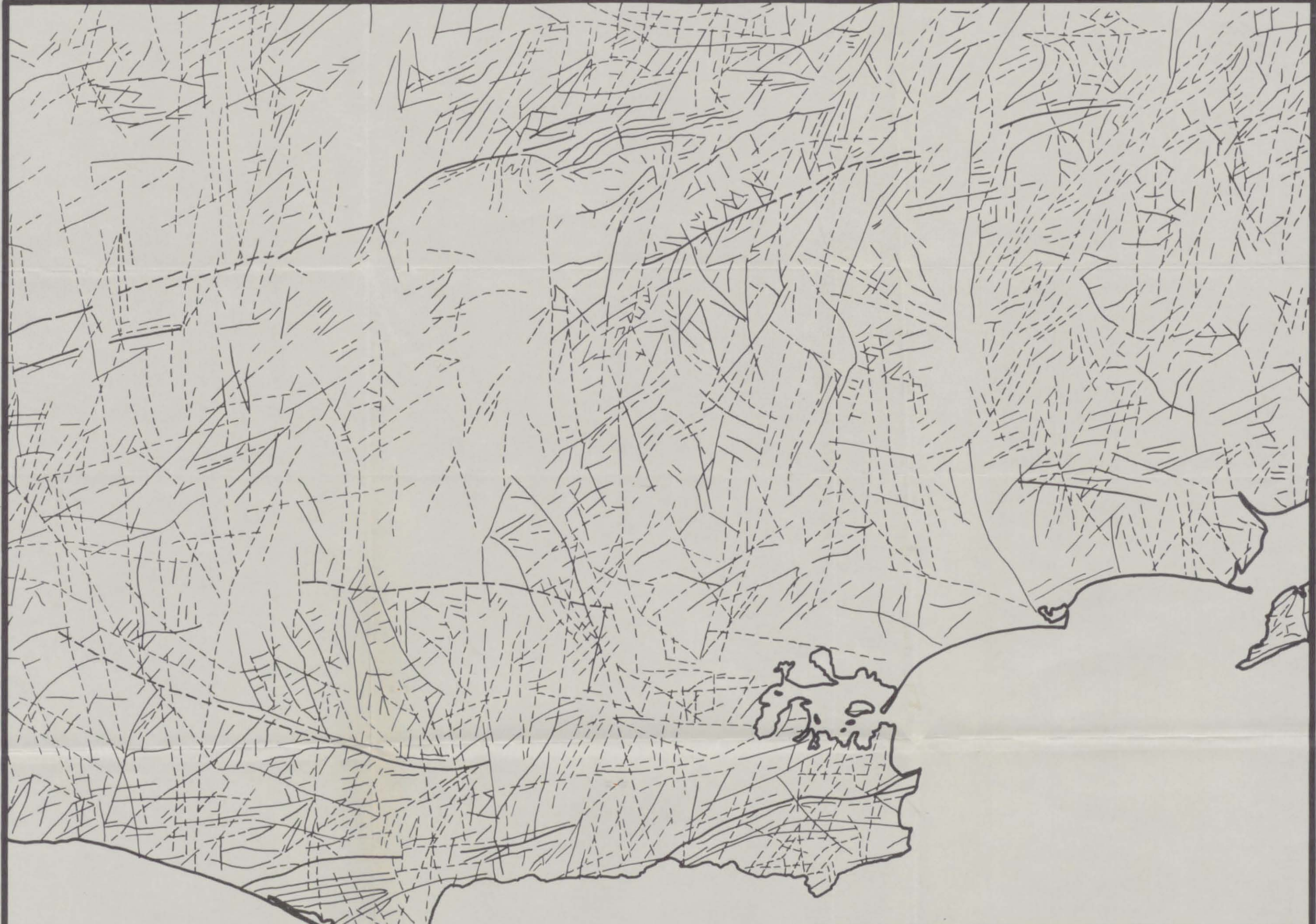
BAND 5 (1.55-1.75  $\mu\text{m}$  NEAR INFRARED)  
IMAGE TAKEN 4-2-83  
Processed on Diad system by N.P.A  
Interpretation by Stuart Lake

DURHAM UNIVERSITY N.E.R.C JAN 1984

### KEY

-  CLEAR LINEAMENTS
-  SUBTLE LINEAMENTS
-  ANTICLINAL AXIS
-  SU BURBAN LONDON



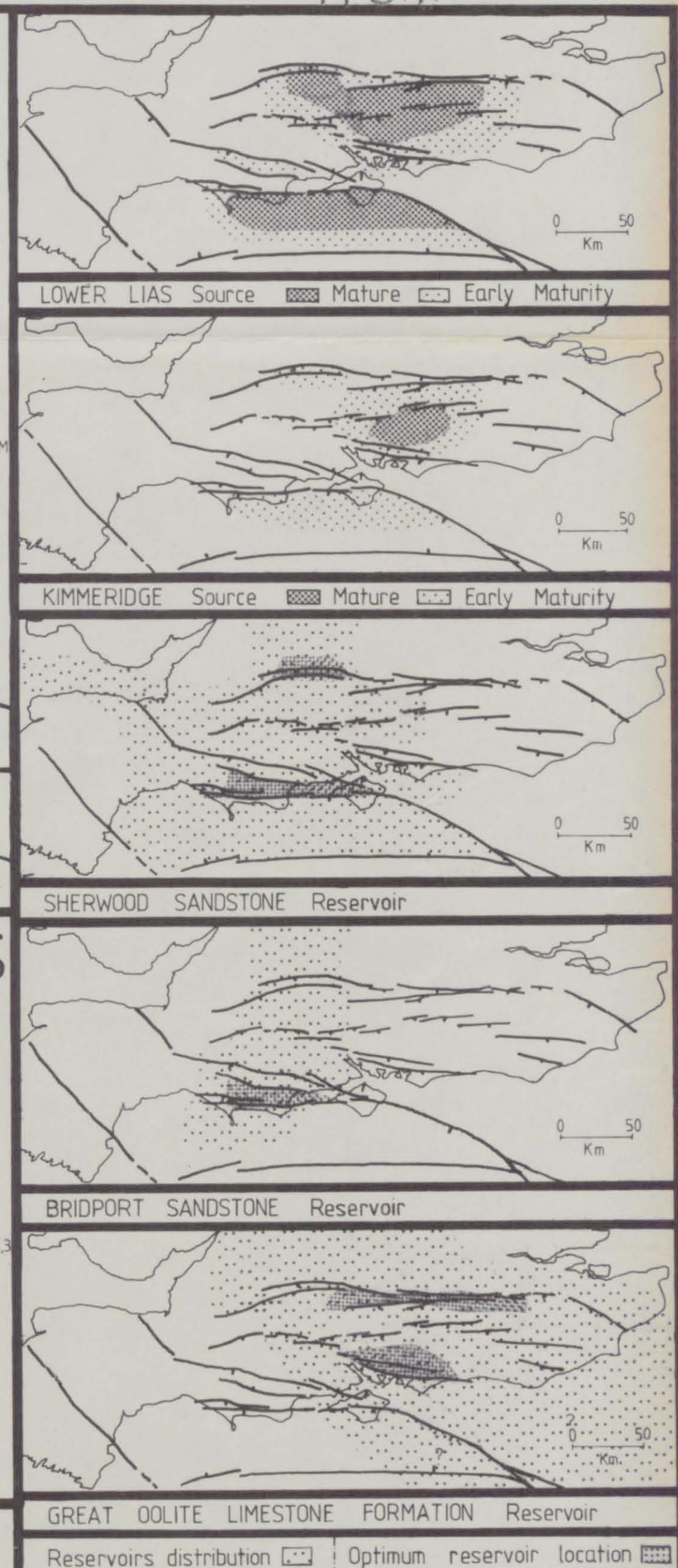
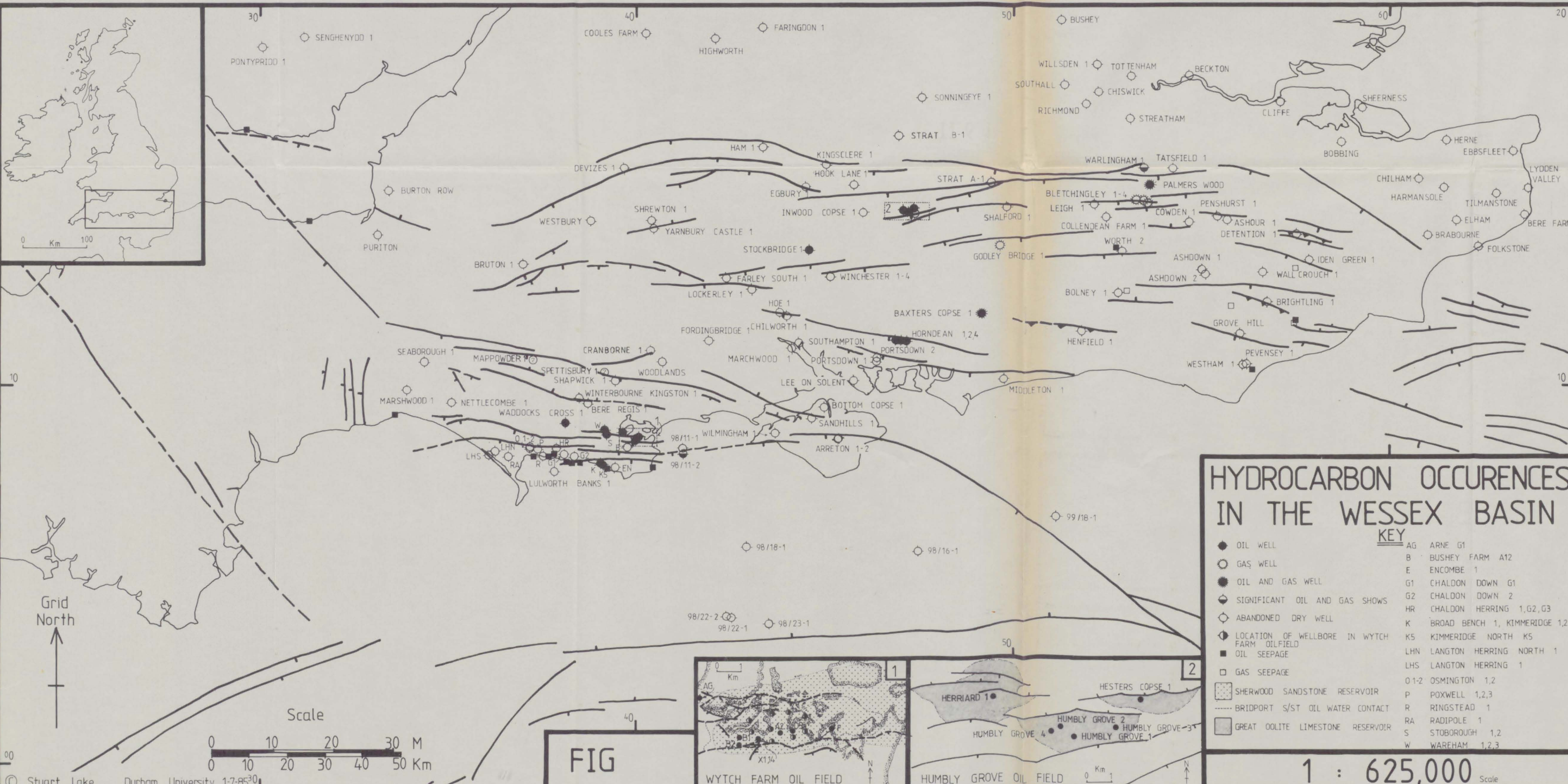


**TM LINEAMENT MAP**

--- Major lineament related to growth f.  
- - - Other lineaments

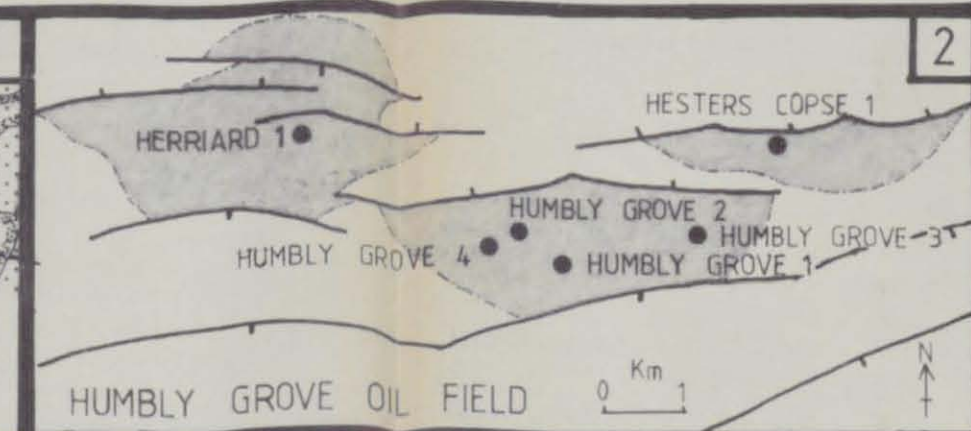
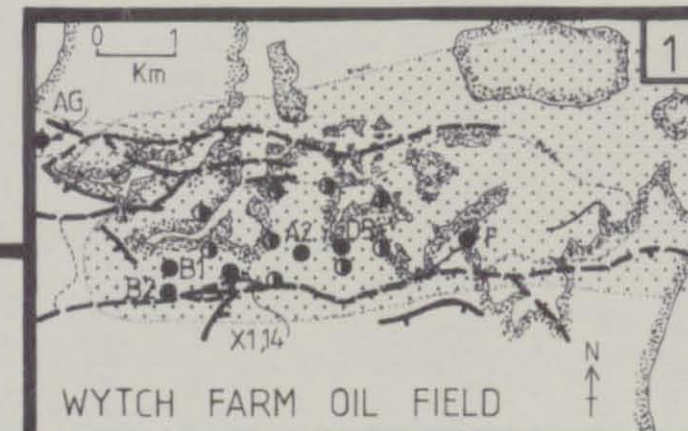
0 5 10 15 20 25 Km

0 5 10 M



# HYDROCARBON OCCURENCES IN THE WESSEX BASIN

- KEY**
- OIL WELL
  - GAS WELL
  - OIL AND GAS WELL
  - SIGNIFICANT OIL AND GAS SHOWS
  - ABANDONED DRY WELL
  - ◇ LOCATION OF WELLBORE IN WYTCH FARM OILFIELD
  - OIL SEEPAGE
  - GAS SEEPAGE
  - ▨ SHERWOOD SANDSTONE RESERVOIR
  - ▩ BRIDPORT S/ST OIL WATER CONTACT
  - GREAT OOLITE LIMESTONE RESERVOIR
- |      |                                 |
|------|---------------------------------|
| AG   | ARNE G1                         |
| B    | BUSHEY FARM A12                 |
| E    | ENCOMBE 1                       |
| G1   | CHALDON DOWN G1                 |
| G2   | CHALDON DOWN 2                  |
| HR   | CHALDON HERRING 1,G2,G3         |
| K    | BROAD BENCH 1, KIMMERIDGE 1,2,3 |
| K5   | KIMMERIDGE NORTH K5             |
| LHN  | LANGTON HERRING NORTH 1         |
| LHS  | LANGTON HERRING 1               |
| O1-2 | OSMINGTON 1,2                   |
| P    | POXWELL 1,2,3                   |
| R    | RINGSTEAD 1                     |
| RA   | RADIPOLE 1                      |
| S    | STOBOROUGH 1,2                  |
| W    | WAREHAM 1,2,3                   |



**FIG**

1 : 625,000 Scale

VOLUME 2

- Fig.II.1.1 Western Wessex Basin, Solid Geology map, (1:250,000 scale).
- Fig.II.2.1 Previous north-south structural profile across the Wessex Basin, 1:100,000 scale based on data acquired prior to this study.
- Fig.II.2.2 Track lines of seismic reflection profiles based on G.S.I. non-exclusive seismic reflection survey and I.G.S. project 76/8 and 77/1 (part) used to compile a structural map of the Top Penarth Group in the English Channel.
- Fig.II.2.3 Top Penarth Group structural map of the English Channel. Interpretation by S.D. Lake. Based on G.S.I. non-exclusive seismic survey.
- Fig.II.2.4 Composite Bouguer Gravity anomaly map, Wessex Basin, 1:500,000 scale (Redrawn from B.G.S. Sources).
- Fig.II.2.5 Two-way time isochron map of dipping reflectors in Lyme Bay and associated active late Palaeozoic/Mesozoic faulting, (1:250,000 scale).
- Fig.II.3.1 Pre-Aptian subcrop map, (1:250,000 scale).
- Fig.II.3.2 Six serial north-south structural profiles across the Wessex Basin. Scale shown. Compiled from geological maps of the onshore British Isles by Whittaker, 1985.
- Fig.II.3.3 Chrono-lithostratigraphic column. Western Wessex Basin, S. England (Permian - Quaternary).
- Fig.II.5.1 Location map at 1:250,000 scale. Three insets of Lyme Bay, Bradstock and Kimmeridge at 1:50,000 scale.
- Fig.II.5.2 Additional Jurassic localities also visited during research.
- Fig.II.5.3 Shear sense indicators (1:250,000 scale). Three insets of Lyme Bay, Burton Bradstock and Kimmeridge at 1:50,000 scale. Dextral and sinistral movements distinguished (frequency also shown).
- Fig.II.5.4 Additional Kinematic indicators (1:250,000 scale). Three insets of the Lyme Regis, Burton Bradstock and Kimmeridge areas enlarged to 1:50,000 scale. The detailed orientation of calcite and pyrite veins and stylolites are also shown.

Fig.II.5.5 Structures in the Bridport Sands, East Cliff, Bridport.

Fig.II.5.6 Primary Joints 1:250,000 scale. Three insets of Lyme Bay, Bradstock and Kimmeridge at 1:50,000 scale. (Frequency also shown).

Fig.II.5.7 Secondary and Tertiary Joints (1:250,000 scale). Three insets of the Lyme Regis, Burton Bradstock and Kimmeridge areas enlarged to 1:50,000. Clay or Calcite infill along joint planes are also distinguished.

Fig.II.5.8 Joints all orientations undefined (1:250,000 scale). Three insets of the Lyme Regis, Burton Bradstock and Kimmeridge areas enlarged to 1:50,000 scale.

Fig.II.6.1 Hydrocarbon occurrences in the Wessex Basin (1:625,000 scale).

Inset 1. Detailed plan of the Wytch Farm Oilfield.

Inset 2. Detailed plan of the Humbly Grove Oilfield.

5 insets 1) Lower Lias Clay source rocks - showing areas of postulated maturity and early maturity.

2) Kimmeridge Clay Source rock - showing areas of postulated maturity and early maturity.

3) Sherwood Sandstone Reservoir - areas of reservoir distribution and postulated optimum reservoir location are also shown.

4) Bridport Sands reservoir - areas of reservoir distribution and postulated optimum reservoir location are also shown.

5) Great Oolite Limestone Formation reservoir - areas of reservoir distribution and postulated optimum reservoir location are also shown.

Fig.II.A.1 Boreholes and wells in the western Wessex Basin, at 1:250,000 Scale (including exploration license blocks).

Fig.II.A.2 Landsat MSS lineament map, path 216: row 24, path 217: row 24 (1:250,000 scale). Band 7 (0.8 - 1.10 m. Near Infra Red) Winter Imagery. Mosaic compiled by G.S.L. (Interpretation by S.D. Lake).

Fig.II.A.3 Landsat TM lineament map, path 202: row 24, 1:250,000 scale. Band 5 (1.55 - 1.75 m Near Infra Red). Image taken 4.2.83. Processed on Dial system by Nigel Press Associates. Interpretation by S.D. Lake.

Fig.II.A.4 TM lineament map, 1:250,000 scale of Dorset. Detail of the structures along the Dorset coast particularly well exemplified.