A New Method for Obtaining Personalized Kinetics from Archived Rock-Eval Data, Applied to the Bakken Formation, Williston Basin

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A method has been developed to obtain kinetics for source-rock kerogens from archived Rock-Eval data. This technique supplements the earlier method of Waples et al. (2002) in which reliable kinetics were obtained from a single new Rock-Eval run. The single-run method, which can be completed in about 20 minutes, has numerous large advantages over the traditional method, which requires three runs and takes a full day per sample. Advantages include much lower cost per sample; the ability to acquire much larger amounts of kinetic data for a given budget; the ability to discern different organic facies based on their kinetics in conjunction with other geochemical and geological data; the ability to use the mean activation energy (mean Ea) as a thermal indicator, similar conceptually to Tmax but more flexible and sensitive; and confidence that the kinetics are reasonable, since the pre-exponential A factor is controlled by the laws of thermodynamics. The main limitation is that the data must include an accurate record of pyrolysis temperature through time. The new method has been applied to 220 previously analyzed samples from the Upper and Lower Bakken from the US portion of the Williston Basin. The samples exhibit a very wide range of maturity, with interpreted Transformation Ratios ranging from zero to 0.95. The kinetic data show clearly that all samples are from a single organic facies. Mean Ea increases regularly with increasing maturity. The narrow activation-energy distribution is typical of Type II kerogens. Mean Ea's were correlated with Transformation Ratio interpreted from Hydrogen Indices, which in turn was correlated with calculated Ro values. Mean Ea was then used in maturity modeling to understand the causes for variations in thermal history across the basin.