Quantitative study on kerogen primary cracking gas using Py-GC

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By using a Gaspro capillary column to separate C_1–C_5 gaseous hydrocarbons and using polystyrene as external standard, we explore a quantitative Py-GC flame ionization detector (FID) method to study the C_1–C_5 pyrolysis products released from kerogens (coals) by primary cracking. Our study suggests that the reproducibility of this method is pretty good. Based on this method, the yields of C_1–C_5 gaseous hydrocarbons released from various kerogen types were quantitatively studied. The results indicate that kerogen type plays a key role in controlling the compositions of C_1–C_5 gaseous hydrocarbons released by kerogen primary cracking. Molecular proportions of C_1/C_2 ratios (by volume) based on logarithmic scales ($Ln(C_1/C_2)$) for kerogen primary cracking gas can may provide the information of kerogen types. For example, $Ln(C_1/C_2) < 0$ for type I kerogen, $Ln(C_1/C_2) > 1.0$ for type III kerogens, and $0 \leq Ln(C_1/C_2) \leq 1$ for type II kerogens.

Due to the high reproducibility, our recent researches suggested that quantitative Py-GC can also be a reliable method in studying the generation kinetics of C_1-C_5 gaseous hydrocarbons by kerogen primary cracking at various maturity stages. The results suggested that most of the C_2-C_5 gaseous hydrocarbons by kerogen primary cracking were released at maturity within oil-generative window, while the generation of C_1 can have broader maturity range, especially for type III kerogens and vitrinite-rich coals. Such differences may be attributed to that C_2–C_5 are mainly generated by the release of alkyl precursors while aromatization and condensation of the kerogen structure may also be an important source of C_1 at high maturity, especially for type III kerogens (vitrinite-rich coals). Our closed-system artificial thermal simulations on both oil-prone type II, type I kerogens and type III kerogen suggest that, for type II and type I kerogens, most of the C_1 is genrated through secondary cracking of oil at high maturity, not by kerogen primary cracking. While for type III kerogen (vitirinite-rich coal), relatively higher content of C_1 can be produced by kerogen primary cracking.