GSA DATA REPOSITORY 2015029

SAMPLE LOCALITIES

Don Camilo: S46°59’13.6’’ W69°32’01.8’’

Gobernador Gregores: S48°34’23.5’’ W70°10’55.5’’

Tres Lagos: S49°11’06.5’’ W71°20’23.2’’

Potrok Aike: S51°57’45.6’’ W70°22’24.6’’

Salsa: S51°59’38.3’’ W70°10’06.8’’

El Ruido: S51°59’24.0’’ W70°08’36.0’’

ANALYTICAL METHODS

Samples were chosen from a pool of >200 fertile lherzolites, depleted lherzolites and harzburgites according to the following criteria:

- Fresh, unweathered mantle xenoliths.
- Representative sample size (7 to 15 cm in diameter) to obtain reasonable whole rock data as well as to provide enough material for mineral separation.
- Polished thin sections were made for all available samples and analyzed by EPMA in order to characterize them.
- Samples were studied under the microscope as well as with microprobe and modally metasomatized samples were excluded (samples containing hydrous phases).
- LA-ICP-MS results of clinopyroxene (cpx), as well as bulk rock major and trace element compositions were determined and samples showing the least cryptic metasomatic overprint were selected.
- Out of the remaining samples, the most depleted ones were chosen (leading to the assumption that most of Re was extracted) in order to minimize continuing ^{187}Os production from ^{187}Re decay after the initial melting event. The degree of depletion was inferred from modal compositions and from bulk rock and mineral compositions (i.e. bulk rock Al_2O_3 contents, bulk rock and olivine Mg#).

Host basalt rims were completely removed from mantle xenoliths and the inner parts of the samples were then crushed and processed to rock powders in an agate mill.

Bulk rock major and some trace elements were analyzed with the sequential X-ray spectrometer Phillips PW 2400, equipped with a Rh-excitation source at the University of Vienna, Department of Lithospheric Research. Fused disks for major element analyses were produced at 950°C from a mixture of specimen and $Li_2B_4O_7$ flux, diluted 1:5 to gain accurate and precise results. Trace elements were analyzed on pressed pellets. Replicate analyses of geo-standard GSR-3 gave an overall procedural uncertainty better than 2% for major elements and 5% (Cu = 8.5%) for trace elements.

~100 mg of whole rock powder per sample were dissolved in a mixture of HNO_3 and HF and trace elements were analyzed as solutions on an ICP-MS system (Agilent 7500) at the Central Lab for Water, Minerals and Rocks, NAWI Graz, Karl-Franzens-University of Graz and Graz University of Technology. (See Repository Data, Table 2 for element list)

Bulk rock osmium isotopes and Re-Os concentrations were obtained at the Academy of Sciences of the Czech Republic (chemistry and ICP-MS) and at the Czech Geological Survey in Prague (N-TIMS). The samples were dissolved and equilibrated with a mixed ^{185}Re-^{190}Os spike using Carius Tube technique (Shirey and Walker, 1995), followed by Os separation through solvent extraction by CCl_4 (Cohen and Waters, 1996) and Os microdistillation (Birck et al., 1997). Rhenium was separated using anion exchange chromatography and then analyzed on sector field ICP-MS *Element 2* (Thermo) coupled with an Aridus II^{TM} (CETAC) desolvating nebulizer. The Os isotopic compositions were determined by N-TIMS technique (Creaser et al., 1991; Völkening et al., 1991) on Finnigan MAT 262 thermal ionization spectrometer. Rhenium depletions ages (T_{RD}) were calculated using primitive upper mantle values from Meisel et al. (2001): $^{187}Re/^{188}Os = 0.4353$ and $^{187}Os/^{188}Os = 0.1296$; $\lambda^{187}Re = 1.666*10^{-11}$ from Smoliar et al. (1996). Rhenium measurements were corrected for isotopic fractionation using a linear law and standard Re (NIST 3143) solutions. In-run precision of measured isotopic ratios was always better than ±0.4% (2σ). After analysis, raw Os isotopic ratios were corrected offline for oxygen isobaric interferences, spike contribution, instrumental mass fractionation using $^{192}Os/^{188}Os$ = 3.08271 (Shirey and Walker, 1998) and blank contribution. Total procedural blanks were 2.3 ±1.7 pg and 0.5 ±0.1 pg for Re and Os, respectively.

For Hf-Nd-Sr analyses, ~100 mg of cpx per sample was separated at the University of Vienna, Department of Lithospheric Sciences. Spongy rims and inclusions were completely removed. The separates were then leached in hot 6N HCl overnight and dissolved in 4 ml of mixture conc. HF:HNO_3 (1:3) for 3 days before being dried down.

The Hf isotope ratios were determined at the Center for Elemental Mass, University of South Carolina on a NEPTUNE MC-ICP-MS, with the Plus option installed (Bizimis et al., 2013). Hf was separated from the matrix on the Ln resin (Eichrom, USA), following Munker et al., 2001. Sample introduction was through a 100µl Teflon nebulizer coupled to an APEX system (ESI, USA). The measured ratios were corrected for mass fractionation using $^{179}Hf/^{177}Hf$ = 0.7325. The JMC-475 standard was determined with $^{176}Hf/^{177}Hf$ = 0.282134 ± 5 (n=13, ~35ng Hf runs). All data are reported relative to the accepted JMC value of $^{176}Hf/^{177}Hf$ = 0.282160. Hf blanks are typically <50 pg.

Sr and Nd isotopic compositions were obtained at the University of Vienna, Department of Lithospheric Research. About 50 mg of separated cpx fractions were dissolved using the same protocol as for Hf. Element extraction (Sr, REE) was performed using AG 50W-X8 (200-400 mesh, Bio-Rad) resin and 2.5 N and 4.0 N HCl as eluents. Nd was separated from the REE group using teflon-coated HdEHP and 0.24 N HCl as eluent. Maximum total procedural blanks were < 1 ng for Sr and 50 pg for Nd, and were taken as negligible. The pure element fractions were evaporated using a Re double filament assembly and run in static mode on a Thermo-Finnigan Triton TIMS machine. A mean $^{87}Sr/^{86}Sr$ ratio of 0.710284 ± 0.000003 (n=2) was determined for NBS987 (Sr) and a mean $^{143}Nd/^{144}Nd$ ratio of 0.511851 ± 0.000004 (n = 2) for La Jolla (Nd) international standards during the period of investigation. Within-run mass fractionation was corrected using $^{88}Sr/^{86}Sr$ = 8.3752, and $^{146}Nd/^{144}Nd$ = 0.7219, respectively.

Cpx trace elements were analyzed with a LA-ICP-MS system (Laser ablation unit: ESI NWR 193; ICP-MS: Agilent 7500) at the Central Lab for Water, Minerals and Rocks, NAWI Graz, Karl-Franzens-University of Graz and Graz University of Technology. The material was ablated by using a 193 nm laser pulsed at 10 Hz, 50 to 75 µm spot size with an energy of ~7 J/cm2. Helium was used as carrier gas at ~0.7 l/min flow and data were acquired in time resolved mode. For each analysis a 30 second gas blank was obtained for background correction. A laser warmup for 30 seconds was done prior to ablation, then it was active for 60 seconds followed by 60 seconds washout time. The standard glasses NIST610 or NIST612 were routinely analyzed for standardization and drift correction while standards NIST614 and BCR-2 were analyzed as unknowns to monitor the accuracy of the measurements. Both standards could be reproduced within ±10% of the certified values. Silicon or calcium was used as internal standard.

Table 1
Isotopic analyses

Sample	rock type[†]	Ol	Opx	Cpx	Sp	Al_2O_3[§] [wt%]	Fo[††]	Cr#[§§]	Re [ppb]	Os [ppb]	Ir [ppb]	Ru [ppb]	Pt [ppb]	Pd [ppb]
Pali Aike														
SA 02	L	64.7	23.7	9.4	2.3	2.51	90.3	25.7	0.015	1.24	2.20	4.36	6.35	2.29
SA 03	H	78.6	19.9	1.2	0.4	0.79	91.6	56.1	0.002	0.87	0.98	2.40	2.16	0.68
SA 11	H	70.5	25.6	2.9	1.0	1.47	92.0	33.2	0.010	3.28	3.12	5.98	3.46	0.66
ELRU 01	H	78.8	18.5	2.3	0.4	1.09	91.5	35.9	0.022	1.68	3.24	5.38	6.28	1.67
ELRU 03	L	68.1	21.1	9.1	1.7	2.23	90.6	16.0	0.014	1.44	2.62	5.72	4.35	2.91
ELRU 04	H	80.6	17.2	2.1	0.1	0.63	91.1	54.4	0.005	3.31	3.35	8.85	8.51	1.03
ELRU 15	H	70.0	27.1	2.0	0.9	1.31	92.1	34.0	0.011	0.71	1.41	3.52	2.20	0.80
ELRU 16	H	71.2	25.5	2.5	0.8	1.08	90.6	54.4	0.004	1.57	2.34	3.31	7.65	0.44
ELRU 19	H	86.5	11.0	1.4	1.1	0.92	92.2	26.4	0.016	1.92	3.17	6.06	3.69	1.28
ELRU 19[##]	H								n.d.	n.d.	2.89	5.68	3.51	1.18
POKA 42	L	67.3	22.5	9.1	1.1	2.14	90.4	20.2	0.050	1.77	2.64	5.24	4.06	2.79
POKA 48	L	64.8	27.1	6.2	1.9	2.26	91.1	15.7	0.031	1.63	1.64	4.74	2.89	1.70
POKA 50	H	75.8	19.0	4.1	1.0	1.34	91.2	33.3	0.034	0.50	1.31	5.26	3.42	1.72
POKA 51	H	75.2	19.9	3.8	1.1	1.35	91.1	25.7	0.037	1.81	2.06	5.93	4.06	2.20
Tres Lagos														
TL 141	H	75.3	19.3	4.7	0.7	1.35	90.8	29.1	0.010	1.28	1.68	3.16	2.85	0.58
TL 142	H	65.8	29.3	3.8	1.1	1.41	90.5	30.0	0.015	0.54	2.41	2.39	2.05	0.37
TL 143	H	73.9	20.8	4.7	0.6	1.40	90.9	21.7	0.006	1.40	n.d.	n.d.	n.d.	n.d.
TL 143[##]	H								0.014	1.83	1.97	2.94	6.01	0.88
TL 145	H	70.4	25.2	3.3	1.1	1.49	90.6	22.4	0.043	1.28	1.91	3.30	3.14	1.15
Gobernador Gregores														
DUB 170	L	61.6	24.5	12.3	1.6	2.67	90.3	13.1	0.054	1.08	2.12	4.26	4.66	3.20
DUB 300	L	69.4	24.1	5.7	0.8	1.38	90.9	30.9	0.005	1.28	2.61	4.81	4.90	2.30
DUB 312	L	74.8	17.6	6.7	0.9	1.39	91.1	33.5	0.019	1.00	2.57	5.43	3.14	1.43
DUB 317	L	63.1	26.8	8.7	1.3	2.34	90.8	16.6	0.047	1.67	3.05	5.97	5.16	3.54
Don Camilo														
DC 08	L	58.9	23.9	15.4	1.8	2.74	90.4	14.9	0.054	1.62	2.73	5.42	4.45	2.90
DC 09	L	64.3	26.3	7.6	1.8	2.04	90.6	16.7	0.105	1.69	2.26	5.66	5.65	3.20
DC 18	L	63.8	27.3	7.3	1.5	1.96	90.7	19.4	0.085	1.51	2.14	5.98	5.03	3.28

[†]rock type: L, lherzolite, H, harzburgite; Ol, olivine, Opx, orthopyroxene, Cpx, clinopyroxene, Sp, spinel. [**]Re-Os Model ages (T_{MA} and T_{RD}) were calculated using primitive upper mantle values from Meisel et al. (2001): $^{187}Re/^{188}Os$ = 0.4353 and $^{187}Os/^{188}Os$ = 0.1296, $\lambda^{187}Re = 1.666*10^{-11}$ from Smoliar et al. (1996); $^{187}Os/^{188}Os_{(m)}$ = measured value, $^{187}Os/^{188}Os_{(EA)}$ = calculated value at time of eruption (4 Ma); $^{187}Re/^{188}Os$ determined using Re and Os concentrations; $T_{RD(EA)}$ = Rhenium depletion age at time of eruption assuming Re = 0; $^{176}Lu/^{177}Hf$ and $^{147}Sm/^{144}Nd$ determined using Lu and Hf and Sm and Nd concentrations in Cpx from LA-ICP-MS analyses; εHf and εNd calculated with reference to CHUR values $^{176}Hf^{177}Hf$ = 0.282785 and $^{143}Nd/^{144}Nd$ = 0.512638 (Bouvier et al., 2008); [§]whole rock composition determined by XRF, [††]Olivine forsterite content (Fo = $Mg/(Mg + Fe^{2+})*100$), [§§]Cr number in spinel (Cr# = Cr/(Cr + Al)*100), [##]duplicate TIMS analyses of sample.

Table 1 cont.

Sample	$^{187}Re/^{188}Os$	$^{187}Os/^{188}Os_{(m)}$	$^{187}Os/^{188}Os_{(EA)}$	$2\sigma*10^{-6}$	γOs	T_{MA} [Ga]**	$T_{RD(EA)}$ [Ga]**
Pali Aike							
SA 02	0.057	0.12344	0.12344	6	-4.8	1.0	0.8
SA 03	0.011	0.12661	0.12661	12	-2.3	0.4	0.4
SA 11	0.014	0.11145	0.11145	12	-14.0	2.5	2.5
ELRU 01	0.063	0.11224	0.11224	4	-13.4	2.7	2.3
ELRU 03	0.046	0.12189	0.12189	10	-6.0	1.2	1.1
ELRU 04	0.007	0.12023	0.12023	6	-7.2	1.3	1.3
ELRU 15	0.075	0.12358	0.12358	6	-4.7	1.0	0.8
ELRU 16	0.012	0.12089	0.12089	6	-6.7	1.2	1.2
ELRU 19	0.040	0.11203	0.11203	6	-13.6	n.d	n.d.
ELRU 19 *)	n.d.	n.d.	n.d.		n.d.	2.6	2.4
POKA 42	0.135	0.12171	0.12170	8	-6.1	1.6	1.1
POKA 48	0.091	0.12487	0.12487	18	-3.7	0.8	0.6
POKA 50	0.327	0.11887	0.11885	10	-8.3	5.7	1.5
POKA 51	0.098	0.11673	0.11672	4	-9.9	2.3	1.7
Tres Lagos							
TL 141	0.039	0.11599	0.11599	10	-10.5	2.0	1.8
TL 142	0.134	0.12505	0.12504	16	-3.5	0.9	0.6
TL 143	0.022	0.12018	0.12018	16	-7.3	1.4	1.3
TL 143 *)	0.037	0.12014	0.12014	6	-7.3	1.4	1.3
TL 145	0.162	0.11734	0.11733	8	-9.5	2.6	1.7
Gobernador Gregores							
DUB 170	0.241	0.12632	0.12631	10	-2.5	1.0	0.5
DUB 300	0.021	0.12002	0.12002	4	-7.4	1.4	1.3
DUB 312	0.091	0.12163	0.12162	6	-6.2	1.4	1.1
DUB 317	0.136	0.12112	0.12111	10	-6.6	1.7	1.2
Don Camilo							
DC 08	0.160	0.13268	0.13267	4	2.4	-0.7	-0.4
DC 09	0.299	0.12272	0.12270	10	-5.3	3.0	0.9
DC 18	0.271	0.12297	0.12295	6	-5.1	2.4	0.9

Table 1 cont.

Sample	$^{176}Lu/^{177}Hf$	$^{176}Hf/^{177}Hf$	$2\sigma*10^{-6}$	εHf	$^{87}Sr/^{86}Sr$	$2\sigma*10^{-6}$	$^{143}Nd/^{144}Nd$	$2\sigma*10^{-6}$	εNd
Pali Aike									
SA 02	0.0214	0.283128	4	12.14	0.703493	6	0.512965	4	6.38
SA 03	0.0224	0.282999	5	7.58	0.703275	7	0.512911	4	5.33
SA 11	0.0131	0.282566	5	-7.74	0.704442	8	0.512551	4	-1.69
ELRU 01	0.0101	0.282970	16	6.55	0.703900	8	0.512848	4	4.10
ELRU 03	0.0462	0.283436	3	23.01	0.702820	7	0.513181	4	10.59
ELRU 04	0.0057	0.282301	5	-17.10	0.707693	6	0.512088	4	-10.72
ELRU 15	0.0220	0.282788	3	0.10	0.704339	6	0.512556	3	-1.61
ELRU 16	0.0106	0.283136	5	12.40	0.703699	7	0.512853	4	4.20
ELRU 19	0.0265	0.282926	4	5.00	0.703986	7	0.512735	5	1.89
ELRU 19 *)	n.d.	n.d.		n.d.	n.d.		n.d.		n.d.
POKA 42	0.0273	0.283257	4	16.70	0.702931	6	0.513135	4	9.69
POKA 48	0.0136	0.283070	5	10.09	0.703432	7	0.512938	4	5.84
POKA 50	0.0137	0.283154	4	13.06	0.703285	7	0.512896	5	5.03
POKA 51	0.0135	0.283175	4	13.80	0.703314	6	0.512915	4	5.41
Tres Lagos									
TL 141	0.0470	0.284256	3	52.02	0.702246	4	0.513181	4	10.60
TL 142	0.0600	0.283694	4	32.16	0.703041	5	0.513056	5	8.15
TL 143	0.0309	0.283216	4	15.23	0.702966	4	0.512808	4	3.32
TL 143 *)	n.d.	n.d.		n.d.	n.d.		n.d.		n.d.
TL 145	0.0723	0.283381	5	21.09	0.703204	4	0.513211	4	11.17
Gobernador Gregores									
DUB 170	n.d.	n.d.		n.d.	n.d.		n.d.		n.d.
DUB 300	0.0361	0.283644	4	30.37	0.703318	4	0.512668	4	0.59
DUB 312	0.0181	0.282948	4	5.78	0.704258	3	0.512675	4	0.72
DUB 317	0.0382	0.283522	4	26.07	0.702617	4	0.513122	4	9.45
Don Camilo									
DC 08	0.0393	0.283109	4	11.45	0.704045	2	0.512826	4	3.66
DC 09	0.0447	0.283578	4	28.04	0.702777	4	0.513279	4	12.50
DC 18	0.0876	0.283958	4	41.48	0.705876	2	0.512232	4	-7.92

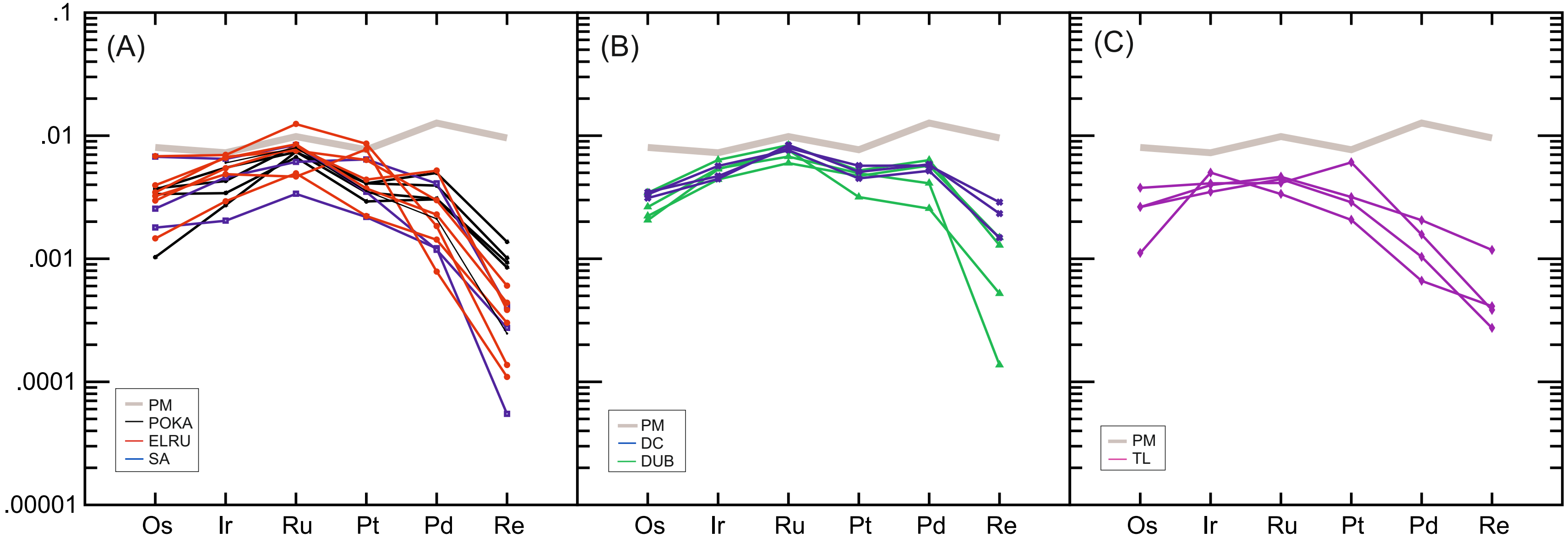

Fig.1: PGE abundances of Pali Aike (A), Deseado Massif (B) and Tres Lagos (C) sample suits, normalized to CI chondrite after Anders and Grevesse (1989), compared to PM values from Becker et al. (2006)

Table 2

Bulk rock analyzes, major elements from XRF (wt.%), trace elements from XRF (ppm) and *ICP-MS* (ppm)

	SA 02	SA 03	SA 11	ELRU 01	ELRU 03	ELRU 04	ELRU 15	ELRU 16	ELRU 19	POKA 42	POKA 48	POKA 50
SiO2	45.31	44.84	45.06	44.36	44.17	44.34	45.04	44.82	42.50	44.70	45.01	43.86
TiO2	0.14	0.05	0.08	0.07	0.08	0.06	0.10	0.05	0.04	0.10	0.10	0.05
Al2O3	2.51	0.79	1.47	1.09	2.23	0.63	1.31	1.08	0.92	2.14	2.26	1.34
FeO	7.70	7.41	6.93	7.56	7.88	8.00	7.26	7.85	7.38	8.06	8.46	7.67
MnO	0.12	0.12	0.11	0.12	0.13	0.12	0.11	0.13	0.11	0.13	0.12	0.12
MgO	42.27	47.05	44.81	47.02	42.09	47.39	44.96	44.54	47.78	42.61	42.35	45.08
CaO	2.17	0.53	0.83	0.66	2.09	0.65	0.66	0.86	0.42	2.05	1.47	1.02
Na2O	0.26	0.00	0.06	0.01	0.51	0.00	0.01	-0.01	-0.07	0.12	0.06	0.03
K2O	0.09	0.02	0.04	0.04	0.01	0.03	0.02	0.03	0.00	0.02	0.02	0.02
P2O5	0.04	0.01	0.02	0.02	0.03	0.03	0.01	0.02	0.01	0.02	0.01	0.02
Total	100.61	100.83	100.09	100.93	99.88	101.24	100.13	100.11	99.77	100.59	100.49	99.86
Mg#	0.91	0.92	0.92	0.92	0.90	0.91	0.92	0.91	0.92	0.90	0.90	0.91
Cr#	0.10	0.22	0.15	0.16	0.10	0.18	0.15	0.20	0.19	0.10	0.09	0.14
LOI%	-0.38	0.24	-0.30	-0.38	-0.41	-0.43	-0.34	-0.38	-0.40	-0.36	-0.44	-0.42
Zr	*16.41*	*3.63*	*5.79*	*6.22*	*5.04*	*5.04*	*4.31*	*4.05*	*0.76*	*9.52*	*4.19*	*8.21*
Sr	*39.81*	*6.58*	*20.19*	*12.47*	*19.45*	*18.62*	*6.57*	*17.29*	*n.a.*	*8.98*	*4.06*	*5.66*
Rb	*1.18*	*0.21*	*0.56*	*0.42*	*0.24*	*0.40*	*0.14*	*0.38*	*0.02*	*0.05*	*0.29*	*0.07*
Ga	2.40	0.50	1.10	1.00	1.70	0.20	1.40	1.00	1.00	1.80	2.40	1.10
Zn	55	49	44	47	49	45	48	48	43	52	66	50
Ni	2142	2403	2222	2431	2152	2477	2236	2277	2523	2178	2147	2310
Co	110	114	109	116	112	121	112	114	119	113	116	115
Cr	2828	2232	2492	2052	2532	1371	2242	2573	2082	2343	2099	2207
Sc	9.5	6.0	5.4	4.0	10.3	5.9	5.3	6.9	4.5	8.3	7.7	7.2
V	48.4	19.8	27.3	22.5	46.0	17.2	24.0	33.6	18.9	45.3	45.6	28.0
Y	*2.04*	*0.26*	*0.85*	*0.66*	*1.96*	*0.46*	*0.41*	*0.39*	*0.28*	*0.88*	*0.74*	*0.70*
Nb	*3.76*	*0.69*	*1.76*	*1.31*	*0.94*	*1.45*	*4.17*	*1.30*	*0.16*	*0.79*	*0.26*	*1.04*
Mo	*0.43*	*0.29*	*0.36*	*0.31*	*0.40*	*0.32*	*0.26*	*0.31*	*0.27*	*0.26*	*0.26*	*0.27*
Ba	*28.66*	*8.79*	*15.28*	*22.80*	*6.07*	*8.20*	*3.83*	*8.50*	*7.09*	*8.80*	*3.44*	*4.98*
La	*1.80*	*0.45*	*1.05*	*0.86*	*1.29*	*1.23*	*0.40*	*1.28*	*0.14*	*0.50*	*0.24*	*0.23*
Ce	*3.67*	*0.93*	*2.04*	*1.59*	*2.56*	*2.52*	*0.88*	*2.29*	*0.28*	*1.17*	*0.58*	*0.66*
Pr	*0.45*	*0.14*	*0.26*	*0.22*	*0.32*	*0.34*	*0.14*	*0.27*	*0.07*	*0.20*	*0.12*	*0.15*
Nd	*1.90*	*0.60*	*1.10*	*0.91*	*1.38*	*1.44*	*0.58*	*1.09*	*0.29*	*0.96*	*0.59*	*0.78*
Sm	*0.43*	*0.13*	*0.25*	*0.20*	*0.32*	*0.27*	*0.14*	*0.20*	*0.08*	*0.26*	*0.17*	*0.23*
Eu	*0.14*	*0.04*	*0.08*	*0.07*	*0.10*	*0.07*	*0.04*	*0.06*	*0.03*	*0.08*	*0.06*	*0.07*
Gd	*0.46*	*0.14*	*0.23*	*0.20*	*0.36*	*0.23*	*0.14*	*0.20*	*0.08*	*0.26*	*0.19*	*0.23*
Tb	*0.07*	*0.02*	*0.04*	*0.03*	*0.06*	*0.03*	*0.02*	*0.03*	*0.01*	*0.04*	*0.03*	*0.04*
Dy	*0.41*	*0.10*	*0.20*	*0.16*	*0.37*	*0.14*	*0.12*	*0.13*	*0.09*	*0.23*	*0.19*	*0.20*
Ho	*0.08*	*0.02*	*0.04*	*0.03*	*0.08*	*0.03*	*0.02*	*0.02*	*0.02*	*0.04*	*0.04*	*0.04*
Er	*0.23*	*0.05*	*0.10*	*0.09*	*0.23*	*0.07*	*0.07*	*0.06*	*0.06*	*0.11*	*0.10*	*0.09*
Tm	*0.03*	*0.01*	*0.02*	*0.01*	*0.04*	*0.01*	*0.01*	*0.01*	*0.01*	*0.02*	*0.02*	*0.01*
Yb	*0.21*	*0.04*	*0.10*	*0.08*	*0.22*	*0.06*	*0.06*	*0.06*	*0.06*	*0.10*	*0.10*	*0.08*
Lu	*0.03*	*0.00*	*0.01*	*0.01*	*0.03*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Hf	*0.44*	*0.12*	*0.16*	*0.19*	*0.16*	*0.14*	*0.17*	*0.11*	*0.05*	*0.27*	*0.17*	*0.15*
Ta	*0.25*	*0.04*	*0.23*	*0.06*	*0.03*	*0.07*	*0.48*	*0.08*	*0.04*	*0.06*	*0.03*	*0.09*
W	*24.52*	*4.91*	*64.53*	*13.93*	*3.08*	*23.04*	*421.85*	*74.02*	*37.93*	*25.85*	*1.26*	*57.94*
Pb	*0.24*	*0.35*	*0.68*	*0.86*	*0.75*	*0.38*	*0.25*	*0.28*	*0.16*	*0.21*	*0.10*	*0.10*
Th	*0.25*	*0.08*	*0.14*	*0.12*	*0.17*	*0.14*	*0.06*	*0.13*	*0.04*	*0.07*	*0.04*	*0.04*
U	*0.07*	*0.02*	*0.04*	*0.04*	*0.06*	*0.04*	*0.02*	*0.04*	*0.01*	*0.02*	*0.01*	*0.02*

n.a. - not analysed; bdl - blow detection limit

Table 2 cont.

	POKA 51	TL 141	TL 142	TL 143	TL 145	DUB 170	DUB 300	DUB 312	DUB 317	DC 08	DC 09	DC 18
SiO2	43.97	44.44	45.37	44.43	44.71	45.13	45.85	43.88	45.55	45.02	44.65	44.73
TiO2	0.07	0.05	0.05	0.04	0.04	0.09	0.03	0.08	0.08	0.08	0.08	0.04
Al2O3	1.35	1.35	1.41	1.40	1.49	2.67	1.38	1.39	2.34	2.74	2.04	1.96
FeO	8.14	8.05	8.11	7.96	8.18	7.81	7.64	7.85	7.58	7.44	7.99	7.75
MnO	0.12	0.13	0.13	0.12	0.13	0.13	0.12	0.13	0.12	0.12	0.13	0.12
MgO	44.85	45.48	43.71	44.80	44.38	41.27	44.54	44.22	42.00	39.66	41.97	42.16
CaO	0.97	1.17	1.11	1.15	0.88	2.81	1.50	1.48	2.10	3.44	1.76	1.76
Na2O	0.02	0.00	0.00	0.00	0.00	0.04	0.00	0.06	0.05	0.11	0.03	0.01
K2O	0.02	0.00	0.01	0.00	0.00	0.02	0.01	0.01	0.00	0.07	0.01	0.01
P2O5	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.01	0.02	0.03	0.07
Total	100.17	100.69	100.56	100.56	100.43	99.99	101.09	99.87	100.48	99.54	99.57	99.49
Mg#	0.91	0.91	0.91	0.91	0.91	0.90	0.91	0.91	0.91	0.90	0.90	0.91
Cr#	0.14	0.17	0.15	0.14	0.13	0.12	0.14	0.17	0.10	0.08	0.14	14.17
LOI%	-0.45	-0.36	-0.36	-0.40	-0.42	-0.18	-0.08	-0.17	-0.23	0.02	0.91	-0.18
Zr	*8.17*	*1.64*	*3.15*	*2.44*	*1.29*	*4.96*	*1.81*	*4.14*	*2.58*	7	8	7
Sr	*7.32*	*0.98*	*0.16*	*0.14*	*n.a.*	*9.42*	*7.57*	*29.08*	*3.24*	6	19	17
Rb	*0.08*	*bdl*	*0.10*	*bdl*	*bdl*	*0.28*	*0.07*	*0.06*	*bdl*	<2	2	<2
Ga	0.80	1.40	1.20	1.30	1.60	4.8	0.90	1.20	1.80	6.90	<2	3.70
Zn	60	48	45	47	48	71.7	45	51	45	46	54	52
Ni	2326	2185	2160	2311	2177	2583.3	2233	2250	2071	2334	2022	2133
Co	115	116	113	117	114	189.2	112	116	110	125	111	119
Cr	2169	2792	2394	2194	2234	3424.1	2173	2794	2560	2440	3259	3173
Sc	5.9	8.2	8.2	7.0	8.5	11.6	7.6	6.6	8.4	8.4	10.6	10.2
V	27.0	32.3	28.9	26.5	35.7	75.6	31.8	31.5	45.7	58.4	50.4	41.7
Y	*0.68*	*0.57*	*0.60*	*0.49*	*0.45*	*2.08*	*0.29*	*1.05*	*1.55*	*1.45*	*2.02*	*1.06*
Nb	*0.61*	*0.02*	*0.27*	*0.02*	*0.11*	*1.90*	*0.25*	*0.54*	*0.17*	3	3	2
Mo	*0.26*	*0.26*	*0.27*	*0.26*	*0.28*	*0.26*	*0.28*	*0.32*	*0.25*	*n.a.*	*n.a.*	*n.a.*
Ba	*2.20*	*b. dl*	*2.31*	*0.49*	*5.20*	*4.86*	*0.73*	*4.20*	*10.80*	38	2	14
La	*0.34*	*0.08*	*0.18*	*0.04*	*0.16*	*0.61*	*0.38*	*1.42*	*0.07*	*0.29*	*0.39*	*0.24*
Ce	*0.82*	*0.19*	*0.38*	*0.17*	*0.26*	*1.36*	*0.56*	*3.36*	*0.30*	*0.67*	*0.87*	*0.56*
Pr	*0.15*	*0.06*	*0.08*	*0.06*	*0.06*	*0.20*	*0.09*	*0.40*	*0.08*	*0.09*	*0.12*	*0.07*
Nd	*0.69*	*0.31*	*0.34*	*0.34*	*0.26*	*0.92*	*0.39*	*1.62*	*0.45*	*0.53*	*0.69*	*0.42*
Sm	*0.19*	*0.09*	*0.09*	*0.10*	*0.06*	*0.26*	*0.08*	*0.29*	*0.16*	*0.15*	*0.21*	*0.10*
Eu	*0.06*	*0.03*	*0.03*	*0.03*	*0.02*	*0.09*	*0.03*	*0.09*	*0.06*	*0.06*	*0.08*	*0.04*
Gd	*0.20*	*0.11*	*0.11*	*0.11*	*0.08*	*0.31*	*0.10*	*0.29*	*0.20*	*0.22*	*0.30*	*0.14*
Tb	*0.03*	*0.02*	*0.02*	*0.02*	*0.02*	*0.06*	*0.01*	*0.04*	*0.04*	*0.04*	*0.05*	*0.02*
Dy	*0.18*	*0.12*	*0.12*	*0.12*	*0.10*	*0.40*	*0.08*	*0.23*	*0.28*	*0.26*	*0.37*	*0.17*
Ho	*0.03*	*0.03*	*0.03*	*0.03*	*0.02*	*0.09*	*0.02*	*0.04*	*0.06*	*0.06*	*0.08*	*0.04*
Er	*0.09*	*0.09*	*0.09*	*0.08*	*0.08*	*0.26*	*0.06*	*0.13*	*0.19*	*0.19*	*0.26*	*0.15*
Tm	*0.01*	*0.01*	*0.02*	*0.01*	*0.01*	*0.04*	*0.01*	*0.02*	*0.03*	*0.03*	*0.04*	*0.02*
Yb	*0.09*	*0.10*	*0.11*	*0.09*	*0.10*	*0.26*	*0.07*	*0.11*	*0.20*	*0.22*	*0.29*	*0.18*
Lu	*0.01*	*0.02*	*0.02*	*0.01*	*0.02*	*0.04*	*0.01*	*0.02*	*0.03*	*0.04*	*0.05*	*0.03*
Hf	*0.21*	*0.07*	*0.09*	*0.10*	*0.06*	*0.42*	*0.07*	*0.13*	*0.11*	*n.a.*	*n.a.*	*n.a.*
Ta	*0.04*	*0.00*	*0.06*	*0.05*	*0.10*	*0.57*	*0.02*	*0.03*	*0.41*	*n.a.*	*n.a.*	*n.a.*
W	*65.45*	*14.06*	*0.91*	*0.97*	*5.51*	*9.90*	*53.78*	*72.56*	*618.10*	*n.a.*	*n.a.*	*n.a.*
Pb	*0.08*	*0.83*	*0.58*	*0.14*	*0.57*	*0.77*	*0.29*	*0.61*	*0.42*	*n.a.*	*n.a.*	*n.a.*
Th	*0.05*	*0.04*	*0.08*	*0.03*	*0.05*	*0.13*	*0.09*	*0.09*	*0.03*	*0.04*	*0.07*	*0.07*
U	*0.01*	*0.01*	*0.02*	*0.01*	*0.02*	*0.05*	*0.04*	*0.05*	*0.02*	*n.a.*	*n.a.*	*n.a.*

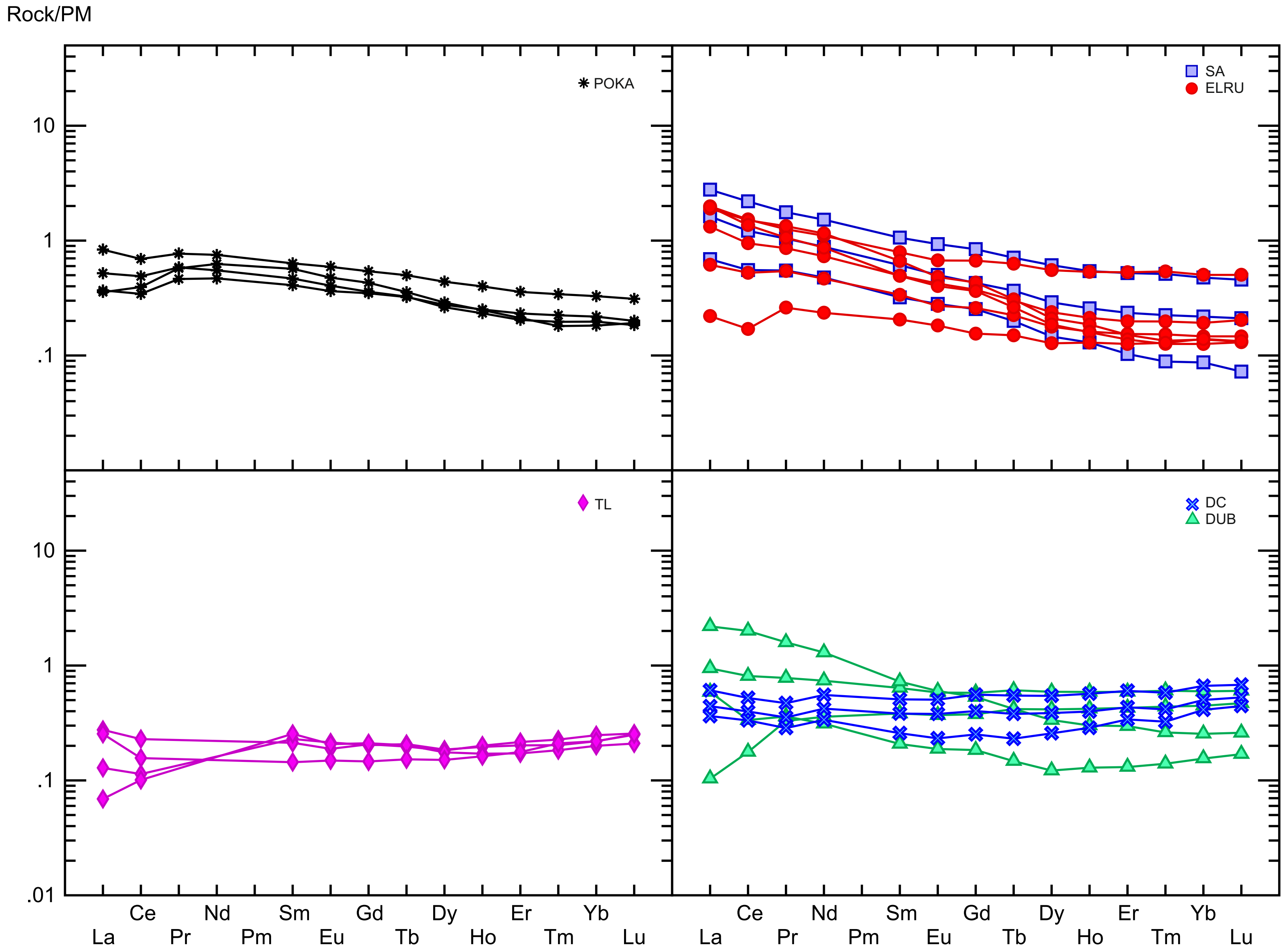

Fig.2: Bulk rock rare earth element patterns normalized to primitive mantle (PM) values from McDonough and Sun, 1995. Legend: POKA, Potrok Aike; SA, Salsa; ELRU, El Ruido; TL, Tres Lagos; DC, Don Camilo; DUB, Gobernador Gregores

Table 3

Clinopyroxene major element microprobe analyzes (wt.%) and LA-ICP-MS trace elements (ppm)

	SA 02	SA 03	SA 11	ELRU 01	ELRU 03	ELRU 04	ELRU 15	ELRU 16	ELRU 19
SiO2	52.26	53.43	53.28	52.98	52.35	53.52	52.84	53.30	52.14
TiO2	0.52	0.49	0.18	0.21	0.42	0.12	0.16	0.04	0.43
Al2O3	5.41	2.62	4.81	4.33	6.11	2.25	4.60	2.71	4.25
Cr2O3	1.12	1.62	1.48	1.39	1.11	0.89	1.39	1.04	1.09
FeO†	2.78	2.80	2.29	2.43	2.16	2.41	2.31	2.55	1.77
MnO	0.09	0.09	0.08	0.09	0.08	0.09	0.09	0.09	0.05
MgO	15.65	17.93	16.18	16.38	14.87	17.74	16.37	17.27	15.76
CaO	20.55	20.14	20.30	20.72	21.32	22.39	20.39	21.91	23.62
NiO	0.05	0.06	n.a.	0.05	0.04	0.07	0.06	0.05	0.03
Na2O	1.56	0.94	1.51	1.32	1.65	0.56	1.55	0.70	0.89
Total	99.99	100.11	100.12	99.90	100.10	100.04	99.76	99.67	100.06
Mg#*100	90.95	91.95	92.65	92.31	92.48	92.91	92.67	92.36	94.07
En	48.86	52.69	50.40	50.12	47.29	50.35	50.57	50.06	46.68
Fs	5.02	4.77	4.15	4.33	3.99	3.99	4.16	4.28	3.03
Wo	46.12	42.55	45.45	45.55	48.72	45.67	45.27	45.66	50.29
Cr	7325	9347	9020	8861	7896	4986	8776	6808	8856
Co	20.5	23.5	20.4	22.7	20.3	24.8	21.6	23.9	18.9
Ni	372	402	384	420	331	441	400	430	325
Zn	10.3	11.6	8.7	10.0	15.9	10.5	9.4	10.1	10.0
Cu	1.51	1.46	1.73	2.00	1.18	2.33	1.61	1.81	0.57
V	235	155	209	232	254	169	207	197	283
Sr	80.9	45.7	76.2	76.8	55.7	177.3	90.7	124.0	16.4
Y	10.95	1.95	9.59	9.42	15.20	4.20	8.22	2.94	12.61
Zr	67.2	11.0	32.0	65.8	19.2	44.5	24.3	32.7	18.3
La	2.146	0.674	0.815	2.665	1.658	4.508	1.467	7.163	0.485
Ce	7.450	2.740	4.545	6.070	4.078	16.475	6.803	17.885	1.906
Pr	1.195	0.485	0.942	0.897	0.606	3.213	1.245	2.186	0.428
Nd	5.958	2.503	5.498	4.760	3.258	17.653	6.288	8.800	3.555
Sm	1.803	0.679	1.924	1.558	1.321	3.305	1.751	1.649	2.014
Eu	0.681	0.251	0.692	0.583	0.574	0.916	0.627	0.486	0.732
Gd	2.064	0.650	2.201	1.838	2.033	2.045	1.905	1.318	2.545
Tb	0.343	0.086	0.339	0.310	0.392	0.251	0.288	0.156	0.409
Dy	2.246	0.480	2.096	1.916	2.760	1.131	1.697	0.744	2.618
Ho	0.450	0.081	0.401	0.397	0.617	0.189	0.344	0.123	0.523
Er	1.305	0.180	1.081	1.102	1.727	0.422	0.927	0.343	1.450
Tm	0.168	0.020	0.135	0.145	0.251	0.050	0.117	0.042	0.179
Yb	1.112	0.131	0.842	0.886	1.611	0.354	0.707	0.301	1.116
Lu	0.150	0.019	0.109	0.123	0.229	0.053	0.107	0.050	0.157
Hf	1.111	0.128	1.178	1.921	0.701	1.338	0.692	0.668	0.841

†Fe total as FeO; n.a. - not analysed

Table 3 cont.

	POKA 42	POKA 48	POKA 50	POKA 51	TL 141		TL 142		TL 143		TL 145	
					core	rim	core	rim	core	rim	core	rim
SiO2	52.35	52.48	53.10	52.60	52.20	52.50	52.54	52.94	52.51	53.03	52.51	52.96
TiO2	0.38	0.40	0.19	0.27	0.36	0.35	0.26	0.24	0.20	0.19	0.28	0.22
Al2O3	5.78	6.25	4.80	5.17	4.86	4.24	4.52	3.73	4.96	4.01	4.21	3.41
Cr2O3	1.01	0.99	1.29	1.26	1.43	1.28	1.38	1.04	1.34	1.01	0.94	0.80
FeO*	2.83	2.73	2.54	2.55	2.12	2.20	2.14	2.29	2.02	2.10	2.11	2.23
MnO	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.07	0.08	0.07
MgO	15.54	15.48	15.85	15.72	15.44	15.78	15.45	16.08	15.25	15.99	15.95	16.49
CaO	20.40	19.80	20.33	20.35	22.25	22.63	22.30	22.55	22.25	22.56	22.94	23.15
NiO	0.09	n.a.	0.05	0.04	0.04	0.05	0.04	0.05	0.05	0.05	0.03	0.05
Na2O	1.66	1.73	1.74	1.65	1.29	1.07	1.22	0.92	1.39	1.15	0.96	0.76
Total	100.14	99.95	99.97	99.71	100.05	100.18	99.92	99.89	100.01	100.16	100.02	100.16
Mg#*100	90.74	90.99	91.76	91.67	92.86	92.73	92.77	92.62	93.09	93.13	93.08	92.95
En	48.81	49.46	49.63	49.39	47.28	47.35	47.22	47.85	47.05	47.83	47.38	47.91
Fs	5.13	5.05	4.61	4.64	3.76	3.83	3.79	3.92	3.60	3.65	3.65	3.75
Wo	46.05	45.48	45.76	45.97	48.96	48.82	49.00	48.23	49.35	48.52	48.97	48.34
Cr	6475	6194	8014	8012	10107		9499		9192		7941	
Co	22.6	22.6	20.7	21.8	20.1		20.1		20.6		22.4	
Ni	390	382	363	380	313		325		335		347	
Zn	10.9	12.0	10.0	12.0	13.3		13.0		16.6		22.5	
Cu	2.07	1.91	0.97	2.14	3.04		1.19		0.94		1.05	
V	257	278	240	241	280		224		253		275	
Sr	61.1	42.6	86.0	84.9	64.9		20.5		46.4		10.5	
Y	12.49	8.25	9.54	9.46	10.30		10.01		9.02		10.31	
Zr	36.5	46.9	94.2	75.4	16.3		10.4		22.9		7.1	
La	1.791	0.665	1.066	2.272	0.865		0.486		0.543		0.141	
Ce	4.695	2.976	5.835	8.080	3.498		1.707		2.666		0.583	
Pr	0.763	0.619	1.356	1.408	0.698		0.331		0.632		0.132	
Nd	4.290	3.810	8.670	7.793	4.085		1.976		4.325		0.982	
Sm	1.524	1.498	3.038	2.508	1.425		0.759		1.547		0.610	
Eu	0.581	0.551	1.053	0.850	0.530		0.319		0.512		0.264	
Gd	2.140	1.870	2.995	2.558	1.823		1.230		1.680		1.053	
Tb	0.377	0.304	0.435	0.394	0.295		0.240		0.270		0.224	
Dy	2.518	1.857	2.410	2.231	1.952		1.722		1.706		1.803	
Ho	0.519	0.359	0.426	0.396	0.416		0.405		0.352		0.403	
Er	1.501	1.003	1.106	1.085	1.227		1.222		1.045		1.335	
Tm	0.196	0.124	0.129	0.136	0.164		0.177		0.145		0.190	
Yb	1.239	0.764	0.851	0.868	1.166		1.143		0.982		1.241	
Lu	0.176	0.108	0.114	0.112	0.177		0.168		0.143		0.180	
Hf	0.978	1.295	1.327	1.494	0.579		0.394		0.678		0.346	

Table 3 cont.

	DUB 170		DUB 300	DUB 312	DUB 317		DC 08		DC 09		DC 18
	core	rim			core	rim	core	rim	core	rim	
SiO2	51.27	51.50	53.00	52.83	52.19	52.29	51.90	52.30	52.52	52.43	52.92
TiO2	0.46	0.46	0.09	0.41	0.39	0.44	0.49	0.52	0.43	0.40	0.23
Al2O3	5.94	5.08	4.07	5.21	5.35	4.79	5.93	5.33	5.25	5.65	4.24
Cr2O3	0.87	0.71	1.15	1.56	1.11	1.10	0.96	0.89	0.84	1.10	0.82
FeO*	2.15	2.20	2.47	2.18	2.11	2.38	2.35	2.35	2.45	2.40	2.30
MnO	0.09	0.08	0.08	0.09	0.07	0.07	0.08	0.08	0.07	0.07	0.06
MgO	15.06	15.51	16.55	15.04	15.29	16.33	15.25	15.64	16.19	15.41	16.12
CaO	21.45	21.68	21.68	20.32	22.53	21.68	21.67	21.82	20.99	21.23	22.07
NiO	0.02	0.06	0.05	0.04	n.a.	n.a.	0.03	0.04	0.04	0.04	0.05
Na2O	1.79	1.60	1.07	2.05	1.01	0.89	1.30	1.28	1.25	1.43	1.17
Total	99.14	98.91	100.20	99.74	100.03	99.97	99.97	100.26	100.03	100.16	99.99
Mg#*100	92.57	92.61	92.28	92.50	92.82	92.46	92.04	92.22	92.18	91.96	92.59
En	47.44	47.89	49.32	48.64	46.76	49.07	47.38	47.84	49.53	48.08	48.39
Fs	3.99	3.99	4.26	4.12	3.73	4.14	4.24	4.17	4.33	4.32	3.98
Wo	48.57	48.12	46.42	47.24	49.51	46.80	48.38	47.99	46.14	47.60	47.63
Cr	n.a.		7563	9957	7281		n.a.		8422		n.a.
Co	n.a.		22.5	19.1	21.7		n.a.		18.9		n.a.
Ni	n.a.		392	325	350		n.a.		326		n.a.
Zn	n.a.		9.9	8.7	19.4		n.a.		8.0		n.a.
Cu	n.a.		1.64	4.06	1.25		n.a.		1.09		n.a.
V	n.a.		224	260	247		n.a.		260		n.a.
Sr	n.a.		84.5	101.8	40.9		49.6		49.2		52.0
Y	n.a.		4.07	10.47	13.77		16.95		14.38		12.45
Zr	n.a.		11.5	30.1	20.1		20.2		22.0		11.7
La	n.a.		5.730	3.990	0.639		1.162		0.672		1.062
Ce	n.a.		6.610	7.005	2.980		3.354		2.519		3.176
Pr	n.a.		0.679	0.921	0.579		0.663		0.501		0.589
Nd	n.a.		2.795	4.985	3.313		4.190		3.153		3.503
Sm	n.a.		0.628	1.634	1.348		1.608		1.277		1.065
Eu	n.a.		0.250	0.668	0.545		0.648		0.543		0.368
Gd	n.a.		0.647	1.959	1.973		2.233		1.936		1.346
Tb	n.a.		0.116	0.356	0.364		0.416		0.375		0.250
Dy	n.a.		0.750	2.144	2.583		3.006		2.638		2.048
Ho	n.a.		0.160	0.464	0.560		0.671		0.569		0.477
Er	n.a.		0.483	1.148	1.664		1.897		1.661		1.409
Tm	n.a.		0.070	0.156	0.231		0.264		0.237		0.216
Yb	n.a.		0.515	1.024	1.485		1.871		1.560		1.516
Lu	n.a.		0.077	0.139	0.214		0.231		0.212		0.226
Hf	n.a.		0.332	1.064	0.749		0.835		0.673		0.367

Table 4
Sulfide occurrences in analyzed mantle xenoliths

Sample	enclosed	comment	interstitial	comment
Pali Aike				
SA 02	✔	inclusion in ol, trails in ol	✔✔	around spongy cpx, in glass
SA 03	n.f.		✔	intergranular altered
SA 11	✔✔	inclusions in ol, trails in ol	✔	in HB MI
ELRU 01	✔	inclusion in ol	✔	in HB MI
ELRU 03	✔	inclusion in ol	✔✔	in HB MI, in MP
ELRU 04	✔	around ol inclusion in opx	n.f.	
ELRU 15	✔	inclusion in ol	✔	in HB MI
ELRU 16	n.f.		n.f.	
ELRU 19	✔	inclusion in ol	n.f.	
POKA 42	✔✔	inclusions in ol, trails in ol	✔✔	intergranular and in MP
POKA 48	✔✔	inclusions in ol	✔✔	intergranular and with spongy cpx
POKA 50	n.i.		n.i.	
POKA 51	✔	inclusion in ol	✔✔	intergranular and with spongy cpx
Tres Lagos				
TL 141	✔✔	inclusions ol, trails in opx	✔	intergranular, altered
TL 142	✔	inclusions in ol and opx, trails	✔✔	intergranular, altered
TL 143	n.f.		n.f.	
TL 145	✔✔	inclusion in ol, trails in ol	n.f.	
Gobernador Gregores				
DUB 170	n.i.		n.i.	
DUB 300	✔✔	large inclusions in opx, trails	✔	in HB MI
DUB 312	n.i.		n.i.	
DUB 317	✔✔	inclusion in ol, trails in cpx	✔	in HB MI
Don Camilo				
DC 08	✔	inclusion in ol, trails in ol and opx	✔✔✔	intergranular with serpentinized glass
DC 09	n.i.		n.i.	
DC 18	✔✔	inclusion in ol and sp	✔	elongated intergranular, partially altered

✔, rare (≤2 per thin section); ✔✔, common (>2 per thin section); ✔✔✔, very common; n.f., none found; n.i., not investigated;
HB, host basalt; MP, melt pocket; MI, melt infiltration.

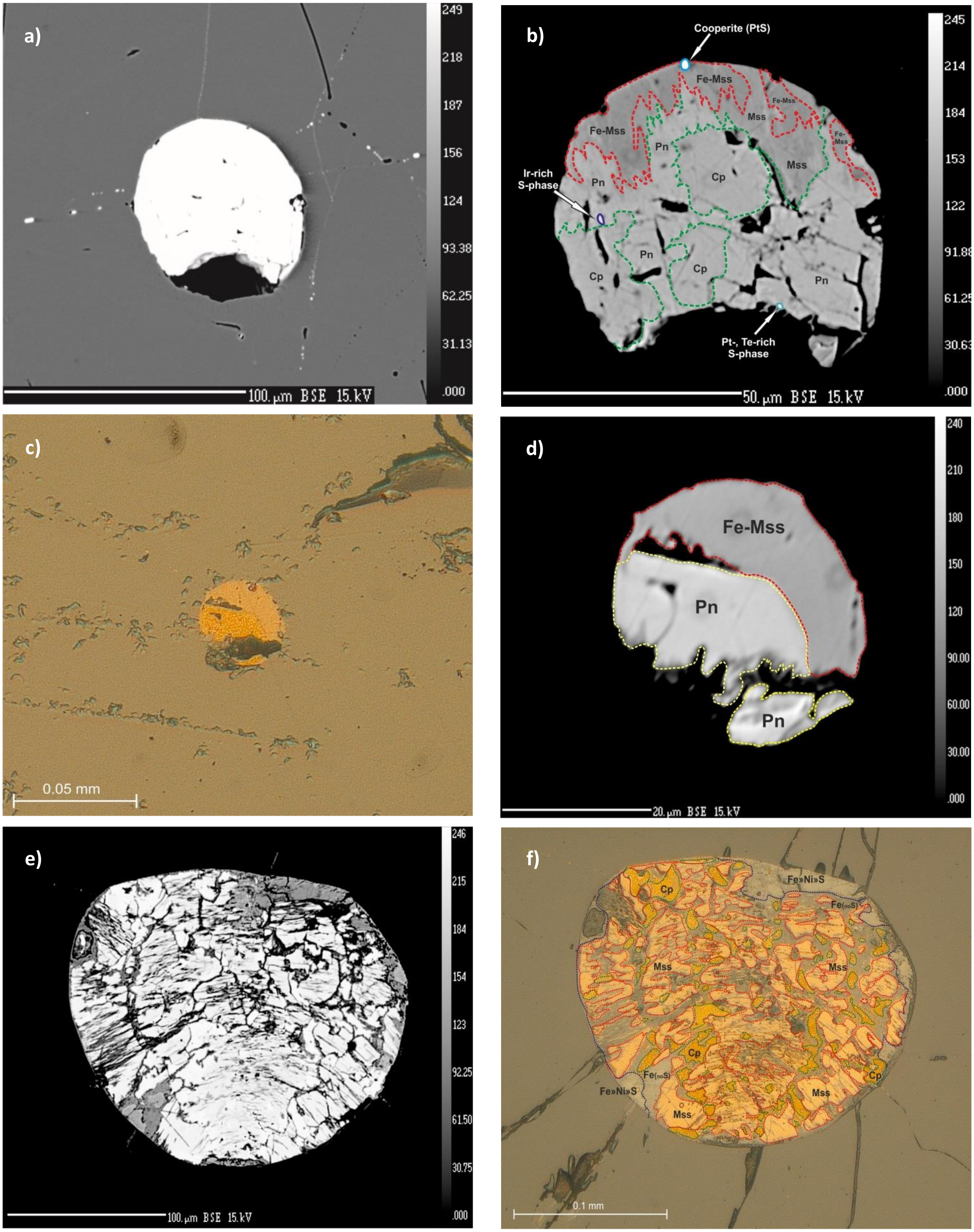

Fig.3: Backscattered-electron images (BSE) and photomicrographs of southern Patagonian mantle xenoliths displaying sulphide occurence and mineralogy. a-f primary sulphides; a) and b) sample SA11, BSE of primary spherical sulphide inclusion and trails in ol. c) photomicrograph in reflected light and d) BSE of 2-phase round sulphide inclusion in Ol of sample TL145. e) and d) sample DUB300: BSE and photomicrograph in reflected light, respectively, of multi-phase round sulphide inclusion in opx. Note sulphide alteration around the edges.

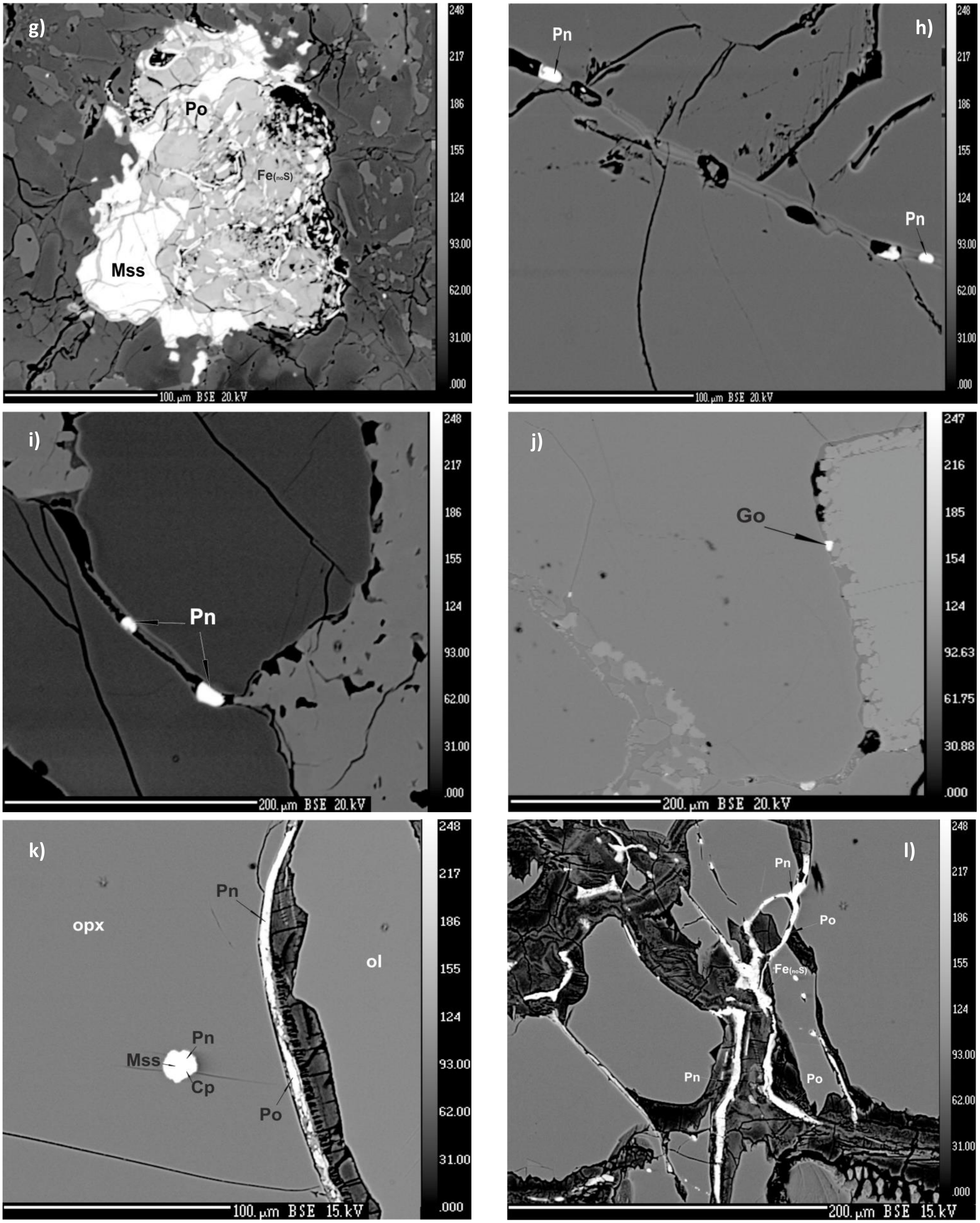

Fig.3. cont.: g-l BSE images of secondary sulphides. g) and h) sample POKA42; g) irregular shaped, strongly altered sulphide in melt pocket. h) secondary sulphides (Pn) in melt infiltration along cracks in ol . i) elongated round intergranular sulfides formed of Pn (POKA48). j) sample SA02: round godlevskite in spongy rim of cpx. k) (primary) 3-phase round sulphide inclusion in opx (left). k) (right) and l) elongated intergranular Pn, Po and alteration product of sulphide together with serpentinized glass in sample DC08. Mss, monosulfide solid solution; Fe-Mss, iron rich Mss; Pn, pentlandite; Cp, chalcopyrite; Po, pyrrhotite; Go, godleveskite.

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