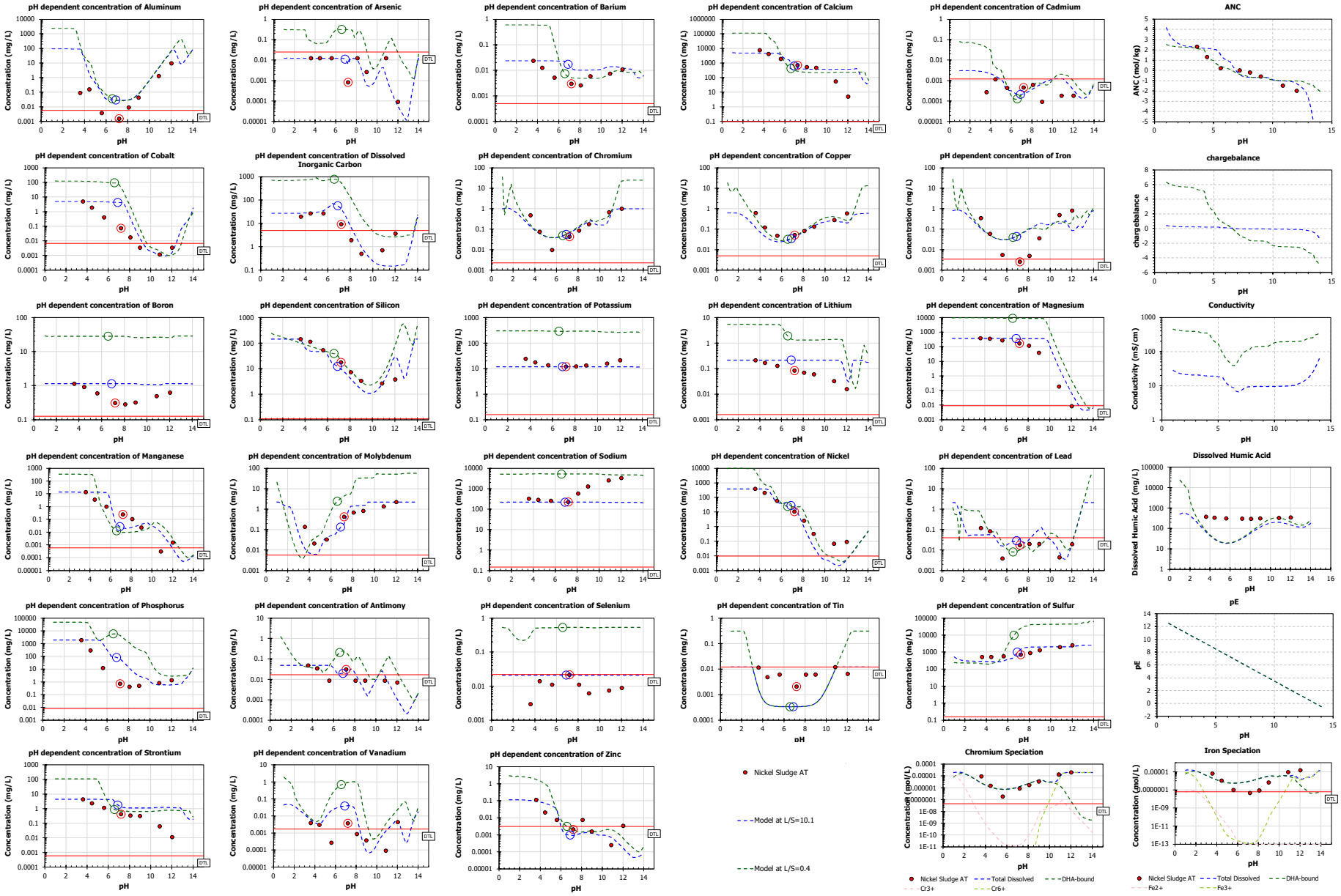
NICKEL SLUDGE AT

COMPARISON pH DEPENDENCE WITH MODEL



Object pH Dependent Leaching Test Model
Name Nickel Sludge AT

pH Dependent Leaching Test Scenario

Lab Test

Extra L/S Simulation

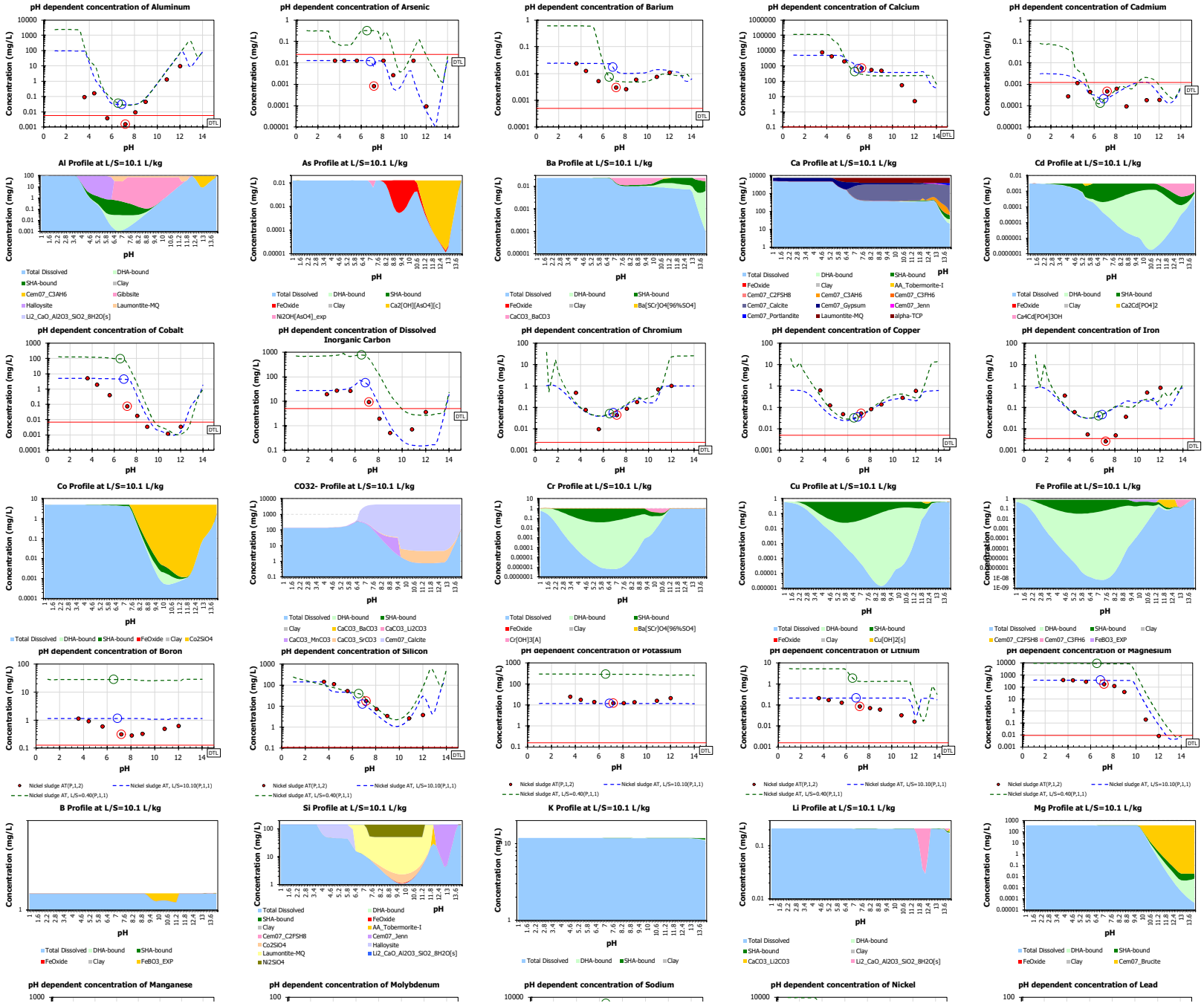
Lab Test

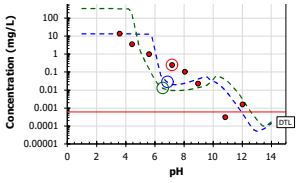
Model Parameters

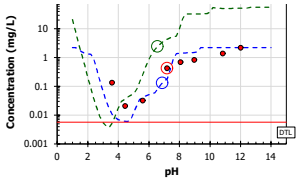
Entity	Unit	Default	Available Content Entity	mg/kg	Entity	mg/kg	Entity	mg/kg
c0		-4.514	Al	949.9	B	11.48	Sb	0.4925
c1		1.683	As	0.1274	Si	1444	Se	0.2131
c2		-0.9169	Ba	0.2413	Hg	2.006E-07	Sn	0.1225
c3		0.1653	Ca	7.683E+04	K	119.9	SO4	7.651E+04
c4		-0.01216	Cd	0.03145	Li	2.151	Sr	43.74
c5		0.0003163	Cl	3.545E-08	Mg	3789	V	0.4435
Clay	mg/kg	3000	Co	50.99	Mn	135.9	Zn	1.150
Hydrous Ferric Oxid	mg/kg	50.00	CO32-	4.336E+04	Mo	22.46		
L/S	L/kg	10.10	Cr	10.23	Na	2199		
pE		6.300	Cu	6.312	Ni	3886		
pH		7.200	F	5.000	Pb	21.20		
Solid Humic Acid	mg/kg	5000	Fe	8.204	PO4	5.886E+04		
Simulated Low L/S	L/kg	0.4000						

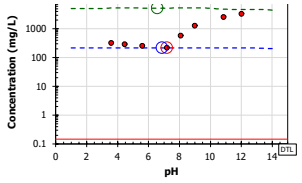
Minerals

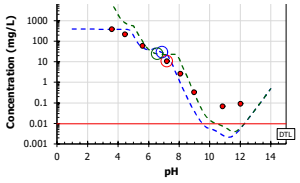
Name	Log(K)	Reaction
AA_Tobermorite-I	23.86	AA_Tobermorite-I -> 2 Ca+2 + 0.8 H+ + 1.2 H2O + 2.4 H2SiO4-2
alpha-TCP	25.50	alpha-TCP -> 3 Ca+2 + 2 PO4-3
Arsenocrandallite-t	95.56	Arsenocrandallite-therm + 6 H2O -> 3 Al[OH]4- + 2 AsO4-3 + 1 Ca+2 + 7 H+
Ba[SCr]O4[96%SO4	9.790	Ba[SCr]O4[96%SO4] -> 1 Ba+2 + 0.04 CrO4-2 + 0.96 SO4-2
Ca[OH]Sb[OH]6[s]	2.000	Ca[OH]Sb[OH]6[s] + 1 H+ -> 1 Ca+2 + 1 H2O + 1 Sb[OH]6-
Ca2[OH][AsO4][c]	4.000	Ca2[OH][AsO4][c] + 1 H+ -> 1 AsO4-3 + 2 Ca+2 + 1 H2O
Ca2Cd[PO4]2	32.95	Ca2Cd[PO4]2 -> 2 Ca+2 + 1 Cd+2 + 2 PO4-3
Ca4Cd[PO4]3OH	39.23	Ca4Cd[PO4]3OH + 1 H+ -> 4 Ca+2 + 1 Cd+2 + 1 H2O + 3 PO4-3
CaCO3_BaCO3	22.00	CaCO3_BaCO3 -> 1 Ba+2 + 2 CO3-2 + 1 Ca+2
CaCO3_Li2CO3	21.30	CaCO3_Li2CO3 -> 2 CO3-2 + 1 Ca+2 + 2 Li+
CaCO3_MnCO3	21.48	CaCO3_MnCO3 -> 2 CO3-2 + 1 Ca+2 + 1 Mn+2
CaCO3_SrCO3	19.85	CaCO3_SrCO3 -> 2 CO3-2 + 1 Ca+2 + 1 Sr+2
CaMoO4[c]	7.940	CaMoO4[c] -> 1 Ca+2 + 1 MoO4-2
CaSb[OH]6[s]2_exp	19.41	CaSb[OH]6[s]2_exp -> 1 Ca+2 + 2 Sb[OH]6-
Cem07_Brucite	-16.83	Cem07_Brucite + 2 H+ -> 2 H2O + 1 Mg+2
Cem07_C2FSH8	21.41	Cem07_C2FSH8 -> 2 Ca+2 + 2 Fe[OH]4- + 3 H2O + 1 H2SiO4-2
Cem07_C3AH6	-35.14	Cem07_C3AH6 + 4 H+ -> 2 Al[OH]4- + 3 Ca+2 + 4 H2O
Cem07_C3FH6	-30.82	Cem07_C3FH6 + 4 H+ -> 3 Ca+2 + 2 Fe[OH]4- + 4 H2O
Cem07_Calcite	8.485	Cem07_Calcite -> 1 CO3-2 + 1 Ca+2
Cem07_Gypsum	4.583	Cem07_Gypsum -> 1 Ca+2 + 2 H2O + 1 SO4-2
Cem07_Jenn	-7.799	Cem07_Jenn + 1.3333333 H+ -> 1.6666667 Ca+2 + 1.7666666 H2O + 1 H2SiO4-2
Cem07_Portlandite	-22.79	Cem07_Portlandite + 2 H+ -> 1 Ca+2 + 2 H2O
Co2SiO4	5.289	Co2SiO4 + 2 H+ -> 2 Co+2 + 1 H2SiO4-2
Cr[OH]3[A]	68.13	Cr[OH]3[A] + 1 H2O -> 1 CrO4-2 + 5 H+ + 3 e-
Cu[OH]2[s]	-8.640	Cu[OH]2[s] + 2 H+ -> 1 Cu+2 + 2 H2O
Fe2[SeO3]3:2I	183.8	Fe2[SeO3]3:2H2O + 7 H2O -> 2 Fe[OH]4- + 14 H+ + 3 SeO4-2 + 6 e-
FeBO3_EXP	32.48	FeBO3_EXP + 2 H2O -> 1 Fe[OH]4- + 2 H+ + 1 H2BO3-
Fluorite	10.96	Fluorite -> 1 Ca+2 + 2 F-
Gibbsite	14.71	Gibbsite + 1 H2O -> 1 Al[OH]4- + 1 H+
Halloysite	79.12	Halloysite + 7 H2O -> 2 Al[OH]4- + 6 H+ + 2 H2SiO4-2
Laumontite-M	118.0	Laumontite-MQ + 8 H2O -> 2 Al[OH]4- + 1 Ca+2 + 8 H+ + 4 H2SiO4-2
LDH_Zn_zc	20.91	LDH_Zn_zc + 3 H+ -> 1 Al[OH]4- + 1 CO3-2 + 3 H2O + 3 Zn+2
Li2_CaO_Al2C	22.69	Li2_CaO_Al2O3_SiO2_8H2O[s] -> 2 Al[OH]4- + 1 Ca+2 + 3 H2O + 1 H2SiO4-2 + 2 Li+
Magadiite	165.6	Magadiite + 9 H2O -> 13 H+ + 7 H2SiO4-2 + 1 Na+
Manganite	-25.27	Manganite + 3 H+ + 1 e- -> 2 H2O + 1 Mn+2
Ni[OH]2.Zn[OI	-12.00	Ni[OH]2.Zn[OH]2-Exp + 4 H+ -> 4 H2O + 1 Ni+2 + 1 Zn+2
Ni[OH]2[s]	-10.80	Ni[OH]2[s] + 2 H+ -> 2 H2O + 1 Ni+2
Ni2OH[AsO4]_	14.00	Ni2OH[AsO4]_exp + 1 H+ -> 1 AsO4-3 + 1 H2O + 2 Ni+2
Ni2SiO4	5.498	Ni2SiO4 + 2 H+ -> 1 H2SiO4-2 + 2 Ni+2
Ni3[PO4]2	31.30	Ni3[PO4]2 -> 3 Ni+2 + 2 PO4-3
NiMoO4	11.15	NiMoO4 -> 1 MoO4-2 + 1 Ni+2
Pb[OH]2[C]	-8.150	Pb[OH]2[C] + 2 H+ -> 2 H2O + 1 Pb+2
PbMoO4[c]	15.80	PbMoO4[c] -> 1 MoO4-2 + 1 Pb+2
PbOH[Sb[OH]	12.00	PbOH[Sb[OH]6]_exp1 + 1 H+ -> 1 H2O + 1 Pb+2 + 1 Sb[OH]6-
Sn[OH]2[s]	1.447	Sn[OH]2[s] + 2 H+ -> 2 H2O + 1 Sn+2
Strengite	47.97	Strengite + 2 H2O -> 1 Fe[OH]4- + 4 H+ + 1 PO4-3

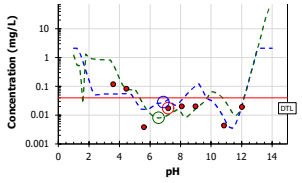

pH dependent concentration of Aluminum
pH dependent concentration of Arsenic
pH dependent concentration of Barium
pH dependent concentration of Calcium
pH dependent concentration of Cadmium
Al Profile at L/S=10.1 L/kg
As Profile at L/S=10.1 L/kg
Ba Profile at L/S=10.1 L/kg
Ca Profile at L/S=10.1 L/kg
Cd Profile at L/S=10.1 L/kg
pH dependent concentration of Cobalt
pH dependent concentration of Dissolved Inorganic Carbon
pH dependent concentration of Chromium
pH dependent concentration of Copper
pH dependent concentration of Iron
Co Profile at L/S=10.1 L/kg
CO32- Profile at L/S=10.1 L/kg
Cr Profile at L/S=10.1 L/kg
Cu Profile at L/S=10.1 L/kg
Fe Profile at L/S=10.1 L/kg
pH dependent concentration of Boron
pH dependent concentration of Silicon
pH dependent concentration of Potassium
pH dependent concentration of Lithium
pH dependent concentration of Magnesium
B Profile at L/S=10.1 L/kg
Si Profile at L/S=10.1 L/kg
K Profile at L/S=10.1 L/kg
Li Profile at L/S=10.1 L/kg
Mg Profile at L/S=10.1 L/kg
pH dependent concentration of Manganese
pH dependent concentration of Molybdenum
pH dependent concentration of Sodium
pH dependent concentration of Nickel
pH dependent concentration of Lead
Concentration (mg/L)
pH
DTL
Total Dissolved
DHA-bound
SHA-bound
Clay
Cem07_C3AH6
Gibbsite
Halloysite
Laumontite-MQ
Li2_CaO_Al2O3_SiO2_8H2O[s]
FeOxide
Ca2[OH][AsO4][c]
Ni2OH[AsO4]_exp
Ba[SCr]O4[96%SO4]
CaCO3_BaCO3
AA_Tobermorite-I
Cem07_C2FSH8
Cem07_C3FH6
Cem07_Calcite
Cem07_Gypsum
Cem07_Jenn
Cem07_Portlandite
alpha-TCP
Ca2Cd[PO4]2
Ca4Cd[PO4]3OH
Co2SiO4
CaCO3_Li2CO3
CaCO3_MnCO3
CaCO3_SrCO3
Cr[OH]3[A]
Cu[OH]2[s]
FeBO3_EXP
Nickel sludge AT(P,1,2)
Nickel sludge AT, L/S=10.10(P,1,1)
Nickel sludge AT, L/S=0.40(P,1,1)



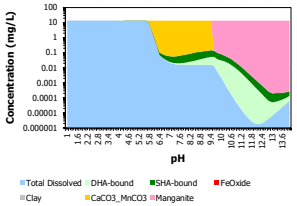




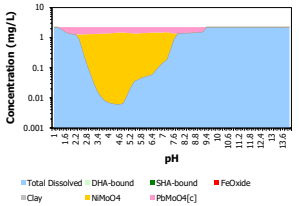




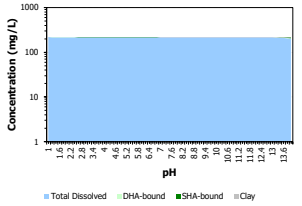
Mn Profile at L/S=10.1 L/kg



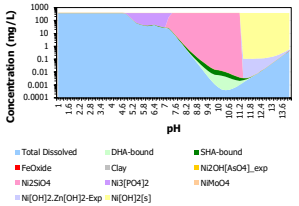
Mo Profile at L/S=10.1 L/kg



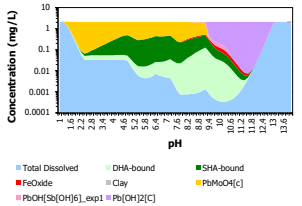
Na Profile at L/S=10.1 L/kg



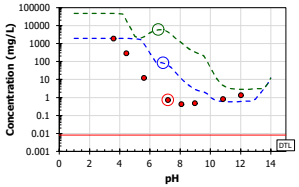
Ni Profile at L/S=10.1 L/kg



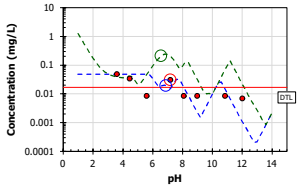
Pb Profile at L/S=10.1 L/kg



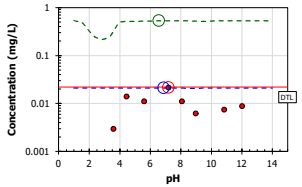
pH dependent concentration of Phosphorus



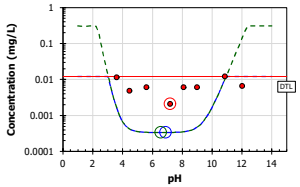
pH dependent concentration of Antimony



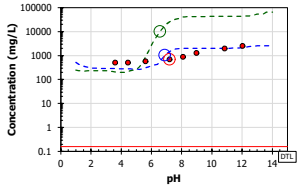
pH dependent concentration of Selenium



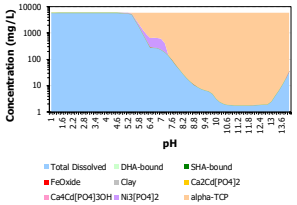
pH dependent concentration of Tin



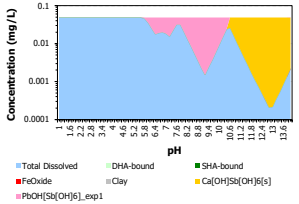
pH dependent concentration of Sulfur



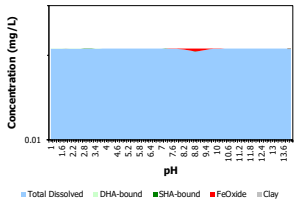
PO4 Profile at L/S=10.1 L/kg



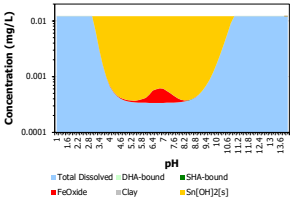
Sb Profile at L/S=10.1 L/kg



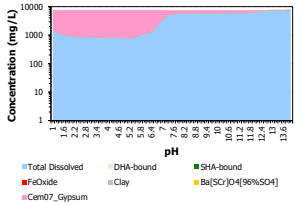
Se Profile at L/S=10.1 L/kg



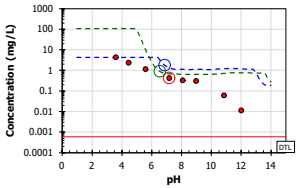
Sn Profile at L/S=10.1 L/kg



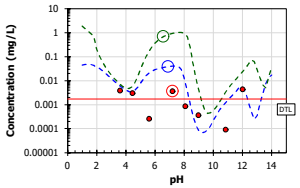
SO4 Profile at L/S=10.1 L/kg



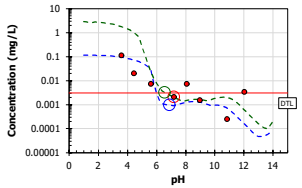
pH dependent concentration of Strontium



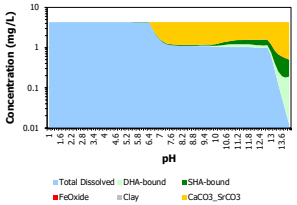
pH dependent concentration of Vanadium



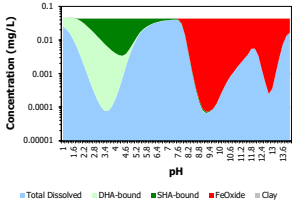
pH dependent concentration of Zinc



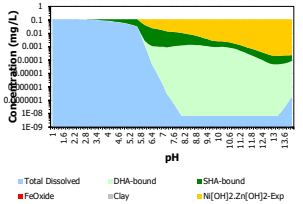
Sr Profile at L/S=10.1 L/kg



V Profile at L/S=10.1 L/kg



Zn Profile at L/S=10.1 L/kg



Model Comparison: residuals - Concentration

Name Ni Sludge AT

Legend

Total Average Deviation	Square root of the sum of the squared values of residuals divided by the number of values, over the entire X range.
User Average Deviation	Square root of the sum of the squared values of residuals divided by the number of values, over the user defined X range.
Fractional Average Deviation	Square root of the sum of the squared values of residuals divided by the number of values, over the fraction.
	Note that the Total and User Average Deviation columns are averages as well.

Residual details, concentrations

Residuals as log(model/sample)

Fraction	*8*	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*Total Avg*
pH	*3.60*	*4.46*	*5.61*	*7.20*	*8.09*	*8.99*	*10.9*	*12.0*	*Deviation*
Al	3.00	1.03	1.33	1.28	0.53	0.26	0.59	0.88	0.48
As	0.01	0.01	0.01	0.89	-0.11	-0.63	-0.89	-0.23	0.18
Ba	0.00	0.28	0.66	0.61	0.60	0.25	0.28	0.07	0.15
Ca	-0.20	0.07	0.22	-0.18	-0.14	-0.09	0.85	1.89	0.26
Cd	0.98	0.17	-0.08	-0.30	-0.18	0.91	0.84	0.26	0.21
Cl	-	-	-	-	-	-	-	-	-
Co	0.00	0.41	1.08	1.76	1.28	0.64	-0.05	-0.30	0.32
CO32-	-	-	-	-	-	-	-	-	-
Cr	-0.54	-0.09	0.61	0.19	0.17	0.14	-0.31	0.00	0.12
Cu	-0.71	-0.43	-0.29	-0.10	-0.01	0.04	-0.04	-0.45	0.12
Fe	-0.50	-0.09	0.75	1.33	1.32	0.73	-0.39	-0.97	0.31
B	0.01	0.10	0.29	0.57	0.61	0.55	0.34	0.27	0.14
Si	0.01	-0.36	-0.05	-0.25	-0.26	-0.33	-0.01	0.89	0.13
Hg	-	-	-	-	-	-	-	-	-
K	-0.31	-0.17	-0.06	-0.01	-0.01	-0.05	-0.12	-0.25	0.06
Li	0.00	0.10	0.23	0.41	0.49	0.55	0.82	0.36	0.16
Mg	0.00	0.04	0.14	0.33	0.49	0.97	1.27	0.89	0.24
Mn	0.00	0.58	1.11	-1.05	-0.63	0.26	1.48	-0.52	0.30
Mo	-1.08	-0.52	0.11	-0.36	0.32	0.27	0.21	0.00	0.17
Na	-0.17	-0.12	-0.07	-0.01	-0.42	-0.77	-1.06	-1.18	0.23
Ni	0.00	0.26	-0.08	0.37	-0.45	-0.92	-1.40	-1.20	0.27
Pb	-0.33	-0.16	0.62	0.32	0.24	0.72	0.23	0.07	0.14
PO4	-	-	-	-	-	-	-	-	-
Sb	0.01	0.16	0.75	-0.29	0.30	-0.57	0.23	-0.82	0.17
Se	0.86	0.18	0.28	0.00	0.28	0.53	0.45	0.38	0.16
Sn	-0.85	-1.06	-1.25	-0.79	-1.24	-1.11	-0.09	0.27	0.33
SO4	-	-	-	-	-	-	-	-	-
Sr	0.00	0.27	0.58	0.50	0.53	0.57	1.30	2.03	0.33
V	0.20	0.08	1.91	1.05	0.93	-0.64	1.16	0.07	0.34
Zn	-0.07	0.55	0.61	-0.36	-0.77	-0.09	0.44	-1.32	0.23
Avg Deviation	0.15	0.08	0.14	0.14	0.12	0.12	0.15	0.17	0.22

Yellow = own pH All residuals within + 1 or - 1 are considered to represent a good fit.