Data Repository Item, Analytical Methods DR1

Analytical methods

Hand-picked rock chips (100 mg; < 500 μm) were leached in hot 6M HCl acid for 30 min. Following this, the leaching acid was decanted and the residual sample rinsed several times with MQ H_2O. Samples were digested in HF-HNO_3 acid for 24 hours on a hotplate at 140°C, followed by sequential evaporation of concentrated HNO_3 and 7M HCl acid. The sample was then taken into solution in 1M HBr. Pb was separated using standard anion exchange chemical techniques; eluting matrix with 1M HBr and collecting Pb with 7M HCl (Baker et al., 2004).

The eluted matrix from the Pb chemistry was evaporated and used for Nd separation. HNO_3 acid was added and evaporated before the sample was dissolved in 6M HCl. Evaporation was followed by dissolution in a loading solution of 2M HCl. After centrifuging to remove any undissolved solid, the sample was loaded onto a cation exchange column. Major elements, Rb, and Sr were eluted with 2M HCl and Ba with 2M HNO_3. The REE were collected in 6M HCl. Nd was then cleaned up with a small column pass, using RE-spec resin, eluting matrix in 3M HNO_3 and collecting the REE in dilute in HNO_3.

Pb and Nd isotopes were measured on a VG Axiom multiple collector inductively coupled plasma mass spectrometer at the Danish Lithosphere Centre. Pb isotope analyses were corrected for instrumental mass bias using a ^{207}Pb-^{204}Pb spike (Baker et al., 2004). The majority of samples have internal precisions better than ± 0.002, ± 0.002 and ± 0.003 for $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$, respectively (2SE). A few samples have larger internal precisions up to ± 0.011, ± 0.011 and ± 0.028, respectively. Replicate digestions in different analytical batches have reproducibilities of 180-526 ppm for $^{206}Pb/^{204}Pb$. However, the reproducibility of the measured $^{207}Pb/^{204}Pb$ ratios on replicate digestions were markedly better and varied from 52-115 ppm. Somewhat worse reproducibility for the basalt samples as opposed to that for SRM 981 standard reflect the non-zero age of the studied samples. The isotopic heterogeneity of the replicate digestions reflects real sample heterogeneity related to the 55 Myr age of the studied rocks which is variably sampled in each digestion and further accentuated by leaching of Pb from minerals with highly variable U/Pb and Th/Pb ratios. Pb isotopic data are reported relative to values obtained for SRM981 during the course of this study of 16.9429 ± 0.0007, 15.5007 ± 0.0008 and 36.7245 ± 0.0019 (2 SD, n = 11) for $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$, respectively. Total procedural blanks for Pb during this study varied from 20-50 pg and are insignificant. High precision Pb isotopes are age corrected using U/Pb and Th/Pb ratios calculated from U-Th-Pb concentrations measured by ICP-MS at Oregon State University.

Nd isotopes are reported relative to an Ames Nd metal standard with $^{143}Nd/^{144}Nd$ = 0.51213, equivalent to a ratio of 0.51186 for La Jolla. Internal precisions of measured $^{143}Nd/^{144}Nd$ ratios were typically better than ± 0.000011. External reproducibility for $^{143}Nd/^{144}Nd$ ratios are better than ± 0.000010 (2 SD). Procedural blanks for Nd varied from 20 - 33 pg.

In order to be able to directly compare the mantle sources of 55 Myr old East Greenland Plateau Basalts with the present-day sources of the Iceland plume, a mantle source age correction has been applied to the $^{143}Nd/^{144}Nd$ ratio measured on the Plateau Basalts using the following procedure:

1. Correction of measured $^{143}Nd/^{144}Nd$ back to 55 Myr ago using the measured Sm/Nd ratio.
2. Forward projection of source $^{143}Nd/^{144}Nd$ to the present-day using a modelled Sm/Nd source ratio (e.g. Salters and White, 1998).

References

Baker, J., Peate, D.W., Waight, T., and Meyzen, C., 2004, Pb isotopic analysis of standards and samples using a ^{207}Pb-^{204}Pb double spike and thallium to correct for mass bias with a double-focusing MC-ICP-MS: Chemical Geology, v. 211, p. 275-303.

Salters, V.J.M., and White, W.M., 1998, Hf isotope constraints on mantle evolution: Chemical Geology, v. 145, p. 447-460.

Sample	Formation	Flow	$^{206}Pb/^{204}Pb_m$	2se	$^{207}Pb/^{204}Pb_m$	2se	$^{208}Pb/^{204}Pb_m$	2se
436022*	MLF	3	17.500	0.002	15.353	0.001	37.531	0.004
404213*	MLF	39	16.029	0.001	15.040	0.001	36.530	0.003
404210*	MLF	40	16.006	0.001	15.004	0.001	36.461	0.002
408208*	MLF	42	16.681	0.001	15.155	0.001	38.116	0.003
404197*	MLF	45	16.372	0.001	15.122	0.001	37.545	0.002
404241	MLF	72	18.131	0.002	15.432	0.003	38.012	0.006
404262	MLF	82	17.846	0.011	15.383	0.011	37.666	0.028
404256	MLF	88	17.906	0.006	15.391	0.005	37.774	0.013
404253	MLF	91	18.432	0.002	15.446	0.002	38.248	0.005
437159	GPF	116	18.357	0.001	15.444	0.001	38.359	0.003
404279	GPF	135	18.415	0.002	15.463	0.002	38.366	0.005
404279d	GPF	135	18.438	0.001	15.465	0.001	38.387	0.003
404279d	GPF	135	18.429	0.001	15.464	0.001	38.381	0.003
404279d	GPF	135	18.428	0.001	15.463	0.001	38.381	0.002
404279d	GPF	135	18.428	0.001	15.464	0.001	38.386	0.002
436011	GPF	157	18.424	0.001	15.443	0.001	38.267	0.003
436062	RFF	184	19.179	0.002	15.513	0.002	38.773	0.004
436062d	RFF	184	19.196	0.004	15.531	0.003	38.832	0.009
436057	RFF	188	19.256	0.001	15.533	0.001	38.831	0.003
436065	RFF	190	19.146	0.002	15.518	0.002	38.721	0.005
436068	RFF	191	19.140	0.000	15.523	0.001	38.684	0.003
436070	RFF	193	19.036	0.002	15.515	0.002	38.678	0.005
435570	RFF	207	19.331	0.001	15.541	0.001	38.898	0.002
435570d	RFF	207	19.352	0.001	15.545	0.001	38.955	0.002
435570d	RFF	207	19.349	0.001	15.542	0.001	38.948	0.003
435570d	RFF	207	19.356	0.001	15.545	0.001	38.962	0.001
435570d	RFF	207	19.353	0.001	15.544	0.001	38.955	0.002
435571	RFF	208	19.304	0.001	15.540	0.001	38.871	0.003
435571d	RFF	208	19.309	0.001	15.544	0.001	38.897	0.003
412495	RFF	209	19.204	0.001	15.522	0.001	38.768	0.003
435533	RFF	211	19.123	0.001	15.525	0.001	38.699	0.003
412497	RFF	214	18.956	0.001	15.503	0.001	38.636	0.003
435541*	RFF	216	18.537	0.001	15.445	0.001	38.410	0.003
435504*	RFF	219	18.802	0.002	15.501	0.001	38.527	0.003
435508*	RFF	226	18.879	0.001	15.506	0.001	38.597	0.003
412465	RFF	230	18.869	0.001	15.506	0.001	38.606	0.002
412466	RFF	231	18.862	0.001	15.509	0.001	38.644	0.002
412467*	L-SF	232	18.556	0.001	15.475	0.001	38.481	0.003
412476*	L-SF	240	17.508	0.003	15.328	0.003	37.814	0.006
412481	L-SF	243	18.770	0.001	15.502	0.001	38.472	0.003
412483	L-SF	245	18.726	0.002	15.505	0.002	38.446	0.006
412488	L-SF	249	18.712	0.002	15.503	0.002	38.420	0.005
412490*	L-SF	251	18.668	0.001	15.474	0.001	38.364	0.003
412493*	L-SF	253	18.073	0.002	15.423	0.001	38.155	0.003
435516*	L-SF	258	18.514	0.002	15.462	0.002	38.376	0.005

Sample	Formation	Flow	$^{206}Pb/^{204}Pb_m$	2se	$^{207}Pb/^{204}Pb_m$	2se	$^{208}Pb/^{204}Pb_m$	2se
412412	L-SF	259	18.823	0.001	15.513	0.001	38.529	0.003
412421*	L-SF	265	18.705	0.003	15.496	0.002	38.388	0.006
412423*	L-SF	267	18.578	0.001	15.420	0.001	38.198	0.003
412434	L-SF	272	18.667	0.003	15.490	0.002	38.330	0.005
412435	L-SF	273	18.599	0.001	15.485	0.001	38.291	0.003
412449*	L-SF	285	18.059	0.001	15.386	0.001	38.172	0.001
412455	L-SF	290	18.606	0.002	15.477	0.002	38.368	0.004
412402*	M-SF	301	16.446	0.001	15.132	0.001	37.408	0.003
412406*	M-SF	304	16.231	0.001	15.047	0.001	37.326	0.002
412364*	M-SF	315	17.981	0.002	15.373	0.002	37.996	0.005
412392*	U.SF	330	17.628	0.001	15.312	0.001	37.760	0.003

* denotes contaminated samples

m denotes measured isotopic ratios, S denotes source age corrected ratios.

d denotes duplicate analysis of sample on replicate digestions

A denotes data from Andreasen, R., Peate, D.W., and Brooks, C.K. (2004). Magma plumbing systems in large igneous provinces: Inferences from cyclical variations in Palaeogene East Greenland basalts: Controbutions to Mineralogy and Petrology, v. 147, p 438-452.

Sample	Formation	Flow	$^{144}Nd/^{143}Nd_m$	2se	ε_{Nd-m}	$^{144}Nd/^{143}Nd_S$	ε_{Nd-S}	La/Sm_N	Dy/Yb_N
436022*	MLF	3	0.512935	0.000006	5.79	0.512951	6.11	1.19	3.20
404213*	MLF	39	0.512483	0.000013	-3.03	0.512489	-2.91	1.40	3.55
404210*	MLF	40	0.512422	0.000008	-4.21	0.512426	-4.14	1.41	3.63
408208*	MLF	42	0.512150	0.000007	-9.52	0.512154	-9.44	2.08	6.24
404197*	MLF	45	0.511981	0.000007	-12.82	0.511979	-12.86	1.98	5.20
404241	MLF	72	0.513146	0.000007	9.91	0.513149	9.96	0.57	1.14
404262	MLF	82	0.513168	0.000011	10.34	0.513167	10.31	0.41	1.04
404256	MLF	88	0.513065	0.000013	8.33	0.513055	8.14	0.42	1.04
404253	MLF	91	0.513002	0.000009	7.11	0.513023	7.50	1.34	1.50
437159	GPF	116	0.512948[A]	-	7.8	0.513029	7.64	1.41	1.38
404279	GPF	135	0.512946[A]	-	7.7	0.513027	7.60	1.40	1.42
436011	GPF	157	0.512939[A]	-	7.6	0.513020	7.46	1.30	1.31
436062	RFF	184	0.512937	0.000007	5.84	0.512962	6.31	1.86	1.49
436057	RFF	188	0.512949	0.000007	6.07	0.512973	6.53	1.79	1.51
436065	RFF	190	0.512950	0.000007	6.09	0.512975	6.58	1.90	1.54
436068	RFF	191	0.512947	0.000009	6.04	0.512974	6.55	1.91	1.59
436070	RFF	193	-	0.000000	-	-	-	1.46	1.52
435570	RFF	207	0.512958	0.000021	6.25	0.512987	6.81	2.05	1.56
435571	RFF	208	0.512943	0.000009	5.94	0.512970	6.47	1.96	1.51
412495	RFF	209	0.512946	0.000007	6.00	0.512972	6.51	1.87	1.54
435533	RFF	211	0.512950	0.000011	6.09	0.512976	6.59	1.75	1.62
412497	RFF	214	0.512969	0.000011	6.46	0.512992	6.90	1.58	1.53
435541*	RFF	216	0.512904	0.000007	5.20	0.512926	5.62	1.63	1.52
435504	RFF	219	0.512944	0.000008	5.96	0.512970	6.47	1.76	1.50
435508*	RFF	226	0.512682	0.000006	0.85	0.512698	1.17	1.53	1.43
412465	RFF	230	0.512969	0.000007	6.46	0.512994	6.94	1.54	1.40
412466	RFF	231	0.512945	0.000008	5.99	0.512968	6.44	1.47	1.55
412467*	L-SF	232	0.513016	0.000007	7.38	0.513039	7.82	1.41	1.40
412476*	L-SF	240	0.513049	0.000010	8.02	0.513047	7.99	0.70	1.03
412481	L-SF	243	-	-	-	-	-	1.29	1.32
412483	L-SF	245	0.513009	0.000007	7.23	0.513026	7.56	1.12	1.19
412488	L-SF	249	-	-	-	-	-	1.06	1.18
412490*	L-SF	251	0.512835	0.000006	3.84	0.512856	4.26	1.50	1.56
412493*	L-SF	253	-	-	-	-	-	0.92	1.04
435516*	L-SF	258	0.513036	0.000009	7.77	0.513040	7.85	0.76	1.14

Sample	Formation	Flow	$^{144}Nd/^{143}Nd_m$	2se	ε_{Nd-m}	$^{144}Nd/^{143}Nd_S$	ε_{Nd-S}	La/Sm_N	Dy/Yb_N
412412	L-SF	259	0.513027	0.000007	7.58	0.513046	7.96	1.31	1.43
412421*	L-SF	265	0.512726	0.000006	1.72	0.512739	1.97	1.39	1.46
412423*	L-SF	267	0.512981	0.000005	6.68	0.513005	7.16	1.57	1.54
412434	L-SF	272	0.513032	0.000007	7.69	0.513044	7.92	1.06	1.32
412435	L-SF	273	0.513018	0.000007	7.42	0.513035	7.74	1.13	1.26
412449*	L-SF	285	0.512925	0.000008	5.59	0.512941	5.90	1.32	1.48
412455	L-SF	290	0.512992	0.000006	6.90	0.513009	7.24	1.28	1.44
412402*	M-SF	301	0.512729	0.000011	1.78	0.512745	2.08	1.63	1.38
412406*	M-SF	304	-	-	-	-	-	1.63	1.45
412364*	M-SF	315	0.512595	0.000006	-0.84	0.512606	-0.62	1.25	1.34
412392*	U.SF	330	-	-	-	-	-	1.42	1.39

* denotes contaminated samples

N.B. La/Sm_N and Dy/Yb_N data from Tegner et al. (1998)

m denotes measured isotopic ratios, S denotes source age corrected ratios.

A denotes data from Andreasen, R., Peate, D.W., and Brooks, C.K. (2004). Magma plumbing systems in large igneous provinces: Inferences from cyclical variations in Palaeogene East Greenland basalts: Controbutions to Mineralogy and Petrology, v. 147, p 438-452.