Diffusive anisotropy in low-permeability Ordovician sedimentary rocks from the Michigan basin in southwest Ontario

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Diffusive anisotropy and its scale-dependence were investigated using samples from the Upper Ordovician Georgian Bay Formation (shale and thin interbeds or 'hardbeds' of limestone and siltstone) and Middle Ordovician argillaceous limestone from the Michigan Basin of southwest Ontario, Canada. Effective diffusion coefficients (D_e) were determined for iodide (I^-) and tritiated water (HTO) tracers on paired cm-scale subsamples oriented normal (NB) and parallel to bedding (PB). Measurements were conducted using X-ray radiography and through-diffusion methods. The D_e values range from 4.8×10^{-13} to 5.3×10^{-12} $m^2 \cdot s^{-1}$ for shale, 2.1×10^{-13} to 1.3×10^{-12} $m^2 \cdot s^{-1}$ for limestone, and 4.1×10^{-14} to 5.6×10^{-13} $m^2 \cdot s^{-1}$ for siltstone interbeds within the Georgian Bay shale formation. The sample-scale anisotropy ratios ($D_{e\text{-}PB}$: $D_{e\text{-}NB}$) for D_e values obtained using I^- tracer are 0.9 to 4.8, and the anisotropy ratios for HTO tracer are in the range of 1.1 to 7.0. A formation-scale anisotropy ratio of 8.0 was calculated for the Georgian Bay Formation from the ratio of the arithmetic to the harmonic mean of D_e data measured at the sample scale and weighted for the thickness of interbedded siltstone/limestone and shale units.

The influence of porosity distribution on diffusive anisotropy has been investigated using one-dimensional spatially-resolved profiles of I^--accessible porosity obtained from radiography experiments, and the use of $AgNO_3$ for fixation of I^- tracer in the pores, allowing for SEM visualization of I^--accessible pore networks. The porosity profiles generally display greatest heterogeneity in the direction normal to bedding. The SEM imaging suggests that diffusion pathways are preferentially oriented parallel to bedding in the shale, and that diffusion occurs dominantly within the argillaceous component of the limestone but fine clay-filled voids in the limestone are also accessible for diffusive transport.

Characteristics and prediction of high quality coal measure source rocks in Oligocene Yacheng Formation of Qiongdongnan Basin, Northwestern South China Sea

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The coal measure strata of marine-terrigenous facies in Oligocene Yacheng Formation are the major source rocks of Qiongdongnan Basin. Through comprehensive studies, main characteristics of this set of coal measure source rocks can be concluded as following: (1) they consist chiefly of coals, carbonaceous mudstones and dark mudstones with relatively high organic matter abundance and type II_2-III kerogen. Among them, coals have been most noticed because of the highest organic carbon abundance (19.9-95.9%) and hydrocarbon-generating potential (14.3-142.8mg/g), (2) the drilling and logging data shows that coals are developed in multiple seams with thin single seam thickness and unstable plane distribution, and their logging responses are high neutron porosity, high acoustic interval transit time, high resistivity, low natural gamma ray, and low lithology density, (3) coal seams in Yacheng Formation mostly form by the gelatification and are deposited in the peat swamp environments of braided river delta plain, fan delta plain, and upper intertidal zone and supratidal zone in tidal flat, and (4) the relatively gentle paleotopography and the approximately equivalent sedimentary rate and subsidence rate are the two key control factors of the development of coal measure strata. According to the above conclusions, three favorable development areas of high quality coal measure source rocks in Yacheng Formation are predicted, including Yacheng area of western Qiongdongnan Basin, northeastern slope and southern slope of the basin.

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