Geochemical modelling of As solubility at oxic and anoxic conditions – from the laboratory to the field scale

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A former wood impregnation site in Hjältevad, Sweden, is heavily contaminated with arsenic, mainly As(III). As a basis for risk assessment and possible remediation options the gechemistry of the contaminated aquifer was thourougly characterized. As a complement to ground water measurements we performed batch leaching tests (pH 5-9) on sediment samples obtained from the corresponding depth. Leaching tests were made at oxic conditions to ensure that As prevailed as As(V). The geochemical model Visual MINTEQ was optimized on these data by varying the fraction of active iron (hydr)oxide surface (ferrihydrite), based on oxalate extraction (5-40%). The model was subsequently used to predict the solubility of As(V)-As(III) at field conditions.

Results and Discussion

The correspondance between modelled and measured As solubility, expressed as K_d values, was surprisingly good, considering the large spatial variability in the field (Table 1).

Sample	pH[1]	Redox[1] (mV)	K_d, field[1]	K_d, batch[2]	K_d, model[3]
1705_2	5.7	-107	48	2800	5
1708_2	6.8	-10	38	2990	88
1709_2	6.5	-94	5	970	3
1711_2	7.3	-129	32	1070	15
1712_2	6.5	-7	36	690	5
1713_2	6,2	-16	1	210	2
1715_2	6.8	-110	2	100	3
Mean			23	1260	17

[1] Field measaurement, K_d calculated from field.
[2] K_d calculated from results in batch measurements (oxic conditions).
[3] K_d from simulation using measured ground water chemistry.

Table 1: Calculated K_d values (l/kg).