Supporting Information: Supporting Tables for Oxygen Three-Isotope Analysis

Table S1. Instrumental biases of SIMS oxygen isotope analyses.

Relative bias on d18O		**bias***	**2SD**	**2SE**	**N**
Standard					
San Carlos olivine	Fo 89	=0.00	0.30	0.11	8
HN 16	Fo 100	-0.01	0.38	0.19	4
SP 79-11 En	En 97	-2.13	0.17	0.09	4
95AK-6	Wo 50	0.14	0.17	0.08	5
PL3	An 95	-2.43	0.50	0.21	6
Sierra Leone	An 60	-3.69	0.46	0.17	7
Estimated bias* for NWA 7325 minerals					
Olivine	Fo 98	0.00		0.22	
Pyroxene	Wo 45	-0.08		0.13	
Plagioclase	An 90	-2.61		0.36	

Olivine (Fo100-Fo89)	bias*=0
Pyroxene (Wo: 0-50)	bias*=0.0454*(Wo)-2.13
Plagioclase (An:60-95)	bias*=0.036*(An)-5.84

Table S2. Trace element analyses of standard and NWA 7325 plagioclase.

Samples	Elements	SiO2 %	Na2O %	Al2O3 %	CaO %	Mg ppm	K ppm	Sc ppm	Ti ppm	Cr ppm	Mn ppm	Fe ppm	Co ppm	Ni ppm	Cu ppm	Rb ppm	Sr ppm	Ba ppm
	SIMS data	28Si cps	23Na/28Si	27Al/28Si	40Ca/28Si	24Mg/28Si	39K/28Si	45Sc/28Si	47Ti/28Si	52Cr/28Si	55Mn/28Si	57Fe/28Si	59Co/28Si	60Ni/28Si	63Cu/28Si	85Rb/28Si	88Sr/28Si	138Ba/28Si
Standard																		
NIST 610 (n=3)	SIMS	7.52E+06	4.99E+00	1.97E-01	1.79E+00	7.25E-03	2.43E-02	5.48E-03	2.82E-04	2.29E-03	2.25E-03	3.26E-05	7.33E-04	1.20E-04	1.87E-04	8.79E-03	4.67E-03	2.45E-03
	1SD % (*1)		4.5	1.4	3.0	2.4	4.2	2.1	2.4	3.0	3.2	2.5	4.2	4.7	4.6	4.4	2.9	3.1
	Concentrations	72.3	14.0	2.0	11.4	465.3	486.0	441.1	434.0	405.0	433.3	457.1	405.0	443.9	430.3	431.1	497.4	424.1
	RSF		**3.88E-02**	**1.40E-01**	**8.79E-02**	**8.87E+02**	**2.77E+02**	**1.11E+03**	**2.13E+04**	**2.44E+03**	**2.66E+03**	**1.94E+05**	**7.64E+03**	**5.10E+04**	**3.18E+04**	**6.79E+02**	**1.47E+03**	**2.39E+03**
Synthethic glass IG	SIMS	3.55E+06	7.26E-01	3.79E+00	3.95E+00	1.72E-02	6.57E-02	1.16E-05	1.18E-04	5.12E-05	3.14E-04	4.10E-04	1.77E-06	2.74E-07	3.10E-06	5.55E-06	5.55E-03	8.05E-05
	1SD %		0.6	0.5	0.4	0.3	0.4	3.7	1.9	1.9	0.8	0.6	9.9	38.0	6.9	4.6	0.3	1.8
	Concentrations	45.8	1.2	34.7	17.7	946.7		0.7	155.8		69.7	5192.5	1.0				451.0	13.0
	RSF		3.51E-02	2.00E-01	9.79E-02	1.20E+03		1.32E+03	2.88E+04		4.84E+03	2.77E+05	1.19E+04				1.77E+03	3.53E+03
Synthethic glass OG (n=2)	SIMS	3.91E+06	9.91E-01	3.55E+00	3.55E+00	1.02E-02	6.98E-02	1.02E-05	9.74E-05	2.81E-05	3.32E-04	4.24E-04	1.07E-06	3.83E-07	2.95E-06	8.24E-06	4.96E-03	1.36E-04
	1SD % (*1)		2.1	0.4	1.3	1.3	5.8	0.4	0.5	2.8	1.4	0.7	11.0	3.2	2.0	3.1	0.8	2.9
	Concentrations	46.8	1.8	33.4	16.7	578.9		0.7	125.9		77.4	5744.3	0.7				430.0	25.0
	RSF		3.83E-02	2.01E-01	1.00E-01	1.22E+03		1.40E+03	2.76E+04		4.99E+03	2.89E+05	1.32E+04				1.85E+03	3.92E+03
Synthethic glass DG	SIMS	3.92E+06	1.23E+00	3.33E+00	3.23E+00	9.14E-03	7.24E-02	1.66E-05	1.43E-04	1.53E-05	4.45E-04	4.24E-04	1.40E-06	1.62E-07	1.71E-06	1.68E-05	4.42E-03	2.07E-04
	1SD %		0.3	0.3	0.4	0.4	0.6	2.5	0.8	2.4	0.8	0.9	8.0	30.8	8.2	3.7	0.3	1.1
	Concentrations	48.9	2.3	32.5	15.5	536.7		1.0	197.8		116.2	5860.9	1.1				397.0	35.0
	RSF		3.77E-02	2.00E-01	9.82E-02	1.20E+03		1.28E+03	2.83E+04		5.33E+03	2.82E+05	1.65E+04				1.84E+03	3.46E+03
Plagioclase Lab1	SIMS	7.23E+06	2.29E+00	2.99E+00	2.44E+00	1.11E-02	1.72E-01	1.20E-06	3.02E-04	6.63E-07	1.39E-04	1.80E-04	8.60E-07	1.22E-07	7.53E-07	1.23E-05	1.16E-02	8.61E-04
	1SD %		0.5	0.4	0.3	0.3	0.2	5.6	0.6	11.7	0.8	0.9	7.3	21.2	6.8	2.3	0.3	0.2
	Concentrations	53.3	4.4	29.9	12.0	651.2	2415.7		389.6		39.5	2899.4	0.5				965.0	124.0
	RSF		3.60E-02	1.88E-01	9.21E-02	1.10E+03	2.63E+02		2.42E+04		5.32E+03	3.02E+05	1.14E+04				1.57E+03	2.71E+03
Plagioclase Hachijo-jima	SIMS	4.73E+06	2.95E-01	4.28E+00	4.70E+00	9.55E-03	1.22E-03	2.78E-06	2.88E-05	1.16E-06	1.60E-04	3.20E-04	8.59E-07	6.06E-08	1.53E-07	1.95E-06	3.40E-03	2.50E-05
	1SD %		0.5	0.6	0.4	0.4	0.9	6.0	1.2	11.8	0.8	1.2	8.9	47.3	27.6	10.6	0.2	2.1
	Concentrations	43.8	0.42	36.2	19.2				36.0			3614.5					262.0	
	RSF		3.23E-02	1.93E-01	9.36E-02				2.85E+04			2.58E+05					1.76E+03	
	Concentrations	43.8	0.46	36.8	19.8	494	14.1	0.16	35	0.18	27	3943	0.42	0.20	0.31	0.06	261	3.1
Plagioclae Miyake-jima	SIMS	3.37E+06	3.73E-01	4.06E+00	4.36E+00	1.09E-02	2.53E-03	3.12E-06	3.73E-05	2.69E-06	1.50E-04	3.45E-04	7.01E-07	1.26E-07	1.27E-06	2.20E-06	4.20E-03	5.29E-05
	1SD %		0.4	0.5	0.4	0.3	0.3	2.8	1.7	8.3	1.2	0.5	11.2	47.2	10.4	6.6	0.2	1.2
	Concentrations	43.9	0.59	35.0	18.4	567	29	0.18	45	0.42	25	4269	0.34	0.41	2.6	0.07	324	6.6
Plagioclase RSF	Average		3.59E-02	1.96E-01	9.64E-02	1.18E+03	2.63E+02	1.33E+03	2.75E+04		5.12E+03	2.82E+05	1.32E+04				1.76E+03	3.40E+03
	1SD % (*1)		6.6	2.9	3.5	4.4		4.6	6.8		4.8	5.7	17.3				6.5	14.9
	Plagioclase/NIST 610		0.92	1.40	1.10	1.33	0.95	1.20	1.29	*(1.45)*	*(1.45)*	1.45	*(1.45)*	*(1.45)*	*(1.45)*	*(1.00)*	1.19	*(1.19)*
	Assigned RSF(*2)		**3.59E-02**	**1.96E-01**	**9.64E-02**	**1.18E+03**	**2.63E+02**	**1.33E+03**	**2.75E+04**	***3.55E+03***	***3.86E+03***	**2.82E+05**	***1.11E+04***	***7.39E+04***	***4.61E+04***	***6.79E+02***	**1.76E+03**	***2.86E+03***
NWA 7325 plagioclase (assuming SiO2=45%)																		
An-1-1	SIMS	3.69E+06	6.43E-01	3.67E+00	3.91E+00	2.82E-02	2.51E-03	7.45E-06	1.30E-05	4.94E-05	8.46E-05	1.43E-05	2.29E-07	2.29E-08	6.85E-08	5.25E-06	4.08E-03	2.20E-06
	1SD %		0.4	0.5	0.7	2.3	0.9	8.3	7.2	9.8	6.5	4.8	33.0	65.5	49.1	9.6	0.4	7.5
	Concentrations	**45**	**1.04**	**32.4**	**17.0**	**1498**	**30**	**0.45**	**16.1**	**7.9**	**14.7**	**181**	**0.11**	**0.08**	**0.14**	**0.160**	**323**	**0.28**
An-1-3	SIMS	3.85E+06	6.21E-01	3.77E+00	3.94E+00	2.28E-02	2.06E-03	3.98E-06	9.51E-06	1.96E-05	4.28E-05	9.63E-06	1.32E-07	7.62E-08 DL		2.24E-06	4.07E-03	1.80E-06
	1SD %		0.4	0.5	0.5	0.3	0.5	6.8	3.7	5.4	1.1	2.2	28.0	33.6		6.1	0.2	5.3
	Concentrations	**45**	**1.00**	**33.3**	**17.1**	**1211**	**24**	**0.24**	**11.8**	**3.1**	**7.4**	**122**	**0.07**	**0.25**		**0.068**	**322**	**0.23**
An-2-1	SIMS	3.63E+06	6.51E-01	3.78E+00	3.95E+00	2.60E-02	2.20E-03	3.24E-06	7.67E-06	3.50E-05	4.09E-05	1.37E-05	3.14E-07	5.81E-08	1.05E-07	2.33E-06	4.03E-03	2.56E-06
	1SD %		0.3	0.4	0.6	0.3	0.4	6.3	4.9	2.8	1.9	3.4	18.4	29.3	20.0	8.2	0.3	14.1
	Concentrations	**45**	**1.05**	**33.4**	**17.1**	**1381**	**26**	**0.19**	**9.5**	**5.6**	**7.1**	**174**	**0.16**	**0.19**	**0.22**	**0.071**	**318**	**0.33**
An-4-1	SIMS	3.73E+06	6.35E-01	3.79E+00	3.95E+00	2.58E-02	1.99E-03	3.47E-06	8.35E-06	3.42E-05	4.66E-05	1.48E-05	3.40E-07	6.81E-08	7.89E-08	1.70E-06	4.08E-03	1.44E-06
	1SD %		0.4	0.6	0.4	0.4	0.3	5.0	3.8	7.1	1.5	2.7	14.2	41.9	39.7	8.4	0.2	14.6
	Concentrations	**45**	**1.02**	**33.4**	**17.1**	**1368**	**24**	**0.21**	**10.3**	**5.5**	**8.1**	**187**	**0.17**	**0.23**	**0.16**	**0.052**	**323**	**0.18**
An-4-2	SIMS	3.84E+06	6.64E-01	3.63E+00	3.86E+00	3.46E-02	2.82E-03	9.00E-06	1.23E-05	8.86E-05	8.21E-05	2.54E-05	2.52E-07	2.19E-08	1.43E-07	6.69E-06	4.02E-03	1.77E-06
	1SD %		0.5	0.3	0.6	0.7	1.8	2.9	3.6	2.8	2.5	1.8	26.6	65.5	23.2	6.4	0.4	8.7
	Concentrations	**45**	**1.07**	**32.1**	**16.8**	**1836**	**33**	**0.54**	**15.3**	**14.1**	**14.3**	**322**	**0.13**	**0.07**	**0.30**	**0.204**	**318**	**0.23**
An-7-1	SIMS	3.77E+06	6.42E-01	3.75E+00	3.91E+00	2.44E-02	2.11E-03	2.69E-06	6.19E-06	2.58E-05	4.29E-05	1.18E-05	2.35E-07	2.24E-08	4.46E-08	1.58E-06	4.05E-03	1.15E-06
	1SD %		0.5	0.5	0.4	0.4	0.4	8.0	2.6	11.6	2.5	2.7	27.0	65.5	53.4	6.0	0.4	12.7
	Concentrations	**45**	**1.04**	**33.2**	**17.0**	**1295**	**25**	**0.16**	**7.7**	**4.1**	**7.5**	**150**	**0.12**	**0.07**	**0.09**	**0.048**	**320**	**0.15**
An-7-2	SIMS	3.81E+06	6.25E-01	3.72E+00	3.88E+00	2.48E-02	1.80E-03	3.28E-06	8.17E-06	2.69E-05	3.94E-05	1.16E-05	2.20E-07	5.52E-08	4.43E-08	1.34E-06	4.09E-03	1.08E-06
	1SD %		0.4	0.6	0.4	0.5	0.4	5.9	4.3	4.3	2.0	2.9	27.9	51.8	37.8	9.1	0.4	10.9
	Concentrations	**45**	**1.01**	**32.9**	**16.8**	**1317**	**21**	**0.20**	**10.1**	**4.3**	**6.8**	**147**	**0.11**	**0.18**	**0.09**	**0.041**	**323**	**0.14**
	Average (n=7)		**1.03**	**33.0**	**17.0**	**1415**	**26**	**0.28**	**11.5**	**6.4**	**9.4**	**183**	**0.12**	**0.15**	**0.17**	**0.092**	**321**	**0.22**
	1SD (%)		**2.3**	**1.6**	**0.9**	**15**	**16**	**52**	**27**	**59**	**37**	**36**	**28**	**51**	**47**	**69**	**0.6**	**32**
Rejected data																		
An-1-2	SIMS	3.37E+06	7.98E-01	4.79E+00	3.85E+00	6.59E-02	2.53E-03	2.94E-06	1.11E-05	7.57E-04	1.05E-04	3.39E-05	1.20E-06	8.70E-08	3.83E-08	1.84E-06	3.68E-03	1.77E-06
	1SD %		1.0	0.8	0.5	1.9	1.2	3.5	3.7	1.5	2.4	2.4	6.4	25.6	69.9	12.9	0.3	14.9
	Concentrations	45	1.29	42.3	16.7	3500	30	0.18	13.7	120.8	18.3	429	0.60	0.29	0.08	0.056	291	0.23
An-2-2	SIMS	3.10E+06	7.70E-01	5.71E+00	3.87E+00	6.12E-02	2.52E-03	3.38E-06	1.01E-05	6.86E-04	6.42E-05	2.70E-05	1.26E-06	9.52E-08	9.57E-08	2.03E-06	3.77E-03	1.68E-06
	1SD %		0.8	0.7	0.5	1.7	0.6	3.3	4.2	1.6	2.2	2.0	13.6	54.7	33.6	7.2	0.4	7.4
	Concentrations	45	1.24	50.4	16.8	3255	30	0.20	12.5	109.5	11.1	342	0.63	0.32	0.20	0.062	298	0.22

*1: standard deviation of multiple analyses.

*2: RSF is estimated to be 1.45 times of those in NIST 610 for Cr, Mn, Co, Ni, Cu (same as Fe), 1.00 times for Rb, and 1.19 times for Ba (same as Sr).

Table S3. Oxygen three isotope

Analysis#	Location	d18O (±0.35)	d17O (±0.39)	D17O (±0.35)	Mode %
20131018-42	Ol-1	7.79	2.91	-1.14	
20131018-43	Ol-2	7.81	3.37	-0.70	
20131018-50	Ol-4	7.59	2.82	-1.12	
20131018-53	Ol-5	7.70	3.00	-1.00	
20131018-61	Ol-6	7.56	3.12	-0.81	
20131018-62	Ol-7	7.45	3.07	-0.80	
20131018-63	Ol-8	7.60	2.78	-1.18	
	Olivine average	**7.64**	**3.01**	**-0.97**	12.5
	2SD (n=7)	0.26	0.40	0.39	
	Error of the mean	**0.29**	**0.24**	**0.17**	
20131018-64	Px-1	7.31	2.97	-0.83	
20131018-65	Px-2	7.08	2.68	-1.00	
20131018-66	Px-3	7.12	2.78	-0.93	
20131018-49	Px-11	7.30	2.71	-1.09	
20131018-45	Px-12 core	7.52	3.22	-0.69	
20131018-46	Px-12 rim	7.32	3.29	-0.51	
20131018-48	Px-18	7.46	3.02	-0.86	
	Pyroxene average	**7.30**	**2.95**	**-0.84**	27.5
	2SD (n=7)	0.32	0.49	0.39	
	Error of the mean	**0.23**	**0.23**	**0.17**	
20131018-47	An-1	7.83	3.21	-0.86	
20131018-51	An-4	7.89	3.24	-0.87	
20131018-52	An-4 2nd	8.04	3.28	-0.90	
20131018-60	An-7	7.93	3.17	-0.96	
20131018-44	*An-2: hit dark zones*	*8.67*	*3.91*	*-0.60*	
	plagioclase average	**7.92**	**3.22**	**-0.90**	57.5
	2SD (n=4)	0.17	0.09	0.09	
	Error of the mean	**0.43**	**0.31**	**0.20**	
	All data average	**7.71**	**3.12**	**-0.90**	97.5
	2SD (n=18)	**0.36**	**0.28**	0.35	
	2SE			**0.13**	

2SD of individual analyses are evaluated from bracketting standard analyse. n=5-6 for d18O and d17O and n=11 for D17O. "An-2" is not included for plagioclase average.

Supplementary Material S4

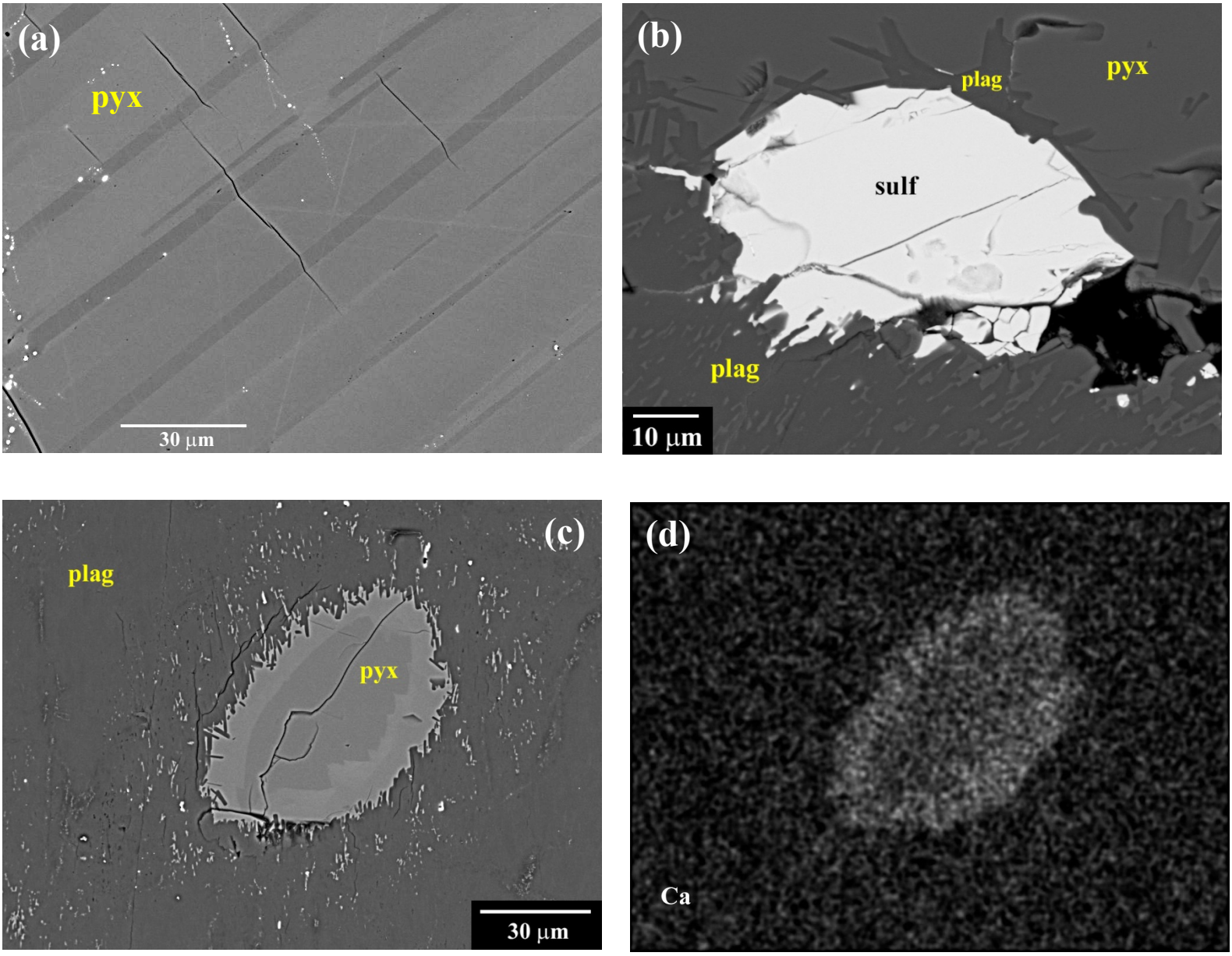


Fig. S4. Back-scattered electron images (BEI) of NWA 7325. (a) Polysynthetic twin lamellae in pyroxene (pyx), seen in BEI due to electron channeling. (b) Sulfide grain (sulf) along reacted grain boundary between plagioclase (pyx) and pyroxene. (c) Small grain of pyroxene showing reaction texture with surrounding plagioclase. Plagioclase protruding into the pyroxene grain as idiomorphic terminations is more soidic the bulk of the plagioclase. (d) Ca x-ray map of the area in [c], showing that the rim of the pyroxene has higher Ca content than the core (which is similar in composition to the large pyroxene grains in NWA 7325).

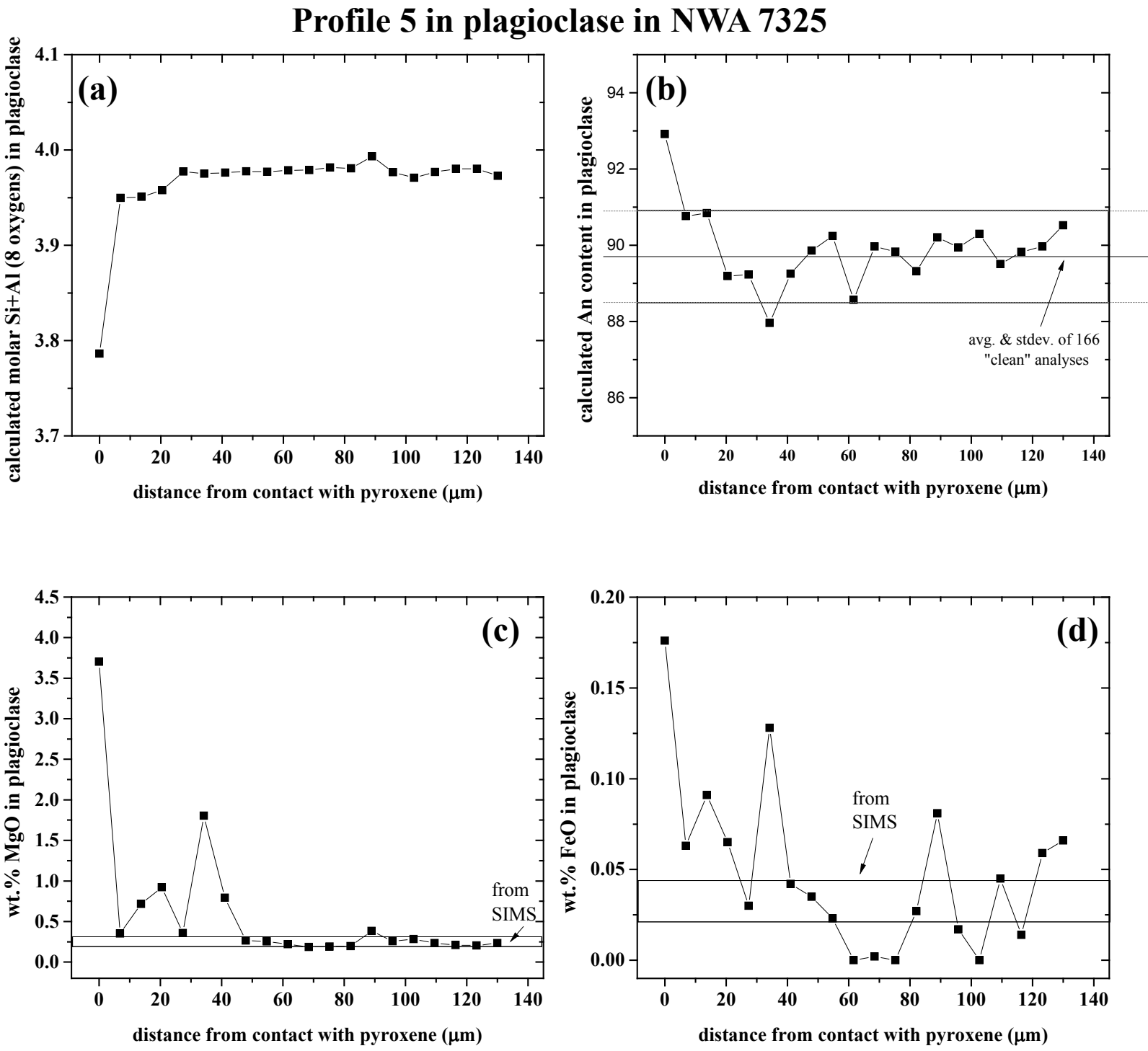
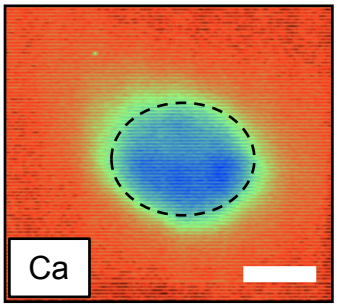


Fig. S5. Compositional profile in plagioclase moving away from contact with large pyroxene grain in NWA 7325. Analyses near the pyroxene have excesses of MgO, FeO and CaO (leading to artificially high An content) and deficits of Si+Al relative to the "cleaner" analyses from the interior, showing overlap with the small pyroxene inclusions in the analyses. They also sometimes show significant amounts of S due to dispersed sulfide inclusions.

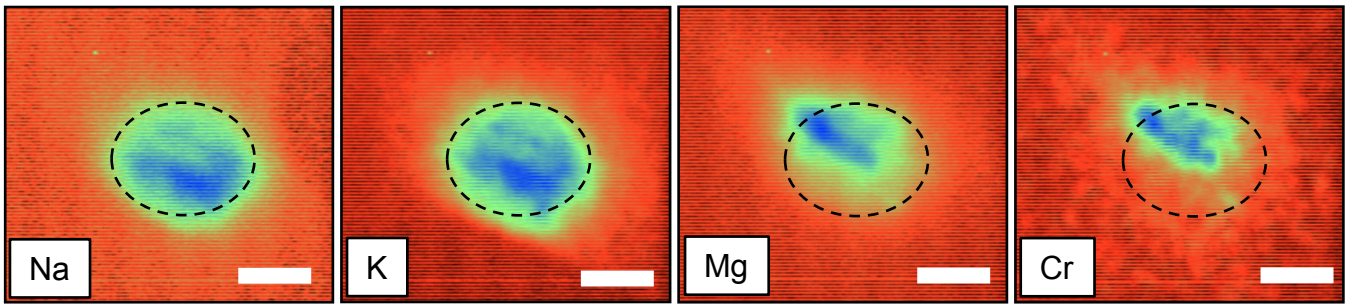
Supporting Information S6

Supporting Information
Ion imaging after trace element analysis of plagioclase in NWA 7325

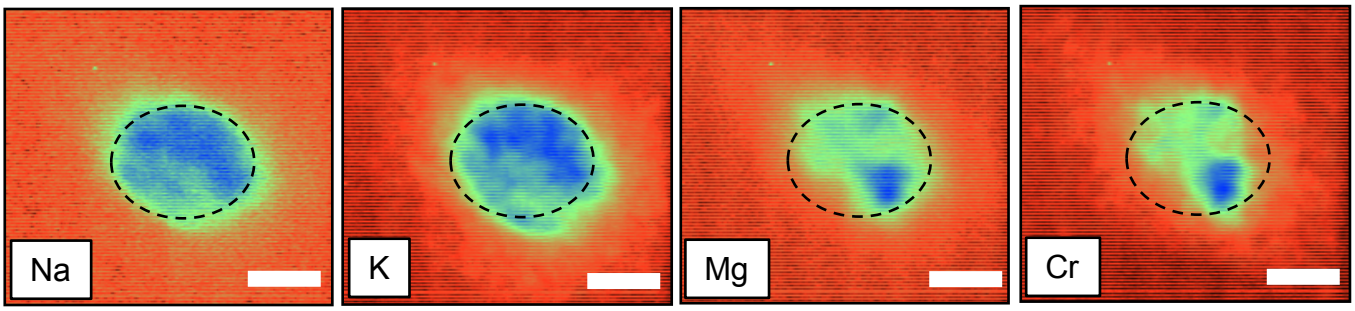
Analyses A1-2: heterogeneity in Na, K, Mg, and Cr.



Detector: multi-channel plate.
Field of view= 44 µm x 40 µm
Spot size = 20 µm x 15 µm (oval dashed line)
Scale bar = 10 µm
Image resolution ~ 2-3 µm



Analyses A2-2: heterogeneity in Na, K, Mg, and Cr.



Analyses A1-3: homogeneous ion image.