



Supplementary Materials

Table S1. Elemental Concentration Obtained from INAA Analysis of Dust Samples

Elements	unit	Abadan (Aug-2018)	Abadan (Sep-2018)	Abadan (Dec-2019)	Ahvaz (Apr-2020)	Dezful (Feb-2020)	Hoveyzeh (Feb-2020)
Al	g/kg	26.96±4.53	21.36±4.19	38.34±6.21	30.90±4.79	39.13±6.22	37.49±5.96
As	mg/kg	7.80±3.30	BDL	BDL	6.66±1.20	5.40±1.00	4.90±0.90
Ba	mg/kg	239.60±51.30	361.60±74.50	445.90±100.80	425.400±71.50	208.40±37.70	223.70±42.50
Br	mg/kg	24.70±4.00	22.70±4.80	8.70±2.80	2.50±0.80	3.50±0.80	4.00±0.90
Ca	g/kg	144.70±24.89	186.63±31.91	173.47±31.22	176.27±28.73	151.73±24.88	177.28±29.25
Ce	mg/kg	28.40±5.20	67.80±13.60	83.20±18.50	34.80±5.70	32.40±5.50	36.30±6.00
Co	mg/kg	12.10±2.10	13.50±2.30	13.40±2.40	11.20±1.80	10.20±1.60	10.00±1.60
Cr	mg/kg	88.80±17.70	134.90±22.00	134.20±23.50	202.40±31.80	229.30±35.90	306.30±47.80
Dy	mg/kg	2.40±0.20	BDL	2.20±0.20	2.50±0.60	2.20±0.50	2.40±0.50
Eu	mg/kg	© BDL	BDL	0.60±0.10	0.60±0.10	0.60±0.20	0.60±0.10
Fe	g/kg	23.48±3.78	26.28±4.18	42.26±6.80	45.97±7.01	46.15±7.06	21.81±3.38
Hf	mg/kg	2.80±0.60	3.20±0.60	4.10±0.80	2.60±0.40	3.20±0.50	3.00±0.50
K	g/kg	BDL	BDL	BDL	7.02±1.55	6.81±1.58	7.06±1.10
La	mg/kg	19.30±3.20	19.10±3.20	15.20±2.80	13.40±2.10	14.60±2.30	14.30±2.30
Lu	mg/kg	0.21±0.04	0.23±0.04	0.28±0.10	0.15±0.02	0.26±0.07	0.10±0.02
Mg	g/kg	19.68±3.35	25.17±4.25	17.43±3.10	14.06±2.60	18.02±3.26	14.14±2.38
Mn	mg/kg	507.70±85.50	645.20±109.70	564.30±93.70	465.40±71.70	343.50±53.60	469.90±72.80
Na	g/kg	35.52±5.56	28.37±5.62	5.83±0.95	5.59±0.87	3.69±0.57	4.79±0.75
Nd	mg/kg	12.50±3.70	12.30±1.30	298.20±50.10	12.80±2.70	15.50±3.10	14.90±3.10
Rb	mg/kg	14.40±12.00	41.10±10.40	14.40±12.00	23.30±5.40	23.90±5.60	27.00±6.10
Sc	mg/kg	8.00±1.30	8.50±1.30	8.70±1.40	6.40±1.00	6.10±0.90	7.40±1.10
Se	mg/kg	BDL	BDL	BDL	4.10±1.50	2.70±1.05	0.38±0.10
Sm	mg/kg	3.00±0.50	BDL	3.30±0.60	2.10±0.30	2.50±0.40	2.40±0.40
Ta	mg/kg	0.80±0.10	1.30±0.40	0.90±0.20	0.30±0.10	0.40±0.10	0.30±0.10
Ti	g/kg	1.33±0.37	2.61±0.61	2.30±0.56	3.55±0.65	3.41±0.64	2.12±0.46
V	mg/kg	74.30±14.00	97.20±17.90	107.30±20.40	120.40±19.90	94.30±15.80	73.90±13.40
Yb	mg/kg	1.20±0.30	1.40±0.40	1.70±0.40	1.00±0.20	1.31±0.20	1.20±0.20
Zn	mg/kg	188.20±36.30	404.40±69.60	196.10±40.60	227.30±37.70	333.50±54.00	134.60±23.30
U	mg/kg	BDL	BDL	BDL	1.50±0.40	1.60±0.40	1.30±0.30
Th	mg/kg	BDL	BDL	BDL	4.40±0.90	3.20±0.60	3.40±0.70

Table S1. Continued

Elements	unit	Mahshahr (Feb-2020)	Omidieh (Feb-2020)	Ramhormoz (Feb-2020)	Shush (Feb-2020)	Susangerd (Feb-2020)
Al	g/kg	25.98±4.16	33.66±5.15	35.28±5.50	42.64±6.65	40.83±6.33
As	mg/kg	4.90±0.90	6.40±1.20	4.40±0.90	5.70±1.10	6.80±1.30
Ba	mg/kg	229.40±42.20	212.30±38.40	214.50±39.00	181.20±35.50	224.30±50.00
Br	mg/kg	7.60±1.70	3.20±0.80	5.30±1.10	3.90±0.90	1.70±1.40
Ca	g/kg	196.39±32.40	205.46±33.90	189.98±31.54	138.54±23.14	126.06±21.05
Ce	mg/kg	30.70±5.10	25.80±4.30	27.20±4.60	36.80±6.10	36.30±6.10
Co	mg/kg	10.20±1.70	7.30±1.20	7.50±1.20	10.00±1.60	11.90±1.90
Cr	g/kg	222.60±35.00	189.90±29.90	133.90±21.40	229.10±36.20	235.20±37.20
Dy	mg/kg	0.90±0.30	2.50±0.60	2.30±0.50	3.00±0.60	3.70±0.80
Eu	mg/kg	0.60±0.10	0.70±0.20	0.60±0.20	0.70±0.20	0.90±0.20
Fe	g/kg	34.00±5.24	17.51±2.71	17.94±2.80	22.69±3.54	36.06±5.55
Hf	mg/kg	2.50±0.40	2.10±0.40	2.20±0.40	2.90±0.50	3.20±0.50
K	g/kg	4.36±1.08	8.53±2.20	8.95±1.95	9.78±2.06	8.41±1.80
La	mg/kg	12.50±2.00	11.10±1.80	11.20±1.80	15.00±2.40	15.00±2.40
Lu	mg/kg	0.17±0.04	0.17±0.05	0.19±0.04	0.27±0.05	0.24±0.06
Mg	g/kg	13.97±2.74	14.84±2.91	13.74±2.29	15.18±2.56	16.69±2.79
Mn	mg/kg	291.50±46.90	469.90±72.40	342.60±54.10	467.90±72.10	523.60±81.20
Na	g/kg	8.14±1.27	5.61±0.89	6.54±1.02	5.18±0.81	6.05±0.94
Nd	mg/kg	12.30±2.90	10.50±2.40	10.60±2.30	14.40±3.00	17.20±3.60
Rb	mg/kg	29.30±7.00	22.50±5.00	19.80±4.60	33.60±7.50	32.80±7.30
Sc	mg/kg	7.60±1.20	6.70±1.00	6.10±0.90	6.50±1.00	6.70±1.00
Se	mg/kg	BDL	BDL	0.28±0.10	0.27±0.10	0.30±0.11
Sm	mg/kg	2.20±0.40	1.90±0.30	1.80±0.30	2.60±0.40	2.70±0.40
Ta	mg/kg	0.35±0.11	0.25±0.15	0.34±0.10	0.42±0.11	0.42±0.12
Ti	g/kg	1.84±0.44	1.35±0.33	2.11±0.45	2.81±0.56	3.07±0.61
V	mg/kg	59.80±11.20	126.90±22.20	66.10±11.70	99.90±17.10	86.20±14.90
Yb	mg/kg	0.90±0.20	0.90±0.20	0.95±0.23	1.35±0.30	1.31±0.30
Zn	g/kg	0.62±0.10	0.17±0.03	0.47±0.08	0.13±0.02	1.06±0.17
U	mg/kg	1.60±0.40	1.70±0.42	1.73±0.41	1.40±0.38	1.30±0.36
Th	mg/kg	2.70±0.60	3.31±0.60	3.30±0.62	4.60±0.90	4.60±0.95

© Below Detection Limit

Table S2. Input Data in PMF Modeling Assuming Five Factors

Species	Category	S/N	Min	25th	Median	75th	Max
Al	Weak	5.21051	21.35500	26.96100	35.28400	39.13200	42.63900
As	Strong	3.73176	0.00435	0.00489	0.00644	0.00777	0.02050
Ba	Weak	4.15754	0.18124	0.21232	0.22432	0.36164	0.44592
Br	Strong	2.92230	0.00172	0.00319	0.00397	0.00872	0.02475
Ca	Weak	4.96654	126.06000	144.70000	176.27000	189.98000	205.46000
Ce	Weak	4.72882	0.02580	0.02844	0.03477	0.03675	0.08325
Co	Strong	5.04740	0.00735	0.01000	0.01023	0.01208	0.01351
Cr	Weak	5.15000	0.08883	0.13424	0.20235	0.22933	0.30628
Dy	Weak	2.61897	0.00095	0.00223	0.00237	0.00254	0.00369
Eu	Weak	2.43116	0.00057	0.00059	0.00060	0.00068	0.00093
Fe	Weak	5.41052	17.51450	21.80500	26.27567	42.26400	46.14650
Hf	Strong	4.71807	0.00213	0.00246	0.00289	0.00316	0.00408
K	Weak	3.20182	4.35630	7.02440	8.53140	9.77850	12.07650
La	Strong	5.11958	0.01105	0.01248	0.01461	0.01521	0.01931
Lu	Strong	4.40365	0.00011	0.00012	0.00015	0.00016	0.00021
Mg	Weak	4.67249	13.73600	14.06100	15.17500	18.01700	25.17200
Mn	Weak	5.28921	0.29155	0.34351	0.46991	0.52363	0.64519
Na	Strong	5.25367	3.69383	5.18297	5.82775	8.13760	35.51565
Nd	Strong	4.11387	0.01047	0.01227	0.01283	0.01551	0.29822
Rb	Weak	2.75456	0.01439	0.01981	0.02386	0.03275	0.04107
Sc	Weak	5.46213	0.00611	0.00640	0.00675	0.00803	0.00873
Se	Bad	1.31734	0.00019	0.00024	0.00415	0.00415	0.00415
Sm	Weak	4.76244	0.00011	0.00191	0.00245	0.00266	0.00326
Ta	Weak	3.79638	0.00022	0.00028	0.00037	0.00077	0.00130
Ti	Weak	3.59035	1.32800	1.84310	2.29290	3.07430	3.55250
V	Weak	4.62424	0.05975	0.07385	0.09425	0.10728	0.12689
Yb	Strong	3.63580	0.00087	0.00094	0.00117	0.00132	0.00170
Zn	Strong	4.83940	0.12583	0.17150	0.22728	0.47234	1.05865
U	Bad	2.68733	0.00124	0.00124	0.00172	0.00187	0.00203
Th	Weak	2.95868	0.00155	0.00155	0.00319	0.00419	0.00446

	Al	As	Ba	Br	Ca	Ce	Co	Cr	Dy	Eu	Fe	Hf	K	La	Lu	Mg	Mn	Na	Nd	Rb	Sc	Se	Sm	Ta	Ti	V	Yb	Zn
Al	1.00	-0.06	-0.30	-0.75	-0.50	-0.09	-0.26	0.48	0.57	0.45	0.12	0.26	0.02	-0.35	0.34	-0.48	-0.16	-0.71	0.23	-0.14	-0.49	-0.73	0.62	-0.48	0.34	0.15	0.29	0.01
As		1.00	0.75	0.36	0.04	0.92	0.68	-0.48	-0.02	-0.11	0.32	0.78	0.66	0.38	0.76	0.46	0.64	0.18	0.90	-0.23	0.74	0.47	0.11	0.69	-0.03	0.35	0.78	-0.16
Ba			1.00	0.25	0.74	0.64	-0.36	-0.11	-0.30	0.53	0.52	0.37	0.24	0.41	0.30	0.52	0.12	0.62	-0.16	0.52	0.60	-0.13	0.53	0.27	0.45	0.43	-0.17	
Br				1.00	0.05	0.37	0.56	-0.69	-0.25	-0.34	-0.22	0.18	0.49	0.80	0.19	0.83	0.51	0.95	0.02	0.08	0.72	0.51	-0.41	0.85	-0.36	-0.19	0.26	-0.13
Ca					1.00	0.05	-0.38	-0.11	-0.64	-0.59	-0.26	-0.42	-0.12	-0.48	-0.57	-0.16	-0.19	-0.09	0.03	-0.08	0.14	0.48	-0.50	-0.05	-0.43	0.08	-0.46	-0.25
Ce						1.00	0.74	-0.30	-0.04	-0.13	0.31	0.82	0.69	0.43	0.72	0.54	0.66	0.14	0.79	0.08	0.73	0.32	-0.12	0.76	0.15	0.26	0.83	-0.10
Co							1.00	-0.27	0.06	0.08	0.49	0.80	0.44	0.80	0.76	0.68	0.67	0.48	0.46	0.16	0.72	0.35	0.00	0.79	0.28	0.06	0.74	0.11
Cr								1.00	0.12	0.30	0.12	-0.06	-0.49	-0.38	-0.15	-0.49	-0.31	-0.67	-0.29	0.40	-0.42	-0.53	0.15	-0.58	0.36	-0.04	-0.17	0.11
Dy									1.00	0.72	-0.08	0.16	0.40	0.14	0.28	0.04	0.47	-0.11	-0.08	0.16	-0.32	-0.45	0.16	-0.03	0.36	0.36	0.31	0.20
Eu										1.00	0.09	0.11	-0.02	0.00	0.21	-0.01	0.20	-0.21	-0.13	0.35	-0.24	-0.34	0.19	-0.19	0.26	0.12	0.16	0.68
Fe											1.00	0.53	-0.27	0.06	0.43	0.05	-0.06	-0.27	0.37	-0.10	0.01	0.13	0.28	0.03	0.69	0.24	0.33	0.20
Hf												1.00	0.51	0.54	0.95	0.44	0.53	0.04	0.75	-0.04	0.56	0.00	0.30	0.58	0.34	0.13	0.95	-0.02
K													1.00	0.54	0.53	0.61	0.83	0.39	0.45	0.05	0.50	0.08	-0.21	0.75	-0.08	0.30	0.71	-0.27
La														1.00	0.57	0.84	0.66	0.80	0.08	0.19	0.62	0.21	-0.11	0.83	0.04	-0.08	0.59	-0.08
Lu															1.00	0.38	0.54	0.11	0.75	-0.16	0.53	-0.02	0.48	0.52	0.22	0.11	0.94	-0.02
Mg																1.00	0.67	0.75	0.08	0.32	0.58	0.30	-0.48	0.91	0.05	0.09	0.54	0.03
Mn																	1.00	0.47	0.33	0.22	0.60	0.31	-0.24	0.77	0.03	0.44	0.65	-0.12
Na																		1.00	-0.15	0.02	0.58	0.46	-0.31	0.72	-0.38	-0.20	0.12	-0.09
Nd																			1.00	-0.45	0.56	0.28	0.42	0.35	-0.04	0.24	0.70	-0.18
Rb																				1.00	-0.04	-0.21	-0.64	0.20	0.36	-0.02	0.04	0.37
Sc																					1.00	0.60	-0.08	0.78	-0.40	-0.09	0.52	-0.12
Se																						1.00	-0.21	0.42	-0.37	0.33	-0.05	-0.23
Sm																							1.00	-0.39	-0.05	-0.08	0.21	-0.09
Ta																								1.00	-0.03	0.08	0.66	-0.11
Ti																									1.00	0.28	0.29	0.23
V																										1.00	0.22	-0.37
Yb																											1.00	-0.08
Zn																												1.00

Fig. S1. Correlation coefficients among the chemical elements in dust samples.

Table S3. Some Sources of Pollutants [27-31]

Pollution Sources	Elemental Composition of Pollution Sources
Soil- Crustal (world averaged)	[Al, Fe, Ca, K, Mg, Ti, Na, Mn] (%), [Ba, Ce](ppm)
Refinery	
Oil production	
Gasoline and hybrids, diesel	Rare Earth Elements used as Catalysts
Fuel additive	(Ce, Dy, Eu, La, Lu, Nd, Sm, Sc, Yb, Hf, ...)
Fluid cracking	
Ethane polymerization	
Petcock Production	V, Ni, Al, Fe, Si
Cement Facility	Ca, Mg
Steel Production	Fe, K, Na, Pb, Zn, Co, Cr, Mn
Metalworking	Fe, K, Na, Pb, Zn
Oil-Fired Power Plants	V, Ni, rare earths (Ce, Dy, Eu, La, Lu, Nd, Sm, Sc, Yb, Hf...)
Solid Fuel Utilization (such as coal combustion and Mazut in Power Plants)	As, Se, Cr, Mn, Zn, Ba, Co, V, Ti, Th, U, Mg, Al, Na
Waste (Waste Incineration)	As, Co, Zn, Cd, Pb, Sb, Na, Ti, K, Cl
Monazites	Including rare earth elements, Th, U, Fe and, other minerals
Carbonatites	Including mineral oxides, U and Th.

Table S4. Calculated Enrichment Factors (EF) for Elemental Concentrations of Dust Samples

Element	Abadan (Aug-18)	Abadan (Sep-18)	Abadan (Dec-18)	Ahvaz	Dezful	Hoveyzeh	Mahshahr	Omidieh	Ramhormoz	Shush	Susangerd
Al	0.60	0.45	0.79	0.86	1.15	0.91	0.61	0.90	1.03	1.18	1.08
As	7.97	0.00	0.00	8.55	7.31	5.44	5.32	7.94	5.85	7.20	8.25
Ba	0.71	1.01	1.21	1.58	0.81	0.72	0.72	0.75	0.83	0.67	0.79
Br	13.64	14.12	4.82	1.89	2.78	2.60	4.86	2.31	4.17	2.88	1.23
Ca	8.79	10.76	9.69	13.44	12.12	11.73	12.64	15.01	15.12	10.45	9.11
Ce	0.66	1.50	1.78	1.01	0.99	0.92	0.76	0.72	0.83	1.06	1.00
Co	1.76	1.86	1.80	2.03	1.95	1.58	1.57	1.28	1.42	1.81	2.05
Cr	2.21	3.19	3.08	6.33	7.51	8.31	5.88	5.69	4.37	7.09	6.97
Dy	1.03	0.93	0.89	1.30	1.26	1.13	0.44	1.33	1.33	1.62	1.91
Eu	0.00	0.00	0.71	0.92	1.04	0.80	0.79	1.02	0.92	1.06	1.37
Fe	1.16	1.23	1.91	2.84	2.99	1.17	1.77	1.04	1.16	1.39	2.11
Hf	1.64	1.75	2.18	1.93	2.42	1.89	1.51	1.49	1.71	2.09	2.18
K	0.58	0.71	0.66	0.55	0.55	0.57	0.29	0.63	0.72	0.75	0.62
La	0.77	0.72	0.55	0.67	0.76	0.62	0.52	0.53	0.58	0.74	0.71
Lu	0.47	0.42	0.57	0.48	0.60	0.47	0.38	0.40	0.45	0.58	0.59
Mg	2.47	3.00	2.01	2.21	2.97	1.93	1.86	2.24	2.26	2.36	2.49
Mn	1.28	1.55	1.31	1.48	1.14	1.29	0.78	1.43	1.13	1.47	1.57
Na	2.53	1.92	0.38	0.50	0.35	0.37	0.61	0.48	0.61	0.46	0.51
Nd	0.73	0.68	15.94	0.94	1.19	0.94	0.76	0.73	0.81	1.04	1.19
Rb	0.21	0.57	0.19	0.42	0.46	0.43	0.45	0.39	0.38	0.61	0.57
Sc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Se	80.40	76.27	73.93	100.92	6.17	5.34	85.17	96.63	4.93	5.18	6.28
Sm	0.78	0.03	0.79	0.70	0.88	0.70	0.62	0.61	0.64	0.86	0.83
Ta	0.39	0.63	0.40	0.21	0.25	0.19	0.14	0.14	0.19	0.26	0.23
Ti	0.49	0.92	0.78	1.65	1.66	0.86	0.72	0.60	1.03	1.30	1.36
V	1.36	1.69	1.81	2.78	2.27	1.48	1.16	2.80	1.59	2.28	1.88
Yb	0.60	0.67	0.80	0.64	0.86	0.65	0.47	0.56	0.63	0.84	0.79
Zn	5.47	11.15	5.24	8.29	12.74	4.26	19.20	5.99	17.98	4.54	36.61
U	©--	--	0.00	0.97	1.03	0.71	0.82	1.04	1.09	0.86	0.79
Th	--	--	0.00	0.87	0.67	0.58	0.45	0.63	0.68	0.91	0.87

© there was no concentration value to calculate EF