

Petroleum systems and plays in their basin history context: Building a predictive framework for new opportunity identification

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Abstract

This presentation describes a methodology that relates plays and petroleum systems to their sedimentary cycle or basin stage. The approach clarifies the relationship between tectonostratigraphic basin evolution and hydrocarbon resources or prospects. I believe it can provide a valuable framework for the use of analogue play data in exploration and thus assist in prospectivity assessment, particularly of relatively poorly known areas.

In brief, the methodology involves creating a matrix from a plot of (i) the natural tectonic cycles and stages of sedimentary basin evolution against (ii) the sequence of depositional environment-defined lithofacies that characterise them. In this matrix, the evolutionary “trajectories” of defined sedimentary basins or parts of basins as well as the domains of the petroleum systems present can be plotted in such a way that analogous areas of whatever age or location can be directly compared.

Plays developed in petroliferous basins and provinces may then be placed in their natural basin-evolutionary and petroleum system environment. In principle, this should make it easier to identify truly appropriate play analogues, drawn from widespread, possibly global distributions. In order to facilitate comparisons, a standard definition of plays is proposed, which includes consideration of a hierarchy of constituent parameters and relates them to the tectonostratigraphic basin-phase setting in which they occur.

A flexible approach to the use of the petroleum system concept also is recommended, to account for situations where they may be in practice difficult to identify as defined. This applies especially to provinces, such as rift basins, where local lithofacies-development and mixing of charge from multiple levels may lead to petroleum systems becoming stacked, mixed or shared.

In order to illustrate the above, I shall review the petroleum systems, plays and play types developed in a number of areas that passed through relatively comparable syn-rift to post-rift basin evolution, albeit at different times and involving different mechanisms and environments. I will compare the North Sea province with parts of the Northwest Shelf of Australia and a selection of Southeast Asian Tertiary basins with similar basins in east and southeast Australasia (such as Gippsland and Taranaki).

From these comparisons, I will highlight issues related to the recognition and definition of petroleum systems. I will argue that in basins characterised by similar tectonostratigraphic evolution, a simplified petroleum system framework can help us to recognize commonalities between them, allowing us to gain valuable insights into overall prospectivity and helping us to focus exploration in less well known areas.

Keywords: Petroleum systems, plays, sedimentary basin evolution, rift/post-rift basins, Far East, Australasia.



Biography

Harry Doust graduated with a PhD in geology from Imperial College, London in 1968. He joined Shell International directly thereafter, where he worked in petroleum exploration for more than 30 years. He has lived in the Netherlands, Turkey, Oman, Malaysia and Nigeria and, in addition, has carried out evaluation work in many other parts of the world. His last jobs with Shell were Head of Regional Studies and Global Geological Adviser, responsible for reviewing operating company plans. He retired two years ago, and took up the position of Professor of Regional and Petroleum Geology at the Vrije (Free) University of Amsterdam in the Netherlands. He is a member of several professional bodies, including AAPG, Geological Society of London and the EAGE.