The geochemical characteristics of natural gas and its origin in Tazhong Uplift of Tarim Basin, China

GUO YI HU [1]*, JIN LI [2] AND ZHISHENG LI[2]

[1]Research Institute of Petroleum Exploration and Development, PetroChina, Beijing, 100083, China (*correspondence: huguoyi69@petrochina.com.cn)
[2]RIPED-Langfang, Hebei, 065007, China

The Tazhong Uplift is a favorable zone for natural gas exploration in Tarim basin and Tazhong gas field with proven reserves of 36.6 BCM was discovered in the carbonate reservoir of Ordovician in 2005. Based on the geochemical data of natural gases from 36 gas wells in Tazhong Uplift, the geochemical characteristics of natural gas and its origin have been studied. The carbon isotope of methane is very lighter with $\delta^{13}C_1$ from -54.4‰ to -38.0‰ and The carbon isotope of ethane varies widely with$\delta^{13}C_2$ from -43.0‰ to -30.7‰. The $\delta^{13}C$ values of benzene, toluene and methylcyclohexane of natural gas are less than -24.0‰. According to the genetic classification scheme by the carbon isotope of ethane [1,2] and the above three compounds [3], gases in Tazhong Uplift origined from source rock with organic matter type I-II.

Based on the carbon isotope value of methane and ethane, there are three groups of gases in Tazhong Uplift. Group one with $\delta^{13}C_1$ less than -50.0‰, $\delta^{13}C_2$ ranged from -39.0‰ to -35.0‰ is oil-cracking gas. All of them locate in the west of Tazhong Uplift. Group two with $\delta^{13}C_1$ more than -43.0‰, $\delta^{13}C_2$ more than -38.0‰ sourced from source rock in Middle to Upper Ordovician with the organic matter type II.All of them locate in the east of Tazhong Uplift. Group three with $\delta^{13}C_1$ from -42.0‰ to 47.0‰, $\delta^{13}C_2$ less than -39.0‰ and the values of $\delta^{13}C_2$ minus $\delta^{13}C_1$ less than 5‰ locates in the center of Tazhong Uplift. The geochemical characteristics of these gases are similar to the gas produced from Cambrian reservoir in Tarim basin. So authors deduced that gases in group three came from source rock with organic matter type I-II in Cambrian.

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Partitions of Sn, Cu, W, Au between liquid and vapor phases at sub-critical states of metal bearing fluids

SHUMIN HU, RONGHUA ZHANG AND XUETONG ZHANG

Institute of Mineral resources, Chinese Academy of Geol.Sci., Lab. Geochemical Kinetics.Baiwanzhuang road 26, Beijing 100037 (zrhhsm@pku.edu.cn)

In order to understand metal transportation by vapor, which was found by detecting volcanic gases, authors performed vapor-liquid separation experiments at sub-critical states. The experiments indicate that metal transportation by vapor of hydrothermal systems is derived from the liquid and vapor separation occurred in the transitions of hydrothermal fluids of $NaCl\text{-}H_2O\text{-} CO_2$ from a supercritical state to vapor-liquid immiscibility field at a sub-critical state.

Authors designed and assembled a liquid and vapor separator for supercritical fluids, which is a multi-channel reaction device and includes liquid reservoir, pump, main pressure vessel, V-L phase separator, cooling system, back pressure regulators, tubing etc. The main pressure vessel with a Zr metal liner tube mounted vertically. The V-L separation could be controlled and operated at temperatures (T) from 450 to 250°C and at pressures (P) from 40 to 22MPa. We performed vapor-liquid immiscibility field experiments at sub-critical states of a metal (Sn, Cu, Au, W and Zn) bearing $NaHCO_3\text{-}HCl\text{-}H_2O$ (or $NaCl\text{-}H_2O$) as decreasing T or P, and collected L and V samples separately. The results indicated that samples of liquid phase have higher concentrations of Na and Cl than those of vapor samples. For instance, liquid-vapor partition coefficients for Na and Cl, $D_{Na\ (V/L)}$ (or $D_{Cl(V/L)}$) (<1) vary with temperatures or pressure. And the liquid-vapor partition coefficients for Sn, $D_{Sn\ (V/L)}$ varies from 0.5 to 2.9. $D_{Sn\ (V/L)}$ is correlated to $D_{Na\ (V/L)}$ (or $D_{Cl(V/L)}$). The experiments suggest that Sn, Cu, W, Au could be transported by vapor phase of $NaCl\text{-}H_2O$. But zinc would be transported by a vapor phase of CO_2-rich solution of $NaCl\text{-}H_2O\text{-}CO_2$ system.