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Thermodynamic Properties of Solid Alkali Aluminosilicates at Elevated Temperatures

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National Bureau of Standards
Center for Chemical Physics
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Final Report

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U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, *Secretary*
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director*

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Washington, D.C. 20234

Abstract

This report presents selected heat capacities, entropies, enthalpies, standard enthalpies of formation, standard free energies of formation and the equilibrium formation constants for solid sodium aluminate, solid potassium aluminate and solid aluminosilicates of lithium, sodium, and potassium. Values are listed in 28 tables for 17 different compositions (13 pure compounds and their polymorphs; 4 mixtures, each in low- and high-temperature configurations) from 298K to temperatures ranging up to 2000K.

Key words: selected values; enthalpy; entropy; equilibrium constant of formation; free energy of formation; Gibbs energy function; heat capacity; heat of formation; thermochemical tables.

1. Introduction

This report presents selected values of thermodynamic properties of solid lithium, sodium, and potassium aluminosilicates and sodium and potassium aluminates at temperatures ranging from 298K to 2000K.

1.1 Definitions, Units, Special Considerations

A standard process, in the thermodynamic sense, is one in which the reactants (starting substances; elements or compounds) and products are all in their standard states, i.e., one atmosphere pressure, solid or liquid as determined by the melting point. In this report, the liquid state is taken as the standard state for all elements above their normal boiling points (n.b., the alkali elements). Note that the standard state of a substance is defined anew for each temperature.

The thermal functions are listed as the increase of the property above the base temperature: 298.15 K (25°C). They are given in units of calories (and kilocalories), kelvins (K), and moles in terms of the 1977 atomic weights (77IUPAC), rounded. 1 cal = 4.1840J.

Thermal functions for other materials, especially the elements, are taken from the JANAF Tables (71JANAF), adapted to the liquid state for all the temperatures above the melting point.

The temperature 298 K is to be read 298.15 K.

Some compounds (e.g., Albite, $NaAlSi_3O_8$, low* and high varieties) exist as two or more polymorphs both of which are "stable" over wide temperature ranges. In such cases, where the polymorphs are capable of independent existence with overlapping temperature ranges, their values are listed in separate tables; the form with the more negative $\Delta_f G$ at a particular temperature is the thermodynamically stable one. In the case (e.g. $KAlSiO_4$, α and β) where the polymorphs are readily converted one

---

*low and high, here, refer in a qualitative way, to the temperature range over which they are thermodynamically stable.

to the other near the transition temperature, the two forms are listed in their separate temperature ranges on the same table (sometimes called an equilibrium table). $NaAlSiO_4$ has polymorphs connected by both kinds of transformations; one table lists the α, β and γ forms of nepheline in an equilibrium table, another table lists α and β forms of carnegieite.

1.2 Generation of Tables

The tables are generated and printed by machine computation, with the following inputs:

(1) for each element and compound the following thermal functions at 100-kelvin intervals and at the transition temperatures:

(a) the relative enthalpy above 298.15 K, $H_T - H_{298}$,

(b) the relative entropy above 298.15 K, $S_T - S_{298}$ for the compounds; absolute entropy, S_T, for the elments;

(2) for each compound at 298.15 K:

(a) the standard enthalpy of formation, $\Delta_f H_{298}$,

(b) the absolute entropy, S_{298} (in some cases this includes a zero-point entropy which persists as a non-equilibrium condition at all temperatures below the "glass temperature" of the compound);

(3) for each compound, at 100-kelvin intervals and at the transition temperatures:

(a) heat capacity C_p.

The standard enthalpy of formation listed at other temperatures is derived from

$$\Delta_f H_T = \Delta_f H_{298} + \Sigma(H_T - H_{298})_{prod} - \Sigma(H_T - H_{298})_{react}.$$

The standard free energy of formation listed at various temperatures is derived from

$$\Delta_f G_T = \Delta_f H_T - T\Delta_f S_T,$$

where $\Delta_f S_T = [(S_T - S_{298}) + S_{298}]$ for the product less ΣS_T for the elements.

The logarithm of the formation constant is given by:

$$\log_{10} K_f = \frac{-\Delta_f G_T}{RT}$$

Every value of the tables is rounded in the last digit.

1.3 Use of Tables

The $\Delta_r H$ of a reaction which involves compounds in their standard states can be obtained by subtracting the algebraic sum of the enthalpies of formation of the reactants from the corresponding sum for the products. The enthalpies and Gibbs energies of formation of the elments are zero at all temperatures.

$$\Delta_r H = \Sigma\ \Delta_f H(\text{prod}) - \Sigma\ \Delta_f H(\text{react})$$

Analogous equations hold for $\Delta_r G$, $\Delta_r S$, and $\Delta_r Cp$.

At the transition temperatures of the compounds, and at the melting points of Li, Na, K, Al and Si, both indicated on the tables by broken lines, there are discontinuities in their thermodynamic properties. Interpolation of values of compounds should not cross these boundaries.

Properties of derived reactions, however, may be interpolated without regard for transition points or melting points of the elements if they do not occur in the reactions as free elements.

To illustrate, consider the reaction

$$NaAlSiO_4 \text{ (nepheline)} + SiO_2 \text{ (quartz)} \rightarrow NaAlSi_2O_6 \text{ (jadeite)}$$

The ΔH of this reaction at 700 K is

$$-724.93 \text{ (jadeite)} - [-501.20 \text{ (nepheline)} + (-217.27)(\text{quartz})]$$
$$= -6.46 \text{kcal}$$

and its ΔG at 700 K is

$$-623.87 - [-436.14 + (-187.24)] = -0.49 \text{ kcal}.$$

The latter quantity, a negative $\Delta_r G$ value, shows that jadeite is thermodynamically stable at 700 K relative to $NaAlSiO_4$ and SiO_2. At 800 K, the reaction has a $\Delta_r H$ value of -6.51, but a $\Delta_r G$ value of + 0.36. That is, at 800 K (and above) jadeite is thermodynamically unstable with respect to nepheline and free quartz.

The standard enthalpies of formation of both nepheline and jadeite show a jump discontinuity between 900 and 1000 K due to the melting of aluminum at 933 K. There is a change in the temperature coefficient of the free energy of formation for the same reason, but no jump discontinuity. Discontinuities due to change of state of the elements do not persist in the derived reactions, if the reactions do not include the free elements, and reaction values may be interpolated up to the transition point of any of the compounds involved.

The values in these tables may be combined with those in the JANAF publications (preferred) (71, 74, 78, and 81 JANAF) or those in 78ROB/HEM. However, both of the latter tables use the gaseous standard state for elements above the boiling points of the elements. Thus thermodynamic properties of compounds taken from other tables, if their values are based on the gaseous form of the alkali element above the element's boiling point (1620 K for Li, 1156 for Na, 1037 K for K), must be converted to the liquid-element basis if they are to be used with the present tables.

$$\Delta_f H_T \text{ (liq.-element basis)} = \Delta_f H_T \text{ (gas-element basis)} + \Delta_{vap} H_T(X)$$

$$\Delta_f G_T \text{ (liq.-element basis)} = \Delta_f G_T \text{ (gas-element basis)} + \Delta_{vap} H_T(X) + T\,(S_T(X,l) - S_T(X,g)),$$ where X denotes the alkali element.

The $\Delta_{vap} H_T(X)$ is given by $H_T(g)-H_{298}(c)$ of the "other" tables less the $H_T(l)-H_{298}(c)$ of the present tables. These conversions are required only at temperatures above the boiling point of X. Note, also, that 78ROB/HEM's tables are in joules and that their gas entropies contain an additional 0.109 J (0.026 cal)/K for each mol of gas, due to their use of the bar (an SI unit; 100 kilopascals; 0.9869 atmosphere) as the standard state pressure. The gas entropies of the elements of 78ROB/HEM should be reduced by

0.109 J/K·mol to be compatible with the present values and with JANAF values. Similarly, in order to be consistent with the present tables and with 71JANAF and its supplements, Gibbs energies of formation of compounds from the elements listed in 78ROB/HEM, must be adjusted by + 0.000109·T·$\Delta\nu$ kJ where $\Delta\nu$ is the net number of gaseous molecules formed in the formation reaction. For most cases both of these corrections are minor.

2. Acknowledgement

The FORTRAN-IV program used to generate these tables, with five-point Lagrangian interpolation for thermodynamic properties when required at temperatures not tabulated, was written by David B. Neumann of the Chemical Thermodynamics Division.

$LiAlSiO_4$ eucryptite Mol. wt. 126.006

S_{298} = 24.8±0.2 cal/degr,mol $\Delta_f H_{298}$ = -507.7±0.6 kcal/mol

Tr. pt. 1300K

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	----cal/deg,mol-----		---------kcal/mol----------			
298.	27.09	0.00	0.00	-507.70	-480.44	352.17
300.	27.21	.17	.05	-507.71	-480.27	349.88
400.	32.51	8.79	3.06	-507.84	-471.09	257.39
500.	35.80	16.42	6.49	-508.47	-461.84	201.87
600.	38.09	23.17	10.19	-508.22	-452.54	164.84
700.	39.81	29.17	14.09	-507.85	-443.28	138.40
800.	41.16	34.58	18.14	-507.40	-434.09	118.59
900.	42.25	39.49	22.31	-506.92	-424.95	103.19
1000.	43.17	43.99	26.58	-508.95	-415.69	90.85
1100.	43.94	48.15	30.94	-508.35	-406.40	80.74
1200.	43.47	52.00	35.31	-507.78	-397.22	72.34
1300.	44.26	55.58	39.71	-507.18	-388.10	65.24
1300.	46.11	55.79	39.98	-506.91	-388.10	65.25
1400.	48.00	59.27	44.68	-506.05	-378.99	59.16
1500.	49.89	62.64	49.58	-505.01	-369.94	53.90
1600.	51.79	65.92	54.66	-503.80	-360.97	49.31

SOURCES: S_{298}: 67PAN/WEL $H-H_{298}$ and $S-S_{298}$: 67PAN/WEL(78ROB/HEM) $\Delta_f H$: 66BAR/ADA

$LiAlSi_2O_6$ alpha spodumene Mol. wt. 186.090

S_{298} = 30.9±0.2 cal/deg,mol $\Delta_f H_{298}$ = -730.1±1.0 kcal/mol

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	-----cal/deg,mol-----		---------kcal/mol----------			
298.	37.97	0.00	0.00	-730.10	-688.71	504.83
300.	38.11	.24	.07	-730.11	-688.45	501.53
400.	44.14	12.07	4.20	-730.34	-674.52	368.54
500.	48.57	22.42	8.85	-731.03	-660.48	288.70
600.	51.89	31.58	13.88	-730.77	-646.40	235.45
700.	54.43	39.78	19.20	-730.34	-632.37	197.43
800.	56.43	47.18	24.74	-729.79	-618.41	168.94
900.	58.01	53.93	30.47	-729.19	-604.53	146.80
1000.	59.28	60.11	36.34	-731.07	-590.53	129.06
1100.	60.31	65.81	42.32	-730.32	-576.51	114.54
1200.	61.14	71.09	48.39	-729.53	-562.55	102.45

SOURCES: S_{298}: 67PAN/WEL $H-H_{298}$ and $S-S_{298}$: 67PAN/WEL(78ROB/HEM)

$\Delta_f H_{298}$: 66BAR/ADA

$LiAlSi_2O_6$ beta spodumene Mol. wt. 186.090

S_{298} = 36.9±0.3 cal/degr,mol $\Delta_f H_{298}$ = -723.4±1.0 kcal/mol

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	----cal/deg,mol-----		----------kcal/mol----------			
298.	38.91	0.00	0.00	-723.40	-683.80	501.23
300.	39.06	.24	.07	-723.41	-683.55	497.96
400.	45.32	12.40	4.31	-723.53	-670.23	366.20
500.	49.56	22.99	9.07	-724.10	-656.85	287.11
600.	52.67	32.32	14.19	-723.76	-643.43	234.37
700.	55.07	40.63	19.58	-723.25	-630.08	196.72
800.	56.99	48.11	25.19	-722.65	-616.81	168.50
900.	58.56	54.92	30.97	-721.99	-603.62	146.58
1000.	59.87	61.15	36.89	-723.82	-590.32	129.01
1100.	60.99	66.92	42.93	-723.01	-577.01	114.64
1200.	61.96	72.26	49.08	-722.14	-563.77	102.68
1300.	62.80	77.26	55.32	-721.22	-550.61	92.57
1400.	63.54	81.94	61.64	-720.27	-537.52	83.91
1500.	64.20	86.35	68.03	-719.29	-524.50	76.42
1600.	64.78	90.51	74.48	-718.28	-511.55	69.87
1700.	65.31	94.45	80.98	-741.23	-498.45	64.08

SOURCES: S_{298}: 67PAN/WEL $H-H_{298}$ and $S-S_{298}$: 67PAN/WEL $\Delta_f H_{298}$: 66BAR/ADA

$Li_2Al_2Si_8O_{20}$ petalite Mol. wt. 612.5177

S_{298} = 111.0 ± 0.1 cal/degr,mol $\Delta_f H_{298}$ = -2355.6 ± 2.3 kcal/mol

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	-----cal/deg,mol-----		----------kcal/mol----------			
298.	117.20	0.00	0.00	-2335.60	-2203.67	1615.33
300.	117.60	.70	.22	-2335.63	-2202.84	1604.77
400.	139.70	37.90	13.18	-2336.26	-2158.47	1179.33
500.	154.60	70.70	27.94	-2337.26	-2113.87	923.97
600.	165.30	99.90	43.96	-2336.08	-2069.31	753.74
700.	173.00	126.00	60.90	-2334.37	-2024.98	632.22
800.	178.40	149.50	79.84	-2332.03	-1980.59	541.07
900.	182.30	170.70	96.53	-2330.28	-1937.09	470.39
1000.	185.10	190.10	114.90	-2333.22	-1893.20	413.76
1100.	187.40	207.80	133.50	-2330.98	-1849.27	367.42
1200.	189.70	224.20	152.40	-2328.62	-1805.53	328.83
1300.	192.40	239.60	171.50	-2326.20	-1762.19	296.25

SOURCES: S_{298}: 80BEN/STU $H-H_{298}$ and $S-S_{298}$: 80BEN/STU

$\Delta_f H_{298}$: 80BEN/STU

$NaAlO_2$ sodium aluminate Mol. wt. 81.970

S_{298} = 16.9±0.1/cal degr,mol $\Delta_f H_{298}$ = -271.7±0.4 kcal/mol

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	----cal/deg,mol-----		----------kcal/mol----------			
298.	17.61	0.00	0.00	-271.70	-256.44	187.98
300.	17.66	.11	.03	-271.70	-256.35	186.75
400.	19.94	5.52	1.92	-272.47	-251.16	137.23
500.	21.41	10.14	3.99	-272.50	-245.82	107.45
600.	22.53	14.15	6.19	-272.44	-240.49	87.60
700.	23.49	17.69	8.49	-272.30	-235.18	73.43
800.	23.60	21.26	11.16	-271.85	-229.91	62.81
900.	24.03	24.06	13.54	-271.73	-224.68	54.56
1000.	24.45	26.62	15.96	-274.16	-219.27	47.92
1100.	24.87	28.97	18.43	-273.99	-213.79	42.48
1200.	25.30	31.15	20.94	-273.79	-208.33	37.94
1300.	25.72	33.19	23.49	-273.57	-202.88	34.11
1400.	26.15	35.11	26.08	-273.34	-197.45	30.82
1500.	26.57	36.93	28.72	-273.09	-192.04	27.98
1600.	26.99	38.66	31.40	-272.83	-186.65	25.49
1700.	27.43	40.31	34.12	-272.55	-181.27	23.30
1800.	27.84	41.89	36.88	-272.25	-175.90	21.36
1900.	28.24	43.40	39.69	-271.94	-170.56	19.62
2000.	28.62	44.86	42.53	-271.61	-165.24	18.06

SOURCES: S_{298}: 55KIN $H-H_{298}$ and $S-S_{298}$: JANAF 63/3 (60CHR/CON)

$\Delta_f H_{298}$: 77HEM/ROB

$NaAlSiO_4$ nepheline Mol. wt. 142.054

S_{298} = 29.7±0.3 cal/mol $\Delta_f H_{298}$ =-501.0±1.0 kcal/mol

Tr. pts. α - 467K - β - 1180K - γ - 1522K - carnegieite - 1799 - liq.

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	-----cal/deg,mol-----		---------kcal/mol----------			
298.	26.21	0.00	0.00	-501.00	-473.61	347.16
300.	26.37	.16	.05	-501.01	-473.44	344.90
400.	34.80	8.90	3.11	-501.82	-464.15	253.60
467.	40.45	14.72	5.63	-501.56	-457.86	214.27
467.	34.11	14.91	5.72	-501.48	-457.86	214.27
500.	34.63	17.25	6.85	-501.46	-454.78	198.78
600.	36.22	23.71	10.39	-501.37	-445.45	162.25
700.	37.81	29.41	14.09	-501.20	-436.14	136.17
800.	39.40	34.56	17.95	-500.95	-426.86	116.61
900.	40.98	39.29	21.97	-500.62	-417.62	101.41
1000.	42.57	43.70	26.15	-502.75	-408.23	89.22
1100.	44.16	47.83	30.49	-502.18	-398.81	79.24
1180.	45.43	50.97	34.07	-501.63	-391.32	72.48
1180.	42.67	51.08	34.20	-501.51	-391.31	72.48
1200.	42.69	51.80	35.05	-501.42	-389.45	70.93
1300.	42.83	55.22	39.33	-500.99	-380.13	63.91
1400.	42.96	58.40	43.62	-500.59	-370.85	57.89
1500.	43.09	61.37	47.92	-500.22	-361.60	52.69

SOURCES: S_{298}: S3KEL/TOD $H-H_{298}$ and $S-S_{298}$: S3KEL/TOD $\Delta_f H_{298}$: S3KRA/NEU

$NaAlSiO_4$ carnegieite Mol. wt. 142.054

S_{298} unknown $\Delta_f H_{298}$ unknown

T	C_p	$S-S_{298}$	$H-H_{298}$
deg K	----cal/deg,mol----		--kcal/mol--
298.	28.10	0.00	0.00
300.	28.21	0.17	0.05
400.	32.76	8.94	3.11
500.	35.79	16.58	6.54
600.	38.22	23.35	10.26
700.	40.36	29.44	14.21
800.	42.36	34.96	18.35
900.	44.26	40.04	22.66
980.	45.75	43.87	26.26
980.	44.48	45.95	28.30
1000.	44.50	46.85	29.19
1100.	44.61	51.10	33.65
1200	44.71	54.98	38.12
1300.	44.82	58.56	42.59
1400.	44.92	61.89	47.07
1500.	45.03	64.99	51.56
1600.	45.14	67.90	56.07
1700.	45.24	70.64	60.60

SOURCES: $H-H_{298}$ and $S-S_{298}$: S3KEL/TOD

NOTE: thermod. unstable rel. to nepheline below 1525K, stable above.

$NaAlSi_2O_6$ jadeite Mol.wt. 202.139

S_{298} = 31.95 ± 0.30 cal/degr,mol $\Delta_f H_{298}$ = -724.8 ± 0.9 kcal/mol

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	----cal/deg,mol----		----------kcal/mol----------			
298.	38.16	0.00	0.00	-724.80	-682.13	500.01
300.	38.30	.24	.07	-724.81	-681.86	496.73
400.	44.82	12.21	4.25	-725.72	-667.44	364.67
500.	49.20	22.71	8.96	-725.66	-652.87	285.37
600.	52.15	31.96	14.04	-725.36	-638.34	232.52
700.	54.24	40.16	19.36	-724.93	-623.87	194.78
800.	55.82	47.51	24.87	-724.43	-609.47	166.50
900.	55.07	54.16	30.52	-723.90	-595.13	144.52
1000.	58.09	60.23	36.28	-725.90	-580.67	126.90
1100.	58.97	65.81	42.13	-725.28	-566.18	112.49
1200.	59.74	70.98	48.07	-724.65	-551.75	100.49

SOURCES: S_{298}: 53KEL/TOD, 65FUR/REI $H-H_{298}$ and $S-S_{298}$: 65FUR/REI

$\Delta_f H_{298}$: 53KRA/NEU, 51KRA/NEU

$NaAlSi_2O_6$ dehydrated analcite Mol.wt. 202.139

S_{298} = 41.9 ± 0.4 cal/degr,mol $\Delta_f H_{298}$ = -712.8 ± 0.5 kcal/mol

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	----cal/deg,mol-----		---------kcal/mol----------			
298.	39.30	0.00	0.00	-712.80	-673.09	493.39
300.	39.41	.24	.07	-712.81	-672.84	490.17
400.	45.44	11.92	4.35	-713.62	-659.21	360.17
500.	51.03	22.71	9.19	-713.43	-645.61	282.20
600.	54.78	32.36	14.50	-712.91	-632.10	230.24
700.	57.65	41.03	20.12	-712.18	-618.69	193.16
800.	60.06	48.89	26.01	-711.29	-605.39	165.38
900.	62.20	56.09	32.13	-710.30	-592.21	143.81
1000.	64.18	62.75	38.44	-711.73	-578.97	126.53

SOURCES: S_{298}: 61KIN/WEL $H-H_{298}$ and $S-S_{298}$: 68PAN

$\Delta_f H_{298}$: 80JOH, 68HLA/KLE

$NaAlSi_2O_6:H_2O$ analcite Mol. wt. 238.170

S_{298} = 53.7 ± 0.2 cal/degr,mol,K Δ_fH_{298} = -791.4 ± 0.3kcal/mol

T	C_p	$S-S_{298}$	$H-H_{298}$	Δ_fH	Δ_fG	$Log_{10}K_f$
deg K	----cal/deg,mol------		----------kcal/mol----------			
298.	50.13	0.00	0.00	-791.40	-738.60	541.41
300.	50.19	.31	.09	-791.41	-738.27	537.83
400.	55.70	15.46	5.37	-792.26	-720.47	393.65
500.	62.12	28.58	11.26	-792.09	-702.53	307.07
600.	67.59	40.41	17.76	-791.45	-684.67	249.39

SOURCES: S: 80JOH $H-H_{298}$ and $S-S_{298}$: 80JOH Δ_fH_{298}: 80JOH

Remark: Adj'd from 0.96[$NaAlSi_2O_6:H_2O$:1/16($2SiO_2:H_2O$)]

$NaAlSi_3O_8$ low albite Mol. wt. 262.223

S_{298} = 49.57±0.10cal/degr,mol $\Delta_f H_{298}$ = -940.94±0.50 kcal/mo

M. pt. see high albite

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	----cal/deg,mol-----		---------kcal/mol----------			
298.	49.02	0.00	0.00	-940.94	-887.57	650.60
300.	49.21	.30	.09	-940.95	-887.24	646.35
400.	57.29	15.65	5.44	-941.90	-869.22	474.92
500.	62.76	29.06	11.46	-941.81	-851.05	371.99
600.	66.64	40.86	17.94	-941.43	-832.93	303.39
700.	69.48	51.36	24.76	-940.88	-814.89	254.42
800.	71.63	60.78	31.82	-940.22	-796.94	217.71
900.	73.30	69.32	39.07	-939.52	-779.06	189.18
1000.	74.65	77.11	46.47	-941.32	-761.09	166.34
1100.	75.76	84.28	53.99	-940.51	-743.11	147.64
1200.	76.71	90.92	61.61	-939.68	-725.20	132.08
1300.	77.54	97.09	69.33	-938.83	-707.37	118.92
1400.	78.31	102.87	77.12	-937.99	-689.59	107.65

SOURCES: S_{298}: 76OPE/HEM $H-H_{298}$ and $S-S_{298}$: 78ROB/HEM(60KEL, 78HEM/KRU)

$\Delta_f H_{298}$: 77HEM/ROB

$NaAlSi_3O_8$ high albite (analbite) Mol. wt. 262.223

S_{298} = 54.11±0.10 cal/degr,mol $\Delta_f H_{298}$ = -938.31±0.60 kcal/mol

M. pt. 1391K

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	----cal/deg,mol-----		---------kcal/mol----------			
298.	48.95	0.00	0.00	-938.31	-886.29	649.67
300.	49.13	.30	.10	-938.31	-885.96	645.42
400.	57.29	15.63	5.44	-939.28	-868.40	474.47
500.	62.92	29.05	11.46	-939.18	-850.69	371.83
600.	66.88	40.90	17.97	-938.78	-833.02	303.43
700.	69.72	51.43	24.80	-938.20	-815.44	254.59
800.	71.81	60.88	31.88	-937.53	-797.95	217.99
900.	73.40	69.44	39.15	-936.81	-780.54	189.54
1000.	74.63	77.24	46.55	-938.60	-763.04	166.76
1100.	75.64	84.40	54.07	-937.81	-745.52	148.12
1200.	76.49	91.02	61.68	-936.99	-728.08	132.60
1300.	77.25	97.17	69.36	-936.17	-710.71	119.48
1391.	79.90	102.42	76.42	-935.43	-694.95	109.19
1400.	77.96	102.92	77.12	-935.36	-693.39	108.24

SOURCES: S_{298}: 78ROB/HEM $H-H_{298}$ and $S-S_{298}$: 78ROB/HEM(78MEM/KRU)

$\Delta_f H_{298}$: 68WAL, 68HOL/KLE

$NaAlSi_3O_8$ glass Mol. wt. 262.223

S_{298} = 61.19±0.5 cal/degr,mol $\Delta_f H_{298}$ = -926.5±0.7 kcal/mol

M. pt. 1391K Glass temp. 1050K

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	----cal/deg,mol----		---------kcal/mol----------			
298.	50.17	0.00	0.00	-926.50	-876.59	642.56
300.	50.53	.31	.09	-926.51	-876.28	638.37
400.	58.88	16.04	5.58	-927.33	-859.45	469.58
500.	64.65	29.84	11.78	-927.06	-842.50	368.25
600.	68.61	42.00	18.45	-926.49	-825.64	300.74
700.	71.47	52.80	25.46	-925.73	-808.89	252.54
800.	73.71	62.50	32.72	-924.88	-792.26	216.43
900.	75.69	71.29	40.20	-923.95	-775.73	188.37
1000.	77.61	79.37	47.86	-925.49	-759.13	165.91
1100.	79.64	86.86	55.72	-924.34	-742.55	147.53
1200.	81.91	93.88	63.80	-923.06	-726.08	132.24
1300.	84.49	100.54	72.11	-921.61	-709.73	119.32
1391.	87.17	106.34	79.92	-920.12	-694.95	109.19
1400.	87.45	106.90	80.71	-919.96	-693.49	108.26

SOURCES: S_{298}: 78ROB/HEM $H-H_{298}$ and $S-S_{298}$: 79KRU/ROB

$\Delta_f H_{298}$: 68WAL, 68HLA/KLE

$KAlO_2$, potassium aluminate Mol. wt. 98.079

S_{298} = 20.45 ± 0.20 $\Delta_f H_{298}$ unknown

Tr. pt. 810 K

T	C_p	$S-S_{298}$	$H-H_{298}$
deg K	----cal/deg-mol----		--kcal/mol--
298.	18.20	0.00	0.00
300.	18.25	0.12	0.03
400.	20.60	5.72	1.99
500.	22.23	10.50	4.13
600.	23.49	14.67	6.42
700.	24.51	18.37	8.82
800.	25.34	21.70	11.32
810.	25.42	22.01	11.57
810.	24.30	22.39	11.88
900.	24.56	24.97	14.08
1000.	24.85	27.57	16.55
1100.	25.14	29.95	19.05
1200.	25.42	32.15	21.58
1300.	25.71	34.20	24.13
1400.	26.00	36.11	26.72

SOURCES: S: 80BEY/FER $H-H_{298}$: 80BEY/FER

$KAlSiO_4$ kaliophilite Mol. wt. 158.163

S_{298} = 31.85 ± 0.30 cal/degr,mol $\Delta_f H_{298}$ = -506.4 ± 0.5 kcal/mol

Tr. pts. α - 810K - β - (~1800K) - liq

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	----cal/deg,mol-----		---------kcal/mol----------			
298.	28.63	0.00	0.00	-506.40	-478.71	350.90
300.	28.73	.18	.05	-506.41	-478.53	348.61
400.	33.05	9.09	3.16	-507.14	-469.10	256.31
500.	35.98	16.79	6.62	-507.06	-459.60	200.89
600.	38.37	23.57	10.34	-506.80	-450.13	163.96
700.	40.50	29.65	14.28	-506.40	-440.72	137.60
800.	42.49	35.19	18.43	-505.88	-431.37	117.84
810.	42.68	35.72	18.86	-505.82	-430.44	116.14
810.	42.50	35.92	19.03	-505.65	-430.44	116.14
900.	42.50	40.40	22.85	-505.17	-422.11	102.50
1000.	42.50	44.88	27.10	-507.26	-412.72	90.20
1100.	42.50	48.93	31.35	-506.81	-403.29	80.13
1200.	42.50	52.63	35.60	-506.41	-393.89	71.74
1300.	42.50	56.03	39.85	-506.06	-384.53	64.65
1400.	42.50	59.18	44.10	-505.76	-375.20	58.57
1500.	42.50	62.11	48.35	-505.50	-365.88	53.31
1600.	42.50	64.85	52.60	-505.29	-356.58	48.71
1700.	42.50	67.43	56.85	-517.11	-347.19	44.63
1800.	42.50	69.86	61.10	-516.92	-337.19	40.94

SOURCES: S_{298}: 53KEL/TOD $H-H_{298}$ and $S-S_{298}$: 68PAN $\Delta_f H_{298}$: 66BAR/ADA

KAlSi2O6 leucite Mol. wt. 218.247

S_{298} = 47.85 ± 0.41 cal/degr,mol $\Delta_f H$ = -720.4 ± 1.0 kcal/mol

Tr. pt. 955K, m. pt. 1974K

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	-----cal/deg,mol-----		----------kcal/mol----------			
298.	39.24	0.00	0.00	-720.40	-681.53	499.57
300.	39.36	.24	.07	-720.41	-681.28	496.31
400.	45.02	12.39	4.31	-721.23	-668.09	365.02
500.	49.44	22.92	9.04	-721.16	-654.80	286.21
600.	53.26	32.38	14.18	-720.80	-641.62	233.71
700.	57.06	40.78	19.70	-720.18	-628.39	196.19
800.	60.63	48.63	25.59	-719.32	-615.33	168.10
900.	64.13	55.67	31.83	-718.22	-602.12	146.21
955.	66.03	59.82	35.40	-720.07	-595.27	136.22
955.	56.36	59.82	35.40	-720.07	-595.27	136.22
1000.	56.50	62.42	37.94	-719.89	-589.39	128.81
1100.	56.81	67.81	43.61	-719.50	-576.35	114.51
1200.	57.13	72.77	49.31	-719.15	-563.36	102.60
1300.	57.44	77.36	55.04	-718.83	-550.39	92.53
1400.	57.76	81.63	60.80	-718.54	-537.45	83.90
1500.	58.07	85.62	66.59	-718.29	-524.52	76.42
1600.	58.38	89.38	72.41	-718.06	-511.61	69.88
1700.	58.70	92.93	78.24	-741.88	-498.53	64.09
1800.	59.01	96.29	84.15	-741.57	-484.18	58.79
1900.	59.33	102.54	90.07	-741.30	-475.69	54.72
2000.	59.64	102.54	96.01	-741.04	-455.62	49.79

SOURCES: S_{298}: 53KEL/TOD, 78ROB/HEM $H-H_{298}$ and $S-S_{298}$: 68PAN

$\Delta_f H_{298}$: 66BAR/ADA

$KAlSi_3O_8$ microcline Mol. wt. 278.331

S_{298} = 51.2 ± 0.3 cal/degr,mol $\Delta_f H_{298}$ = -948.3 ± 1.0kcal/mol

M. pt. see sanidine

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	-----cal/deg,mol-----		---------kcal/mol----------			
298.	48.37	0.00	0.00	-948.30	-894.47	655.66
300.	48.54	.30	.09	-948.31	-894.14	651.38
400.	56.51	15.42	5.36	-949.31	-875.89	478.56
500.	62.16	28.67	11.31	-949.29	-857.53	374.82
600.	66.14	40.38	17.74	-948.98	-839.20	305.68
700.	69.01	50.80	24.51	-948.48	-820.94	256.31
800.	71.14	60.16	31.52	-947.89	-802.77	219.31
900.	72.80	68.64	38.72	-947.25	-784.66	190.54
1000.	74.16	76.38	46.07	-949.14	-766.45	167.51
1100.	75.35	83.51	53.54	-948.41	-748.22	148.66
1200.	76.47	90.11	61.14	-947.66	-730.05	132.96
1300.	77.59	96.28	68.84	-946.88	-711.95	119.69
1400.	78.75	102.07	76.65	-946.07	-693.91	108.32

SOURCES: S_{298}: 760PE/HEM $H-H_{298}$ and $S-S_{298}$: 78ROB/HEM(60KEL, 78HEM/KRU)

$\Delta_f H_{298}$: 71WAL/ROB

$KAlSi_3O_8$ sanidine Mol. wt. 278.332

S_{298} = 55.67 ± 0.30 cal/degr.,mol $\Delta_f H_{298}$ = -946.4 ± 1.0kcal/m

M. pt. 1423K (incongr., to $KAlSi_2O_6$ + liq)

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	----cal/deg,mol----		----------kcal/mol----------			
298.	48.88	0.00	0.00	-946.40	-893.90	655.25
300.	49.05	.30	.09	-946.41	-893.58	650.97
400.	57.11	15.59	5.42	-947.35	-875.79	478.51
500.	62.68	28.97	11.43	-947.28	-857.90	374.99
600.	66.59	40.76	17.90	-946.91	-840.05	305.99
700.	69.42	51.25	24.71	-946.37	-822.28	256.73
800.	71.52	60.66	31.76	-945.74	-804.60	219.81
900.	73.16	69.18	39.00	-945.07	-787.00	191.11
1000.	74.49	76.96	46.38	-946.92	-769.29	168.13
1100.	75.64	84.12	53.89	-946.17	-751.56	149.32
1200.	76.68	90.74	61.51	-945.39	-733.90	133.66
1300.	77.67	96.92	69.23	-944.59	-716.31	120.42
1400.	78.68	102.71	77.04	-943.78	-698.78	109.08
1423.	78.92	103.00	78.86	-943.46	-693.21	106.47

SOURCES: S_{298}: 76OPE/HEM $H-H_{298}$ and $S-S_{298}$: 78ROB/HEM(60KEL, 78HEM/KRU)

$\Delta_f H_{298}$: 77HEM/ROB

KAlSi3O8 glass Mol. wt. 278.332

S_{298} = 62.52 ± 1.00 cal/degr,mol $\Delta_f H_{298}$ = -935.7 ± 0.4 kcal/mol

Glass temp. 1213K

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	----cal/deg,mol------		----------kcal/mol----------			
298.	50.05	0.00	0.00	-935.70	-885.25	648.90
300.	50.23	.31	.09	-935.71	-884.93	644.67
400.	58.40	15.95	5.55	-936.53	-867.85	474.17
500.	63.97	29.62	11.69	-936.32	-850.69	371.84
600.	67.87	41.65	18.29	-935.83	-833.61	303.64
700.	70.66	52.34	25.22	-935.16	-816.62	254.96
800.	72.68	61.91	32.40	-934.41	-799.75	218.48
900.	74.16	70.56	39.74	-933.63	-782.96	190.13
1000.	75.26	78.43	47.22	-935.39	-766.08	167.43
1100.	76.07	85.65	54.78	-934.57	-749.18	148.85
1200.	76.67	92.29	62.42	-933.77	-732.37	133.38
1300.	77.12	98.45	70.11	-933.00	-715.62	120.31

SOURCES: S_{298}: 78ROB/HEM $H-H_{298}$ and $S-S_{298}$: 79KRU/ROB

$\Delta_f H_{298}$: 71WAL/ROB

$KAl_3Si_3O_{10}(OH)_2$ muscovite mica Mol. wt. 398.308

S_{298} = 73.23 ± 0.15 cal/degr,mol $\Delta_f H_{298}$ = -1427.3 ± 1.0 kcal/mol

Decomp. temp. 1323K

T	C_p	$S-S_{298}$	$H-H_{298}$	$\Delta_f H$	$\Delta_f G$	$Log_{10} K_f$
deg K	-----cal/deg,mol-----		---------kcal/mol----------			
298.	77.93	0.00	0.00	-1427.30	-1337.48	980.39
300.	78.25	.48	.14	-1427.32	-1336.92	973.94
400.	92.15	25.03	8.71	-1428.34	-1306.58	713 88
500.	101.74	46.68	18.43	-1427.97	-1276.17	557.81
600.	108.61	65.87	28.97	-1427.07	-1245.89	453.81
700.	113.66	83.01	40.09	-1425.84	-1215.78	379.58
800.	117.44	98.45	51.66	-1424.44	-1185.88	323.97
900.	120.28	112.45	63.55	-1422.97	-1156.14	280.75
1000.	122.41	125.24	75.69	-1429.11	-1126.02	246.09

SOURCES: S_{298}: ROB/HEM(76ROB/HEM, 63WEL/KIN) $H-H_{298}$ and $S-S_{298}$: 79KRU/ROB (=78ROB/HEM, 64PAN) $\Delta_f H_{298}$: 64BAR, 79KRU/ROB

$(Na_{0.2}K_{0.8})Al_3Si_3O_8$ 1:4 low albite-microcline crystal solutions

T	$\Delta_f H$	$\Delta_f G$	$LogK_f$
deg K	-----kcal/mol----		
500.	-946.54	-855.79	374.07
600.	-946.21	-837.67	305.12
700.	-945.70	-819.62	255.90
800.	-945.10	-801.65	219.00
900.	-944.45	-783.76	190.32
1000.	-946.31	-765.76	167.36
1100.	-945.57	-747.73	148.56

SOURCES: $\Delta_{xs}G$: 71WAL/ROB

$(Na_{0.4}K_{0.6})Al_3Si_3O_8$ 2:3 low albite-microcline crystal solutions

T	$\Delta_f H$	$\Delta_f G$	$LogK_f$
deg K	------kcal/mol------		
500.	-944.34	-854.22	373.38
600.	-944.09	-836.21	304.59
700.	-943.57	-818.26	255.47
800.	-942.96	-800.41	218.66
900.	-942.29	-782.63	190.05
1000.	-944.14	-764.74	167.13
1100.	-943.39	-746.84	148.38

SOURCES: $\Delta_{xs}G$: 71WAL/ROB

$(Na_{0.6}K_{0.4})Al_3Si_3O_8$ 3:2 low albite-microcline crystal solutions

T	$\Delta_f H$	$\Delta_f G$	$LogK_f$
deg K	-----kcal/mol----		
500.	-942.96	-852.95	372.82
600.	-942.61	-834.97	304.14
700.	-942.08	-817.08	255.10
800.	-941.45	-799.27	218.35
900.	-940.77	-781.53	189.78
1000.	-942.60	-763.69	166.90
1100.	-941.83	-745.84	148.18

SOURCES: $\Delta_{xs}G$: 71WAL ROB

$(Na_{0.8}K_{0.2})Al_3Si_3O_8$ 4:1 low albite-microcline crystal solutions

T	$\Delta_f H$	$\Delta_f G$	$LogK_f$
deg K	-----kcal/mol----		
500.	-942.09	-851.95	372.39
600.	-942.73	-833.95	303.77
700.	-941.19	-816.03	254.78
800.	-940.54	-798.20	218.06
900.	-939.85	-780.44	189.52
1000.	-941.67	-762.59	166.66
1100.	-940.88	-744.72	147.96

SOURCES: $\Delta_{xs}G$: 71WAL/ROB

$(Na_{0.2}K_{0.8})Al_3Si_3O_8$ 1:4 high albite-sanidine crystal solutions

T	$\Delta_f H$	$\Delta_f G$	$LogK_f$
deg K	-----kcal/mol----		
500.	-944.60	-856.26	374.27
600.	-944.23	-838.62	305.47
700.	-943.68	-821.06	256.35
800.	-943.04	-803.59	219.53
900.	-942.36	-786.19	190.91
1000.	-944.20	-786.69	171.93
1100.	-943.44	-751.18	149.25

SOURCES: $\Delta_{xs}G$: 69WAL/THO

$(Na_{0.4}K_{0.6})Al_3Si_3O_8$ 2:3 high albite-sanidine crystal solutions

T	$\Delta_f H$	$\Delta_f G$	$LogK_f$
deg K	-----kcal/mol----		
500.	-942.39	-854.55	373.52
600.	-942.01	-837.02	304.88
700.	-941.46	-819.56	255.88
800.	-940.81	-802.20	219.15
900.	-940.12	-784.91	190.60
1000.	-941.95	-767.52	167.74
1100.	-941.17	-750.11	149.03

SOURCES: $\Delta_{xs}G$: 69WAL/THO

$(Na_{0.6}K_{0.4})Al_3Si_3O_8$ 3:2 high albite-sanidine crystal solutions

T	$\Delta_f H$	$\Delta_f G$	$LogK_f$
deg K	-----kcal/mol----		
500.	-940.71	-853.03	372.86
600.	-940.32	-835.53	304.34
700.	-939.76	-818.10	255.42
800.	-939.10	-800.77	218.76
900.	-938.40	-783.52	190.26
1000.	-940.22	-766.16	167.44
1100.	-939.44	-748.80	148.77

SOURCES: $\Delta_{xs}G$: 69WAL/THO

$(Na_{0.8}K_{0.2})Al_3Si_3O_8$ 4:1 high albite-sanidine crystal solutions

T	$\Delta_f H$	$\Delta_f G$	$LogK_f$
deg K	-----kcal/mol----		
500.	-939.62	-851.76	372.30
600.	-939.22	-834.23	303.87
700.	-938.65	-816.77	255.01
800.	-937.98	-799.41	218.39
900.	-937.27	-782.12	189.92
1000.	-939.08	-764.74	167.13
1100.	-938.29	-747.35	148.48

SOURCES: $\Delta_{xs}G$: 69WAL/THO

Element 02 Mol. wt. 31.9988

Ref. State, JANAF Tables(77/3)

T	S	$H-H_{298}$
degK	cal/K mol	kcal/mol
0.00	0.000	-2.075
100.00	41.395	-1.381
200.00	46.218	-0.685
298.15	49.005	0.000
300.00	49.049	.013
400.00	51.090	.723
500.00	52.721	1.454
600.00	54.097	2.209
700.00	55.296	2.987
800.00	56.360	3.785
900.00	57.319	4.599
1000.00	58.190	5.426
1100.00	58.990	6.265
1200.00	59.728	7.113
1300.00	60.413	7.969
1400.00	61.053	8.833
1500.00	61.653	9.703
1600.00	62.219	10.580
1700.00	62.754	11.462
1800.00	63.262	12.350
1900.00	63.745	13.244
2000.00	64.206	14.143

Element H2 Mol. wt. 2.0158

Ref. State, JANAF Tables(61/3)

T	S	$H-H_{298}$
degK	cal/K mol	kcal/mol
0.00	0.000	-2.024
100.00	24.387	-1.265
200.00	28.520	-0.662
298.15	31.208	0.000
300.00	31.251	.013
400.00	33.247	.707
500.00	34.806	1.406
600.00	36.082	2.106
700.00	37.165	2.808
800.00	38.107	3.514
900.00	38.946	4.226
1000.00	39.702	4.944
1100.00	40.394	5.670
1200.00	41.033	6.404
1300.00	41.628	7.148
1400.00	42.187	7.902
1500.00	42.716	8.668
1600.00	43.217	9.446
1700.00	43.695	10.233
1800.00	44.150	11.030
1900.00	44.586	11.836
2000.00	45.004	12.651

Element Si At. wt. 28.0855

Ref. State, JANAF Tables(67/3) M. pt. 1685K

T	S	$H-H_{298}$
degK	cal/K mol	kcal/mol
0.00	0.000	-0.769
100.00	.916	-0.705
200.00	2.788	-0.424
298.15	4.498	0.000
300.00	4.528	.009
400.00	5.983	.516
500.00	7.197	1.060
600.00	8.231	1.628
700.00	9.133	2.213
800.00	9.933	2.813
900.00	10.655	3.425
1000.00	11.312	4.049
1100.00	11.917	4.684
1200.00	12.478	5.329
1300.00	13.002	5.984
1400.00	13.495	6.649
1500.00	13.961	7.324
1600.00	14.403	8.009
1685.00	14.760	8.600
1685.00	21.883	20.600
1700.00	21.941	20.697
1800.00	22.313	21.347
1900.00	22.664	21.997
2000.00	22.998	22.647

Element Al At. wt. 26.9815

Ref. State, JANAF Tables(65/12) M. pt. 933K

T degK	S cal/K mol	$H-H_{298}$ kcal/mol
0.00	0.000	-1.094
100.00	1.650	-0.988
200.00	4.572	-0.546
298.15	6.769	0.000
300.00	6.805	.011
400.00	8.528	.610
500.00	9.934	1.241
600.00	11.134	1.900
700.00	12.190	2.585
800.00	13.147	3.302
900.00	14.044	4.064
933.00	14.333	4.328
933.00	17.077	6.888
1000.00	17.603	7.397
1100.00	18.326	8.156
1200.00	18.986	8.915
1300.00	19.593	9.673
1400.00	20.156	10.432
1500.00	20.679	11.191
1600.00	21.169	11.950
1700.00	21.629	12.709
1800.00	22.063	13.467
1900.00	22.473	14.226
2000.00	22.862	14.985

Element Li At. wt. 6.941

Ref. State, JANAF Tables(62/6) M. pt. 453.69K
Liquid retained as Ref. State above b. pt. 1620K.

T degK	S cal/K mol	$H-H_{298}$ kcal/mol
0.00	0.000	-1.105
100.00	1.758	-0.986
200.00	4.742	-0.546
298.15	6.954	0.000
300.00	6.990	.011
400.00	8.774	.632
453.69	9.631	.998
453.69	11.212	1.715
500.00	11.915	2.050
600.00	13.216	2.763
700.00	14.294	3.463
800.00	15.218	4.155
900.00	16.032	4.846
1000.00	16.759	5.536
1100.00	17.415	6.224
1200.00	18.013	6.912
1300.00	18.562	7.598
1400.00	19.070	8.283
1500.00	19.541	8.966
1600.00	19.981	9.647
1700.00	20.393	10.326
1800.00	20.780	11.003
1900.00	21.146	11.680
2000.00	21.493	12.357

Element Na At. wt. 22.9898

Ref. State, JANAF Tables(62/6) M. pt. 370.98K
Liquid retained as Ref. State above b. pt. 1156K.

T	S	$H-H_{298}$
degK	cal/K mol	kcal/mol
0.00	0.000	-1.541
100.00	5.690	-1.221
200.00	9.725	-0.634
298.15	12.298	0.000
300.00	12.340	.012
370.98	13.843	.515
370.98	15.520	1.137
400.00	16.086	1.356
500.00	17.741	2.097
600.00	19.056	2.818
700.00	20.143	3.524
800.00	21.072	4.219
900.00	21.885	4.909
1000.00	22.612	5.599
1100.00	23.274	6.295
1200.00	23.884	7.000
1300.00	24.462	7.720
1400.00	25.009	8.459
1500.00	25.533	9.219
1600.00	26.036	9.998
1700.00	26.521	10.797
1800.00	26.989	11.616
1900.00	27.443	12.456
2000.00	27.883	13.315

Element K At. wt. 39.0983

Ref. State, JANAF Tables(61/12) M. pt. 336.35K
Liquid retained as Ref. State above b. pt. 1037K.

T	S	$H-H_{298}$
degK	cal/K mol	kcal/mol
0.00	0.000	-1.693
100.00	8.509	-1.279
200.00	12.785	-0.659
298.15	15.457	0.000
300.00	15.501	.013
336.35	16.363	.284
336.35	18.022	.842
400.00	19.332	1.327
500.00	20.990	2.070
600.00	22.315	2.796
700.00	23.419	3.512
800.00	24.369	4.224
900.00	25.208	4.936
1000.00	25.967	5.657
1100.00	26.666	6.390
1200.00	27.320	7.142
1300.00	27.938	7.915
1400.00	28.527	8.710
1500.00	29.091	8.980
1600.00	29.632	10.366
1700.00	30.154	11.227
1800.00	30.659	12.110
1900.00	31.148	13.015
2000.00	31.623	13.942

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This report presents selected heat capacities, entropies, enthalpies, standard enthalpies of formation, standard free energies of formation and the equilibrium formation constants for solid sodium aluminate, solid potassium aluminate and solid aluminosilicates of lithium, sodium, and potassium. Values are listed in 28 tables for 17 different compositions (13 pure compounds and their polymorphs; 4 mixtures, each in low- and high-temperature configurations) from 298K to temperatures ranging up to 2000K.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

selected values; enthalpy; entropy; equilibrium constant of formation; free energy of formation; Gibbs energy function; heat capacity; heat of formation; thermochemical tables

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