geoconvention
Calgary • Canada • May 12-14 2025

Tracing The Origin Of Annulus-B Oil to Its Source Using Integrated Geochemical Analysis, A Case Study From A Giant Gas Condensate Field

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Summary

Article text should be Arial 11pt, left and right justified. 2 pages including at least one graphic is suggested. Please use the headings that are appropriate for your work, deleting the ones that are not.

Theory / Method / Workflow

The shallow aquifer and annulus hydrocarbon surveillance study was conducted using gas isotope geochemistry in a field with eleven (12) stacked reservoirs, producing both oil and gas, with H2S content ranging from 0 to more than 20%. The study aims to monitor wells integrity in this area field to ensure no gas leakage to shallow zones from H2S reservoirs. Gas isotope fingerprinting was used to characterize all gases collected from annuli, water, gas injectors, gas and oil producer wells. Finally, the isotope geochemistry data was integrated with petrophysical and reservoir engineering data to assess well integrity and investigate any possible source (s) of leaked gas.

Thirty-two (32) gas samples were collected from twelve (12) different reservoirs across a large study area. The analyses include molecular and carbon isotope composition of C1-C4 for finding gas source (fingerprinting) in annuli that could be traced back to the producing reservoirs. The gas molecular composition also included the non-hydrocarbon components. Carbon isotopes analysis was performed by Ion Isotope Ratio – Mass Spectrometry. Certified standards were analyzed together with each batch and duplicate analysis were also run for quality assurance and control. The geochemical isotope data were combined with production and well information for understanding distribution of gases and correlate it to reservoirs.

Results, Observations, Conclusions

Several challenges were faced during this study, including a lack of early production isotopes baseline, lack of well-distributed representative samples from some of reservoirs, limited gas samples from some wells and very high H2S content in some of the investigated gases. Despite these limitations, critical information was obtained to assist in the investigation.

Results indicate presence of gas of thermogenic origin in all injection and production wells with some thermal maturity variations. Although, carbon isotopes values (δ13C) vary within a relatively narrow range, differences are systematic and allow discrimination of gases from various reservoirs with methane being the most distinctive component. Samples collected from

low-pressure annuli may show artifact compositional variations. Nevertheless, these factors do not affect isotope values and fingerprinting can still be performed. Gas in annuli show a perfect match with XX reservoir based on C1-C4 carbon isotope composition. Some reservoirs cannot be totally discarded based on isotopic analysis, thus integration with other data is fundamental.

Novel/Additive Information

Gas isotope analysis has been utilized for the first time in Abu Dhabi to assess annuli and well integrity and correlate it to the source reservoir. The findings of this study emphasize importance of developing adequate compositional and isotope baseline and monitoring strategies as part of a gas field development plan for early detection of production, well integrity issues and potential hazardous leakage. We will present a novel comprehensive workflow for gas reservoir surveillance, including multiple data sources for an integrated approach.

Acknowledgements

We would like to acknowledge the Field Operators for their support and permission to publish this work

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