Table S1. APT measurement parameters

	OGR-16-1 (untreated concordant)			OGR-21-1 (untreated discordant)			OGR-14-1 (untreated discordant)			OGA-23-2 (annealed concordant)				
Specimen/Data Set	**85062**	**84840**	**84845**	**82932**	**83650**	**82937**	**87032**	**87058**	**87473**	**78075**	**78174**	**78229**	**78402**	**78434**
Instrument Model	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR
Instrument settings														
Laser wavelength (nm)	355	355	355	355	355	355	355	355	355	355	355	355	355	355
Laser pulse energy (pJ)	550	600	575	650	575	700	425	500	550	400	400	475	575	600
Voltage pulse fraction (%)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Pulse frequency (kHz)	125	125	125	125	125	125	100	100	125	200	125	125	125	100
Evaporation control	detection rate	detection rate	detection rate	detection rate	detection rate	detection rate	detection rate	detection rate	detection rate	detection rate	detection rate	detection rate	detection rate	detection rate
Detection rate (ions/pulse)	0.05	0.05	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.1	0.1	0.05	0.05
Nominal flight path (mm)	382	382	382	382	382	382	382	382	382	382	382	382	382	382
Set point temperature (K)	50	60	50	50	50	50	50	50	50	50	50	50	50	50
Sample temperature (K)	50	60	50	50	50	50	50	50	50	50	50	50	50	50
Chamber pressure (Torr)	9.59E-11	1.49E-11	1.01E-10	3.34E-11	9.71E-11	4.29E-11	1.27E-11	1.25E-11	2.03E-11	5.01E-11	4.41E-11	4.62E-11	4.47E-11	4.03E-11
Data summary														
LAS root version	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.597f	18.46.597f	18.46.597f	18.46.533c	18.46.533c	18.46.533c	18.46.533c	18.46.533c
CAMECAROOT version	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.597f	18.46.597f	18.46.597f	18.46.533c	18.46.533c	18.46.533c	18.46.533c	18.46.533c
Analysis software	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3	AP Suite 6.1	AP Suite 6.1	AP Suite 6.1	AP Suite 6.1	AP Suite 6.1
Total ions:	24966723	4686959	30328801	33362109	11823796	18897671	13392880	24423978	6995154	44679248	33537438	13542451	13318835	19738952
Single (%)	78.83	77.43	79.96	78.24	78.35	80.56	74.65	74.99	79.04	71.29	71.22	70.87	78.25	79.66
Multiple (%)	20.37	21.72	19.16	20.98	20.86	18.66	24.18	24.06	19.7	28.01	28.00	28.24	20.78	19.33
Partial (%)	0.79	0.85	0.88	0.78	0.79	0.78	1.17	0.95	1.26	0.7	0.78	0.89	0.97	1.01
Reconstructed ions:	23083793	4387253	27735633	31525549	11015724	17891971	12338318	22247975	5530331	38792424	28885991	11333263	11468499	17281322
Ranged (%)	81.30	82.13	85.99	85.06	78.56	81.04	81.41	80.36	87.74	91.91	89.53	88.19	89.13	83.38
Unranged (%)	18.70	17.87	14.01	14.94	21.44	18.96	18.59	19.64	12.26	8.09	10.47	11.81	10.87	16.62
Volt./bowl corr. peak (Da)	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Mass calib. (peaks/interp.)	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.
$(M/\Delta M)$	1119.76	1131.85	1147.55	1193.43	1243.05	1241.86	1129.63	1133.99	1092.78	1135.56	1144.94	1105.77	1185.14	1218.32
$(M/\Delta M_{10})$	234.65	261.15	248.14	239.41	255.75	249.05	275.34	258.65	258.69	245.34	244.2	259.87	258.16	279.98
Background (ppm/ns)	22.65	22.12	14.90	10.02	8.99	9.27	19.85	11.58	10.78	18.77	14.34	18.22	16.75	20.02
Reconstruction														
Final specimen state	intact	fractured	intact	fractured	intact	fractured	intact	intact	fractured	fractured	intact	unknown	intact	fractured
Pre-/post-analysis imaging	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a
Radius evolution model	voltage	voltage	voltage	voltage	voltage	voltage	voltage	voltage	voltage	voltage	voltage	voltage	voltage	voltage
Field factor (k)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Image compression factor	1.55	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Assumed E-field (V/nm)	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Detector efficiency (%)	52	52	52	52	52	52	52	52	52	52	52	52	52	52
Avg. atomic volume (nm^3)	species specific volume used (see range file)			species specific volume used (see range file)			species specific volume used (see range file)			species specific volume used (see range file)				
V initial; V final (V)	6142; 10782	4725; 8524	5006; 7861	4653; 7612	5608; 7665	6227; 8427	3836; 6414	5193; 7242	5056; 6489	5214; 7410	3813; 7271	4008; 6158	4009; 6455	3600; 6749

Table S1. APT measurement parameters (continued)

	OGA-17-1 (annealed discordant)			OGC-13-1 (chemically abraded concordant)				
Specimen/Data Set	**79815**	**79906**	**80175**	**85476**	**85586**	**85640**	**85690**	**85698**
Instrument Model	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR	LEAP 5000 XR
Instrument settings								
Laser wavelength (nm)	355	355	355	355	355	355	355	355
Laser pulse energy (pJ)	425	525	450	525	550	600	600	600
Voltage pulse fraction (%)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Pulse frequency (kHz)	125	125	125	125	125	125	125	125
Evaporation control	detection rate	detection rate	detection rate	detection rate	detection rate	detection rate	detection rate	detection rate
Detection rate (ions/pulse)	0.05	0.05	0.05	0.05	0.03	0.03	0.05	0.05
Nominal flight path (mm)	382	382	382	382	382	382	382	382
Set point temperature (K)	50	50	50	50	50	50	50	50
Sample temperature (K)	50	50	50	50	50	50	50	50
Chamber pressure (Torr)	5.55E-11	5.60E-11	5.49E-11	9.08E-10	2.58E-11	1.29E-09	7.52E-11	7.38E-11
Data summary								
LAS root version	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.581b
CAMECAROOT version	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.581b	18.46.581b
Analysis software	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3	AP Suite 6.3
Total ions:	11276543	13109501	34557076	5073038	29895410	20485864	15000053	32369795
Single (%)	74.21	78.41	77.51	76.61	80.18	81.2	76.13	75.81
Multiple (%)	24.92	20.76	21.64	22.47	18.97	17.92	23.06	23.24
Partial (%)	0.87	0.82	0.85	0.92	0.85	0.88	0.82	0.85
Reconstructed ions:	10354616	11998614	32207925	3823534	24803599	18934703	13500366	29935192
Ranged (%)	84.67	79.60	80.05	86.47	83.42	81.25	85.11	86.88
Unranged (%)	15.33	20.40	19.95	13.53	16.58	18.75	14.89	13.12
Volt./bowl corr. peak (Da)	16	16	16	16	16	16	16	16
Mass calib. (peaks/interp.)	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.	5/Lin.
$(M/\Delta M)$	1119.7	1210.41	1140.03	1121.63	1120.22	1137.88	1161.82	1155.64
$(M/\Delta M_{10})$	237.69	242.74	236.26	235.87	229.31	233.95	242.18	229.49
Background (ppm/ns)	25.14	26.05	28.69	19.59	19.37	21.21	15.23	15.45
Reconstruction								
Final specimen state	intact	intact	intact	fractured	intact	intact	intact	intact
Pre-/post-analysis imaging	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a	SEM/n.a
Radius evolution model	voltage	voltage	voltage	voltage	voltage	voltage	voltage	voltage
Field factor (k)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Image compression factor	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Assumed E-field (V/nm)	28	28	28	28	28	28	28	28
Detector efficiency (%)	52	52	52	52	52	52	52	52
Avg. atomic volume (nm^3)	species specific volume used (see range file)			species specific volume used (see range file)				
V initial; *V* final (V)	3686; 5902	4444; 8545	3550; 7370	5192; 6802	7308; 9584	6201; 9580	5940; 9088	4904; 7587

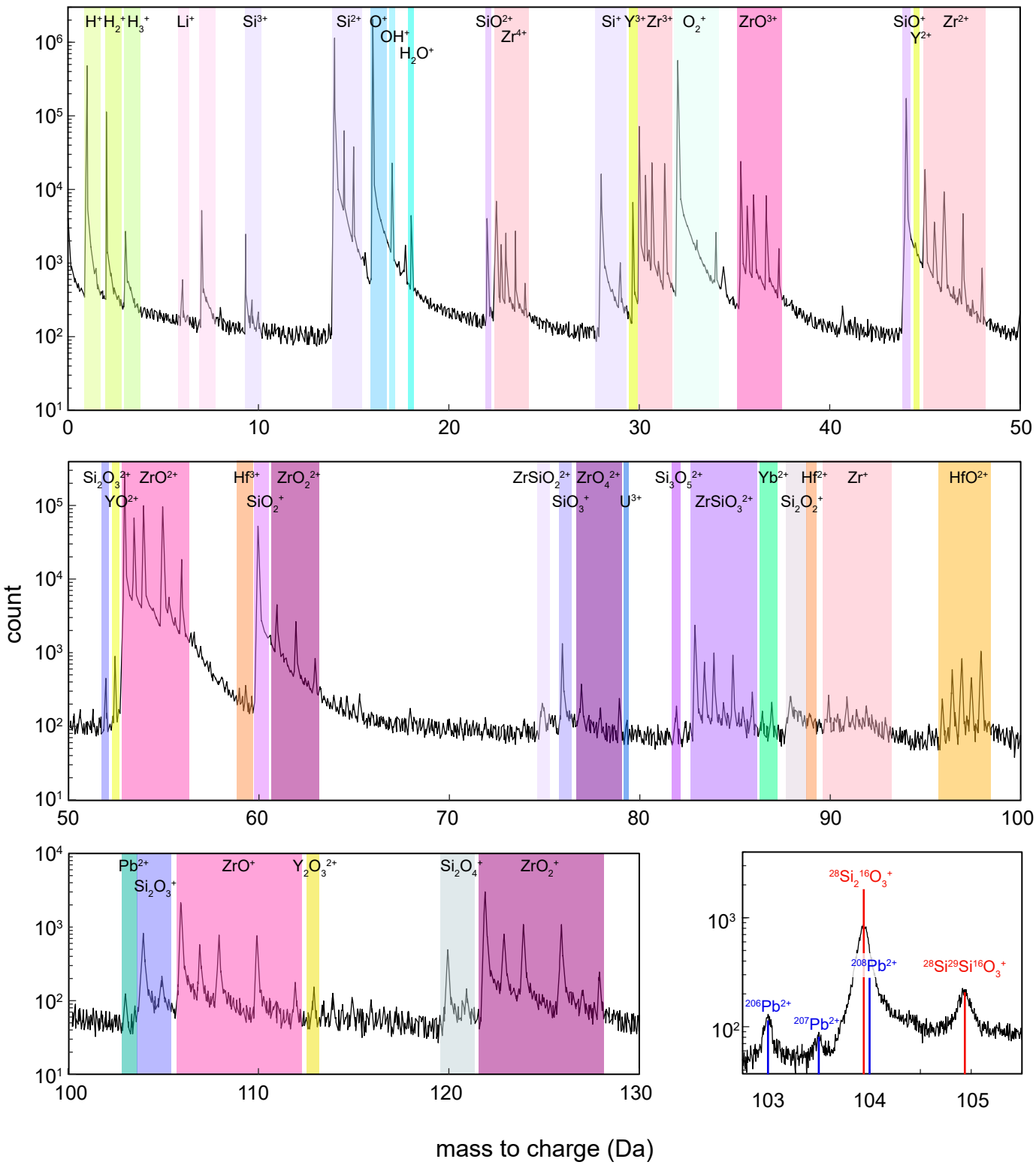

Figure S1. APT mass spectra.

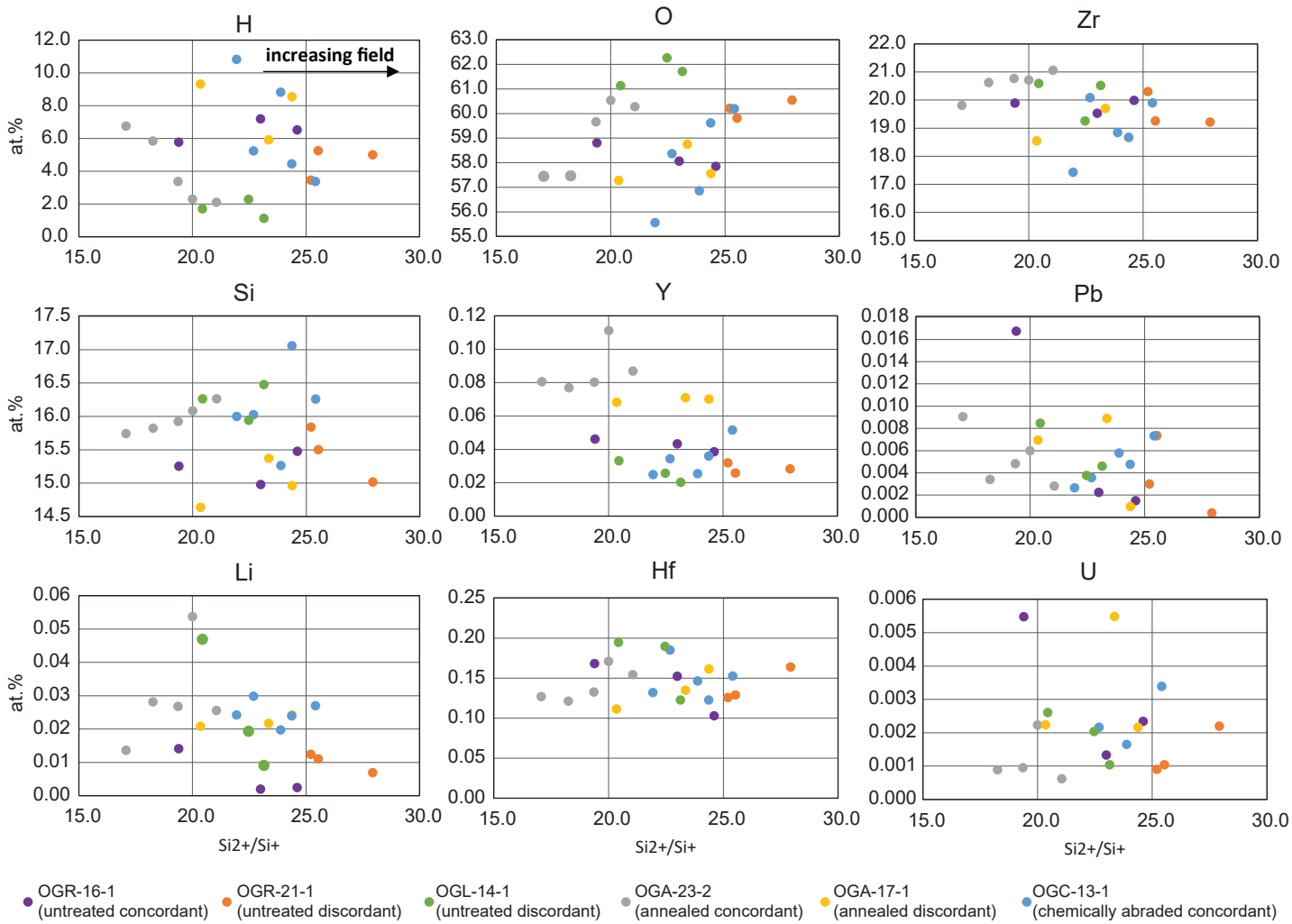

Figure S2. Atomic yield vs field energy.

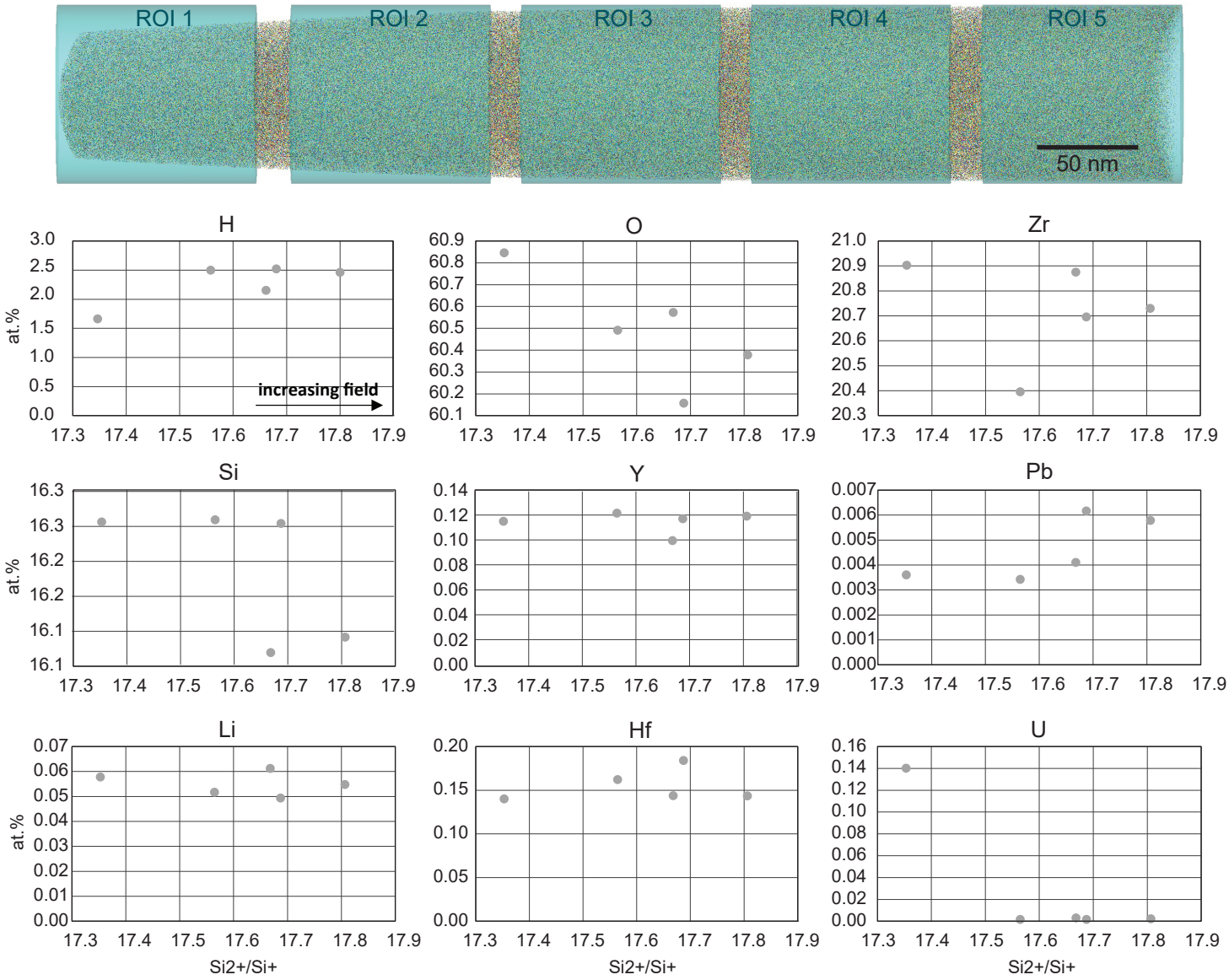

Figure S3. Atomic yield vs field energy for sections of 78075.

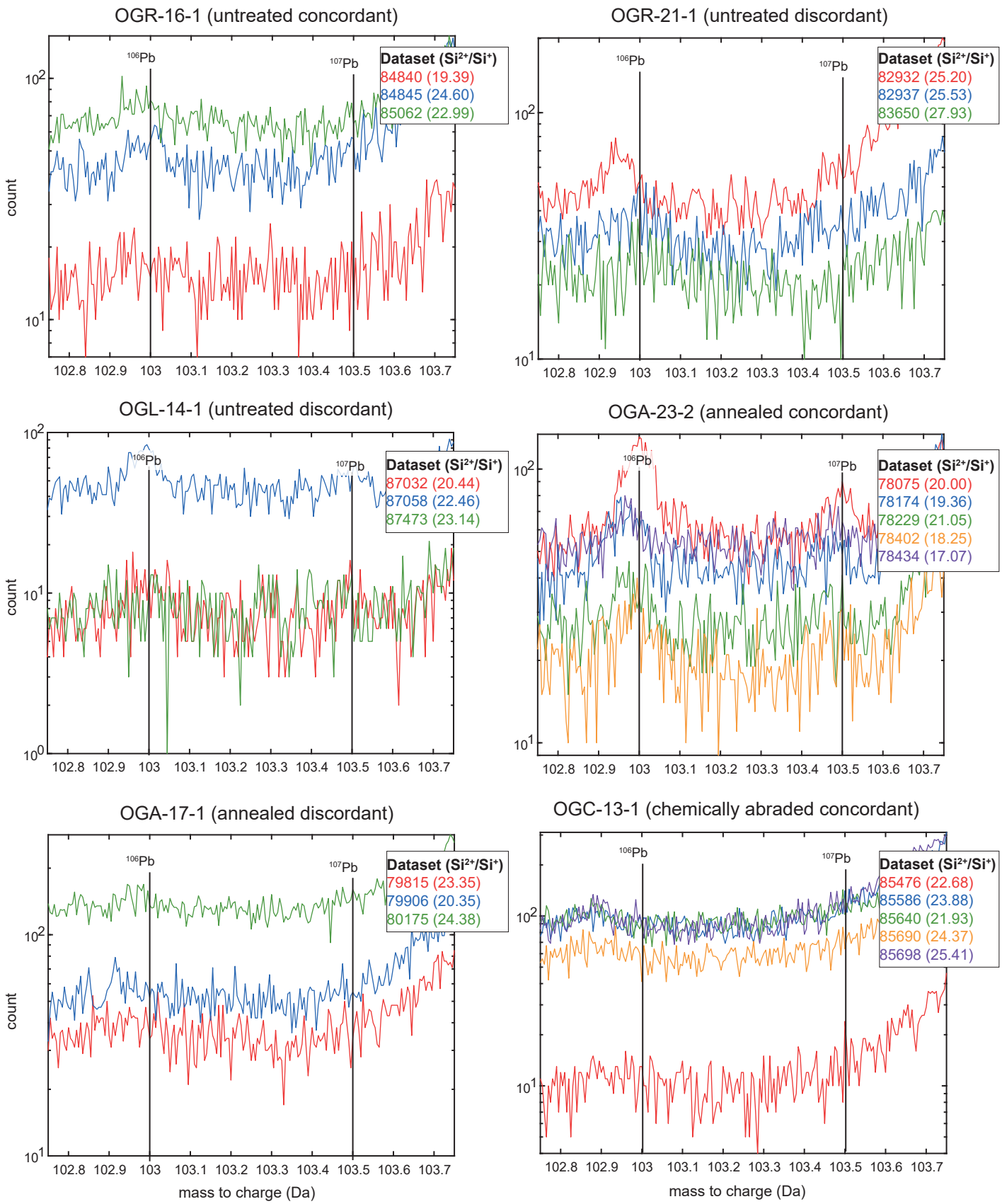

Figure S4. Pb peaks from each run.

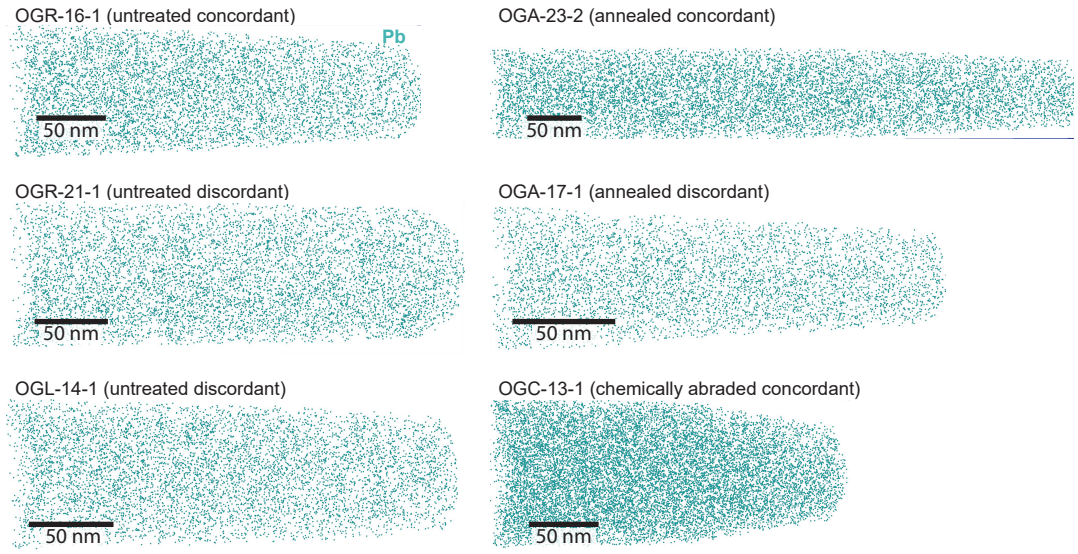

Figure S5 Pb reconstructions