



Pb ISOTOPIC ANALYSIS OF THE NBS 981 STANDARD BY TIMS AT LAGIR, FACULTY OF GEOLOGY, STATE UNIVERSITY OF RIO DE JANEIRO

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ABSTRACT

This work presents 28 lead isotope analyses by TIMS in the NBS981 standard, using a Finnigan Triton mass spectrometer. Between 35 and 100 ng of lead was deposited on Rhenium filaments and analysed in multi-collector static mode. The following averages for isotope ratios are: $^{206}\text{Pb}/^{204}\text{Pb} = 16,027 \pm 0,0011$, $^{207}\text{Pb}/^{204}\text{Pb} = 15,4446 \pm 0,0014$, $^{208}\text{Pb}/^{204}\text{Pb} = 36,5544 \pm 0,0044$, $^{208}\text{Pb}/^{207}\text{Pb} = 0,91374 \pm 0,00002$ e $^{207}\text{Pb}/^{206}\text{Pb} = 0,9134 \pm 0,0001$. The calculated mass fractionation averages 0,07 ‰/a.m.u.

INTRODUCTION

The Laboratory of Geochronology and Radiogenic Isotopes (LAGIR) is installed in the Faculty of Geology (Rio de Janeiro State University). The facilities comprise clean rooms for chemical procedures and a Finnigan Triton thermal ionization mass spectrometer (TIMS). The laboratory presents conditions to develop the Sm-Nd, Pb-Pb, (both in final procedures to start the routine analysis), Rb-Sr, U-Pb and Re-Os.

This contribution aims to present the initial results of Pb isotopes analysis realized on NBS 981 standard at LAGIR. The results are discussed here in order to define the correction factor for the mass fractionation observed in our laboratory compared with published results of this standard in other laboratories. The determination of the mass fractionation factor for Pb isotope analysis is important for improving the precision of lead isotopic analysis. The principal reason for the difference in overall reproducibility is that, among the four stable lead isotopes, only ^{204}Pb is nonradiogenic so that there is no naturally invariant ratio that can be used for internal normalization.

PROCEDURES

The NBS 981 standard was loaded on a previously degassed single Re filament using silica gel and H_3PO_4 1N. The spectrometric analyses were run in static mode using 4 Faraday collectors (Table 1). Samples were loaded with weight varying from 35 and 100 ng. Two important cause of mass fractionation is the concentrations of silica-gel and phosphoric acid. Both aspect were similar during the procedures of the analysis presented in Table 2.

Collector	C	H1	H2	H3
Isotope	^{204}Pb	^{206}Pb	^{207}Pb	^{208}Pb

Table 1. Collectors setting for natural isotopes Pb analysis.

RESULTS AND Pb ISOTOPIC FRACTIONATION

The Pb isotopic results of the NBS 981 standard show a range of values (Table 2) due to isotopic fractionation indicating temperature-dependent and intensity-dependent (^{208}Pb signal). This fractionation is not smaller at higher temperatures (Fig. 1). The analyses were run in the temperature range between 1200 °C and 1400 °C. The lower temperature (ca. 1.250 °C) is preferable in LAGIR due high sensitivity of the collectors. In addition, at lower temperatures the intensity of ^{208}Pb signal is not too high (at about 1,0 V for 60 ng of Pb load).



Temp	Pb	²⁰⁸ Pb	²⁰⁶ Pb/	(1σ)	²⁰⁷ Pb/	(1σ)	²⁰⁸ Pb/	(1σ)	²⁰⁷ Pb/	(1σ)	²⁰⁸ Pb/	(1σ)	²⁰⁸ Pb/	(1σ)
°C	ng	V	²⁰⁴ Pb	Std error	²⁰⁴ Pb	Std error	²⁰⁴ Pb	Std error	²⁰⁶ Pb	Std error	²⁰⁶ Pb	Std error	²⁰⁷ Pb	Std error
1258	35	2.754	16.8934	7	15.4323	6	36.5137	153	0.9135	1	2.1614	1	2.3661	1
1251	35	0.805	16.9045	59	15.4447	56	36.5472	131	0.9136	1	2.1620	4	2.3664	6
1329	70	0.629	16.9015	54	15.4434	47	36.5531	111	0.9137	4	2.1627	10	2.3669	7
1253	35	0.931	16.9042	30	15.4455	29	36.5524	70	0.9137	1	2.1623	4	2.3665	3
1309	70	1.028	16.9057	27	15.4487	18	36.5678	77	0.9138	4	2.1629	15	2.3669	10
1280	35	1.496	16.8978	18	15.4382	9	36.5316	24	0.9136	3	2.1619	4	2.3663	5
1314	35	1.385	16.9145	23	15.4596	23	36.6043	58	0.9140	4	2.1641	7	2.3678	8
1351	35	2.690	16.8993	48	15.4401	43	36.5443	102	0.9137	2	2.1625	3	2.3668	4
1315	50	2.825	16.8953	35	15.4344	33	36.5201	93	0.9135	1	2.1615	12	2.3662	10
1374	35	2.339	16.9114	9	15.4540	7	36.5872	17	0.9138	1	2.1635	2	2.3675	2
1217	35	0.618	16.8989	39	15.4412	38	36.5422	69	0.9137	4	2.1626	10	2.3668	4
1381	35	1.138	16.9005	14	15.4412	12	36.5465	20	0.9137	2	2.1624	6	2.3667	6
1389	35	2.406	16.9079	8	15.4503	13	36.5768	16	0.9138	1	2.1633	3	2.3673	2
1313	35	0.561	16.9082	59	15.4492	55	36.5649	13	0.9137	1	2.1625	6	2.3668	7
1242	70	3.173	16.8991	11	15.4410	10	36.5400	24	0.9137	2	2.1622	4	2.3664	2
1276	35	2.102	16.9036	15	15.4464	24	36.5588	58	0.9138	2	2.1628	13	2.3670	7
1269	35	3.063	16.8956	6	15.4352	5	36.5225	10	0.9136	1	2.1616	2	2.3661	1
1334	35	1.313	16.9067	16	15.4491	17	36.5710	46	0.9138	4	2.1631	12	2.3672	5
1331	35	4.187	16.8979	5	15.4389	3	36.5355	12	0.9137	1	2.1621	2	2.3665	4
1259	35	2.825	16.8993	12	15.4405	10	36.5380	25	0.9137	1	2.1621	1	2.3664	3
1259	100	4.145	16.8967	16	15.4377	15	36.5306	36	0.9136	2	2.1620	5	2.3663	1
1309	70	1.585	16.9110	33	15.4563	33	36.5923	70	0.9140	1	2.1638	9	2.3675	6
1259	70	1.817	16.9143	27	15.4597	24	36.5974	58	0.9140	2	2.1637	8	2.3673	1
1298	35	0.901	16.9037	50	15.4443	49	36.5523	132	0.9137	4	2.1625	18	2.3669	10
1362	64	0.5372	16.8939	53	15.4386	50	36.5561	116	0.9139	4	2.1641	1	2.3678	10
1417	32	0.1975	16.9093	75	15.4533	63	36.5845	148	0.9139	4	2.1639	1	2.3678	10
1365	32	3.3487	16.9014	9	15.4425	8	36.5477	19	0.9137	1	2.1624	0	2.3667	1
1304	90	2.3583	16.9010	11	15.4421	10	36.5442	24	0.9137	1	2.1623	0	2.3666	1
average			16.9027		15.4446		36.5544		0.91374		2.1627		2.3668	
1σ Std Err (abs)			0.0011		0.0014		0.0044		0.00002		0.0001		0.0001	

Table 2. Pb isotopic NBS 981 standard results obtained at LAGIR.

The procedure to correct this mass fractionation is obtained applying the corrector factor. The calculation of this factor depends of the NBS 981 values published obtained in several isotope laboratories around the world. The NBS 981 ²⁰⁷Pb/²⁰⁶Pb value used for calibration is 0,914573 as published by Todd *et al.* (1995), similar to the value reported by Volker *et al.* (1993) of 0,914684. These reported values are compared with the data obtained in LAGIR and the results indicated the following fractionation factor (Table 3):

Isotopic ratio	²⁰⁸ Pb/ ²⁰⁴ Pb	²⁰⁷ Pb/ ²⁰⁴ Pb	²⁰⁶ Pb/ ²⁰⁴ Pb	²⁰⁷ Pb/ ²⁰⁶ Pb	²⁰⁸ Pb/ ²⁰⁶ Pb	²⁰⁸ Pb/ ²⁰⁷ Pb
Fractionation	0.00065	0.00067	0.00061	0.00069	0.00070	0.00070

Table 3. Calculated fractionation factor for Pb isotopic ratios

CONCLUSIONS

The results are statically accurate using the multicollectors with rapid time of data integration. The Pb isotope values obtained at LAGIR are coherent with the results reported in the literature and define a



fractionation factor for the mass spectrometer with an average value at 0,0007. In addition, the isotopic fractionation had low influence of temperatures changes.

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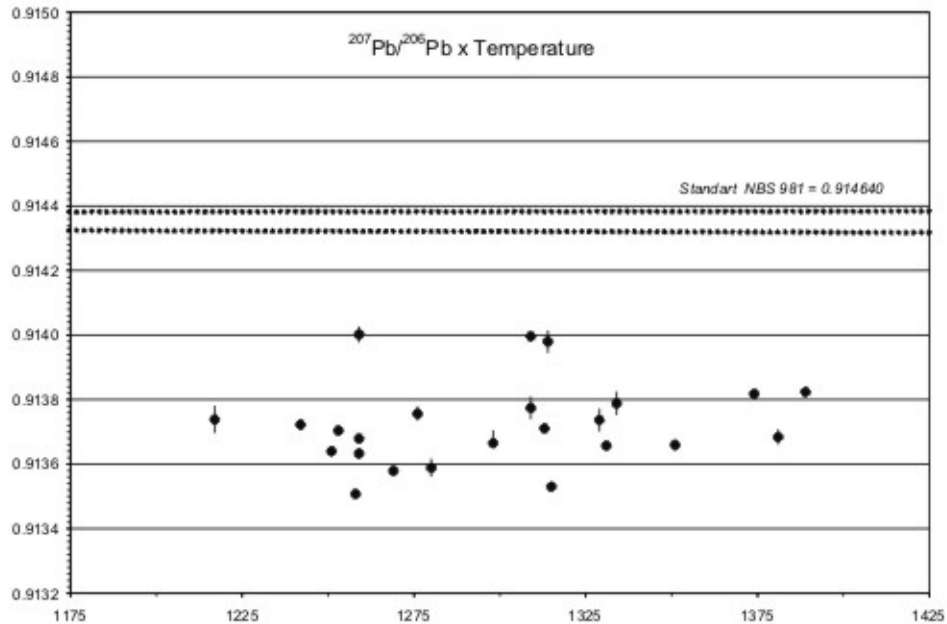


Figure 1. $^{207}\text{Pb}/^{206}\text{Pb}$ versus temperature diagram for the NBS 981 standard.

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