The distribution of biomarkers and the geological significance of the severely biodegraded crude oil in Gudao reservoir

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Biodegraded crude oil in China are distributed widely and make up a certain portion of heavy-oil resources. An unresolved complex mixture (UCM) of hydrocarbons isolated from a biodegraded crude oil of the Gudao reservoir in the Shengli Oilfield, China. Some of the hydrocarbons were identified using GC-MS. The result showed that the hydrocarbons expect for tricyclic terpanes, steranes, hopanes, 25-norhopanes, were completely depleted in saturated fraction, as well as hydrocarbons expect for triaromatic steranes and few methylnaphthalenes, methylphenanthrenes, chrysene series in the aromatic fraction, which indicate that severe biodegradation occurred in this reservoir. Relatively abundant pentacyclic terpane characterized by high concentration of norhopane and gammacerane, low content of Ts and Tm, the "L"-type and asymmetrical "V"-type distribution of regular steranes and 4-methylsteranes, and high maturity as revealed by sterane and terpane parameters, suggesting aerobic depositional environment with a salt and stratified water body. Furthermore, The results also showed that the magnitude of "UCM" hump existed in the aromatic fraction is apparently larger than that of "UCM" hump existed in the saturated fraction, which implied that the biodegradation rate for aromatic hydrocarbons is parallel or even exceed that of saturated hydrocarbons and the alteration occurred in this reservoir was associated with biodegradation with water-washing.

Supported by grants No. KZCX2-YW-Q05-05, XDA05120204, KZCX2-EW -104(2), NSFC No.40672123 and 2005CB422001.

Determination on nitrate use capacity in plants via isotope tracer

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Materials and Treatments

Broussonetia papyrifera (BP) and *Morus alba* (MA) seedlings were cultured in the modified Hoagland nurient solution adding different concentrations (0, 20, 60 g L^{-1}) of polyethylene glycol (PEG, simulating drought) (pH5.5). *Orychophragmus violaceus* (OV) seedlings were cultured in the modified Hoagland nurient solution adding different concentrations (0, 2.5, 10 mM) of $NaHCO_3$ (BC) (pH 8.2). The sole nitrate N was potassium nitrate with 16.99‰ of the $\delta^{15}N$. The sole ammonium N was $NH_4H_2PO_4$ with -1.21‰ of the $\delta^{15}N$. The $\delta^{15}N$, net photosynthetic rate (Pn, μmol $m^{-2}s^{-1}$) and N content (Cn, mg g^{-1}) of the third or fourth fully expanded leaf were measured. The proportion (f_B) of nitrate to total inorganic N was calculated by a two-component mixing model. The nitrate use capacity (NUC, mg $m^{-2}h^{-1}$) in plants was calculated by the formula: $NUC= 90CnPnf_B$.

Results and discussion

From Table 1, we can found that OV under high concentration BC had the greatest NUC, MA under drought stress the least. Even under drought stress, BP had a great NUC. The great NUC of BP and OV under the Karst drought or high concentration bicarbonate resulted in their adaptability to Karst environment, partly. The plants of the adaptability to Karst environment alternately use nitrate and ammonium N under Karst environment.

PS-T	$\delta^{15}N$	Pn	f_B	NUC
MA-PEG/0	-2.41	6.3	0.11	1.59
MA-PEG/20	-1.51	1.0	0.15	0.40
MA-PEG/60	-1.53	0.1	0.15	0.03
BP-PEG/0	-1.25	2.8	0.17	1.04
BP-PEG/20	3.19	2.9	0.38	2.39
BP-PEG/60	2.91	3.9	0.37	3.10
OV-BC/0	12.73	3.9	0.84	6.28
OV-BC/2.5	15.95	2.1	0.99	4.77
OV-BC/10	16.08	3.3	1.00	7.10

Table 1: NUC of several species of plants under different treatment (PS=plant species, T=treatment).

This work was supported by NSFC (No. 40973060, No.31070365).