

## **Palaeogeographic and Palaeoclimatic Evolution of the North Atlantic: The Role of Earth Systems Modelling in the Predictive Mapping of Source Rock Environments**

**Jim Harris<sup>1</sup>, Alexandra Ashley<sup>1</sup>, Fiona Healey<sup>1</sup>, Simon Otto<sup>1</sup>, Sean Pyman<sup>1</sup>, Watson John<sup>1</sup>, Windmill Richard<sup>1</sup>, Mike Goodrich<sup>1</sup>, Jon Hill<sup>2</sup>, and Alexandros Avdis<sup>2</sup>**

<sup>1</sup>CGG Services UK

<sup>2</sup>Imperial College

### **Abstract**

The Late Palaeozoic - Cenozoic break-up history of the North Atlantic margin basins was accompanied by wholesale variations in palaeoclimate that represent the main controls on stratigraphy and resource potential. Given the complexities of this regional geohistory the distribution of source rocks and the lateral variation in source quality are significant difficulties for exploration in these basins. To construct a predictive tool designed to address this problem, deformable Plate Wizard 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 for the region together with legacy data representing over 35 years of petroleum geological studies. A novel method relating topography and bathymetry to plate tectonic environments was used in the construction of palaeo digital elevation models (DEMs). The DEMs were coupled with state-of-the-art palaeo-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 that were used to test the veracity of the modelling results. In conjunction with the DEMs, palaeo-Earth systems were used to create a new predictive model of organic matter productivity, dilution, and preservation. This model defines source facies depositional space for the broad range of marine source rock environments that developed during the break-up history of the North Atlantic margin basins and the gridded model results provide an objective assessment of lateral variability in source quality for key source rock horizons. This approach also provides an understanding of regional palaeogeographic and palaeoclimatic geohistory that includes drainage basin evolution and the quantification of clastic sediment flux.