P35-MO

UNRAVELLING THE OILY PAST OF GIANT GAS FIELDS USING OIL-BEARING FLUID INCLUSIONS

Herbert VOLK[1], Simon C. GEORGE[2], Mark P. BRINCAT[3], John M. KENNARD[4], Dianne S. EDWARDS[4], Chris J. BOREHAM[4], Manzur AHMED[1] and Mark LISK[5]

1. CSIRO Petroleum, PO Box 136, North Ryde, NSW 1670, Australia
2. Australian Centre for Astrobiology, Macquarie University, Sydney, NSW 2109, Australia
3. Strike Oil Limited, Level 9, Wesfarmers House 40, The Esplanade, Perth WA 6000, Australia
4. Geoscience Australia, GPO Box 378, Canberra, ACT 2601, Australia
5. Woodside Energy Ltd, 240 St. Georges Terrace, Perth WA 6000, Australia.

Currently gas-filled structures sometimes received an earlier charge of liquid hydrocarbons, and one area where this is common is the Browse Basin, NW Shelf of Australia (Brincat *et al.*, 2004). Giant gas resources in this basin are currently being appraised for LNG development, and oil accumulations are yet to be found in more off-shore regions of this basin. However, abundant oil-bearing fluid inclusions (FI) in present-day gas columns give testimony to liquid petroleum systems that were active in the past. Although analytically challenging, it is possible to analyse the molecular chemistry of these trapped oils, including in cases where the FI oil yields are high, the carbon isotopic composition of individual *n*-alkanes (George *et al.*, 2006). These data provide information about palaeo oil charge composition (e.g. source and thermal maturity at expulsion) and reservoir fill history.

In this study, seven FI oils recovered from gas columns in the Browse Basin were analysed (Heywood-1, Crux-1, North Scott Reef-1, Argus-1, and Ichthys-region FI oils Brewster-1A, Dinichthys-1 and Titanichthys-1). FI oil source and maturity characteristics have been compared to those of condensates recovered in the region. Biomarker evidence from Heywood-1 FI oil suggests that Jurassic source rocks, similar to those that generated oils in other fields on the NW Shelf, have also generated oil in the Browse Basin. In contrast, Ichthys-region and Crux-1 FI oils contain relatively high abundances of 30-norhopanes and 2α-methylhopanes, indicating that a carbonate source containing significant amounts of algal and/or bacterial organic matter has contributed to the hydrocarbon charge. North Scott Reef and Argus FI oils have biomarker signatures intermediate between the "Jurassic" and the "calcareous" biomarker signatures, while low-abundance biomarkers of the condensates may be compromised by migration-contamination, a process that clearly lends extraneous biomarkers to Gorgonichthys condensate. The oils from the more inboard Browse Basin oil fields such as Cornea and Gwydion fields, that are believed to be derived from the Lower Cretaceous Echuca Shoals Formation, are geochemically different, thus suggesting the presence of at least three different effective oil source rocks in the region.

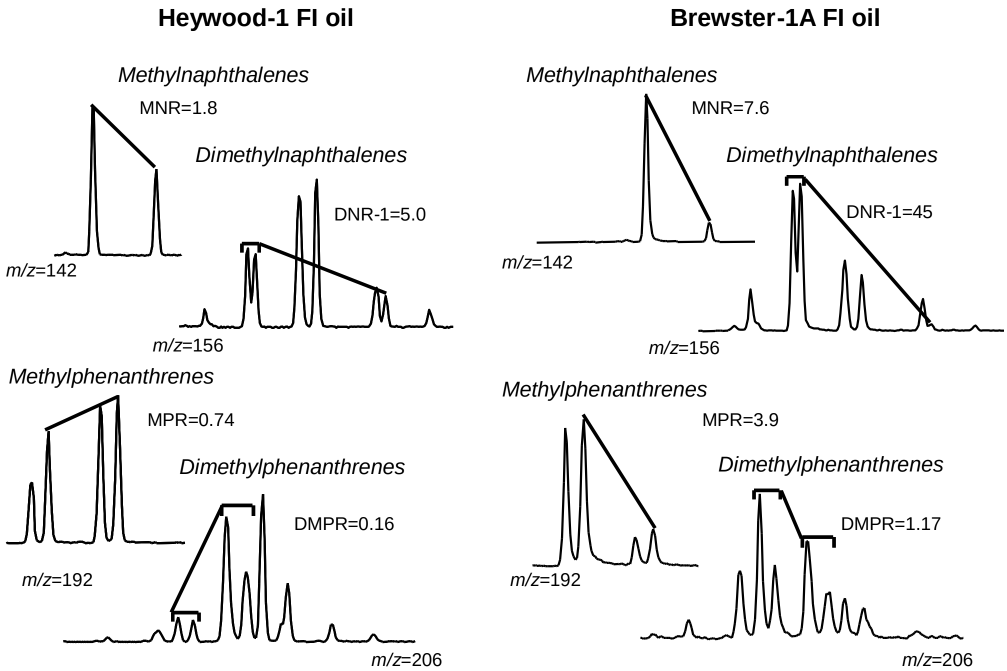

Figure 1. Normal oil window and unusually high aromatic maturity parameters for Heywood-1 and Brewster-1A FI oils.

Unusually high aromatic maturity parameters for samples from the Ichthys-region (e.g. DNR-1 ratios > 40 for Brewster and Gorgonichthys; Fig. 1) coupled with basin modelling analysis constrained by homogenisation temperatures of oil-bearing and co-eval aqueous FIs indicate post in-reservoir thermal alteration of hydrocarbons. Very high low-molecular-weight hydrocarbon aromaticity values also suggest that some of the FI oils and most of the condensates experienced evaporative fractionation.

The distribution of oil inclusions may give hints as to where an early oil charge has been displaced by a later gas charge, or how much of this oil may be dissolved in the gas phase. In addition, the geochemistry of FI oils may also help to predict condensate contents in neighbouring plays. Most importantly, our data demonstrate that the first, often liquid hydrocarbon charge in gas fields can be constrained by the distribution and composition of oil inclusions, and such oil may be related to both known and hitherto unknown petroleum systems.

REFERENCES

George, S.C., Volk, H. and Ahmed, M. (2006) Geochemical analysis techniques and geological applications of oil-bearing fluid inclusions, with some Australian case studies. *Journal of Petroleum Science and Engineering*, in press, available on-line.

Brincat, M.P., Lisk, M., Kennard, J.M., Bailey, W.R. and Eadington, P.J. (2004) Evaluating the oil potential of the gas-prone Caswell Sub-Basin: insights from fluid inclusion studies. In: G.K. Ellis, P.W. Baillie and T.J. Munson (eds): *Timor Sea Petroleum Geoscience: Proceedings of the Timor Sea Symposium*, Darwin, Northern Territory, 19-20 June, 2003, Northern Territory Geological Survey, Special Publication 1 (CD-ROM).