Linking Petroleum Systems to Sedimentary Basin Evolution

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ENGLISH SUMMARY

This thesis concentrates on a study of sedimentary basin development along the divergent boundaries of tectonic plates.

Extensional forces lead to thinning of the crust. The thinning of the crust may lead to crustal break up and the formation of new oceanic crust at mid-ocean ridges. Before the crustal break up, a long period of extension can take place. Sediments fill up the crustal depression, such as organic rich sediments that could eventually generate petroleum if the temperature is sufficiently enough at its burial depth.

Common sedimentary patterns and structural styles can usually be recognized, although the depositional environment and tectonic situation may change considerably over short distances. This helps recognizing common petroleum system types with related parameters, as well as plays likely to be associated with them. If the development of petroleum habitats can be related to these basic patterns, a broad scale comparisons of petroleum systems between different basins with similar geological history can be made.

In this thesis I studied the evolution of extension and the related crustal thinning, fault patterns and sedimentary fill. I looked at the possible occurrence and characteristics of associated source rocks in order to ultimately predict important trends in oil and gas generation and trapping potential.

In Chapter 2 the basic structural and sedimentary patterns of the Northern North Sea, Central Graben and Moray Firth Jurassic rift provinces in the North Sea are divided in standard tectonostratigraphic cycles and stages. This division helps to understand the stages in basin evolution and allows to compare the basins with each other more readily. Although the provinces in the North Sea share common source rocks and comparable depositional environments, the style of rifting differs, affecting the trap formation.

The Tertiary sub-basins in the Pannonian Basin System in Eastern Europe experienced comparable styles of rifting. In Chapter 3 it is demonstrated that a relation exists between the tectonic cycles (syn-rift and post-rift with inversion), play levels, trap types and the thermal structure for the different sub-basins.

The effect of different styles of rifting on the source rock maturation is discussed in Chapter 4. This study is based on integrated analogue and numerical modelling. This integrated modelling highlights the differences in fault-structures, subsidence patterns, graben migration paths, sediment stacking patterns and heat flow between symmetric and asymmetric grabens. All these factors contribute to the graben's source rock maturation architecture.

The thermal consequences of faulting (in this case the main boundary fault) are studied in Chapter 5, showing its significance at high deformation rates.

Finally Chapter 6 presents an operational model of the method presented in the thesis. This model allows us to make predictions of potential petroleum system

development and kinds of plays that may be expected in under-explored basins or regions.