Palaeogeography, palaeo-earth systems, and the predictive modelling of source rock environments in Atlantic margin basins

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The breakup history of the Atlantic margin basins was accompanied by wholesale variations in palaeoclimate that represent the main controls on stratigraphy and resource potential. Given this complex regional geohistory, the distribution of source rocks and the lateral variation in source quality are significant difficulties for exploration. To construct a predictive tool designed to address this problem, deformable plate kinematics reconstructions were used as the basis for palaeogeographic mapping. Detailed gross depositional environment maps were prepared using a database of stratigraphic, seismic, palaeoenvironmental, lithofacies, and source rock data compiled from a legacy data resource representing over 35 years of petroleum geological studies and the public domain.

A novel method relating topography and bathymetry to plate tectonic environments was used in the construction of paleo-digital elevation models (DEMs). The DEMs were coupled with state-of-the-art paleo-earth systems models (UK Met Office HadCM3 palaeoclimate model) and an unstructured mesh model to simulate palaeotides (Imperial College, UK, ICOM tide model). The database also includes climate proxies used to test the veracity of the modelling results. This approach provides an understanding of regional paleogeographic and paleoclimatic geohistory that includes drainage basin evolution and the quantification of clastic sediment flux.

In conjunction with the DEMs, paleo-earth systems were used to create a new predictive model of organic matter productivity, accumulation, dilution, and preservation that defines source facies depositional space for a broad range of marine source rock environments developed during the breakup history of the Atlantic margin. The gridded model results also provide an objective assessment of lateral variability in source quality for key source rock horizons.

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