The geological implication of noble gas isotopies in shale gas

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Gas geochemical indicators, such as molecular compositions, carbon and hydrogen isotopes, and noble gas isotopes of shale gas, have been used to evaluate gas sources, and physical (mixing, degassing, diffusion, adsorption/ desorption, migration and accumulation etc.) and geochemical (generation, gas origin etc.) processes (Kotarba et al., 2014).

In our recently study, the noble gas abundance and isotopic composition of shale gas from the Longmaxi Formation in the Changning and Weiyuan areas have been analyzed during 3 years shale gas production, and the gas origin, gas releasing mechanism from minerals matrix to fracture network, and possible cause for differences in carbon isotope between the Changning and Weiyuan shale gases are investigated(Cao et al., 2017; Zhang et al., 2017).

$^{3}He/^{4}He$ and $^{40}Ar/^{36}Ar$ ratios are varied with well location and production time. A negative correlation between $^{40}Ar/^{36}Ar$ ratios and ^{40}Ar contents is observed, indicating a decreasing extent of shale gas dilution to radiogenic ^{40}Ar released from rock degassing. The Weiyuan shale gases show an increased ^{40}Ar contents but a slight decrease in $^{40}Ar/^{36}Ar$ during shale gas production, suggesting the insufficient free gas supply. In contrast, the Changing shale gases display small fluctuations in ^{40}Ar and ^{4}He contents during shale gas production, indicating abundant gas supply source from mineral matrix to fracture network system because of high in-situ gas content or better connectivity of hydraulic fracture networks.

Kr and Xe isotope ratios of Changning and Weiyuan shale gases are stable, like atmosphere characters. But, the contents of Kr and Xe are varied slightly. However, this maybe the very important informations to go further discuss the origin of shale gas.

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References:

[2] Kotarba et al. (2012) Chemical Geology 164-179, 383

[3] Cao et al. (2017) Marine and Petroleum Geology In press.

[4] Zhang et al. (2017) Marine and Petroleum Geology In press.