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A NEW FIELD FOR NATURAL GAS EXPLORATION OF WESTERN SLOPE, SONGLIAO BASIN – INSPISSATED BIODEGRADATION GAS

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Most of heavy oil fields in shallow strata found globally are related to bacterial degradation (Röling, *et al*. 2003). The oil densification in many reservoirs is the result of anaerobic bacteria degradation which generally makes oil property reduce to low rank and also generate some new hydrocarbons (mainly CH_4). Methane, generated from a series of microbes included oil anaerobic biodegradation (Whiticar *et al*., 1986; Larter *et al*., 2003), is actually a sort of water-hydrocarbon reactions which get involved anaerobe (Zengler *et al*., 1999; Larter *et al*., 2003).

The distribution of methane, generated due to anaerobic bacteria, is rather widespread throughout western slope in Songliao Basin and Bohai Bay Basin (Zhu, *et al*., 2005). The western slope has crucial heavy oil accumulation in Songliao Basin, whose geological resource exceeds 1 billion tons although buried chiefly in shallow formation (400~1200m). Oils in seminary region are seriously degraded, density varies between 0.90-0.95g/cm^3, viscosity between 100~1000mPa.s. On approaching the brim of slope viscosity and density increase correspondently.

The possible mechanism for biodegraded oil evolvement should be as follows: The closed reservoir beds are reworked to semi-closed state by geological movement and expose to exterior environment. On condition that the faults develop and cut through reservoir beds, microbes will be brought into oil beds by agency of surface water. In early stage when O_2 are sufficient, aerobic bacteria take dominance: large-molecule hydrocarbons are degraded and give birth to CO_2. With O_2 consumption increasing, facultative bacteria gradually gear up and finally complete transition from aerobiotic to anaerobic environment. In the late stage, anaerobic bacteria take advantage of nutrient (especially CO_2 and H_2) produced before and propagate in masses. This is the reason that we can always find secondary biogenetic gas around heavy oil reservoirs. Alaxin, Erzhan, Baiyinnuole and some other gas fields located in western slope demonstrate the genetic relation to heavy oil.

Gas samplings from western slope show that hydrocarbons make up 80~95%, among which CH_4 holds 75%~95%; C_2^+ about 0.04~2%, little propane is detected while N_2 compose of the main content of nonhydrocarbon, around 3~25%, usually between 5~15%; CO_2 about

0.3~1.0%, commonly between 0.5~0.8%, helium approximate 0.01~0.8% and only a trait of hydrogen is found present. The composition is quite different from oil dissolved gas in Changhuan, Daqing oil field.

The carbon isotope of methane and homologue is more enriched in ^{12}C and consequently has 15% weight shrinkage than that of regular gas. $\delta^{13}C_1$ value commonly varies around -40~-53‰ which is characteristic of biogas; $\delta^{13}C_2$ value occurs between -30~-42‰, average -30‰. The abnormal CO_2 carbon isotope value occurred in the western slope should have close relation with distillation in process of generation, since the abiotic origin CO_2 is not qualified.

From deep bottom to margin, gases tend to get drier while carbon isotope of methane, ethane and propane become lighter from east to west. The N_2 content along the brim of depression can be over 15%, part of which is as high as 20%. The probable reason maybe due to the depletion of O_2 and when consumed completely by aerobic bacteria, N_2 are preserved and relative abundant. This process can account for the high N_2 content in western slope.

The temperature of Shaertu reservoir bed is about 30~50˚C, which fit for microbes development. Low degree mineralization together with neutralness or alkalescence ($NaHCO_3$) formation water stimulate the propagation which is the main reason cause oil degradation; another phenomenon is that inspissated biodegradation gas always associated with water/oil bed, which may be considered that free water is indispensable at the time when anaerobic degradation occurred.

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