Controls on the solute geochemistry of subglacial discharge from the Russell Glacier, Greenland Ice Sheet using Phreecq

> Kaitlyn Fleming NDSU GEOL 628 Geochemistry

> > December 2018





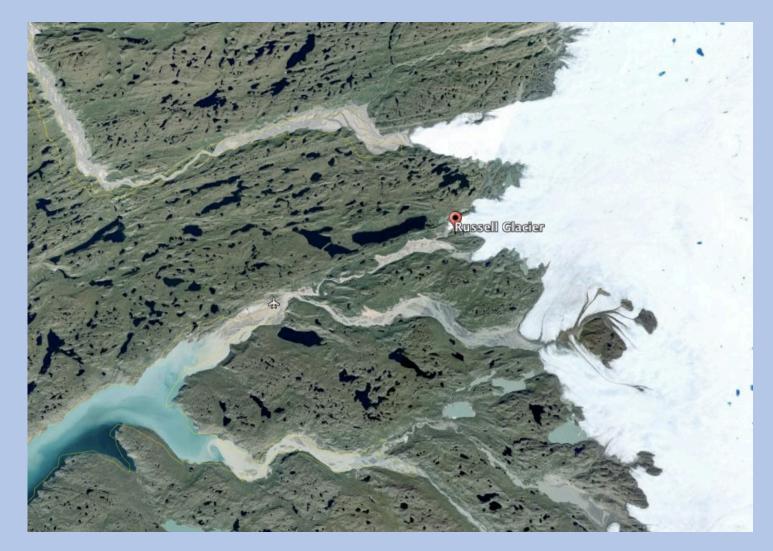
Study Area: Kangerlussuaq region of western Greenland



Russell Glacier Ce camp

Study Area: Kangerlussuaq region of western Greenland

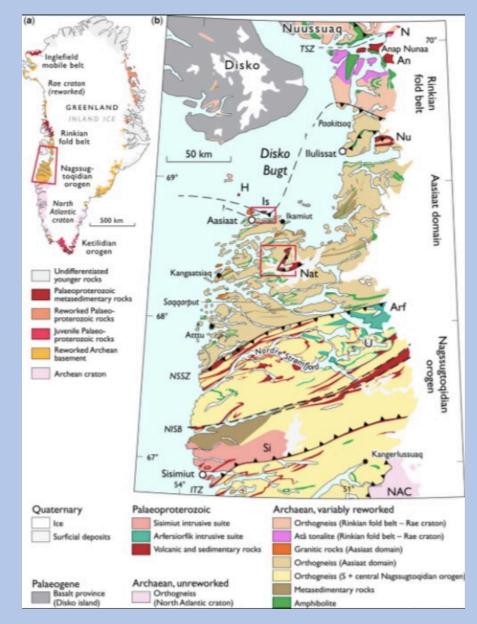
- Akuliarusiarsuup Kuua River (AKR), which drains the Russell Glacier, a land terminating lobe of the Greenland Ice Sheet (GrIS) located in the Kangerlussuaq region of western Greenland
- AKR integrates water from Seashore Lake and another small subglacial discharge tributary
- Climate is low Arctic polar desert
- Mean annual precipitation is low



Google Earth Image

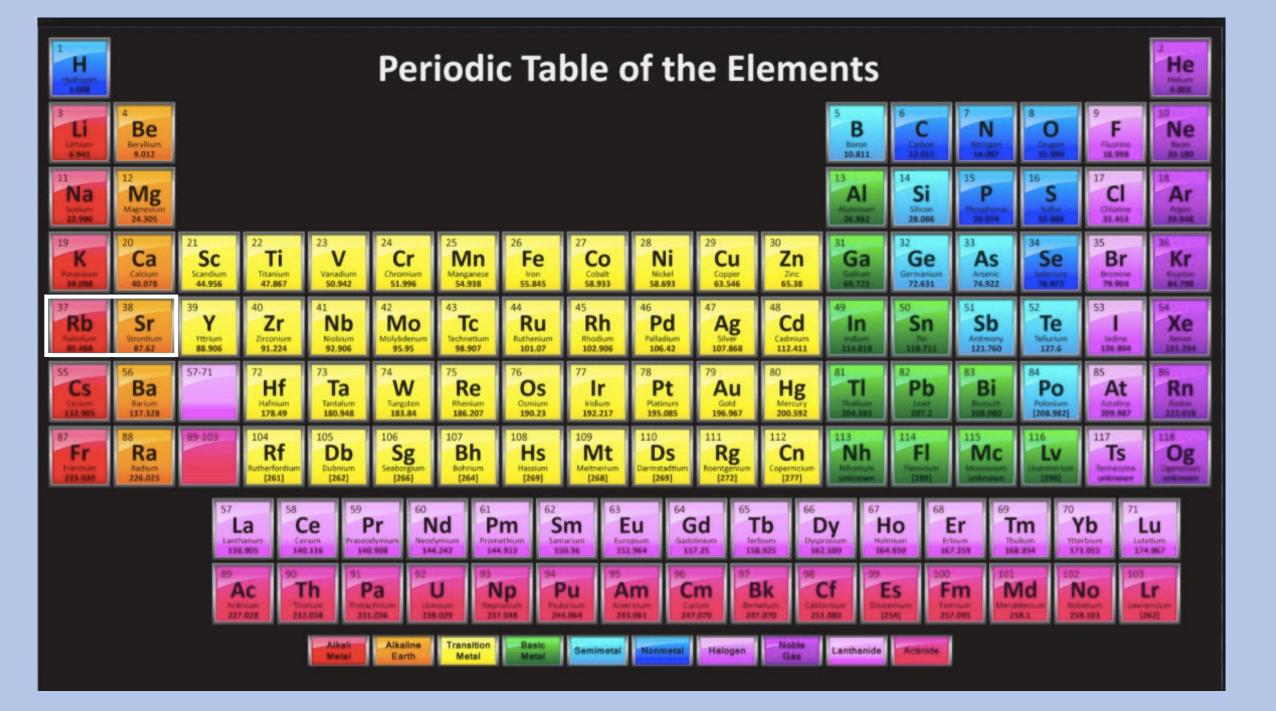
Geologic Background

- Russell and Leverett Glaciers overlie a geologic boundary between the southern Nagssugtoqidian Orogen to the north and the North Atlantic craton to the south
- Regionally dominated by Archaean gneisses
 - Southern Nagssugtoqidian Orogen: amphibolite-facies
 - North Atlantic Craton: granulate facies
- Northward transition from undeformed to deformed Kangamiut dykes marks the boundary between the terranes



Why Did I Chose this Topic?

- Glaciers
- Radiogenic and stable Sr isotope ratios (⁸⁷Sr/⁸⁶Sr)
- The paper came out just this year
- Has to do with hard-rock geochemistry as well as aqueous geochemistry



⁸⁷Sr/⁸⁶Sr

- Isotopes are atoms of the same element that differ in the number of neutrons
- The difference between ⁸⁷Sr and ⁸⁶Sr is the number of neutrons in the nucleus
 - ⁸⁶Sr means that the mass number (number of protons plus the number of neutrons) of this isotope is 86
 - ⁸⁷Sr means that the mass number of this isotope is 87
- The β^{-} decay of naturally occurring $^{87}Rb_{37}$ to stable $^{87}Sr_{38}$ is the basis for the Rb-Sr method of dating
- Geochronometry equation is written in terms of the isotopic ratio ⁸⁷Sr/⁸⁶Sr
- Used to date Rb-rich minerals such as muscovite, biotite, and K-feldspar in igneous and metamorphic rocks based on assumed values of the initial ⁸⁷Sr/⁸⁶Sr ratio

Stable Sr isotope ratios (⁸⁷Sr/⁸⁶Sr)

- Strontium has 4 stable, naturally occurring isotopes: ⁸⁴Sr (0.56%), ⁸⁶Sr (9.86%), ⁸¹Sr (7.0%), and ⁸⁸Sr (82.5%)
- Important concept for isotopic tracing is that Sr derived from any mineral through weathering reaction will have the same ⁸⁷Sr/⁸⁶Sr as the mineral
- Only ⁸⁷Sr is radiogenic
 - Produced by decay from radioactive alkali metal ⁸⁷Rb
 - Two sources of ⁸⁷Sr in any material: formed during primordial nucleo-synthesis along with ⁸⁴Sr, ⁸⁶Sr, and ⁸⁸Sr, as well as that formed by radioactive decay of ⁸⁷Rb

Applications

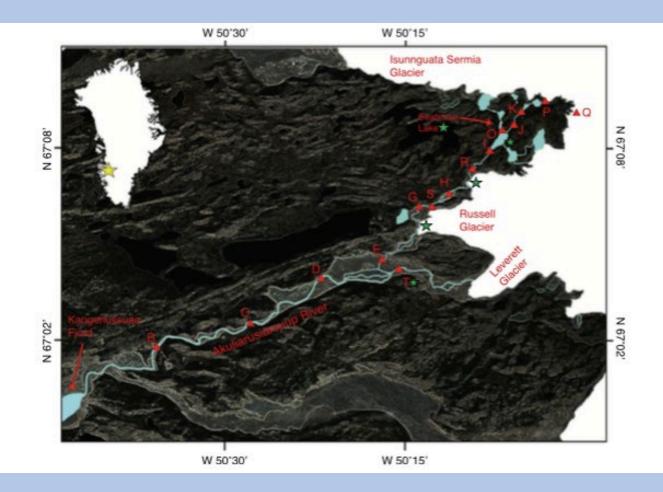
- Provenance identification
- Global weathering and hydrothermal activity cycles
- Stratigraphy and correlation of marine sediments
- Mixing of seawater and freshwater sources
- Tracing the source and constraining the timing of formation of groundwater pathways and processes
- Forensics (ivory, wood, ceramics, etc.)





Previous Work Objectives

- How does silicate weathering affect the geochemistry of subglacial discharge from the Russell Glacier into the proglacial AKR?
 - How do elemental concentrations and radiogenic and stable Sr isotope affect the geochemistry?
- What is the elemental and Sr isotope geochemistry of suspended sediments, bedload sediments, bulk rocks, and mineral separates?
- What are the solute sources that are determined by ⁸⁷Sr/⁸⁶Sr ratios?



(Andrews and Jacobson, 2018)

Previous Work

- Using radiogenic and Sr isotope ratios (⁸⁷Sr/⁸⁶Sr)to examine controls on solute acquisition in subglacial discharge from the Russell Glacier
- Two melt seasons (2014 and 2015)
- Analyses of mineral separates from bulk rocks
- Water samples were collected once per week, from June through August
- Downstream transect samples of the AKR were collected within one week of each other, once per month
- Water temperatures
- Anion, cation, and Si concentration analyses as well as Sr isotope analyses

Results of the research

- Silicate mineral weathering dominates the solute geochemistry of the Greenland Ice Sheet subglacial discharge in contrast to valley glaciers
- Ice sheet subglacial chemical weathering may have a greater impact on long-term CO2 drawdown
- Radiogenic Sr isotope ratios of subglacial discharge, sediment, and bulk rocks suggest that minerals with high ⁸⁷Sr/⁸⁶Sr ratios preferentially weather and elevate ⁸⁷Sr/⁸⁶Sr ratios of the dissolved load above the background level of bulk bedrock
- Calcite weathering doesn't appear to be the prevailing control on subglacial discharge ⁸⁷Sr/⁸⁶Sr ratios

How am I going to improve the project/ my contribution

- Inverse Modeling in Phreecq to:
 - Confirm the idea that the subglacial discharge from Russell Glacier is acquiring elemental geochemistry from the rocks that are within the area.
 - Another modeling approach was done in order to look at the interaction between the AKR and Seashore Lake.

Inverse Modeling

PHREEQC Interactive - [Geochem_proj2]	- 🗆 X
File Edit Insert View Options Window Help	_ 8 3
) 📂 🖶 🎒 👗 🖻 💼 🎒 🤷 💽 🔢 Run	
itial conditions 🍶 🌆 🌖 🗙 🛗 🔿 🚺 🔿 🗞 🏹 🔸	
orward and inverse modeling 🔐 🚳 🌡 🛥 🏷 🏦 🏂 K 🛛 🎬 🎬	à
	× INVERSE MODELING 1
- 👙 Input files	-solutions 1 2
⊡	-uncertainty 1 1
🗄 🔚 Geochem_proj2	-phases
🚊 🧰 Simulation 1	Albite dis
abc TITLE Inverse Modeling Russell Glacier	Anorthite dis
🕀 🚆 SOLUTION 1 pure water	Barite dis
🗄 🚡 SOLUTION 2 akr	Calcite dis
E fat INVERSE_MODELING 1	Goethite dis
• END	Chlorite(14A) dis
Simulation 2	Celestite dis Quartz dis
	H2O(g) dis
	Hematite dis
	K-feldspar dis
	K-mica dis
	CO2(q) dis
	-balances
	pH 0.1 0.1
	-range 1000
	-tolerance 1e-10
	-mineral water true
	END
Input 🥞 Output 👙 Database 🖑 Errors 🛍 PfW	
idy	NUM

Forward and inverse modeling I I I I I I I I I I I I I I I I I I I
Geochem_proj2

Sample D	Site ID	Distance (km)			Ca (µmol/L)	Mg (μmol/L)	K (μmol/L)	Na (µmol/L)	Al (μmol/L)	Ba (nmol/L)	Fe (µmol/L)	Si (µmol/L)	Sr (nmol/L)	SO4 (µmol/L)	Alkalinity (µeq/L)	pН	⁸⁷ Sr/ ⁸⁶ Sr	δ ^{88/86} Sr (‰)	Suspende Sediment (g/L)
1 kuliarusi	arsuup 1	Kuua River									_								
N25	Р	0.1	6-17	0.2	25	8.2	10	8.7	3.2	20	1.5	17	56	bdl	85	7.01	0.72596	0.332	0.12
V26	ĸ	1.0	6-17	1.1	22	8.2	7.7	8.7	2.4	17	0.8	15	54	bdl	78	nd	0.72487	nd	nd
V27	J	2.4	6-17	2.1	22	8.2	7.7	8.7	3.0	20	1.0	16	52	bdl	78	nd	0.72496	nd	nd
/28	I	4.4	6-18	3.6	32	8.2	10	8.7	0.7	20	0.2	19	73	11	78	nd	0.72502	nd	nd
/30	H	9.2	6-21	2.3	30	8.2	10	8.7	2.2	17	1.0	16	58	bdl	95	nd	0.73141	nd	nd
/29	G	11.0	6-18	3.2	30	8.2	13	8.7	5.9	26	2.3	24	66	10	78	nd	0.73211	nd	nd
/31	E	15.6	6-21	1.6	32	8.2	15	22	7.0	19	2.3	28	58	11	96	nd	0.74183	nd	nd
/32	D	20.7	6-21	2.0	45	12	31	61	4.1	12	1.3	32	66	21	165	nd	0.74764	nd	nd
/33	С	27.2	6-22	1.5	42	12	28	57	3.3	12	1.0	30	64	20	155	nd	0.74674	nd	nd
/34	в	32.1	6-22	2.0	45	12	28	61	8.5	25	1.8	43	76	18	167	nd	0.74712	nd	nd
/44	Р	0.1	6-28	0.1	20	8.2	5.1	8.7	9.6	32	3.9	26	60	bdl	70	6.92	0.71988	0.334	0.05
/55	Р	0.1	7–7	0.2	20	8.2	5.1	4.3	1.5	15	0.8	13	49	bdl	66	6.79	0.72330	0.409	0.10
/65	Р	0.1	7-22	0.3	10	bdl	2.6	bdl	0.9	7.3	0.6	6.1	27	bdl	23	6.20	0.72127	0.432	0.12
/66	ĸ	1.0	7-23	1.6	10	bdl	2.6	bdl	2.8	13	1.1	10	29	bdl	23	nd	0.72112	nd	nd
/67	J	2.4	7-23	2.6	10	bdl	2.6	bdl	3.7	18	1.3	14	31	bdl	23	nd	0.72109	nd	nd
/68	I	4.4	7-23	5.5	15	4.1	5.1	4.3	1.9	15	0.7	13	38	bdl	48	nd	0.72496	nd	nd
/69	н	9.2	7–24	3.4	20	8.2	7.7	4.3	4.8	24	1.6	20	45	bdl	68	nd		nd	nd
/70	G	11.0	7–24	4.0	20	8.2	7.7	4.3	4.4	23	1.4	19	47	bdl	68	nd	0.72914	nd	nd
/71	Е	15.6	7–24	3.7	20	4.1	7.7	8.7	2.4	8.7	1.1	12	37	bdl	65	nd	0.73852	nd	nd
/72	D	20.7	7-25	0.9	52	8.2	33	57	4.1	8.7	0.7	29	75	17	177	nd	0.74663	nd	nd
/73	С	27.2	7–25	2.6	60	12	38	61	12	39	3.6	53	98	18	207	nd	0.74643	nd	nd
/74	в	32.1	7–25	3.0	55	8.2	33	57	1.7	8.7	0.5	28	79	22	171	nd	0.74671	nd	nd
76	Р	0.1	7–28	0.3	12	4.1	2.6	bdl	1.8	12	1.2	8.5	34	bdl	36	nd	0.72015	0.408	nd
/89	Р	0.1	8–2	0.3	17	4.1	2.6	bdl	0.4	11	1.1	7.8	43	bdl	46		0.72207	nd	nd
/101	Р	0.1	8-12	0.3	20	8.2	5.1	4.3	2.7	17	1.2	16	56	bdl	66		0.72124	0.403	0.07
/102	ĸ	1.0	8-12	1.6	15	4.1	5.1	bdl	1.4	12	0.6	10	38	bdl	43		0.72229	nd	nd
/103	J	2.4	8-12	2.1	17	4.1	5.1	4.3	1.6	13	0.7	12	42	bdl	53	nd	0.72175	nd	nd
/104	I	4.4	8-13	4.3	20	8.2	5.1	4.3	0.7	13	0.3	12	41	bdl	66	nd	0.72787	nd	nd
105	\mathbf{H}	9.2	8-13	2.7	20	4.1	7.7	4.3	2.1	13	1.1	12	39	bdl	60			nd	nd
/106	G	11.0	8-13	2.8	20	4.1	7.7	4.3	1.7	12	0.9	12	40	bdl	60	nd	0.73187	nd	nd
107	Е	15.6	8-14	2.2	30	8.2	13	17	2.7	10	1.1	18	54	bdl	107	nd		nd	nd
108	D	20.7	8-15	0.9	45	8.2	26	39	2.8	11	1.0	27	67	17	137	nd	0.74770	nd	nd
109	в	32.1	8-15	1.6	47	8.2	26	43	2.0	9.5	0.8	26	73	20	141	nd	0.74841	nd	nd
ahorse 1	Lake																		
24	0	3.4	6-16	7.6	35	16	10	13	14	43	4.7	50	75	13	101	nd	0.72992	nd	nd

"nd" indicates no data, "bdl" indicates below instrumental detection limit. Cl concentrations not shown because all samples were bdl (≤ 1 ppm). SO₄ concentrations were bdl when ≤ 1 ppm. Site ID and distance corresponds to Fig. 1.

M.G. Andrews, A.D. Jacobson/Geochimica et Cosmochimica Acta 239 (2018) 312-329

Selected Output 1

Solution 1: pure water

	Input		Delta		Input+Delta
pH	7.000e+00	+	0.000e+00	=	7.000e+00
Al	0.000e+00	+	0.000e+00	=	0.000e+00
Alkalinity	-8.520e-08	+	8.520e-08	=	0.000e+00
Ba	0.000e+00	+	0.000e+00	=	0.000e+00
C(-4)	0.000e+00	+	0.000e+00	=	0.000e+00
C(4)	0.000e+00	+	0.000e+00	=	0.000e+00
Ca	0.000e+00	+	0.000e+00	=	0.000e+00
Fe(2)	0.000e+00	+	0.000e+00	=	0.000e+00
Fe(3)	0.000e+00	+	0.000e+00	=	0.000e+00
H(0)	0.000e+00	+	0.000e+00	=	0.000e+00
K	0.000e+00	+	0.000e+00	=	0.000e+00
Mg	0.000e+00	+	0.000e+00	=	0.000e+00
Na	0.000e+00	+	0.000e+00	=	0.000e+00
0(0)	0.000e+00	+	0.000e+00	=	0.000e+00
S(-2)	0.000e+00	+	0.000e+00	=	0.000e+00
S(6)	0.000e+00	+	0.000e+00	=	0.000e+00
Si	0.000e+00	+	0.000e+00	=	0.000e+00
Sr	0.000e+00	+	0.000e+00	=	0.000e+00

		Input		Delta		Input+Delta	
	pH	6.500e+00	+	0.000e+00	=	6.500e+00	
	Al	1.200e-05	+	0.000e+00	=	1.200e-05	
Alkalini	ity	2.070e-04	+	-1.980e-05	=	1.872e-04	
	Ba	3.900e-08	+	0.000e+00	=	3.900e-08	
C (-	-4)	0.000e+00	+	0.000e+00	=	0.000e+00	
C	(4)	3.793e-04	+	0.000e+00	=	3.793e-04	
	Ca	6.000e-05	+	0.000e+00	=	6.000e-05	
Fe	(2)	3.598e-06	+	-3.598e-06	=	0.000e+00	
Fe	(3)	1.971e-09	+	0.000e+00	=	1.971e-09	
H	(0)	0.000e+00	+	0.000e+00	=	0.000e+00	
	K	3.800e-05	+	-3.080e-05	=	7.200e-06	
	Mg	1.200e-05	+	0.000e+00	=	1.200e-05	
	Na	6.100e-05	+	-6.100e-05	=	0.000e+00	
0	(0)	0.000e+00	+	0.000e+00	=	0.000e+00	
S (-	-2)	0.000e+00	+	0.000e+00	=	0.000e+00	
S	(6)	1.800e-05	+	-1.786e-05	=	1.370e-07	
	Si	5.300e-05	+	0.000e+00	=	5.300e-05	
	Sr	9.800e-08	+	0.000e+00	=	9.800e-08	
Solution frac	ctions	1		Minimum		Maximum	
Solution	1	1.000e+00		1.000e+00		1.000e+00	
Solution	2	1.000e+00		1.000e+00		1.000e+00	
Phase mole th	ransfei	cs:		Minimum		Maximum	
Bari	ite	3.900e-08		0.000e+00		7.800e-08	BaSO4
Calci	ite	6.000e-05		0.000e+00		1.200e-04	CaCO3
Chlorite (14	4A)	2.400e-06		0.000e+00		4.800e-06	Mg5A12Si3O10(OH)8
Celesti	ite	9.800e-08		0.000e+00		1.960e-07	SrSO4
Quar	rtz	2.420e-05		0.000e+00		1.060e-04	SiO2
Hemati	ite	9.854e-10		0.000e+00		0.000e+00	Fe203
K-felds	par	7.200e-06		0.000e+00		2.400e-05	KA1Si308
C02	(g)	3.193e-04		0.000e+00		7.586e-04	CO2

Selected Output 2

	Input		Delta		Input+Delta	
pH	6.500e+00	+	0.000e+00	=	6.500e+00	
Al	1.200e-05	+	0.000e+00	=	1.200e-05	
Alkalinity	2.070e-04	+	-5.100e-05	=	1.560e-04	
Ba	3.900e-08	+	0.000e+00	=	3.900e-08	
C(-4)	0.000e+00	+	0.000e+00	=	0.000e+00	
C(4)	3.793e-04	+	-3.253e-04	=	5.400e-05	
Ca	6.000e-05	+	0.000e+00	=	6.000e-05	
Fe (2)	3.598e-06	+	-3.598e-06	=	0.000e+00	
Fe (3)	1.971e-09	+	0.000e+00	=	1.971e-09	
H(0)	0.000e+00	+	0.000e+00	=	0.000e+00	
K	3.800e-05	+	-3.800e-05	=	0.000e+00	
Mg	1.200e-05	+	-1.200e-05	=	0.000e+00	
Na	6.100e-05	+	-6.100e-05	=	0.000e+00	
0(0)	0.000e+00	+	0.000e+00	=	0.000e+00	
S(-2)	0.000e+00	+	0.000e+00	=	0.000e+00	
S(6)	1.800e-05	+	-1.796e-05	=	3.900e-08	
Si	5.300e-05	+	0.000e+00	=	5.300e-05	
Sr	9.800e-08	+	-9.800e-08	=	0.000e+00	
Solution fractions:			Minimum		Maximum	
Solution 1	1.000e+00		1.000e+00		1.000e+00	
Solution 2	1.000e+00		1.000e+00		1.000e+00	
Phase mole transfer	s:		Minimum		Maximum	
Anorthite	6.000e-06		0.000e+00		1.200e-05	CaAl2Si208
Barite	3.900e-08		0.000e+00		7.800e-08	BaSO4
Calcite	5.400e-05		0.000e+00		1.200e-04	CaCO3
Goethite	1.971e-09		0.000e+00		3.942e-09	FeOOH
Quartz	4.100e-05		0.000e+00		1.060e-04	SiO2

Output of Equilibrium Phases

Phase	SI**	log IAP	log K(275 K, 1 atm)
Al (OH) 3 (a)	0.66	13.04	12.38	Al (OH) 3
Albite	-3.17	-22.71	-19.54	NaAlsi308
Alunite	4.04			KA13 (SO4) 2 (OH) 6
Anhydrite	-4.99			
Anorthite	-3.73	-24.13	-20.40	CaAl2Si208
Aragonite	-3.87			
Barite	-2.15			
Ca-Montmorillon				50 Ca0.165A12.33si3.67010(OH)2
Calcite			-8.39	
Celestite	-5.29	-11.83	-6.54	SrSO4
Chalcedony				
				Mg5A12Si3010 (OH) 8
Chrysotile	-19.62	15.58	35.19	Mg3si205 (OH) 4
CO2 (g)	-2.55			
Dolomite				CaMg (CO3) 2
Fe(OH)3(a)	-0.47	4.42	4,89	Fe(OH)3
Gibbsite	3.57	13.04	9.47	Al (OH) 3
Goethite	4.55	4.42	-0.14	FeOOH
Gypsum	-4.42	-9.04	-4.62	CaS04:2H2O
H2 (g)	-21.02	-24.05	-3.02	H2
H2O(g)	-2.13	-0.00	2.13	H2O
Hematite	11.00	8.83	-2.17	Fe203
Illite	3.84	-39.68	-43.52	K0.6Mg0.25A12.3si3.5010(OH)2
Jarosite-K	-12.90	-20.25	-7.35	KFe3(SO4)2(OH)6
K-feldspar	-0.51	-22.92	-22.41	KAlsi308
K-mica	12.13	28.37	16.24	KA135i3010 (OH) 2
Kaolinite	8.00	17.53	9.54	Al2si205(OH)4
Melanterite	-7.75	-10.27	-2.53	FeS04:7H20
02 (g)	-49.42	-52.11	-2.69	02
Quartz	0.06	-4.28	-4.34	sio2
Sepiolite	-13.14	3.26	16.40	Mg2si307.50H:3H20
Sepiolite(d)	-15.40	3.26	18.66	Mg2si307.50H:3H20
Siderite	-2.58			
Si02(a)	-1.36			
Strontianite	-5.56	-14.88	-9.32	SrC03
Talc	-17.13	7.02	24.16	Mg3si4010(OH)2
Witherite	-6.58	-15.29	-8.70	BaCO3

Sample D	Site ID	Distance (km)			Ca (µmol/L)	Mg (μmol/L)	K (μmol/L)	Na (µmol/L)	Al (µmol/L)	Ba (nmol/L)	Fe (µmol/L)	Si (µmol/L)	Sr (nmol/L)	SO4 (µmol/L)	Alkalinity (µeq/L)	pН	⁸⁷ Sr/ ⁸⁶ Sr	δ ^{88/86} Sr (‰)	Suspende Sediment (g/L)
4 kuliarusi	arsuup I	Kuua River																	
W25	Р	0.1	6-17	0.2	25	8.2	10	8.7	3.2	20	1.5	17	56	bdl	85	7.01	0.72596	0.332	0.12
W26	ĸ	1.0	6-17	1.1	22		7.7	8.7	2.4	17	0.8	15	54	bdl	78	nd	0.72487	nd	nd
N27	J	2.4	6-17	2.1	22		7.7	8.7	3.0	20	1.0	16	52	bdl	78	nd		nd	nd
W28	I	4.4	6-18	3.6	32	8.2	10	8.7	0.7	20	0.2	19	73	11	78	nd	0.72502	nd	nd
N30	н	9.2	6-21	2.3	30	8.2	10	8.7	2.2	17	1.0	16	58	bdl	95	nd	0.73141	nd	nd
W29	G	11.0	6-18	3.2	30	8.2	13	8.7	5.9	26	2.3	24	66	10	78	nd	0.73211	nd	nd
W31	E	15.6	6-21	1.6	32	8.2	15	22	7.0	19	2.3	28	58	11	96	nd	0.74183	nd	nd
N32	D	20.7	6-21	2.0	45	12	31	61	4.1	12	1.3	32	66	21	165	nd	0.74764	nd	nd
N33	С	27.2	6-22	1.5	42	12	28	57	3.3	12	1.0	30	64	20	155	nd	0.74674	nd	nd
N34	B	32.1	6-22	2.0	45	12	28	61	8.5	25	1.8	43	76	18	167	nd	0.74712	nd	nd
N44	Р	0.1	6-28	0.1	20	8.2	5.1	8.7	9.6	32	3.9	26	60	bdl	70	6.92	0.71988	0.334	0.05
N55	Р	0.1	7-7	0.2	20	8.2	5.1	4.3	1.5	15	0.8	13	49	bdl	66	6.79	0.72330	0.409	0.10
N65	Р	0.1	7-22	0.3	10	bdl	2.6	bdl	0.9	7.3	0.6	6.1	27	bdl	23	6.20	0.72127	0.432	0.12
N66	ĸ	1.0	7-23	1.6	10	bdl	2.6	bdl	2.8	13	1.1	10	29	bdl	23	nd	0.72112	nd	nd
N67	J	2.4	7-23	2.6	10	bdl	2.6	bdl	3.7	18	1.3	14	31	bdl	23	nd	0.72109	nd	nd
N68	I	4.4	7-23	5.5	15	4.1	5.1	4.3	1.9	15	0.7	13	38	bdl	48	nd	0.72496	nd	nd
N69	н	9.2	7-24	3.4	20	8.2	7.7	4.3	4.8	24	1.6	20	45	bdl	68	nd	0.72895	nd	nd
N70	G	11.0	7-24	4.0	20	8.2	7.7	4.3	4.4	23	1.4	19	47	bdl	68	nd	0.72914	nd	nd
W71	E	15.6	7-24	3.7	20		7.7	8.7	2.4	8.7	1.1	12	37	bdl	65	nd	0.73852	nd	nd
W72	D	20.7	7-25	0.9	52	8.2	33	57	4.1	8.7	0.7	29	75	17	177	nd	0.74663	nd	nd
N73	С	27.2	7-25	2.6	60	12	38	61	12	39	3.6	53	98	18	207	nd	0.74643	nd	nd
W74	В	32.1	7-25	3.0	55	8.2	33	57	1.7	8.7	0.5	28	79	22	171	nd	0.74671	nd	nd
N76	P	0.1	7-28	0.3	12	4.1	2.6	bdl	1.8	12	1.2	8.5	34	bdl	36	nd		0.408	nd
V89	Р	0.1	8-2	0.3	17	4.1	2.6	bdl	0.4	11	1.1	7.8	43	bdl	46	6.42	0.72207	nd	nd
V101	Р	0.1	8-12	0.3	20	8.2	5.1	4.3	2.7	17	1.2	16	56	bdl	66			0.403	0.07
V102	ĸ	1.0	8-12	1.6	15	4.1	5.1	bdl	1.4	12	0.6	10	38	bdl	43	nd	0.72229	nd	nd
V103	J	2.4	8-12	2.1	17	4.1	5.1	4.3	1.6	13	0.7	12	42	bdl	53	nd	0.72175	nd	nd
W104	I	4.4	8-13	4.3	20	8.2	5.1	4.3	0.7	13	0.3	12	41	bdl	66	nd	0.72787	nd	nd
V105	Ĥ	9.2	8-13	2.7	20	4.1	7.7	4.3	2.1	13	1.1	12	39	bdl	60	nd	0.73158	nd	nd
V106	G	11.0	8-13	2.8	20	4.1	7.7	4.3	1.7	12	0.9	12	40	bdl	60	nd	0.73187	nd	nd
V107	E	15.6	8-14	2.2	30		13	17	2.7	10	1.1	18	54	bdl	107	nd	0.73960	nd	nd
V108	Ď	20.7	8-15	0.9	45	8.2	26	39	2.8	11	1.0	27	67	17	137	nd	0.74770	nd	nd
V109	В	32.1	~ ~ ~	1.6	47	8.2	26	43	2.0	9.5	0.8	26	73	20	141	nd	0.74841	nd	nd
	Laka																		
' <u>eahorse I</u> V24	O O	3.4		7.6	25	16	10	13	14	43	4.7	50	75	13	101		0.72992	nd	nd

"nd" indicates no data, "bdl" indicates below instrumental detection limit. Cl concentrations not shown because all samples were bdl (≤ 1 ppm). SO₄ concentrations were bdl when ≤ 1 ppm. Site ID and distance corresponds to Fig. 1.

M.G. Andrews, A.D. Jacobson/Geochimica et Cosmochimica Acta 239 (2018) 312-329

AKR Distribution of Species

Ba	3.900e-08					<i>i</i> i:
Ba+2	3.868e-08	3.565e-08	-7.413	-7.448	-0.035	-14.67
BaS04	2.935e-10	2.935e-10	-9.532	-9.532	0.000	(0)
BaHCO3+	3.068e-11	3.006e-11	-10.513	-10.522	-0.009	(0)
BaC03	1.704e-13	1.704e-13	-12.769	-12.769	0.000	-11.00
BaOH+	3.898e-15	3.820e-15	-14.409	-14.418	-0.009	(0)
C(4)	3.793e-04					1. 10
CO2	1.974e-04	1.975e-04	-3.705	-3.705	0.000	33.22
HCO3-	1.817e-04	1.780e-04	-3.741	-3.749	-0.009	21.91
CaHCO3+	7.322e-08	7.176e-08	-7.135	-7.144	-0.009	8.37
FeHCO3+	5.919e-08	5.800e-08	-7.228	-7.237	-0.009	(0)
MgHCO3+	2.248e-08	2.202e-08	-7.648	-7.657	-0.009	4.43
CO3-2	1.572e-08	1.450e-08	-7.803	-7.839	-0.035	-9.42
NaHCO3	6.862e-09	6.862e-09	-8.164	-8.164	0.000	1.80
FeC03	1.133e-09	1.133e-09	-8.946	-8.946	0.000	(0)
CaCO3	1.078e-09	1.078e-09	-8.967	-8.967	0.000	-14.69
(CO2)2	3.081e-10	3.081e-10	-9.511	-9.511	0.000	66.44
SrHCO3+	1.163e-10	1.140e-10	-9.934	-9.943	-0.009	(0)
MgCO3	1.082e-10	1.082e-10	-9.966	-9.966	0.000	-17.06
BaHCO3+	3.068e-11	3.006e-11	-10.513	-10.522	-0.009	(0)
NaCO3-	4.856e-12	4.758e-12	-11.314	-11.323	-0.009	-4.72
SrC03	4.304e-13	4.304e-13	-12.366	-12.366	0.000	-14.25
BaCO3	1.704e-13	1.704e-13	-12.769	-12.769	0.000	-11.00
Ca	6.000e-05					
Ca+2	5.979e-05	5.514e-05	-4.223	-4.258	-0.035	-18.78
CaSO4	1.343e-07	1.343e-07	-6.872	-6.872	0.000	6.27
CaHCO3+	7.322e-08	7.176e-08	-7.135	-7.144	-0.009	8.37
CaCO3	1.078e-09	1.078e-09	-8.967	-8.967	0.000	-14.69
CaOH+	2.954e-11	2.894e-11	-10.530	-10.539	-0.009	(0)
CaHSO4+	2.203e-13	2.159e-13	-12.657	-12.666	-0.009	(0)
Fe(2)	3.598e-06					10.00
Fe+2	3.531e-06	3.258e-06	-5.452	-5.487	-0.035	-24.23
FeHCO3+	5.919e-08	5.800e-08	-7.228	-7.237	-0.009	(0)
FeSO4	6.111e-09	6.112e-09	-8.214	-8.214	0.000	53.38
FeC03	1.133e-09	1.133e-09	-8.946	-8.946	0.000	(0)
FeOH+	5.442e-10	5.333e-10	-9.264	-9.273	-0.009	(0)
FeHSO4+	1.301e-14	1.275e-14	-13.886	-13.894	-0.009	(0)
Fe (OH) 2	1.746e-15	1.746e-15	-14.758	-14.758	0.000	(0)
Fe (OH) 3-	1.650e-19	1.617e-19	-18,782	-18.791	-0.009	(0)

Seashore Lake Distribution of Species

Ba	4.300e-08					
Ba+2	4.274e-08	4.015e-08	-7.369	-7.396	-0.027	-14.69
BaSO4	2.438e-10	2.439e-10	-9.613	-9.613	0.000	(0)
BaHCO3+	1.359e-11	1.338e-11	-10.867	-10.874	-0.007	(0)
BaCO3	7.581e-14	7.582e-14	-13.120	-13.120	0.000	-11.00
BaOH+	4.370e-15	4.302e-15	-14.360	-14.366	-0.007	(0)
C(4)	1.495e-04					
CO2	7.802e-05	7.803e-05	-4.108	-4.108	0.000	33.22
HCO3-	7.146e-05	7.035e-05	-4.146	-4.153	-0.007	21.90
FeHCO3+	3.129e-08	3.080e-08	-7.505	-7.511	-0.007	(0)
CaHCO3+	1.714e-08	1.688e-08	-7.766	-7.773	-0.007	8.36
MgHCO3+	1.203e-08	1.184e-08	-7.920	-7.927	-0.007	4.43
CO3-2	6.099e-09	5.731e-09	-8.215	-8.242	-0.027	-9.44
FeCO3	6.019e-10	6.019e-10	-9.220	-9.220	0.000	(0)
NaHCO3	5.807e-10	5.807e-10	-9.236	-9.236	0.000	1.80
CaCO3	2.536e-10	2.536e-10	-9.596	-9.596	0.000	-14.69
MgCO3	5.817e-11	5.817e-11	-10.235	-10.235	0.000	-17.06
(CO2) 2	4.811e-11	4.812e-11	-10.318	-10.318	0.000	66.44
SrHCO3+	3.570e-11	3.515e-11	-10.447	-10.454	-0.007	(0)
BaHCO3+	1.359e-11	1.338e-11	-10.867	-10.874	-0.007	(0)
NaCO3-	4.089e-13	4.026e-13	-12.388	-12.395	-0.007	-4.72
SrC03	1.328e-13	1.328e-13	-12.877	-12.877	0.000	-14.25
BaCO3	7.581e-14	7.582e-14	-13.120	-13.120	0.000	-11.00
Ca	3.500e-05					
Ca+2	3.492e-05	3.281e-05	-4.457	-4.484	-0.027	-18.80
CaSO4	5.897e-08	5.897e-08	-7.229	-7.229	0.000	6.27
CaHCO3+	1.714e-08	1.688e-08	-7.766	-7.773	-0.007	8.36
CaCO3	2.536e-10	2.536e-10	-9.596	-9.596	0.000	-14.69
CaOH+	1.749e-11	1.722e-11	-10.757	-10.764	-0.007	(0)
CaHSO4+	9.625e-14	9.475e-14	-13.017	-13.023	-0.007	(0)
Fe(2)	4.697e-06					
Fe+2	4.659e-06	4.378e-06	-5.332	-5.359	-0.027	-24.25
FeHCO3+	3.129e-08	3.080e-08	-7.505	-7.511	-0.007	(0)
FeSO4	6.059e-09	6.059e-09	-8.218	-8.218	0.000	53.38
FeOH+	7.280e-10	7.167e-10	-9.138	-9.145	-0.007	(0)
FeCO3	6.019e-10	6.019e-10	-9.220	-9.220	0.000	(0)
FeHSO4+	1.284e-14	1.264e-14	-13.891	-13.898	-0.007	(0)
Fe (OH) 2	2.347e-15	2.347e-15	-14.630	-14.630	0.000	(0)
Fe (OH) 3-	2.208e-19	2.173e-19	-18.656	-18.663	-0.007	(0)

AKR a	nd Seasho	re Lake	e Distr	ibutio	n of S _l	pecie
C(-4)	0.000e+00					000.000
CH4	0.000e+00	0.000e+00	-60.294	-60.294	0.000	33.02
C(4)	2.644e-04					
C02	1.377e-04	1.377e-04	-3.861	-3.861	0.000	33.22
HCO3-	1.266e-04	1.243e-04	-3.898	-3.906	-0.008	21.91
FeHCO3+	4.819e-08	4.733e-08	-7.317	-7.325	-0.008	(0)
CaHCO3+	4.076e-08	4.003e-08	-7.390	-7.398	-0.008	8.36
MgHCO3+	1.844e-08	1.811e-08	-7.734	-7.742	-0.008	4.43
CO3-2	1.089e-08	1.013e-08	-7.963	-7.994	-0.031	-9.43
NaHCO3	2.912e-09	2.912e-09	-8.536	-8.536	0.000	1.80
FeC03	9.255e-10	9.256e-10	-9.034	-9.034	0.000	(0)
CaCO3	6.021e-10	6.021e-10	-9.220	-9.220	0.000	-14.69
(CO2) 2	1.499e-10	1.500e-10	-9.824	-9.824	0.000	66.44
MgCO3	8.903e-11	8.903e-11	-10.050	-10.050	0.000	-17.06
SrHCO3+	7.216e-11	7.087e-11	-10.142	-10.150	-0.008	(0)
BaHC03+	2.269e-11	2.228e-11	-10.644	-10.652	-0.008	(0)
NaCO3-	2.058e-12	2.021e-12	-11.687	-11.694	-0.008	-4.72
SrC03	2.679e-13	2.679e-13	-12.572	-12.572	0.000	-14.25
BaCO3	1.264e-13	1.264e-13	-12.898	-12.898	0.000	-11.00
Ca	4.750e-05					
Ca+2	4.737e-05	4.406e-05	-4.325	-4.356	-0.031	-18.79
CaSO4	9.335e-08	9.336e-08	-7.030	-7.030	0.000	6.27
CaHCO3+	4.076e-08	4.003e-08	-7.390	-7.398	-0.008	8.36
CaCO3	6.021e-10	6.021e-10	-9.220	-9.220	0.000	-14.69
CaOH+	2.357e-11	2.314e-11	-10.628		-0.008	(0)
CaHSO4+	1.526e-13	1.499e-13	-12.816	-12.824	-0.008	(0)
Fe (2)	4.148e-06					/
Fe+2	4.092e-06	3.808e-06	-5.388	-5.419	-0.031	-24.24
FeHCO3+	4.819e-08	4.733e-08	-7.317	-7.325	-0.008	(0)
FeSO4	6.212e-09	6.213e-09	-8.207	-8.207	0.000	53.38
FeC03	9.255e-10	9.256e-10	-9.034	-9.034	0.000	(0)
FeOH+	6.352e-10	6.238e-10	-9.197	-9.205	-0.008	(0)
FeHSO4+	1.319e-14	1.295e-14	-13.880	-13.888	-0.008	(0)
Fe (OH) 2	2.044e-15	2.044e-15	-14.690	-14.690	0.000	(0)
Fe (OH) 3-	1.929e-19	1.895e-19	-18.715	-18.722	-0.008	(0)
Fe(HS)2		0.000e+00				(0)
Fe (HS) 3-		0.000e+00				(0)
	2.304e-09					1-1
Fe (OH) 2+	2.018e-09	1.982e-09	-8.695	-8.703	-0.008	(0)
Fe (OH) 3		2.811e-10			0.000	(0)
FeOH+2		4.739e-12			-0.031	(0)
Fe (OH) 4-		3.065e-13			-0.008	(0)
Fe+3	1.132e-15	9.651e-16	-14.946	-15.015	-0.069	(0)

------Saturation indices------

AKR Saturation Indices

Phase	SI**	log IAP	log K(275 K, 1 atm)
Al(OH)3(a)	0.70	13.08	12.38	A1 (OH) 3
Albite	-3.39	-22.93	-19.54	NaAlSi308
Alunite				KA13 (SO4) 2 (OH) 6
Anhydrite	-5.15	-9.20	-4.05	CaSO4
Anorthite	-3.78	-24.18	-20.40	Ca504 CaA125i208
Aragonite	-4.12	-12.35	-8.23	CaCO3
Barite		-12.27		
Ca-Montmorillo				50 Ca0.165A12.33Si3.67O10(OH)2
	-3.96			
Celestite				
	-57.78			
Chlorite (14A)	-23.54	53.86	77.40	SiO2 Mg5Al2Si3Ol0(OH)8
Chrysotile	-19.43	15.77	35.19	Mg3Si2O5(OH)4
CO2 (g)	-2.71			
Dolomite				
Fe (OH) 3 (a)	-0.41	4.49	4.89	CaMg (CO3) 2 Fe (OH) 3
FeS(ppt)	-53.12	-57.04	-3.92	FeS
Gibbsite	3.61	13.08	9.47	A1 (OH) 3
Goethite	4.62	4.49	-0.14	FeOOH
Gypsum	-4.58	-9.20	-4.62	CaS04:2H20
H2 (g)	-21.02	-24.05	-3.02	H2
H2O(g)	-2.13	-0.00	2.13	H2O
H2S(g)	-56.56 11.14	-64.62	-8.06	H2S
Hematite	11.14	8.97	-2.17	Fe203
Illite	3.78	-39.74	-43.52	K0.6Mg0.25A12.3Si3.5O10(OH)2
Jarosite-K	-13.01	-20.36	-7.35	KFe3 (SO4) 2 (OH) 6
K-feldspar	-0.71	-23.12	-22.41	KA15i308 KA135i3010 (OH) 2
K-mica	12.01	28.24	16.24	KA13Si3O10 (OH) 2
Kaolinite	8.04	17.58	9.54	A1251205 (OH) 4
Mackinawite	-52.39	-57.04	-4.65	FeS
Melanterite	-7.74	-10.26	-2.53	FeS04:7H20
02 (g)	-49.41			
Pyrite	-81.51	-100.66	-19.15	FeS2
Quartz	0.05	-4.29	-4.34	SiO2
Sepiolite	-13.03	3.36	16.40	Mg2Si307.50H:3H2O
				Mg2Si307.50H:3H2O
Siderite				
SiO2(a)	-1.38	-4.29	-2.91	S102

Fhase SI** log IAP log K(275 K, l atm) Al(OH)3(a) 0.66 13.04 12.38 Al(OH)3 Albite -3.17 -22.71 -19.54 NaAlSi308 Alunite 4.04 5.63 1.59 KA13(SO4)2(OH)6 Anhydrite -4.99 -9.04 -4.05 CaSO4 Anorthite -3.73 -24.13 -20.40 CaAl2Si208 Aragonite -3.87 -12.10 -8.23 CaCO3 Barite -2.15 -48.50 CaO.165Al2.33513.67010(OH)2 Calcite -3.71 -12.10 -8.39 CaCO3 Calcite -3.71 -12.10 -8.39 CaCO3 Chalcedony -0.44 -4.28 -3.83 SiO2 Chlorite(14A) -23.93 53.47 77.40 MgSh12Si3010(OH)8 Chrysotile -19.62 15.58 35.19 Mg3Si2O5(OH)4 CO2 (g) -2.55 -3.70 -1.15 CO2 Dolomite -8.36 -24.89 -16.53			Sacur	ation in	dices
Albite -3.17 -22.71 -19.54 NaAlSi308 Aluntte 4.04 5.63 1.59 KA13(SO4)2(OH)6 Anhydrite -4.99 -9.04 -4.05 CasO4 Anorthite -3.73 -24.13 -20.40 CaAl2Si208 Aragonite -3.87 -12.10 -8.23 CaCO3 Barite -2.15 -12.23 -10.08 BaSO4 Ca-Montmorillonite 5.92 -42.59 -48.50 CaO.165A12.33Si3.67010(OH)2 Calcite -3.71 -12.10 -8.39 CaCO3 Celestite -5.29 -11.83 -6.54 SrSO4 Chalcedony -0.44 -4.28 -3.83 SiO2 Chlorite(14A) -23.93 53.47 77.40 Mg5A12Si3010(OH)8 Chrysotile -19.62 15.58 35.19 Mg3312O5(OH)4 CO2(g) -2.55 -3.70 -1.15 CO2 Dolomite -8.36 -24.89 -16.53 CaMg(CO3)2 Fe(OH)3(a) -0.47 4.42 -0.14 FeOOH Gopthite	Phase	SI**	log IAP	log K(275 K, l atm)
Alunite 4.04 5.63 1.59 KAl3(SO4)2(OH)6 Anhydrite -4.99 -9.04 -4.05 CaSO4 Anorthite -3.73 -24.13 -20.40 CaAl2Si208 Aragonite -3.87 -12.10 -8.23 CaCO3 Barite -2.15 -12.23 -10.08 BaSO4 Calctre -3.71 -12.10 -8.39 CaCO3 Calette -5.29 -11.83 -6.54 SrSO4 Chalcedony -0.44 -4.28 -3.83 SiO2 Chlorite(14A) -23.93 53.47 77.40 Mg5Al2Si3010(OH)8 Chrysotile -19.62 15.58 35.19 Mg3Al2Si3010(OH)8 Chrysotile -19.62 15.58 35.19 Mg5Al2Si3010(OH)8 Chrysotile -19.62 15.58 CaMg(CO3)2 Pere(OH)3 Goethite 4.55 4.42 -0.14 FeOH Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H20(g) -21.02 -24.05 -3.02 H2 H20(g) -21.3	Al(OH)3(a)	0.66	13.04	12.38	Al (OH) 3
Alunite 4.04 5.63 1.59 KAl3(SO4)2(OH)6 Anhydrite -4.99 -9.04 -4.05 CaSO4 Anorthite -3.73 -24.13 -20.40 CaAl2Si208 Aragonite -3.87 -12.10 -8.23 CaCO3 Barite -2.15 -12.23 -10.08 BaSO4 Ca-Montmorillonite 5.92 -42.59 -48.50 CaO.165Al2.33Si3.67010(OH)2 Calcite -3.71 -12.10 -8.39 CaO3 Celestite -5.29 -11.83 -6.54 SrSO4 Chalcedony -0.44 -4.28 -3.83 SiO2 Chlorite(14A) -23.93 53.47 77.40 Mg5Al2Si3010(OH)8 Chrysotile -19.62 15.58 35.19 Mg3Ai2OS(OH)4 CO2(g) -2.55 -3.70 -1.15 CO2 Dolomite -8.36 -24.89 -16.53 CaMg(CO3)2 Fe(OH)3(a) -0.47 4.42 -9.04 4.62 CaSO4:2H2O Goethite 4.55 4.42 -0.14 FeOH Gypsum	Albite	-3.17	-22.71	-19.54	NaAlSi308
Anorthite -3.73 -24.13 -20.40 CaAl2Si208 Aragonite -3.87 -12.10 -8.23 CaC03 Barite -2.15 -12.23 -10.08 BaS04 Ca-Montmorillonite 5.92 -42.59 -48.50 CaC03 Celestite -5.29 -11.83 -6.54 SrS04 Chalcedony -0.44 -4.28 -3.83 SiO2 Chlorite(14A) -23.93 53.47 77.40 MgSh12Si3010(0H)8 Chrysotile -19.62 15.58 35.19 MgSh22Si3010(0H)8 Golpomite -8.36 -24.89 -16.53 CaMg(CO3)2 Fe (OH)3 (a) -0.47 4.42 -0.14 FeOH Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H20 (g) -21.02 -24.05 -3.02 H2 <	Alunite	4.04	5.63	1.59	KA13 (SO4) 2 (OH) 6
Aragonite -3.87 -12.10 -8.23 CaCO3 Barite -2.15 -12.23 -10.08 BaSO4 Ca-Montmorillonite 5.92 -42.59 -48.50 CaO.165Al2.33Si3.67Ol0(OH)2 Calcite -3.71 -12.10 -8.39 CaCO3 Celestite -5.29 -11.83 -6.54 SISO4 Chalcedony -0.44 -4.28 -3.83 SiO2 Chorte(14A) -23.93 53.47 77.40 Mg5Al25I3Ol0(OH)8 Chrysotile -19.62 15.58 35.19 Mg3Si2O5(OH)4 CO2(g) -2.55 -3.70 -1.15 CO2 Dolomite -8.36 -24.89 -16.53 CaMg(CO3)2 Fe(OH)3(a) -0.47 4.42 4.89 Fe(OH)3 Gibbsite 3.57 13.04 9.47 Al(OH)3 Goethite 4.55 4.42 -0.14 FeOM Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H2(g) -21.02 -24.05 -3.02 H2 H2(g) -21.02 -		-4.99	-9.04	-4.05	CaSO4
Barite -2.15 -12.23 -10.08 BaS04 Ca-Montmorillonite 5.92 -42.59 -48.50 Ca0.165Al2.33Si3.67Ol0(OH)2 Calcite -3.71 -12.10 -8.39 CaCO3 Celestite -5.29 -11.83 -6.54 SrS04 Chalcedony -0.44 -4.28 -3.33 SiO2 Chlorite(14A) -23.93 53.47 77.40 MgSAl2Si3Ol0(OH)8 Chrysotile -19.62 15.58 35.19 Mg3Si2O5(OH)4 CO2(g) -2.55 -3.70 -1.15 CO2 Dolomite -8.36 -24.89 -16.53 CaMg(CO3)2 Fe(OH)3(a) -0.47 4.42 4.89 Fe(OH)3 Gobsite 3.57 13.04 9.47 Al(OH)3 Goethite 4.55 4.42 -0.14 FeOH Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H2(g) -21.02 -24.05 -3.02 H2 H20(g) -21.02	Anorthite	-3.73	-24.13	-20.40	CaAl2Si2O8
Ca-Montmorillonite 5.92 -42.59 -48.50 Ca0.165Al2.33Si3.67010(OH)2 Calcite -3.71 -12.10 -8.39 CaCO3 Celestite -5.29 -11.83 -6.54 SrSO4 Chalcedony -0.44 -4.28 -3.83 SiO2 Chorite(14A) -23.93 53.47 77.40 MgSAl2Si3O10(OH)8 Chrysotile -19.62 15.58 35.19 Mg3Si2O5(OH)4 CO2(g) -2.55 -3.70 -1.15 CO2 Dolomite -8.36 -24.89 -16.53 CaMg (CO3)2 Fe(OH)3(a) -0.47 4.42 4.89 Fe(OH)3 Gibbsite 3.57 13.04 9.47 Al (OH)3 Goethite 4.55 4.42 -0.14 FeOOH Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H2(g) -21.02 -24.05 -3.02 H2 H2(g) -21.13 -0.00 2.13 H2O Hematite 11.00 8.83 -2.17 Fe2O3 Illite 3.84 -39.68	Aragonite	-3.87	-12.10	-8.23	CaCO3
Calcite -3.71 -12.10 -8.39 CaC03 Celestite -5.29 -11.83 -6.54 SrSO4 Chalcedony -0.44 -4.28 -3.83 SiO2 Chlorite(14A) -23.93 53.47 77.40 MgSAl2Si3010(OH)8 Chrysotile -19.62 15.58 35.19 MgSSi2O5(OH)4 CO2(g) -2.55 -3.70 -1.15 CO2 Dolomite -8.36 -24.89 -16.53 CaMg(CO3)2 Fe(OH)3(a) -0.47 4.42 4.89 Fe(OH)3 Gobbsite 3.57 13.04 9.47 A1(OH)3 Goethite 4.55 4.42 -0.14 FeOOH Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H2(g) -21.02 -24.05 -3.02 H2 H2O(g) -21.3 -0.00 2.13 H2O Hematite 11.00 8.83 -2.17 Fe203 Illite 3.84 -39.68 -43.52 K0.6Mg0.2SA12.3Si3.5010(OH)2 Jarosite-K -12.99 -22.55	Barite	-2.15	-12.23	-10.08	BaS04
Chalcedony -0.44 -4.28 -3.83 SiO2 Chlorite(14A) -23.93 53.47 77.40 Mg5Al2Si3Ol0(OH)8 Chrysotile -19.62 15.58 35.19 Mg3Sl2O5(OH)4 CO2(g) -2.55 -3.70 -1.15 CO2 Dolomite -8.36 -24.89 -16.53 CaMg(CO3)2 Fe(OH)3(a) -0.47 4.42 4.89 Fe(OH)3 Gibbsite 3.57 13.04 9.47 Al(OH)3 Goethite 4.55 4.42 -0.14 FeOOH Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H20(g) -21.02 -24.05 -3.02 H2 H20(g) -21.3 -0.00 2.13 H2O Hematite 11.00 8.83 -2.17 Fe2O3 Illite 3.84 -39.68 -43.52 K0.6Mg0.25A12.3Si3.5O10(OH)2 Jarosite-K -12.90 -20.25 -7.35 KFe3(SO4)2(OH)6 K-feldspar -0.51 -22.92 -22.41 KA15i3O10(OH)2 Kaolinite 8.00					
Chalcedony -0.44 -4.28 -3.83 SiO2 Chlorite(14A) -23.93 53.47 77.40 Mg5Al2Si3Ol0(OH)8 Chrysotile -19.62 15.58 35.19 Mg3Sl2O5(OH)4 CO2(g) -2.55 -3.70 -1.15 CO2 Dolomite -8.36 -24.89 -16.53 CaMg(CO3)2 Fe(OH)3(a) -0.47 4.42 4.89 Fe(OH)3 Gibbsite 3.57 13.04 9.47 Al(OH)3 Goethite 4.55 4.42 -0.14 FeOOH Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H20(g) -21.02 -24.05 -3.02 H2 H20(g) -21.3 -0.00 2.13 H2O Hematite 11.00 8.83 -2.17 Fe2O3 Illite 3.84 -39.68 -43.52 K0.6Mg0.25A12.3Si3.5O10(OH)2 Jarosite-K -12.90 -20.25 -7.35 KFe3(SO4)2(OH)6 K-feldspar -0.51 -22.92 -22.41 KA15i3O10(OH)2 Kaolinite 8.00	Calcite	-3.71	-12.10	-8.39	CaCO3
Chlorite(14A) -23.93 53.47 77.40 Mg5Al2Si3Ol0(OH)8 Chrysotile -19.62 15.58 35.19 Mg3Si2O5(OH)4 CO2(g) -2.55 -3.70 -1.15 CO2 Dolomite -8.36 -24.89 -16.53 CaMg(CO3)2 Fe(OH)3(a) -0.47 4.42 4.89 Fe(OH)3 Gibbsite 3.57 13.04 9.47 Al(OH)3 Goethite 4.55 4.42 -0.14 FeOH)3 Goethite 4.55 4.42 -0.14 FeOH Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H2(g) -21.02 -24.05 -3.02 H2 H2O(g) -2.13 -0.00 2.13 H2O Hematite 11.00 8.83 -2.17 Fe2O3 Illite 3.84 -39.68 -43.52 K0.6Mg0.25A12.3Si3.5010(OH)2 Jarosite-K -12.90 -20.25 -7.35 KFe3(SO4)2(OH)6 K-mica 12.13 28.37 16.24 KA13Si3010(OH)2 Kaolinite 8.00 <t< td=""><td>Celestite</td><td>-5.29</td><td>-11.83</td><td>-6.54</td><td>SrS04</td></t<>	Celestite	-5.29	-11.83	-6.54	SrS04
Chrysotile -19.62 15.58 35.19 Mg3Si2O5(OH)4 CO2(g) -2.55 -3.70 -1.15 CO2 Dolomite -8.36 -24.89 -16.53 CaMg(CO3)2 Fe(OH)3(a) -0.47 4.42 4.89 Fe(OH)3 Gibbsite 3.57 13.04 9.47 Al (OH)3 Goethite 4.55 4.42 -0.14 FeOOH Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H2(g) -21.02 -24.05 -3.02 H2 H2O(g) -2.13 -0.00 2.13 H2O Hematite 11.00 8.83 -2.17 Fe2O3 Illite 3.84 -39.68 -43.52 K0.6Mg0.25A12.3Si3.5010(OH)2 Jarosite-K -12.90 -20.25 -7.35 KFe3(SO4)2(OH)6 K-feldspar -0.51 -22.92 -22.41 KAlSi308 K-mica 12.13 28.37 16.24 KAlSi300(OH)2 Kaolinite 8.00 17.53 9.54 Al2Si2O5(OH)4 Melanterite -7.75 <t< td=""><td></td><td></td><td></td><td></td><td></td></t<>					
$\begin{array}{llllllllllllllllllllllllllllllllllll$	Chlorite(14A)	-23.93	53.47	77.40	Mg5A12Si3O10(OH)8
Dolomite -8.36 -24.89 -16.53 CaMg (CO3) 2 Fe (OH) 3 (a) -0.47 4.42 4.89 Fe (OH) 3 Gibbsite 3.57 13.04 9.47 Al (OH) 3 Goethite 4.55 4.42 -0.14 FeOOH Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H2 (g) -21.02 -24.05 -3.02 H2 H2O(g) -2.13 -0.00 2.13 H2O Hematite 11.00 8.83 -2.17 Fe2O3 Illite 3.84 -39.68 -43.52 KO.6Mg0.25Al2.3Si3.5Ol0(OH)2 Jarosite-K -12.90 -20.25 -7.35 KFe3 (SO4)2 (OH)6 K-feldspar -0.51 -22.92 -22.41 KAl5i308 K-mica 12.13 28.37 16.24 KAl35i3010 (OH)2 Kaolinite 8.00 17.53 9.54 Al2Si2O5 (OH)4 Melanterite -7.75 -10.27 -2.53 FeSO4:7H2O O2 (g) -49.42 -52.11 -2.69 O2 Quartz 0.06	Chrysotile				
Dolomite -8.36 -24.89 -16.53 CaMg (CO3) 2 Fe (OH) 3 (a) -0.47 4.42 4.89 Fe (OH) 3 Gibbsite 3.57 13.04 9.47 Al (OH) 3 Goethite 4.55 4.42 -0.14 FeOOH Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H2 (g) -21.02 -24.05 -3.02 H2 H2O(g) -2.13 -0.00 2.13 H2O Hematite 11.00 8.83 -2.17 Fe2O3 Illite 3.84 -39.68 -43.52 KO.6Mg0.25Al2.3Si3.5Ol0(OH)2 Jarosite-K -12.90 -20.25 -7.35 KFe3 (SO4)2 (OH)6 K-feldspar -0.51 -22.92 -22.41 KAl5i308 K-mica 12.13 28.37 16.24 KAl35i3010 (OH)2 Kaolinite 8.00 17.53 9.54 Al2Si2O5 (OH)4 Melanterite -7.75 -10.27 -2.53 FeSO4:7H2O O2 (g) -49.42 -52.11 -2.69 O2 Quartz 0.06	CO2 (g)	-2.55	-3.70	-1.15	C02
Fe (OH) 3 (a) -0.47 4.42 4.89 Fe (OH) 3 Gibbsite 3.57 13.04 9.47 Al (OH) 3 Goethite 4.55 4.42 -0.14 FeOOH Gypsum -4.42 -9.04 -4.62 CaSO4:2H2O H2 (g) -21.02 -24.05 -3.02 H2 H2O (g) -2.13 -0.00 2.13 H2O Hematite 11.00 8.83 -2.17 Fe2O3 Illite 3.84 -39.68 -43.52 K0.6Mg0.25Al2.3Si3.5O10 (OH) 2 Jarosite-K -12.90 -20.25 -7.35 KFe3 (SO4) 2 (OH) 6 K-feldspar -0.51 -22.92 -22.41 KAl5i308 K-mica 12.13 28.37 16.24 KAl5i3010 (OH) 2 Kaolinite 8.00 17.53 9.54 Al2Si2O5 (OH) 4 Melanterite -7.75 -10.27 -2.53 FeSO4:7H2O O2 (g) -49.42 -52.11 -2.69 O2 Quartz 0.06 -4.28 -4.34 SiO2 Sepiolite (d) -15.40 <td>Dolomite</td> <td>-8.36</td> <td>-24.89</td> <td>-16.53</td> <td>CaMg (CO3) 2</td>	Dolomite	-8.36	-24.89	-16.53	CaMg (CO3) 2
Goethite4.554.42-0.14FeOOHGypsum-4.42-9.04-4.62CaSO4:2H2OH2(g)-21.02-24.05-3.02H2H2O(g)-2.13-0.002.13H2OHematite11.008.83-2.17Fe2O3Illite3.84-39.68-43.52K0.6Mg0.25A12.3Si3.5O10(OH)2Jarosite-K-12.90-20.25-7.35KFe3(SO4)2(OH)6K-feldspar-0.51-22.92-22.41KA1Si3008K-mica12.1328.3716.24KA1Si3010(OH)2Kaolinite8.0017.539.54A12Si2O5(OH)4Melanterite-7.75-10.27-2.53FeSO4:7H2OO2(g)-49.42-52.11-2.69O2Quartz0.06-4.28-4.34SiO2Sepiolite-13.143.2616.40Mg2Si307.5OH:3H2OSiderite-2.58-13.33-10.74FeCO3SiO2(a)-1.36-4.28-2.91SiO2Strontianite-5.56-14.88-9.32SrCO3Talc-17.137.0224.16Mg3Si4010(OH)2	Fe (OH) 3 (a)	-0.47	4.42	4.89	Fe (OH) 3
Gypsum-4.42-9.04-4.62CaSO4:2H2OH2(g)-21.02-24.05-3.02H2H2O(g)-2.13-0.002.13H2OHematite11.008.83-2.17Fe2O3Illite3.84-39.68-43.52K0.6Mg0.25A12.3Si3.5O10(OH)2Jarosite-K-12.90-20.25-7.35KFe3(SO4)2(OH)6K-feldspar-0.51-22.92-22.41KAISi3008K-mica12.1328.3716.24KAISi3010(OH)2Kaolinite8.0017.539.54A12Si2O5(OH)4Melanterite-7.75-10.27-2.53FeSO4:7H2OO2(g)-49.42-52.11-2.69O2Quartz0.06-4.28-4.34SiO2Sepiolite-13.143.2616.40Mg2Si307.5OH:3H2OSiderite-2.58-13.33-10.74FeCO3SiO2(a)-1.36-4.28-2.91SiO2Strontianite-5.56-14.88-9.32SrCO3Talc-17.137.0224.16Mg3Si4010(OH)2	Gibbsite	3.57	13.04	9.47	A1 (OH) 3
H2(g)-21.02-24.05-3.02H2H2O(g)-2.13-0.002.13H2OHematite11.008.83-2.17Fe2O3Illite3.84-39.68-43.52K0.6Mg0.25Al2.3Si3.5Ol0(OH)2Jarosite-K-12.90-20.25-7.35KFe3(SO4)2(OH)6K-feldspar-0.51-22.92-22.41KAlSi308K-mica12.1328.3716.24KAlSi3010(OH)2Kaolinite8.0017.539.54Al2Si2O5(OH)4Melanterite-7.75-10.27-2.53FeSO4:7H2OO2(g)-49.42-52.11-2.69O2Quartz0.06-4.28-4.34SiO2Sepiolite-13.143.2616.40Mg2Si307.5OH:3H2OSiderite-2.58-13.33-10.74FeCO3SiO2(a)-1.36-4.28-2.91SiO2Strontianite-5.56-14.88-9.32SrCO3Talc-17.137.0224.16Mg3Si4010(OH)2	Goethite	4.55	4.42	-0.14	FeOOH
H20(g)-2.13-0.002.13H20Hematite11.008.83-2.17Fe203Illite3.84-39.68-43.52K0.6Mg0.25Al2.3Si3.5Ol0(OH)2Jarosite-K-12.90-20.25-7.35KFe3(SO4)2(OH)6K-feldspar-0.51-22.92-22.41KAlSi308K-mica12.1328.3716.24KAl3Si3010(OH)2Kaolinite8.0017.539.54Al2Si205(OH)4Melanterite-7.75-10.27-2.53FeSO4:7H20O2(g)-49.42-52.11-2.69O2Quartz0.06-4.28-4.34SiO2Sepiolite-13.143.2616.40Mg2Si307.5OH:3H20Siderite-2.58-13.33-10.74FeCO3SiO2(a)-1.36-4.28-2.91SiO2Strontianite-5.56-14.88-9.32SrCO3Talc-17.137.0224.16Mg3Si4010(OH)2	Gypsum	-4.42	-9.04	-4.62	CaS04:2H20
H20(g)-2.13-0.002.13H20Hematite11.008.83-2.17Fe203Illite3.84-39.68-43.52K0.6Mg0.25Al2.3Si3.5Ol0(OH)2Jarosite-K-12.90-20.25-7.35KFe3(SO4)2(OH)6K-feldspar-0.51-22.92-22.41KAlSi308K-mica12.1328.3716.24KAl3Si3010(OH)2Kaolinite8.0017.539.54Al2Si205(OH)4Melanterite-7.75-10.27-2.53FeSO4:7H20O2(g)-49.42-52.11-2.69O2Quartz0.06-4.28-4.34SiO2Sepiolite-13.143.2616.40Mg2Si307.5OH:3H20Siderite-2.58-13.33-10.74FeCO3SiO2(a)-1.36-4.28-2.91SiO2Strontianite-5.56-14.88-9.32SrCO3Talc-17.137.0224.16Mg3Si4010(OH)2	H2(g)	-21.02	-24.05	-3.02	H2
Hematite 11.00 8.83 -2.17 Fe203 Illite 3.84 -39.68 -43.52 K0.6Mg0.25Al2.3Si3.5010(OH)2 Jarosite-K -12.90 -20.25 -7.35 KFe3(S04)2(OH)6 K-feldspar -0.51 -22.92 -22.41 KAlSi3008 K-mica 12.13 28.37 16.24 KAl3Si3010(OH)2 Kaolinite 8.00 17.53 9.54 Al2Si205(OH)4 Melanterite -7.75 -10.27 -2.53 FeS04:7H20 O2(g) -49.42 -52.11 -2.69 O2 Quartz 0.06 -4.28 -4.34 SiO2 Sepiolite -13.14 3.26 16.40 Mg2Si307.5OH:3H20 Sepiolite(d) -15.40 3.26 18.66 Mg2Si307.5OH:3H20 Siderite -2.58 -13.33 -10.74 FeCO3 SiO2(a) -1.36 -4.28 -2.91 SiO2 Strontianite -5.56 -14.88 -9.32 SrCO3 Talc -17.13 7.02 24.16 Mg3Si4010(OH)2		-2.13	-0.00	2.13	H2O
Illite3.84-39.68-43.52K0.6Mg0.25Al2.3Si3.5Ol0(OH)2Jarosite-K-12.90-20.25-7.35KFe3(SO4)2(OH)6K-feldspar-0.51-22.92-22.41KAlSi3O8K-mica12.1328.3716.24KAl3Si3Ol0(OH)2Kaolinite8.0017.539.54Al2Si2O5(OH)4Melanterite-7.75-10.27-2.53FeSO4:7H2OO2(g)-49.42-52.11-2.69O2Quartz0.06-4.28-4.34SiO2Sepiolite-13.143.2616.40Mg2Si3O7.5OH:3H2OSepiolite(d)-15.403.2618.66Mg2Si3O7.5OH:3H2OSiderite-2.58-13.33-10.74FeCO3SiO2(a)-1.36-4.28-2.91SiO2Strontianite-5.56-14.88-9.32SrCO3Talc-17.137.0224.16Mg3Si4O10(OH)2	Hematite	11.00	8.83	-2.17	rezos
Jarosite-K-12.90-20.25-7.35KFe3(SO4)2(OH)6K-feldspar-0.51-22.92-22.41KAlSi3O8K-mica12.1328.3716.24KAl3Si3O10(OH)2Kaolinite8.0017.539.54Al2Si2O5(OH)4Melanterite-7.75-10.27-2.53FeSO4:7H2OO2(g)-49.42-52.11-2.69O2Quartz0.06-4.28-4.34SiO2Sepiolite-13.143.2616.40Mg2Si3O7.5OH:3H2OSiderite-2.58-13.33-10.74FeCO3SiO2(a)-1.36-4.28-2.91SiO2Strontianite-5.56-14.88-9.32SrCO3Talc-17.137.0224.16Mg3Si4O10(OH)2	Illite	3.84	-39.68	-43.52	K0.6Mg0.25A12.3Si3.5010(OH)2
K-mica12.1328.3716.24KAl3Si3Ol0(OH)2Kaolinite8.0017.539.54Al2Si2O5(OH)4Melanterite-7.75-10.27-2.53FeSO4:7H2OO2(g)-49.42-52.11-2.69O2Quartz0.06-4.28-4.34SiO2Sepiolite-13.143.2616.40Mg2Si3O7.5OH:3H2OSepiolite(d)-15.403.2618.66Mg2Si3O7.5OH:3H2OSiderite-2.58-13.33-10.74FeCO3SiO2(a)-1.36-4.28-2.91SiO2Strontianite-5.56-14.88-9.32SrCO3Talc-17.137.0224.16Mg3Si4O10(OH)2	Jarosite-K	-12.90	-20.25	-7.35	KFe3 (SO4) 2 (OH) 6
Kaolinite 8.00 17.53 9.54 Al2Si2O5(OH)4 Melanterite -7.75 -10.27 -2.53 FeSO4:7H2O O2(g) -49.42 -52.11 -2.69 O2 Quartz 0.06 -4.28 -4.34 SiO2 Sepiolite -13.14 3.26 16.40 Mg2Si3O7.5OH:3H2O Sepiolite(d) -15.40 3.26 18.66 Mg2Si3O7.5OH:3H2O Siderite -2.58 -13.33 -10.74 FeCO3 SiO2(a) -1.36 -4.28 -2.91 SiO2 Strontianite -5.56 -14.88 -9.32 SrCO3 Talc -17.13 7.02 24.16 Mg3Si4O10(OH)2	K-feldspar	-0.51	-22.92	-22.41	KA1Si308
Kaolinite 8.00 17.53 9.54 Al2Si2O5(OH)4 Melanterite -7.75 -10.27 -2.53 FeSO4:7H2O O2(g) -49.42 -52.11 -2.69 O2 Quartz 0.06 -4.28 -4.34 SiO2 Sepiolite -13.14 3.26 16.40 Mg2Si3O7.5OH:3H2O Sepiolite(d) -15.40 3.26 18.66 Mg2Si3O7.5OH:3H2O Siderite -2.58 -13.33 -10.74 FeCO3 SiO2(a) -1.36 -4.28 -2.91 SiO2 Strontianite -5.56 -14.88 -9.32 SrCO3 Talc -17.13 7.02 24.16 Mg3Si4O10(OH)2	K-mica	12.13	28.37	16.24	KA135i3010 (OH) 2
Melanterite -7.75 -10.27 -2.53 FeS04:7H20 O2(g) -49.42 -52.11 -2.69 O2 Quartz 0.06 -4.28 -4.34 SiO2 Sepiolite -13.14 3.26 16.40 Mg2Si307.50H:3H20 Sepiolite(d) -15.40 3.26 18.66 Mg2Si307.50H:3H20 Siderite -2.58 -13.33 -10.74 FeC03 SiO2(a) -1.36 -4.28 -2.91 SiO2 Strontianite -5.56 -14.88 -9.32 SrC03 Talc -17.13 7.02 24.16 Mg3Si4010 (OH) 2	Kaolinite	8.00	17.53	9.54	A1251205 (OH) 4
Quartz 0.06 -4.28 -4.34 Si02 Sepiolite -13.14 3.26 16.40 Mg2Si307.50H:3H20 Sepiolite(d) -15.40 3.26 18.66 Mg2Si307.50H:3H20 Siderite -2.58 -13.33 -10.74 FeC03 SiO2(a) -1.36 -4.28 -2.91 SiO2 Strontianite -5.56 -14.88 -9.32 SrC03 Talc -17.13 7.02 24.16 Mg3Si4010(OH)2	Melanterite	-7.75	-10.27	-2.53	FeS04:7H20
Sepiolite -13.14 3.26 16.40 Mg2Si307.50H:3H20 Sepiolite(d) -15.40 3.26 18.66 Mg2Si307.50H:3H20 Siderite -2.58 -13.33 -10.74 FeC03 SiO2(a) -1.36 -4.28 -2.91 SiO2 Strontianite -5.56 -14.88 -9.32 SrC03 Talc -17.13 7.02 24.16 Mg3Si4010 (OH) 2	02 (g)	-49.42	-52.11	-2.69	02
Sepiolite(d) -15.40 3.26 18.66 Mg2Si307.50H:3H20 Siderite -2.58 -13.33 -10.74 FeC03 SiO2(a) -1.36 -4.28 -2.91 SiO2 Strontianite -5.56 -14.88 -9.32 SrC03 Talc -17.13 7.02 24.16 Mg3Si4010(OH)2	Quartz	0.06	-4.28	-4.34	S102
Siderite -2.58 -13.33 -10.74 FeC03 Si02(a) -1.36 -4.28 -2.91 Si02 Strontianite -5.56 -14.88 -9.32 SrC03 Talc -17.13 7.02 24.16 Mg3Si4010(OH)2	Sepiolite	-13.14	3.26	16.40	Mg2Si307.50H:3H20
Siderite -2.58 -13.33 -10.74 FeC03 Si02(a) -1.36 -4.28 -2.91 Si02 Strontianite -5.56 -14.88 -9.32 SrC03 Talc -17.13 7.02 24.16 Mg3Si4010(OH)2	Sepiolite(d)	-15.40	3.26	18.66	Mg2Si307.50H:3H20
SiO2(a) -1.36 -4.28 -2.91 SiO2 Strontianite -5.56 -14.88 -9.32 SrCO3 Talc -17.13 7.02 24.16 Mg3Si4O10(OH)2	Siderite	-2.58	-13.33	-10.74	
Strontianite -5.56 -14.88 -9.32 SrC03 Talc -17.13 7.02 24.16 Mg3Si4010(OH)2	SiO2(a)	-1.36	-4.28	-2.91	S102
Talc -17.13 7.02 24.16 Mg3Si4Ol0(OH)2	Strontianite	-5.56	-14.88	-9.32	SrC03
Witherite -6.58 -15.29 -8.70 BaCO3	Talc	-17.13	7.02	24.16	Mg35i4010(OH)2
	Witherite	-6.58	-15.29	-8.70	BaC03

⁸⁷Sr/⁸⁶Sr Isotope Modeling us Phreecq

SOLUTION

Isotopes: 🗆 11B

13C

13C(4)

13C(-4)

180(0)

180(-2)

180

2H

2H(0)

2H(1)

34S

34S(-2)

34S(6)

General Individual element input Isotopes (Advanced)

³⁷ Sr/ ⁸⁶ Sr Isotop	e Mo	delir	ıg us	ing	Initial/Final solution	is Phases Balance ainties	s Is <mark>o</mark> topes (Advanced)									
Phreecq					11B □ 2H □ 13C □ 2H(0) □ 13C(4) □ 2H(1)	□ 2H(0) □ 2H(1)	Freeze	Isotope	1	2 (final)							^
ITION eral Individual element input Isotopes	(Advanced)				□ 13C(-4) □ 180 □ 180(0) □ 180(-2) <	☐ 34S ☐ 34S(-2) ☐ 34S(6) ☐ 87Sr	>				•						~
topes: 11B				L Un a set sinch a	Phases					bite	Ang.	orthite	D-	arite	C -1	cite	
13C		Name	Value	Uncertainty limit	□ 13C	□ 2H □ 2H(0)	Freeze	Isotope	Value	Uncert.	Value	Uncert.	Value	Uncert.	Value	Uncert.	v î
13C(4)	1				13C(4)	2H(1)					57. 57						
13C(-4)	2				13C(-4)	🗆 34S			i.	53 83			52 52 825		50 53 83	52 53 83	
180	3			3S	180	34S(-2)		53 83	2. Sa	5.5 8.5	53 83	53 53	52 8.5	53 84	53 53	53 8.5	
180(0)	4	12			□ 18O(0)	34S(6)		8	82 84	82 8.5	8	83	5.5 7.5	85	83 83	53 53	-
180(-2)	5				180(-2)	287Sr							l .				
24	6				<		>	<									>
2H(0)	7				Description of in												
2H(1)	8					list the isotope(s) in w	hich to include	in this knows	rd block (T	ha anna a hart	agalaa tha at	sta of the obe	ok hov)				
34S	9				Select from the	list the isotope(s) in wi		rin this keywo	TO DIOCK. (1	ne space bar t	oggies the su	ale of the che	CK DOX).				
34S(-2)	10	1															
34S(6)	11																
343(0)	12																
escription of input	13													0	к	Cancel	Help
elect from the list the isotope(s) in which tate of the check box).	to include in thi	s keyword bl	ock. (The sj	oace bar toggles ti	~												

×

?

OK Cancel Help

INVERSE_MODELING

Conclusions

- The results from the two models in Phreecq suggest that silicate minerals for the phase mole transfers can be abundant in the AKR.
- Once the AKR and Seashore Lake interact with one another and the AKR is bringing its geochemical properties to the Seashore lake, silicate minerals are precipitating out in abundance
- A difference between the distribution of species can be seen before and after the interaction between the AKR and Seashore Lake.
- Focusing on the interaction between the AKR and Seashore Lake once they meet, it can be seen in the distribution of species that calcium, carbon dioxide, and bi-carbonate values level out compared to before they meet.

References

- Andrews, G.M., Jacobson A.D., 2018. Controls of the solute geochemistry of subglacial discharge from the Russell Glacier, Greenland Ice Sheet determined by radiogenic and stable Sr isotope ratios. *Elsevier*, 0016-7037.
- Faure, Gunter. *Principles and Applications of Geochemistry: a Comprehensive Textbook for Geology Students*. Prentice Hall, 1998.



