

# **ePS Understanding Mudstone Lithofacies and Geochemical Variability in a UK Carboniferous Basin\***

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## **Abstract**

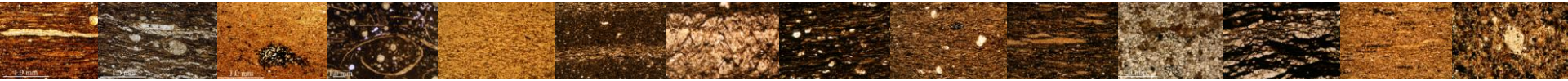
In sedimentary basins of Western Europe and along the western margin of the Appalachian Mountains in the USA, there are significant thicknesses of siliciclastic mudstones of Latest Mississippian to Pennsylvanian age. Strata of this age are well exposed in the UK and Ireland and are age-equivalents of US shale gas plays, such as the Barnett Shale in the lower Mississippian of Central Texas, US.

This study examines the characteristics of a stratigraphically well-constrained Bashkirian mudstone succession from a number of locations in a UK Carboniferous basin using a variety of methods including petrography and whole rock geochemistry. Thin section analysis by optical and electron optical methods from closely spaced sampling highlights a range of key facies within the succession, including homogeneous clay-rich mudstones, pelleted silt-rich mudstones and carbonate-rich mudstones. Variation is observed vertically and laterally on a range of scales from centimetre to metre scale within the one location to 10s to 100s of kilometres across the basin. This method of analysis provides more detailed insights into mudstone processes of transport and deposition including suspension settling, advective transport of sediment by debris flows and deposition of intervals with abundant fossils and carbonate which are not the result of suspension settling.

A number of lithofacies are identified based on textures/mineralogy from this section, geochemical variations and total organic carbon content (TOC). Mudstones deposited closer to the sediment supply have a higher proportion of silt-sized clasts which is reflected in higher average SiO<sub>2</sub> (ca. 52%) compared to 45.56% SiO<sub>2</sub> in a more distal location. The type of organic matter, primarily derived from terrestrial plant debris and microscopic spores with marine algal matter, varies across the basin. TOC abundances range from 1.19-5.31% in a proximal location to 0-8.49% in a more distal location.

The regional variability in lithofacies, and hence process, suggests that some sedimentology processes are more localised. Geochemical signatures can also vary as a result of primary production and physical transport and depositional processes. As anticipated the proximity of a sediment source has an important control on the abundance of siliciclastic material but similar sediment delivery processes occur across the basin.

# Understanding mudstone lithofacies variability and geochemical variability in a UK Carboniferous basin.

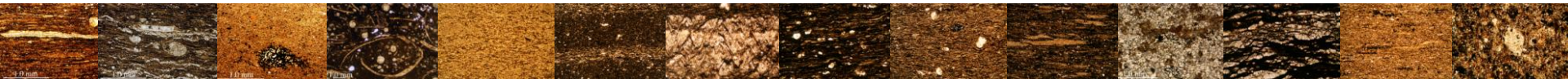


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# Key Aims of the Research

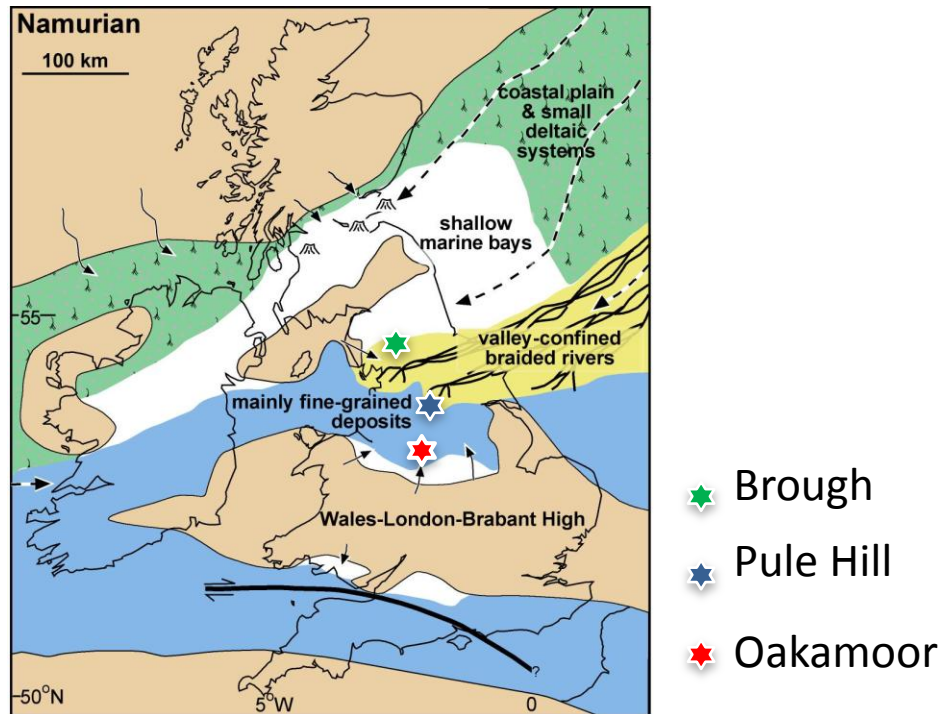
- Understand transport and depositional mechanisms of fine-grained sediment
- Investigate the temporal and spatial variability of mudstone lithofacies
- 2 main techniques with very closely spaced sampling:
  - Whole rock geochemistry
  - Thin section analysis



# Field Locations

## Palaeogeography in the Carboniferous

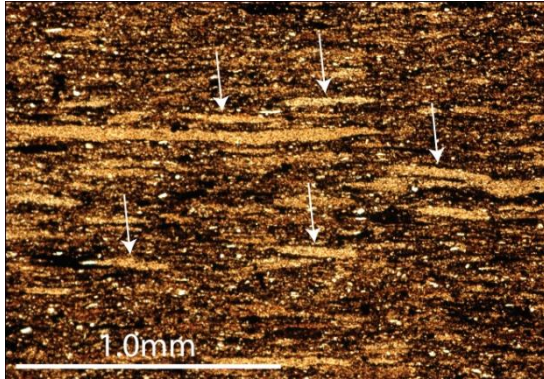
- Proximal to distal transect across the basin
- Sampled a stratigraphically well-constrained Carboniferous succession with a key marker horizon to allow correlation across the basin



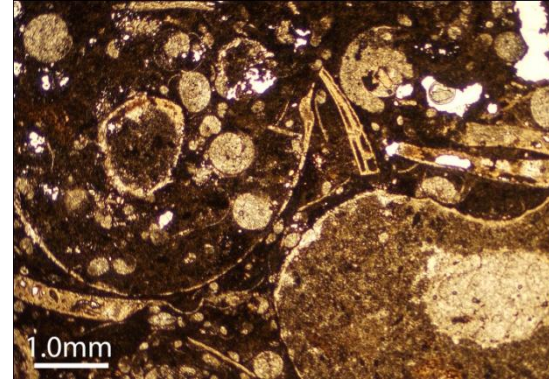


# Lithofacies Variability

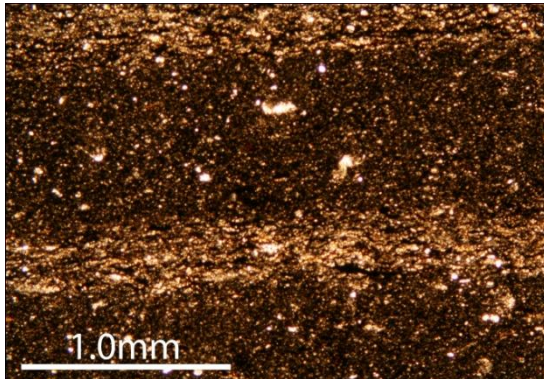
Pelleted



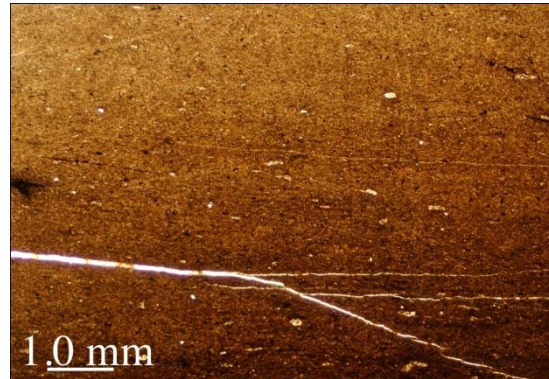
Goniatite-bearing



Bedded

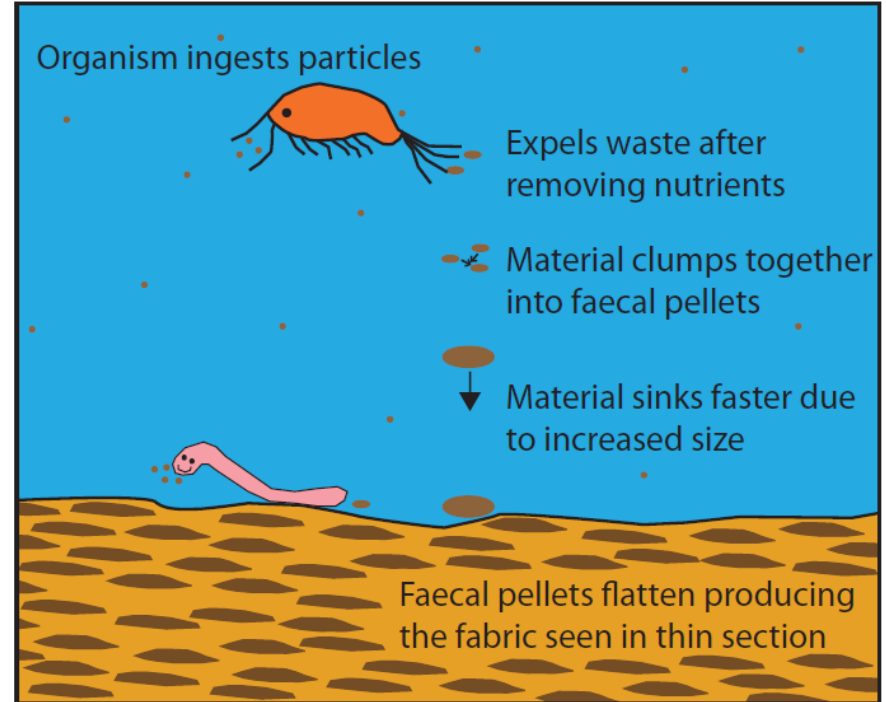
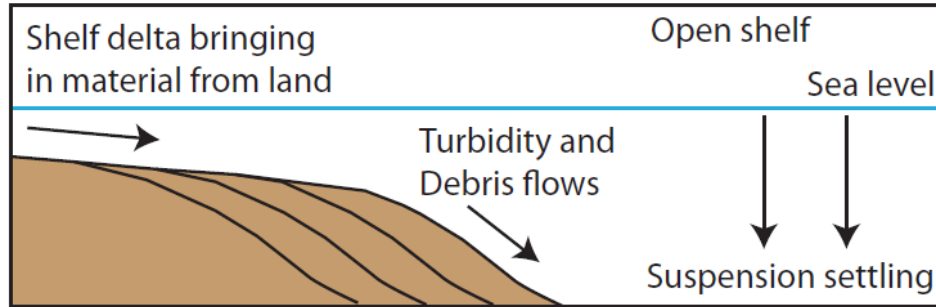


Homogeneous



# Facies Interpretation

## Popular view – suspension settling

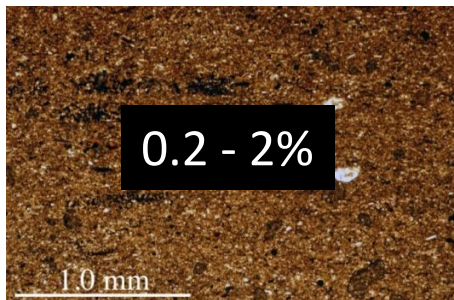
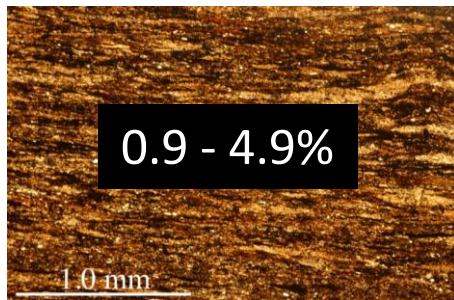
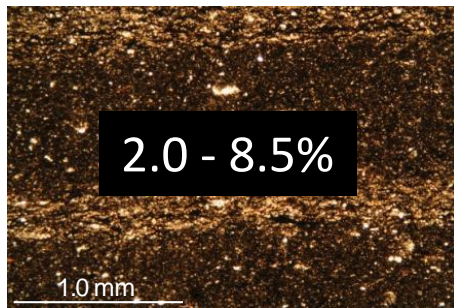


Interpretation for pelleted lithofacies formation



# TOC Variability between location and facies

## Oakamoor

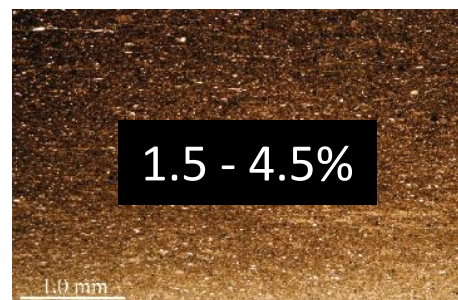
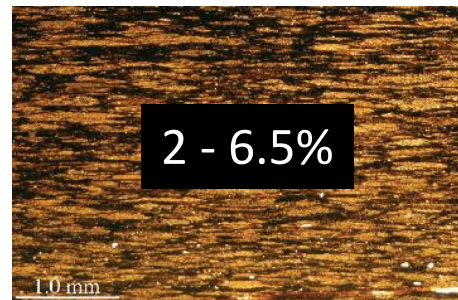
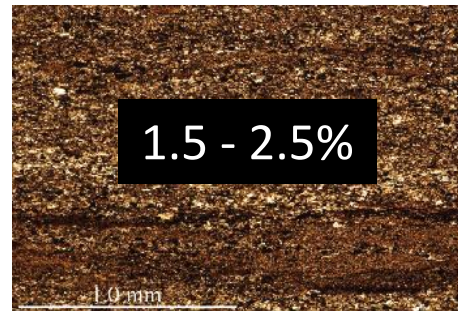


Bedded

Pelleted

Homogeneous

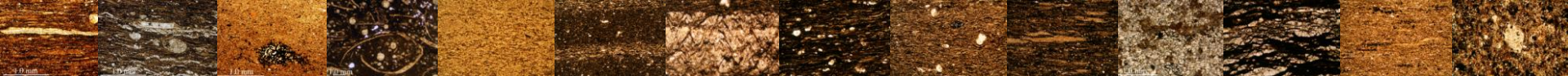
## Pule Hill

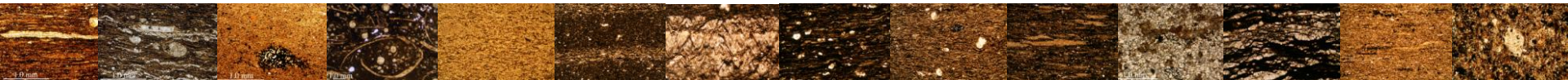




# Key Messages

- Mudstones can vary considerably vertically and laterally on a range of scales
- Different lithofacies are produced from changing transport and depositional processes
- Mineralogical and TOC variations can be attributed to proximity to sediment source
- Comprehensive sampling is required to examine these variations





Thank you for your attention

Any questions please contact me:  
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