



## ORAL PRESENTATION

---

### **Real-Time Isotope Logging in Central Luconia Province, Offshore Sarawak; Assessing Seal Competency Using Contrasting Results from Two Recent Exploration Wells**

**Robert C. Davis<sup>1</sup>**, Ana Gironés<sup>2</sup>

<sup>1</sup>*Mubadala Petroleum, Malaysia*

<sup>2</sup>*Geolog International, Malaysia*

*bob.davis@mubadalapetroleum.com*

---

Mud gas isotope analysis (MGIL) is an old geochemical technique which began by offline GC-IRMS analysis of the headspace in canned cuttings samples (Mattavelli et al, 1983). It gained a new lease of life around the turn of the 21st century with the advent of routine isotube analysis (e.g. Ellis et al, 2003; Dawson and Murray, 2011), but only recently have advances in acquisition methods enabled such measurements to be reported while drilling (e.g. Niemann et al, 2010; Hammerschmidt et al, 2014).

Mubadala Petroleum's recent drilling campaign in Central Luconia Province, offshore Sarawak, produced one hydrocarbon discovery and one dry hole. Real time mud gas isotope analysis was commissioned in addition to routine mud logging. The objective of this analysis was primarily to assist with post-well evaluation, particularly with respect to charge focus and seal competency, in the light of numerous sub-commercial discoveries and dry holes in the vicinity. Column heights in Luconia reefs appear to be controlled by several mechanisms: access to charge (migration focus), overpressure, and thief zones interbedded with sealing lithologies. It was anticipated that a continuous isotope profile through the overburden would greatly assist in differentiating general seal failure due to overpressure, from discrete thief beds or absence of thermogenic charge, in the event of a dry hole.

The data are similar to those provided by isotube mud gas programs, except in real time, and at several orders of magnitude higher sampling density (every few minutes during active drilling), giving a much higher resolution isotope log. The down-side is that reliable measurements require minimum hydrocarbon concentrations in the hundreds of ppm – an order of magnitude or more greater than required for offline measurements. Methane isotopes easily distinguish between biogenic and thermogenic gas, and the degree of mixing, which is extremely useful in establishing whether migrating gas has infiltrated the overburden and to which stratigraphic level.

Results from the two wells were highly contrasting. The isotope profile from the dry hole was entirely biogenic, whereas the discovery revealed abundant thermogenic gas in overburden, hundreds of metres above the target reservoir. Data were used in conjunction with seismic profiles and a high-resolution basin model to identify the failure mechanism for the dry hole and improve our understanding of the plumbing beneath Central Luconia pinnacle reefs, thereby allowing better polarisation of charge risk in undrilled targets.

## REFERENCES

Dawson, D. and Murray, A., 2011. Applications of mud gas isotope logging in petroleum systems analysis. AAPG Hedberg Research Conf. Natural Gas Geochemistry: Recent Developments, Applications, and Technologies, May 9th-12th 2011, Beijing, China.

Ellis, L., Brown, A., Schoell, M. and Uchytel, S., 2003. Mud gas isotope logging (MGIL) assists in oil and gas drilling operations. Oil and Gas Journal, 101(21), 32-41.

Hammerschmidt, S.B., Wiersberg, T., Heuer, V.B., Wendt, J., Erzinger, J and Kopf, A., 2014. Real-time drilling mud gas monitoring for qualitative evaluation of hydrocarbon gas composition during deep sea drilling in the Nankai Trough, Kumano Basin. *Geochem. Trans.* 15:15, 1-15.

Mattavelli, L., Ricchiuto, T. and Schoell, M., 1983. Chemical and isotopic analyses on trace gases in exploration wells. Poster presentation, 11th Int. Mtg. Org. Geochem. The Hague.

Niemann, M., Breviere, J. and Shell FEAST Team, 2010. Continuous isotope logging in real time while drilling. Abstract, AAPG Hedberg Research Conf. Applications of Reservoir Fluids Geochemistry, June 8th-11th 2010, Vail, Colorado, USA.

## SPEAKER BIOGRAPHY

Bob is Mubadala's Subject Matter Expert for petroleum systems in Southeast Asia. He is a graduate of Nottingham University, and holds a Master's degree from the University of Newcastle-upon-Tyne. Bob spent the early part of his career in Indonesia, as a geochemist and basin modeller consulting for numerous mid-sized and major oil companies. He moved to Australia with Woodside Energy in 1999 where he worked the North West Shelf and southern margin basins, followed by an international assignment to Houston, Texas in 2007, evaluating the petroleum systems of the deep water Gulf of Mexico. After short stints with Apache, BP and Statoil, he settled in Malaysia in 2015, where he guides Mubadala Petroleum's basin modelling, geochemical, and internal petroleum systems training programs.

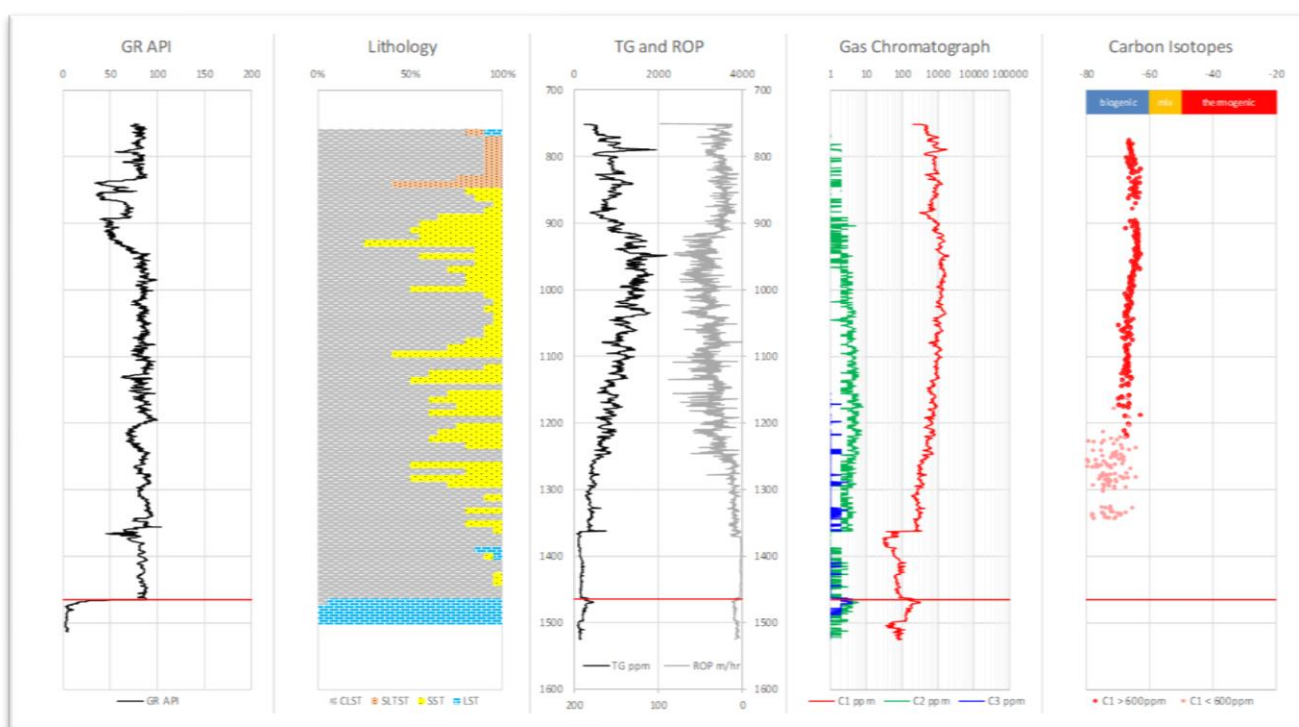


Figure 1. Log data and isotopes from dry hole

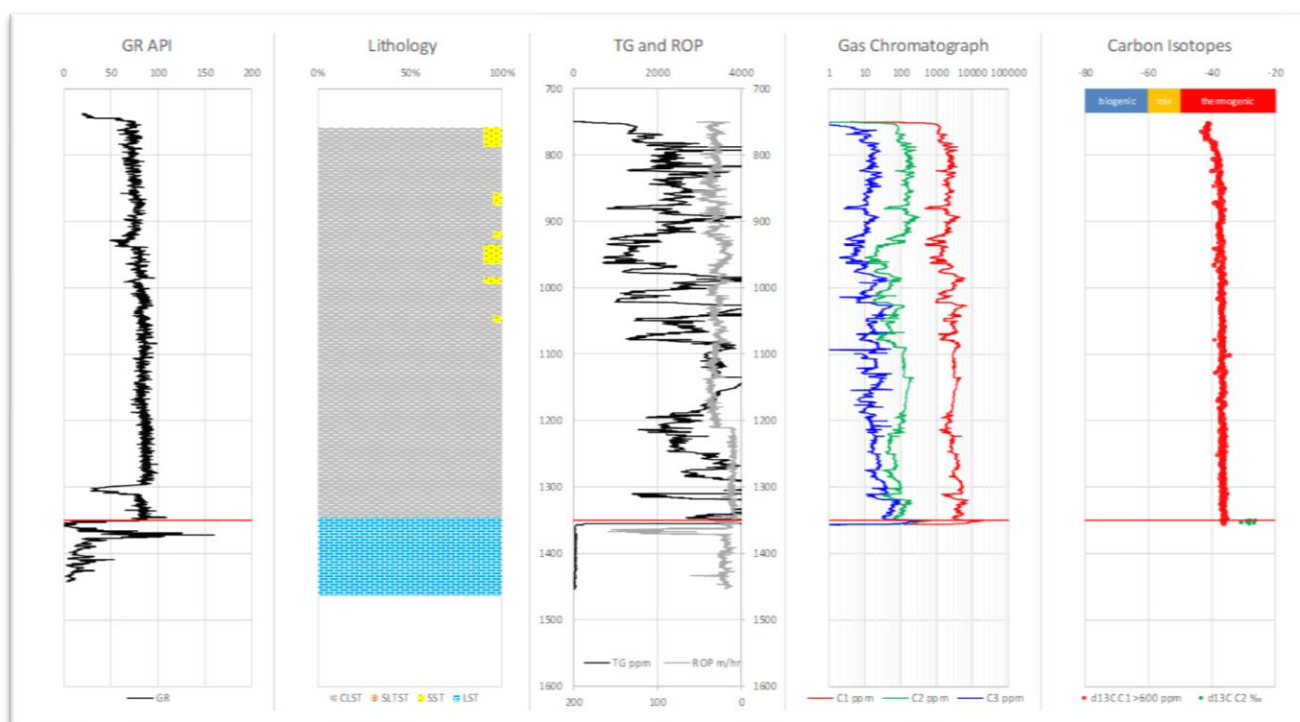


Figure 2. Log data and isotopes from discovery well