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Research Advances

New Sr Isotope Evidence to Support the Material Source of the Mengyejing Potash Deposit in the Simao Basin from Ancient Marine Halite or Residual Sea

MIAO Zhongying*

MLR Key Laboratory of Saline Lake Resources and Environments, Institute of Mineral Resources, CAGS, Beijing 100037, China

Objective

The Mengyejing potash deposit in the Simao Basin is the only producing area of solid potash at present in China. There is still controversy about the material source and distribution of the potash in this deposit (Shen Lijian et al., 2017), which has influenced not only the prospecting direction and efficiency but also the understanding of the control of Tethys tectonic evolution on the formation and distribution of the mineral resources. This work analyzed the Sr isotope geochemical characteristics of evaporites from core samples in the well MZK-3 in order to further clarify the material source and to explore the potash distribution in the Simao Basin.

Methods

Sixteen evaporate samples from the well MZK-3 were ground into 200-mesh powder. The powder was decomposed by high-pressure PTFE bombs. Strontium was purified from the same digestion solution by two steps column chemistry. The first exchange column combined with BioRad AG50W×8 and Sr Spec resin was used to separate Sr from sample matrix. The Sr-bearing elution was dried down and re-dissolved in 1.0 ml 2wt% HNO_3. Small aliquots of each were analyzed using Agilent Technologies 7700x quadrupole ICP-MS (Hachioji, Tokyo, Japan) to determine the exact contents of available Sr. Diluted solution (50 ppb Sr doping with 10ppb Tl) was introduced into Nu Instruments Nu Plasma II MC-ICP-MS (Wrexham, Wales, UK) by Teledyne Cetac Technologies Aridus II desolvating nebulizer system (Omaha, Nebraska, USA).

Raw data of isotopic ratios were corrected for mass fractionation by normalizing to ^{86}Sr/^{88}Sr=0.1194 for Srwith exponential law. International isotopic standards (NIST SRM 987 for Sr) were periodically analyzed to correct instrumental drift. Geochemical reference materials of USGS BCR-2, BHVO-2, AVG-2 and RGM-2 were treated as quality control (Weis et al., 2006).

* Corresponding author. E-mail: zhymiao@foxmail.com

Results

Values of the ^{87}Sr/^{86}Sr of the analyzed 16 evaporite samples are shown in the Appendix 1. These data range between 0.707488 and 0.710095, with average 0.708088 and standard deviation of 8.0×10^{-4} (Fig. 1a). In these data, values of ^{87}Sr/^{86}Sr of two anhydrite samples are 0.708213 and 0.707599, respectively, indicating that matter source is typical marine; values of ^{87}Sr/^{86}Sr of all halite range between 0.707488 and 0.710095, with average 0.708114, which also indicates a typical marine matter source. The value of ^{87}Sr/^{86}Sr is greater than 0.7095, only appearing in one halite sample, and indicates that freshwater occasionally influences halite sedimentation.

Conclusions

Compared with previous data (Fig. 1b), our sample values of ^{87}Sr/^{86}Sr are restricted in a narrower range, and the average is lower, which better highlights the characteristics that the matter source of the evaporite is seawater. We further analyzed Sr isotope of surrounding rocks, and the results show that ^{87}Sr/^{86}Sr values range between 0.710035 and 0.738988 with an average value of 0.718081. Differences of the ^{87}Sr/^{86}Sr values between evaporite and surrounding rocks suggest: (1) Their sedimentary environment is typical marine and continental, respectively; (2) Cognition about origin of evaporite is transgression events in the epicontinental basin have not been supported by Sr isotope, because ^{87}Sr/^{86}Sr values of all clastic rocks are >0.7095; (3) The matter sources of the evaporite from Mengyejing potash deposit in the Simao Basin may be ancient marine halite or residual sea which lateral transfers here under control of tectonic activity under an extremely arid climate.

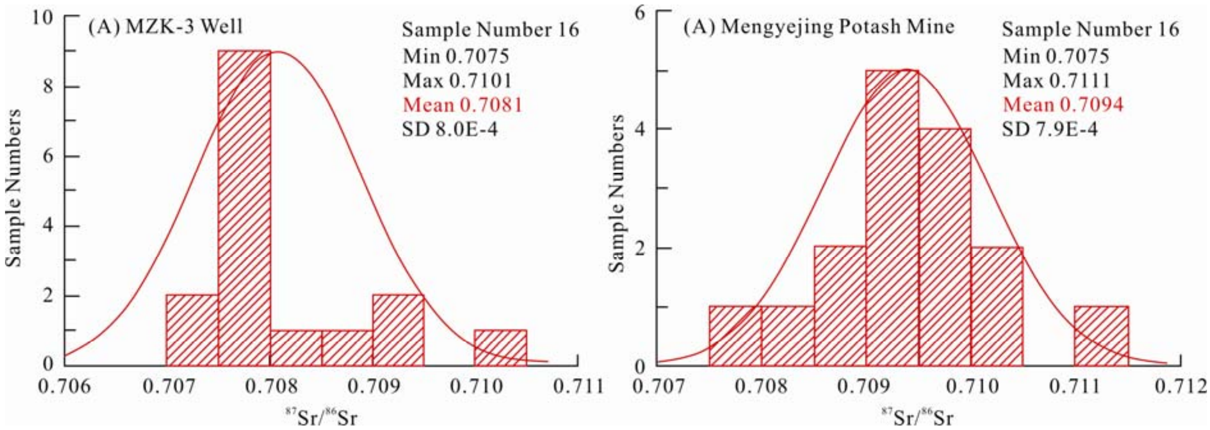

Fig. 1. Statistical characteristics of $^{87}Sr/^{86}Sr$ values of evaporites from the well MZK-3 (a) and Mengyejing potash deposit (b, after Zheng Zhijie et al., 2012), Simao Basin, southwest China.

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Appendix 1 $^{87}Sr/^{86}Sr$ of evaporite from the MZK-3 well, Simao Basin, southwest China

Number	Depth(m)	Lithology	$^{87}Sr/^{86}Sr$	SD
MZK-3-6-1	178.5	Anhydrite	0.708213	0.000004
MZK-3-6-2	179.1	Anhydrite	0.707599	0.000003
MZK-3-7-1	181.6	Halite	0.707488	0.000003
MZK-3-7-2	189.1	Halite	0.707489	0.000004
MZK-3-7-3	203.5	Halite	0.707537	0.000003
MZK-3-8-1	206.1	Halite	0.707667	0.000003
MZK-3-8-2	207.4	Halite	0.707988	0.000004
MZK-3-8-3	209.8	Halite	0.710095	0.000004
MZK-3-8-4	211.8	Halite	0.709369	0.000004
MZK-3-8-5	213.0	Halite	0.707618	0.000004
MZK-3-10-1	228.5	Halite	0.707541	0.000003
MZK-3-10-2	232.4	Halite	0.707724	0.000003
MZK-3-10-3	235.0	Halite	0.708667	0.000003
MZK-3-10-4	240.3	Halite	0.709158	0.000004
MZK-3-10-5	244.2	Halite	0.707697	0.000003
MZK-3-12-1	248.2	Halite	0.707553	0.000003
BCR-2	/	Basalt	0.705047	0.000004
AGV-2	/	Andesite	0.703999	0.000003

SD, Standard deviation; BCR-2, AGV-2, Geochemical reference materials of USGS.