Molybdenum isotopic studies of mantle reservoirs

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Mass dependent isotope fractionation of (for example) silicon isotopes between meteorites and planetary materials has been used to assess processes that occurred during formation of Earth and its core (e.g. [1, 2]).

Thus far little is known about the mass dependent isotope fractionation of Mo in the solar system. Molybdenum is a refractory and moderately siderophile element. The processes that might have fractionated Mo in the early solar system include condensation and evaporation of dust grains, metal-silicate segregation, core crystallization, and aqueous alteration. To make comparisons with the silicate Earth it is first necessary to assess how much fractionation takes place during mantle melting.

Although we know much about the behavior of Mo in low temperature environments, little is known of Mo isotope behavior during high temperature processes. In this study we analyzed mafic and ultramafic rocks from a variety of settings. The $\delta^{95/98}$Mo values of mid-ocean ridge basalts (MORB) range from -0.18 to +0.10, and the $\delta^{95/98}$Mo values of oceanic island basalts (OIB) vary from -0.04 to +0.25 (+-<0.1permil (2s. d.) on $^{98/95}$Mo by double spike and MC-ICP-MS, this study; [3]). There is no significant variation in Mo isotope composition in a differentiation sequence from Ketla on Iceland over a range of Si contents. The mean isotope composition of OIB is slightly higher than MORB, but withinuncertainty the same. According to these preliminary results, it seems unlikely that there could exist any significant isotopic variability between these mantle Mo reservoirs. Our results also make Mo isotope fractionation during fractional crystallization unlikely.

[1] Georg *et al*. (2007) *Nature* **447**, 1102-1106. [2] Ziegler *et al*. (2010) *Earth & Planetary Science Letters* **295**, 487-496. [3] Siebert *et al*. (2001) *Geochemistry, Geophysics, Geosystems* **2**, 2000GC000124.

Geochemical characteristics and genetic types of natural gas in the Yinggehai Basin, China

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The genetic types of natural gas in the Yinggehai Basin are complex and dominated by thermogenic gas, with a small quantity of microbial gas and microbial-thermogenic mixed gas. The $\delta^{13}C_1$ values of natural gas in this area range from -28.6‰ to -74.7‰, and the $\delta^{13}C_2$ values range from -21.8‰ to -27‰, showing humic characteristics. In the C_1/C_{2+3}-$\delta^{13}C_1$ diagram (Fig.1), proportion of samples locate in the range of kerogen type III, and the others out of the range for mixing or migration. This phenomenon may be induced by episodic fluid flow in the Yinggehai Basin. The $\delta^{13}C_1$ values of microbial gas range from -74.4‰ to -62.5‰ and the δD values are heavy, ranging from -172.1‰ to -108.5‰. The previous studies suggested that the δD values were influenced by the sedimentary environment and the δD values of microbial gas in this area indicated that the microbial gas was generated in marine environment. Compared to the microbial-thermogenic mixed gas, the thermogenic gas and microbial gas are mixed in proportion and the results indicate that in the microbial-thermogenic mixed gas, the contents of the microbial gas range from 10% to 30%, and those of the thermogenic gas range from 70% to 90%.

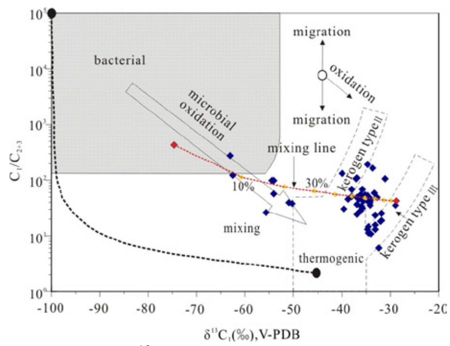

Figure 1: C_1/C_{2+3}-$\delta^{13}C_1$ diagram of natural gas in the Yinggehai Basin(the base map is according to Whiticar [1], the data are according to previous authors [2-6]).

[1] Whiticar *et al*. (1999) *Chem Geol* **161**, 291–314. [2] Dai *et al*. (2003) *China Offshore Oil & Gas(Geol)* **63**, 149-150. [3] Zhao *et al*. (2005) *Acta Sediment Sin* **23**, 156–161. [5] Hao *et al*. (2000) *AAPG Bull* **84**, 607–626. [6] Shen *et al*. (1996) *Nal Gas Geosci* **7**, 7–16.