Establishment and significance of the total life cycle hydrocarbon generation model

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In 1978, Tissot published the hydrocarbon generation model. Through a large number of experiments and exploration practice, this classical model was proved to be a correct and near-perfect model to describe the process of hydrocarbon generation. Recent years, petroleum explorationists are increasingly concerned about the quantitative relationship between retained hydrocarbon and expelled hydrocarbon and their respective evolution characteristics, so as to indicate the direction of exploration. We chose different kerogen types and different organic matter abundance of source rocks as the samples. Through the simulating experiments, we quantitatively modelled the process of generation and expulsion of hydrocarbon and established a new whole process of hydrocarbon evolution model. This model has the following new understandings: (1) The new model refined the evolution of thermal characteristics of hydrocarbon generation at different stages, quantitatively described the evolution process of retained hydrocarbon and expelled hydrocarbon, and made the model of Tissot further developed. (2) The maturity of main gas generation for oil cracking gas is 1.6%~3.2%, while kerogen cracking gas is 1.3%~2.5%. The amount of oil cracking gas is 3 to 4 times than kerogen cracking gas. Therefore, oil cracking gas should be mainly searched in marine strata at high to over mature stage. (3) The quantitative chart of expulsion efficiency of hydrocarbon and retained hydrocarbon amount in different evolution stages were established. For source rocks with type Ⅰ and $Ⅱ_1$ kerogen, expulsion efficiency is 20%～50% at oil-condensate window(Ro=0.8%～1.3%) and 50%～80% at high mature stage(Ro=1.3%～2.0%). Determining the amount of retained hydrocarbon provides the basis for resource evaluation of shale oil and gas in selecting the parameter value. (4) The cracking temperature for alkane gases were confirmed, for example, the lower limit of Ro for methane cracking is greater than 5%. Therefore, at the particularly high stage of hydrocarbon evolution, there still has exploration potential for natural gas, and this new finding provides a theoretical basis for deep gas exploration.