Table 1. Salts used in the ESD process and analysis.

Mineral name	Salts	Sources	MP (°C) *	time duration of ESD	Raman	XRD	MB	VNIR	IC
Epsomite	$MgSO_4.7H_2O$	Sigma-Aldrich	150	0.25, 1, 2, 7h	*as is* surfaces	bulk sample			
Starkeyite	$MgSO_4.4H_2O$	made from $MgSO_4.7H_2O$	NA	1.5h	*as is* surfaces	bulk sample			
Kieserite	$MgSO_4.H_2O$	Aldrich	150	1.5h, 8.5h	*as is* surfaces	bulk sample			
Melanterite	$FeSO_4.7H_2O$	Fisher	60	0.25, 1, 3, 7h @ < 30°C*	*as is* surfaces	bulk sample	bulk sample	*as is* surfaces	
Rozenite	$FeSO_4.4H_2O$	made from $FeSO_4.7H_2O$	NA	1.5h	*as is* surfaces	bulk sample			
Szomolnokite	$FeSO_4.H_2O$	made from $FeSO_4.7H_2O$	300	1.5, 8.5, 15.5h	*as is* surfaces	bulk sample			
Ferricopiapite	$Fe_{4.67}(SO_4)_6(OH)_2.20H_2O$	made from $Fe_2(SO_4)_3.5H_2O$ of ACROS	NA	0.25h, 1h, 2h, 3h, 7h	*as is* surfaces				
Na-Jarosite	$NaFe_3(OH)_6(SO_4)_2$	RUBLEV	NA	0.25h, 1h, 2h, 7h,28h, 31h, 57h, 64h	*as is* surfaces		bulk sample	*as is* surfaces	
Na-jarosite +	$MgCl_2.6H_2O$ at 1:1		NA	1h, 2h, 3h, 7h	*as is* surfaces		bulk sample		
Na-jarosite +	$MgSO_4.7H_2O$ at 1:1		NA	1h, 2h, 3h, 7h	*as is* surfaces		bulk sample		
Gypsum	$CaSO_4.2H_2O$	Alfa Aesor	150	0.25, 1, 2, 7, 14, 16, 18h	*as is* surfaces				
Thenardite_	Na_2SO_4	Sigma-Aldrich	884	0.25, 1, 2, 7h	*as is* surfaces				
Sodium sulfite	Na_2SO_3	Sigma	NA	0.25, 1, 2, 7h	*as is* surfaces	bulk sample			Dissolved bulk sample
Sodium bisulfite	$NaHSO_3$	Sigma	NA	0.25, 1, 2, 7, 11h	*as is* surfaces	bulk sample			
Halite	NaCl	Sigma-Aldrich	801	7h		bulk sample			
Sylvite	KCl	Fisher	771	7h		bulk sample			
Bischofite	$MgCl_2.6H_2O$	Sigma-Aldrich	100	7h, 14h@ < 30°C		bulk sample			
Rokuhnite	$FeCl_2.4H_2O$	Fisher	105	7h @ < 30°C	*as is* surfaces	bulk sample	bulk sample	*as is* surfaces	
Sinjarite	$CaCl_2.2H_2O$	ACROS	175	7h, 14h @ < 30°C		bulk sample			
Chloraluminite	$AlCl_3.6H_2O$	Sigma	100	7h @ < 30°C		bulk sample			
Pyrite	FeS_2	natural from Huanzala, Peru	NA	3h, 7h, 10h, 14h	*as is* surfaces	bulk sample	bulk sample	*as is* surfaces	
Akaganeite	FeO(OH,Cl)	made by Fu et al., 2019	NA	0.25h, 1h, 2h, 3h, 7h	*as is* surfaces		bulk sample		

* melting point (°C) from CRC Handbook of Chemistry and Physics, 82nd edition (Lide 2001)

Table 2. Mössbauer parameters obtained from curve fittings.

Sample	7h-ESD from $FeCl_2{\cdot}4H_2O$	7h-ESD from $FeSO_4{\cdot}7H_2O$	7h-ESD from $FeSO_4{\cdot}7H_2O$
Model	Lorentzian/Full Hamiltonian	Lorentzian/Full Hamiltonian	QSD/Velocity approximation
Parameter			
CS 1	0.37	0.49	0.47
QS 1	0.55	0.57	0.57
Width 1	0.29	0.40	0.35*
Area 1	48	23	15
CS 2	0.38	0.42	0.42
QS 2	0.93	1.20	1.09
Width 2	0.32	0.49	0.54
Area 2	40	21	29
CS 3	1.22	1.28	1.27
QS 3	2.96	2.64	2.66
Width 3	0.26*	0.39	0.38
Area 3	5	19	19
CS 4	1.26	1.21	1.24
QS 4	2.10	2.29	2.24
Width 4	0.26	0.45	0.40
Area 4	7	24	20
CS 5		1.29	1.29
QS 5		1.55	1.61
Width 5		0.47	0.53
Area 5		13	17
$\Sigma\%Fe^{3+}$	88	44	44
χ^2	5.98	1.30	1.38

*indicates parameter held constant.

Table 3. Compilation of analyses results of ESD products of the salts studied

Minerals	Salts	Mid-phase after short ESD (≤ 1.5 h)	Final phase after long ESD (≥7h)
Epsomite	$MgSO_4.7H_2O$	$MgSO_4.4H_2O$, Amor-III (Raman)	Amor-III (Raman, XRD)
Starkeyite	$MgSO_4.4H_2O$	Amor-III (Raman)	
Kieserite	$MgSO_4.H_2O$	Amor-II (Raman, XRD)	Amor-II (XRD)
Melanterite	$FeSO_4.7H_2O$	$FeS_{O4}.4H_2O$, FeSO4.H2O, Amor-II (Raman)	Amor-III, $FeSO_4.H_2O$ (Raman, XRD), Fe^{3+}/Fe_{total} =44% (MB)
Rozenite	$FeSO_4.4H_2O$	$FeSO_4.H_2O$, Amor-III (Raman)	
Szomolnokite	$FeSO_4.H_2O$	$FeSO_4.H_2O$, Fe^{2+} to Fe^{3+} (Raman)	Fe^{2+} to Fe^{3+}, $FeSO_4.H_2O$ (Raman, XRD)
Ferricopiapite	$Fe_{4.67}(SO_4)_6(OH)_2.20H_2O$	Ferricopiapite, Rhomboclase, Amor-III (Raman)	Amor-III, mikasaite, $Fe_2(SO_4)_3$ (Raman)
Na-Jarosite	$NaFe_3(OH)_6(SO_4)_2$	No obvious phase change	no obvious phase change, rare hematite, ~ 100% jarosite (MB)
Na-jarosite +	$MgCl_2.6H_2O$ at 1:1	No obvious phase change	No obvious phase change, rare hematite, goethite, ~ 100% jarosite (MB)
Na-jarosite +	$MgSO_4.7H_2O$ at 1:1	No obvious phase change	No obvious phase change, ~100% jarosite (MB)
Gypsum	$CaSO_4.2H_2O$		γ-anhydrite, basanite, Amor-I (Raman)
Thenardite	Na_2SO_4		Amor-I (Raman)
Sodium sulfite	Na_2SO_3		Amor-I (Raman),S^{4+} to S^{6+} (IC)
Sodium bisulfite	$NaHSO_3$		Amor-I, S^{4+} to S^{6+} (XRD)
Halite	NaCl		No obvious phase change
Sylvite	KCl		No obvious phase change
Bischofite	$MgCl_2.6H_2O$		$MgCl_2$ xH_2O (x=1, 2, 4), Amor-I, Cl^{1-} to Cl^{7+} (XRD)
Rokuhnite	$FeCl_2.4H_2O$	Amor-III (Raman)	$FeCl_2.2H_2O$, $FeCl_2$, Amor-III, Fe^{2+} to Fe^{3+}(Raman, XRD), Fe^{3+}/Fe_{total} =88% (MB)
Sinjarite	$CaCl_2.2H_2O$		dehydration
Chloraluminite	$AlCl_3.6H_2O$		Amor-III (XRD)
Akaganiete	FeO(OH,Cl)		No obvious change, ~ 100% Fe^{3+} (MB)
Pyrite	FeS_2		Minor changes (Raman, VNIR, XRD), ~ 98% Fe^{3+} (MB)

Table 4. Rough calculations on grain saltation (GS) and global dust storm (GDS) induced ESD probabilities based on mission observations and various assumptions

Basics		
a year on Mars	668 sols	
a sol on Mars	24h 39m 24s	
total Earth days in a Mars year (day)	687	
total Earth hours in a Mars year (hour)	16488	
Probability in a Mars year	**GS***	**GDS****
Once per every three Mars years		0.33
Assumed duration (10% of a Mars year)		0.1
Assumed area coverage (80% surface)		0.8
Probability having a GDS pass a site		0.026
Total duration of a GDS at a site (hour)		435
Probability of wind speed > 5 m/s (Gale crater)	0.53	
Total duration of GS at Gale crater (hour)	8739	
Chosen ESD occurring probability	**1%**	**0.01%**
Probability to see ESD at a site	5.30E-03	2.6E-06
Duration of ESD at a site (hour)	87	0.0435
Electron flux density vs. current study (ESD-NGD)		
ESD-NGD of same level by GDS		1.0
typical TDD by GS	1.00E-04	
To reach the same level of PT* on Mars (year)**		
End-phases of 0.25h-ESD-NGD	**29**	**5.7**
End-phases of 7h-ESD-NGD	**801**	**161**

* GS = Grain Saltation
** GDS = Global Dust Storm
*** PT= phase transformation