Electronic Supplementary Material (ESI) for Analytical Methods.

Supplementary information

Synthetic matrix recipe

A synthetic matrix was used throughout developmental experiments, to take into consideration the ionic characteristics of natural water samples. This matrix was created following Smith et al. (2002), and ionic concentrations are shown in Supplementary Table 1 alongside major ion chemistry from experimental data at ASGM sites in Kenya (Ondayo et al 2023).

Supplementary Table 1: Comparison of major ion chemistry in a synthetic hardwater recipe (Smith et al (2002))[35], and measured concentrations from ASGM sites in Kakamega gold belt, Kenya (Ondayo et al (2023))[12]

Ion	**Synthetic matrix (mg/L) (Smith *et al.* (2002))35**	**Natural water (mg/L) (Ondayo *et al.* (2023))[12]**
Sodium	5.748	7.72
Magnesium	1.458	6.64
Calcium	10.621	12.5
Potassium	0.977	1.87
Chloride	9.926	2.98
Carbonate	23.491	73.5
Sulphate	11.046	9.39

Supplementary Table 2: ICP-MS parameters and conditions used in experimental analysis

Parameter	**Value**
ICP-MS	Agilent 8900
Nebulizer	MicroMist 100µm
Isotope	^{201}Hg, ^{202}Hg
RF Power	1550W
Replicates	3
Plasma gas flow rate	15 L min^{-1}
Auxiliary gas flow rate	0.9 L min^{-1}
Nebulizer gas flow rate	1.00 L min^{-1}
Makeup Gas	0.2 L min^{-1}
Dwell time	100 ms

Supplementary Table 3: Measurements of a blank solution applied to the developed method to calculate a method detection limit (3σ)

Number (n=10)	**Measurement (µg L^{-1} Hg)**
1	-0.001
2	0.004
3	-0.003
4	0.002
5	0.001
6	0.002
7	0.000
8	0.004
9	0.005
10	0.006
LoD (3σ)	0.008

Supplementary Table 4: Water geochemistry of samples from ASGM sites across Kakamega gold belt (Bushiangala, Lunyerere, Malinya, Rosterman, and Viyalo mine sites)

Sample	Location	Field pH	Field Conductivity	Conductivity	pH	Hg	Ca	Mg	Na	K	Total Alk	Cl^-	SO_4^{2-}	NO_3^-
			$\mu S\ cm^{-1}$	$\mu S\ cm^{-1}$		$\mu g\ L^{-1}$	$mg\ l^{-1}$	$mg\ l^{-1}$	$mg\ l^{-1}$	$mg\ l^{-1}$	$mg\ l^{-1}\ HCO_3^-$	$mg\ l^{-1}$	$mg\ l^{-1}$	$mg\ l^{-1}$
M1	Lunyerere	7.50	370	434	8.01	0.179	28.9	5.79	37.5	5.01	115	11.2	44.0	70.8
M2	Malinya	6.00	160	207	7.77	0.255	17.0	9.09	8.4	2.12	112	5.11	2.51	11.4
M3	Bushiangala	6.20	60	68.7	7.08	0.348	5.2	2.18	2.4	1.70	38.8	1.59	0.786	4.52
M4	Bushiangala	6.20	30	79.2	7.29	0.041	7.4	2.94	2.1	1.39	43.9	0.823	1.09	7.55
M5	Rosterman	6.60	220	280	8.12	0.045	27.4	13.1	7.5	1.17	164	6.97	6.25	4.04
R1	Lunyerere	6.30	80	101	7.35	0.166	7.5	2.90	5.0	1.74	36.2	4.22	2.56	17.7
R2	Lunyerere	6.20	30	101	7.06	0.148	7.8	2.91	5.1	1.68	36.0	4.22	2.85	18.1
R3	Malinya	6.60	110	143	7.72	0.023	10.9	6.20	8.0	1.30	77.6	5.28	1.08	7.44
R4	Bushiangala	5.80	50	70.9	7.08	0.084	7.2	2.12	2.2	0.80	39.7	1.12	1.33	5.51
R5	Rosterman	6.80	160	207	7.98	0.020	14.3	14.0	5.3	1.57	132	3.51	0.725	0.865
R6	Rosterman	6.90	150	211	7.96	0.032	15.4	13.1	5.3	1.72	134	3.60	0.796	0.951
R7	Rosterman	7.00	100	138	7.65	0.141	10.3	4.89	7.8	1.24	69.4	5.13	1.71	7.71
R8	Rosterman	7.00	110	154	7.77	0.028	11.3	6.64	7.4	1.35	83.0	4.78	1.56	6.34
S1	Lunyerere	5.40	70	95.0	6.75	0.132	7.0	2.90	4.4	1.79	28.4	4.64	2.34	19.7
S2	Viyalo	6.70	260	332	7.54	0.079	36.0	6.99	10.0	6.32	31.2	7.66	86.4	11.3
S3	Viyalo	5.40	70	94.3	7.66	0.043	5.4	3.84	4.2	1.55	31.4	3.22	2.12	22.6
S4	Bushiangala	5.50	60	85.9	7.27	0.036	9.5	2.63	2.3	0.69	49.8	0.835	1.07	5.89
S5	Rosterman	6.10	160	209	7.80	0.055	14.4	12.2	7.7	0.84	120	3.70	1.57	9.07
S6	Rosterman	6.60	150	203	7.97	0.010	14.0	13.5	5.1	1.54	129	3.52	0.717	0.861
S7	Rosterman	6.70	150	204	8.03	0.043	14.3	13.4	5.2	1.72	128	3.56	0.874	1.02
O1	Lunyerere	7.70	240	299	7.96	0.151	26.6	7.89	15.7	4.06	94.2	9.92	44.8	17.3
O2	Malinya	7.00	190	229	7.93	0.030	17.7	8.38	11.6	3.93	109	10.4	12.2	4.35
O3	Malinya	6.70	60	86.5	6.52	0.046	4.3	1.95	5.8	2.03	15.8	11.6	6.53	5.80
O4	Bushiangala	6.70	140	175	6.99	0.162	14.2	1.68	9.4	7.76	30.3	8.79	27.9	19.1

O5	Bushiangala	6.20	70	94.7	7.24	0.102	5.4	2.59	5.4	5.80	53.8	1.21	1.42	5.83
O6	Rosterman	6.70	270	349	7.93	0.277	29.4	10.4	15.9	8.88	119	19.6	45.3	1.29
O7	Rosterman	6.50	270	351	7.92	0.162	29.0	10.3	15.6	8.58	119	19.6	45.0	1.30
O8	Rosterman	6.60	180	232	7.87	0.032	23.6	6.91	6.7	4.84	113	7.47	14.2	2.94
O9	Rosterman	7.10	150	209	8.00	0.058	14.6	13.6	5.2	1.61	132	3.57	0.750	0.952