A 3D Evaluation of Reservoirs Associated with the Break-up of Alaska and Assessment of the Impact of Mantle Plumes

Kate C. Evans*, Neftex Petroleum Consultants, 97 Milton Park, Abingdon OX14 4RY, UK
Kate.evans@neftex.com

and

Roger B. Davies, Andrew Davies, Domenico Lodola and Richard Martin, Neftex Petroleum Consultants, 97 Milton Park, Abingdon OX14 4RY, UK

GeoConvention 2012:Vision

Summary

The North Slope of Alaska is an established petroliferous region with vast amounts of data, much of which is now in the public domain, thereby facilitating a comprehensive review of its geological history and its petroleum systems. The tectonic history of North Slope is complex and has had a profound influence on the deposition of both reservoir and source rocks. Key unconformities that can be correlated to major tectonic events are recognised in the stratigraphy. One such major feature is the Lower Cretaceous Unconformity, or the Break-Up Unconformity, caused by Northern Alaska rifting away from Arctic Canada

The trigger for this break up is uncertain, although we propose it may be related to the presence of a hot spot plume in the vicinity of Arctic Alaska and the Canadian Arctic Islands during the Early Cretaceous. The break-up caused very rapid uplift along the line of the Barrow Arch across the North Slope and US Chukchi regions although the expression of the resulting unconformity varies along this region. Following the uplift event, subsurface data shows a very pronounced, but rapid subsidence phase in the region leading to a return to deep marine conditions. This series of events is consistent with the passage of a mantle plume and led to the deposition of sandstones during the transgressive phase associated with the rapid subsidence. The sandstones form important proven and potential reservoir facies although they are relatively localised.

Here we show how we have used a comprehensive data set derived from the public domain to address the distribution of petroleum elements across the North Slope. The data set has been interpreted within a proprietary global sequence stratigraphic model and used to build a set of gross depositional environment maps that illustrate the changes in palaeo-environments associated with the break-up event. By placing these maps within a regional 3D model and applying proprietary palinspastic reconstructions, we have gained much improved insights into the causes of the major tectonic events as well as the potential extents of petroleum elements relating to the Lower Cretaceous Unconformity. Results from this approach to interpret data in the North Slope should also provide good analogues for the neighbouring US Chukchi and Beaufort Sea regions.