

## **Carbon isotopic reversals of coal-derived gases due to mixing of primary and secondary products**

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Great efforts have been made in recent years to understand the cause of  $\delta^{13}\text{C}_2$ ,  $\delta^{13}\text{C}_3$  and  $i\text{C}_4/n\text{C}_4$  rollover as well as isotopic reversals among gas components observed in unconventional gas systems. As for coal-derived gas, it is usually accumulated in conventional reservoirs and may experience intensive tectonic movements and hydrocarbon loss after the end of gas generation.  $\delta^{13}\text{C}_1 > \delta^{13}\text{C}_2$  was rarely discovered for the conventional coal-derived gas, and the carbon isotope reversals among hydrocarbon components in conventional petroleum reservoirs are usually regard as the result of mixing of natural gases generated from different source rocks and/or at different maturities or migration fractionation. The research on whether the mixing of type III kerogen cracking and oil cracking gas can result in the carbon isotope reversal for natural gases in terrigenous formations has not been carried out.

Based on the study of coal-derived gases in the Kuqa Depression, Tarim Basin, northwestern China, the carbon isotope evolution curves of each component were established. It was found for the first time that the cracking of coal-based crude oil during the high to over maturity stage can also lead to the carbon isotope reversal of ethane, propane and butane. The evolution of  $\delta^{13}\text{C}_2$  and  $\delta^{13}\text{C}_3$  of coal-derived gases can be also be divided into pre-rollover, rollover and post-rollover three stages.