

Table S1. Abundance of crystalline phases detected in Gale crater samples with CheMin. Abundances determined by Rietveld refinement.

Rocknest			John Klein			Cumberland			Windjana			Confidence Hills						
Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ				
Plagioclase	40.8	2.4	Andesine	43.5	2.6	Plagioclase	43.6	2.7	Plagioclase	5.6	1.4	Plagioclase	38	2.2				
Forsterite	22.4	1.9	Pigeonite	11.3	3	Sanidine	3.1	1.7	K-Feldspar	21.1	3.5	K-Feldspar	8.0	1.3				
Augite	14.6	2.8	Augite	7.6	2.2	Forsterite	1.8	1.6	Forsterite	5.2	1.4	Forsterite	3.3	1.2				
Pigeonite	13.8	2.8	Magnetite	7.6	1.6	Augite	8.1	2.5	Augite	29	3.3	Augite	11.4	1.8				
Magnetite	2.1	0.8	Orthopyroxene	6.1	2	Pigeonite	15.6	3.5	Pigeonite	16.7	3.1	Pigeonite	9.9	2.4				
Anhydrite	1.5	0.7	Forsterite	5.7	1.5	Orthopyroxene	8.1	3.1	Enstatite	1.0	0.9	Enstatite	5.4	2.6				
Quartz	1.4	0.6	Anhydrite	5.3	1.4	Magnetite	8.7	1.9	Magnetite	13.8	1.3	Magnetite	6.9	0.8				
Sanidine	1.3	1.3	Sanidine	2.4	1.5	Anhydrite	1.6	1.2	Anhydrite	1.4	1.1	Quartz	0.8	0.3				
Hematite	1.1	0.9	Akaganeite	2.3	1.2	Bassanite	1.4	0.7	Bassanite	0.2	0.2	Hematite	13.4	0.9				
Ilmenite	0.9	0.9	Bassanite	2.1	0.7	Quartz	0.2	0.3	Quartz	0.2	0.2	Ilmenite	1.4	0.6				
			Pyrrhotite	2	0.9	Hematite	1.3	1.0	Hematite	0.9	0.8	Jarosite	1.5	0.5				
			Albite	1.3	0.8	Ilmenite	1.0	0.9	Akaganeite	2.5	1.2							
			Hematite	1.2	1.1	Akaganeite	3.4	1.3	Pyrrhotite	1.3	0.8							
			Quartz	0.9	0.9	Halite	0.2	0.3	Ilmenite	1.1	0.7							
			Pyrite	0.6	0.5	Pyrrhotite	1.9	1.1										
			Halite	0.3	0.3													
Mojave2			Telegraph Peak			Buckskin			Big Sky			Greenhorn						
Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ				
Plagioclase	55.1	4.5	Plagioclase	38	3.5	Plagioclase	42.8	3.0	Plagioclase	46.7	3.0	Plagioclase	42.1	2.0				
Augite	2.6	0.6	K-Feldspar	5.9	1.1	Tridymite	34.1	2.0	Pigeonite	19.1	2.0	Pigeonite	4.7	1.0				
Pigeonite	12.7	2.6	Augite	2.1	0.5	Sanidine	8.4	1.8	Orthopyroxene	13.9	2.0	Orthopyroxene	7.6	2.0				
Fe-Forsterite	2.0	1.3	Pigeonite	7.0	1.3	Magnetite	6.9	0.8	Magnetite	13.1	1.0	Magnetite	17.3	1.0				
Magnetite	6.8	1.0	Enstatite	2.8	1.1	Cristobalite	6.0	0.8	Quartz	1.5	0.3	Quartz	2.2	1.0				
Quartz	1.5	0.6	Magnetite	10.9	0.7	Anhydrite	1.8	0.6	Tridymite	1.7	1.0	Hematite	6	1.0				
Hematite	7.4	1.1	Quartz	1.2	0.3				Hematite	2.8	1.0	Anhydrite	16.1	1.0				
Ilmenite	0.9	0.4	Cristobalite	8.7	0.7				Anhydrite	1.1	0.0	Bassanite	4	1.0				
Jarosite	6.8	0.8	Opal-Ct	14.5	3.0													
Apatite	4.2	1.2	Hematite	1.6	0.5													
			Ilmenite	0.9	0.4													
			Anhydrite	0.5	0.2													
			Bassanite	0.5	0.3													
			Jarosite	2.4	0.5													
			Apatite	3.0	0.5													
Gobabeb			Lubango			Okoruso			Oudam			Marimba						
Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ				
Plagioclase	35.8	2.0	Plagioclase	43.2	2.0	Plagioclase	41.9	3.0	Plagioclase	51.1	2.0	Plagioclase	45.8	4.0				
Olivine	28.0	2.0	Pigeonite	5.9	1.0	K-Feldspar	2.9	1.0	Hematite	26.0	1.0	Hematite	16.4	2.0				
Augite	20.2	2.0	Orthopyroxene	10.4	2.0	Pigeonite	20.8	2.0	Pyroxene	9.7	2.0	Anhydrite	10.2	1.0				
Pigeonite	10.9	2.0	Magnetite	11.1	1.0	Orthopyroxene	11.0	2.0	Anhydrite	5.8	0.2	Sanidine	7.7	3.0				
Magnetite	2.8	1.0	Hematite	2.3	1.0	Magnetite	17.3	1.0	Gypsum	5.5	1.0	Gypsum	6.4	1.0				
Anhydrite	1.0	0.2	Quartz	3.5	1.0	Hematite	1.1	1.0	Quartz	1.9	1.0	Forsterite	5.3	2.0				
Quartz	0.7	0.3	Anhydrite	12.3	1.0	Quartz	1.4	0.3				Pyroxene	3.6	4.0				
Hematite	0.5	0.5	Bassanite	9.0	1.0	Anhydrite	0.8	1.0				Bassanite	1.9	1.0				
			Gypsum	2.3	1.0	Bassanite	1.2	1.0				Jarosite	1.5	1.0				
						Apatite	1.6	1.0				Quartz	1.2	1.0				
Quela			Sebina			Ogunquit Beach			Duluth			Stoer						
Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ				
Plagioclase	44.0	2.0	Plagioclase	38.4	2.4	Plagioclase	47.1	2.1	Plagioclase	55.8	1.8	Plagioclase	44.1	1.7				
Hematite	20.0	2.0	Hematite	20.4	1.7	Forsterite	18.2	1.2	Hematite	13.0	0.8	Hematite	28.3	1.0				
Anhydrite	10.7	1.0	Anhydrite	16.9	1.1	Augite	15.7	1.8	Sanidine	9.0	0.9	Pyroxene	7.3	1.3				
Sanidine	6.1	2.0	Pyroxene	6.8	4.2	Pigeonite	10.2	1.8	Pyroxene	9.0	1.4	Anhydrite	5.3	0.5				
Pyroxene	5.3	2.0	Sanidine	5.1	2	Magnetite	2.5	0.6	Bassanite	5.4	0.4	Gypsum	4.2	0.3				
Forsterite	5.1	2.0	Gypsum	3.8	1.3	Hematite	2.3	0.5	Anhydrite	3.0	0.5	Sanidine	4.0	0.7				
Bassanite	4.5	1.0	Forsterite	3.0	1.0	Anhydrite	2.3	0.5	Gypsum	1.8	0.1	Jarosite	2.2	0.3				
Gypsum	1.8	1.0	Jarosite	2.6	0.6	Quartz	1.6	0.4	Magnetite	1.6	0.3	Akaganeite	1.6	0.1				
Jarosite	1.4	1.0	Bassanite	1.8	0.5				Quartz	1.3	0.2	Quartz	1.5	0.3				
Quartz	1.1	1.0	Quartz	1.2	0.6							Bassanite	0.8	0.3				
												Magnetite	0.7	0.2				
Highfield			Rock Hall			Aberlady			Kilmarie			Glen Etive						
Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ	Phase	wt. %	1σ				
Plagioclase	47.3	2.1	Plagioclase	38.2	4.1	Plagioclase	34.7	3.8	Plagioclase	32.5	3.6	Plagioclase	40.0	2.8				
Hematite	20.2	1.3	Anhydrite	21.2	2.6	Anhydrite	18.9	2.2	Anhydrite	29.3	1.3	Anhydrite	34.0	1.3				
Pyroxene	10.1	3.4	Pyroxene	17.1	1.9	Bassanite	18.4	1.4	Pyroxene	13.4	4.6	Hematite	7.0	2.5				

Anhydrite	8.2	1.0	Akaganeite	11.3	0.9	Pyroxene	14.7	5.6	Bassanite	10.0	1.0	Pyroxene	6.0	1.9
Gypsum	5.2	1.0	Hematite	5.4	0.4	Hematite	5.5	1.4	Siderite	8.0	1.0	Sanidine	5.0	2.4
Sanidine	3.7	1.0	Jarosite	4.3	0.9	Sanidine	3.9	1.6	Hematite	3.8	1.0	Bassanite	3.0	1.2
Bassanite	2.6	0.6	Apatite	2.5	0.8	Quartz	2.1	1.0	Sanidine	2.3	2.0	Siderite	3.0	0.9
Magnetite	1.4	1.3				Magnetite	1.9	1.1	Quartz	0.8	0.4	Quartz	2.0	0.8
Quartz	1.3	0.7												
Glen Etive 2			Hutton			Edinburgh			Glasgow			Mary Anning		
<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>	<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>	<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>	<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>	<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>
Plagioclase	63.0	3.1	Plagioclase	49.7	6.4	Plagioclase	39.6	2.9	Plagioclase	50.4	3.5	Plagioclase	70.5	4.1
Pyroxene	11.0	2.6	Pyroxene	14.1	2.0	Pyroxene	27.6	2.9	Anhydrite	18.5	2.6	Pyroxene	11.6	3.5
Anhydrite	10.0	0.6	Magnetite	12.4	3.4	Magnetite	14.0	1.8	Hematite	13.4	3.1	Sanidine	6.3	1.8
Sanidine	6.0	1.5	Cristobalite	9.3	1.4	Fe-Forsterite	11.5	2.5	Pyroxene	5.8	3.7	Anhydrite	3.9	1.3
Hematite	4.0	1.3	Hematite	4.8	1.2	Sanidine	4.6	2.3	Sanidine	3.7	8.8	Fe-Carbonate	3.1	0.9
Bassanite	3.0	0.8	Sanidine	4.7	1.2	Apatite	2.0	1.3	Quartz	3.3	2.8	Hematite	2.5	1.6
Quartz	2.0	0.2	Apatite	3.8	1.8	Hematite	0.5	0.8	Bassanite	3.2	1.9	Quartz	2.1	0.6
			Anhydrite	1.2	0.8	Quartz	0.2	0.4	Apatite	1.0	1.8			
									Cristobalite	0.7	1.0			
Mary Anning 3			Grokn			Nontnon			Bardou			Pontours		
<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>	<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>	<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>	<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>	<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>
Plagioclase	63.7	2.8	Plagioclase	57.0	2.6	Plagioclase	51.3	1.5	Plagioclase	53.0	1.8	Plagioclase	58.4	4.4
Pyroxene	13.9	5.7	Anhydrite	11.4	1.0	Hematite	17.1	1.9	Hematite	21.0	2.2	Pyroxene	16.7	1.8
Sanidine	6.3	3.2	Pyroxene	9.9	3.2	Pyroxene	8.7	3.2	Pyroxene	8.8	4.0	Hematite	9.3	2.0
Bassanite	4.8	0.5	Bassanite	7.8	0.6	Anhydrite	8.0	2.0	Bassanite	5.5	1.4	Sanidine	5.7	3.0
Anhydrite	4.6	1.2	Fe-Carbonate	7.3	2.6	Bassanite	5.2	1.4	Sanidine	4.2	1.8	Bassanite	3.1	1.6
Fe-Carbonate	2.5	1.7	Sanidine	4.8	1.6	Sanidine	3.7	1.2	Ankerite	2.6	1.8	Gypsum	2.0	0.8
Quartz	2.3	1.0	Quartz	1.8	1.2	Goethite	2.4	1.5	Anhydrite	2.0	1.4	Quartz	1.8	1.0
Hematite	1.9	0.5				Ankerite	2.2	0.7	Quartz	1.7	1.2	Goethite	1.7	1.2
						Quartz	1.5	0.2	Gypsum	1.2	0.8	Halite	1.2	0.6
Maria Gordon			Zechstein			Avanavero			Canaima			Tapo Caparo		
<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>	<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>	<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>	<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>	<i>Phase</i>	<i>wt. %</i>	<i>1σ</i>
Plagioclase	51.7	3.4	Plagioclase	37.8	3.2	Plagioclase	41.7	6.0	Plagioclase	44.5	3.2	Plagioclase	38.2	3.4
Hematite	16.2	2.0	Gypsum	33.7	1.0	Hematite	17.4	5.0	Hematite	12.4	2.1	Siderite	26.3	2.6
Pyroxene	7.6	1.8	Pyroxene	12.6	2.2	Anhydrite	12.2	3.8	Gypsum	10.5	1.1	Pyroxene	21.8	3.8
Alkali Feldspar	6.1	1.6	Hematite	9.6	2.2	Goethite	9.9	3.4	Sanidine	8.4	2.1	Kieserite	8.0	2.2
Goethite	5.5	3.2	Bassanite	4.4	0.8	Pyroxene	8.7	1.8	Pyroxene	8.4	5.8	Bassanite	3.8	1.8
Anhydrite	4.8	1.0	Quartz	1.9	0.6	Bassanite	4.6	1.2	Starkeyite	6.1	1.6	Anhydrite	2.0	1.2
Bassanite	4.4	1.6				Sanidine	3.5	1.8	Goethite	5.8	3.2			
Gypsum	2.1	1.0				Quartz	1.0	1.0	Anhydrite	1.6	1.6			
Quartz	1.6	0.8				Ilmenite	1.0	1.2	Quartz	1.3	1.1			
									Bassanite	1.1	1.6			

Table S2: Unit-cell parameters of feldspar, olivine, pyroxene, and spinel group mineral phases detected in Gale crater, Mars and analyzed by the CheMin instrument. Uncertainty reported as 1σ .

Plagioclase Unit-Cell Parameters												
Sample	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	α (°)	σ_α (°)	β (°)	σ_β (°)	γ (°)	σ_γ (°)
RK	8.168	0.006	12.863	0.006	7.108	0.004	93.460	0.050	116.220	0.030	90.120	0.030
JK	8.162	0.005	12.860	0.008	7.108	0.005	93.470	0.050	116.290	0.030	90.100	0.040
CB	8.162	0.007	12.860	0.008	7.112	0.007	93.420	0.053	116.337	0.037	90.103	0.035
WJ	8.172	0.040	12.912	0.081	7.108	0.049	94.345	0.977	116.271	0.450	89.902	0.606
CH	8.166	0.007	12.859	0.007	7.111	0.004	93.440	0.060	116.310	0.040	90.160	0.040
MJ2	8.164	0.004	12.859	0.003	7.110	0.002	93.500	0.040	116.280	0.010	90.100	0.030
TP	8.157	0.003	12.858	0.006	7.111	0.002	93.470	0.020	116.280	0.020	90.080	0.020
BK	8.155	0.003	12.862	0.004	7.106	0.004	93.320	0.020	116.280	0.020	90.100	0.020
BS	8.159	0.008	12.875	0.008	7.103	0.007	93.470	0.060	116.090	0.040	89.970	0.050
GH	8.165	0.007	12.891	0.009	7.108	0.007	93.240	0.070	116.100	0.040	90.060	0.040
GB	8.181	0.007	12.868	0.007	7.107	0.006	93.490	0.050	116.190	0.040	90.060	0.030
LB	8.166	0.011	12.891	0.011	7.111	0.009	93.260	0.100	116.210	0.050	90.040	0.060
OU	8.163	0.005	12.852	0.007	7.110	0.004	93.520	0.040	116.310	0.040	90.050	0.050
OK	8.160	0.008	12.880	0.007	7.108	0.006	93.590	0.070	116.170	0.040	89.910	0.060
MB	8.161	0.007	12.853	0.010	7.112	0.004	93.380	0.060	116.290	0.040	90.100	0.020
SB	8.162	0.009	12.875	0.019	7.110	0.007	93.410	0.160	116.220	0.070	90.020	0.090
QL	8.162	0.009	12.875	0.018	7.110	0.007	93.410	0.150	116.220	0.060	90.020	0.090

OG	8.169	0.006	12.866	0.012	7.107	0.004	93.418	0.023	116.229	0.035	90.169	0.050
DU	8.165	0.006	12.864	0.006	7.116	0.002	93.457	0.044	116.268	0.019	90.081	0.019
ST	8.151	0.003	12.865	0.009	7.104	0.005	93.316	0.036	116.231	0.018	90.111	0.023
RH	8.155	0.005	12.875	0.001	7.113	0.002	93.434	0.047	116.247	0.023	90.150	0.023
HF	8.177	0.008	12.879	0.012	7.106	0.003	92.860	0.300	116.330	0.040	90.270	0.030
EB	8.149	0.010	12.849	0.027	7.109	0.008	92.846	0.209	116.470	0.092	90.167	0.102
AL	8.176	0.011	12.850	0.011	7.112	0.007	93.409	0.096	116.172	0.054	90.225	0.059
KM	8.154	0.006	12.871	0.006	7.108	0.007	93.453	0.042	116.167	0.033	90.096	0.027
GE	8.157	0.005	12.863	0.010	7.107	0.005	93.412	0.125	116.206	0.021	90.129	0.061
GE2	8.164	0.006	12.854	0.008	7.110	0.006	93.407	0.036	116.282	0.051	90.104	0.034
HU	8.163	0.005	12.888	0.004	7.110	0.004	93.510	0.088	116.262	0.041	90.072	0.051
GG	8.144	0.008	12.841	0.009	7.105	0.005	93.339	0.045	116.242	0.031	90.156	0.029
MA	8.160	0.003	12.865	0.003	7.109	0.002	93.437	0.018	116.255	0.018	90.111	0.014
MA3	8.158	0.005	12.864	0.006	7.110	0.004	93.458	0.053	116.248	0.022	90.131	0.021
GR	8.162	0.004	12.862	0.003	7.111	0.002	93.477	0.039	116.236	0.022	90.095	0.018
NT	8.162	0.004	12.872	0.005	7.110	0.003	93.434	0.042	116.219	0.025	90.126	0.024
BD	8.160	0.008	12.864	0.004	7.108	0.003	93.493	0.025	116.235	0.029	90.089	0.017
PT	8.159	0.007	12.862	0.006	7.106	0.003	93.438	0.059	116.257	0.035	90.137	0.045
MG	8.157	0.006	12.860	0.006	7.104	0.004	93.501	0.045	116.221	0.025	90.072	0.024
ZE	8.167	0.006	12.867	0.005	7.111	0.005	93.450	0.044	116.262	0.018	90.108	0.034
AV	8.163	0.002	12.870	0.005	7.108	0.003	93.279	0.040	116.218	0.021	90.194	0.031
CA	8.152	0.003	12.841	0.009	7.108	0.004	93.487	0.113	116.260	0.045	90.066	0.044
TC	8.161	0.010	12.862	0.008	7.105	0.002	93.336	0.054	116.137	0.028	90.109	0.111

Alkali Feldspar Unit-Cell Parameters												
Sample	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	α (°)	σ_α (°)	β (°)	σ_β (°)	γ (°)	σ_γ (°)
JK	8.551	0.026	12.952	0.030	7.147	0.024	90	--	115.73	0.14	90	--
CB	8.525	0.027	12.973	0.030	7.175	0.027	90	--	115.56	0.18	90	--
WJ	8.578	0.006	13.016	0.007	7.165	0.007	90	--	116.00	0.06	90	--
CH	8.584	0.013	13.009	0.018	7.160	0.015	90	--	115.96	0.13	90	--
TP	8.526	0.020	12.986	0.016	7.152	0.015	90	--	115.94	0.17	90	--
BK	8.540	0.020	13.010	0.020	7.150	0.020	90	--	115.80	0.10	90	--
DU	8.622	0.034	12.910	0.024	7.200	0.072	90	--	116.21	0.37	90	--
GE	8.607	0.078	12.989	0.025	7.239	0.034	90	--	117.13	1.27	90	--
GE2	8.630	0.041	12.887	0.037	7.149	0.011	90	--	115.96	0.08	90	--
GG	8.618	0.021	12.943	0.043	7.220	0.026	90	--	116.80	0.55	90	--
CA	8.625	0.005	12.932	0.015	7.179	0.019	90	--	116.62	0.14	90	--

Olivine Unit-Cell Parameters												
Sample	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	α (°)	σ_α (°)	β (°)	σ_β (°)	γ (°)	σ_γ (°)
RK	4.7850	0.0030	10.3180	0.0040	6.0250	0.0030	90	--	90	--	90	--
JK	4.7912	0.0189	10.2890	0.0124	6.0440	0.0157	90	--	90	--	90	--
CB	4.8085	0.0317	10.2770	0.0209	6.0260	0.0409	90	--	90	--	90	--
WJ	4.7727	0.0074	10.2885	0.0095	6.0057	0.0111	90	--	90	--	90	--
GB	4.7850	0.0030	10.3270	0.0030	6.0330	0.0040	90	--	90	--	90	--
OG	4.7842	0.0056	10.3111	0.0074	6.0297	0.0057	90	--	90	--	90	--
EB	4.7603	0.0035	10.3019	0.0038	6.0173	0.0056	90	--	90	--	90	--

Augite Unit-Cell Parameters												
Sample	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	α (°)	σ_α (°)	β (°)	σ_β (°)	γ (°)	σ_γ (°)
RK	9.767	0.022	8.924	0.013	5.263	0.011	90	--	106.47	0.21	90	--
WJ	9.744	0.009	8.925	0.011	5.258	0.010	90	--	106.36	0.06	90	--
GB	9.785	0.015	8.922	0.013	5.276	0.013	90	--	106.45	0.09	90	--
OG	9.728	0.045	8.907	0.022	5.268	0.012	90	--	106.82	0.35	90	--
DU	9.698	0.013	8.999	0.021	5.249	0.031	90	--	105.75	0.19	90	--
ST	9.632	0.077	9.013	0.036	5.236	0.010	90	--	105.81	0.16	90	--
RH	9.736	0.028	9.005	0.004	5.239	0.008	90	--	105.53	0.15	90	--
GR	9.661	0.161	8.998	0.086	5.236	0.050	90	--	105.49	1.15	90	--
NT	9.582	0.154	9.017	0.125	5.218	0.057	90	--	105.38	0.30	90	--
PT	9.734	0.063	8.977	0.059	5.251	0.056	90	--	106.13	0.34	90	--

MG	9.808	0.085	8.904	0.092	5.227	0.045	90	--	106.09	0.32	90	--
ZE	9.693	0.046	8.954	0.095	5.250	0.043	90	--	105.97	0.48	90	--
CA	9.790	0.079	8.902	0.071	5.249	0.029	90	--	106.25	0.64	90	--
TC	9.742	0.010	8.939	0.016	5.272	0.004	90	--	106.26	0.20	90	--

Pigeonite Unit-Cell Parameters												
Sample	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	α (°)	σ_α (°)	β (°)	σ_β (°)	γ (°)	σ_γ (°)
RK	9.651	0.015	8.942	0.018	5.235	0.021	90	--	108.35	0.08	90	--
JK	9.686	0.020	8.917	0.018	5.208	0.019	90	--	108.57	0.14	90	--
CB	9.680	0.019	8.925	0.020	5.220	0.021	90	--	108.53	0.10	90	--
WJ	9.648	0.016	8.895	0.029	5.210	0.016	90	--	108.58	0.21	90	--
CH	9.651	0.016	8.920	0.021	5.210	0.016	90	--	108.57	0.09	90	--
MJ2	9.670	0.031	8.916	0.034	5.197	0.038	90	--	108.66	0.34	90	--
TP	9.670	0.040	8.926	0.057	5.194	0.038	90	--	108.62	0.29	90	--
BS	9.672	0.009	8.886	0.010	5.222	0.009	90	--	108.56	0.04	90	--
GB	9.675	0.022	8.941	0.027	5.254	0.029	90	--	108.69	0.14	90	--
LB	9.673	0.030	8.889	0.027	5.213	0.030	90	--	108.28	0.14	90	--
OK	9.667	0.007	8.891	0.008	5.217	0.008	90	--	108.51	0.03	90	--
OG	9.677	0.041	8.908	0.043	5.246	0.031	90	--	108.58	0.30	90	--
EB	9.625	0.022	8.925	0.069	5.168	0.023	90	--	108.34	0.47	90	--
HU	9.683	0.032	8.884	0.089	5.189	0.018	90	--	108.47	0.28	90	--
GG	9.614	0.063	8.866	0.061	5.258	0.071	90	--	108.36	0.38	90	--
MA	9.633	0.016	8.902	0.021	5.206	0.013	90	--	108.30	0.11	90	--
MA3	9.621	0.048	8.919	0.032	5.211	0.012	90	--	108.53	0.21	90	--
GR	9.591	0.008	8.988	0.024	5.162	0.034	90	--	107.89	0.13	90	--
NT	9.610	0.019	8.952	0.027	5.209	0.019	90	--	107.77	0.17	90	--
BD	9.619	0.021	8.977	0.021	5.198	0.021	90	--	108.08	0.15	90	--
PT	9.693	0.035	8.815	0.035	5.240	0.036	90	--	109.16	0.18	90	--
MG	9.731	0.044	8.832	0.040	5.271	0.047	90	--	108.96	0.30	90	--
ZE	9.677	0.042	8.915	0.053	5.223	0.019	90	--	108.45	0.25	90	--
AV	9.703	0.021	8.895	0.028	5.262	0.007	90	--	109.01	0.10	90	--
CA	9.696	0.050	8.843	0.048	5.250	0.024	90	--	109.30	0.48	90	--
TC	9.701	0.069	8.914	0.047	5.253	0.036	90	--	108.49	0.22	90	--

Orthopyroxene Unit-Cell Parameters												
Sample	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	α (°)	σ_α (°)	β (°)	σ_β (°)	γ (°)	σ_γ (°)
JK	18.33	0.03	8.96	0.01	5.23	0.01	90	--	90	--	90	--
CB	18.34	0.02	8.95	0.01	5.24	0.01	90	--	90	--	90	--
BS	18.27	0.02	8.99	0.01	5.22	0.01	90	--	90	--	90	--
GH	18.35	0.04	8.96	0.01	5.25	0.01	90	--	90	--	90	--
LB	18.33	0.05	8.96	0.02	5.25	0.01	90	--	90	--	90	--
OK	18.31	0.06	8.95	0.05	5.24	0.02	90	--	90	--	90	--
OU	18.33	0.04	8.96	0.02	5.24	0.01	90	--	90	--	90	--
DU	18.39	0.03	8.87	0.05	5.30	0.09	90	--	90	--	90	--
ST	18.32	0.02	8.97	0.00	5.26	0.01	90	--	90	--	90	--
RH	18.38	0.03	8.86	0.06	5.24	0.01	90	--	90	--	90	--
HF	18.38	0.01	8.92	0.02	5.24	0.00	90	--	90	--	90	--
GR	18.29	0.04	8.90	0.03	5.22	0.00	90	--	90	--	90	--
BD	18.28	0.02	8.91	0.01	5.23	0.01	90	--	90	--	90	--
PT	18.35	0.02	8.91	0.02	5.26	0.01	90	--	90	--	90	--
MG	18.44	0.13	8.92	0.04	5.22	0.04	90	--	90	--	90	--
ZE	18.32	0.03	8.89	0.01	5.23	0.01	90	--	90	--	90	--
AV	18.36	0.03	8.86	0.04	5.26	0.03	90	--	90	--	90	--
CA	18.31	0.11	8.93	0.05	5.26	0.02	90	--	90	--	90	--

Cubic Spinel Oxide Unit-Cell Parameters												
Sample	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	α (°)	σ_α (°)	β (°)	σ_β (°)	γ (°)	σ_γ (°)
RK	8.381	0.004	--	--	--	--	90	--	90	--	90	--
JK	8.372	0.002	--	--	--	--	90	--	90	--	90	--

CB	8.369	0.002	--	--	--	--	90	--	90	--	90	--
WJ	8.373	0.001	--	--	--	--	90	--	90	--	90	--
CH	8.365	0.003	--	--	--	--	90	--	90	--	90	--
MJ2	8.357	0.002	--	--	--	--	90	--	90	--	90	--
TP	8.355	0.001	--	--	--	--	90	--	90	--	90	--
BK	8.359	0.001	--	--	--	--	90	--	90	--	90	--
BS	8.389	0.001	--	--	--	--	90	--	90	--	90	--
GH	8.387	0.001	--	--	--	--	90	--	90	--	90	--
GB	8.380	0.008	--	--	--	--	90	--	90	--	90	--
LB	8.380	0.003	--	--	--	--	90	--	90	--	90	--
OK	8.383	0.001	--	--	--	--	90	--	90	--	90	--
OG	8.370	0.017	--	--	--	--	90	--	90	--	90	--
ST	8.313	0.014	--	--	--	--	90	--	90	--	90	--
EB	8.362	0.003	--	--	--	--	90	--	90	--	90	--
HU	8.391	0.001	--	--	--	--	90	--	90	--	90	--

Table S3. Unit-cell parameters and estimated Ca compositions of plagioclase observed in Gale crater samples by the CheMin instrument. Uncertainty reported as 1σ .

Sample	Plagioclase Compositions													Ca (apfu)	σ_{Ca} (apfu)
	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	α (°)	σ_α (°)	β (°)	σ_β (°)	γ (°)	σ_γ (°)			
RK	8.168	0.006	12.863	0.006	7.108	0.004	93.460	0.050	116.220	0.030	90.120	0.030	0.48	0.04	
JK	8.162	0.005	12.860	0.008	7.108	0.005	93.470	0.050	116.290	0.030	90.100	0.040	0.40	0.04	
CB	8.162	0.007	12.860	0.008	7.112	0.007	93.420	0.053	116.337	0.037	90.103	0.035	0.32	0.05	
WJ	8.172	0.040	12.912	0.081	7.108	0.049	94.345	0.977	116.271	0.450	89.902	0.606	0.14	0.68	
CH	8.166	0.007	12.859	0.007	7.111	0.004	93.440	0.060	116.310	0.040	90.160	0.040	0.38	0.04	
MJ2	8.164	0.004	12.859	0.003	7.110	0.002	93.500	0.040	116.280	0.010	90.100	0.030	0.41	0.03	
TP	8.157	0.003	12.858	0.006	7.111	0.002	93.470	0.020	116.280	0.020	90.080	0.020	0.36	0.03	
BK	8.155	0.003	12.862	0.004	7.106	0.004	93.320	0.020	116.280	0.020	90.100	0.020	0.39	0.03	
BS	8.159	0.008	12.875	0.008	7.103	0.007	93.470	0.060	116.090	0.040	89.970	0.050	0.52	0.05	
GH	8.165	0.007	12.891	0.009	7.108	0.007	93.240	0.070	116.100	0.040	90.060	0.040	0.38	0.06	
GB	8.181	0.007	12.868	0.007	7.107	0.006	93.490	0.050	116.190	0.040	90.060	0.030	0.63	0.06	
LB	8.166	0.011	12.891	0.011	7.111	0.009	93.260	0.100	116.210	0.050	90.040	0.060	0.27	0.08	
OU	8.163	0.005	12.852	0.007	7.110	0.004	93.520	0.040	116.310	0.040	90.050	0.050	0.41	0.04	
OK	8.160	0.008	12.880	0.007	7.108	0.006	93.590	0.070	116.170	0.040	89.910	0.060	0.38	0.05	
MB	8.161	0.007	12.853	0.010	7.112	0.004	93.380	0.060	116.290	0.040	90.100	0.020	0.38	0.04	
SB	8.162	0.009	12.875	0.019	7.110	0.007	93.410	0.160	116.220	0.070	90.020	0.090	0.36	0.08	
QL	8.162	0.009	12.875	0.018	7.110	0.007	93.410	0.150	116.220	0.060	90.020	0.090	0.36	0.08	
OG	8.169	0.006	12.866	0.012	7.107	0.004	93.418	0.023	116.229	0.035	90.169	0.050	0.48	0.05	
DU	8.165	0.006	12.864	0.006	7.116	0.002	93.457	0.044	116.268	0.019	90.081	0.019	0.34	0.04	
ST	8.151	0.003	12.865	0.009	7.104	0.005	93.316	0.036	116.231	0.018	90.111	0.023	0.42	0.04	
RH	8.155	0.005	12.875	0.001	7.113	0.002	93.434	0.047	116.247	0.023	90.150	0.023	0.27	0.03	
HF	8.177	0.008	12.879	0.012	7.106	0.003	92.860	0.300	116.330	0.040	90.270	0.030	0.43	0.07	
EB	8.149	0.010	12.849	0.027	7.109	0.008	92.846	0.209	116.470	0.092	90.167	0.102	0.24	0.08	
AL	8.176	0.011	12.850	0.011	7.112	0.007	93.409	0.096	116.172	0.054	90.225	0.059	0.59	0.08	
KM	8.154	0.006	12.871	0.006	7.108	0.007	93.453	0.042	116.167	0.033	90.096	0.027	0.39	0.05	
GE	8.157	0.005	12.863	0.010	7.107	0.005	93.412	0.125	116.206	0.021	90.129	0.061	0.43	0.04	
GE2	8.164	0.006	12.854	0.008	7.110	0.006	93.407	0.036	116.282	0.051	90.104	0.034	0.43	0.05	
HU	8.163	0.005	12.888	0.004	7.110	0.004	93.510	0.088	116.262	0.041	90.072	0.051	0.25	0.04	
GG	8.144	0.008	12.841	0.009	7.105	0.005	93.339	0.045	116.242	0.031	90.156	0.029	0.46	0.04	
MA	8.160	0.003	12.865	0.003	7.109	0.002	93.437	0.018	116.255	0.018	90.111	0.014	0.38	0.03	
MA3	8.158	0.005	12.864	0.006	7.110	0.004	93.458	0.053	116.248	0.022	90.131	0.021	0.37	0.04	
GR	8.162	0.004	12.862	0.003	7.111	0.002	93.477	0.039	116.236	0.022	90.095	0.018	0.40	0.03	
NT	8.162	0.004	12.872	0.005	7.110	0.003	93.434	0.042	116.219	0.025	90.126	0.024	0.37	0.03	
BD	8.160	0.008	12.864	0.004	7.108	0.003	93.493	0.025	116.235	0.029	90.089	0.017	0.41	0.04	
PT	8.159	0.007	12.862	0.006	7.106	0.003	93.438	0.059	116.257	0.035	90.137	0.045	0.43	0.04	
MG	8.157	0.006	12.860	0.006	7.104	0.004	93.501	0.045	116.221	0.025	90.072	0.024	0.47	0.04	
ZE	8.167	0.006	12.867	0.005	7.111	0.005	93.450	0.044	116.262	0.018	90.108	0.034	0.40	0.04	
AV	8.163	0.002	12.870	0.005	7.108	0.003	93.279	0.040	116.218	0.021	90.194	0.031	0.40	0.03	
CA	8.152	0.003	12.841	0.009	7.108	0.004	93.487	0.113	116.260	0.045	90.066	0.044	0.43	0.03	
TC	8.161	0.010	12.862	0.008	7.105	0.002	93.336	0.054	116.137	0.028	90.109	0.111	0.53	0.05	

Table S4. Unit-cell parameters and estimated Na compositions and ordering state of alkali feldspar observed in Gale crater samples by the CheMin instrument. Uncertainty reported as 1σ .

Alkali Feldspar Compositions and Ordering State												
Sample	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	β (°)	σ_β (°)	Na (apfu)	σ_{Na} (apfu)	Ordering	σ_{Ordering}
JK	8.551	0.026	12.952	0.030	7.147	0.024	115.73	0.14	0.47	0.18	0.05	0.36
CB	8.525	0.027	12.973	0.030	7.175	0.027	115.56	0.18	0.23	0.19	0.31	0.40
WJ	8.578	0.006	13.016	0.007	7.165	0.007	116.00	0.06	0.13	0.05	-0.07	0.10
CH	8.584	0.013	13.009	0.018	7.160	0.015	115.96	0.13	0.18	0.11	-0.10	0.23
TP	8.526	0.020	12.986	0.016	7.152	0.015	115.94	0.17	0.31	0.11	-0.07	0.22
BK	8.540	0.020	13.010	0.020	7.150	0.020	115.80	0.10	0.23	0.14	-0.24	0.29
DU	8.622	0.034	12.910	0.024	7.200	0.072	116.21	0.37	0.32	0.43	1.01	0.97
GE	8.607	0.078	12.989	0.025	7.239	0.034	117.13	1.27	-0.20	0.22	1.07	0.47
GE2	8.630	0.041	12.887	0.037	7.149	0.011	115.96	0.08	0.70	0.15	0.46	0.26
GG	8.618	0.021	12.943	0.043	7.220	0.026	116.80	0.55	0.08	0.22	1.08	0.43
CA	8.625	0.005	12.932	0.015	7.179	0.019	116.62	0.14	0.36	0.12	0.60	0.27

Table S5. Unit-cell parameters and estimated Mg compositions of olivine observed in Gale crater samples by the CheMin instrument. Uncertainty reported as 1σ .

Olivine Compositions									
Sample	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	Mg (apfu)	σ_{Mg} (apfu)	
RK	4.7850	0.0030	10.3180	0.0040	6.0250	0.0030	1.14	0.03	
JK	4.7912	0.0189	10.2890	0.0124	6.0440	0.0157	1.35	0.09	
CB	4.8085	0.0317	10.2770	0.0209	6.0260	0.0409	1.44	0.15	
WJ	4.7727	0.0074	10.2885	0.0095	6.0057	0.0111	1.35	0.07	
GB	4.7850	0.0030	10.3270	0.0030	6.0330	0.0040	1.08	0.03	
OG	4.7842	0.0056	10.3111	0.0074	6.0297	0.0057	1.19	0.06	
EB	4.7603	0.0035	10.3019	0.0038	6.0173	0.0056	1.26	0.03	

Table S6. Unit-cell parameters and estimated Mg, Ca, and Fe compositions of augite observed in Gale crater samples by the CheMin instrument. Uncertainty reported as 1σ .

Augite Compositions														
Sample	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	β (°)	σ_β (°)	Mg (apfu)	σ_{Mg} (apfu)	Ca (apfu)	σ_{Ca} (apfu)	Fe (apfu)	σ_{Fe} (apfu)
RK	9.767	0.022	8.924	0.013	5.263	0.011	106.47	0.21	0.94	0.09	0.72	0.04	0.34	0.10
WJ	9.744	0.009	8.925	0.011	5.258	0.010	106.36	0.06	1.03	0.07	0.75	0.04	0.21	0.09
GB	9.785	0.015	8.922	0.013	5.276	0.013	106.45	0.09	0.89	0.08	0.73	0.03	0.38	0.09
OG	9.728	0.045	8.907	0.022	5.268	0.012	106.82	0.35	1.27	0.19	0.66	0.07	0.07	0.23
DU	9.698	0.013	8.999	0.021	5.249	0.031	105.75	0.19	0.57	0.12	0.77	0.05	0.66	0.16
ST	9.632	0.077	9.013	0.036	5.236	0.010	105.81	0.16	0.65	0.27	0.74	0.08	0.60	0.34
RH	9.736	0.028	9.005	0.004	5.239	0.008	105.53	0.15	0.41	0.06	0.81	0.04	0.78	0.07
GR	9.661	0.161	8.998	0.086	5.236	0.050	105.49	1.15	0.77	0.54	0.88	0.24	0.35	0.73
NT	9.582	0.154	9.017	0.125	5.218	0.057	105.38	0.30	1.00	0.71	0.95	0.26	0.06	0.96
PT	9.734	0.063	8.977	0.059	5.251	0.056	106.13	0.34	0.63	0.26	0.72	0.09	0.65	0.32
MG	9.808	0.085	8.904	0.092	5.227	0.045	106.09	0.32	0.94	0.39	0.89	0.15	0.16	0.47
ZE	9.693	0.046	8.954	0.095	5.250	0.043	105.97	0.48	1.14	0.60	0.99	0.30	-0.13	0.88
CA	9.790	0.079	8.902	0.071	5.249	0.029	106.25	0.64	1.03	0.35	0.82	0.13	0.14	0.41
TC	9.742	0.010	8.939	0.016	5.272	0.004	106.26	0.20	0.92	0.09	0.76	0.05	0.32	0.12

Table S7. Unit-cell parameters and estimated Mg, Ca, and Fe compositions of pigeonite observed in Gale crater samples by the CheMin instrument. Uncertainty reported as 1σ .

Pigeonite Compositions														
Sample	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	β (°)	σ_β (°)	Mg (apfu)	σ_{Mg} (apfu)	Ca (apfu)	σ_{Ca} (apfu)	Fe (apfu)	σ_{Fe} (apfu)
RK	9.651	0.015	8.942	0.018	5.235	0.021	108.35	0.08	0.97	0.08	0.00	0.03	1.03	0.09
JK	9.686	0.020	8.917	0.018	5.208	0.019	108.57	0.14	1.17	0.10	0.19	0.06	0.64	0.14

CB	9.680	0.019	8.925	0.020	5.220	0.021	108.53	0.10	1.08	0.11	0.14	0.08	0.78	0.16
WJ	9.648	0.016	8.895	0.029	5.210	0.016	108.58	0.21	1.29	0.13	0.01	0.06	0.70	0.15
CH	9.651	0.016	8.920	0.021	5.210	0.016	108.57	0.09	1.10	0.09	0.00	0.04	0.90	0.09
MJ2	9.670	0.031	8.916	0.034	5.197	0.038	108.66	0.34	1.14	0.16	0.08	0.10	0.78	0.22
TP	9.670	0.040	8.926	0.057	5.194	0.038	108.62	0.29	1.05	0.23	0.06	0.13	0.89	0.30
BS	9.672	0.009	8.886	0.010	5.222	0.009	108.56	0.04	1.44	0.07	0.17	0.04	0.40	0.09
GB	9.675	0.022	8.941	0.027	5.254	0.029	108.69	0.14	0.94	0.12	0.06	0.08	1.00	0.17
LB	9.673	0.030	8.889	0.027	5.213	0.030	108.28	0.14	1.54	0.17	0.28	0.06	0.18	0.17
OK	9.667	0.007	8.891	0.008	5.217	0.008	108.51	0.03	1.39	0.07	0.13	0.05	0.48	0.10
OG	9.677	0.041	8.908	0.043	5.246	0.031	108.58	0.30	1.23	0.21	0.15	0.11	0.63	0.28
EB	9.625	0.022	8.925	0.069	5.168	0.023	108.34	0.47	1.15	0.28	0.00	0.03	0.85	0.28
HU	9.683	0.032	8.884	0.089	5.189	0.018	108.47	0.28	1.49	0.46	0.24	0.12	0.27	0.57
GG	9.614	0.063	8.866	0.061	5.258	0.071	108.36	0.38	1.60	0.27	0.00	0.14	0.40	0.32
MA	9.633	0.016	8.902	0.021	5.206	0.013	108.30	0.11	1.29	0.10	0.00	0.03	0.71	0.10
MA3	9.621	0.048	8.919	0.032	5.211	0.012	108.53	0.21	1.18	0.14	0.00	0.04	0.82	0.14
GR	9.591	0.008	8.988	0.024	5.162	0.034	107.89	0.13	0.79	0.11	0.00	0.03	1.21	0.12
NT	9.610	0.019	8.952	0.027	5.209	0.019	107.77	0.17	1.03	0.14	0.00	0.29	0.97	0.35
BD	9.619	0.021	8.977	0.021	5.198	0.021	108.08	0.15	0.80	0.10	0.00	0.03	1.20	0.10
PT	9.693	0.035	8.815	0.035	5.240	0.036	109.16	0.18	1.75	0.14	0.15	0.04	0.10	0.13
MG	9.731	0.044	8.832	0.040	5.271	0.047	108.96	0.30	1.62	0.16	0.23	0.05	0.15	0.14
ZE	9.677	0.042	8.915	0.053	5.223	0.019	108.45	0.25	1.19	0.26	0.17	0.13	0.64	0.35
AV	9.703	0.021	8.895	0.028	5.262	0.007	109.01	0.10	1.26	0.12	0.19	0.04	0.54	0.13
CA	9.696	0.050	8.843	0.048	5.250	0.024	109.30	0.48	1.55	0.18	0.16	0.05	0.29	0.17
TC	9.701	0.069	8.914	0.047	5.253	0.036	108.49	0.22	1.20	0.25	0.29	0.09	0.51	0.30

Table S8. Unit-cell parameters and estimated Mg, Ca, and Fe compositions of orthopyroxene observed in Gale crater samples by the CheMin instrument. Uncertainty reported as 1σ .

Sample	Orthopyroxene Composition											
	a (Å)	σ_a (Å)	b (Å)	σ_b (Å)	c (Å)	σ_c (Å)	Mg (apfu)	σ_{Mg} (apfu)	Ca (apfu)	σ_{Ca} (apfu)	Fe (apfu)	σ_{Fe} (apfu)
JK	18.33	0.03	8.96	0.01	5.23	0.01	0.75	0.08	0.00	0.04	1.25	0.08
CB	18.34	0.02	8.95	0.01	5.24	0.01	0.83	0.08	0.02	0.05	1.16	0.10
BS	18.27	0.02	8.99	0.01	5.22	0.01	0.69	0.07	0.00	0.02	1.31	0.07
GH	18.35	0.04	8.96	0.01	5.25	0.01	0.80	0.08	0.04	0.04	1.16	0.09
LB	18.33	0.05	8.96	0.02	5.25	0.01	0.81	0.10	0.00	0.06	1.19	0.11
OK	18.31	0.06	8.95	0.05	5.24	0.02	0.86	0.20	0.00	0.06	1.14	0.20
OU	18.33	0.04	8.96	0.02	5.24	0.01	0.81	0.11	0.01	0.06	1.19	0.12
DU	18.39	0.03	8.87	0.05	5.30	0.09	1.34	0.25	0.08	0.02	0.58	0.25
ST	18.32	0.02	8.97	0.00	5.26	0.01	0.73	0.05	0.00	0.02	1.27	0.05
RH	18.38	0.03	8.86	0.06	5.24	0.01	1.50	0.31	0.08	0.02	0.42	0.31
HF	18.38	0.01	8.92	0.02	5.24	0.00	0.99	0.12	0.08	0.02	0.93	0.12
GR	18.29	0.04	8.90	0.03	5.22	0.00	1.24	0.15	0.01	0.05	0.75	0.16
BD	18.28	0.02	8.91	0.01	5.23	0.01	1.15	0.08	0.00	0.03	0.85	0.08
PT	18.35	0.02	8.91	0.02	5.26	0.01	1.15	0.10	0.08	0.02	0.77	0.10
MG	18.44	0.13	8.92	0.04	5.22	0.04	0.97	0.23	0.08	0.02	0.95	0.23
ZE	18.32	0.03	8.89	0.01	5.23	0.01	1.28	0.09	0.08	0.02	0.64	0.09
AV	18.36	0.03	8.86	0.04	5.26	0.03	1.50	0.21	0.08	0.02	0.42	0.21
CA	18.31	0.11	8.93	0.05	5.26	0.02	1.01	0.24	0.01	0.05	0.98	0.23

Table S9. Unit-cell parameters and estimated chemical compositions, as cation apfu, of cubic spinel oxides observed in Gale crater samples by the CheMin instrument. Uncertainty reported as 1σ .

Cubic Spinel Oxide Compositions																		
Source		RK	JK	CB	WJ	CH	MJ2	TP	BK	BS	GH	GB	LB	OK	OG	ST	EB	HU
a (Å)		8.381	8.372	8.369	8.373	8.365	8.357	8.355	8.359	8.389	8.387	8.38	8.38	8.383	8.37	8.313	8.362	8.391
σ_a (Å)		0.004	0.002	0.002	0.001	0.003	0.002	0.001	0.001	0.001	0.001	0.008	0.003	0.001	0.017	0.014	0.003	0.001
$\text{Fe}_{3-x}\text{O}_4$	Fe (apfu)	2.86	2.82	2.81	2.83	2.79	2.76	2.75	2.77	2.90	2.89	2.86	2.86	2.87	2.81	2.57	2.78	2.91
	σ_{Fe} (apfu)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.05	0.09	0.08	0.05	0.05
MgFe_2O_4	Fe	--	--	--	--	--	--	--	--	2.37	2.22	--	--	--	--	--	--	2.52
	σ_{Fe}	--	--	--	--	--	--	--	--	0.09	0.09	--	--	--	--	--	--	0.12
	Mg	--	--	--	--	--	--	--	--	0.63	0.78	--	--	--	--	--	--	0.48
Fe_2TiO_4	Fe	--	--	--	--	--	--	--	--	2.99	--	--	--	--	--	--	--	2.98
	σ_{Fe}	--	--	--	--	--	--	--	--	0.03	--	--	--	--	--	--	--	0.03
	Ti	--	--	--	--	--	--	--	--	0.01	--	--	--	--	--	--	--	0.02
FeAl_2O_4	Fe	2.87	2.79	2.77	2.8	2.74	2.67	2.65	2.69	2.93	2.92	2.86	2.86	2.89	2.78	2.31	2.71	2.95

	σ_{Fe}	0.04	0.03	0.03	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.07	0.03	0.02	0.14	0.12	0.03	0.02
	Al	0.13	0.21	0.23	0.20	0.26	0.33	0.35	0.31	0.07	0.08	0.14	0.14	0.11	0.22	0.69	0.29	0.05
NiFe ₂ O ₄	Fe	2.73	2.57	2.52	2.59	2.44	2.03	2.27	2.34	2.87	2.84	2.71	2.71	2.76	2.53	--	2.38	2.91
	σ_{Fe}	0.04	0.03	0.03	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.07	0.03	0.02	0.14	--	0.03	0.02
	Ni	0.27	0.43	0.48	0.41	0.56	0.70	0.73	0.66	0.13	0.16	0.29	0.29	0.24	0.47	--	0.62	0.09
(FeMgCr ³⁺) ₃ O ₄	Fe	1.09	0.89	0.82	0.91	0.73	0.55	0.51	0.6	--	--	1.07	1.07	--	0.84	--	0.66	--
	σ_{Fe}	0.09	0.05	0.05	0.03	0.07	0.05	0.03	0.03	--	--	0.18	0.07	--	0.38	--	0.07	--
	Mg	-0.09	0.11	0.18	0.09	0.27	0.45	0.49	0.40	--	--	-0.07	-0.07	--	0.16	--	0.34	--
	σ_{Mg}	0.09	0.05	0.05	0.03	0.07	0.05	0.03	0.03	--	--	0.18	0.07	--	0.38	--	0.07	--
	Cr	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	--	--	2.00	2.00	--	2.00	--	2.00	--
	σ_{Cr}	0.13	0.07	0.07	0.05	0.10	0.07	0.05	0.05	--	--	0.26	0.10	--	0.54	--	0.10	--
Fe _{1-x} Al _{2-y-x+y} O ₄	Fe	2.76	2.71	2.69	2.71	2.66	2.61	2.6	2.62	2.82	2.80	2.76	2.76	2.78	2.69	2.32	2.64	2.83
	σ_{Fe}	0.05	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.07	0.05	0.04	0.12	0.10	0.05	0.04
	Al	0.11	0.14	0.15	0.14	0.16	0.19	0.2	0.19	0.08	0.08	0.11	0.11	0.10	0.15	0.36	0.18	0.07
	σ_{Al}	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.09	0.08	0.06	0.06
	Vac ()	0.13	0.16	0.16	0.15	0.18	0.20	0.20	0.19	0.11	0.11	0.13	0.13	0.12	0.16	0.32	0.18	0.10
	σ	0.08	0.07	0.07	0.07	0.08	0.07	0.07	0.07	0.07	0.07	0.09	0.08	0.07	0.15	0.13	0.08	0.07