XIANG Yu, ZHU Zhengjie and XIANG Xiaojun. 2014. Problems of Lithium Isotope Research in Salt Lake Study. *Acta Geologica Sinica* (English Edition), 88(supp. 1): 165-166.

Problems of Lithium Isotope Research in Salt Lake Study

XIANG Yu[1,2], ZHU Zhengjie[1] and XIANG Xiaojun[1]

1Chongqing Key Laboratory of Exogenic Mineralization and Mine Environment, Chongqing Institute of Geology and Mineral Resources, Chongqing, 400042, P.R. China;
2 State Key Laboratory of Coal Resources and Mining Safety Research Center in Chongqing, Chongqing, 400042, P.R. China

Lithium in nature mainly exists in the forms of solid minerals and ionic liquid. More than 150 lithium minerals exist, which are mainly pegmatite mineral including triphane, lithionite and petalite. Liquid lithium mainly exists in seawater, salt lake brine, oil field water and underground brine (table 1). And the brine accounted for more than 80% of the total lithium resources reserves. Lithium has two stable isotopes (^{6}Li and ^{7}Li) with great mass difference (the average relative abundance of ^{6}Li and ^{7}Li are 7.42% and 92.58%). Hence lithium isotope fractionation is significant. Lithium isotope ratios can effectively indicate many geochemical processes and phenomena, which can be used in the research of salt lake brine and underground high-potassium brine to indicate the source material lithium deposits and the evolution process of brine.

Lithium isotope study of salt lake on international development rapidly, but the research in China is relatively lagging behind, for only a few works has been carried out. A in-depth research is that using lithium isotopic tracer to study the direction, velocity and quantity of the intercrystalline brine in brine extraction process in initial minery of Qarhan Salt Lake (Xiao et al., 1999a; Xiao et al., 1999b; Wang et al., 2006; Qing et al., 2011). Additionally, Xiao used ion exchange to measure lithium isotopic composition, and VG354 mass spectrometer to measure the intensity of $^7Li^+$ and $^6Li^+$ and also the $^7Li^+$ / $^6Li^+$ ratio.

Along with deeper research, the problems of lithium isotope research in salt lake study of China show up, two of which are regarded as major problems:

1. Mechanism of lithium isotopic fractionation is now not well established; and lithium isotope is easily disturbed by other metal ions, it need purified. In the lithium isotope analyzing process, the result is easily influenced by both the matrix effect and the existence of K^+、Ca^{2+}、Na^+、Mg^{2+} (Tomascak P B, 2004; Zhang et al., 2010). Hence, in order to separate Li from other elements completely, the purification is needed before analyzing. The predicaments of the lithium extraction from salt lake brine are: a) Lithium and sodium have similar chemical properties, and the abundance of sodium is much larger than that of lithium in the lithosphere. Therefore it is difficult to separate Li from Na completely when we use organic ion exchange resin to extract lithium. b) Separating Li from Mg is also a problem the researchers face, for their chemical properties are extremely similar and yet the abundance of magnesium is much larger than that of lithium.

2. The researches in salt lakes of Tertiary and Quaternary indicate that the variation of lithium isotope shows a periodic trend in different epochs; the difference value between the maximum value and the minimum value is 15Ma. But this phenomenon against the analysis results of $\delta^{13}C$, $\delta^{18}O$, $\delta^{34}S$, and other isotopes in corresponding epochs (H Jochen and S Michael, 1997; Chan and M Edmond, 1998; Liu and Wei, 1999). The mechanism needs a deeper research to make it feasible to start accurate contrast studies with different isotopes. In brief, a

Table 1 Lithium contents in brine and seawater

	Lake	lithium content (mg/L)
Seawater		0.17
Interior salt lake brine	BangkogCo Salt Lake (Tibet)	68.8-245.0
	Jartai Salt Lake (Inner Mongolia)	2.0
	LeXieWudan Salt Lake (Qinghai)	171.0
	Da Qaidam Salt Lake (Qinghai)	117-227
	Lop Nur Salt Lake (Sinkiang)	2.435
Foreign salt lake brine	Dead Sea	13.60
	Artakama Salt Lake (Chile)	1500
	Uyuni Salt Lake (Bolivia)	80-1500

(After Ma et al., 2012)

* Corresponding author. E-mail: xiangpilgrim@163.com

systematic comparative study within lithium isotope and other stable isotopes such as carbon isotope, oxygen isotope, sulfur isotope, and hydrogen isotope, is vacant at the present time in our salt lake researches (Zhang et al., 2007). Meanwhile, the researches of salt lake in western China show that the variations of lithium isotope has a coherence with boron isotope in the source water of salt lake, and the similar phenomenon exists in both brine and sediment of salt lake (Zheng et al., 1983; Zhang et al., 1987). Such as, in Da Qaidam Lake, the δ^7Li ratio of the brine is +22.2‰, obviously below that of seawater (δ^7Li =31.5‰), boron isotope too has comparability; the source water with high δ^{10}B ratio is likely has a high δ^6Li ratio (Xiao et al., 1992). This is an important research subject to study, for the scope of application and the basic reason of this phenomenon remains unknown.

Key words: lithium isotope, salt lake, brine, boron isotope

Acknowledgements

Reviews of this manuscript by anonymous reviewers are gratefully acknowledged.

References

Basak Klsakurek, Widdowson M, James R H, 2004. Behaviour of Li isotopes during continental weathering: the Bidar laterite profile, India. Chemical Geology, 212: 27-44.

Chan L H, John M E, 1998. Variation of lithium isotope composition in the marine environment: A preliminary report. Geochim Cosmochim Acta, 62: 1711-1717

Hoffs J, Sywall M, 1997. Lithium isotope composition of Quaternary and Tertiary biogene carbonates and a global lithium isotope balance. Geochim Cosmochim Acta,61: 2679-2690

Liu X F, Wei L J, 1999. Advances in lithium isotope Geochemistry. Acta Geoscientia Sinica, 20: 445-449(in Chinese)

Ma R Y, Han F Q, Luo C G et al., 2012. Efficient separation and accurate isotopic determination of lithium in brine. Journal of Salt Lake Research, 20(2): 52-58(in Chinese)

Qing D L, Ma H Z, Li B K, 2011. Lithium isotope geochemical research progress. Journal of Salt Lake Research, 19(4): 64-72 (in Chinese)

Tomascak P B, 2004. Developments in the understanding and application of Lithium isotopes in the earth and planetary sciences. Reviews in Mineralogy & Geochemisty, 55: 153-195

Wang Q L, Zhao Z Q, Liu C Q, 2006. New progress in lithium isotope environmental geochemistry. Acta Mineralogica Sinica, 26(2): 196-202(in Chinese)

Xiao Y K，Sun D P, Wang H P, et al.,1992. Boron isotopic composition of brine, sediments and source water in Da Qaidam Lake, Qinghai, China. Geochim Cosmochim Acta, 56 (4): 1561-1568

Xiao Y K, Qi H P, Wang Y H, et al., 1994. Lithium isotopic compositions of brine sediments and source water in Da QaiDam Lake, Qinghai, China. Geochimica, 23(4): 329-338 (in Chinese)

Zhang Q H, Li S P, Sun S Y, et al., 2010. LiMn2O4 spinel direct synthesis and lithium ion selective adsorption. Chemical Engineering Science, 65(1) : 169-173(in Chinese)