Characteristics of deformation bands and relationship to primary deposition: an outcrop study from the Wirral, north-west England

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Introduction

A talk of three halves:

Primary sedimentology: Fluvial/Aeolian sandstone- lithology and environments of deposition

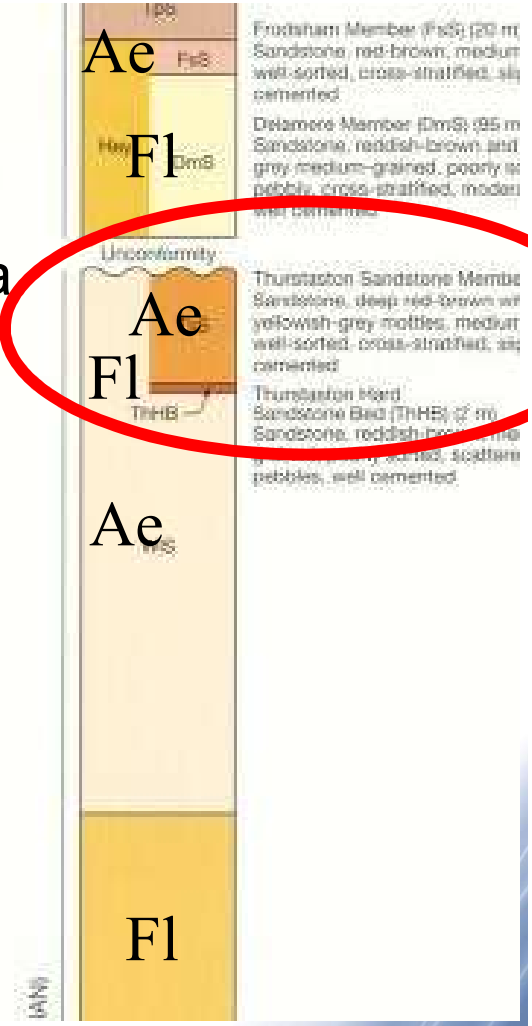
Secondary processes: geometry, style and properties of deformation bands – the Wirral

…but not their formation and timing

Consequence: potential impacts on subsurface management

Geological context

- Mid-Triassic Sherwood Sandstone Group
- Onshore extent of southern East Irish Sea Basin
- Preserved geology- fluvial and aeolian terrestrial dryland



BGS Liverpool sheet

Sedimentology- Thurstaston and Grange Hill, Wirral

- Detailed facies include:

Aeolian dune

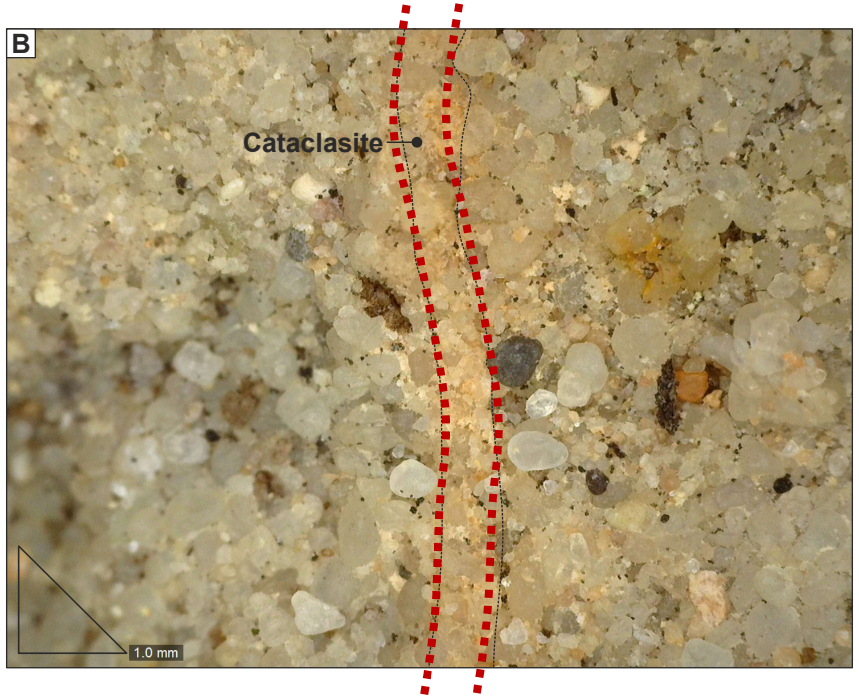
Dry interdune

Fluvial crossbed

Channel lag

Deformation Bands

Thurstaston Hill



Saughall Massie OBH

Planar zones of crushing of framework grains, fusing and grainsize reduction; commoner in ‘clean’ sandstone; result in formation of flow barriers and baffles

Impact on flow- paleo-indicator

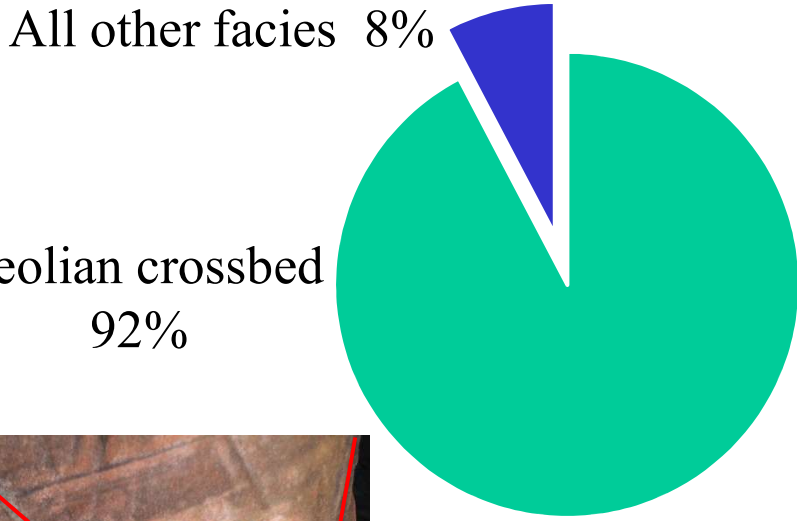
Thurstaston Heath- aeolian dune facies

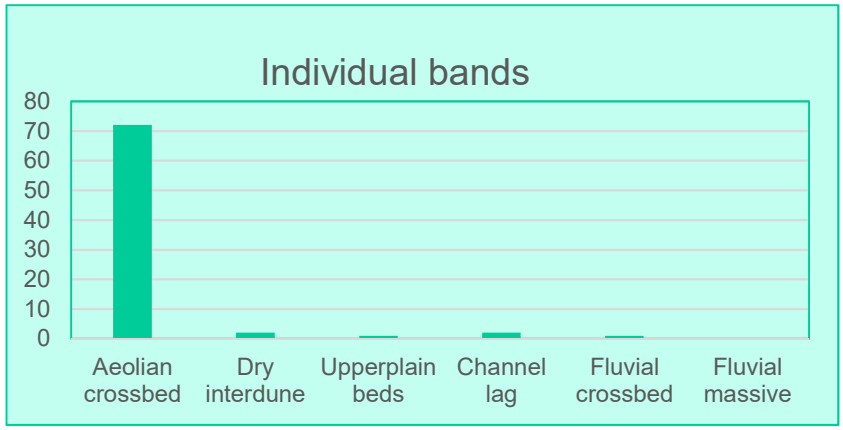
Character of deformation bands

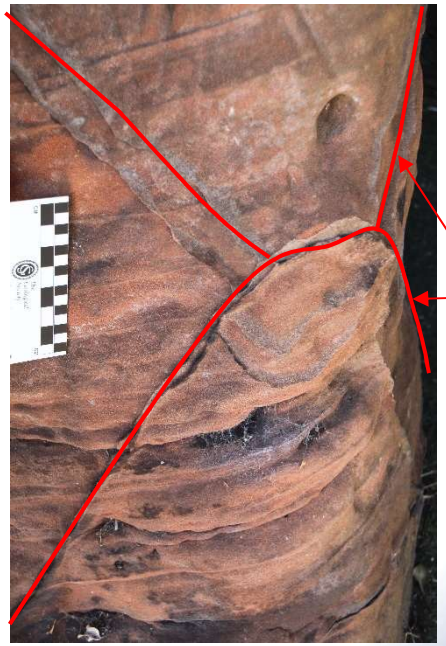
- Mapped out and measured- thickness, lateral and vertical extents where possible; host lith and facies
- Allocated to one of 4 morphological classes
- Permeability measured in the field and from cores- mini-permeameter
  - A field portable instrument
  - Probe measures resistance of gas flow by formation
  - Correction factor translates to permeability estimate

Facies control on occurrence; influence of primary deposition

Facies type	Individual bands	
Aeolian crossbed	72	74
Dry interdune	2	
Upperplain beds	1	4
Channel lag	2	
Fluvial crossbed	1	
Fluvial massive	0	

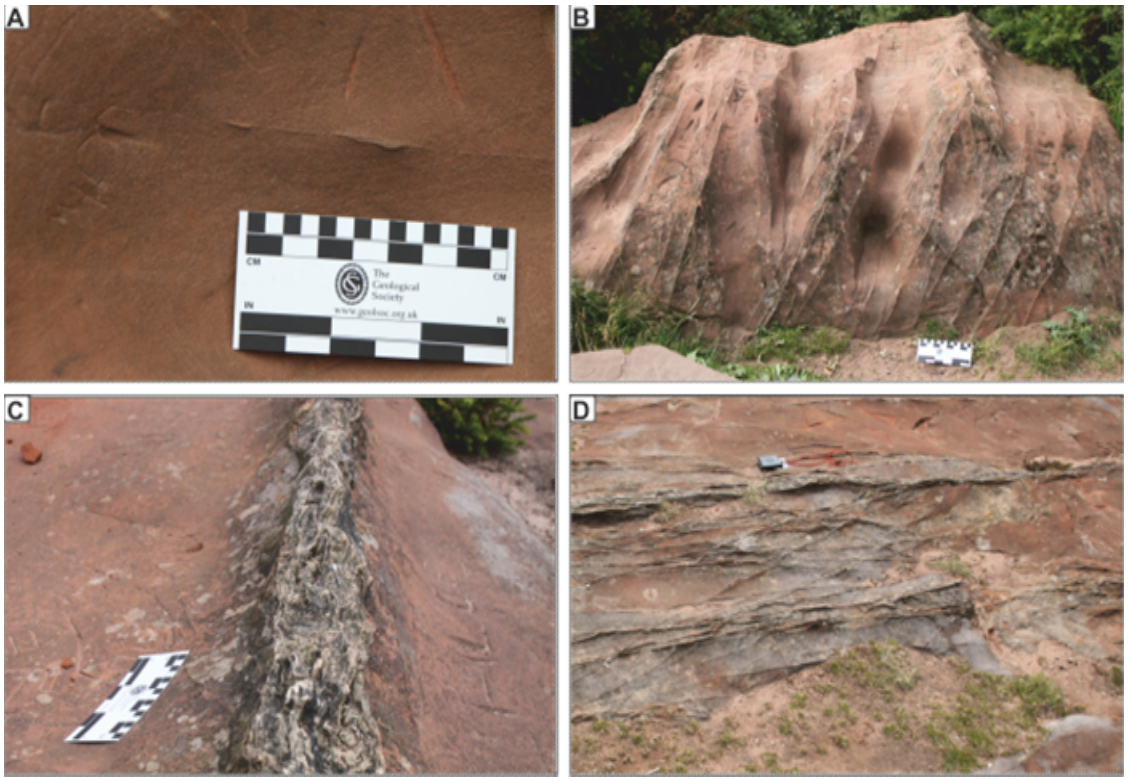


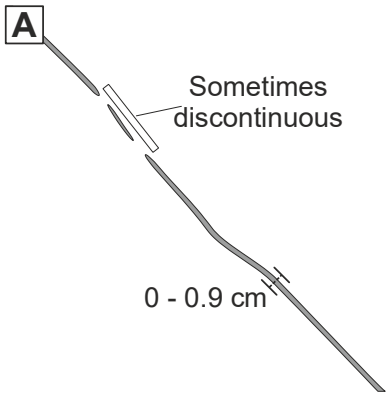


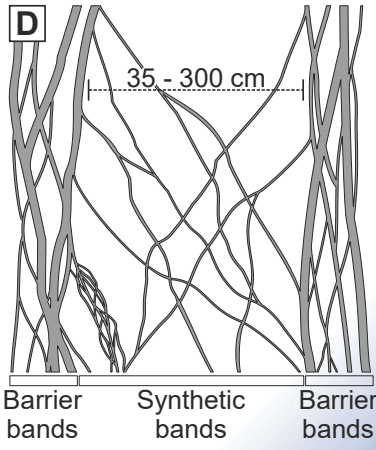


Morphology of deformation bands

- Individual ‘thread’
- Conjugate set
- Braid
- Composite





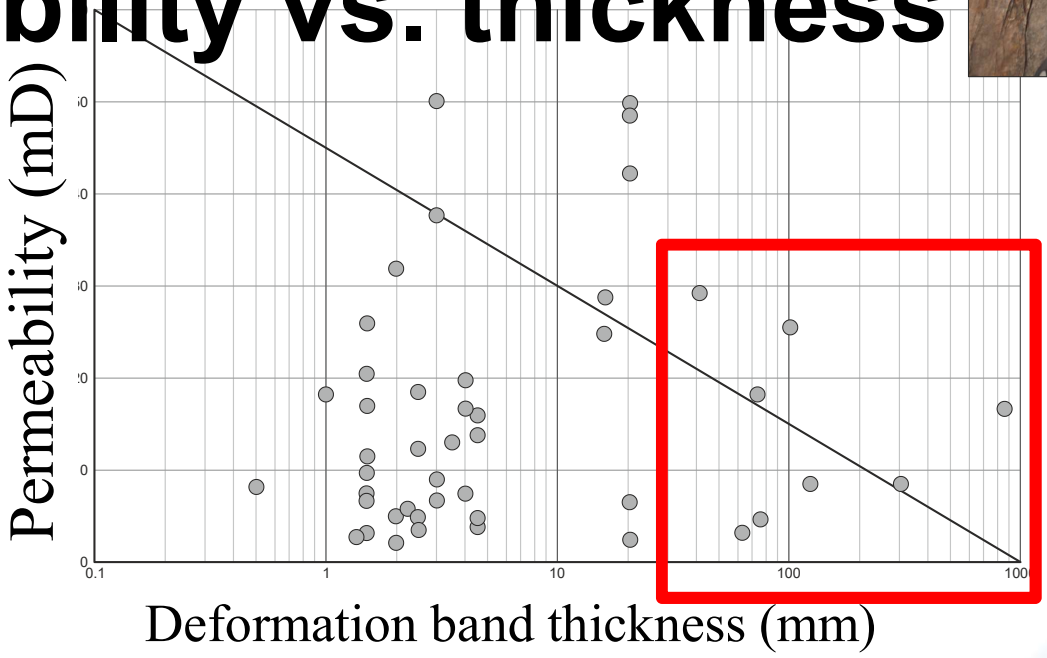


Permeability vs. classes

Class	Perm min (mD)	Perm max (mD)
Thread	2.10	25.97
Braid	2.41	49.43
Conjugate	3.47	50.11
Composite	4.73	25.46
Undeformed host (Bloomfield et al., 2006)	69	5100

Thurstaston Hill

Permeability vs. thickness



Discussion- impacts

- Wood Report- maximise production in the depleting North Sea- compartmentalise where reservoir pressures are lower
- Aquifer management- enhance production; inform contaminant models
- Effect on monitoring and testing in the regions subsurface- NERC Energy Security Innovation and Observation System (ESIOS)
- Identification in cores/seismic reflection problematical
- Potential lateral and vertical extent informed by understanding facies geometries

Conclusions

- Supports influence of lithology on development:
  - More common in grain fall and grain flow (dune) facies; less common in interdune and channel/channel lag
- 4 distinct classes proposed, based on morphology
- Permeabilities up to 2 orders of magnitude lower than undeformed host
- Primary sedimentology as a tool for prediction

… a factor in extending the life of mature basins?

…relevance to groundwater fluid flow models- better aquifer management; a consideration for ESIOS?

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Thanks for listening

Any questions?

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