

## A COMPARISON OF OIL GENERATION FROM COAL AND CARBONACEOUS MUDSTONE IN A CONFINED PYROLYSIS SYSTEM

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Tuha Basin has been considered to be a prolific area for coal-derived oils in China. Here two Jurassic coals and one carbonaceous mudstone were chosen from this basin for pyrolysis in a confined system in order to gain insight on their oil generation characteristics. The samples are all immature and contain type III organic matter, as shown by their low H/C atomic ratios (Table 1). The hydrogen index of the carbonaceous mudstone is about 146 mg/g TOC, much lower than those of the coals (Table 1).

Kerogens were isolated from these samples and pyrolyzed in a confined gold vessel placed inside an autoclave under 50 mPa pressure. Two heating rates (20 and 2 K/hr) were used. The results show that the carbonaceous mudstone was much more oil prone than the coals though it has similar HI and H/C ratios to the coals. The maximum yield of the C<sub>6+</sub> fractions from the carbonaceous mudstone is about 80 mg/gTOC, 2.7 and 6 times as much as those from the No. 1 coal (30 mg/gTOC) and No.2 coal (only 13 mg/gTOC) respectively. Therefore, both Hydrogen Index and H/C atomic ratio are not adequate parameters to measure the true hydrocarbon generative potential of various source rocks in coal measures. In other words, application of the same set of criteria in evaluating petroleum potential for coals and carbonaceous mudstones may significantly under estimate the contribution from dispersed organic matter in carbonaceous mudstone or shale.

Table 1. Basic data of the samples used in pyrolysis experiments.

Sample	Burial depth (m)	Age	Lithology	TOC (%)	Tmax (°C)	S <sub>1</sub> (mg/g)	S <sub>2</sub> (mg/g)	S <sub>3</sub> (mg/g)	S <sub>1</sub> +S <sub>2</sub> (mg/g)	HI (mg/g TOC)	Extract (%)	H/C atomic ratio	Ro (%)
No.1	Coal mine	J <sub>1</sub> b	Coal	72.07	436	9.89	187.54	5.79	197.43	260	23.2750	0.82	0.63
No.2	2257-2259	J <sub>1</sub> b	Coal	67.01	429	3.75	133.26	6.84	137.01	199	27.865	0.75	0.59
No.3	2494-2495	J <sub>1</sub> b	Carbonaceous mudstone	3.58	439	0.39	5.22	0.44	5.61	146	1.058	0.77	0.64

A comparison of the possible C<sub>15</sub><sup>+</sup> potentials determined by pyrolysis experiments and the measured C<sub>15</sub><sup>+</sup> quantities (by solvent extraction) for samples collected from the Taibei Depression of the Tuha Basin indicates that the coaly petroleum in this depression was more likely derived from the coaly dispersed organic matter in carbonaceous mudstones/shales

instead of the coals. The solvent extract yield in the Middle and Lower Jurassic coals ranges from 1.19 to 3.0%, within the same range as their maximum hydrocarbon potential (0.85-1.14%). The maximum  $C_{15}^+$  yield was measured using the No. 1 high grade coal. However, the mean solvent extract yield in the Middle and Lower Jurassic mudstones is only about 0.0607%, much lower than their hydrocarbon generative potentials. Clearly, most of the generated hydrocarbons in the coals are adsorbed by themselves, but the carbonaceous mudstones could expel most of the generated hydrocarbons.

The  $C_6^+$  fraction was generated relatively early in the coal measures. The  $C_6^+$  yield peaks at around 395-405°C (20 K/hr) or about 0.85-0.95% (EASY- $R_o$ ) (Fig.1). The early hydrocarbon generation and cracking coincides with the natural evolution trend indicated by solvent extract yields in coals in the Tuha Basin. The drop in the  $C_{15}^+$  yields in coal could be caused by early cracking rather by expulsion. Therefore, the HI evolution with  $R_o$  as a measure of petroleum expulsion should be used with caution.

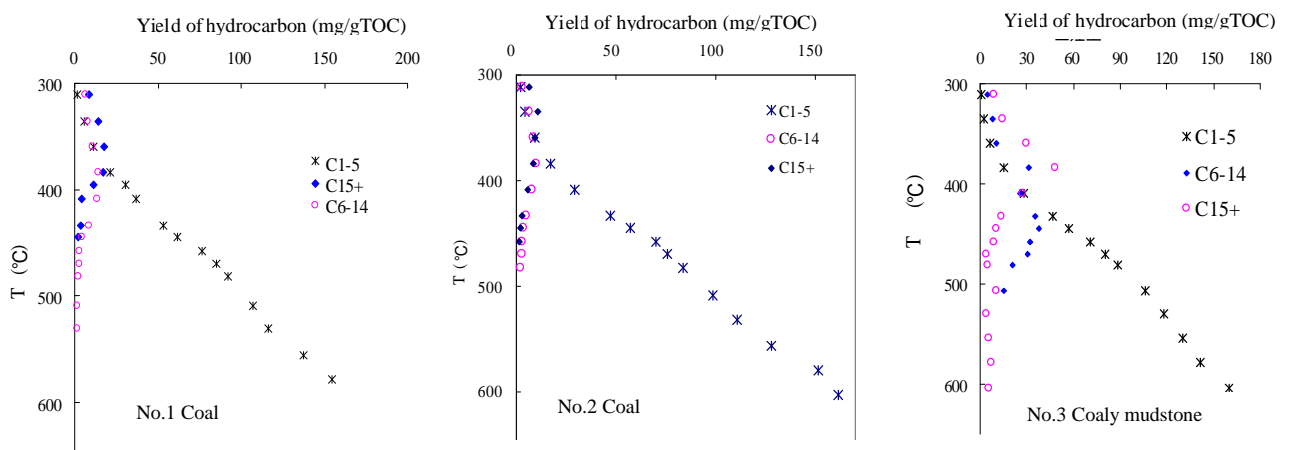


Figure 1. The yields of  $C_{1-5}$ ,  $C_{6-14}$  and  $C_{15}^+$  fractions generated from the samples at a 20 K/hr heating rate.