Supplementary Materials

The Thermodynamics of Selenium Minerals in Near-Surface Environments

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Table S1. Selenim minerals: Chemical formula, type locality (TL) and number of localities (NL).

Mineral	Chemical Formula	TL	NL	References
Achávalite	FeSe	(1)	2	[1]
Aguilarite	Ag_4SeS	(48)	65	[2]
Ahlfeldite	$NiSeO_3·2H_2O$	(2)	2	[3]
Alfredopetrovite	$Al_2(SeO_3)_3·6H_2O$	(3)	1	[4]
Allochalcoselite	$CuCu_5PbO_2(SeO_3)_2Cl_5$	(5)	1	[5]
Antimonselite	Sb_2Se_3	(59)	6	[6]
Athabascaite	Cu_5Se_4	(37)	14	[7]
Bambollaite	$CuSe_2$	(30)	3	[8]
Bellidoite	Cu_2Se	(27)	6	[9]
Berzelianite	Cu_2Se	(52)	61	[10]
Bohdanowiczite	$AgBiSe_2$	(33)	31	[11]
Bornhardtite	$CoCo_2Se_4$	(57)	3	[12]
Brodtkorbite	Cu_2HgSe_2	(58)	2	[13]
Bukovite	$Cu_4Tl_2Se_4$	(16)	10	[14]
Burnsite	$KCdCu_7(SeO_3)_2O_2Cl_9$	(5)	1	[15]
Bytízite	Cu_3SbSe_3	(51)	2	[16]
Cadmoselite	CdSe	(56)	3	[17]
Carlosruizite	$K_6Na_4Na_6Mg_{10}(SeO_4)_{12}(IO_3)_{12}·12H_2O$	(11)	2	[18]
Chalcomenite	$CuSeO_3·2H_2O$	(1)	35	[19]
Chaméanite	$(Cu_3Fe)_{\Sigma 4}AsSe_4$	(20)	3	[20]
Chloromenite	$Cu_9(SeO_3)_4O_2Cl_6$	(5)	1	[21]
Chrisstanleyite	$Ag_2Pd_3Se_4$	(28)	5	[22]
Clausthalite	PbSe	(54)	239	[23]
Cobaltomenite	$CoSeO_3·2H_2O$	(1)	12	[24]
Crookesite	Cu_7TlSe_4	(52)	12	[25]
Demesmaekerite	$Pb_2Cu_5(UO_2)_2(SeO_3)_6(OH)_6·2H_2O$	(7)	2	[26]
Derriksite	$Cu_4(UO_2)(SeO_3)_2(OH)_6·H_2O$	(7)	1	[27]
Downeyite	SeO_2	(26)	2	[28]
Drysdallite	$MoSe_2$	(31)	2	[29]
Dzharkenite	$FeSe_2$	(55)	4	[30]
Eldragónite	$Cu_6BiSe_4(Se_2)$	(3)	1	[31]
Eskebornite	$CuFeSe_2$	(24)	22	[32]
Eucairite	CuAgSe	(52)	51	[33]
Favreauite	$PbBiCu_6O_4(SeO_3)_4(OH)·H_2O$	(3)	1	[34]
Ferroselite	$FeSe_2$	(56)	49	[35]
Fischesserite	Ag_3AuSe_2	(46)	19	[36]
Francisite	$Cu_3Bi(SeO_3)_2O_2Cl$	(4)	2	[37]
Freboldite	CoSe	(57)	4	[38]
Geffroyite	Cu_9Se_8	(20)	6	[20]
Georgbokiite	$Cu_5(SeO_3)_2O_2Cl_2$	(5)	2	[39]
Giraudite	$Cu_6Cu_4Zn_2(AsSe_3)_4S$	(20)	5	[20]
Grundmannite	$CuBiSe_2$	(3)	2	[40]

Table S1. *Cont.*

Mineral	Chemical Formula	TL	NL	References
Guanajuatite	Bi_2Se_3	(49)	30	[41]
Guilleminite	$Ba(UO_2)_3(SeO_3)_2(OH)_4{\cdot}3H_2O$	(7)	3	[42]
Hakite	$Cu_6Cu_4Hg_2(SbSe_3)_4Se$	(46)	12	[43]
Hansblockite	$CuBiSe_2$	(3)	1	[44]
Haynesite	$(UO_2)_3(SeO_3)_2(OH)_2{\cdot}5H_2O$	(9)	1	[45]
Ilinskite	$NaCu_5(SeO_3)_2O_2Cl_3$	(5)	2	[46]
Jacutingaite	Pt_2HgSe_3	(29)	2	[47]
Jagüéite	$Cu_2Pd_3Se_4$	(23)	2	[48]
Jolliffeite	NiAsSe	(19)	3	[49]
Kalungaite	PdAsSe	(17)	1	[50]
Kawazulite	Bi_2Te_2Se	(25)	25	[51]
Kitkaite	NiTeSe	(32)	1	[52]
Klockmannite	CuSe	(35)	57	[53]
Krut'aite	$CuSe_2$	(43)	7	[54]
Kullerudite	$NiSe_2$	(32)	3	[55]
Kurilite	Ag_8Te_3Se	(45)	2	[56]
Laitakarite	Bi_4Se_3	(41)	21	[57]
Laphamite	As_2Se_3	(18)	1	[58]
Larisaite	$Na(H_3O)(UO_2)_3(SeO_3)_2O_2{\cdot}4H_2O$	(9)	1	[59]
Litochlebite	$Ag_2PbBi_4Se_8$	(34)	1	[60]
Luberoite	Pt_5Se_4	(36)	2	[61]
Mäkinenite	NiSe	(32)	2	[55]
Mandarinoite	$Fe_2(SeO_3)_3{\cdot}6H_2O$	(2)	13	[62]
Marthozite	$Cu(UO_2)_3(SeO_3)_2O_2{\cdot}8H_2O$	(7)	2	[63]
Mgriite	Cu_3AsSe_3	(50)	1	[64]
Miessiite	$Pd_{11}Te_2Se_2$	(38)	1	[65]
Milotaite	PdSbSe	(46)	1	[66]
Molybdomenite	$PbSeO_3$	(1)	13	[24]
Munakataite	$Pb_2Cu_2(SeO_3)(SO_4)(OH)_4$	(12)	16	[67]
Naumannite	Ag_2Se	(24)	156	[68]
Nestolaite	$CaSeO_3{\cdot}H_2O$	(13)	2	[69]
Nevskite	BiSe	(39)	5	[70]
Nicksobolevite	$Cu_7(SeO_3)_2O_2Cl_6$	(5)	1	[71]
Olsacherite	$Pb_2(SeO_4)(SO_4)$	(2)	8	[72]
Oosterboschite	Pd_7Se_5	(7)	4	[73]
Orlandiite	$Pb_3(SeO_3)Cl_4{\cdot}H_2O$	(6)	1	[74]
Padmaite	PdBiSe	(53)	3	[75]
Palladseite	$Pd_{17}Se_{15}$	(29)	5	[76]
Parageorgbokiite	$Cu_5(SeO_3)_2O_2Cl_2$	(5)	1	[77]
Paraguanajuatite	Bi_2Se_3	(49)	7	[78]
Pauladamsite	$Cu_4(SeO_3)(SO_4)(OH)_4{\cdot}2H_2O$	(14)	1	[79]
Penroseite	$NiSe_2$	(2)	14	[80]
Permingeatite	Cu_3SbSe_4	(46)	5	[81]
Petříčekite	$CuSe_2$	(46)	1	[82]
Petrovicite	$Cu_3HgPbBiSe_5$	(43)	6	[83]
Piretite	$Ca(UO_2)_3(SeO_3)_2(OH)_4{\cdot}4H_2O$	(8)	1	[84]
Plumboselite	$Pb_3(SeO_3)O_2$	(15)	1	[85]
Poubaite	$PbBi_2Se_4$	(40)	4	[86]
Prewittite	$K_2Pb_3Zn_2Cu_{12}(SeO_3)_4O_4Cl_{20}$	(5)	1	[87]
Příbramite	$CuSbSe_2$	(51)	3	[88]

Table S1. *Cont.*

Mineral	Chemical Formula	TL	NL	References
Quijarroite	$Cu_6HgPb_2Bi_4Se_{12}$	(3)	1	[89]
Sabatierite	Cu_6TlSe_4	(16)	4	[90]
Sarrabusite	$Pb_5Cu(SeO_3)_4Cl_4$	(6)	1	[91]
Schlemaite	Cu_6PbSe_4	(50)	1	[92]
Schmiederite	$Pb_2Cu_2(SeO_3)(SeO_4)(OH)_4$	(10)	14	[93]
Sederholmite	NiSe	(32)	1	[55]
Selenium	Se	(?)	134	[94]
Selenojalpaite	Ag_3CuSe_2	(52)	1	[95]
Selenopolybasite	$CuAg_6Ag_9Sb_2S_9Se_2$	(21)	3	[96]
Selenostephanite	$Ag_5(SbSe_3)Se$	(47)	2	[97]
Skippenite	Bi_2Se_2Te	(42)	6	[98]
Sofiite	$Zn_2(SeO_3)Cl_2$	(5)	2	[99]
Stilleite	ZnSe	(8)	7	[100]
Sudovikovite	$PtSe_2$	(53)	3	[101]
Telluronevskite	Bi_3TeSe_2	(44)	1	[102]
Tiemannite	HgSe	(54)	75	[103]
Tischendorfite	$Pd_8Hg_3Se_9$	(24)	1	[104]
Trogtalite	$CoSe_2$	(57)	9	[12]
Trüstedtite	$NiNi_2Se_4$	(32)	4	[55]
Tyrrellite	$CuCo_2Se_4$	(22)	13	[105]
Umangite	Cu_3Se_2	(35)	68	[106]
Verbeekite	$PdSe_2$	(7)	2	[107]
Vihorlatite	$Bi_{24}Se_{17}Te_4$	(44)	1	[108]
Watkinsonite	$Cu_2PbBi_4Se_8$	(42)	5	[98]
Wilkmanite	Ni_3Se_4	(32)	1	[55]
Zincomenite	$ZnSeO_3$	(5)	1	[109]

Note: (1) – Cerro de Cacheuta Mine, Mendoza, Argentina; (2) – Virgen de Surumi mine, Potosí Department, Bolivia; (3) – El Dragón mine, Potosí Department, Bolivia; (4) – Iron Monarch open cut, South Australia; (5) – Tolbachik volcano, Kamchatka, Russia; (6) – Baccu Locci Mine, Sardinia, Italy; (7) – Musonoi Mine, Katanga, Democratic Republic of Congo; (8) – Shinkolobwe Mine, Katanga, Democratic Republic of Congo; (9) – Repete Mine, Utah, USA; (10) – El Cóndor Mine, Vinchina Department, Argentina; (11) – Zapiga, Tarapacá Region, Chile; (12) – Kato mine, Kyushu Region, Japan; (13) – Little Eva Mine, Utah, USA; (14) – Santa Rosa Mine, California, USA; (15) – Tsumeb Mine, Otjikoto Region, Namibia; (16) – Bukov Mine, Moravia, Czech Republic; (17) – Buraco Do Ouro Mine, Goiás, Brazil; (18) – Burnside, Pennsylvania, USA; (19) – Fish Hook Bay property, Black Bay Uranium Mines, Beaverlodge Lake area, Saskatchewan, Canada; (20) – Chaméane Uranium Deposit, Auvergne-Rhône-Alpes, France; (21) – De Lamar Mine, Idaho, USA; (22) – Eagle Claims, Saskatchewan, Canada; (23) – El Chire Prospect, La Rioja, Argentina; (24) – Eskaborn Adit, Saxony-Anhalt, Germany; (25) – Kawazu mine, Honshu Island, Japan; (26) – Forestville, Pennsylvania, USA; (27) – Habři Mine, Moravia, Czech Republic; (28) – Hope's Nose, Devon, England, UK; (29) – Itabira, Minas Gerais, Brazil; (30) – Moctezuma Mine, Sonora, Mexico; (31) – Kampijimpanga, North-Western Province, Zambia; (32) – Kitka River Valley, Kuusamo, Finland; (33) – Kletno, Lower Silesia, Poland; (34) – Zálesí, Javorník, Olomouc Region, Moravia, Czech Republic; (35) – Las Asperezas mine, La Rioja, Argentina; (36) – Lubero Region, Kivu, Democratic Republic Of Congo; (37) – Martin Lake mine, Saskatchewan, Canada; (38) – Miessijoki River, Lapland Region, Finland; (39) – Nevskoe W-Sn Deposit, Magadanskaya Oblast', Russia; (40) – Oldřichov, Bohemia, Czech Republic; (41) – Orijärvi, Salo, Finland; (42) – Otish Mountains U deposit, Québec, Canada; (43) – Petrovice, Moravia, Czech Republic; (44) – Poruba Pod Vihorlatom, Košice Region, Slovakia; (45) – Prasolovskoe Au Deposit, Kunashir Island, Russia; (46) – Předbořice, Bohemia, Czech Republic; (47) – Rudnaya Sopka Ag-Au Deposit, Chukotskii Autonomous Okrug, Russia; (48) – San Carlos Mine, Guanajuato, Mexico; (49) – Santa Catarina Mine, Guanajuato, Mexico; (50) – Schlema-Hartenstein District, Saxony, Germany; (51)

– Háje, Příbram, Central Bohemia Region, Bohemia, Czech Republic; (52) – Skrikerum Mine, Östergötland, Sweden; (53) – Srednyaya Padma mine, Karelia Republic, Russia; (54) – St Lorenz Mine, Lower Saxony, Germany; (55) – Suluchekinskoye Se-U deposit, Almaty Province, Kazakhstan; (56) – Ust' Uyok deposit, Tuva Republic, Russia; (57) – Trogtal Quarries, Lower Saxony, Germany; (58) – Tumiñico Mine, La Rioja, Argentina; (59) – U deposit No. 504, Guizhou Province, China.

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