INTEGRATING PASSIVE MARGIN EVOLUTION, HYDROCARBON GENERATION AND MIGRATION, AND THE OCCURRENCE OF HYDROCABRON SEEPAGE FEATURES THROUGH 3D BASIN MODELLING IN THE ORANGE BASIN, SOUTH AFRICA

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Integrating the evolution of passive continental margins with the generation and migration of hydrocarbons is commonly undertaken. In addition, seafloor expressions of gas seepage, including mud volcanoes, pock-marks and carbonate mounds, have been identified in most passive margin settings and have been attributed to either thermogenic gas sourced from the underlying hydrocarbon system or to in-situ biogenic gas generation. However, there has been no attempt to integrate passive margin, and associated hydrocarbon system, evolution with either present-day or paleo- seepage events.

This paper presents data from the Orange Basin, South Africa. This is a suitable area to investigate the interaction of margin evolution, hydrocarbon systems and the occurrence of sea floor expressions of gas leakage because of 1) the high quality sub-surface data available from offshore exploration, 2) the presence of an active hydrocarbon system and 3) the occurrence of a number of well documented sea floor features and seismic gas chimneys. In this area the occurrence of hydrocarbon seepage has also been associated with the development of gas hydrate deposits.

3D basin modelling in the Orange Basin is being undertaken to model the development of the margin, and to attempt to quantify the volume of hydrocarbons generated throughout the evolution of the margin. The model comprises a transect across the entire basin margin from deep marine to shallow shelf and includes the entire margin time-frame from syn-rift through post-rift to the present. For each time-step in the model the volume of hydrocarbons generated is calculated, and direction and volume of fluid flow of hydrocarbons within the system assessed. Through this type modelling a mass-balance of hydrocarbon generation is attempted in order to estimate the proportion of fossil carbon being input into the atmosphere during basin evolution. The model results are used to determine the timing of possible leakage events and the results calibrated against the presence, or absence of present- or paleo-seafloor surface features.

It is envisaged that the application of such a model will lead to a better understanding of the role of hydrocarbon seepage on a number of key issues of passive margins including margin slope stability, interplay between margin development and climate change, and the presence and stability of hydrates through time.