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East Africa Gas: Source Type or Maturity?

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Summary

Interpretation of gas geochemistry from Block 2 offshore Tanzania. Presentation of results, and interpretation of possible source type. Will also introduce the application of Clumped Isotope Gas Geochemistry to basin modelling and petroleum systems analysis

Abstract

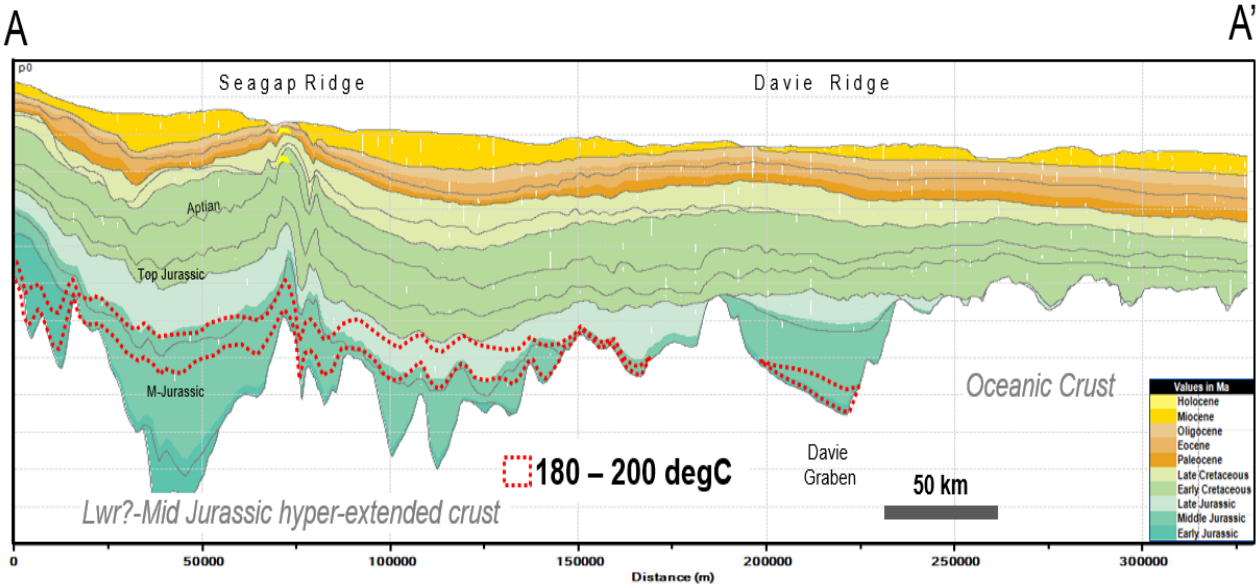
East Africa offshore is currently viewed as a major gas province with approximately 180 TCF found in the vicinity of the Rovuma delta and southern Tanzania. East Africa's early break-up history seems ideally suited for establishing conditions conducive for Jurassic marine source rocks development. However, exploration activities over the last 30 years have found little commercial oil. Predicting future potential, in particular the likelihood for liquids, relies on understanding organic matter type, distribution and thermal maturity. Unfortunately, little to no calibration of offshore source intervals exists as yet**,** so techniques such as gas geochemistry, Fluid Inclusion Volatiles (FIV) and regional integration are important methods for characterising the offshore hydrocarbon system.

Offshore discoveries in Tanzania and Mozambique are dominated by dry gas. Methane constitutes between 97-98%, with ethane and propane <3%. With such limited material to interpret (oils commonly have 100's -1000's of compounds whereas gas has only seven) it is challenging to confidently predict original source type. We will present data from recent exploration in Block 2 Tanzania that have been utilized, in conjunction with several new and refined analytical techniques, to provide insights on the origin of these hydrocarbons. We will examine recent advances in the interpretation of gas geochemistry and question the utilization of widely invoked discrimination plots. Clumped isotope analysis (Stolper *et al*. 2014) is a new technique that leverages high-resolution isotope signatures of methane as a thermometer to determine the temperature of bulk generation. Integrated with basin models, this technique provides a prediction of the most likely stratigraphic position of source intervals. Finally, Fluid Inclusion Volatiles analysis, in which trapped inclusions in mineral cements from cuttings or core are released by squeezing and crushing the rock samples, can provide evidence for early generated and migrated fluids. Analysis over regular intervals within a well can provide not only critical geochemical data, but also yields information on sealing intervals and migration pathways.

Despite the number of datasets available, the techniques described herein may lead to non-definitive interpretations, and so different scenarios are plausible. Notwithstanding, using these techniques and integrating with regional understanding and 3-D basin modelling leads us to the proposal that gas in offshore Tanzania is most likely from a Type III terrestrial source interval at a temperature of approximately 200°C. Within the interpreted hydrocarbon kitchen areas of the Tanzania Block 2 discoveries, this isotherm lies within the Jurassic stratigraphic interval present day.

Reference

Stolper, D.A., Lawson, M., Davis, C., Ferreira, A.A., Santos Neto, E.V., Ellis, G.S., Lewan, M.D., Martini, A.M., Tang, Y., Schoell, M., Sessions, A.L., Eiler, J.M. (2014). Formation temperatures of thermogenic and biogenic methane. Science, 27, 1500-1503.



2D profile along the Tanzania margin showing the predicted position of the 200degC isotherm.