Shale Gas Prospectivity

The British Geological Survey (BGS) has been running a shale gas project for the last year. We have collected as much of the relevant data we possess from subsurface exploration of all kinds and also from publications to make a GIS of the main shale formations. This poster and the paper submitted represent a selection of the data being assembled.

The US has been a model repeatedly followed in UK hydrocarbon exploration and we anticipate that exploration will begin in Carboniferous shales. But older and younger shales will eventually be tested too.

We look forward to seeing a new surge in subsurface geological knowledge of the UK from shale gas exploration.

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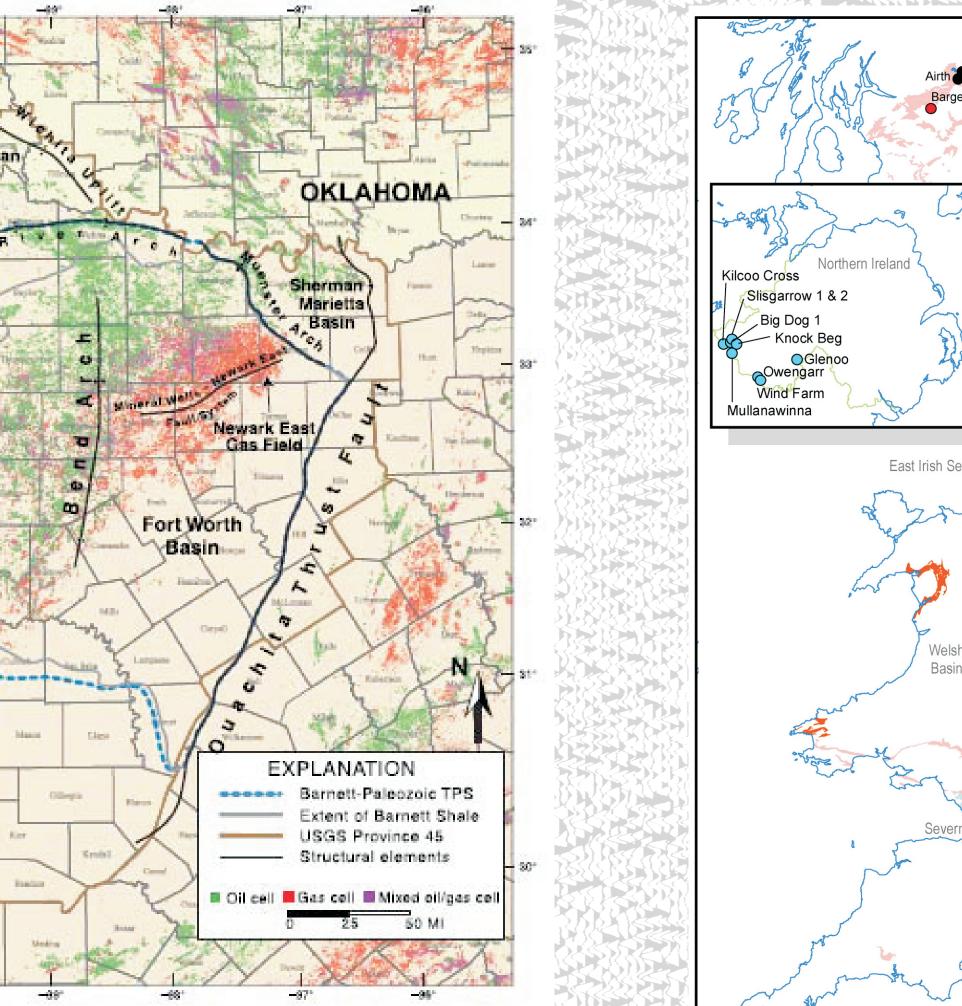
BARNETT SHALE FORT WORTH BASIN USA

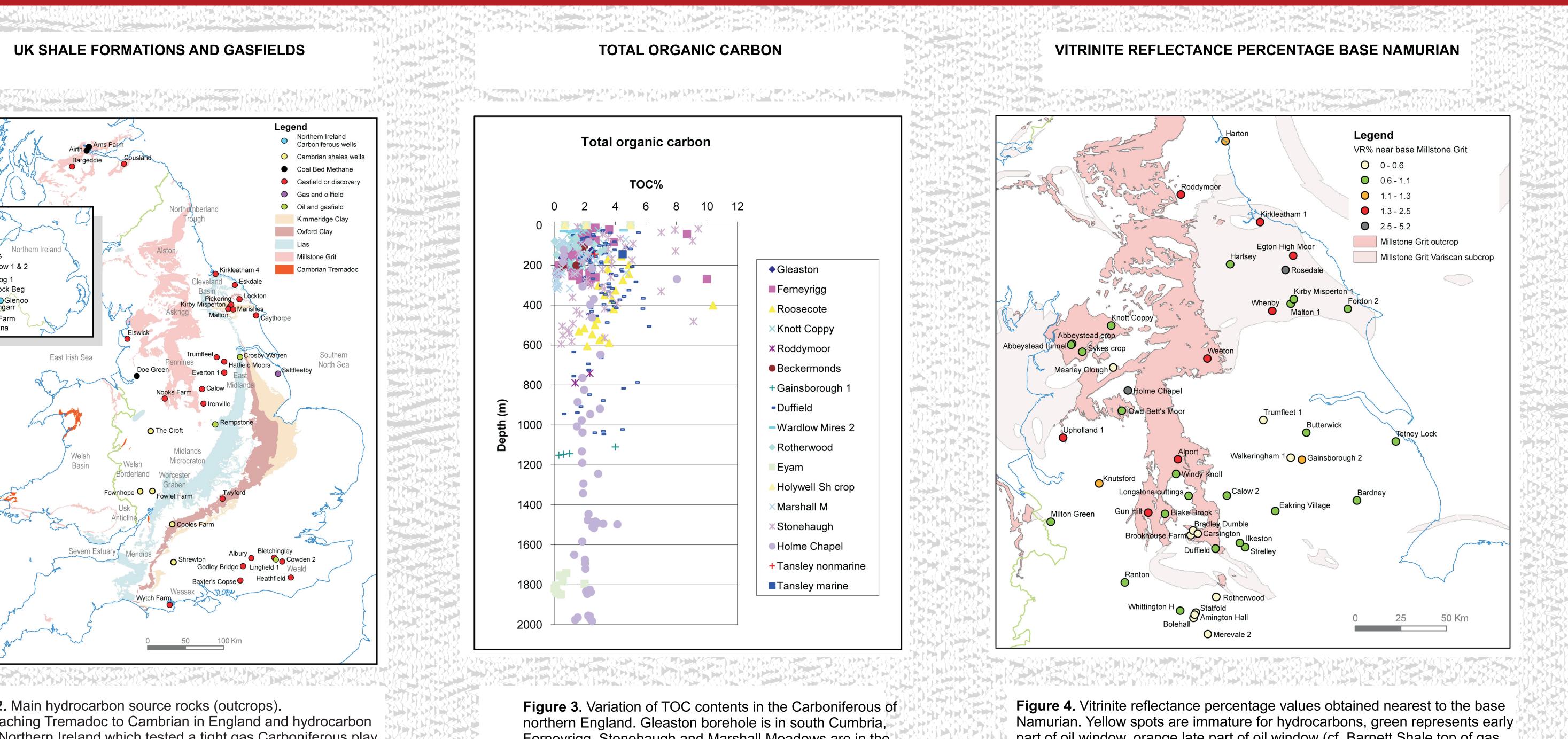
Palo Duro Basin TEXAS OKLAHOMA Eastern Shelf Newark East/ Gas Field Fort Worth Basin 110 200 EXPLANATION Barnett-Paleozoic TPS Extent of Barnett Shale USGS Province 45 ------ Structural elements

Figure 1. Fort Worth Basin, USA: The Lower Carboniferous Barnett Shale is a source rock for conventional hydrocarbons and the most important shale gas reservoir in America at the moment. It lies unconformably on Ordovician strata and thickens northwards against the Muenster Arch. This uplift is part of the Southern Oklahoma Aulacogen system which formed a triple junction with the Ouachita fold belt (=Variscides).

Airth Arns Farm Bargeddie Cousland Slisgarrow 1 & 2 Big Dog 1 Knock Beg Owengarr Wind Farm ooks Farm Calow 🖌 🔵 Ironville O The Croft Midlands Borderland Worcester

Figure 2. Main hydrocarbon source rocks (outcrops). Wells reaching Tremadoc to Cambrian in England and hydrocarbon wells in Northern Ireland which tested a tight gas Carboniferous play





in several phases (Griffith 1983) as recently as 2001

Ferneyrigg, Stonehaugh and Marshall Meadows are in the Northumberland Trough, Roddymoor is on the Alston Block and Beckermonds is on the Askrigg Block. The other boreholes are in the Pennine Basin.

part of oil window, orange late part of oil window (cf. Barnett Shale top of gas window), red the gas window and grey overmature. Most existing hydrocarbon wells were drilled on structural highs and likely to possess lower maturity than the potential source rock.

MUDSTONE POROSITY WITH DEPTH

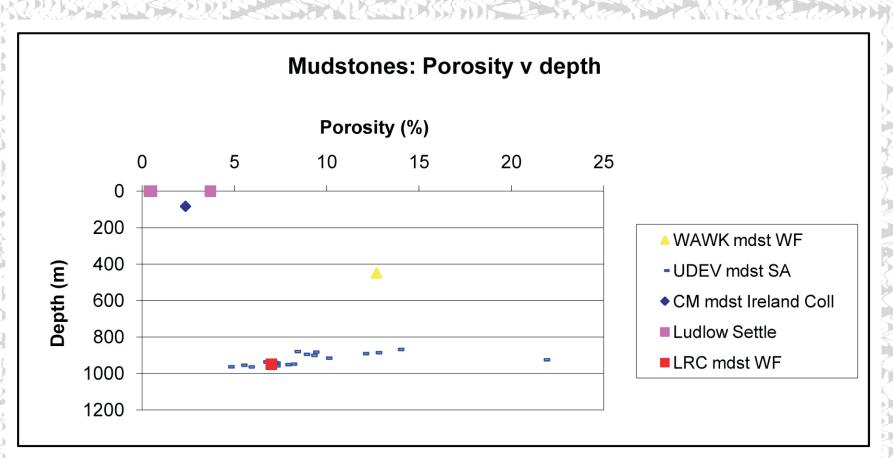
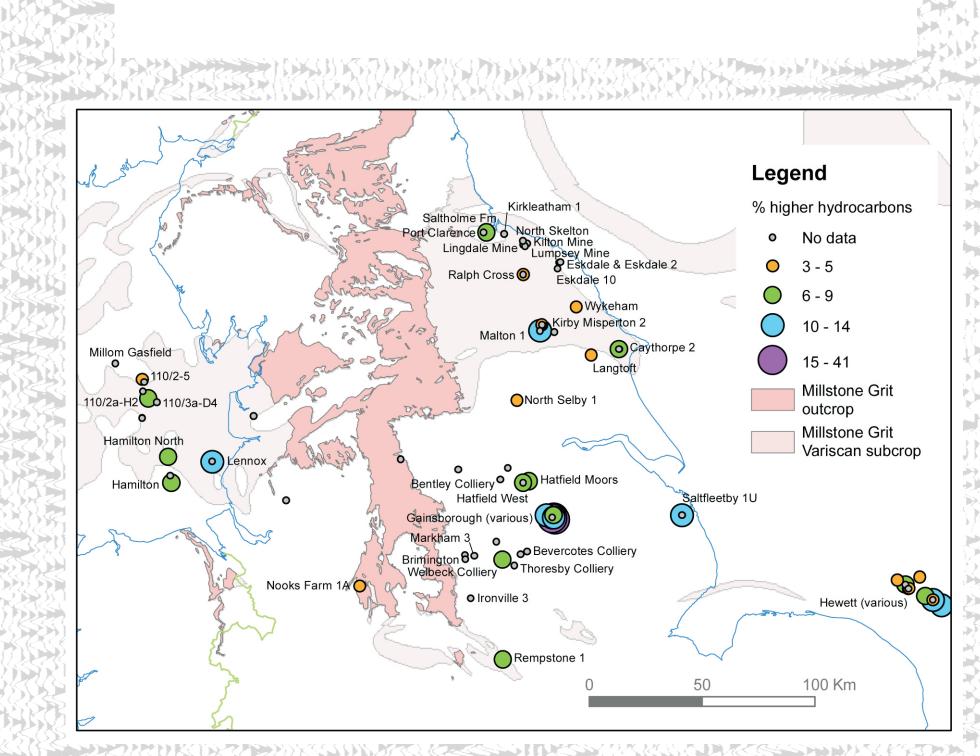


Figure 5. Mudstones: porosity decline with depth. WAWK Warwickshire Group, UDEV Upper Devonian, CM Coal

Measures, LRC Lower Cambrian, WF Withycombe Farm, SA Steeple Aston, Coll Colliery.

Engineering data indicates Jurassic mudstones have porosity between 30-40% at about 30 m. These could lie on a trend through the Withycombe Farm Warwickshire Group value (Poole 1978) and to the Upper Devonian (Poole 1977) and Cambrian values (Poole 1978). The Ireland Colliery value (Derbyshire, Arscott & Hackett 1969) and Ludlow samples on the Settle geological map (Arthurton et al. 1988) with porosity less than 5%, might have been uplifted.



GAS WETNESS RATIO

Figure 6. Gas wetness ratio of analysed gases. The gases associated with oilfields have higher gas wetness values (a greater percentage of higher hydrocarbons). Welbeck Colliery has a high gas wetness, suggesting perhaps some gas from sources other than Coal Measures. These values suggest that source rocks, which have sourced the gas, exist in strata other than Coal Measures. However potential shale gas is likely to be nearer to dry methane within deeper parts of the half graben.

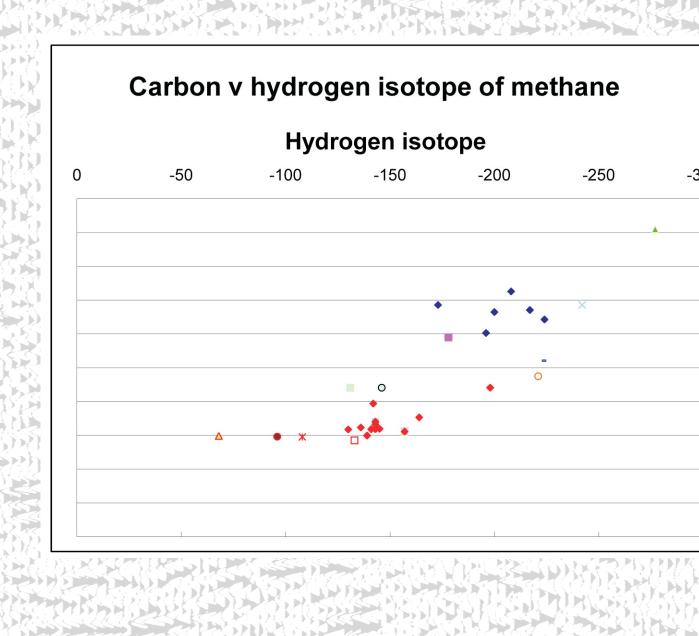


Figure 7. Carbon and hydrogen isotope ranges in various methane gases. $\delta 13C$ values 0 to -20% are probably abiogenically-derived (e.g Fischer-Tropsch reactions with hydrogen). δ13C values -20 to about -55‰ represent thermogenic methane. The gasfield methanes (Lokhurst 1998) are migrated gases and may therefore be typified by less depleted δ 13C values than shale gases. Coalfield gases (Hitchma et al. 1989) might be more depleted than the migrated gases, with biogenic and CO2-reduced gases (Bath et al. 1986) even more depleted. Kimm Kimmeridge, CB Cornbrash, BPS Bridport Sandstone, SSG Sherwood Sandstone Group, LLI Lower Lias, OM organic matter, PSC Deep Soft Coal, SNS Southern North Sea, QT Quaternary.



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