

Table S.1. Parameters utilized in calculation of contamination indices in this work

M, Co, Cn	Concentration of the analyzed PTEs
X, Cb	Concentration of a normalizer element (Fe)
Bn	Geochemical background concentration of the PTEs (n) in shale
1.5	Introduced to minimize the effects of possible variations in the background values
Er ^d	Potential ecological risk factor of an individual PTEs
Tri	Biological toxic response factor of an individual PTEs (Zn = 1, Cr = 2, Ni = 6, Cu = Pb = Ni = 5, As = 10)
Cf ^f	Contamination factor for each single element

Table S. 2. Classification of the contamination indices.

EF	EF < 2	Deficiency to minimal enrichment	PLI	PLI > 1	Polluted
	EF= 2–5	Moderate enrichment		PLI = 1	Baseline levels of pollution
	EF= 5–20	Significant enrichment		PLI < 1	Not polluted
	EF= 20–40	Very high enrichment		Er < 40	Low ecological risk
CF	EF > 40	Extremely high enrichment	RI	40 < Er ≤ 80	Moderate ecological risk
	Cf < 1	Low contamination factor		80 < Er ≤ 160	Considerable ecological risk
	1 ≤ Cf < 3	Moderate contamination factor		160 < Er ≤ 320	High ecological risk
	3 ≤ Cf < 6	Considerable contamination factor		Er > 320	Serious ecological risk
Igeo	Cf ≥ 6	Very high contamination factor	RI	RI < 150	Low ecological risk
	Igeo < 0	Uncontaminated		150 < RI < 300	Moderate ecological risk
	0 < Igeo < 1	Unpolluted to moderately contaminated		300 < RI < 600	High potential ecological risk
	1 < Igeo < 2	Moderately contaminated		RI ≥ 600	Significantly high ecological risk
	2 < Igeo < 3	Moderately to strongly contaminated			
	3 < Igeo < 4	Strongly contaminated			
	4 < Igeo < 5	Strongly to extremely contaminated			
	Igeo > 5	Extremely high contaminated			

Table S. 3. Exposure factors used in estimation of chronic daily intake (CDI) for non-carcinogenic.

Parameter	Units	Adults	Children
Ingestion rate (IngR)	mg/day	100	200
Exposure frequency (EF)	days/year	350	350
Exposure duration (ED)	year	24	6
Body weight (BW)	Kg	70	15
Average Time for non-carcinogenic risk (AT _{nc})	days	8760	2190
Average Time for carcinogenic risk (AT _c)	days	25550	25550
Skin surface area (SA)	cm ²	5700	2800
Adherence factor (AF)	mg/cm	0.07	0.2
Dermal absorption factor (ABS)	-	0.001	0.001
Conversion factor (CF)	Kg/mg	10 ⁻⁶	10 ⁻⁶
Concentration of heavy metal(loid)s (C)	Mg/kg	-	-

Table S. 4. The reference dose (RfD) and the cancer slope factors (CSF) for PTEs.

PTEs	RfD _{ing}	RfD _{derm}
Cr	3×10^{-3}	6×10^{-5}
Cu	4×10^{-2}	4.02×10^{-2}
Ni	2×10^{-2}	5.4×10^{-3}
V	7×10^{-3}	7×10^{-5}
Fe	7×10^{-1}	-
Zn	3×10^{-1}	6×10^{-2}
Pb	3.5×10^{-3}	3.25×10^{-4}
As	3×10^{-4}	1.23×10^{-4}
PTEs	CSF _{ing}	CSF _{derm}
As	1.5	3.66
Pb	0.0085	-
Cr	0.5	20

Table 5. Concentration of PTEs (dw, µg/g), and values of the PLI, and RI in Al Lith coastal sediment.

S.N.	As	Cr	Cu	Ni	Pb	V	Zn	Fe	PLI	RI
S1	5.00	11.00	5.00	8.00	3.00	19.00	17.00	9000	0.22	7.05
S2	3.00	16.00	7.00	7.00	3.00	23.00	16.00	13800	0.23	5.97
S3	2.00	7.00	5.00	4.00	2.00	10.00	12.00	4000	0.13	3.60
S4	1.00	8.00	4.00	3.00	1.80	12.00	7.00	5300	0.12	2.64
S5	2.00	14.00	6.00	7.00	3.00	30.00	17.00	9800	0.20	5.02
S6	1.00	6.00	3.00	3.00	3.00	6.00	8.00	3600	0.10	2.63
S7	2.00	15.00	7.00	8.00	5.00	31.00	20.00	11100	0.23	5.86
S8	1.00	4.00	1.00	2.00	1.00	4.00	4.00	1600	0.06	1.61
S9	2.00	5.00	2.00	2.00	1.80	5.00	5.00	2200	0.08	2.75
S10	5.00	13.00	6.00	7.00	1.80	24.00	18.00	11400	0.21	7.14
S11	1.90	8.00	3.00	3.00	1.70	9.00	6.00	7800	0.12	3.28
S12	2.00	7.00	2.00	3.00	1.50	9.00	7.00	6200	0.11	3.12
S13	2.00	9.00	3.00	5.00	1.40	15.00	12.00	7100	0.14	3.65
S14	2.00	8.00	3.00	3.00	1.20	11.00	7.00	8300	0.11	3.30
S15	2.00	6.00	2.00	2.00	1.10	7.00	5.00	6000	0.09	2.84
S16	5.00	35.00	29.00	24.00	3.00	60.00	53.00	30500	0.39	13.89
S17	4.00	32.00	12.00	13.00	1.00	73.00	26.00	24800	0.26	9.07
S18	3.00	36.00	24.00	20.00	2.00	62.00	39.00	31700	0.36	11.04
S19	4.00	30.00	25.00	20.00	2.00	56.00	45.00	24500	0.35	11.52
S20	2.00	29.00	27.00	19.00	3.00	61.00	49.00	29600	0.32	10.67
S21	5.00	58.00	73.00	54.00	8.00	92.00	104.00	48700	0.68	25.80
S22	2.00	9.00	4.00	3.00	1.90	10.00	8.00	9600	0.14	3.66
S23	2.00	11.00	4.00	5.00	1.70	25.00	12.00	10800	0.17	4.21
S24	2.00	10.00	2.00	4.00	1.40	7.00	4.00	11700	0.10	3.43
S25	3.00	5.00	2.00	2.00	1.20	7.00	5.00	5600	0.08	3.58

Table S. 6. The HI for non-carcinogenic risk of PTEs in adults and children

	As		Cr		Pb		V		Cu		Ni		Zn		Fe	
S.N.	Adults	Children	Adults	Children	Adults	Children	Adults	Children	Adults	Children	Adults	Children	Adults	Children	Adults	Children
S1	0.0229	0.2135	0.0050	0.0470	0.0012	0.0110	0.0029	0.0270	0.0002	0.0018	0.0002	0.0019	0.000078	0.000726	0.0177	0.1647
S2	0.0138	0.1281	0.0073	0.0683	0.0012	0.0110	0.0035	0.0327	0.0003	0.0025	0.0001	0.0013	0.000073	0.000683	0.0271	0.2526
S3	0.0092	0.0854	0.0032	0.0299	0.0008	0.0073	0.0015	0.0142	0.0002	0.0018	0.0001	0.0013	0.000055	0.000512	0.0079	0.0732
S4	0.0046	0.0427	0.0037	0.0342	0.0007	0.0066	0.0018	0.0171	0.0002	0.0014	0.0003	0.0026	0.000032	0.000299	0.0104	0.0970
S5	0.0092	0.0854	0.0064	0.0598	0.0012	0.0110	0.0046	0.0427	0.0002	0.0022	0.0001	0.0013	0.000078	0.000726	0.0193	0.1794
S6	0.0046	0.0427	0.0028	0.0256	0.0012	0.0110	0.0009	0.0085	0.0001	0.0011	0.0003	0.0026	0.000037	0.000342	0.0071	0.0659
S7	0.0092	0.0854	0.0069	0.0641	0.0020	0.0183	0.0047	0.0441	0.0003	0.0025	0.0001	0.0006	0.000092	0.000854	0.0218	0.2031
S8	0.0046	0.0427	0.0018	0.0171	0.0004	0.0037	0.0006	0.0057	0.0000	0.0004	0.0001	0.0013	0.000018	0.000171	0.0031	0.0293
S9	0.0092	0.0854	0.0023	0.0214	0.0007	0.0066	0.0008	0.0071	0.0001	0.0007	0.0001	0.0013	0.000023	0.000214	0.0043	0.0403
S10	0.0229	0.2135	0.0060	0.0555	0.0007	0.0066	0.0037	0.0342	0.0002	0.0021	0.0003	0.0026	0.000083	0.000769	0.0224	0.2086
S11	0.0087	0.0811	0.0037	0.0342	0.0007	0.0062	0.0014	0.0128	0.0001	0.0011	0.0001	0.0006	0.000028	0.000256	0.0153	0.1427
S12	0.0092	0.0854	0.0032	0.0299	0.0006	0.0055	0.0014	0.0128	0.0001	0.0007	0.0000	0.0013	0.000032	0.000299	0.0122	0.1135
S13	0.0092	0.0854	0.0041	0.0384	0.0006	0.0051	0.0023	0.0214	0.0001	0.0011	0.0001	0.0013	0.000055	0.000512	0.0139	0.1299
S14	0.0092	0.0854	0.0037	0.0342	0.0005	0.0044	0.0017	0.0157	0.0001	0.0011	0.0002	0.0019	0.000032	0.000299	0.0163	0.1519
S15	0.0092	0.0854	0.0028	0.0256	0.0004	0.0040	0.0011	0.0100	0.0001	0.0007	0.0002	0.0019	0.000023	0.000214	0.0118	0.1098
S16	0.0229	0.2135	0.0160	0.1495	0.0012	0.0110	0.0092	0.0854	0.0011	0.0102	0.0001	0.0013	0.000243	0.002263	0.0599	0.5582
S17	0.0183	0.1708	0.0147	0.1366	0.0004	0.0037	0.0112	0.1039	0.0005	0.0043	0.0002	0.0019	0.000119	0.001110	0.0487	0.4539
S18	0.0138	0.1281	0.0165	0.1537	0.0008	0.0073	0.0095	0.0883	0.0009	0.0084	0.0003	0.0026	0.000179	0.001665	0.0623	0.5802
S19	0.0183	0.1708	0.0138	0.1281	0.0008	0.0073	0.0086	0.0797	0.0010	0.0088	0.0001	0.0013	0.000206	0.001922	0.0481	0.4484
S20	0.0092	0.0854	0.0133	0.1238	0.0012	0.0110	0.0093	0.0868	0.0010	0.0095	0.0002	0.0019	0.000225	0.002092	0.0582	0.5417
S21	0.0229	0.2135	0.0266	0.2477	0.0031	0.0293	0.0141	0.1310	0.0028	0.0254	0.0003	0.0026	0.000477	0.004441	0.0957	0.8913
S22	0.0092	0.0854	0.0041	0.0384	0.0007	0.0070	0.0015	0.0142	0.0002	0.0014	0.0002	0.0019	0.000037	0.000342	0.0189	0.1757
S23	0.0092	0.0854	0.0050	0.0470	0.0007	0.0062	0.0038	0.0356	0.0002	0.0014	0.0003	0.0032	0.000055	0.000512	0.0212	0.1977
S24	0.0092	0.0854	0.0046	0.0427	0.0006	0.0051	0.0011	0.0100	0.0001	0.0007	0.0004	0.0038	0.000018	0.000171	0.0230	0.2141
S25	0.0138	0.1281	0.0023	0.0214	0.0005	0.0044	0.0011	0.0100	0.0001	0.0007	0.0002	0.0019	0.000023	0.000214	0.0110	0.1025

Table S.7. Total lifetime cancer risk (LCR) for As, Cr, and Pb in adults and children

	As		Cr		Pb	
S.N.	Adults	Children	Adults	Children	Adults	Children
S1	1.03E-05	9.61E-05	7.56E-06	7.05E-05	3.51E-08	3.27E-07
S2	6.19E-06	5.76E-05	1.1E-05	0.000102	3.51E-08	3.27E-07
S3	4.13E-06	3.84E-05	4.81E-06	4.48E-05	2.34E-08	2.18E-07
S4	2.06E-06	1.92E-05	5.5E-06	5.12E-05	2.1E-08	1.96E-07
S5	4.13E-06	3.84E-05	9.63E-06	8.97E-05	3.51E-08	3.27E-07
S6	2.06E-06	1.92E-05	4.13E-06	3.84E-05	3.51E-08	3.27E-07
S7	4.13E-06	3.84E-05	1.03E-05	9.61E-05	5.85E-08	5.44E-07
S8	2.06E-06	1.92E-05	2.75E-06	2.56E-05	1.17E-08	1.09E-07
S9	4.13E-06	3.84E-05	3.44E-06	3.2E-05	2.1E-08	1.96E-07
S10	1.03E-05	9.61E-05	8.94E-06	8.33E-05	2.1E-08	1.96E-07
S11	3.92E-06	3.65E-05	5.5E-06	5.12E-05	1.99E-08	1.85E-07
S12	4.13E-06	3.84E-05	4.81E-06	4.48E-05	1.75E-08	1.63E-07
S13	4.13E-06	3.84E-05	6.19E-06	5.76E-05	1.64E-08	1.52E-07
S14	4.13E-06	3.84E-05	5.5E-06	5.12E-05	1.4E-08	1.31E-07
S15	4.13E-06	3.84E-05	4.13E-06	3.84E-05	1.29E-08	1.2E-07
S16	1.03E-05	9.61E-05	2.41E-05	0.000224	3.51E-08	3.27E-07
S17	8.25E-06	7.69E-05	2.2E-05	0.000205	1.17E-08	1.09E-07
S18	6.19E-06	5.76E-05	2.48E-05	0.000231	2.34E-08	2.18E-07
S19	8.25E-06	7.69E-05	2.06E-05	0.000192	2.34E-08	2.18E-07
S20	4.13E-06	3.84E-05	1.99E-05	0.000186	3.51E-08	3.27E-07
S21	1.03E-05	9.61E-05	3.99E-05	0.000372	9.35E-08	8.71E-07
S22	4.13E-06	3.84E-05	6.19E-06	5.76E-05	2.22E-08	2.07E-07
S23	4.13E-06	3.84E-05	7.56E-06	7.05E-05	1.99E-08	1.85E-07
S24	4.13E-06	3.84E-05	6.88E-06	6.41E-05	1.64E-08	1.52E-07
S25	6.19E-06	5.76E-05	3.44E-06	3.2E-05	1.4E-08	1.31E-07