

High Precision Automatic Multi-Dynamic Strontium Isotope Measurements

- Excellent reproducibility using automatic operation for 300 ng Strontium NBS 987 standard samples
- 4.28 ppm (2 RSD) Dynamic Average $^{87}\text{Sr}/^{86}\text{Sr}$
- 29.3 ppm (2 RSD) Static Average $^{84}\text{Sr}/^{86}\text{Sr}$

The isotopic measurement of Strontium by thermal ionisation mass spectrometry (TIMS), is often used as an indication of the performance of a TIMS instrument. The Nu TIMS instrument with Zoom Optics allows ultimate alignment of isotopes. This facilitates flexibility in the much used multi-dynamic analysis technique.

Each measurement step can be tuned to best alignment and instantly switched electronically to the next step in milliseconds during the measurement. This ensures the highest accuracy and precision.

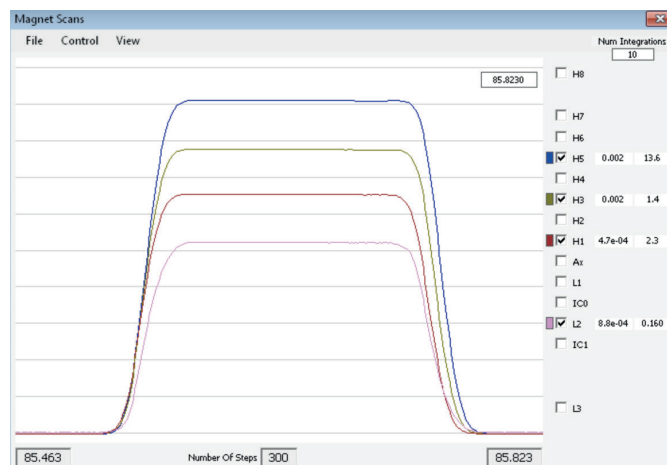


Figure 1: Alignment of Strontium Peaks

Analysis Mass Table - Sr Dyn Static H8H7H5.TRF

File	H8 (0)	H7 (1)	H6 (2)	H5 (3)	H4 (4)	H3 (5)	H2 (6)	H1 (7)	Ax (8)	L1 (9)	IC0 (10)	L2 (11)	IC1 (12)	L3 (13)	Integ Time	Collector Configuration to use	Tuning files to use to set Quad/Defls
Zero 1	87.5	86.5	87	85.5	86	84.5	84	83.5	83	82.5	---	81.5	---	79.5	180		
Meas 1	88	87	87.5	86	86.5	85	84.5	84	83.5	83	---	82	---	80	15	Strontium (88 in H8)	Sr 88 in H8 Lin.Tun
Meas 2	---	88	87.5	87	86.5	86	85.5	85	84.5	84	---	83	---	81	15	Strontium (88 in H7)	Sr 88 in H7 Lin.Tun
Meas 3	---	---	---	88	87.5	87	86.5	86	85.5	85	---	84	---	82	15	Strontium (88 in H5)	Sr 88 in H5 Lin.Tun

Maximum Sample Filament Current (if used) 3000

No. of measurements per block 10

No. of blocks 20

Magnet delay time 3

Centre every 5 blocks

Re-Tune Source after every 5 blocks

☒ Force Time Drift Correction during run

☐ Sit on set (Delta M)

☐ Zero each cycle

Figure 2: Detector configuration and measurement parameters for multi-dynamic measurements of Strontium.

Explanation

For the $^{87}\text{Sr}/^{86}\text{Sr}$ ratio the best precision can be achieved using a multi-dynamic analysis method as described in the Thirwall paper, Chemical Geology (Isotope Geoscience Section), 94 (1991) 85-104. Two dynamic ratio values can be measured, using the routine shown in Figure 2 above, and an average value calculated for improved precision.

Conversely, for the $^{84}\text{Sr}/^{86}\text{Sr}$ ratio, the measurement error is not limited

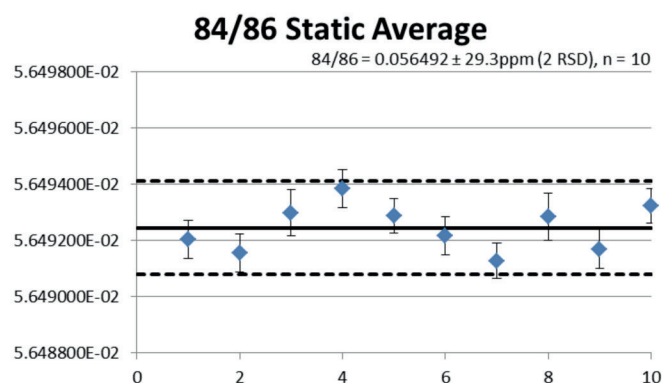
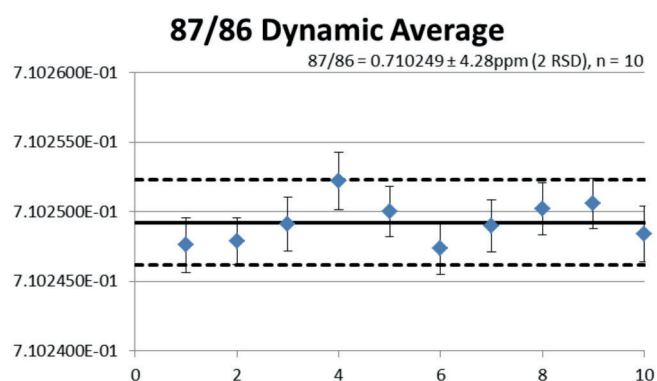
by the gain or Faraday cup factors, but due to the low abundance of the ^{84}Sr isotope. Therefore, a static average from each of the 3 measurement lines can be used for the final result to improve precision.

Parameters						
Sample	Filament Single	Analysis Mode	Target beam intensity	Warm up	Measurement duration	Baselines
300 ng NBS 987 with Ta ₂ O ₅ activator	Zone refined Rhenium	Automatic, multidynamic, 20 blocks of 10 measurements	⁸⁸ Sr at 10 V	~ 1 hour	~ 4.5 hours	180 seconds before each block

Table of data all normalized to $^{86}\text{Sr}/^{88}\text{Sr} = 0.1194$.

Run #	87/86 Average Dynamic	2 RSE (ppm)	84/86 Average Static	2 RSE (ppm)
1	0.710248	2.8	0.056492	12.0
2	0.710248	2.4	0.056492	12.0
3	0.710249	2.8	0.056493	14.6
4	0.710252	3.0	0.056494	12.2
5	0.710250	2.6	0.056493	11.0
6	0.710247	2.6	0.056492	11.8
7	0.710249	2.6	0.056491	11.2
8	0.710250	2.6	0.056493	14.8
9	0.710251	2.6	0.056492	12.2
10	0.710248	2.8	0.056493	11.0
Average	0.710249		0.056492	
2 SD	13.04E-06		1.66E-06	
2 RSD ppm	4.28		29.30	

All Error bars are 2 standard errors. Dotted lines represent +/-2 RSD of the data.



Conclusion

Automatic multi-dynamic measurement of 300 ng size loads of the Strontium standard NBS 987 has been demonstrated to give excellent, reproducible results.