

Table 1) classification of geo accumulation index

Severity of contamination	Igeo range	Pollution severity
No pollution	<0	0
No pollution- medium pollution	$0 < I_{geo} < 1$	1
medium pollution	$1 < I_{geo} < 2$	2
Medium -severe pollution	$2 < I_{geo} < 3$	3
Severe pollution	$3 < I_{geo} < 4$	4
Severe- extreme pollution	$4 < I_{geo} < 5$	5
Extreme pollution	>5	6

Table 3) Kolmogorov-Smirnov normal distribution test

Elements		Iron	Mercury	Silver	Arsenic	Chrome	Manganese	Cobalt	Copper	Molybdenum	Nickel	Zink	Tin	Tungsten	Lead
Number		40	40	40	40	40	40	40	40	40	40	40	40	40	40
Normal Parameter	average	25088	0.0333	0.1150	8.20	78.5	5.30	11.70	16.40	0.84	30.60	5460	0.97	0.46	12.10
	S.D.	17620	0.01474	0.14317	5.40	7.90	3.90	6.70	6.60	0.40	1.20	2.60	0.40	0.31	6.50
Maximum Difference	Absolute	0.177	0.512	0.289	0.212	0.268	0.280	0.186	0.097	0.161	0.105	0.149	0.176	0.251	0.187
	Positive	0.177	0.512	0.289	0.212	0.268	0.280	0.186	0.097	0.161	0.105	0.149	0.176	0.251	0.187
	Negative	-0.127	-0.413	-0.232	-0.148	-0.0229	-0.149	-0.103	-0.045	-0.139	-0.076	-0.067	-0.087	-0.130	-0.105
Kologrov-Smirnov		1.118	3.240	1.827	1.338	1.693	1.773	1.175	0.612	1.021	0.665	0.945	1.111	1.587	1.183
Sim-Sig		0.164	0.005	0.006	0.056	0.006	0.005	0.126	0.848	0.248	0.768	0.334	0.169	0.013	0.122

Table4) Some of the descriptive statistics of heavy metals (mg/kg) in the studied area's soil

Elements	Iron	Mercury	Silver	Arsenic	Chrome	Manganese	Cobalt	Copper	Molybdenum	Nickel	Zink	Tin	Tungsten	Lead
Average	25088	0.0333	0.1150	8.20	78.50	5.30	11.70	16.40	0.84	30.60	54.60	0.97	0.46	12.10
Median	23500	0.0300	0.0600	7.1	56	4.3	10.7	16.3	0.70	30.5	54.1	0.90	0.40	11.10
S.D.	17620	0.01474	0.14317	5.40	7.90	3.90	6.70	6.60	0.40	1.20	2.60	0.40	0.31	6.50
Variance	3.1	0.000	0.022	29.4	6.2	1.5	45	44.5	0.16	152.02	720.4	0.16	0.09	42.80
Range	9.6	0.09	0.57	27.2	452	1998	28.2	28.3	1.80	48	130.9	1.6	1.20	31.60
Minimum	4490	0.03	0.02	2.6	20	122	3.2	4	0.4	13	13.10	0.20	0.05	3.80
Maximum	101000	0.12	0.59	29.8	472	2120	31.4	32.3	2.2	61	144	1.8	1.30	35.40

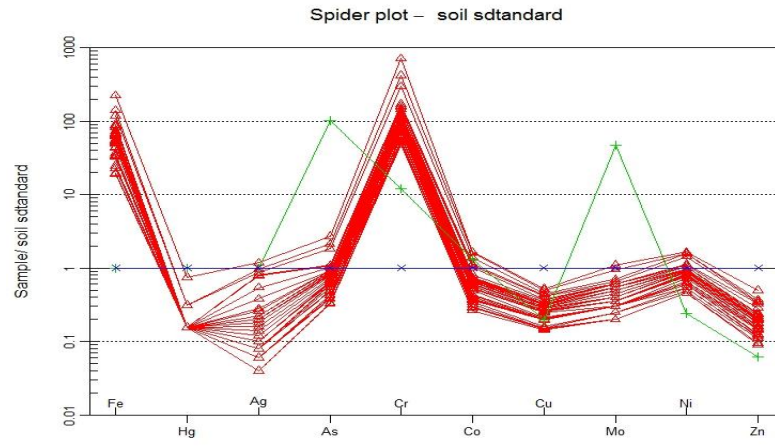
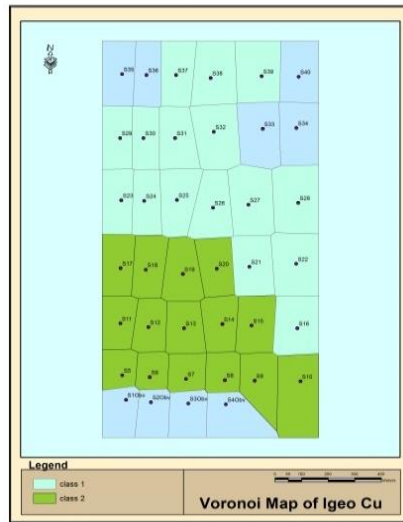
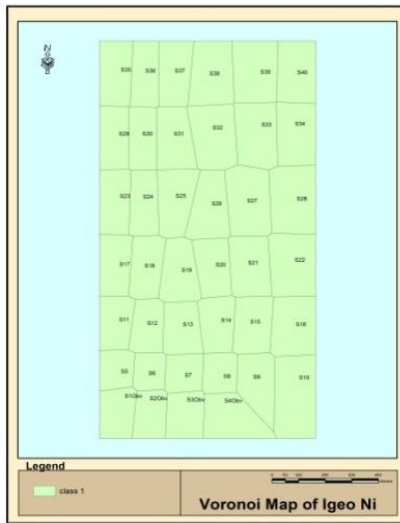
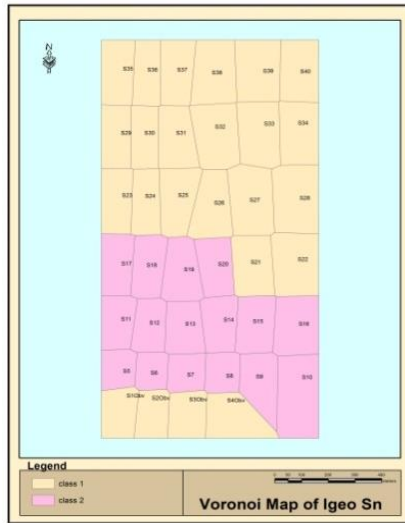


Figure 2) the comparison between the concentration of heavy metals in the soil and the standard amount (Ericson, 2011)

Table5) Geochemical accumulation parameter (Igeo) of different elements in soil samples

Elements	Iron	Arsenic	Chrome	Manganese	Cobalt	Copper	Molybdenum	Nickel	Zink	Tin	Tungsten
S1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
S2	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.2
S3	0.3	0.2	0.5	0.3	0.2	0.3	0.2	0.2	0.3	0.3	0.2
S4	0.3	0.3	0.5	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.2
S5	2.7	0.8	2.7	2.7	1.8	1.5	1.02	0.9	1.5	1.8	4.8
S6	4.5	2.4	4.1	3.3	1.8	1.5	1.03	0.9	2.1	1.8	5.2
S7	2.3	1.5	1.8	2.1	1.5	1.1	0.6	0.6	1.5	1.8	4.01
S8	1.8	1.1	1.1	1.5	1.3	1.1	0.6	0.6	1.5	1.8	4.01
S9	1.4	0.6	1.1	1.01	0.6	1.1	0.6	0.6	1.01	1.3	2.4
S10	1.5	0.6	0.6	1.02	0.6	1.1	0.3	0.6	1.02	1.3	2.4
S11	1.4	0.6	1.1	1.02	0.9	1.2	0.6	0.6	1.02	1.4	3.6
S12	1.5	1.1	1.1	1.2	1.4	1.2	0.6	0.6	1.3	1.6	4.01
S13	1.5	0.6	1.1	1.4	1.05	1.1	0.6	0.6	1.3	1.6	3.6
S14	1.2	0.6	0.6	0.6	0.7	1.1	0.3	0.3	0.9	1.6	1.8
S15	1.2	0.6	0.6	0.6	0.7	1.1	0.3	0.3	0.9	1.6	1.6
S16	1.1	0.6	0.6	0.6	0.7	0.9	0.3	0.3	0.6	1.6	1.6
S17	1.4	0.6	0.6	0.6	0.3	1.05	0.3	0.3	1.05	1.05	2
S18	1.6	0.6	0.6	0.9	0.3	1.06	0.3	0.3	1.06	1.06	2.4
S19	1.6	0.6	0.6	0.9	0.3	1.05	0.3	0.6	1.05	1.05	2.4
S20	1.3	0.6	0.6	0.6	0.3	1.02	0.3	0.3	1.02	1.02	1.6
S21	1	0.5	0.6	0.6	0.3	0.6	0.3	0.3	0.6	0.9	1.6
S22	1.1	0.5	0.6	0.6	0.3	0.6	0.3	0.3	0.6	0.9	1.6
S23	1	0.3	0.3	0.6	0.3	0.6	0.3	0.3	0.6	0.9	1.6
S24	1.1	0.3	0.3	0.6	0.3	0.6	0.3	0.3	0.6	0.9	1.6
S25	1.1	0.3	0.6	0.6	0.6	0.6	0.3	0.3	0.6	0.9	1.6
S26	0.6	0.3	0.3	0.6	0.6	0.6	0.3	0.3	0.6	0.9	1.2
S27	1	0.3	0.3	0.6	0.6	0.6	0.3	0.3	0.6	0.9	1.6
S28	1	0.3	0.3	0.6	0.6	0.6	0.3	0.3	0.6	0.9	1.6
S29	0.6	0.3	0.3	0.6	0.3	0.6	0.3	0.3	0.6	0.6	1.2
S30	0.8	0.3	0.3	0.3	0.3	0.6	0.3	0.3	0.6	0.6	1.2
S31	0.7	0.3	0.3	0.3	0.3	0.6	0.3	0.3	0.6	0.6	1.2
S32	0.6	0.3	0.3	0.3	0.3	0.6	0.3	0.3	0.6	0.6	1.2
S33	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.6
S34	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.6
S35	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.5	0.3	0.6	1.2
S36	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.6	1.2
S37	0.3	0.3	0.3	0.3	0.3	0.6	0.3	0.3	0.3	0.6	1.2
S38	0.6	0.3	0.3	0.3	0.3	0.6	0.3	0.3	0.3	0.6	1.2
S39	0.6	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.6	1.2
S40	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.3



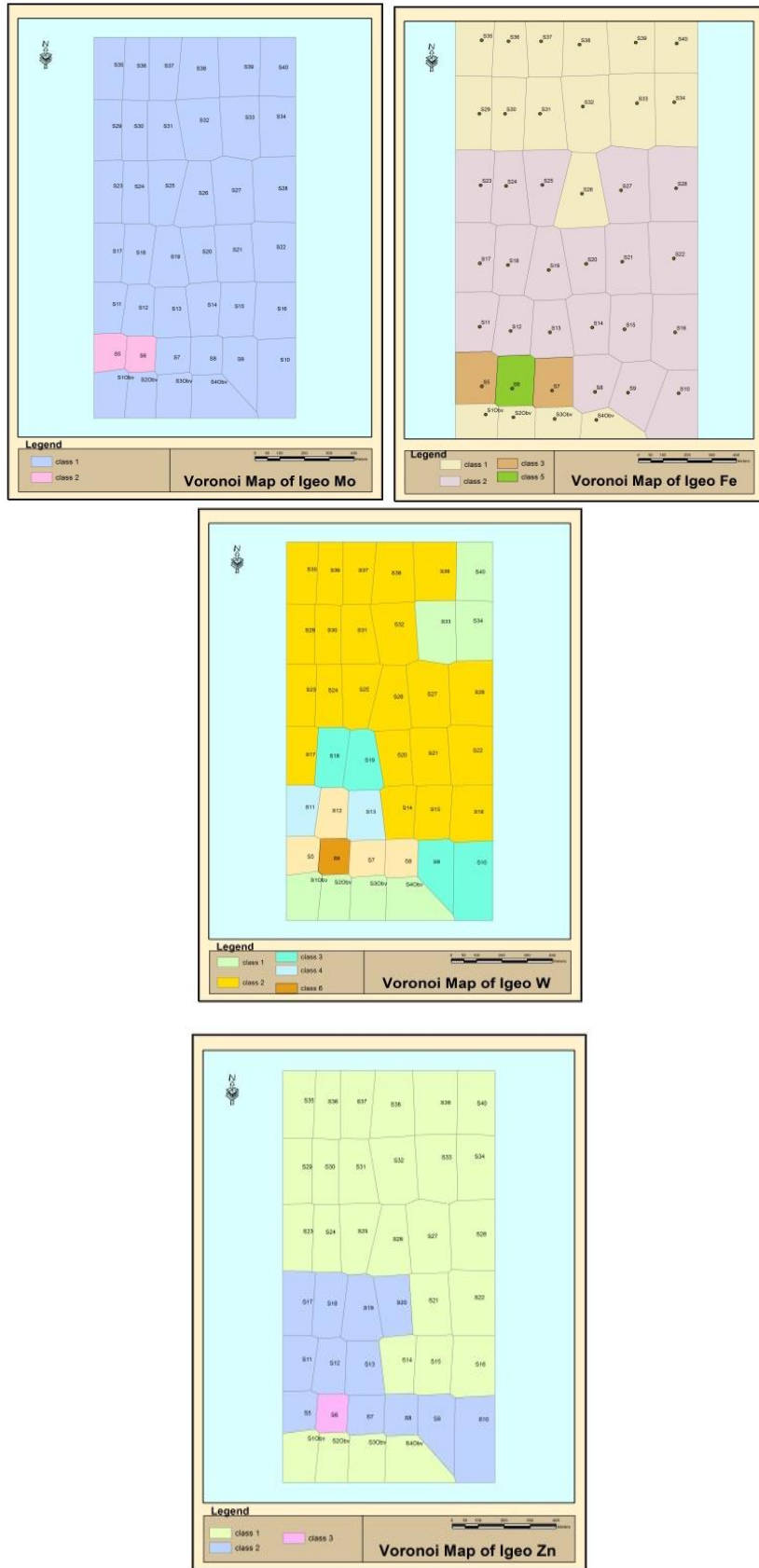
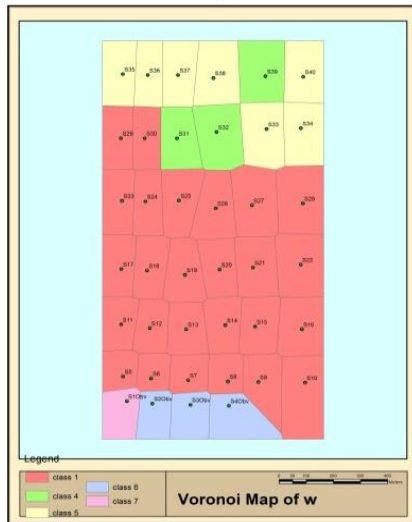
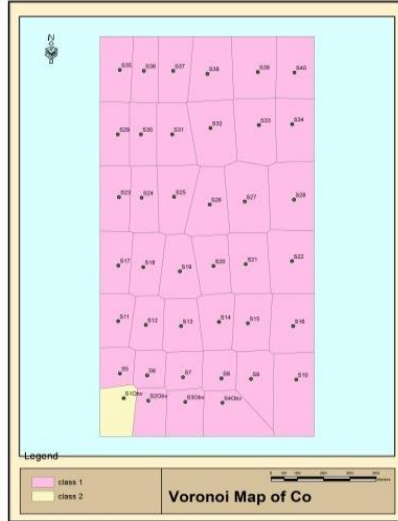
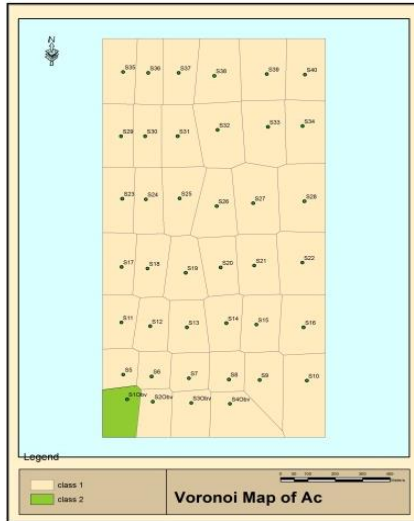


Figure3) Heavy metals zoning map according to Igeo using Voronoi method in GIS

Table6) EF parameter of different elements in soil samples

Elements	Iron	Arsenic	Chrome	Manganese	Cobalt	Copper	Molybdenum	Nickel	Zink	Tin	Tungsten
S1	1	1	1	1	1	1	1	1	1	1	1
S2	0.7	0.8	0.76	0.72	0.5	0.36	0.69	0.93	1.43	0.71	0.77
S3	0.76	0.74	0.82	0.81	0.63	0.33	0.73	0.96	1.63	0.65	0.75
S4	0.82	0.82	0.95	0.91	0.66	0.32	0.76	1	1.62	0.65	0.99
S5	0.65	0.99	0.9	0.69	0.31	0.19	0.33	0.58	0.72	1.91	0.70
S6	0.52	1.05	0.77	0.44	0.2	0.14	0.21	0.49	0.45	1.29	0.41
S7	0.66	0.83	0.98	0.68	0.32	0.16	0.38	0.65	0.84	1.87	0.52
S8	0.52	0.63	0.94	0.74	0.41	0.2	0.46	0.84	1.11	2.48	0.57
S9	0.54	0.65	0.65	0.6	0.4	0.23	0.41	0.7	0.91	1.82	0.65
S10	0.57	0.61	0.68	0.63	0.42	0.22	0.43	0.72	0.96	1.92	0.63
S11	0.54	0.66	0.71	0.65	0.43	0.23	0.41	0.73	1.06	2.73	0.57
S12	0.54	0.61	0.87	0.74	0.41	0.19	0.37	0.83	1.08	2.57	0.47
S13	0.52	0.63	0.86	0.72	0.39	0.2	0.38	0.76	1.08	2.42	0.49
S14	0.54	0.59	0.69	0.62	0.41	0.21	0.41	0.71	0.85	1.71	0.61
S15	0.55	0.6	0.7	0.64	0.42	0.22	0.42	0.73	0.87	1.40	0.63
S16	0.55	0.63	0.75	0.68	0.45	0.22	0.45	0.78	0.99	1.58	0.70
S17	0.55	0.6	0.68	0.62	0.41	0.23	0.41	0.71	0.93	1.69	0.58
S18	0.56	0.59	0.68	0.62	0.41	0.23	0.41	0.73	0.91	1.98	0.57
S19	0.56	0.58	0.67	0.62	0.41	0.22	0.44	0.72	0.89	1.94	0.55
S20	0.55	0.6	0.71	0.64	0.41	0.23	0.43	0.74	0.91	1.45	0.59
S21	0.53	0.61	0.72	0.65	0.44	0.2	0.45	0.78	0.99	1.59	0.65
S22	0.523	0.56	0.68	0.64	0.44	0.2	0.45	0.79	1.01	1.61	0.62
S23	0.53	0.54	0.67	0.65	0.44	0.19	0.45	0.78	0.97	1.73	0.64
S24	0.53	0.54	0.69	0.64	0.43	0.18	0.45	0.81	0.94	1.67	0.59
S25	0.52	0.57	0.69	0.63	0.43	0.21	0.46	0.8	1.03	1.65	0.57
S26	0.59	0.6	0.7	0.7	0.48	0.19	0.47	0.82	1.14	1.52	0.65
S27	0.54	0.55	0.65	0.65	0.44	0.2	0.44	0.74	1.02	1.82	0.57
S28	0.53	0.54	0.62	0.66	0.44	0.19	0.44	0.76	0.98	1.74	0.53
S29	0.66	0.71	0.85	0.72	0.5	0.23	0.52	0.94	1.24	1.86	0.71
S30	0.58	0.59	0.71	0.68	0.42	0.19	0.43	0.81	1.03	1.54	0.58
S31	0.68	0.7	0.84	0.74	0.52	0.24	0.52	0.95	1.29	1.94	0.72
S32	0.62	0.7	0.85	0.7	0.51	0.25	0.5	0.93	1.32	1.97	0.70
S33	0.75	0.89	1.14	0.9	0.66	0.29	0.68	1.1	1.45	2.32	1.16
S34	0.84	0.9	1.17	0.9	0.66	0.28	0.67	1.09	1.42	2.28	1.11
S35	0.73	0.79	1.02	0.83	0.58	0.3	0.61	1.06	1.46	2.91	0.92
S36	0.73	0.81	1.01	0.82	0.55	0.28	0.63	1.03	1.58	2.70	0.86
S37	0.58	0.64	0.8	0.67	0.52	0.26	0.48	0.8	1.21	2.07	0.65
S38	0.63	0.64	0.8	0.67	0.52	0.26	0.52	0.83	1.36	2.04	0.63
S39	0.62	0.63	0.84	0.68	0.51	0.25	0.51	0.84	1.33	2.00	0.61
S40	0.74	0.84	1.05	0.82	0.65	0.29	0.69	1.06	1.46	1.17	0.99



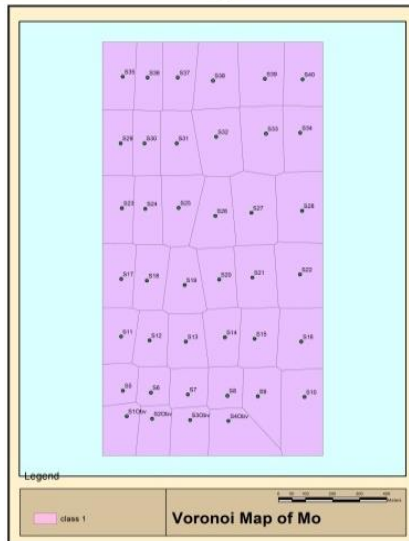
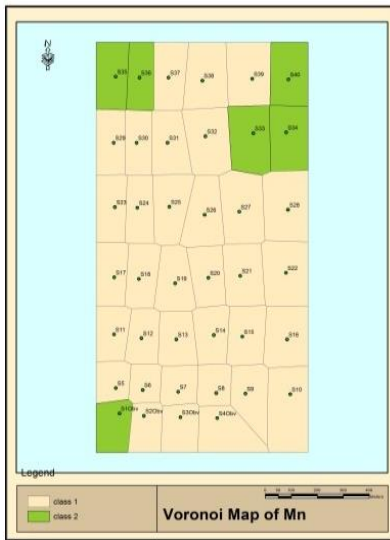
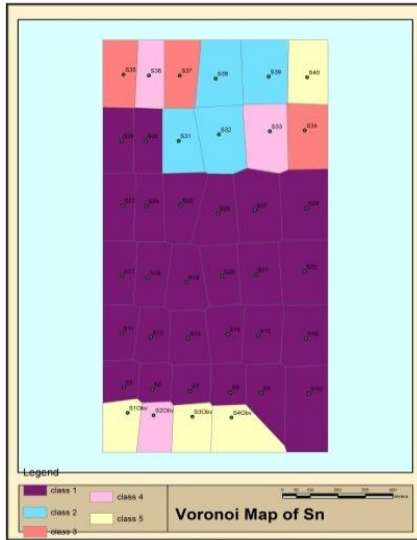




Figure4) Heavy metals zoning according to EF index using Voronoi method in GIS