DR 2011189—Appendix 1: Sample description

Lashaine

Lashaine peridotites include refractory chromite-bearing, garnet-free peridotites, garnet harzburgites and more fertile garnet lherzolites, metasomatized dunites and wehrlites. Garnet-free peridotites from Lashaine are highly refractory and thus do not resemble spinel peridotites carried in alkali basalts (Rudnick et al., 1994). In addition, garnet peridotites are similar to cratonic low-temperature peridotites from the Kaapvaal Craton, having forsterite-rich olivine, abundant opx (up to 35%) and low-Ca garnets ranging to subcalcic compositions; these lithologies are consistent with this mantle section representing reworked Archean cratonic lithosphere (Rudnick et al., 1994). Variably evolved Sr and Nd isotopic compositions in peridotites from Lashaine may signify metasomatism at ~2.0 Ga that involved a major parent-daughter fractionation (Cohen et al., 1984). Chemical zoning in cpx and olivine inclusions in garnet with higher forsterite (Fo) contents than olivine in the matrix reveal an Fe enrichment event (Rudnick et al., 1994). Minerals in garnet peridotites give pressure-temperature estimates plotting slightly above the 44 to 45 mW/m^2 model conductive geotherm (Rudnick et al., 1994).

Olmani

Peridotites at Olmani range from refractory harzburgite to mostly cpx-bearing and opx-free dunites and wehrlites. The presence of secondary cpx, monazite, apatite, high-alkali, high-P glasses and CO_2-rich fluid inclusions combined with Fo-rich olivine (Fo_{93-94}) suggests interaction of ultra-refractory lithospheric mantle with calcio-carbonatite melts (Jones et al., 1983; Rudnick et al., 1993). The Sr and Nd isotopic compositions of peridotites from Olmani are homogeneous despite variable parent daughter ratios and coincide with a few primitive east African carbonatites and basalts, suggesting relatively recent interaction with a common fluid ultimately derived from the asthenosphere (Rudnick et al., 1993), whereas most recent rift lavas are more radiogenic. Rare coexisting orthopyroxene and clinopyroxene give calculated temperatures similar to those from Lashaine peridotites, which are consistent with either a similar derivation depth, if equilibrated to the same geotherm, or a shallower equilibration depth and equilibration to a higher geotherm related to East African Rift volcanism (Rudnick et al., 1993).

Labait

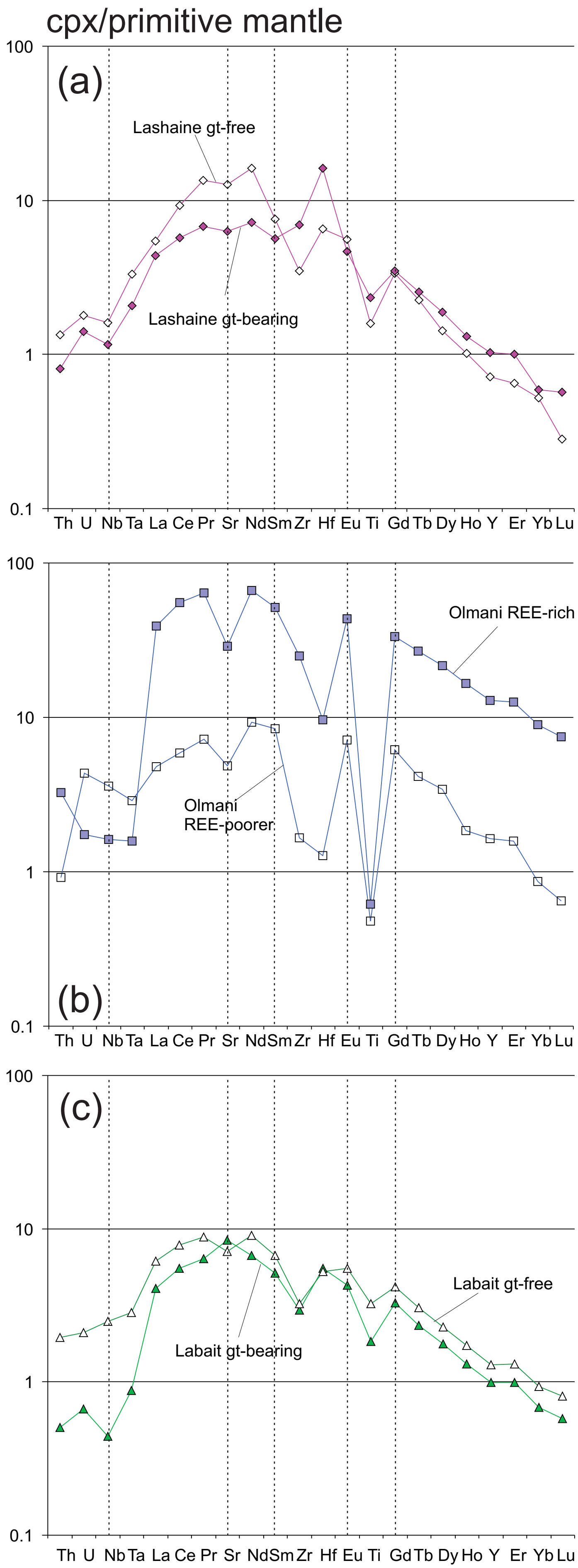
The xenolith suite from Labait, at the margin of the Tanzanian craton, comprises olivine- and Fe-rich peridotites, harzburgites, glimmerites and wehrlites (Dawson, 1999; Lee and Rudnick, 1999). Fe-rich peridotites, garnet harzburgites and garnet lherzolites are relatively fertile and have been overprinted by interaction with recent rift-related melts. They include a sample that is interpreted to have been derived from the lithosphere-asthenosphere boundary and has primitive mantle-like major-element contents and radiogenic Os isotope composition similar to OIBs and precipitates from rift magmas (Lee and Rudnick, 1999; Chesley et al., 1999). By comparison, garnet-free peridotites, which contain low-Al_2O_3 opx typical of garnet-bearing assemblages but do not bear garnet, and spinel peridotites, are highly refractory (Lee and Rudnick, 1999; Chesley et al., 1999). Garnet breakdown coronae, higher Ca contents on orthopyroxene rims and higher Zr content on rutile rims attest to relatively recent heating (Lee and Rudnick, 1999; Watson et al., 2006).

DR 2011189—Appendix 2. Sr and Nd isotopic compositions of standards, mineral separates and whole rocks

Sample		Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$	2se	Sm ppm	Nd ppm	$^{47}Sm/^{144}N$	$^{143}Nd/^{144}Nd$	2se	ε_{Nd}
Standards												
BHVO-1		9.600	388.0	0.0715	0.703430	0.000020	5.87	24.2				
BIR-1			124.0		0.703120	0.000020	1.12	2.37				
DNC-1			148.2		0.708580	0.000020	1.40	4.86				
LASHAINE												
89-661 cpx		0.142	165	0.002	0.713473	0.000018	3.191	13.1	0.147	0.512805	0.000021	3.3
89-661 cpx	r				0.713769	0.000011		10.6		0.512811	0.000011	3.4
89-661 cpx avg					*0.713621*					*0.512808*		*3.3*
2stdev					*0.000419*					*0.000008*		
89-663 cpx		1.606	233	0.020	0.704030	0.000020						
89-663 opx		0.005	5.92	0.002	0.703900	0.000020		0.623		0.512721	0.000021	1.6
89-664 wr		1.80	4.29	1.213	0.705390	0.000020		0.307				
89-664 wr	r		4.01		0.704995	0.000017		0.364		0.512640	0.000140	0.0
89-664 wr avg					*0.705193*			*0.336*				
2stdev					*0.000559*							
89-664 cpx		0.291	87.5	0.010	0.708999	0.000018				0.512766	0.000010	2.5
89-664 cpx	r							7.68		0.512767	0.000021	2.5
89-664 cpx avg										*0.512766*		*2.5*
2stdev										*0.000001*		
89-669 cpx					0.709813	0.000038		14.9		0.512513	0.000011	-2.4
89-669 cpx	d				0.709763	0.000020		14.9		0.512508	0.000016	-2.5
89-669 cpx	r				0.709962	0.000021		14.7		0.512480	0.000019	-3.1
89-669 cpx	d							14.7		0.512439	0.000021	-3.9
89-669 cpx	r							15.2		0.512513	0.000018	-2.4
89-669 avg					*0.709846*			*14.8*		*0.512491*		*-2.9*
2stdev					*0.000207*					*0.000057*		
89-672 cpx					0.704118	0.000020		13.5		0.512392	0.000014	-4.8
89-672 cpx	r				0.704096	0.000015		17.3		0.512367	0.000021	-5.3
89-672 avg					*0.704107*					*0.512380*		*-5.0*
2stdev					*0.000031*					*0.000035*		
89-680 cpx					0.705167	0.000028		14.2		0.512697	0.000017	1.1
89-680 cpx	r				0.705231	0.000041		17.0		0.512655	0.000028	0.3
89-680 cpx*	r				0.705190	0.000020						
89-680 avg					*0.705196*			*15.6*		*0.512676*		*0.7*
2stdev					*0.000065*					*0.000059*		
89-719					0.709636	0.000016						
OLMANI												
89-772 cpx					0.703439	0.000024		17.7		0.512841	0.000014	4.0
89-772 cpx	r				0.703400	0.000020		17.7		0.512822	0.000017	3.6
89-772 cpx	ur									0.512817	0.000016	3.5
89-772 cpx*	r									0.512822	0.000020	3.6
89-772 avg					*0.703420*			*17.7*		*0.512826*		*3.7*
2stdev					*0.000055*					*0.000021*		
89-774 cpx*					0.703470	0.000010		14.0		0.512805	0.000020	3.3
89-776 cpx					0.703435	0.000018		25.2		0.512843	0.000022	4.0
89-776 cpx	d							25.2		0.512788	0.000026	2.9
89-776 avg								*25.2*		*0.512816*		*3.5*
2stdev										*0.000077*		
89-777 cpx					0.703501	0.000020		55.0		0.512840	0.000017	3.9
89-777 cpx	ur				0.703468	0.000017				0.512806	0.000016	3.3
89-777 cpx*	r							59.0		0.512798	0.000010	3.1
89-777 avg					*0.703485*			*57.0*		*0.512814*		*3.4*
2stdev					*0.000047*					*0.000044*		
89-778 cpx*					0.703875	0.000016		5.0		0.512811	0.000014	3.4
89-780 cpx					0.703476	0.000015		36.3		0.512818	0.000015	3.5

d = duplicate r = replicate, ur = unspiked replicate

*From Rudnick et al., 1993.



2011189 - Appendix 3
Trace-element patterns of clinopyroxenes from Lashaine, Olmani and Labait (including data reported in Aulbach et al., 2008) averaged according to mineralogy (garnet-bearing and garnet-free: a, c) or degree of REE enrichment (b), and excluding "anomalous" pattern shown in Fig. 3a (89-680) and Fig. 3c (LB-21). Normalized to Primitive Mantle of McDonough and Sun (1995)

Aulbach et al.