Supplemental Information

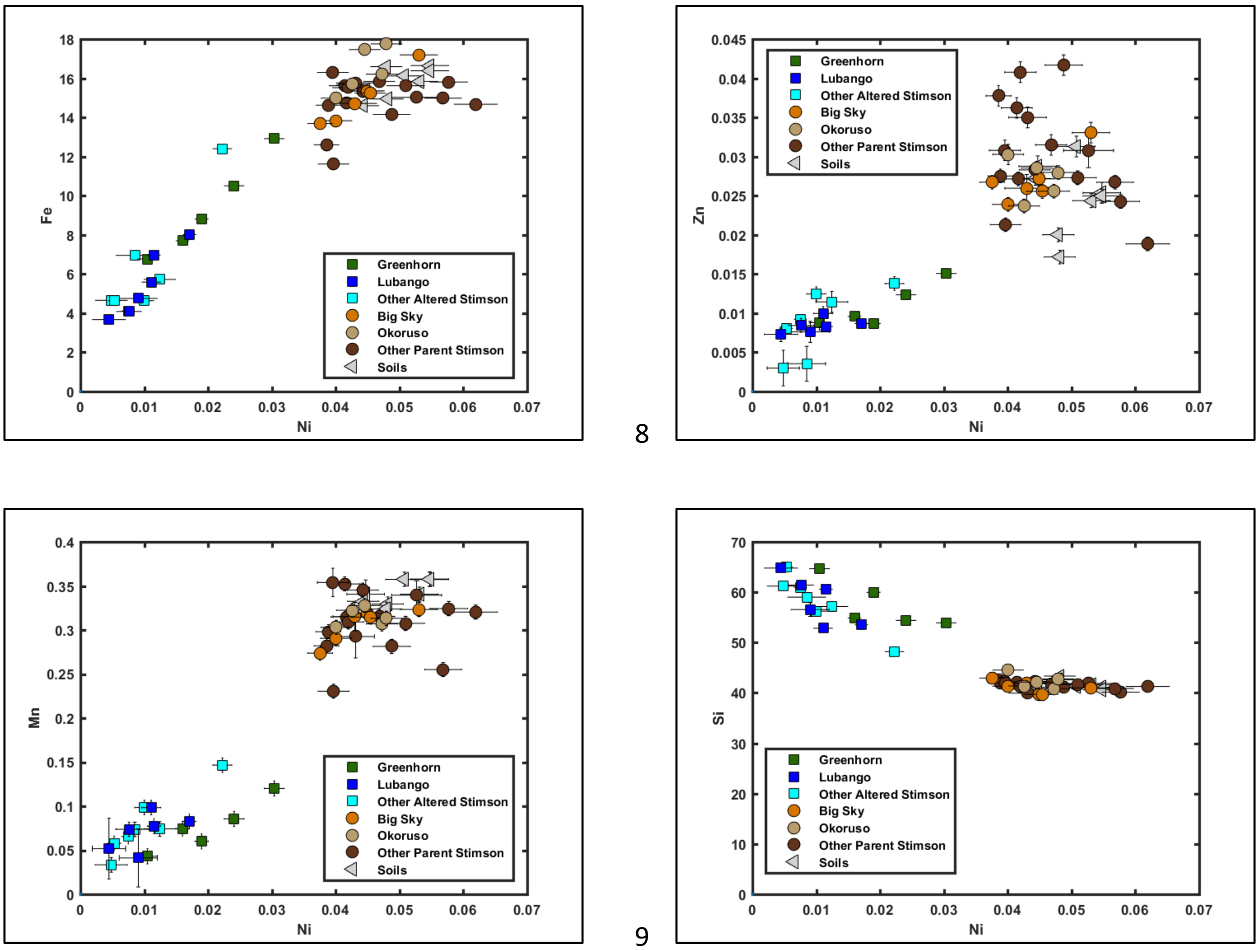

Figure S1: Molar Fe, Zn, Mn and Si versus Ni for silica-enriched and parent Stimson samples. Fe, Mn, Ni and Zn systematically decrease in the alteration halos as Si increases.

Table SI: APXS data

sol	Target Name	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl	K_2O	CaO	TiO_2	Cr_2O_3	MnO	FeO	Ni	Zn	Br	Ge
	Silica-Enriched Stimson Samples																	
1091	Devon	2.57	4.47	6.07	61.04	2.51	6.51	2.01	0.55	3.74	1.29	0.23	0.09	8.60	86	40	490	<40
1092	Ivanhoe	2.20	4.17	4.11	62.07	2.28	11.04	0.98	0.42	5.23	1.48	0.10	0.04	5.65	48	33	546	<40
1130	Greenhorn_DRT	2.53	4.77	5.48	56.23	1.24	10.78	1.54	0.44	5.98	1.00	0.34	0.09	9.43	160	107	336	40-60
1134	Pilgrim	1.96	0.99	1.27	63.59	1.84	13.10	0.82	0.23	6.58	1.14	0.31	0.05	7.96	101	94	545	60-80
1142	Greenhorn_full_drill_tailings	2.15	1.47	2.86	59.15	1.56	13.07	0.54	0.29	7.10	0.91	0.28	0.07	10.39	183	93	441	40-60
1143	Vandalia	2.40	5.60	5.42	58.76	1.09	10.72	1.11	0.41	5.74	1.14	0.32	0.09	7.04	125	128	362	<40
1143	Greenhorn_presieve_dump	2.33	2.11	3.98	53.88	1.34	13.38	0.49	0.30	8.29	0.95	0.33	0.10	12.44	233	133	220	40-60
1202	Greenhorn_post_dump_offset	2.54	2.37	4.34	52.89	1.22	11.76	0.45	0.33	7.66	1.05	0.44	0.15	14.71	282	154	242	<40
1202	Greenhorn_postsieve_dump	2.43	1.81	3.92	53.24	1.15	11.92	0.46	0.30	7.80	1.00	0.45	0.14	15.25	293	162	228	40-60
1300	Gudaus	2.48	5.40	5.55	58.04	0.99	11.15	1.38	0.47	6.97	1.16	0.43	0.12	5.72	101	140	476	<40
1300	Bero_DRT	2.99	7.18	8.93	45.03	0.84	8.62	1.21	0.48	7.52	0.88	0.43	0.27	15.52	323	189	125	<40
1313	Onesi	3.00	6.10	8.70	50.12	1.01	5.94	1.84	0.57	5.73	0.95	0.38	0.20	15.36	238	232	101	<40
1313	Uau	2.16	4.44	4.21	66.61	1.70	7.84	1.23	0.33	3.85	1.34	0.40	0.07	5.68	53	90	161	<40
1314	Kasane	3.04	6.23	8.85	49.03	0.91	6.58	2.08	0.49	6.56	0.93	0.38	0.26	14.57	248	249	76	<40
1318	Lubango_potential_drill	2.07	5.15	5.60	57.99	0.90	11.32	1.71	0.46	6.97	1.02	0.42	0.05	5.83	91	85	411	<40
1318	Cangulo	2.63	5.22	5.95	54.58	1.18	11.90	1.90	0.47	7.54	1.01	0.41	0.12	6.90	112	112	355	<40
1318	Lubango_DRT	2.67	3.90	5.78	54.86	1.06	11.20	2.15	0.43	6.57	0.91	0.34	0.10	9.82	171	97	214	<40
1319	Swartbank_DRT_overnight	2.49	3.96	4.35	63.10	1.50	9.62	2.68	0.49	5.01	1.12	0.37	0.08	5.10	76	104	442	<40
1325	Lubango_fulldrill_tailings	1.59	1.06	2.12	63.58	1.49	15.07	0.31	0.29	8.58	1.07	0.34	0.06	4.31	43	78	83	<40
1326	Lubango_presieve_apxs	1.92	1.55	3.09	59.75	1.33	13.69	0.32	0.31	8.22	1.11	0.29	0.09	8.22	111	89	60	<40
1352	Nauaspoort	2.99	5.33	7.47	50.10	1.85	7.07	2.36	0.51	5.34	0.93	0.35	0.18	15.42	226	156	228	80-100
	AVERAGE:	2.43	3.97	5.15	56.84	1.38	10.59	1.31	0.41	6.52	1.07	0.35	0.12	9.71	157	122	292	~40
	Parent Stimson Samples																	
974	Bigfork	2.89	8.13	10.32	44.07	0.98	4.87	1.20	0.60	6.08	0.95	0.32	0.50	18.95	404	640	157	<40
975	Albert	2.50	7.71	8.84	38.69	0.90	6.62	1.71	0.49	5.09	0.95	0.26	0.50	25.58	471	843	189	<40
998	Ronan_DRT_2	2.69	8.41	10.44	44.72	0.94	6.46	1.22	0.44	6.63	1.05	0.70	0.35	15.84	396	432	76	<40
1092	Ledger	2.63	8.84	9.31	43.87	0.95	5.63	1.08	0.45	6.49	0.94	0.47	0.42	18.82	539	351	96	<40
1097	Conniption	2.78	8.17	11.32	43.39	0.88	5.66	1.56	0.48	5.98	0.96	0.48	0.35	17.83	502	478	126	<40
1114	Big_Sky_DRT_raster1	2.68	8.82	9.38	43.96	0.87	5.93	1.18	0.43	6.36	0.96	0.42	0.39	18.44	440	296	237	<40
1114	Big_Sky_DRT_raster2	2.79	8.52	9.71	43.40	0.94	6.88	1.27	0.47	6.87	0.93	0.42	0.36	17.36	411	273	205	<40
1116	Big_Sky_mini_start_hole	3.23	8.23	12.41	42.14	0.80	3.42	1.21	0.51	6.79	0.92	0.38	0.40	19.50	466	314	371	<40
1123	Big_Sky_full_drill_tailings	3.00	8.05	11.30	41.70	0.73	5.57	0.79	0.49	7.42	0.90	0.45	0.39	19.14	466	292	300	<40
1124	Big_Sky_presieve_dump	2.71	8.54	9.57	43.66	0.89	6.00	1.36	0.42	6.53	0.92	0.40	0.39	18.51	427	310	309	<40
1126	Big_Sky_presieve_dump_corrected	3.15	6.88	12.18	45.19	0.84	4.61	0.84	0.50	6.77	0.95	0.40	0.34	17.22	386	306	301	<40
1132	Big_Sky_postsieve_dump	3.08	7.49	11.52	42.95	0.72	3.35	0.73	0.46	6.12	1.00	0.51	0.40	21.55	543	377	377	<40
1150	Exshaw	2.73	9.54	8.84	44.49	0.78	3.96	1.65	0.29	6.15	0.87	0.43	0.44	19.76	428	417	240	<40
1150	Ellis_Canyon	2.58	9.25	8.70	44.45	0.72	3.89	1.59	0.32	6.13	0.89	0.43	0.44	20.52	407	353	109	<40
1150	Ennis	2.56	10.12	8.79	44.61	0.76	4.90	1.33	0.31	5.51	0.87	0.41	0.43	19.36	456	325	192	<40
1277	Sperrgebiet_raster1	2.71	8.77	9.00	41.63	0.83	6.91	0.91	0.51	7.19	0.94	0.42	0.36	19.65	439	397	195	<40
1277	Sperrgebiet_raster2	2.62	8.68	8.55	43.04	0.94	6.64	0.97	0.48	6.72	1.01	0.49	0.38	19.32	427	462	390	<40
1288	Sesriem_Canyon_DRT	2.56	9.53	10.48	43.67	0.80	4.73	1.51	0.38	5.92	0.87	0.46	0.40	18.56	640	217	178	<40
1294	Brukkaros_DRT	2.63	9.80	8.18	41.96	0.89	7.17	1.11	0.35	6.33	0.88	0.39	0.40	19.75	589	276	187	<40
1330	Okoruso_DRT_offset	2.83	9.14	9.03	43.49	0.91	5.04	1.24	0.40	6.35	0.93	0.37	0.40	19.72	437	271	140	<40
1330	Okoruso_DRT_centre	2.80	9.07	9.03	42.84	0.92	5.28	1.16	0.41	6.40	0.87	0.38	0.38	20.33	484	292	143	<40
1337	Okoruso_full_drill_tailings	2.92	9.96	9.49	44.67	0.78	0.65	0.63	0.33	6.54	0.95	0.38	0.41	22.13	461	329	141	<40
1339	Okoruso_presieve_dump	3.21	8.60	10.62	47.31	0.72	1.04	0.61	0.43	6.63	0.92	0.33	0.38	19.04	416	350	116	<40
1341	Kwakwas_offset	2.99	8.49	9.43	44.10	0.98	5.59	1.25	0.45	6.57	0.91	0.34	0.37	18.39	399	315	147	<40
1341	Kwakwas_centre_DRT	2.64	9.23	11.78	43.44	0.87	3.94	1.90	0.41	4.98	0.81	0.49	0.32	19.04	590	309	273	40-60
1348	Nomeib	2.95	7.68	13.29	44.68	0.86	5.20	1.94	0.42	6.34	0.86	0.51	0.29	14.80	413	247	722	<40
1348	Meob_DRT	2.79	8.74	8.75	43.79	0.95	4.96	1.10	0.36	6.84	0.96	0.35	0.39	19.84	479	359	381	<40
1351	Groendraai	2.73	8.85	8.86	43.61	0.87	5.39	1.09	0.42	6.69	0.97	0.40	0.38	19.55	521	311	157	<40
1359	Okoruso_postsieve_dump_apxs	3.08	8.97	9.64	45.10	0.75	0.96	0.50	0.37	6.36	0.94	0.41	0.39	22.39	494	321	106	<40
	AVERAGE:	2.81	8.70	9.96	43.61	0.85	4.87	1.19	0.43	6.37	0.93	0.42	0.39	19.34	467	361	226	~20
	Representative Soil Samples																	
89	Portage	2.70	8.69	9.37	42.97	0.95	5.47	0.69	0.49	7.26	1.19	0.49	0.42	19.18	456	327	34	<40
532	Argyle	2.64	8.72	9.20	43.66	0.95	6.18	0.79	0.47	7.07	1.07	0.48	0.41	18.23	452	309	43	<40
605	Lagrange	2.68	8.82	8.76	42.29	0.89	5.82	0.76	0.45	6.99	1.05	0.52	0.44	20.40	557	283	23	<40
673	Sourdough_RP	2.78	8.27	9.41	43.05	0.85	5.12	0.64	0.45	7.17	1.10	0.50	0.44	20.09	517	355	26	<40
801	Kelso	2.67	8.91	9.06	42.89	0.85	4.62	0.62	0.44	7.01	1.05	0.47	0.44	20.77	558	288	49	<40
802	Dumont	2.71	8.81	9.04	43.43	0.92	5.21	0.70	0.47	6.97	0.99	0.39	0.42	19.78	542	277	44	<40
	AVERAGE:	2.70	8.70	9.14	43.05	0.90	5.40	0.70	0.46	7.08	1.08	0.48	0.43	19.74	514	307	37	~20
	Murray Samples																	
1109	Ferdig (typical Murray)	2.10	5.07	6.14	53.10	1.03	8.15	0.84	0.73	4.57	1.12	0.28	0.08	16.57	334	567	453	120-140
1109	Cody (altered Murray)	1.75	3.56	3.45	66.83	1.93	9.55	0.81	0.84	3.40	1.31	0.20	0.07	6.08	79	404	627	120-140
	Typical Precision of APXS Measurements (Absolute)																	
		0.14	0.23	0.23	0.52	0.05	0.08	0.02	0.02	0.07	0.03	0.02	0.01	0.23	25	15	10	10

Values for Ni, Zn, Br and Ge are expressed in micrograms/gram; other values in weight percent.

Nodular Stimson, transitional samples, and other atypical Stimson measurements have been excluded from this table. Listed soils are fine-grained samples at Gale crater: Portage is representative of typical martian basaltic soils (Blake et al., 2013), and the other samples are comparable in composition and appearance to Portage.

Table SII: Chemistry of crystalline and amorphous portions of the drill samples

	Big Sky					Okoruso					Greenhorn					Lubango				
	APXS	Xtal	Amor	Xt100	Am100	APXS	Xtal	Amor	Xt100	Am100	APXS	Xtal	Amor	Xt100	Am100	APXS	Xtal	Amor	Xt100	Am100
SiO2	42.9	36.6	6.41	45.7	32.0	45.1	28.8	16.3	44.3	46.6	53.3	11.5	41.7	32.9	64.2	59.8	9.9	49.9	36.9	68.0
TiO2	1.00	0.01	1.00	0.01	4.99	0.94	0.00	0.94	0.00	2.69	1.00	0.00	1.00	0.00	1.54	1.12	0.00	1.12	0.00	1.52
Al2O3	11.5	10.6	0.92	13.3	4.59	9.64	7.57	2.07	11.7	5.92	3.92	3.92	0.00	11.2	0.00	3.09	3.09	0.00	11.5	0.00
Cr2O3	0.51	0.00	0.51	0.00	2.56	0.41	0.00	0.41	0.00	1.18	0.45	0.00	0.45	0.00	0.69	0.29	0.00	0.29	0.00	0.39
FeO	21.5	19.2	2.36	24.0	11.8	22.4	17.4	5.02	26.7	14.3	15.3	9.64	5.62	27.5	8.66	8.22	5.13	3.10	19.0	4.22
MnO	0.40	0.00	0.40	0.00	2.01	0.39	0.00	0.39	0.00	1.13	0.14	0.00	0.14	0.00	0.21	0.09	0.00	0.09	0.00	0.12
MgO	7.49	4.75	2.75	5.93	13.8	8.97	4.00	4.97	6.16	14.2	1.81	0.62	1.20	1.75	1.84	1.55	0.61	0.94	2.26	1.29
CaO	6.12	5.32	0.81	6.65	4.03	6.37	3.71	2.65	5.71	7.58	7.81	4.14	3.66	11.8	5.64	8.23	3.52	4.71	13.1	6.42
Na2O	3.08	2.18	0.91	2.72	4.53	3.08	1.99	1.10	3.06	3.13	2.43	1.02	1.41	2.91	2.17	1.92	0.81	1.11	2.99	1.52
K2O	0.46	0.17	0.29	0.22	1.43	0.37	0.24	0.13	0.36	0.37	0.30	0.00	0.30	0.00	0.46	0.31	0.00	0.31	0.00	0.43
P2O5	0.72	0.47	0.26	0.58	1.28	0.75	0.44	0.31	0.67	0.88	1.15	0.00	1.15	0.00	1.77	1.33	0.00	1.33	0.00	1.81
SO3	3.35	0.71	2.66	0.88	13.3	0.96	0.74	0.22	1.13	0.63	11.9	4.09	7.83	11.7	12.1	13.7	3.57	10.1	13.3	13.8
Cl	0.73	0.00	0.73	0.00	3.67	0.50	0.02	0.48	0.04	1.36	0.46	0.00	0.46	0.00	0.71	0.32	0.00	0.32	0.00	0.44
F		0.04		0.05			0.04		0.06			0.00		0.00			0.00		0.00	
H2O		0.00		0.00			0.05		0.07			0.09		0.25			0.28		1.04	
SUM:	100	80	20	100	100	100	65	35	100	100	100	35	65	100	100	100	27	73	100	100

"APXS" is the bulk chemical composition of the sample. "Xtal" and "Amor" represent the portions of the bulk chemistry found in the crystalline and amorphous fractions of the sample, respectively. "Xt100" and "Am100" renormalize the crystalline and amorphous components to 100%. The fractions of amorphous material in Big Sky and Okoruso were established with FULLPAT fitting while the amorphous fraction for Greenhorn and Lubango was constrained by requiring the aluminum content to be positive or zero. Summed totals are within the uncertainty.

Table SIII: Chemical gains and losses referenced to titanium: (a) Relative differences as fraction of original sample, (b) absolute differences in weight percent

Relative Comparison	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl	K_2O	CaO	TiO_2	Cr_2O_3	MnO	FeO_T	Ni	Zn	Ge	Br
BS to GH - mini start hole	-0.51	**-0.90**	**-0.92**	0.22	0.86	2.09	-0.45	-0.64	-0.22	0.00	-0.34	**-0.89**	-0.67	-0.83	-0.76	**2.34**	0.19
BS to GH - drill tailings	-0.29	-0.82	-0.75	0.40	1.11	1.32	-0.32	-0.41	-0.05	0.00	-0.38	-0.81	-0.46	-0.61	-0.69	**1.33**	0.45
BS to GH - presieve	-0.26	-0.69	-0.67	0.19	0.60	1.90	-0.42	-0.40	0.22	0.00	-0.18	-0.71	-0.28	-0.40	-0.57	**2.31**	-0.27
BS to GH - postsieve	-0.21	**-0.76**	-0.66	0.24	0.60	2.56	-0.37	-0.35	0.27	0.00	-0.12	-0.66	-0.29	-0.46	-0.57	**1.05**	-0.40
OK to LB - drill tailings	-0.52	**-0.91**	-0.80	0.26	0.69	19.4	-0.56	-0.23	0.16	0.00	-0.21	**-0.87**	-0.83	**-0.92**	-0.79	**0.62**	-0.48
OK to LB - presieve	-0.51	**-0.85**	-0.76	0.05	0.54	9.90	-0.57	-0.40	0.03	0.00	-0.27	-0.80	-0.64	-0.78	-0.79	**1.49**	-0.57
OK postsieve to LB presieve	-0.48	**-0.85**	-0.73	0.12	0.50	11.1	-0.46	-0.28	0.09	0.00	-0.41	-0.81	-0.69	-0.81	-0.77	**0.32**	-0.52
BS to LB - drill tailings	-0.55	**-0.89**	-0.84	0.29	0.73	1.28	-0.67	-0.50	-0.03	0.00	-0.36	**-0.87**	-0.81	**-0.92**	-0.77	**0.64**	-0.77
BS to LB - presieve	-0.48	**-0.81**	-0.78	0.13	0.35	1.53	-0.67	-0.47	0.03	0.00	-0.39	-0.78	-0.59	-0.75	-0.75	**1.56**	-0.83

Absolute Comparison	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl	K_2O	CaO	TiO_2	Cr_2O_3	MnO	FeO_T	Ni	Zn	Ge	Br
BS to GH - mini start hole	-2.04	**-9.21**	**-14.1**	**11.4**	0.85	8.86	-0.68	-0.40	-1.83	0.00	-0.16	-0.45	**-16.20**	-0.05	-0.03	0.00	0.01
BS to GH - drill tailings	-0.88	-6.67	**-8.57**	**17.0**	0.82	7.44	-0.26	-0.21	-0.40	0.00	-0.18	-0.32	**-8.96**	-0.03	-0.02	0.00	0.01
BS to GH - presieve	-0.82	-4.77	**-8.20**	**8.69**	0.50	8.77	-0.35	-0.20	1.52	0.00	-0.07	-0.24	**-4.78**	-0.02	-0.02	0.00	-0.01
BS to GH - postsieve	-0.65	**-5.68**	**-7.60**	**10.3**	0.43	8.57	-0.27	-0.16	1.68	0.00	-0.06	-0.26	**-6.30**	-0.03	-0.02	0.00	-0.01
OK to LB - drill tailings	-1.71	**-10.2**	**-8.60**	**13.1**	0.61	14.3	-0.40	-0.09	1.19	0.00	-0.09	-0.41	**-20.7**	-0.05	-0.03	0.00	-0.01
OK to LB - presieve	-1.96	**-8.83**	**-9.72**	**2.69**	0.47	12.4	-0.42	-0.20	0.23	0.00	-0.11	-0.37	**-14.7**	-0.04	-0.03	0.00	-0.01
OK postsieve to LB presieve	-1.74	**-9.09**	**-8.34**	**6.24**	0.44	12.6	-0.27	-0.12	0.67	0.00	-0.20	-0.38	**-18.3**	-0.05	-0.03	0.00	-0.01
BS to LB - drill tailings	-1.97	**-8.49**	**-11.3**	**14.1**	0.63	8.46	-0.63	-0.29	-0.23	0.00	-0.19	-0.40	**-18.4**	-0.05	-0.03	0.00	-0.03
BS to LB - presieve	-1.78	**-6.52**	**-11.2**	**6.74**	0.34	8.29	-0.66	-0.27	0.28	0.00	-0.18	-0.31	**-12.0**	-0.03	-0.03	0.00	-0.03

Parent Stimson samples: BS=Big Sky, OK=Okoruso. Silica-enriched samples: GH=Greenhorn, LB=Lubango. Green represents relative gains >50% and absolute gains >2 wt%. Pink represents relative losses >50% and absolute losses of >2 wt%. Equations for Ti-referenced calculations are described in Section 4.4 of main text. Uncertainties are generally less than 15% of the stated value in (a) and less than 0.5 wt% (absolute) in (b); exceptions are shown in bold and correspond to measurements with low concentrations or in the case for absolute SiO_2 gains and FeO_T losses, the larger uncertainties are a result of the larger parent concentrations. Uncertainties in relative and absolute Ti-referenced gains and losses are depicted by the error bars in Figure 8.