Analysis of Poyang Lake water body dissolved inorganic carbon isotopic tracing and its carbon source contribution

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In recent decades, intensifying global climate changes caused by the greenhouse effect have led to recognition of the importance of the global carbon cycle. The key to the research on this phenomenon is the identification of the source of CO_2, its variations, and its response to human activities. Lake is sensitively responding to regional and global climate changes, being a rather considerable carbon source [1-2]. During the high- and low-water periods of 2009 and 2010, water samples from the Poyang Lake region and the estuary of five rivers were collected. We analyzed the correlation of the temporal and spatial distribution of dissolved inorganic carbon (DIC). We also examined the carbon flux in the lake and the contribution of its three major carbon sources to the flux. Results show that the DIC content in the high-water period is higher than that during the low-water period. In contrast, the value of $\delta^{13}C$ DIC is positive in the low-water period and negative in the high-water period; the monthly DIC carbon flux in Poyang Lake is 2.822t–268.428t, and its mean is 135.836t. The largest contributor (73.07% contribution rate) to the carbon flux in Poyang Lake is the CO_2 water vapor exchange. The second largest contribution (15.53% contribution rate) is the river input. Weathering of rocks with dissolved carbonate is the major mechanism controlling the DIC source and the $\delta^{13}C$ DIC composition. The changes in seasonal rainfall runoff are the main factors.

[1] Yu H & Li N. (2008) *Environmental Science and Technology* 21(2), 1-5. (in Chinese). [2] Kling G.W *et al.* (l99l) *Science* 251, 298-301.

Predicting CO_2 EOR and geological sequestration processes with artificial noble gas tracers

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Naturally occurring noble gas isotopes provide one of the best tools to study gas-fluid-mineral interaction [1]. By injecting and studying artificial noble gas tracers in CO_2 EOR or potential sequestration reservoirs, hydrological modelling can be established to quantify the multi-phase flow of fluids and determine the flow path and flow rate of fluids. This will enable further understanding of gas-aqueous fluid-mineral reactions and kinetics.

We present preliminary results from an artificial noble gas tracer study in a commercial CO_2 EOR reservoir located in Wyoming, USA. We constructed a continuous tracer injection system which consisted of two HPLC pumps, three high pressure cylinders and a wireless remote system monitoring temperature, pressure and weight in real time. Over 9 days, we injected 2 STP litres of ^{3}He and ^{129}X each directly into the EOR CO_2 injection stream. Based on the analysis of background $^{3}He/^{4}He$ and $^{129}Xe/^{132}Xe$ (0.07Ra and 0.98 respectively), our predicted spiked $^{3}He/^{4}He$ and $^{129}Xe/^{132}Xe$ ratios for the mass of injected CO_2 are 49.54Ra and 11.64 respectively. The wellhead injector fluid and 4 production wells surrounding the injector were sampled from September 2010 to February 2011.

Preliminary results show that the highest $^{3}He/^{4}He$ and $^{129}Xe/^{132}Xe$ ratios in the injected CO_2 stream reached 49.0Ra and 23.94 respectively and establish the tracer input function. ^{3}He tracer was detected in all producing fluid samples from 4 monitoring wells. Spike breakthrough is consistent with the reservoir geology with the wells updip of the injector seeing tracer arrival earlier than those located downdip of the injector. Spike breakthrough in wells updip of the injector correlated with the well temperature which was an indication of the CO_2 breakthrough, but in the wells downdip of the injector spike came through, most probably, dissolved in the water phase. $^{3}He/^{4}He$ ratio is at a much lower level than the injected ratio and reflect the magnitude of reservoir fluid and CO_2 interaction.

[1] Gilfillan *et al.* (2009) *Nature* **458**, 614-618.