Assessing and communicating risk in early stage exploration: embedding regional understanding within basin modelling workflows [abstract only]

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Assessing and communicating risk in early stage exploration: implementing regional evaluation in informed basin modelling workflows

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During the early stages of exploration, uncertainties regarding the nature and presence of a petroleum system are significant. The accuracy of exploration predictions is largely dependent on datasets available and the ability of subsurface models to characterize real-world conditions. Multiple scenarios for interpretation must be predicted, tested, and evaluated when conducting exploration in frontier areas; and, during this stage, only a limited number of factors can be equivocally resolved, making risk assessment challenging.

Basin modelling during the early stages of exploration allows for vital investigation of charge risk, a common cause of exploration failure. However, in new frontiers, there is typically little data available to constrain crucial thermal conditions, such as heat flow and geothermal gradient. Regional geological and tectonic context therefore provides a fundamental and primary framework for developing predictions and understanding uncertainty in models. This study presents an integrated workflow for basin modelling in a regional context, using case studies from global frontier rifted margins. This work demonstrates that meaningful, quantitative predictions can be made, even during the early stages of exploration.

Firstly, the work presents how regional context can be implemented to construct and condition subsurface models in frontier kitchen zones. Geological and tectonic framework is used to identify analogues, the adoption and calibration of which can narrow uncertainty in model inputs and inform boundary conditions. Depositional models are applied to help minimize stratigraphic uncertainty, and tectonic and climatic models are used to develop thermal scenarios. Examples from Southeast Asia, South America, and Central America are used to highlight how simple extrapolation of conditions is often inappropriate.

Multiple predicted scenarios are then tested using sensitivity analysis, which quantifies the plausible range of outcomes for a study area, de-risking some inputs and highlighting critical factors for further study. An example from a tectonically complex area of offshore Ireland is presented to illustrate this iterative process. Scenarios are constantly adapted as testing progresses to better hone the subsurface model and help improve predictions. Outcomes and risks are evaluated and uncertainties involved during each stage are clearly communicated.

The results of the case studies presented demonstrate that modelling and sensitivity analysis used together with regional understanding are powerful tools for addressing uncertainty during early stage exploration. This work illustrates that iteration of multiple scenarios helps provide a fuller picture of potential risk than a simple extrapolation of play concepts from proven successes, particularly in tectonically complex areas.