Study of evolution model of Triassic K-rich brine in Sichuan Basin

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Sichuan Basin has rich brine resources in China. It has 2000 years of mining history of Salt in it's southwest mine.

This paper forms the ancient brine hydrogeological conditions, and establishes the Sichuan basin evolution model of K-rich brine. This paper argues that causes of K-rich brine in eastern Sichuan and western Sichuan is not entirely consistent.K-rich Brine formation process in Triassic can be summarized as follows:

1. Early and Middle Triassic, Sichuan Basin become marginal sea with seawater intrusion. Water salinity increased and the initial potassium concentrated. In the end of Early Triassic, the submarine volcanic eruption formed about 1 m thick mung bean rock, and provided a wealth of potassium resources.

2. Indo-China movement in the end of Middle Triassic, almost the entire Sichuan Basin rised above the sea surface. Triassic strata was impact of erosion and denudation. Original sedimentary brine was poured and mixed by leaching water.

3. Late Triassic Basin decreased, seawater intrusion until the Cretaceous. In this period, basin accumulated a thick layer of sediment over 1000m. Original sedimentary brine was deep closed and metamorphism. Rock salt, mung bean rock and plaster provided potassium and water.

4. In the end of Cretaceous, Sichuan movement maked the basin to rise again and also to make the basin have a large number of drapes and fractures,which have become reservoir space of K-rich brine. Sichuan movement has also brought deep hydrothermal which Contain potassium and other elements. K-rich Brine Enriched in the fornix trap structure, formed Brine deposits

In Sichuan basin, K-rich brine was found in eastern Sichuan and western Sichuan. PL4 well in western Sichuan, Boron content is up to 4767.6mg/l, and potassium content is 49.95g/l. The content is about twice the eastern C25 well. This paper argues that PL4 well is deeply influenced by the deep hydrothermal than C25 well, and East Tethys seawater had supply the western basin in the end of Middle Triassic. This view was support by trace element and isotope geochemistry.

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High mass resolution gas-source mass spectrometry

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Conventional gas-source isotope ratio mass spectrometers are fully capable of measuring the relative abundance of the rare $^{13}C^{18}O^{16}O$ isotopologue (m/e ~ 47) in CO_2. Abundances of rare isotopologues of other gases are promising tracers of provenance in geochemistry and atmospheric chemistry, but measurements are not possible at present due to the limitations imposed by gas-source mass spectrometers on the market today. A critical step forward is an increase in the mass resolving power (MRP) of these instruments.

We have begun a project to build a high-MRP gas-source isotope ratio mass spectrometer designed expressly for the purpose of resolving rare isotopologues of a variety of gases, including those of CH_4. The latter have driven the design in large part because of the difficulty in resolving $^{13}CDH_3$ from $^{12}CD_2H_2$ (m/Δm = 6178) together with the great potential that these species would have in establishing the provenance of CH_4.

We utilize the so-called "Matsuda" post-ESA lens arrangement for minimizing aberrations. The design maximizes MRP while minimizing vertical dispersion along the flight path. With a magnetic sector radius of 800 mm the anticipated MRP is ~ 30,000 to 40,000 with acceptable sensitivity. This is sufficient for flat-top peak resolution of a wide variety of rare isotopologues of gases that include CH_4, O_2, N_2O, SO_2, among others. An example calculation of the effect of MRP on separating mass-18 isotopologues of CH_4 is presented in the figure below. Results show that an MRP approaching 30,000 is required for flat-top resolution of $^{18}CH_4$ species.