Quantitative Rules Evaluate Programmed Pyrolysis Data to Improve Interpretations

Allegra Hosford Scheirer[1], Kenneth Peters[2]
[1]Stanford University; [2]Stanford University and Schlumberger

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Abstract

Geochemistry data obtained via programmed pyrolysis of geologic samples are widely used in the oil and gas industry because pyrolysis is a quick and inexpensive technique and the data help to characterize both source and reservoir rock intervals. However, the interpretation of such data is made difficult by several limitations. Among many others, these pitfalls include inconsistency between laboratories and carry-over of the free petroleum signal S1 into the generative potential signal S2, which can cause a low-temperature shoulder on the S2 peak and/or very broad S2, thereby rendering the maximum temperature (T_{max}) suspect. To help remedy these and other deficiencies, we codified nine quantitative rules for screening programmed pyrolysis data. We refer to these collectively as PARSE: Pyrolysis Analytical Rules for Screening and Evaluation. The PARSE rules are designed to filter an input data set by a predefined series of quantitative criteria, resulting in a final data set of: 1) reliable thermal maturity indicator T_{max}; 2) potential source rock intervals; and 3) potential reservoir rock intervals. PARSE can interpret data from a single well or numerous wells (either individually or aggregated). Moreover, the rules are flexible: thresholds within each rule can be adjusted by basin, kerogen type, user experience, or based on patterns observed in the data. More than half of the rules focus on T_{max}. Two of the rules identify intervals of possible migrated oil. Finally, several rules activate when values are deemed geologically or operationally implausible. PARSE has been demonstrated on geochemical logs from oil and gas wells, on outcrop samples, on thermally immature source rock data from an entire basin, and on paired T_{max}-vitrinite reflectance data to establish a linear relationship between the two thermal maturity parameters. In summary, PARSE greatly

improves confidence in programmed pyrolysis data by rejecting spurious values according to a rigorous set of criteria. In the era of big data and machine learning, such pre-processing steps take on more importance than ever before.

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