The geochemistry and isotopic composition of produced waters from gas fields in Sichuan Basin, China

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The Sichuan Basin is one of the most important gas producing areas in China with 125 gas fields and the largest annual gas production from conventional oil and gas wells. In addition, the basin also contains six sets of organic-enriched shale formations, which are expected to be extracted through hydraulic fracturing techniques. In particular, the Lower Cambrian and Lower Silurian shale formations are currently the two most promising tragets for shale gas exploration.

Previous research in Sichuan Basin has shown a wide spatial and vertical distribution in the salinity of produced waters from oil and gas wells [1]. It has been shown that formation waters from the Upper Triassic formations are characterized by relatively high salinity (200 to 300 g/L), while produced waters from the Permian and underlying formations have much lower salinity (50 to 80 g/L) [1]. A new investigation of produced waters from different gas fields in Sichuan Basin aims to evaluate the origin of the brines and reconstruct their geochemical evolution. The new data shows the different in salinity between produced waters from the Triassic Xujiahe Formation (TDS up to 230 g/L) and Cambrian Longwangmiao Formation (68 g/L). We show that the brines in the region are characterized by Ca-chloride composition, high Br/Cl (up to $7.7x10^{-3}$), and stable isotopes ($\delta^{18}O$, $\delta^{2}H$) variations that reflect different degree of meteoric water dilution of remanants of evaporated seawater. The variations in Br/Cl and Na/Cl in the brines indicate different evoilution paths of seawater evaporation. The Ca-chloride composition, elevated B/Cl and Li/Cl ratios coupled with Sr/Ca, Ba/Sr, and $^{87}Sr/^{86}Sr$ variations are used to evaluate the source rocks and the role of the water-rock interactions that have modified the chemical composition of the Sichuan oil and gas brines.

[1] Wei *et al*. (2009) *Petrol. Expl. Develp*. **36**, 428-435.