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Biomarkers Techniques for Petroleum System Types Assessments of Iraqi Oil Fields

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SUMMARY

Analysis of $\delta^{13}\text{C}$ aromatics and saturates hydrocarbons plus extracts from source rocks plots in graphical diagram as well as their $\delta^{13}\text{C}\%$ and C28/C29 ratio of source age sterane biomarkers of 300 scattered Crude oil samples have enabled this study to assess hydrocarbons grouping into families' related to sedimentary basins in Iraq. Oil sources might be Middle Jurassic strata of Sargelu Formation in the Zagross Fold Belt of North Iraq and eastern part of Mesan Governorate with Middle Jurassic as well as Upper Jurassic/ Lower Cretaceous Chia Gara Formation in the North-East based on C28/C29 ratio of nearly 6 and 8 respectively. Mesopotamian Basin oil sources are of mainly Upper Jurassic/ Lower Cretaceous Sulaiy Formation above the Upper Jurassic lower regional seal of the Gotnia Anhydrite except were thinned and faulted with C28/C29 ratio ranges between 5- 9 that could cause mixing with Middle Jurassic Sargelu Formation oil. Middle Triassic oil in North West Iraq is recorded within Kurra Chine Formation with C28/C29 ratio of 4 while Lower Palaeozoic oil sources are recorded in West Iraq. On the other hand, one formation may have multiple pays of Jurassic and Lower Cretaceous sources such as Zubair and Yamama Formation.

Extended Abstract

Analysis of $\delta^{13}\text{C}$ aromatics and saturates hydrocarbons plus extracts from source rocks plots in graphical diagram as well as their $\delta^{13}\text{C}\%$ and C28/C29 ratio of source age sterane biomarkers of 300 scattered Crude oil samples have enabled this study to assess hydrocarbons grouping into families' related to sedimentary basins in Iraq. Oil sources might be Middle Jurassic strata of Sargelu Formation in the Zagross Fold Belt of North Iraq and eastern part of Mesan Governorate with Middle Jurassic as well as Upper Jurassic/ Lower Cretaceous Chia Gara Formation in the North-East based on C28/C29 ratio of nearly 6 and 8 respectively. Mesopotamian Basin oil sources are of mainly Upper Jurassic/ Lower Cretaceous Sulaiy Formation above the Upper Jurassic lower regional seal of the Gotnia Anhydrite except were thinned and faulted with C28/C29 ratio ranges between 5- 9 that could cause mixing with Middle Jurassic Sargelu Formation oil. Middle Triassic oil in North West Iraq is recorded within Kurra Chine Formation with C28/C29 ratio of 4 while Lower Palaeozoic oil sources are recorded in West Iraq. On the other hand, one formation may have multiple pays of Jurassic and Lower Cretaceous sources such as Zubair and Yamama Formation.

The Kerogens of the source rocks are confirmed by chemical studies of pyrolysis analysis and by microscopic studies of palynofacies types of the disseminated organic matters. Petromod software basin modeling for hydrocarbon generation and palynomorphs for source rocks age assessments are discussed too. Oil accumulations in the reservoirs are assessed in this study by petrophysical properties to find the hydrocarbon fillings in the rocks and trapping the dynamically mobile hydrocarbons in structural and stratigraphic traps in structural cross section and seismic sections.

Petroleum systems framework, interpreted in this study, could be used for hydrocarbon exploration and for mineral genesis of sulfur deposits through systematic studies and analysis in the proposed oil field especially when they are plotted on Seismic section images for assessing the source and reservoir rocks extent and hence the predicting hydrocarbon migration paths and finding new reservoirs and pays.

It has been concluded from this article that:

1) Main oil sources in Iraq, that form the base for assessing family types and relates to a petroleum system types are five that are proved by C28-29 and grouped in together within diagram of $\delta^{13}\text{C}$ (%) aromatic versus saturates that contain both lots of oil analysis and source rock extracts, these are the followings;

- i-Middle Jurassic of the Sargelu Formation in North Iraq
- ii-Sargelu and Chia Gara Formations in Diyala and Baghdad
- iii-Upper Jurassic-Lower Cretaceous Sulaiy Formation in Basrah oil fields
- iv-Triassic Kurrachine Formation of Northwest Iraq
- vi-and Lower Paleozoic Khabour and Akkas Formation of West Iraq

2) Main oil traps are in all parts of Iraq within; Structural of the Cretaceous that formed by Upper Cretaceous Orogenies and Tertiary that formed by the Upper Miocene Alpine Orogeny which closed the Tethyan Ocean, Stratigraphic of the Middle Triassic Kurrachine Formation and Lower Cretaceous Ratawi, Zubair and Nahr Umr Formations as well as reef framework of the Upper Cretaceous Mishrif Formation and Oligocene Kirkuk Group. Undiscovered traps within each petroleum system mentioned in this study could be recommended for further studies in the petroleum geology of Iraq.

3) Main gas accumulations are mainly in the Silurian Akkas Formation of West Iraq and Cretaceous-Tertiary of NE-Iraq in the high matures of the high Zagross Fold Belt as well as associated gas in most oil fields in Iraq.

4) Hydrocarbon migrations are mainly vertical through faults and fractures in most parts of Iraq with special cases in North Iraq as well as horizontal through carrier beds everywhere in Iraq.

5) Accumulation sites are Porosities and fractures of especially in the formations of carbonate reservoirs of the Mishrif in the South, Khasib and Tannuma in Central, Hartha in the West, and Kirkuk Group and Jeribe in the North as well as clastic reservoirs of the Zubair and Nahr Umr.

6) Total petroleum systems are elements and processes within two (lower and upper) regional seal or could be confined to one formation and exhibit short migration such as Middle Triassic Kurrachine

in NE Iraq or wide stratigraphic range as Upper Cretaceous Mishrif Formation sourced from Upper Jurassic-Lower Cretaceous Sulaia Formation in South Iraq and Upper Cretaceous-Tertiary reservoirs sourced from Middle Jurassic Sargelu Formation or from mixed Sargelu Formation and the Upper Jurassic-Lower Cretaceous Chia Gara Formation of North Iraq.

Special cases are of one formation petroleum system of Zubair and Yamama Formations that each of them with pays fed from the same formation while other pays fed from older formation such as the Sargelu Formation source rocks.

7) The main regional seal for the total petroleum system of the Jurassic, Cretaceous and Tertiary in Iraq are Upper Jurassic Gotnia Anhydrites Formation as lower regional seal while the Middle Miocene Lower Fars (Fatha) Formation is of upper regional seal in the Mesopotamian Basin and Dyala Governorates. Gotnia Anhydrites disappear in North Iraq in the Zagros Fold Belt and hence the lower regional seal would be Lower Jurassic Allan Anhydrites.

8) Crude oil characterization: It is partly discussed in our previous studies while detailed description could be recommended for further studies of petroleum geology and geochemistry of Iraq.

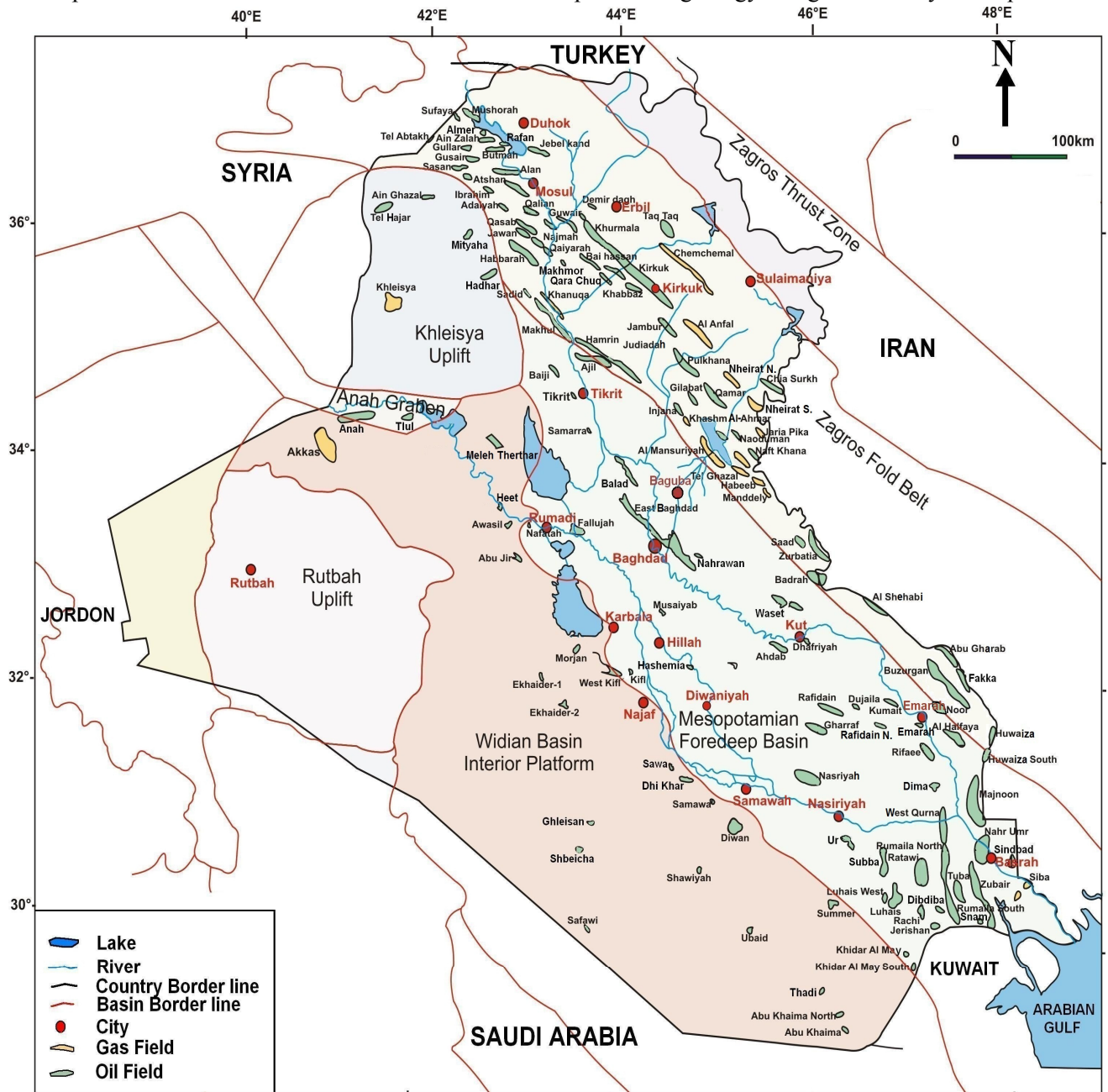


Figure 1 Location map and oil and gas fields and seeps distribution in Iraq with sedimentary basins.

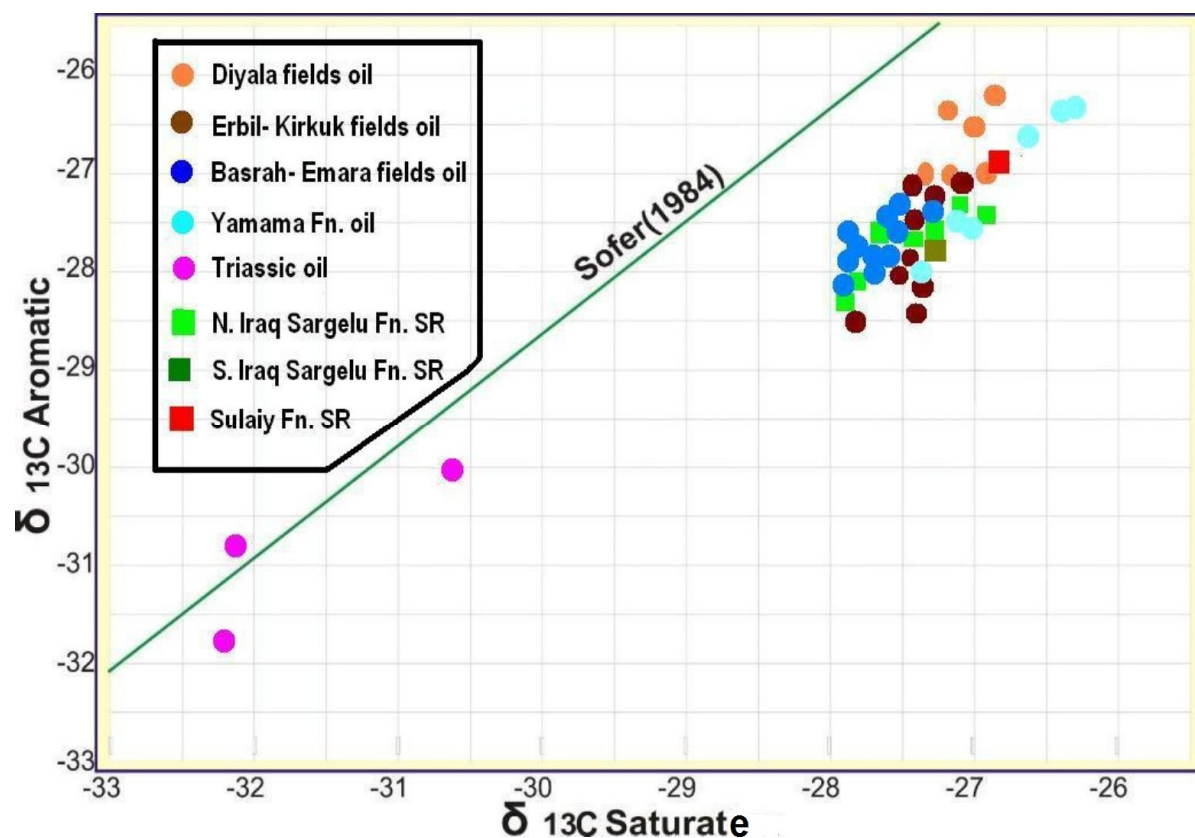


Figure 2 Isotopes diagram of the aromatic and saturate $\delta^{13}\text{C}$ of reservoir oil and source rock extract from scattered locations in Iraq.

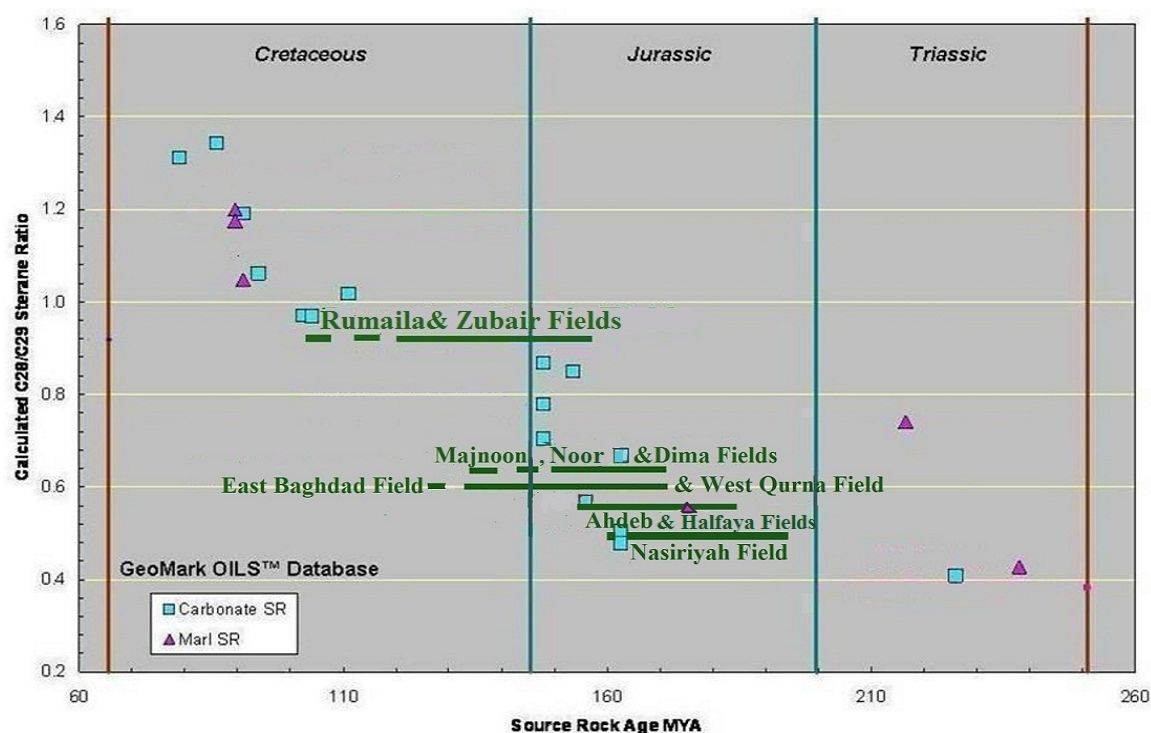


Figure 3 Calculated average C28/C29 sterane ratio (based on both regular steranes and triaromatic steranes) of reservoir oils from Mesopotamian Basin suggesting a source rock of ages. Other data points represent average oil values from 150 global petroleum systems from marine carbonate, distal marine shale, marine marl, and lacustrine shale source rocks from GeoMark Research OILS™ database.