

VOLUMETRIC ESTIMATION OF GAS CHARGE FROM DEEP SOURCES INTO OIL RESERVOIRS AND ESTIMATION OF SEAL INTEGRITY WITH RESPECT TO GAS USING DIAMONDOID/BIOMARKER CURVES

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Crude oils derived from mixed oil-window and gas-window maturity sources can be recognized using diamondoid/biomarker curves (Figure 1). However, most such mixtures in basins throughout the world have been overlooked. Generally, only the oil-window source is identified, most often using correlations involving biomarkers. Recently, we have begun looking at large numbers of oil samples from basins around the world using both biomarkers for recognition of oil window sources, and diamondoids for recognition of high maturity sources. Based on our studies, it is apparent that oil window- and deep source-mixes are the rule rather than the exception, i.e. most basins contain an appreciable number of mixed oils of this type. In some basins, such mixes are found in the majority of the oil fields. The isotopes of the diamondoids (analyzed using compound specific isotope analysis) can be used to correlate their source, and since diamondoids are highly abundant in the cracked oil the deep sources in mixture with oil-window sources can be recognized.

Interestingly, diamondoid/biomarker curves not only identify mixtures of oil from high and lower-maturity sources, they also give quantitative information regarding the relative charge derived from each. We will show that in many cases the charge from previously unrecognized deep sources is actually many times larger than the oil-window source established using biomarker analysis.

Although charge may be greater from the deeper source, that charge is often predominantly gas, which may escape. However, even if the gas has to a large extent leaked out of the reservoir, the diamondoids it carried are left behind dissolved in the reservoir oil. The concentration of diamondoids can then be used to determine approximately how much gas has migrated up through the reservoir providing an estimate of the gas charge from the deep source. By comparing the amount of gas actually trapped with that calculated to have moved through the reservoir based on diamondoid concentrations, the seal integrity (efficiency) can be determined. By calculating the amount of gas versus the amount of time since the gas began charging, the approximate residence time of gas within the reservoir can

be estimated. By comparing seal integrities for many reservoirs within a basin, the risk that seals in a particular basin pose to finding gas accumulations can be predicted.

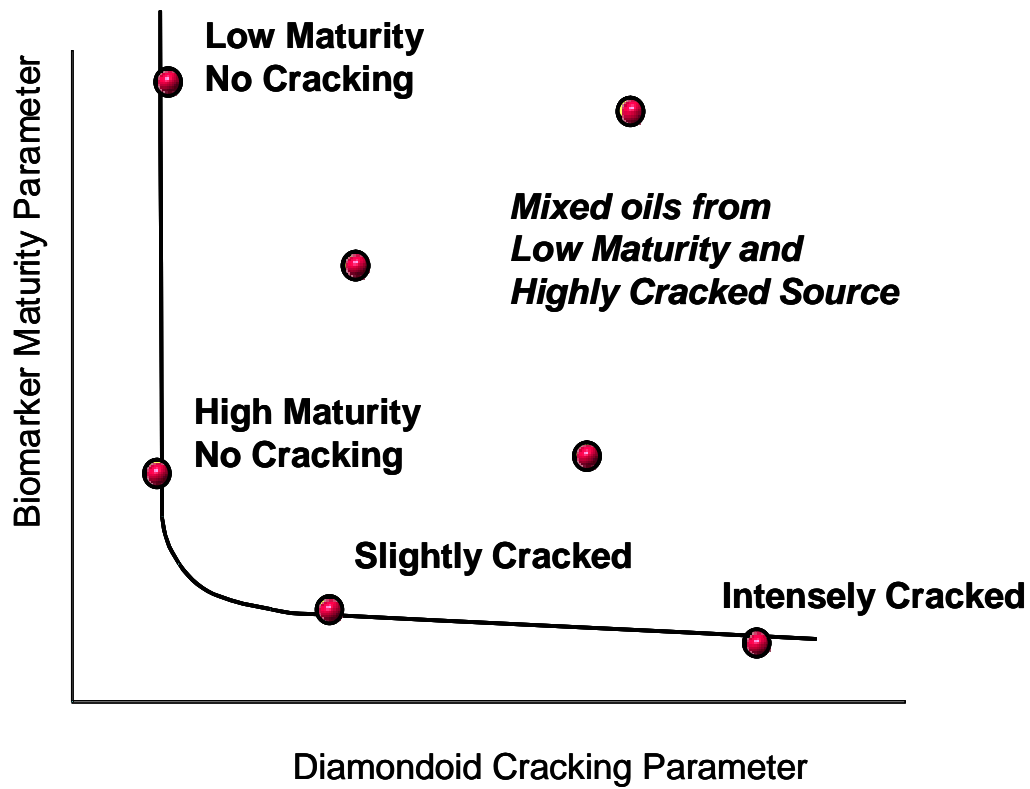


Figure 1. This representation of the diamondoid/biomarker “oil-cracking” analysis shows how oil samples of any maturity can be compared and it allows for the recognition of mixes.