Sample Results Summary Sheet

Please return this form to the Curator for each allocated Sample

Sample ID: RA-QD02-0095

PI: Eizo Nakamura

Type and date of analysis performed: major element analysis (SEM-EDS, and EPMA-WDS) [April 26 - May 2, 2011], trace element (SIMS) [May 11-21, 2011], oxygen-isotope analysis (HR-SIMS) [May 5-6, 2011], TEM analysis [Jul 4-10, 2011]

Elements or phases identified: major phase: diopside, plagioclase; minor phase: K-feldspar, troilite, Ni-Fe sulfide

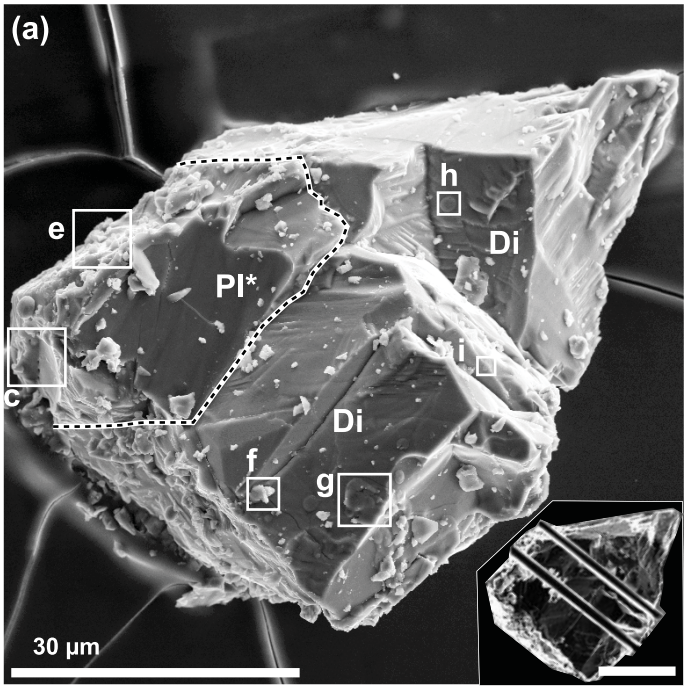
Contaminant phases identified: No

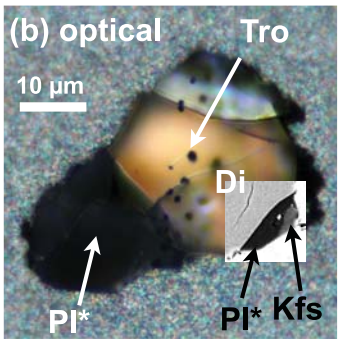
Sample handling: exposed in atmosphere, glued by glycol phthalate, coated C, sliced by FIB, and polished the FIB-sliced slab after acid-leaching, coated Au

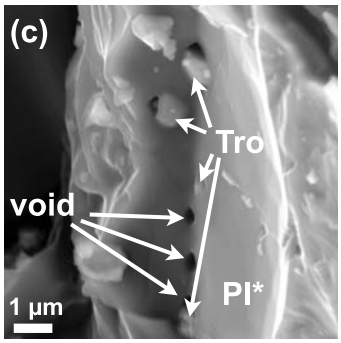
State of sample pre-analysis: atmosphere, glued, C-coated, FIB-sliced, In-mounted, polished section, Au coted

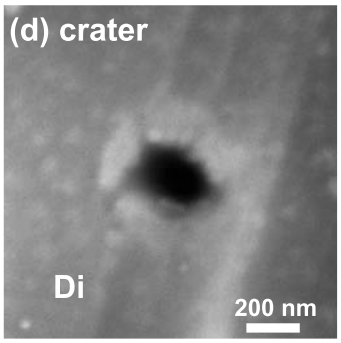
State of sample post-analysis: atmosphere, glued, C-coated, FIB-sliced, In-mounted, polished section, Au coted**,** sputtered by (spotted by) Cs- and O-beams

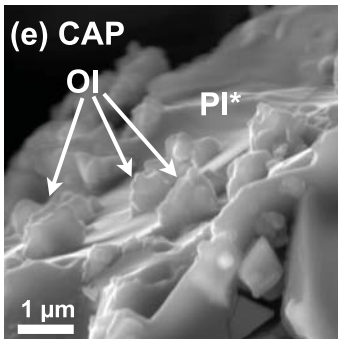
Analysis data Notes: This sample (original size: 70×50 μm) consists of diopside and plagioclase, with minor K-feldspar. A trail of micro-bowls crosscuts both the diopside and the plagioclase. These micro-bowls are filled with troilite, to varying degrees, perhaps reflecting some evaporation of troilite during thermal metamorphism. The plagioclase exhibits unusually low birefringence suggesting that its structure is intermediate between crystalline and glassy. The plagioclase in this sample shows a sharp contact with diopside, likely reflecting formation by devitrification of chondrule glass during the thermal metamorphism. Ratios of Fe/Mg and Mn/Fe diopside fall within the range for LL-ordinary chondrites. See details in Nakamura et al. (2012)'s "grain C".

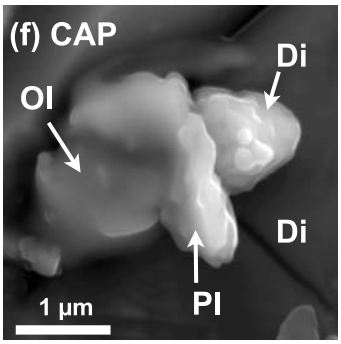

(a)
e
h
Di
Pl*
i
c
Di
f
g
30 µm

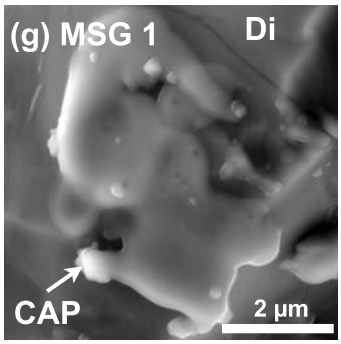

(b) optical
Tro
10 µm
Di
Pl*
Pl*
Kfs

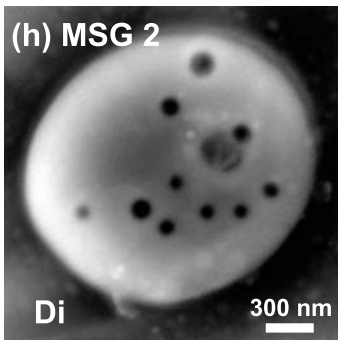

(c)
Tro
void
Pl*
1 µm

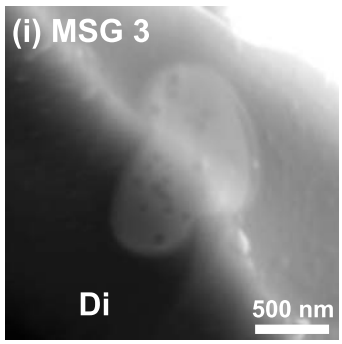

(d) crater
Di
200 nm


(e) CAP
Ol
Pl*
1 µm

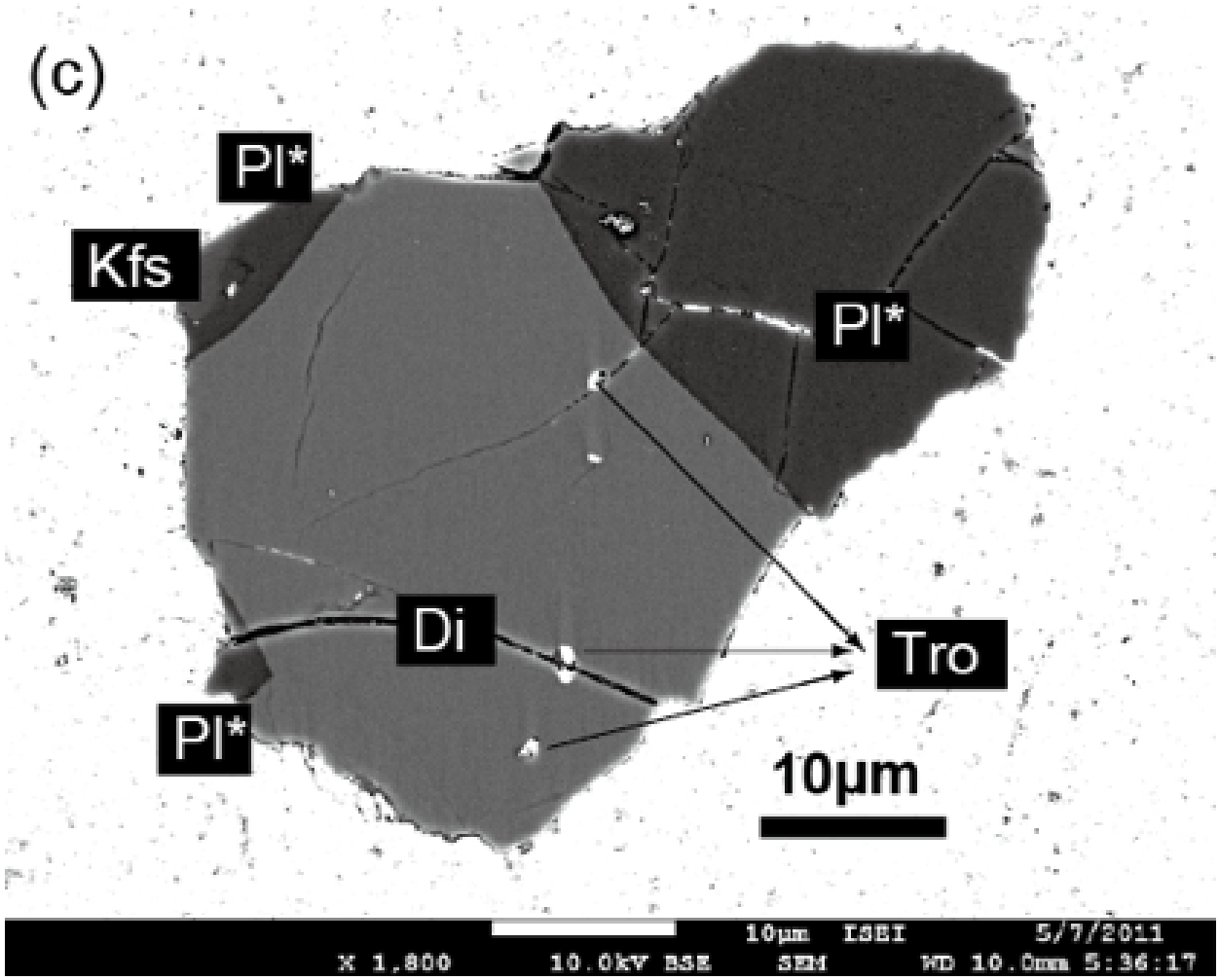

(f) CAP
Di
Ol
Di
1 µm
Pl

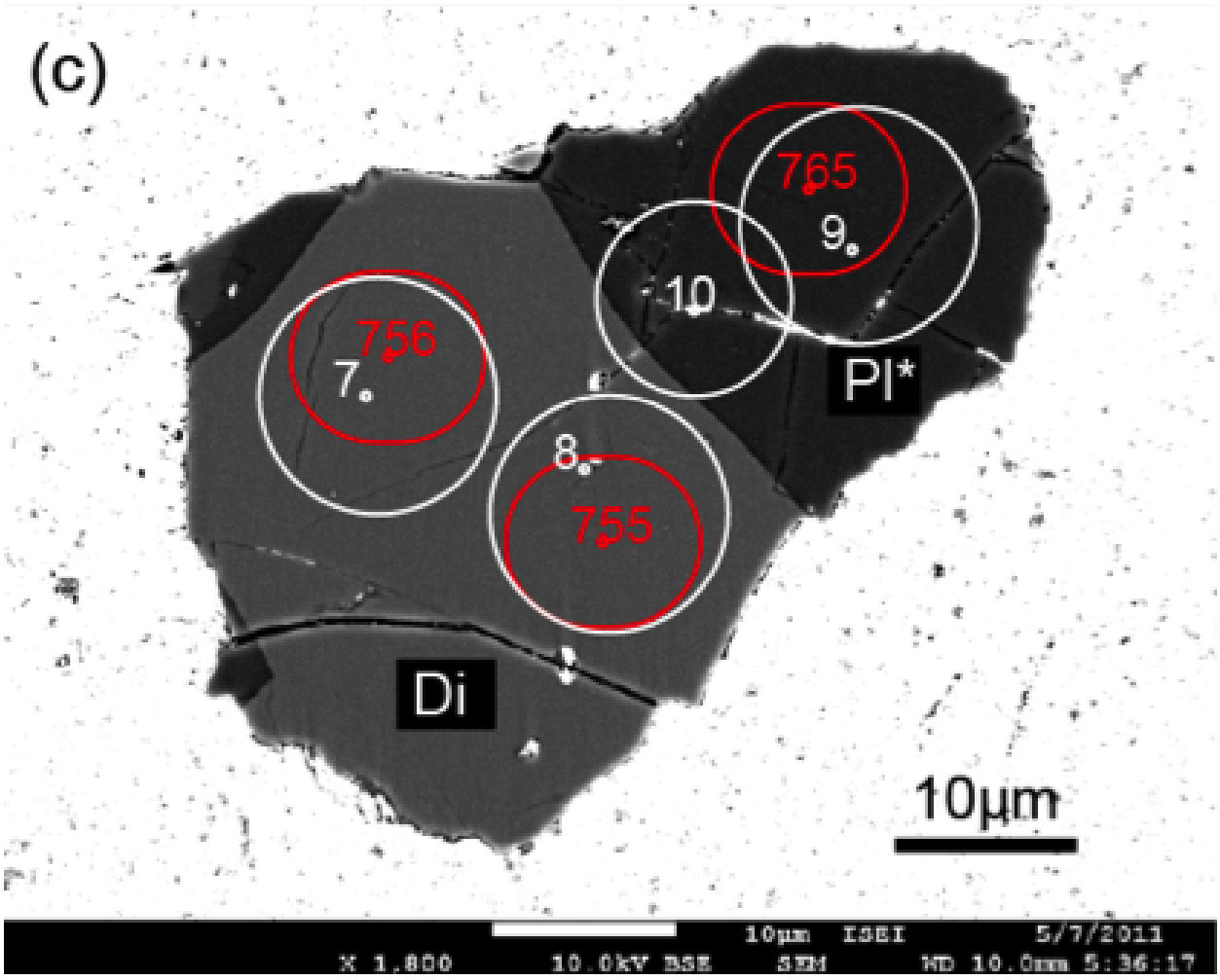

(g) MSG 1
Di
CAP
2 µm


(h) MSG 2
Di
300 nm


(i) MSG 3
Di
500 nm

Target Phase	Grain C					
	$_{n=51}$		Pl*$_{n=8}$		Kfs$_{n=2}$	
SiO_2	54.08	(0.40)	66.95	(0.77)	62.06	(0.28)
TiO_2	0.40	(0.04)	-		-	
Al_2O_3	0.49	(0.04)	20.91	(0.16)	19.34	(0.26)
Cr_2O_3	0.75	(0.05)	-		-	
FeO	5.59	(0.18)	0.25	(-)	0.22	
NiO	-		0.35	(0.13)	-	
MnO	0.21	(0.03)	-		-	
MgO	16.15	(0.22)	-		-	
CaO	20.94	(0.37)	2.28	(0.10)	2.16	(0.02)
Na_2O	0.54	(0.05)	8.78	(1.09)	1.06	(0.11)
K_2O	-		0.94	(0.16)	15.27	(0.07)
total	99.1		100		100	
Formula	en_{45}		$an_{12}ab_{82}or_6$		ab_8or_{82}	
Mg#	84	(0.5)				
$(Fe/Mg)_{atom}$	0.2					
$(Fe/Mn)_{atom}$	26					

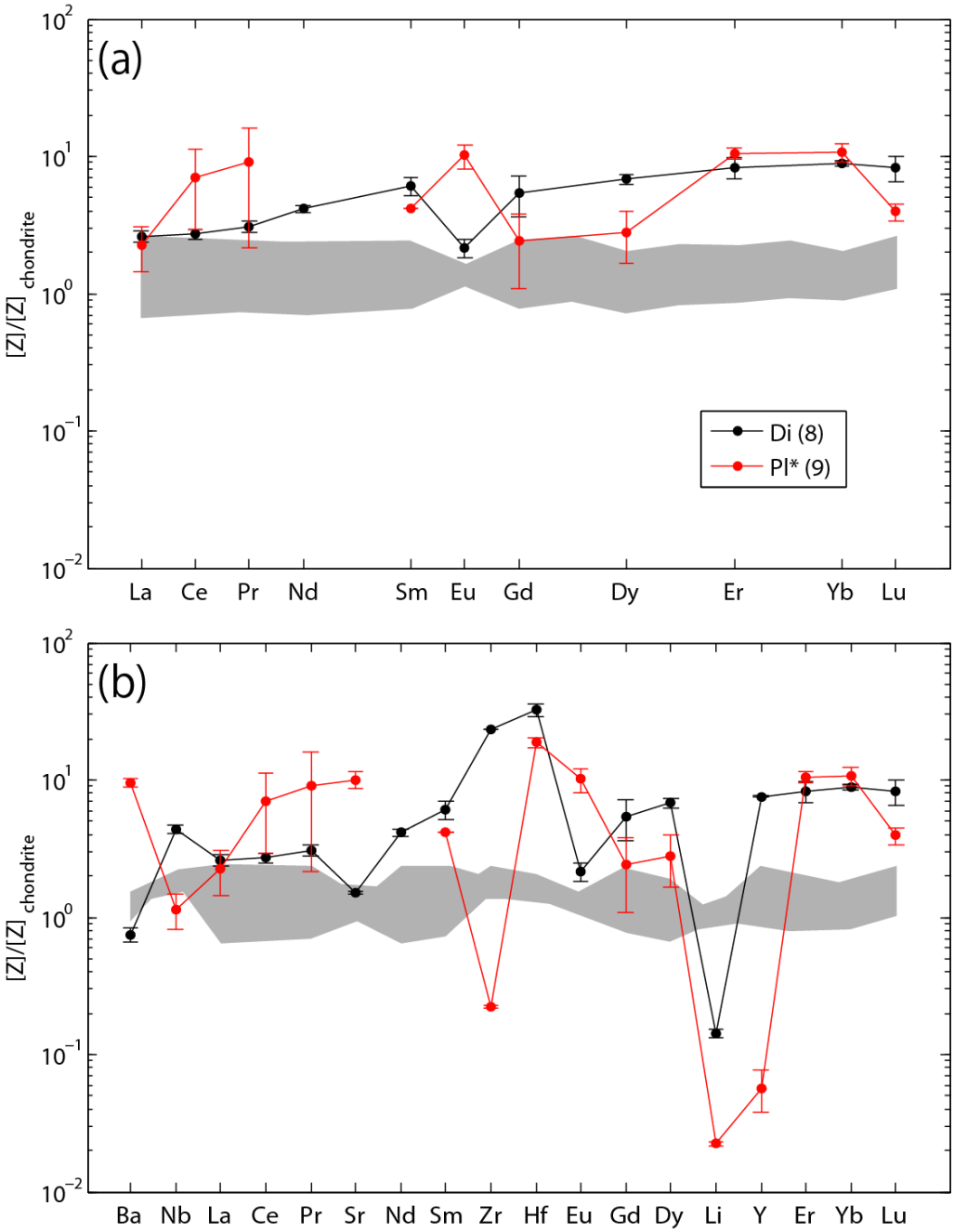

(c)
Pl*
Kfs
Pl*
Di
Tro
Pl*
10µm
10µm ISEI 5/7/2011
X 1,800 10.0kV BSE SEM WD 10.0mm 5:36:17


(c)
765
9
10
756
7
Pl*
8
755
Di
10µm
10µm ISEI 5/7/2011
X 1,800 10.0kV BSE SEM WD 10.0mm 5:36:17

Target	Spot	Phase	$\delta(^{18}O/^{16}O)$	$\delta(^{17}O/^{16}O)$	$\Delta(^{17}O/^{16}O)$
Grain A	802	$Ol_{0.5}$ low-Ca $Px_{0.5}$	6.9	4.1	0.5
Grain B	694	$Ol_{0.95}$ $Pl_{0.05}$	5.2	5.2	2.5
	720	$Ol_{0.8}$ $Pl_{0.2}$	2.4	2.5	1.3
	721	$Ol_{0.8}$ $Pl_{0.2}$	4.0	4.6	2.5
	723	$Ol_{0.6}$ $Pl_{0.4}$	5.1	5.0	2.3
Grain C	755	Di	7.2	5.5	1.8
	756	Di	8.0	4.2	0.1
	765	Pl*	8.8	5.8	1.2
Grain D	782	low-Ca Px	2.9	2.6	1.1
	783	low-Ca Px	1.7	1.7	0.8

Supplemental Table 7 (continued) | Chemical compositions of the Itokawa grains determined using the Cameca ims-5f ion microprobe.

Target	Grain C		Grain C		Grain C		Grain C	
Spot	7		8		9		10	
Phase	Di		Di		Pl*		$Di_{0.95}Di_{0.05}$	
SiO_2	*54.08*		*54.08*		*54.08*		*66.95*	§
TiO_2	6,000	(140)	5,800	(270)	490	(17)	• • •	
Al_2O_3	5,700	(34)	7,600	(54)	200,000	(540)	• • •	
Cr_2O_3	9,000	(78)	9,000	(56)	-		• • •	
FeO	• • •		• • •		• • •		• • •	
NiO	-		310	(160)	-		• • •	
MnO	2,800	(25)	2,700	(29)	-		• • •	
MgO	• • •		• • •		• • •		• • •	
CaO	270,000	(1600)	260,000	(1800)	18,000	(160)	• • •	
Na_2O	7,100	(50)	5,800	(13)	68,000	(820)	• • •	
K_2O	10	(1)	12	(1)	7,700	(20)	• • •	
P_2O_5	-		-		340		310	(12)
H_2O	830	(23)	620	(18)	250	(9)	• • •	
$Li^{\dagger}$	-		-		• • •		• • •	
$Li^{\ddagger}$	0.27	(0.01)	0.22	(0.02)	0.04	(0.001)	• • •	
B	-		-		-		• • •	
F	8.6	(0.4)	11	(1)	160	(19)	330	(28)
Cl	-		5.9	(0.5)	44	(7)	8.7	(0.8)
Sr	8.3	(0.5)	11	(0.3)	73	(10)	• • •	
Y	12	(0.3)	12	(0.1)	0.09	(0.03)	• • •	
Zr	96	(1)	91	(0.4)	0.86	(0.02)	• • •	
Nb	1.1	(0.1)	1.1	(0.1)	0.28	(0.08)	• • •	
Ba	-		1.8	(0.2)	23	(2)	• • •	
La	-		0.62	(0.06)	0.54	(0.19)	• • •	
Ce	1.2	(0.1)	1.7	(0.1)	4.3	(2.5)	• • •	
Pr	-		0.29	(0.03)	0.87	(0.67)	• • •	
Nd	-		1.9	(0.1)	-		• • •	
Sm	-		0.93	(0.15)	0.64	(0.005)	• • •	
Eu	-		0.13	(0.02)	0.59	(0.12)	• • •	
Gd	-		1.1	(0.4)	0.50	(0.28)	• • •	
Dy	-		1.7	(0.1)	0.72	(0.30)	• • •	
Er	-		1.4	(0.2)	1.8	(0.2)	• • •	
Yb	-		1.5	(0.1)	1.8	(0.3)	• • •	
Lu	-		0.21	(0.05)	0.10	(0.01)	• • •	
Hf	-		3.5	(0.4)	2.0	(0.2)	• • •	



Supplemental Figure 6 | Chondrite-normalized element abundances for diopside (Di) and diaplectic plagioclase (Pl*) in Grain C. Numbers in the parentheses correspond to the spot numbers given in Supplemental Table 7 and Supplemental Figure 5. Shaded fields show ranges for L4–6 and LL4–6 bulk chondrites[43,44]. Element abundances for chondrite are after Anders and Grevesse (1989)[45]. (a) The diopside exhibits a slightly light-REE-depleted pattern with a negative Eu anomaly, and the diaplectic plagioclase shows a flat pattern with a positive Eu anomaly. (b) The Li-depleted patterns for diopside and diaplectic plagioclase in Grain C are perhaps indicative of later aqueous alteration processes.