# Genetic type and origin of Ordovician gas in the Gucheng lower uplift, Tarim Basin, NW China

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The Gucheng lower uplift lies in the southeast of Tarim Basin, to the east margin of west carbonate platform and close to the Manjiaer-Yingjisu source kitchen in the east, of which the main hydrocarbon containing formations are Cambrian and Ordovician marine strata. There are serval exploration wells targeting Ordovician dolomite reservoirs obtaining highly productive industrial gas flow, showing promising exploration prospect in this area.

Geochemical character of natural gas shows that the genetic type of the Ordovician gas is distinctive from the Jurassic and Silurian gases in the Manjiaer-Yingjisu depression. Based on statistics, a data set of 260 gas samples with composition and carbon isotope data from 6 basins worldwide shows that oil cracking gas can be discriminated from oil associated gas. Oil cracking gas has much lower wet gas composition ($C_{2+}$), and the ratios of $C_1/C_2$ and $C_2/C_3$ are generally larger than 4 and 2, respectively. As shown in Fig.1, natural gas of the Gucheng area is oil cracking gas with lower wet gas composition (<0.5%) and isotopic reversal (i.e. $\delta^{13}C_1>\delta^{13}C_2$). In contrast, natural gas from Yingjisu depression is oil associated gas with higher wet gas composition (>7% in general) and is usually accompanied by gas condensate.

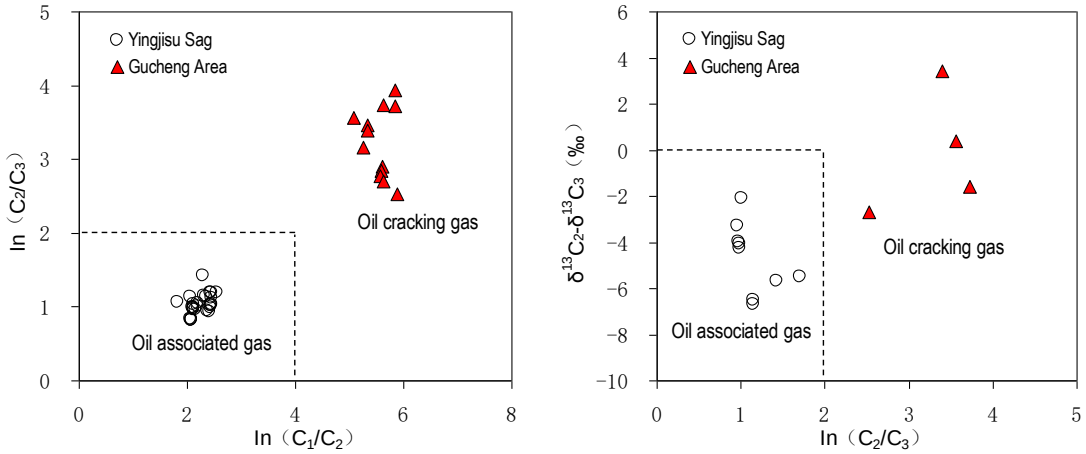


*Fig. 1. Natural gas discrimination plot for east Tarim Basin, NW China*

The carbon isotopic reversal suggests that gases in the Gucheng area are a mixture of in-situ oil cracking gas with lower maturity (Ro=1.95-2.5%, type I) and migrated oil-cracking gas with higher maturity (Ro=2.5-3.8%, type II) from the Manjiaer-Yingjisu depression. Based on pyrolysis experiment and theoretical models, many works have been done on the mechanism of carbon isotopic fractionation and corresponding kinetics (Galimov, 1988; Berner et al., 1995; Rooney et al., 1995; Lorant et al., 1998; Tang et al., 2000; Cramer, 2004; Tian et al., 2012；Zhang et al.，2018). In combination with crude oil cracking pyrolysis results, based on isotopic fractionation kinetics of various alkane gases proposed by Tang et al. (2000) using computational quantum chemistry, the two types of oil cracking gas are quantitatively

estimated for the contribution to the gases in the Gucheng area.

Pyrobitumen is widely distributed in the Ordovician reservoirs of the Gucheng area, of which the abundance is 10-64x$10^4$t/$km^2$ and the equivalent Ro is 1.95-2.5% with an average of 2.0%. A plot based on theoretical mixture of in-situ oil-cracking gas with migrated oil-cracking gases with different maturity is proposed here (Fig. 2). As shown in Fig.2, the in-situ oil-cracking has contribute 10-50% (most at 40~50%) to the gases in the Gucheng area, whereas gases from oil-cracking in the Manjiaer-Yingjisu depression have contributed more than 50%. Based on Fig.2, the maturity of oil-cracking gases from the Manjiaer-Yingjisu depression is mainly in the range of 3.0%-3.5%Ro, which is in accord with thermal maturity of the depression.

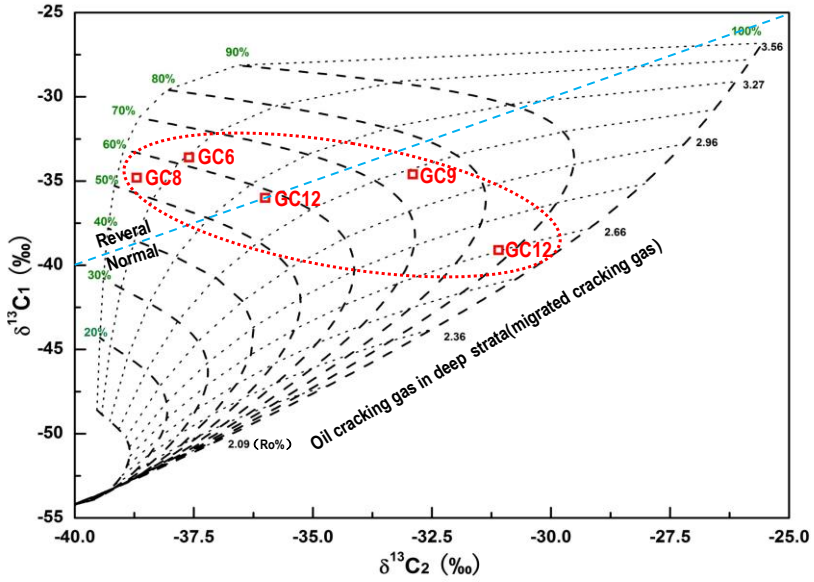


*Fig.2 Theoretical plot for determining gas contribution from different sources in the Gucheng area*

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