

SUPPORTING INFORMATION (SI)

Thermodynamics of the double sulfates $\text{Na}_2\text{M}^{2+}(\text{SO}_4)_2 \cdot n\text{H}_2\text{O}$ (M = Mg, Mn, Co, Ni, Cu, Zn, $n = 2$ or 4) of the blödite-kröhnkite family

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Table S1. Measured values of molar heat capacity for $\text{Na}_2\text{Co}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$.

T	C_p	T	C_p	T	C_p	T	C_p	T	C_p
K	$\text{J}\cdot\text{K}^{-1}$	K	$\text{J}\cdot\text{K}^{-1}$	K	$\text{J}\cdot\text{K}^{-1}$	K	$\text{J}\cdot\text{K}^{-1}$	K	$\text{J}\cdot\text{K}^{-1}$
2.19398	0.044295	6.82504	0.21925	22.0839	10.625	72.0107	118.222	235.072	332.836
2.20096	0.044238	6.82521	0.219148	22.1015	10.4817	72.0136	118.249	235.146	332.704
2.20178	0.044297	6.82718	0.220203	22.102	10.7864	72.0546	118.205	235.147	333.001
2.37416	0.043636	7.3966	0.27765	24.0328	13.5443	78.3509	131.11	255.77	351.173
2.37959	0.043738	7.39965	0.27841	24.0352	13.6616	78.357	131.176	255.887	350.567
2.38055	0.043649	7.40057	0.278222	24.0458	13.5432	78.4013	130.88	255.891	350.959
2.56884	0.043623	8.04241	0.35881	26.1391	17.1056	85.2546	144.303	278.245	370.535
2.57331	0.043687	8.04525	0.359115	26.1485	17.12	85.2647	144.041	278.448	370.271
2.57435	0.043584	8.0467	0.359206	26.1656	17.1487	85.3088	143.16	278.46	370.927
2.78246	0.044086	8.74296	0.46622	28.4498	21.3014	92.7805	157.368	302.93	391.147
2.7853	0.044235	8.74581	0.467083	28.4544	21.3014	92.7874	157.497	302.946	391.214
2.78676	0.04418	8.74705	0.467164	28.459	21.4027	92.8161	157.612	302.977	390.543
3.01463	0.04573	9.51066	0.615481	30.9551	26.2168	100.954	171.605		
3.01577	0.045871	9.51276	0.616763	30.9559	26.237	100.96	171.481		
3.0175	0.04575	9.51576	0.616553	30.965	26.527	100.988	171.799		
3.26546	0.048868	10.3446	0.818001	33.6767	31.9394	109.862	185.838		
3.26576	0.048916	10.3462	0.817748	33.6862	31.9592	109.87	186.125		
3.26724	0.048971	10.3529	0.819937	33.6915	32.0786	109.897	186.461		
3.54237	0.053142	11.2542	1.09554	36.6384	38.383	119.549	200.42		
3.54265	0.053041	11.2568	1.09623	36.6486	38.3693	119.55	201.238		
3.54381	0.05322	11.259	1.09701	36.6556	38.5541	119.559	200.682		
3.83628	0.058963	12.2372	1.469	39.8639	45.7229	130.101	215.986		
3.83776	0.059217	12.2381	1.46921	39.8677	45.7279	130.103	215.587		
3.83808	0.059087	12.2457	1.47127	39.8957	45.7647	130.105	215.867		
4.15742	0.067241	13.3298	1.97976	43.3758	53.7766	141.576	231.526		
4.15887	0.067364	13.3319	1.98342	43.3793	53.7598	141.581	231.124		
4.15925	0.067338	13.3349	1.98228	43.4087	53.7771	141.589	230.982		
4.50742	0.0786	14.4972	2.66683	47.2006	62.6997	154.074	246.537		
4.50908	0.078358	14.4979	2.66842	47.2025	62.7315	154.075	246.863		
4.51062	0.078459	14.5031	2.66529	47.2328	62.6934	154.117	246.147		
4.89031	0.092552	15.7726	3.58692	51.3601	72.4698	167.672	263.634		
4.89202	0.093142	15.7752	3.58241	51.3655	72.4562	167.683	263.573		
4.89213	0.092718	15.7775	3.57285	51.3871	72.461	167.721	263.59		
5.30686	0.111858	17.1549	4.76004	55.885	82.9743	182.491	280.475		
5.30974	0.111901	17.1692	4.79854	55.8917	82.9779	182.494	280.552		
5.30993	0.111949	17.1784	4.78161	55.9145	82.9951	182.522	280.477		
5.76264	0.137641	18.6504	6.29786	60.8072	94.1167	198.608	297.631		
5.76556	0.137764	18.6683	6.28363	60.8158	94.1196	198.61	297.656		
5.76585	0.137489	18.6771	6.32577	60.8428	94.2604	198.645	297.397		
6.27657	0.174194	20.2915	8.25345	66.1695	105.991	216.061	315.195		
6.28066	0.172725	20.3109	8.22699	66.1748	105.988	216.093	315.25		
6.2874	0.173375	20.3117	8.37139	66.2094	105.957	216.097	315.606		

Table S2. Molar thermodynamic functions for $\text{Na}_2\text{Co}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$, calculated from smoothed heat capacity.

T	C_p	H_T	$(H_T - H_0)/T$	S_T	G_T	$-(G_T - G_0)/T$
K	$\text{J}\cdot\text{K}^{-1}$	J	$\text{J}\cdot\text{K}^{-1}$	$\text{J}\cdot\text{K}^{-1}$	J	$\text{J}\cdot\text{K}^{-1}$
0	0	0	NaN	0	0	NaN
5	0.08464	0.1045	0.0209	0.02779	-0.03448	0.006895
10	0.7532	1.798	0.1798	0.2375	-0.577	0.0577
15	2.996	10.19	0.6794	0.8884	-3.135	0.209
20	7.898	36.34	1.817	2.359	-10.85	0.5423
25	15.16	93.1	3.724	4.862	-28.46	1.138
30	24.25	191	6.366	8.406	-61.21	2.04
35	34.67	337.8	9.653	12.91	-114.1	3.261
40	45.94	539.1	13.48	18.27	-191.8	4.794
45	57.65	798	17.73	24.36	-298.1	6.624
50	69.48	1116	22.32	31.04	-436.3	8.727
55	81.17	1493	27.14	38.22	-609.3	11.08
60	92.56	1927	32.12	45.77	-819.1	13.65
65	103.6	2418	37.19	53.62	-1067	16.42
70	114.1	2962	42.31	61.68	-1356	19.37
75	124.2	3558	47.44	69.9	-1685	22.46
80	133.9	4203	52.54	78.22	-2055	25.68
85	143.2	4896	57.6	86.62	-2467	29.02
90	152.3	5635	62.61	95.07	-2921	32.46
95	161	6418	67.56	103.5	-3418	35.97
100	169.6	7245	72.45	112	-3956	39.56
110	186.1	9024	82.04	129	-5161	46.92
120	201.5	10960	91.36	145.8	-6535	54.46
130	215.6	13050	100.4	162.5	-8077	62.13
140	229	15270	109.1	179	-9785	69.89
150	241.8	17630	117.5	195.2	-11660	77.71
160	254.1	20110	125.7	211.2	-13690	85.56
170	266.1	22710	133.6	227	-15880	93.41
180	277.6	25430	141.3	242.5	-18230	101.3
190	288.6	28260	148.7	257.8	-20730	109.1
200	299.2	31200	156	272.9	-23380	116.9
210	309.3	34240	163.1	287.8	-26190	124.7
220	319	37380	169.9	302.4	-29140	132.4
230	328.2	40620	176.6	316.8	-32230	140.1
240	337.1	43950	183.1	330.9	-35470	147.8
250	345.9	47360	189.5	344.9	-38850	155.4
260	354.6	50860	195.6	358.6	-42370	163
270	363.3	54450	201.7	372.1	-46020	170.5
273.15	366	55600	203.6	376.4	-47200	172.8
280	372	58130	207.6	385.5	-49810	177.9
290	380.5	61890	213.4	398.7	-53730	185.3
298.15	387.2	65020	218.1	409.3	-57030	191.3
300	388.7	65740	219.1	411.7	-57790	192.6

Table S3. Measured values of molar heat capacity for $\text{Na}_2\text{Mg}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$.

T	C_p	T	C_p	T	C_p	T	C_p	T	C_p
K	$\text{J}\cdot\text{K}^{-1}$	K	$\text{J}\cdot\text{K}^{-1}$	K	$\text{J}\cdot\text{K}^{-1}$	K	$\text{J}\cdot\text{K}^{-1}$	K	$\text{J}\cdot\text{K}^{-1}$
2.20004	0.008104	6.81241	0.18589	22.065	9.82788	71.9697	112.424	235.043	327.721
2.20069	0.008105	6.81348	0.186054	22.0779	9.33913	71.9832	113.825	235.126	327.522
2.20323	0.008136	6.8172	0.185735	22.0824	10.0953	71.9908	112.327	235.131	327.145
2.37641	0.009679	7.38597	0.239815	24.0053	12.5203	78.3118	124.772	255.71	346.062
2.37779	0.009679	7.38963	0.240088	24.0082	12.533	78.3247	124.813	255.871	345.918
2.3807	0.009692	7.39018	0.240267	24.0364	12.4826	78.3347	125.57	255.876	345.91
2.57093	0.011571	8.02889	0.312893	26.1241	15.8882	85.2286	138.097	278.255	366.506
2.57216	0.011594	8.03239	0.313817	26.1304	15.8998	85.2363	139.263	278.416	366.384
2.57471	0.011605	8.03347	0.313119	26.1345	16.0701	85.2373	137.383	278.455	366.184
2.78257	0.013972	8.73071	0.410149	28.4178	19.8907	92.7413	150.319	302.924	384.735
2.78474	0.013892	8.73362	0.41132	28.4276	19.843	92.7484	149.906	302.975	385.029
2.78741	0.013956	8.73513	0.411412	28.4321	19.9029	92.7503	151.641	302.978	384.929
3.01152	0.017052	9.49835	0.544074	30.9282	24.5474	100.926	164.065		
3.01406	0.016963	9.50005	0.545987	30.9336	24.5168	100.929	164.639		
3.01721	0.016959	9.50396	0.545236	30.9406	24.659	100.933	165.482		
3.26093	0.02137	10.3254	0.727268	33.6491	29.9305	109.826	179.154		
3.26292	0.021361	10.3268	0.727207	33.6628	30.2819	109.834	178.303		
3.26665	0.021313	10.3339	0.726692	33.663	29.9191	109.84	179.512		
3.53832	0.026589	11.2375	0.973551	36.6114	36.0443	119.507	192.457		
3.53952	0.026628	11.2415	0.974947	36.6221	36.592	119.516	192.829		
3.54333	0.02677	11.2444	0.97378	36.6254	36.0364	119.519	192.512		
3.83186	0.033509	12.2268	1.31165	39.8365	43.064	130.045	208.453		
3.83349	0.03344	12.2292	1.31687	39.8368	43.0305	130.061	208.355		
3.83753	0.03381	12.2344	1.31421	39.8705	43.0595	130.079	207.698		
4.1497	0.041991	13.3157	1.77296	43.345	50.7103	141.526	223.418		
4.15213	0.04231	13.3177	1.77715	43.3458	50.7178	141.545	223.114		
4.15591	0.042031	13.3225	1.77251	43.3771	50.71	141.547	223.017		
4.50079	0.053219	14.4825	2.39579	47.1723	59.2229	154.049	238.379		
4.50294	0.053624	14.4833	2.39945	47.1734	59.224	154.05	239.035		
4.50577	0.053501	14.4918	2.38892	47.205	59.2167	154.052	239.105		
4.88202	0.067654	15.762	3.22626	51.33	68.482	167.635	256.346		
4.88437	0.067643	15.7636	3.24788	51.3395	68.486	167.647	256.455		
4.8874	0.067826	15.764	3.21581	51.3511	69.0627	167.669	256.249		
5.29853	0.086205	17.1271	4.30019	55.8546	78.4952	182.442	273.876		
5.30155	0.086506	17.1296	4.29309	55.8662	78.507	182.452	273.771		
5.30313	0.085993	17.1365	4.32608	55.8753	79.1898	182.464	273.736		
5.75504	0.110387	18.6545	5.70633	60.7768	89.1834	198.568	291.208		
5.75797	0.110222	18.6615	5.7603	60.7913	89.1128	198.572	291.11		
5.75882	0.11043	18.6664	5.63792	60.7984	90.0442	198.597	290.933		
6.27143	0.146072	20.2703	7.52162	66.1367	100.458	216.018	309.434		
6.27855	0.143525	20.2827	7.54995	66.1487	101.739	216.063	309.021		
6.29488	0.143433	20.2936	7.53974	66.1549	100.461	216.069	309.215		

Table S4. Molar thermodynamic functions for $\text{Na}_2\text{Mg}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$, calculated from smoothed heat capacity.

T	C_p	H_T	$(H_T - H_0)/T$	S_T	G_T	$-(G_T - G_0)/T$
K	$\text{J} \cdot \text{K}^{-1}$	J	$\text{J} \cdot \text{K}^{-1}$	$\text{J} \cdot \text{K}^{-1}$	J	$\text{J} \cdot \text{K}^{-1}$
0	0	0	NaN	0	0	NaN
5	0.07403	0.09123	0.01825	0.02426	-0.03006	0.006012
10	0.6678	1.585	0.1585	0.2092	-0.5061	0.05061
15	2.702	9.106	0.6071	0.7921	-2.775	0.185
20	7.21	32.84	1.642	2.127	-9.695	0.4848
25	14.03	85.06	3.402	4.429	-25.67	1.027
30	22.68	176.2	5.872	7.727	-55.65	1.855
35	32.66	314.1	8.974	11.96	-104.5	2.986
40	43.46	504.1	12.6	17.02	-176.6	4.416
45	54.66	749.3	16.65	22.78	-275.9	6.13
50	65.93	1051	21.02	29.12	-405.4	8.108
55	77.05	1408	25.61	35.93	-567.9	10.32
60	87.88	1821	30.35	43.1	-765.3	12.76
65	98.37	2287	35.18	50.55	-999.4	15.37
70	108.5	2804	40.06	58.22	-1271	18.16
75	118.3	3371	44.95	66.04	-1582	21.09
80	127.8	3987	49.83	73.98	-1932	24.15
85	137.1	4649	54.69	82.01	-2322	27.31
90	146.1	5357	59.52	90.1	-2752	30.58
95	154.9	6110	64.32	98.24	-3223	33.92
100	163.5	6906	69.06	106.4	-3734	37.34
110	179.5	8622	78.38	122.7	-4880	44.37
120	194.1	10490	87.43	139	-6189	51.58
130	207.7	12500	96.16	155.1	-7660	58.92
140	221.1	14640	104.6	171	-9290	66.36
150	234.1	16920	112.8	186.7	-11080	73.86
160	246.8	19330	120.8	202.2	-13020	81.39
170	259	21850	128.6	217.5	-15120	88.95
180	270.7	24500	136.1	232.6	-17370	96.51
190	282	27270	143.5	247.6	-19770	104.1
200	292.9	30140	150.7	262.3	-22320	111.6
210	303.2	33120	157.7	276.9	-25020	119.1
220	313.1	36210	164.6	291.2	-27860	126.6
230	322.6	39380	171.2	305.3	-30840	134.1
240	331.8	42660	177.7	319.3	-33970	141.5
250	340.8	46020	184.1	333	-37230	148.9
260	349.8	49470	190.3	346.5	-40630	156.3
270	358.8	53020	196.4	359.9	-44160	163.5
273.15	361.7	54150	198.2	364.1	-45300	165.8
280	367.8	56650	202.3	373.1	-47820	170.8
290	376.3	60370	208.2	386.2	-51620	178
298.15	382.2	63460	212.8	396.7	-54810	183.8
300	383.3	64170	213.9	399	-55550	185.2

Table S5. Measured values of molar heat capacity for $\text{Na}_2\text{Mn}(\text{SO}_4)_2 \cdot 2\text{H}_2\text{O}$.

T K	C_p $\text{J}\cdot\text{K}^{-1}$	T K	C_p $\text{J}\cdot\text{K}^{-1}$	T K	C_p $\text{J}\cdot\text{K}^{-1}$	T K	C_p $\text{J}\cdot\text{K}^{-1}$	T K	C_p $\text{J}\cdot\text{K}^{-1}$	T K	C_p $\text{J}\cdot\text{K}^{-1}$
2.20599	6.75699	5.3223	4.69126	10.3586	2.92337	17.1809	5.49015	43.3629	47.706	141.565	182.317
2.21351	6.75683	5.32245	4.68918	10.3616	2.92127	17.3089	5.67843	43.3933	47.7238	141.567	182.24
2.21378	6.75587	5.42598	4.619	10.6222	2.9811	17.593	5.89403	47.1856	55.1501	154.06	192.988
2.38348	6.78733	5.71301	4.39145	10.9154	3.01625	17.8886	6.13446	47.1868	55.158	154.061	193.461
2.39201	6.78326	5.76203	4.35871	11.2023	3.05848	18.1861	6.38286	47.2171	55.1542	154.064	192.339
2.39226	6.78269	5.77888	4.33733	11.2525	3.03312	18.4678	6.63466	51.3447	63.1589	167.647	205.624
2.57643	6.75354	5.77923	4.33942	11.2691	3.03134	18.6378	6.71388	51.3519	63.19	167.654	205.452
2.58583	6.74726	6.00011	4.19338	11.2717	3.03334	18.6741	6.74567	51.3685	63.1844	167.681	205.857
2.58608	6.74723	6.27021	3.96896	11.4925	3.11245	18.6787	6.66558	55.8709	71.6746	182.443	218.148
2.78546	6.669	6.28042	3.95922	11.7859	3.17632	18.7595	6.90342	55.8812	71.6644	182.449	218.049
2.79748	6.65895	6.28097	3.95921	12.071	3.25774	19.0574	7.18226	55.8923	71.8143	182.466	218.105
2.79783	6.65863	6.28674	4.00758	12.2454	3.27699	19.3393	7.45732	60.7949	80.5342	198.568	230.383
3.01382	6.5607	6.5885	3.81925	12.2581	3.27506	19.6332	7.75598	60.8104	80.5747	198.573	230.48
3.02751	6.54379	6.81282	3.66228	12.2601	3.27091	19.9338	8.05677	60.8254	80.8382	198.594	230.677
3.02793	6.54237	6.8326	3.6507	12.3614	3.349	20.2874	8.36619	66.1553	89.8386	216.005	243.617
3.14001	6.48931	6.84861	3.83992	12.6545	3.4397	20.3041	8.38266	66.1712	89.8871	216.06	243.216
3.2684	6.42252	6.87714	3.67603	12.9427	3.55827	20.322	8.28324	66.1805	90.2293	216.063	243.245
3.28332	6.40455	7.15334	3.54793	13.2341	3.67889	22.0731	10.4678	71.9832	99.2258	235.021	256.725
3.28408	6.40307	7.39074	3.40652	13.3198	3.68318	22.0916	10.6334	72.0085	100.258	235.119	256.497
3.43014	6.31996	7.41533	3.39806	13.3311	3.6831	22.1075	10.1711	72.0089	99.0228	235.122	256.386
3.53838	6.24976	7.41719	3.39554	13.332	3.67733	24.0214	13.1392	78.3398	108.917	255.719	270.414
3.5535	6.22996	7.441	3.42767	13.5243	3.82677	24.0223	12.9854	78.3399	109.292	255.864	270.028
3.55395	6.22828	7.73109	3.31764	13.8169	3.97537	24.0259	12.9903	78.3672	109.275	255.865	270.115
3.71315	6.12002	8.01839	3.22755	14.1049	4.14254	26.1269	16.0823	85.245	118.975	278.219	285.534
3.83286	6.01925	8.03506	3.18196	14.3973	4.31813	26.1378	16.0904	85.2494	119.026	278.428	285.065
3.84799	6.00225	8.05791	3.17684	14.4887	4.34597	26.1577	16.0473	85.2677	119.256	278.433	285.144
3.84834	6.00183	8.05949	3.17629	14.4949	4.3294	28.433	19.7583	92.7607	128.334	302.936	298.6
3.99623	5.87767	8.30772	3.15125	14.4996	4.33605	28.437	19.7619	92.7733	128.678	302.966	298.894
4.15278	5.7362	8.59679	3.0773	14.6884	4.51206	28.4428	20.0261	92.7836	129.027	302.966	298.645
4.16909	5.7123	8.73369	3.01681	14.9827	4.73192	30.9426	24.0305	100.941	139.244		
4.16935	5.71174	8.7583	3.01251	15.2663	4.9123	30.9471	24.0476	100.942	139.222		
4.28178	5.61667	8.76206	3.01195	15.5511	4.76611	30.9524	24.2715	100.961	139.599		
4.5043	5.41337	8.88669	3.02664	15.77	4.69401	33.6622	29.004	109.848	150.285		
4.52126	5.38559	9.17686	2.99539	15.7706	4.6956	33.6725	29.0125	109.849	149.512		
4.52154	5.38269	9.46392	2.9686	15.775	4.68135	33.6765	29.1723	109.859	150.558		
4.56687	5.35022	9.50169	2.92802	15.8448	4.76711	36.6231	34.5693	119.526	160.03		
4.85244	5.09161	9.52321	2.92757	16.144	4.91269	36.6352	34.5736	119.533	160.247		
4.88645	5.06338	9.52586	2.921	16.4338	5.07725	36.6364	34.7981	119.547	160.036		
4.90423	5.04142	9.75414	2.94823	16.7284	5.26786	39.8501	40.9025	130.063	171.629		
4.90441	5.04164	10.0441	2.9503	17.016	5.46426	39.853	40.8753	130.085	171.153		
5.13919	4.85134	10.3348	2.95795	17.1422	5.49008	39.8815	40.8693	130.086	171.364		
5.30369	4.7164	10.3392	2.92586	17.148	5.4924	43.3613	47.7099	141.554	182.265		

Table S6. Molar thermodynamic functions for $\text{Na}_2\text{Mn}(\text{SO}_4)_2 \cdot 2\text{H}_2\text{O}$, calculated from smoothed heat capacity.

T	C_p	H_T	$(H_T - H_0)/T$	S_T	G_T	$-(G_T - G_0)/T$
K	$\text{J}\cdot\text{K}^{-1}$	J	$\text{J}\cdot\text{K}^{-1}$	$\text{J}\cdot\text{K}^{-1}$	J	$\text{J}\cdot\text{K}^{-1}$
0	0	0	NaN	0	0	NaN
5	4.962	27.15	5.43	15.8	-51.83	10.37
10	2.943	45.02	4.502	18.36	-138.5	13.85
15	4.748	62.65	4.177	19.76	-233.8	15.58
20	8.078	92.51	4.625	21.45	-336.6	16.83
25	14.38	147.8	5.91	23.89	-449.6	17.98
30	22.45	239.3	7.976	27.21	-577	19.23
35	31.55	373.9	10.68	31.34	-723	20.66
40	41.18	555.6	13.89	36.18	-891.6	22.29
45	50.96	786	17.47	41.59	-1086	24.13
50	60.64	1065	21.3	47.47	-1308	26.17
55	70.08	1392	25.31	53.69	-1561	28.38
60	79.17	1765	29.42	60.18	-1846	30.76
65	87.86	2183	33.58	66.86	-2163	33.28
70	96.14	2643	37.76	73.68	-2515	35.92
75	104	3144	41.92	80.59	-2900	38.67
80	111.5	3683	46.03	87.54	-3320	41.51
85	118.7	4258	50.1	94.52	-3776	44.42
90	125.5	4869	54.1	101.5	-4266	47.4
95	132	5513	58.03	108.5	-4791	50.43
100	138.3	6189	61.89	115.4	-5350	53.5
110	150	7631	69.37	129.1	-6573	59.75
120	160.9	9186	76.55	142.6	-7932	66.1
130	171	10850	83.43	155.9	-9425	72.5
140	180.6	12600	90.03	169	-11050	78.93
150	189.8	14460	96.37	181.7	-12800	85.36
160	198.7	16400	102.5	194.3	-14680	91.77
170	207.5	18430	108.4	206.6	-16690	98.16
180	215.9	20550	114.2	218.7	-18810	104.5
190	224	22750	119.7	230.6	-21060	110.8
200	231.8	25030	125.1	242.3	-23420	117.1
210	239.1	27380	130.4	253.7	-25910	123.4
220	246.2	29810	135.5	265	-28500	129.5
230	253	32300	140.4	276.1	-31210	135.7
240	259.7	34870	145.3	287	-34020	141.8
250	266.4	37500	150	297.8	-36950	147.8
260	273.1	40190	154.6	308.3	-39980	153.8
270	279.8	42960	159.1	318.8	-43110	159.7
273.15	281.8	43840	160.5	322	-44120	161.5
280	286.3	45790	163.5	329.1	-46350	165.5
290	292.3	48680	167.9	339.2	-49690	171.4
298.15	296.6	51080	171.3	347.4	-52490	176.1
300	297.4	51630	172.1	349.2	-53130	177.1

Table S7. Measured values of molar heat capacity for $\text{Na}_2\text{Ni}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$.

T K	C_p $\text{J}\cdot\text{K}^{-1}$	T K	C_p $\text{J}\cdot\text{K}^{-1}$	T K	C_p $\text{J}\cdot\text{K}^{-1}$	T K	C_p $\text{J}\cdot\text{K}^{-1}$	T K	C_p $\text{J}\cdot\text{K}^{-1}$
2.20385	5.16725	6.80592	2.50981	22.0666	10.1534	71.9899	110.98	235.015	323.992
2.21425	5.17463	6.82546	2.50087	22.0868	10.2929	72.0072	111.16	235.113	324.006
2.21444	5.17555	6.82768	2.49359	22.0919	10.2115	72.0199	111.657	235.114	324.131
2.38057	5.29625	7.38043	2.30156	24.0138	12.882	78.3445	123.487	255.7	342.27
2.39246	5.29792	7.40288	2.29186	24.0185	12.879	78.356	123.538	255.843	342.064
2.39251	5.29745	7.40803	2.29022	24.0545	12.9267	78.3688	123.33	255.856	341.818
2.57192	5.33705	8.0279	2.12026	26.1238	16.1862	85.2455	135.858	278.195	362.887
2.58613	5.33166	8.04921	2.11133	26.1432	16.1897	85.2515	136.049	278.399	361.966
2.58668	5.33232	8.05289	2.11005	26.1664	16.0278	85.266	136.695	278.417	362.38
2.78239	5.29706	8.72295	1.99173	28.4387	20.111	92.7593	148.715	302.952	380.242
2.79767	5.28697	8.74537	1.9863	28.4433	20.1228	92.7708	148.868	302.956	380.405
2.7979	5.28627	8.75324	1.98279	28.4503	20.2254	92.7789	149.636	302.963	380.509
3.01116	5.20557	9.49194	1.92297	30.9464	24.6888	100.933	162.682		
3.02485	5.19194	9.50971	1.9238	30.9552	24.7171	100.935	162.354		
3.02794	5.1883	9.51583	1.91968	30.9555	24.8287	100.965	162.526		
3.26024	5.08232	10.3346	1.93411	33.6656	30.0215	109.839	176.839		
3.28324	5.04713	10.3499	1.93223	33.6682	30.0185	109.852	176.719		
3.28396	5.04552	10.3556	1.9316	33.6776	30.243	109.858	177.87		
3.53553	4.88243	11.2367	2.03388	36.6279	36.0245	119.512	191.673		
3.55337	4.8635	11.248	2.03257	36.6362	36.0453	119.525	191.156		
3.5535	4.86197	11.2534	2.03194	36.639	36.2407	119.54	190.928		
3.82956	4.64446	12.2171	2.23933	39.8539	42.9158	130.065	207.045		
3.8479	4.62193	12.2302	2.24071	39.8631	43.1667	130.076	206.266		
3.84811	4.62231	12.2395	2.24211	39.8666	42.9016	130.091	205.998		
4.14966	4.3591	13.3141	2.59458	43.3612	50.4606	141.549	221.901		
4.16871	4.33375	13.3213	2.5956	43.3736	50.4808	141.561	221.724		
4.16879	4.33168	13.3276	2.59427	43.3793	50.7298	141.564	221.615		
4.5012	4.04133	14.4863	3.13038	47.1878	58.8206	154.064	237.1		
4.52044	4.01401	14.4903	3.12949	47.1891	58.8108	154.066	236.485		
4.52078	4.01464	14.4963	3.13114	47.2202	58.8065	154.067	235.227		
4.88309	3.712	15.7631	3.89744	51.3451	67.9021	167.643	253.737		
4.90311	3.68488	15.7665	3.90132	51.3574	67.9234	167.647	253.725		
4.90405	3.68587	15.7742	3.89767	51.3636	68.2487	167.68	253.783		
5.29966	3.39122	17.135	4.9146	55.8709	77.7606	182.422	270.773		
5.32062	3.36703	17.1597	4.96403	55.8851	77.7594	182.463	271.47		
5.32176	3.3635	17.1605	4.94671	55.8895	78.1487	182.468	271.177		
5.75401	3.07414	18.6589	6.29083	60.8007	88.2808	198.57	288.514		
5.77616	3.05322	18.6697	6.31457	60.8178	88.2683	198.571	287.928		
5.77804	3.04997	18.6708	6.34865	60.8218	88.8424	198.599	288.11		
6.2482	2.78702	20.2839	7.96854	66.16	99.4677	215.999	306.315		
6.27228	2.7672	20.3011	8.06134	66.1754	99.4167	216.055	305.885		
6.27494	2.76374	20.3203	8.02921	66.1791	100.131	216.064	305.949		

Table S8. Molar thermodynamic functions for $\text{Na}_2\text{Ni}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$, calculated from smoothed heat capacity.

T	C_p	H_T	$(H_T - H_0)/T$	S_T	G_T	$-(G_T - G_0)/T$
K	$\text{J}\cdot\text{K}^{-1}$	J	$\text{J}\cdot\text{K}^{-1}$	$\text{J}\cdot\text{K}^{-1}$	J	$\text{J}\cdot\text{K}^{-1}$
0	0	0	NaN	0	0	NaN
5	3.66	21.11	4.222	12.37	-40.75	8.151
10	1.941	33.21	3.321	14.12	-108	10.8
15	3.406	45.37	3.025	15.09	-181	12.06
20	7.706	72.07	3.603	16.59	-259.8	12.99
25	14.39	126.4	5.057	18.99	-348.4	13.94
30	22.89	219	7.299	22.34	-451.4	15.05
35	32.67	357.5	10.21	26.59	-573.3	16.38
40	43.23	547	13.67	31.64	-718.6	17.97
45	54.18	790.4	17.57	37.36	-890.9	19.8
50	65.22	1089	21.78	43.64	-1093	21.86
55	76.13	1442	26.23	50.37	-1328	24.15
60	86.8	1850	30.83	57.46	-1597	26.62
65	97.15	2310	35.54	64.81	-1903	29.28
70	107.2	2821	40.3	72.38	-2246	32.09
75	116.9	3381	45.08	80.11	-2627	35.03
80	126.3	3989	49.87	87.96	-3047	38.09
85	135.4	4644	54.63	95.89	-3507	41.26
90	144.3	5343	59.37	103.9	-4006	44.51
95	153	6087	64.07	111.9	-4546	47.85
100	161.4	6873	68.73	120	-5126	51.26
110	177.4	8567	77.88	136.1	-6406	58.24
120	192.3	10420	86.8	152.2	-7848	65.4
130	206.2	12410	95.46	168.1	-9450	72.69
140	219.3	14540	103.8	183.9	-11210	80.07
150	232	16790	112	199.5	-13130	87.51
160	244.3	19180	119.8	214.8	-15200	94.99
170	256.3	21680	127.5	230	-17420	102.5
180	268	24300	135	245	-19800	110
190	279.2	27040	142.3	259.8	-22320	117.5
200	290	29880	149.4	274.4	-24990	125
210	300.2	32830	156.4	288.8	-27810	132.4
220	309.9	35890	163.1	303	-30770	139.9
230	319.2	39030	169.7	317	-33870	147.3
240	328.2	42270	176.1	330.7	-37110	154.6
250	337	45590	182.4	344.3	-40480	161.9
260	346	49010	188.5	357.7	-43990	169.2
270	354.9	52510	194.5	370.9	-47640	176.4
273.15	357.8	53640	196.4	375.1	-48810	178.7
280	363.8	56110	200.4	384	-51410	183.6
290	372.1	59790	206.2	396.9	-55320	190.7
298.15	377.8	62850	210.8	407.3	-58590	196.5
300	378.9	63550	211.8	409.6	-59350	197.8

Table S9. Measured values of molar heat capacity for $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$.

T	C_p	T	C_p	T	C_p	T	C_p	T	C_p
K	$\text{J}\cdot\text{K}^{-1}$	K	$\text{J}\cdot\text{K}^{-1}$	K	$\text{J}\cdot\text{K}^{-1}$	K	$\text{J}\cdot\text{K}^{-1}$	K	$\text{J}\cdot\text{K}^{-1}$
2.19932	0.010854	6.81457	0.231717	22.084	11.6823	71.9876	125.593	235.003	348.11
2.20009	0.010852	6.81789	0.230069	22.0945	11.6374	71.9978	125.467	235.132	348.82
2.20238	0.010877	6.82129	0.231755	22.0969	11.5984	72.0027	125.792	235.133	348.216
2.37647	0.01295	7.38776	0.296404	24.0212	14.807	78.3325	139.083	255.7	367.014
2.37722	0.012987	7.39096	0.297008	24.0338	15.1323	78.3411	138.734	255.877	366.635
2.37986	0.012999	7.39102	0.296767	24.0439	14.8437	78.3469	139.278	255.88	366.282
2.57063	0.015439	8.03061	0.385872	26.1263	18.6398	85.2338	152.596	278.193	387.841
2.5721	0.015471	8.03368	0.386018	26.129	18.6603	85.2497	151.936	278.446	386.722
2.5748	0.015521	8.03473	0.386808	26.1704	18.5812	85.2507	152.834	278.449	386.915
2.78379	0.018509	8.73442	0.505759	28.4358	23.1762	92.7514	166.328	302.938	409.05
2.78441	0.018565	8.7368	0.507109	28.4384	23.1691	92.7643	166.263	302.959	408.799
2.7877	0.0186	8.73922	0.507392	28.442	23.3125	92.7709	166.394	302.971	408.947
3.01308	0.022528	9.49501	0.670769	30.9416	28.4342	100.931	181.398		
3.01438	0.022537	9.49861	0.671563	30.9455	28.6182	100.94	181.086		
3.0171	0.022697	9.50025	0.671296	30.9475	28.4592	100.953	181.197		
3.26243	0.028079	10.3334	0.898151	33.6615	34.5546	109.837	196.457		
3.26406	0.027978	10.337	0.900043	33.6696	34.5211	109.846	196.484		
3.26705	0.028115	10.3388	0.898526	33.6705	34.7312	109.868	196.327		
3.53886	0.034695	11.2385	1.20465	36.6237	41.3898	119.514	211.573		
3.54044	0.034793	11.2397	1.20075	36.6249	41.3754	119.531	211.954		
3.54327	0.034816	11.2451	1.20802	36.6331	41.5323	119.539	211.498		
3.83322	0.043556	12.2288	1.62195	39.8484	49.2457	130.055	227.96		
3.83493	0.043573	12.2327	1.62563	39.851	49.6188	130.086	227.09		
3.83763	0.043716	12.2335	1.62445	39.8611	49.1852	130.086	227.353		
4.15294	0.054546	13.2981	2.18652	43.358	57.7448	141.559	242.144		
4.1549	0.054496	13.3003	2.18335	43.3602	58.2278	141.566	243.219		
4.1581	0.054829	13.3105	2.18941	43.3722	57.7475	141.57	243.451		
4.50284	0.068597	14.4796	2.95025	47.1826	67.1778	154.038	259.086		
4.50457	0.068667	14.4805	2.95381	47.1921	67.6874	154.05	259.129		
4.50826	0.068844	14.488	2.95352	47.1965	67.1788	154.071	259.148		
4.88405	0.086357	15.7615	3.96385	51.3409	77.4279	167.658	276.731		
4.88644	0.086513	15.7636	3.95651	51.3464	78.014	167.667	277.134		
4.88797	0.086614	15.7701	3.97681	51.3543	77.4525	167.668	276.706		
5.30133	0.108904	17.1466	5.27139	55.8662	88.4682	182.478	294.618		
5.30328	0.10906	17.1506	5.27963	55.8715	89.1949	182.479	294.842		
5.30534	0.109592	17.1532	5.33008	55.8814	88.4828	182.496	294.178		
5.75594	0.138667	18.6575	6.93271	60.7889	100.188	198.582	312.065		
5.7587	0.138736	18.6728	6.95481	60.792	101.008	198.584	312.148		
5.75991	0.139135	18.673	6.91077	60.8014	100.176	198.599	312.02		
6.27126	0.178661	20.2996	9.02351	66.155	112.614	215.984	330.579		
6.27903	0.179271	20.3059	9.05161	66.1648	113.315	216.069	330.532		
6.28799	0.180488	20.3207	8.985	66.1684	112.548	216.072	330.154		

Table S10. Molar thermodynamic functions for Na₂Zn(SO₄)₂·4H₂O, calculated from smoothed heat capacity.

T	C_p	H_T	$(H_T-H_0)/T$	S_T	G_T	$-(G_T-G_0)/T$
K	J·K ⁻¹	J	J·K ⁻¹	J·K ⁻¹	J	J·K ⁻¹
0	0	0	NaN	0	0	NaN
5	0.09249	0.1141	0.02282	0.03034	-0.03762	0.007523
10	0.8284	1.973	0.1973	0.2604	-0.6314	0.06314
15	3.335	11.29	0.7525	0.9824	-3.448	0.2299
20	8.657	40.11	2.006	2.604	-11.97	0.5987
25	16.52	102.1	4.084	5.339	-31.36	1.254
30	26.38	208.7	6.956	9.197	-67.24	2.241
35	37.62	368.2	10.52	14.09	-125.1	3.573
40	49.69	586.3	14.66	19.9	-209.7	5.242
45	62.11	865.7	19.24	26.47	-325.3	7.229
50	74.55	1207	24.15	33.66	-475.4	9.508
55	86.76	1611	29.29	41.34	-662.7	12.05
60	98.6	2074	34.57	49.4	-889.4	14.82
65	110	2596	39.94	57.74	-1157	17.8
70	121	3174	45.34	66.3	-1467	20.96
75	131.7	3806	50.75	75.02	-1820	24.27
80	141.9	4490	56.12	83.84	-2218	27.72
85	151.8	5225	61.46	92.75	-2659	31.28
90	161.5	6008	66.76	101.7	-3145	34.95
95	170.8	6839	71.99	110.7	-3676	38.7
100	179.8	7716	77.16	119.7	-4252	42.52
110	196.9	9600	87.28	137.6	-5539	50.35
120	212.6	11650	97.07	155.4	-7004	58.37
130	227.1	13850	106.5	173	-8647	66.51
140	240.9	16190	115.6	190.4	-10460	74.74
150	254.2	18660	124.4	207.5	-12450	83.02
160	267	21270	132.9	224.3	-14610	91.33
170	279.4	24000	141.2	240.8	-16940	99.63
180	291.5	26860	149.2	257.1	-19430	107.9
190	303	29830	157	273.2	-22080	116.2
200	314	32920	164.6	289	-24890	124.5
210	324.3	36110	171.9	304.6	-27860	132.7
220	334.2	39400	179.1	319.9	-30980	140.8
230	343.6	42790	186	335	-34260	148.9
240	352.7	46270	192.8	349.8	-37680	157
250	361.6	49840	199.4	364.4	-41250	165
260	370.5	53500	205.8	378.7	-44970	173
270	379.5	57250	212	392.9	-48830	180.8
273.15	382.4	58450	214	397.3	-50070	183.3
280	388.6	61090	218.2	406.9	-52830	188.7
290	397.6	65030	224.2	420.6	-56960	196.4
298.15	404.8	68290	229.1	431.8	-60440	202.7
300	406.4	69050	230.2	434.3	-61240	204.1