CARBON ISOTOPES FROM MUD GAS: LAB IRMS OR WELLSITE LASER-ASSISTED TECHNOLOGIES?

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Mud gas can be considered a continuous flow of samples and parameters that describes downhole situation. Trapping this sample and gathering the most complete characterization of it along well trajectory is of main interest, as once a data is missing, sample is lost and cannot be recovered. There are two approaches for characterizing these samples: collection in containers and analysis in a laboratory, or direct measurement at wellsite without any storage. The current tendency is to move at wellsite as many analyses as possible, according to instrumental and technological limitations, i.e. methodology robustness, both analytically and operationally. As a matter of fact, most of the time the choice between the two options is a compromise between high accuracy/precision of laboratories and data availability in short-time and high frequency of wellsite.

Part of mud gas characterization includes carbon isotopes detection, (Poirier *et al.*) which has Isotope-Ratio Mass Spectrometry (IRMS) as current benchmark technology. When dealing with gaseous hydrocarbon mixtures, the most widespread approach is integration of a GC module for separation and of an oxidation module for hydrocarbon conversion in CO_2 to the IRMS detector. Unfortunately, extensive skills of IRMS do not include robustness and small footprint that are requirements for rig-site deployment that limited till now its diffusion at wellsite, while laser-assisted technologies can better meet these conditions.

Objective of the study is to highlight differences between GC-IRMS and one of the possible alternative solutions for carbon isotope detection, Cavity Ring-Down Spectroscopy (CRDS), screening both pros and cons of the two approaches in extracting isotopic information from mud gas when running gas samples on both instruments in laboratory conditions.

The instrument deployed for this investigation is based on CRDS coupled with a GC-oxidator module that resembles the approach of GC-IRMS analysers for δ^{13}C1, δ^{13}C2 and δ^{13}C3 detection. While direct comparison inter-laboratories of IRMS and laser-assisted technologies (Isotope Ratio Infrared Spectrometry - IRIS and CRDS) has been recently published in terms of analysis of CO_2 dissolved in water (Cheng *et al.*), only GC-IRMS analysers have been included in the round robin published by Tang *et al.* where natural gas mixtures were investigated. Our scope of work is to draw an honest and detailed table of comparison between the two approaches, laboratory and wellsite, and the two analytical techniques, IRMS and CRDS, spanning from the high accuracy and precision of IRMS to the robustness of laser-techniques.

Comparison will not only include analytical criteria such as accuracy and precision, but also advantages and drawbacks directly correlated to the specific field of application, e.g. necessity of a large dynamic range, being mud gas sample highly variable in concentration, and possible presence of "contaminants" such as alkenes artificially created by drilling bits or influence from biogenic methane mixed with target analytes.

References

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