Mem. Fac. Sci. Shimane Univ.
28, pp.83-86 Dec. 28, 1994

Sr isotope data of some GSJ rock reference samples

Shigeru IIZUMI, Kosuke MAEHARA, Paul A. MORRIS and Yoshihiro SAWADA

Department of Geology, Shimane University, Matsue 690, JAPAN

High precision Sr isotope ratios ($^{87}Sr/^{86}Sr$) have been determined for GSJ reference samples JB-1a, JB-2, JB-3, JA-3 and JG-1a, using a MAT262 mass spectrometer in the Department of Geology, Shimane University. During the course of this study, Sr isotope ratios of NBS987 were measured twice, giving values of 0.710276 ± 0.000007 (2σ) and $0.710274 \pm .000007$ (2σ).

Introduction

As isotope geochemistry is an important tool in geochronological and petrological studies of rocks and minerals, a thermal ionization mass spectrometer (Finigan MAT 262) has recently been installed in the Geology Department at Shimane University. During isotope determination of rocks and minerals, measurement of standard samples is indispensable for inter-laboratory correlation and evaluation of data. The GSJ (Geological Survey of Japan) rock reference samples, "igneous rock series" are widely available, and their Sr isotope ratios have been measured by many authors (SHIBATA and ADACHI, 1972 ; NOHDA and WASSERBURG, 1981 ; KAGAMI *et al.*, 1982 and 1989 ; KURASAWA, 1984, amongst others), and recently compiled by ANDO and SHIBATA (1988). However, there are still only a limited amount of isotope data for these reference samples, and only one or two values have been reported for such samples as JB-3 and JA-3. Also, as pointed out by KAGAMI *et al.* (1989), some GJS rock reference samples show a systematic difference in Sr isotope ratios between laboratories.

In this short note, we report Sr isotope data for six GSJ rock reference samples (JB-1a, JB-2, JB-3, JA-1, JA-3 and JG-1a) and NBS987, and comment on the results.

Analytical methods

Complete analytical procedures for Sr and Nd isotope ratios will be described elsewhere (IIZUMI *et al.*, in prep).

Extraction of Sr was made in a class 1000 clean room in the Department of Geology, Shimane University, essentially following the method of KAGAMI *et al.* (1982 and 1987). Each powdered sample (100 to 150 mg) was decomposed in a sealed teflon vessel using a HF, HCl and HNO_3 mixture. Sr was extracted from the decomposed sample using a column filled with cation exchange resin (Dowex AG 50W-X8, 200-400 mesh). The extracted Sr was loaded on a Re filament with HNO_3. Sr isotope ratios were measured using a Finnigan MAT 262 thermal ionization mass spectrometer equipped with five collectors. Measured Sr isotope ratios

Table 1. Analytical results of NBS987, six GSJ rock reference samples, and previously reported data.
* : mean Sr isotope ratio.
1 : KAGAMI *et al.* (1982) ; 2 : KURASAWA (1984) ; 3 : ZHANG ZICHAO (1987) ; 4 : KAGAMI *et al.* (1989) ; 5 : SHIRAHASE and NAKAJIMA (1984) ; 6 : NOHDA and WASSERBURG (1981).

Samples	$^{87}Sr/^{86}Sr \pm 2\sigma$		
	This study	Previously reported data	
NBS-987	0.710276±0.000007	0.710238±0.000008	1
	0.710274±0.000007	0.710278±0.000009	2
		0.71030 ±0.00003	3
	0.710275±0.000007*	0.710241±0.000024	4
		0.710252±0.000018	4
JB-1 a	0.704127±0.000006	0.704348±0.000015	5
	0.704138±0.000008	0.70420 ±0.00004	3
		0.704083±0.000016	4
	0.704133±0.000007*		
JB-2	0.703691±0.000008	0.703754±0.000014	2
		0.703753±0.000010	5
		0.70376 ±0.00003	3
JB-3	0.703437±0.000005	0.703493±0.000010	5
	0.703440±0.000005	0.703477±0.000014	2
	0.703439±0.000005*		
JA-1	0.703564±0.000008	0.70325 ±0.00005	6
	0.703580±0.000008	0.703586±0.000011	2
		0.703636±0.000010	5
	0.703572±0.000008*	0.70367 ±0.00005	3
		0.703507±0.000016	4
JA-3	0.704197±0.000009	0.70427 ±0.00004	3
JG-1 a	0.710988±0.000008	0.711036±0.000010	5
	0.710983±0.000007	0.71098 ±0.00003	3
	0.710963±0.000007	0.710973±0.000014	4
	0.710978±0.000007*		

were normalized to a $^{86}Sr/^{88}Sr$ ratio of 0.1194. The data were computed from 180 to 240 measurements, comprising ten scans of 18 to 24 blocks.

The total blank for Sr in the whole procedure was 0.6 to 1.0 ng, so the influence of the blank on isotope ratios of the measured GJS rock reference samples is negligible.

Results and Discussion

Sr isotope ratios of analysed samples are listed in Table 1, along with previously reported values. During the course of measurement, we determined the Sr isotope ratio of standard sample NBS987, producing similar ratios of 0.710276±0.000007 (2 σ) and 0.710274±0.000007 (2 σ) (Table 1). These are similar to previously reported data, which range from 0.710238 to 0.71030 (Table 1).

Two aliquots of JB-1a, which were separately decomposed, gave similar Sr isotope ratios of 0.704127±0.000008 (2 σ) and 0.704138±0.000008 (2 σ). Previously reported values for JB-1a show a large variation from 0.70408 to 0.704348 (Table 1). Our data are slightly lower than most values, and are similar to recently reported values by KAGAMI *et al.* (1989) (Table 1). JB-1a is a replacement sample for JB-1 (ANDO *et al.*, 1988), and JB-1a is expected to have a similar isotope ratio to JB-1. However, most of the previously reported values for JB-1 (nine of eleven determinations) are higher than 0.7043, and thus significantly higher than our data for JB-1a. KAGAMI *et al.* (1982) and KURASAWA (1984) reported relatively low Sr isotope ratios for JB-1 of 0.70413±0.000014 (2 σ) and 0.704168±0.000017 (2 σ), respectively. These two values are very close to our data for JB-1a.

Our Sr isotope ratios for JB-2 and JB-3 are slightly lower than previously reported data for these samples (Table 1). Apart from one extremely low Sr isotope ratio, previously reported Sr isotope ratios for JA-1 range from 0.703507±0.000016 (2 σ) to 0.70367±0.00005 (2 σ). Our data for JA-1 lie within this range, but our value for JA-3 is slightly lower than that previously reported (Table 1). Three values for JG-1a are comparable with previously reported data (Table 1).

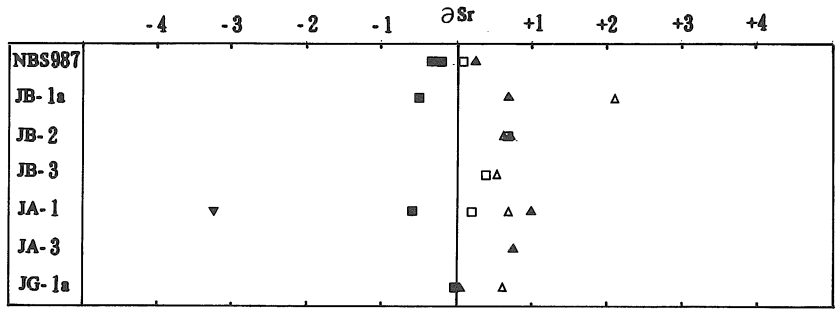

Fig.1. Comparison of Sr isotope data for NBS987 and six GSJ rock reference samples.
εSr : deviation in parts per 10^4 relative to the ratios measured at Department of Geology, Shimane University.
Solid squares : reference 1 and 4 (Table 1) ;
Open squares : reference 2 ; Closed triangles : reference 3 ;
Open triangles : reference 5 ; Inverted closed triangle : reference 6.

Summary

Improved mass spectrometer technology has resulted in improved quality of data, as shown by the highly precise data reported here. A comparison of Sr isotope data for NBS987 and GSJ rock reference samples with previously reported data (Fig. 1), shows a large inter-laboratory variation for some same samples. As pointed out by KAGAMI *et al.* (1989), this variation may be due to different mass spectrometers, and/or experimental procedures. In any case, it is important to systematically measure Sr isotope ratios of standard samples at each laboratory in order to evaluate variations in more detail.

Acknowledgements

We thank Mrs. C. AKASAKA for her help in Sr extraction, and Dr. H. KAGAMI of Okayama University for his generous advice and helpful suggestions during this study.

This work was partially supported by Grants-in Aid for Scientific Research (06452094 and 05402020) from the Ministry of Education, Science and Culture.

References

ANDO, A. and SHIBATA, K. (1988) Isotope data and rare gas compositions of GSJ rock reference samples, "Igneous rock series", 1988. *Geochem. J.*, **22**, 149-156.

KAGAMI, H. IWATA, M., SANO, S. and HONMA, H. (1987) Sr and Nd isotopic compositions and Rb, Sr, Sm and Nd concentrations of standard samples. *Tech. Rept. ISEI, Okayama Univ., Ser. B.* **No.4**, 1-16.

KAGAMI, H., OKANO, O., SUDO, H. and HONMA, H. (1982) Isotope analysis of Rb and Sr using a full automatic thermal ionization mass spectrometer. *Paper Inst. Therm. Spring Ress., Okayama Univ.* **No. 52**, 54-70.

KAGAMI, H. YOKOSE, H. and HONMA, H. (1989) $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ ratios of GSJ rock reference samples ; JB-1a, JA-1 and JG-1a. *Geochem. J.*, **23**, 209-214.

KURASAWA, H. (1984) Strontium isotopic composition of the volcanic rocks from Fuji, Hakone and Izu areas. *Rept. Geol. Surv. Japan*, **35**, 637-659 (Japanese).

NOHDA, S. and WASSERBURG, G. J. (1981) Nd and Sr isotopic study of volcanic rocks from Japan. *Earth Planet. Sci. Lett.*, 52, 264-276.

SHIBATA, K. and ADACHI, M. (1972) Rb-Sr and K-Ar geochronology of metamorphic rocks in the Kamiaso conglomerate, Central Japan. *Jour. Geol. Soc. Japan*, 78, 265-271.

SHIBATA, T. and NAKAJIMA, T. (1984) in ANDO, A. and SHIBATA. K. (1988) Isotope data and rare gas compositions of GSJ rock reference samples, "Igneous rock series", 1988. *Geochem. J.*, **22**, 149-156.

ZHANG ZICHAO (1987) in ANDO, A. and SHIBATA, K. (1988) Isotope data and rare gas compositions of GSJ rock reference samples, "Igneous rock series", 1988. *Geochem. J.*, **22**, 149-156.