Mantle-origin CO_2 gas pools in petroliferous basins, Eastern China

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Faulting and magma activities frequently occurred in Eastern China since Jurassic Period. This create favourable conditions for discharge of mantle-origin gas. Springs and volcanic lakes after Quaternary volcanic period in Wudalianchi volcanic area, Heilongjiang Province and Tianchi, Changbai Mountain, Jilin province, contain a large amount of CO_2. CO_2 content amounts to 77.80%~99.45%, and $\delta^{13}C_{CO2}$ value is -3.83 to -7.50, and $^3He/^4He$ of gas seeps is $(1.67 \pm 0.07) \times 10^{-6} \sim 8.24 \times 10^{-6}$, namely R/Ra is 1.19~5.89. According to gas flux statistics of 3 m^2 water area of Keyan Spring in Wudalianchi volcanic area, 279.3 m^3 gas is discharged daily. Volcanic rock and deep faults are generally distributed in juncture of Jiangxi Province, Guangdong Province. There are many gas seeps in hot spring in Zhegulong, Pingyuan, Guangdong Province and Xunwu, Jiangxi Province. Their CO_2 content varies from 96.7% to 99.96%, and $\delta^{13}C_{CO_2}$ value is -3.39 to -5.62‰, $^3He/^4He$ of gas seeps is $(1.90 \pm 0.06) \times 10^{-6} \sim (3.09 \pm 0.09) \times 10^{-6}$, namely R/Ra is 1.36~3.21. The above $\delta^{13}C_{CO_2}$ is -3.39 to -7.50‰, which shows that CO_2 is of mantle-origin; the R/Ra of 1.19~5.89 shows that helium gas contains a large amount of mantle-origined ^3He. This shows that the discharge of mantle-origin CO_2 and helium is widespread in volcanic area and outcrop area of igneous rock in Eastern China.

The discharge of mantle-origin gas is also widespread in rift petroliferous basin of Eastern China. 24 CO_2 gas pools(fields) has been discovered in Songliao Basin, Bohai Bay Basin, Northern Jiangsu Basin and Sanshui Basin, and East China Sea Basin, Zhujiangkou Basin. CO_2 content of these gas pools is 72.5 to 99.76%, and CO_2 content of most CO_2 gas pools is over 92%, with also hydrocarbon gases(C_{1-4}). $\delta^{13}C_{CO_2}$ value of gas pools is $-3.47 \sim -5.90$‰, which suggest that CO_2 is derived from mantle. $^3He/^4He$ is $(2.80 \pm 0.08) \times 10^{-6}$ $(6.94 \pm 0.20) \times 10^{-6}$, namely R/Ra is 2.00~4.96. This shows that helium gas contains a large amount of mantle ^3He. 11~56% of helium is derived from mantle helium. But the light $\delta^{13}C_1$ of CO_2 gas pools (< -30) along with carbon isotope series of $\delta^{13}C_1 < \delta^{13}C_2 < \delta^{13}C_3 < \delta^{13}C_4$ show that hydrocarbon gas is organic origin. Hydrocarbon gases mixed with mantle-origin gas that migrates and accumulates into petroiliferous basins.

The occurence of mantle-origin CO_2 gas pools is related to area with R/Ra>2, also associated with traps close to deep faults and intrusive rocks. The magnitude of mantle-origin CO_2 flux is quite large, for example, CO_2 reserves of Huangqiao Gas Field in the North Jiangsu Basin is estimated up to $624 \times 10^8 m^3$.