

Palaeogeographic and Geological Constraints on Coupled Ocean-Atmosphere Palaeo-Earth Systems Modeling for Source Rock Prediction in Frontier Basins

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One of the main uncertainties for exploration in frontier basins is the presence of source rocks. To provide an objective, process based, predictive methodology focused on this problem, global palaeogeographic reconstructions underpinned by data were coupled with state-of-the-art palaeo-Earth systems modelling (HadCM3 palaeoclimate model). Palaeotectonics and palaeoenvironments maps for six Mesozoic - Cenozoic time slices were prepared and a new method relating topography and bathymetry to plate tectonic environments was used as the basis for palaeo digital elevation models (DEMs). These were gridded in GIS and used to provide the topographic and bathymetric boundary conditions for coupled ocean-atmosphere general circulation models (GCMs), and a barotropic model to simulate palaeotides.

The compilation of the base maps is based on a global database of palaeoenvironmental and lithofacies data, the legacy of over 25 years of petroleum geological studies and an equally extensive source rocks database. These data include climate proxies that were used to test the veracity of the modelling results, before the models were used for source facies prediction. Source rock depositional space, a concept based on the spatial analysis of the processes responsible for nutrient supply and organic productivity, accumulation and preservation of organic rich sediments together with dilutional processes responsible for the elimination of source rock potential were used to create a series of predictive masks. These were tested against the source rock distribution database and at the basin scale successfully account for over 80% of the source rock occurrences for the time-slices analysed.