

## ARE CURRENT REAL-TIME CONTINUOUS ISOTOPE LOGGING TOOLS GOOD ENOUGH FOR EXPLORATION, DEVELOPMENT AND WELL INTEGRITY ISSUES?

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The strong added value of **mud gases isotopic and molecular compositional data** has been largely demonstrated in many Exploration, Development, and well integrity case studies. At TOTAL, the acquisition of a reference vertical isotopic profile is now mandatory for any potentially developable new reservoir compartment of a field and it has been formalized as company rule.

Mud gases provide relevant information to assess:

- ✓ Gas origin, maturity and involved alteration processes
- ✓ Thermogenic/biogenic/ mixed signatures within the reservoir and in the overburden.
- ✓ Seal efficiency: distinguish *diffusion/mixing/leakage* trends above the reservoir.
- ✓ Localization of ultimate seals & waste zones.
- ✓ Connectivity between the reservoirs.
- ✓ Secondary cracking in high temperature conditions.
- ✓ gas in place in Unconventional reservoir ( )
- ✓ Gas flux in the structure
- ✓ Production allocation from several reservoirs
- ✓ Reservoir Compartmentalization
- ✓ Well integrity & thermogenic gas pools in the overburden

Classically, isotopic measurements of mud gases are carried out in laboratory on few spot samples several days or weeks after the end of the well. Such time lapse is enough for post mortem studies but not for a real-time update of the down-hole sampling strategy nor in case of a well integrity issue.

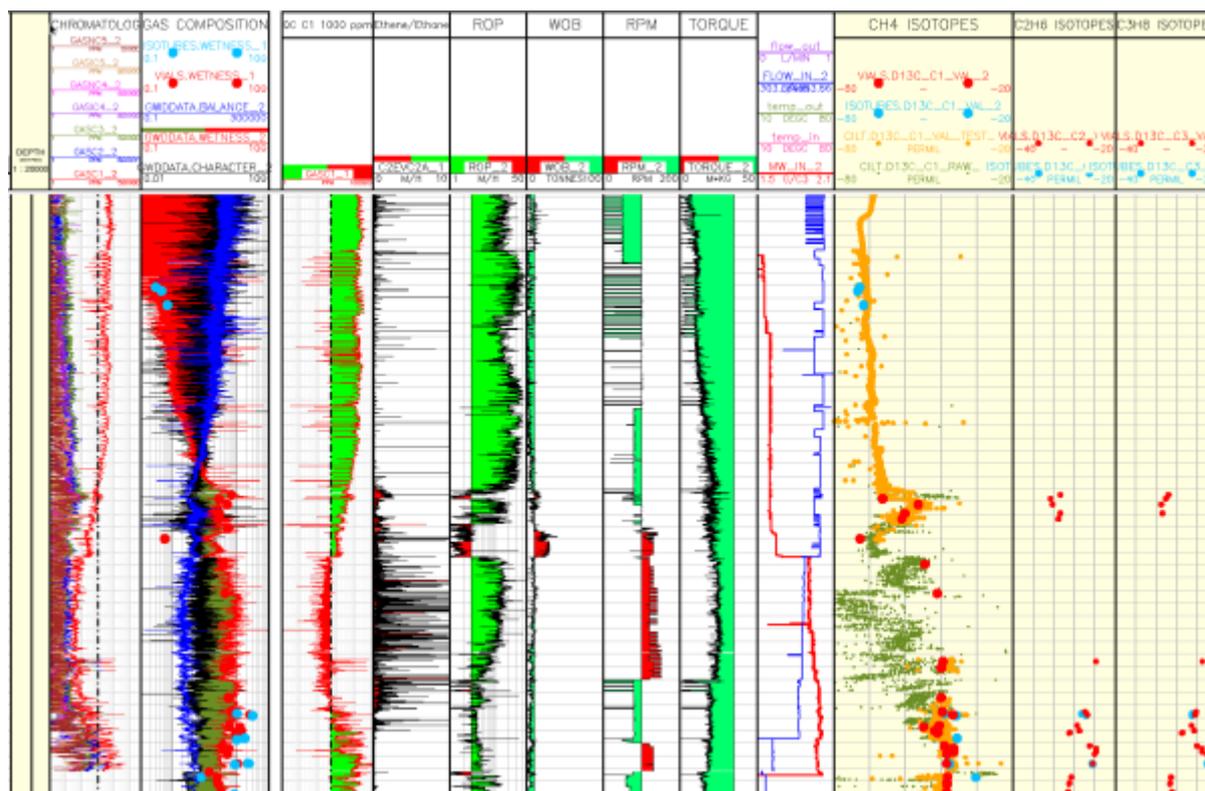
Isotopic measurements while drilling offer real-time data and also improve drastically the vertical resolution.

The option to use commercially available real-time continuous isotope logging tools is an attractive solution that needed to be evaluated.

On various case studies the two methodologies (offline and real-time acquisition) were thus applied and subsequent data compared.

Isotopic dataset cannot be interpreted without gathering geological and wellsite information, since drilling conditions may alter isotopic values.

A specific QC workflow has thus been developed within TOTAL for real-time isotope data, taking into account the technical specifications of instruments and the impact of drilling conditions.



*Figure 1 QC of real time isotopic data*

The main objective of this paper is to discuss the advantages and limitations of the real-time isotope logging and its applicability to isotope geochemistry studies. The applicability to well integrity issues will be presented.

## References

- F. Gelin, D. Dessort, Y. Poirier and F. Montel, Total.SA, Fluid typing for the assessment of the origin of hydrocarbons leaking in the annuli of oil and gas wells, GEO2014, The 11th Middle East Geosciences Conference and Exhibition, March 2014 Manama, Bahrein.
- D. Strapoc, B. Jacquet, Geoservices, a Schlumberger company, use of real time isotopic measurement fro drastic improvement of the isotope spot sampling workflow and interpretation, *IMOG 2013, Tenerife, 2013-231*.
- Estarabadi J., Shoeibi A., Ferroni G, Geolog International, Al-Awadi M., Al-Khamiss A., Al-Ajmi B., Dashti J., Andriany R, KOC., The Application of Well Site Isotopic Analysis for Reservoir Evaluation, 2016, Paper 1553, SPWLA yearly Symposium, Reykjavik, Iceland
- Lloyd M.Wenger & al. ExxonMobil Upstream Research company and Emily Sekula Wood, University of South Carolina, Drill-Bit metamorphism: recognition and impact on show Evaluation, SPE (2009), SPE 125218
- Chung H. M., Gormly J. R.; Squires, R. M., Origin of Gaseous Hydrocarbons in Subsurface Environments: Theoretical Considerations of Carbon Isotope Distribution; *Chemical Geology*, 71 (1998), 97-103.
- Schoell M.; Genetic Characterization of Natural Gases; *The American Society of Petroleum Geologist Bulletin*, 67 (1983), 2225-2238