EUREGEO 2012
European regions
for earth sciences

SPATIAL DISTRIBUTION OF BACKGROUND AND ANOMALOUS POPULATION OF CHROME IN STREAM SEDIMENTS ON TUSCAN-EMILIAN APENNINES BASED ON THRESHOLDS DEFINED FROM CONTINUOUS AND DISCRETE CATCHMENT BASIN SURFACE OF THE CR DATA.

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OpenGeoData ITALIA
Liberiamo i dati geografici

Bologna, 14 june 2012

Introduction:

- The definition of background and anomalous values is a fundamental issue.

  How dividing a geochemical data set?

  Which are the number of classes?

  Which of these classes represent presence of mineralization in a study area?

- The choice of methods depends on the distribution pattern of the data sets.

  Which kind of frequency distribution will be expected?

  How data values shold be treated?

- It can be useful to consider that geochemical landscapes have spatial variability, geometrical properties and scale-invariant charateristics (Li et al, 2003).

  Which kind of technique takes into account such attributes of geochemical landscapes?

Background or anomaly???

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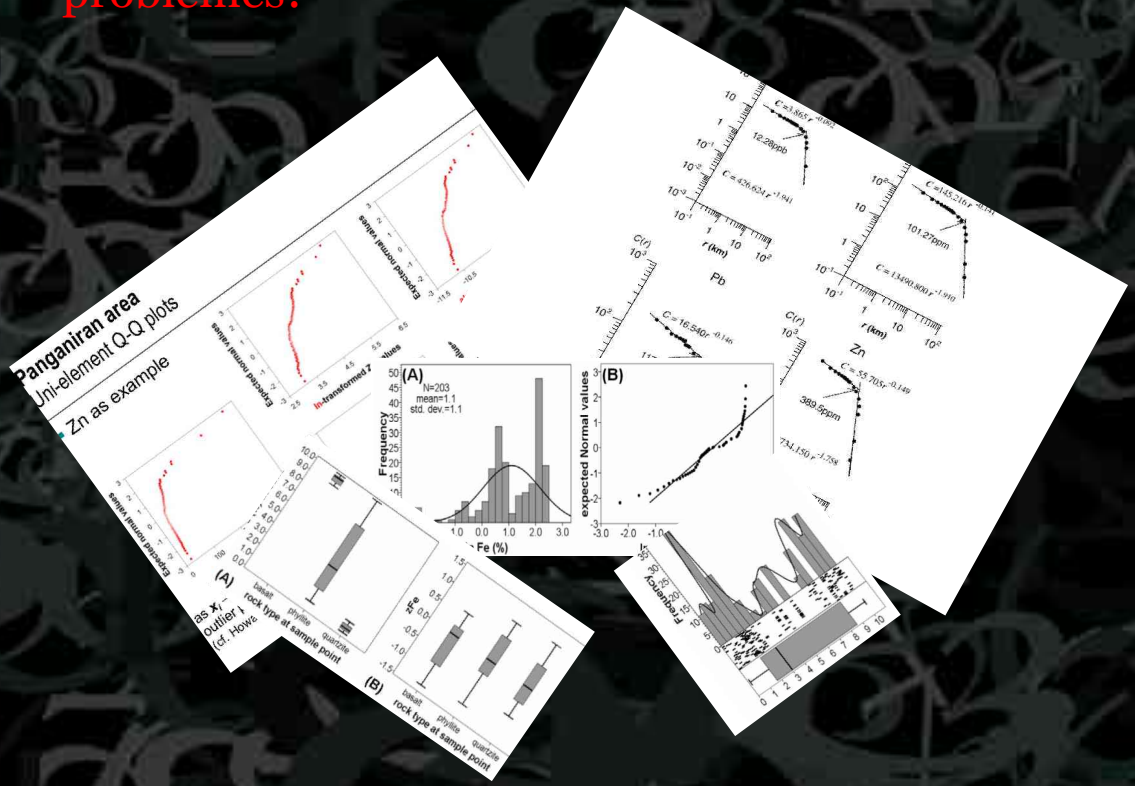
Introduction:

- Can statistics methods help to solve these problemes?



Don't worry!!!
Be statistical!

- Recently, some authors (Reimann & Filzmoser, 2000; Reimann et al, 2005, Reimann, 2005) have been improving various statistical methods.

Can we trust in statistics?

"To trust is good but don't trust is better!"

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Objectives:

- Analyze frequency distribution of geochemical data and select some mapping techniques
- Compare threshold values derived from continuous and discrete field models of stream sediment geochemical landscapes.
- Discuss about limit between anomaly and background values.

Let's go!!!

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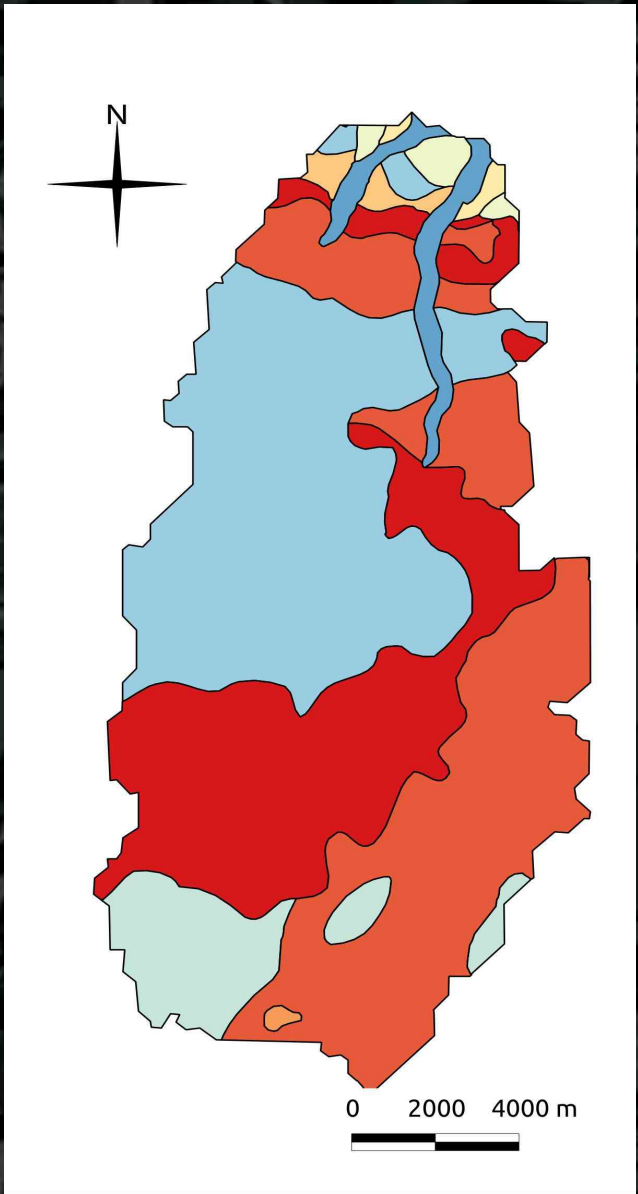
Study area

Area: 207 km^2
Province: Bologna
Municipalities: Loiano, Pianoro
Monzuno

Lithology



Fonte: Catalogo dati geografici del Servizio Geologico Sismico e dei suoli della Regione Emilia Romagna http://geo.regione.emilia-romagna.it/geocatalogo/

- *Areniti e peliti*
- *Argille, argilliti e brecce argillose, marne, arenarie e ofioliti*
- *Gabbri, basalti, serpentiniti, rari graniti e brecce*
- *Gessi, gessoruditi e calcari evaporitici*
- *Ghiaie e sabbie - Depositi di conoide e di terrazzo*
- *Ghiaie, sabbie, limi e limi argillosi - Depositi alluvionali indifferenziati*
- *Marne, argille e calcari*
- *Sabbie ed areniti*
- *Sabbie, limi sabbiosi e limi - Depositi di conoide e di terrazzo*

The area is located in a particular geological site between Tuscan Emilian Apennines and Romagna Apennines characterized by the presence of typical formations (Desio, 1973):

- Formazione delle argille azzurre (Calabriano-Zancleano);
- Formazione a colombacci (Messiniano);
- Formazione gessoso-solfifera (Messiniano-Tortoniano);
- Formazione marnoso arenacea (Tortoniano-Langhiano);
- Depositi epiliguridi (Langhiano-Burdigaliano).

Lithology consists mostly of sedimentary rocks, spanning from the Triassic to the recent age that include:

- stratigraphic Mesozoic units, made up of calcareous-marly and marly-arenaceous-pelitic turbidites,
- detrital and organogenic limestones.
- marly limestones, marls, pelites, sands and conglomerates

(Geological Survey of Italy, 2011).

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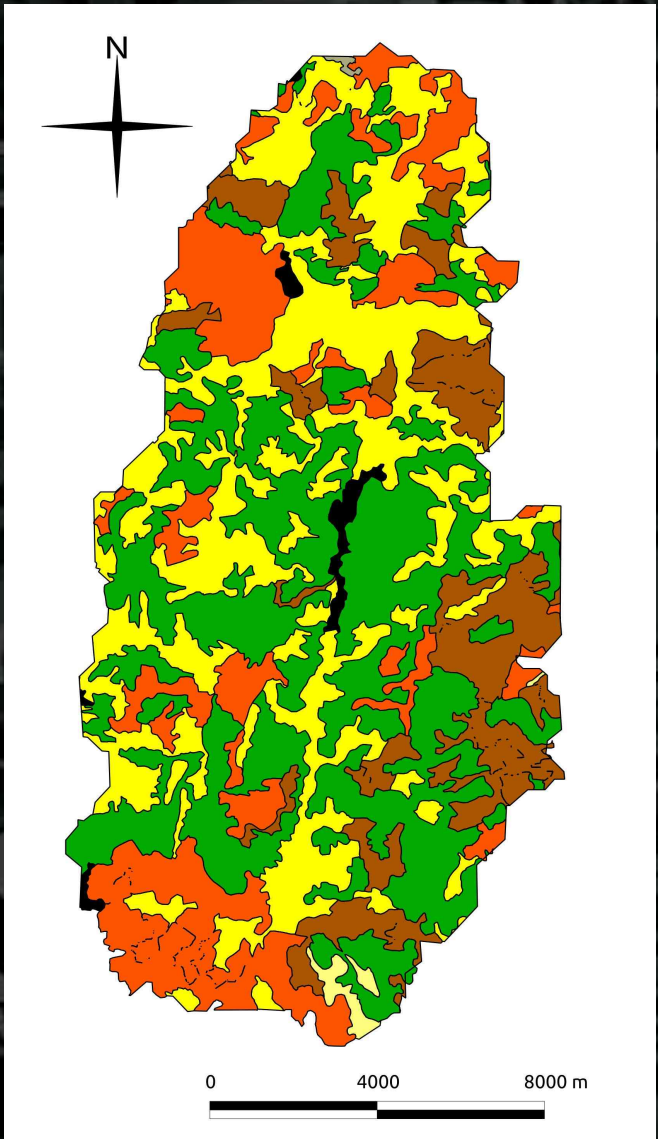
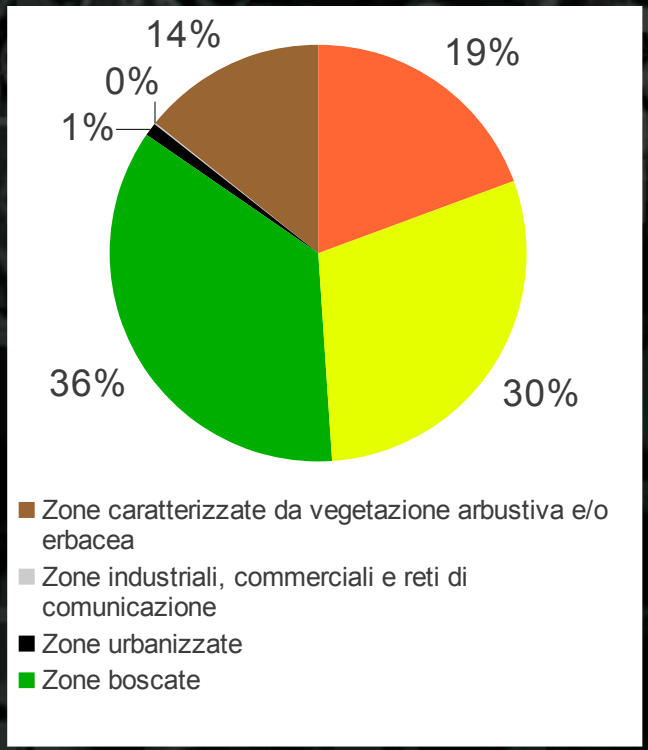
Land Use





Fonte: European Environmental Agency. Corine Lan Cover 2008
http://www.eea.europa.eu/data-and-maps/data/clc-2006-vector-data-version

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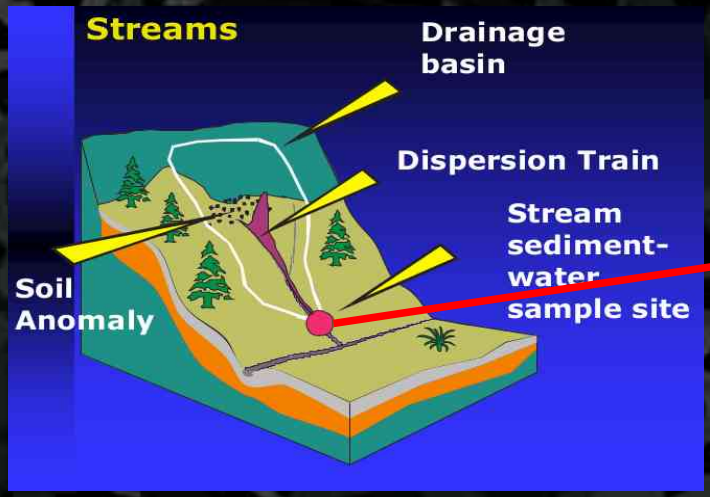
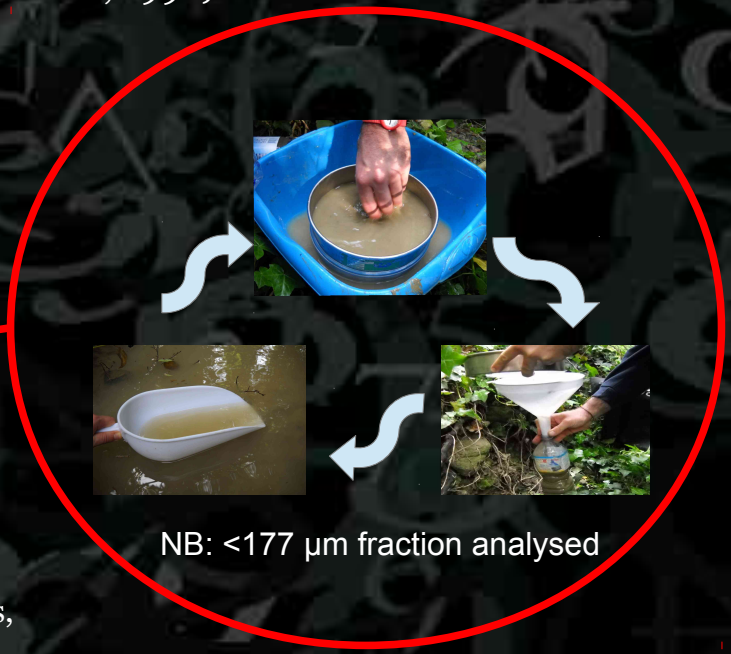
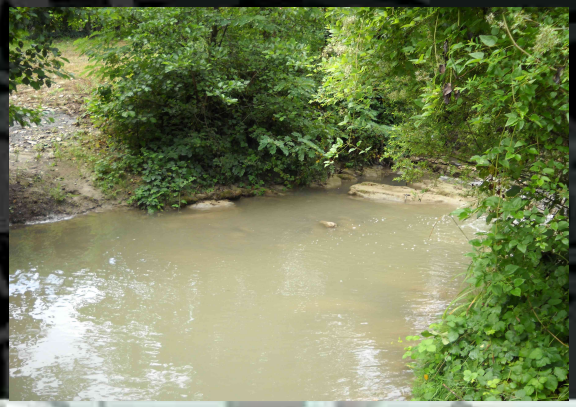
What kind of sampling?

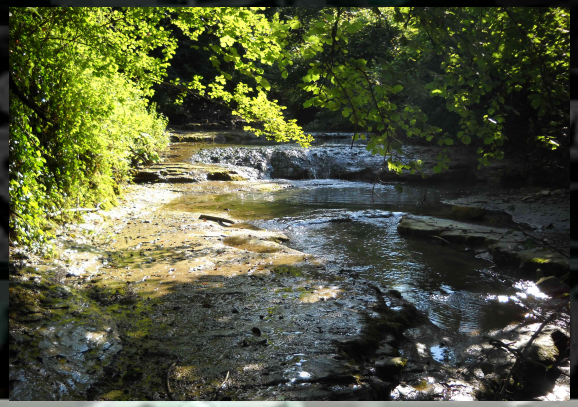
In exploration and environmental geochemistry, one of the most commonly used method of prospecting is based on the study of active stream sediments (Carranza, 2004). They can be considered as averagely representative of the outcropping rocks in the drainage basin, upstream of the sampling point (Webb et al., 1978; Meyer et al., 1979, Bölviken et al., 1986; Lahermo et al., 1996)

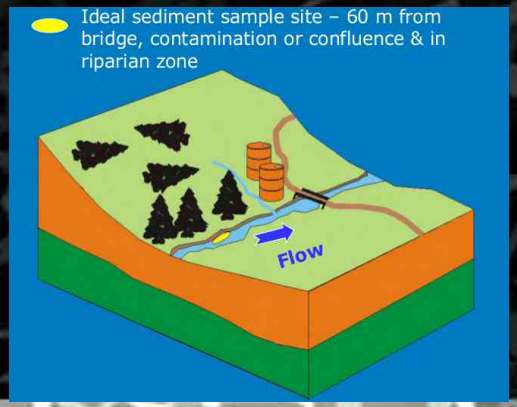




Lett E.R., 2007. Drainage Geochemical Surveys - Stream Sediments, Lake Sediment, Moss Mats, Heavy Minerals







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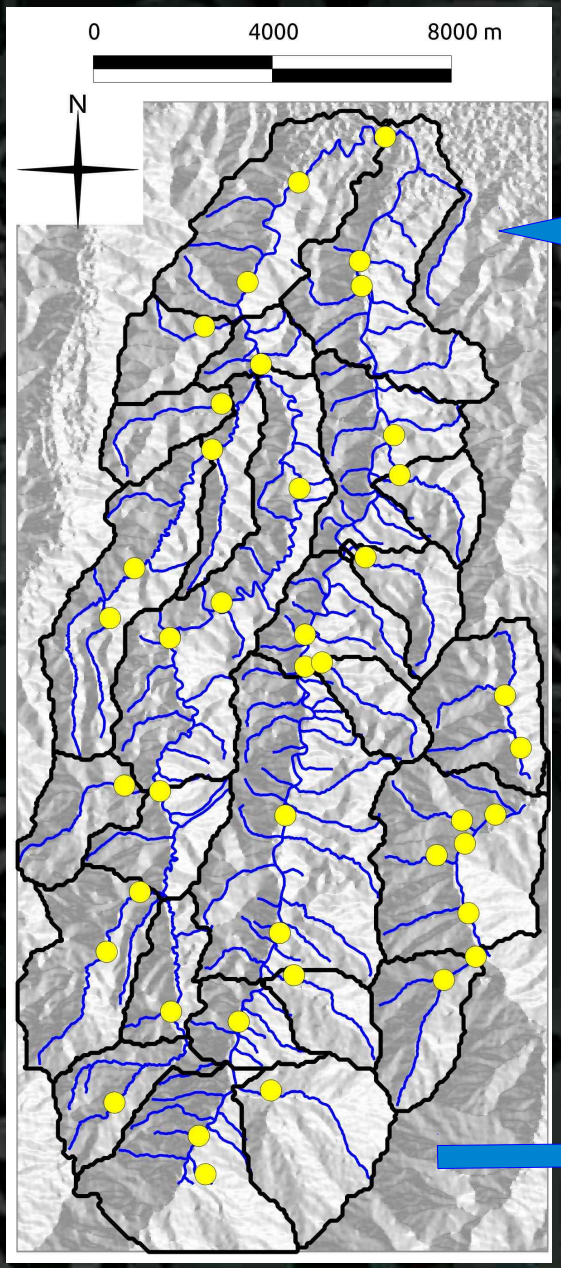
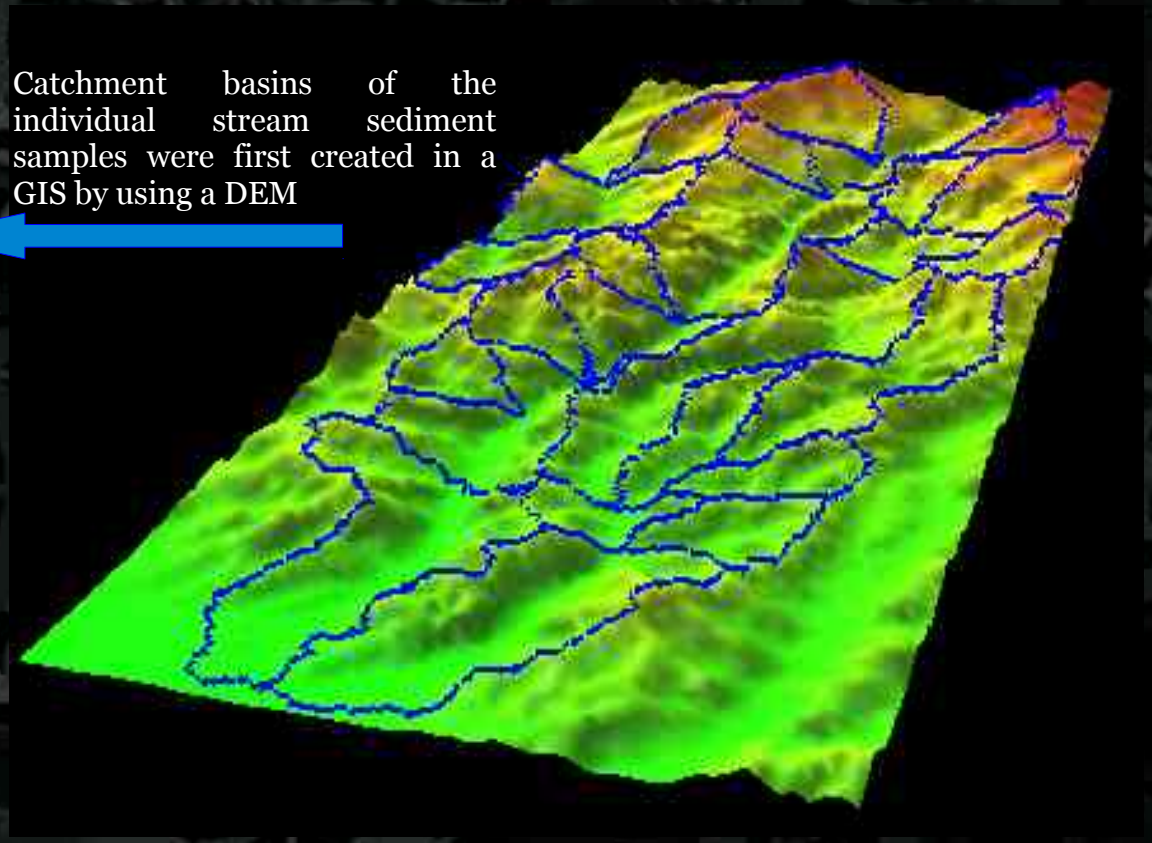
Extraction of catchment basins



Catchment basins of the individual stream sediment samples were first created in a GIS by using a DEM



- 42 Stream sediment Sample

Sampling was organized by choosing at least one sediment sample for each river basin.

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Laboratory analysis

First step



Fragmentation of stream sediment samples

Second step



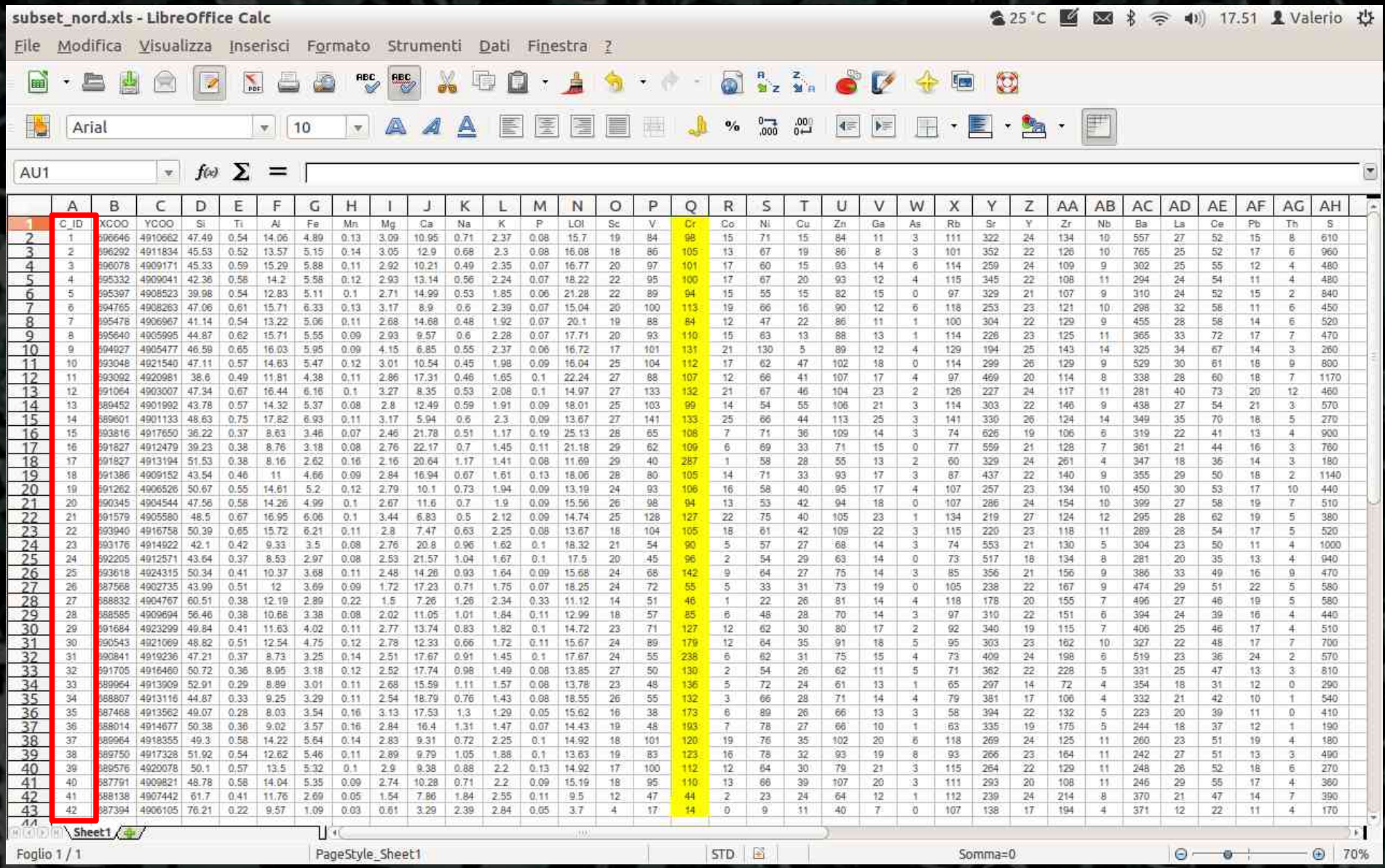
Preparation of tablets for XRF analysis

Third step



XRF analysis (35 elements) LOI Computer computing

Database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File Modifica Visualizza Inserisci Formato Strumenti Dati Finestra ?

Arial 10

AU1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH
1	C_ID	XCOO	YCOO	Si	Ti	Al	Fe	Mn	Mg	Ca	Na	K	P	LOI	Sc	V	Cr	Co	Ni	Cu	Zn	Ga	As	Rb	Sr	Y	Zr	Nb	Ba	La	Ce	Pb	Th	S
2	1	396646	4910662	47.49	0.54	14.06	4.89	0.13	3.09	10.95	0.71	2.37	0.08	15.7	19	84	98	15	71	15	84	11	3	111	322	24	134	10	557	27	52	15	8	610
3	2	396292	4911834	45.53	0.52	13.57	5.15	0.14	3.05	12.9	0.68	2.3	0.08	16.08	18	86	105	13	67	19	86	8	3	101	352	22	126	10	765	25	52	17	6	960
4	3	396078	4909171	45.33	0.59	15.29	5.88	0.11	2.92	10.21	0.49	2.35	0.07	16.77	20	97	101	17	60	15	93	14	6	114	259	24	109	9	302	25	55	12	4	480
5	4	395332	4909041	42.36	0.58	14.2	5.58	0.12	2.93	13.14	0.56	2.24	0.07	18.22	22	95	100	17	67	20	93	12	4	115	345	22	108	11	294	24	54	11	4	480
6	5	395397	4908523	39.98	0.54	12.83	5.11	0.1	2.71	14.99	0.53	1.85	0.06	21.28	22	89	94	15	55	15	82	15	0	97	329	21	107	9	310	24	52	15	2	840
7	6	394765	4908263	47.06	0.61	15.71	6.33	0.13	3.17	8.9	0.6	2.39	0.07	15.04	20	100	113	19	66	16	90	12	6	118	253	23	121	10	298	32	58	11	6	450
8	7	395478	4906967	41.14	0.54	13.22	5.06	0.11	2.68	14.68	0.48	1.92	0.07	20.1	19	88	84	12	47	22	86	11	1	100	304	22	129	9	455	28	58	14	6	520
9	8	395640	4905995	44.87	0.62	15.71	5.55	0.09	2.93	9.57	0.6	2.28	0.07	17.71	20	93	110	15	63	13	88	13	1	114	226	23	125	11	365	33	72	17	7	470
10	9	394027	4905477	46.59	0.65	16.03	5.95	0.09	4.15	6.85	0.55	2.37	0.06	16.72	17	101	131	21	130	5	89	12	4	129	194	25	143	14	325	34	67	14	3	260
11	10	393048	4921540	47.11	0.57	14.63	5.47	0.12	3.01	10.54	0.45	1.98	0.09	16.04	25	104	112	17	62	47	102	18	0	114	299	26	129	9	529	30	61	18	9	800
12	11	393092	4920981	38.6	0.49	11.81	4.38	0.11	2.86	17.31	0.46	1.65	0.1	22.24	27	88	107	12	66	41	107	17	4	97	469	20	114	8	338	28	60	18	7	1170
13	12	391064	4903007	47.34	0.67	16.44	6.16	0.1	3.27	8.35	0.53	2.08	0.1	14.97	27	133	132	21	67	46	104	23	2	126	227	24	117	11	281	40	73	20	12	460
14	13	389452	4901992	43.78	0.57	14.32	5.37	0.08	2.8	12.49	0.59	1.91	0.09	18.01	25	103	99	14	54	55	106	21	3	114	303	22	146	9	438	27	54	21	3	570
15	14	389601	4901133	48.63	0.75	17.82	6.93	0.11	3.17	5.94	0.6	2.3	0.09	13.67	27	141	133	25	66	44	113	25	3	141	330	26	124	14	349	35	70	18	5	270
16	15	393816	4917650	36.22	0.37	8.63	3.46	0.07	2.46	21.78	0.51	1.17	0.19	25.13	28	65	108	7	71	36	109	14	3	74	626	19	106	6	319	22	41	13	4	900
17	16	391827	4912479	39.23	0.38	8.76	3.18	0.08	2.76	22.17	0.7	1.45	0.11	21.18	29	62	109	6	69	33	71	15	0	77	559	21	128	7	361	21	44	16	3	760
18	17	391827	4913194	51.53	0.38	8.16	2.62	0.16	2.16	20.64	1.17	1.41	0.08	11.69	29	40	287	1	58	28	55	13	2	60	329	24	261	4	347	18	36	14	3	180
19	18	391386	4909152	43.54	0.46	11	4.66	0.09	2.84	16.94	0.67	1.61	0.13	18.06	28	80	105	14	71	33	93	17	3	87	437	22	140	9	355	29	50	18	2	1140
20	19	391262	4906526	50.67	0.55	14.61	5.2	0.12	2.79	10.1	0.73	1.94	0.09	13.19	24	93	106	16	58	40	95	17	4	107	257	23	134	10	450	30	53	17	10	440
21	20	390345	4904544	47.56	0.58	14.26	4.99	0.1	2.67	11.6	0.7	1.9	0.09	15.56	26	98	94	13	53	42	94	18	0	107	286	24	154	10	399	27	58	19	7	510
22	21	391579	4905580	48.5	0.67	16.95	6.06	0.1	3.44	6.83	0.5	2.12	0.09	14.74	25	128	127	22	75	40	105	23	1	134	219	27	124	12	295	28	62	19	5	380
23	22	393940	4916758	50.39	0.65	15.72	6.21	0.11	2.8	7.47	0.63	2.25	0.08	13.67	18	104	105	18	61	42	109	22	3	115	220	23	118	11	289	28	54	17	5	520
24	23	393176	4914922	42.1	0.42	9.33	3.5	0.08	2.76	20.8	0.96	1.62	0.1	18.32	21	54	90	5	57	27	68	14	3	74	553	21	130	5	304	23	50	11	4	1000
25	24	392205	4912571	43.64	0.37	8.53	2.97	0.08	2.53	21.57	1.04	1.67	0.1	17.5	20	45	96	2	54	29	63	14	0	73	517	18	134	8	281	20	35	13	4	940
26	25	393618	4924315	50.34	0.41	10.37	3.68	0.11	2.48	14.26	0.93	1.64	0.09	15.68	24	68	142	9	64	27	75	14	3	85	356	21	156	9	386	33	49	16	9	470
27	26	387568	4902735	43.99	0.51	12	3.69	0.09	1.72	17.23	0.71	1.75	0.07	18.25	24	72	55	5	33	31	73	19	0	105	238	22	167	9	474	29	51	22	5	580
28	27	388832	4904767	60.51	0.38	12.19	2.89	0.22	1.5	7.26	1.26	2.34	0.33	11.12	14	51	46	1	22	26	81	14	4	118	178	20	155	7	496	27	46	19	5	580
29	28	388585	4909694	56.46	0.38	10.68	3.38	0.08	2.02	11.05	1.01	1.84	0.11	12.99	18	57	85	6	48	28	70	14	3	97	310	22	151	6	394	24	39	16	4	440
30	29	391684	4923299	49.84	0.41	11.63	4.02	0.11	2.77	13.74	0.83	1.82	0.1	14.72	23	71	127	12	62	30	80	17	2	92	340	19	115	7	406	25	46	17	4	510
31	30	390543	4921069	48.82	0.51	12.54	4.75	0.12	2.78	12.33	0.66	1.72	0.11	15.67	24	89	179	12	64	35	91	18	5	95	303	23	162	10	327	22	48	17	7	700
32	31	390841	4919236	47.21	0.37	8.73	3.25	0.14	2.51	17.67	0.91	1.45	0.1	17.67	24	55	238	6	62	31	75	15	4	73	409	24	198	6	519	23	36	24	2	570
33	32	391705	4916460	50.72	0.36	8.95	3.18	0.12	2.52	17.74	0.98	1.49	0.08	13.85	27	50	130	2	54	26	62	11	5	71	362	22	228	5	331	25	47	13	3	810
34	33	389964	4913909	52.91	0.29	8.89	3.01	0.11	2.68	15.59	1.11	1.57	0.08	13.78	23	48	136	5	72	24	61	13	1	65	297	14	72	4	354	18	31	12	0	290
35	34	388807	4913116	44.87	0.33	9.25	3.29	0.11	2.54	18.79	0.76	1.43	0.08	18.55	26	55	132	3	66	28	71	14	4	79	381	17	106	4	332	21	42	10	1	540
36	35	387468	4913562	49.07	0.28	8.03	3.54	0.16	3.13	17.53	1.3	1.29	0.05	15.62	16	38	173	6	89	26	66	13	3	58	394	22	132	5	223	20	39	11	0	410
37	36	388014	4914677	50.38	0.36	9.02	3.57	0.16	2.84	16.4	1.31	1.47	0.07	14.43	19	48	193	7	78	27	66	10	1	63	335	19	175	5	244	18	37	12	1	190
38	37	389964	4918355	49.3	0.58	14.22	5.64	0.14	2.83	9.31	0.72	2.25	0.1	14.92	18	101	120	19	76	35	102	20	6	118	269	24	125	11	260	23	51	19	4	180
39	38	389750	4917328	51.92	0.54	12.62	5.46	0.11	2.89	9.79	1.05	1.88	0.1	13.63	19	83	123	16	78	32	93	19	8	93	266	23	164	11	242	27	51	13	3	490
40	39	389576	4920078	50.1	0.57	13.5	5.32	0.1	2.9	9.38	0.88	2.2	0.13	14.92	17	100	112	12	64	30	79	21	3	115	264	22	129	11	248	26	52	18	6	270
41	40	387791	4909821	48.78	0.58	14.04	5.35	0.09	2.74	10.28	0.71	2.2	0.09	15.19	18	95	110	13	66	39	107	20	3	111	293	20	108	11	246	29	55	17	4	360
42	41	388138	4907442	61.7	0.41	11.76	2.69	0.05	1.54	7.86	1.84	2.55	0.11	9.5	12	47	44	2	23	24	64	12	1	112	239	24	214	8	370	21	47	14	7	390
43	42	387394	4906105	76.21	0.22	9.57	1.09	0.03	0.61	3.29	2.39	2.84	0.05	3.7	4	17	14	0	9	11	40	7	0	107	138	17	194	4	371	12	22	11	4	170

Sheet1

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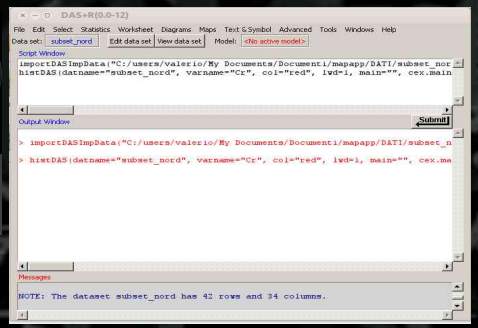
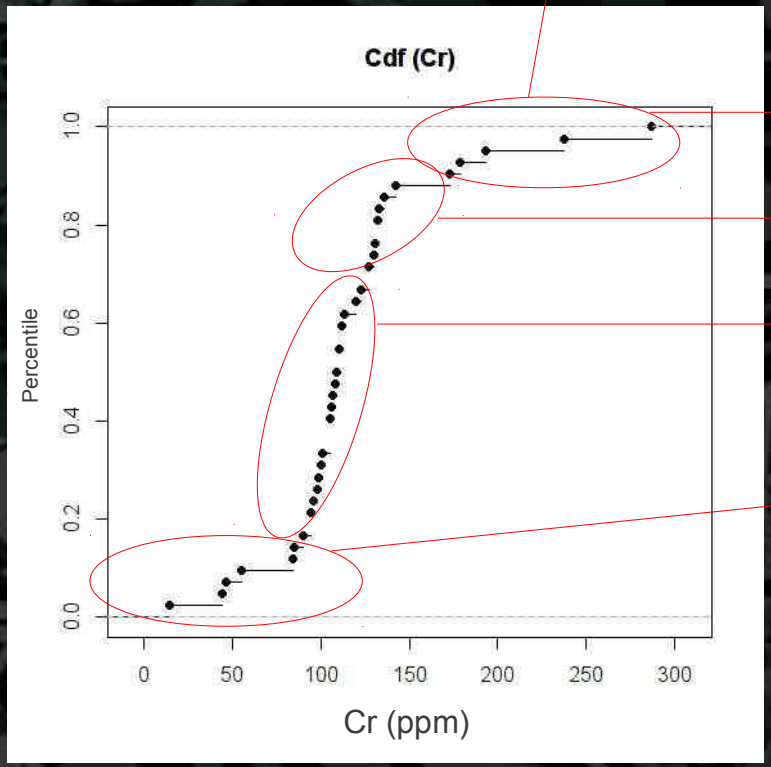
Statistical analysis: frequency distribution



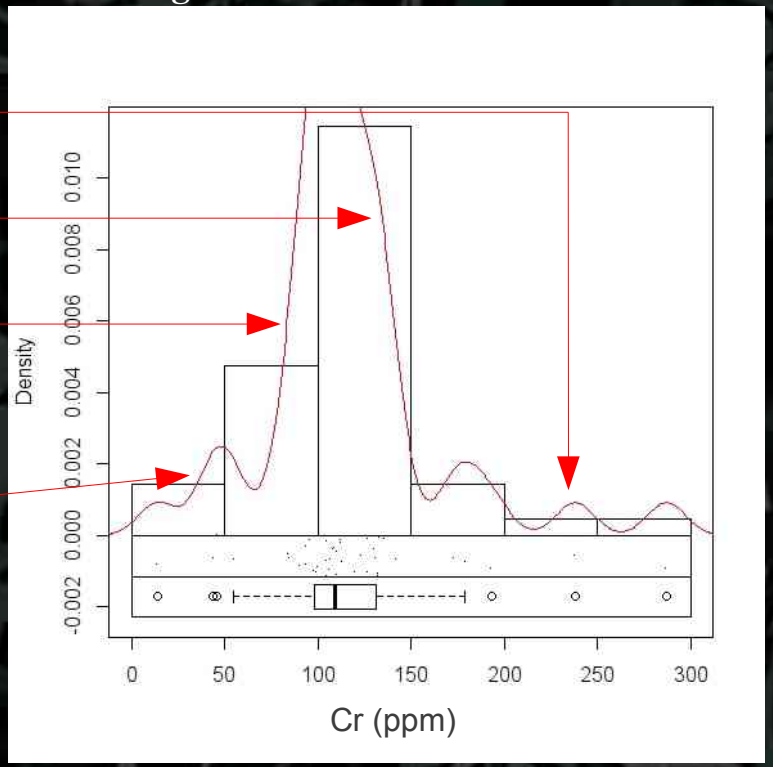
The empirical frequency distributions of measured point values show varying degrees of skewness, implying the presence of multiple and intertwined geochemical populations.

Mapping of anomalies in geochemical data sets containing multiple populations can be facilited by application of probability plot (Sinclair, 1974, 1991).

These plots suggests that geochemical landscapes based on this stream sediment geochemical data are multifractals.



Empirical frequency distributions of point values in selected stream sediment geochemical data



EDA graphics (density trace, jittered one-dimensional scatterplot,boxplot) depicting the empirical density distribution of the soil Fe data

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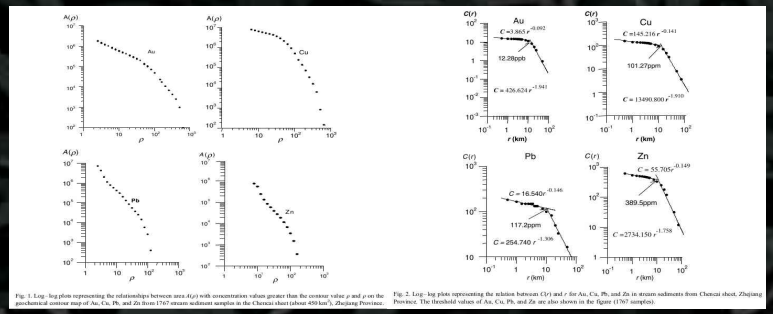
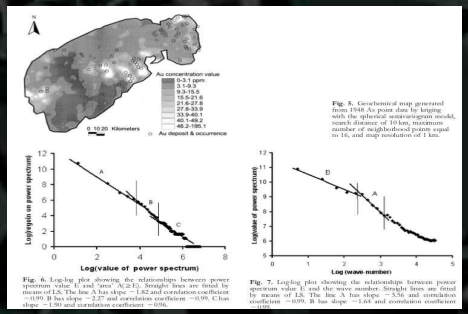
Which kind of mapping techniques?

Several authors have postulated that geochemical landscapes based on stream sediment geochemical data are multifractals (Bölviken et al. 1992; Cheng et al.1996; Cheng 1999; Agterberg 2001; Rantitsch 2001; Li et al. 2002; Shen & Cohen 2005; Carranza,2009). Among these workers, some authors have tried to model geochemical landscapes in different ways:

- Cheng (1999) modelled geochemical landscapes as continuous fields by contouring stream sediment geochemical data and then mapped geochemical anomalies by application of the C-A fractal method (Cheng et al. 1994).

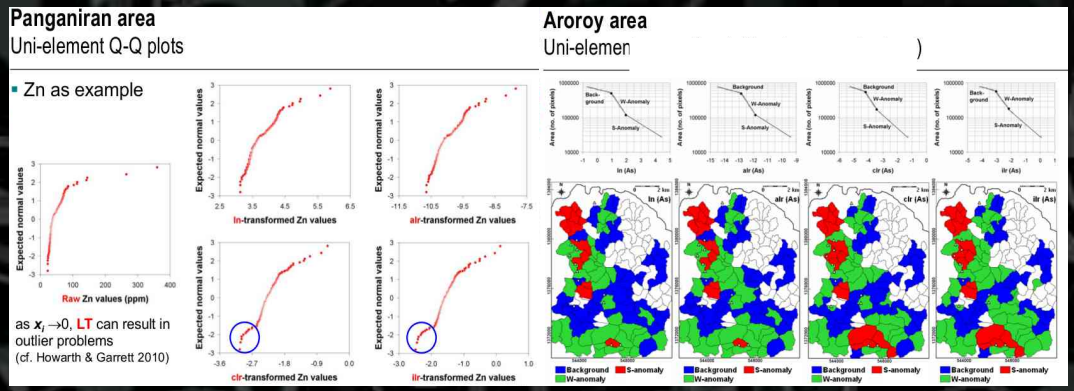


"Application of a fractal method relating concentrations and distances for separation of geochemical anomalies from background". Li, Ma and Shi, 2003.



"A fractal filtering technique for processing regional geochemical maps for mineral exploration". Xu & Cheng, Geochemistry: Exploration, Environment, Analysis, Vol. 1 2001, pp. 147–156

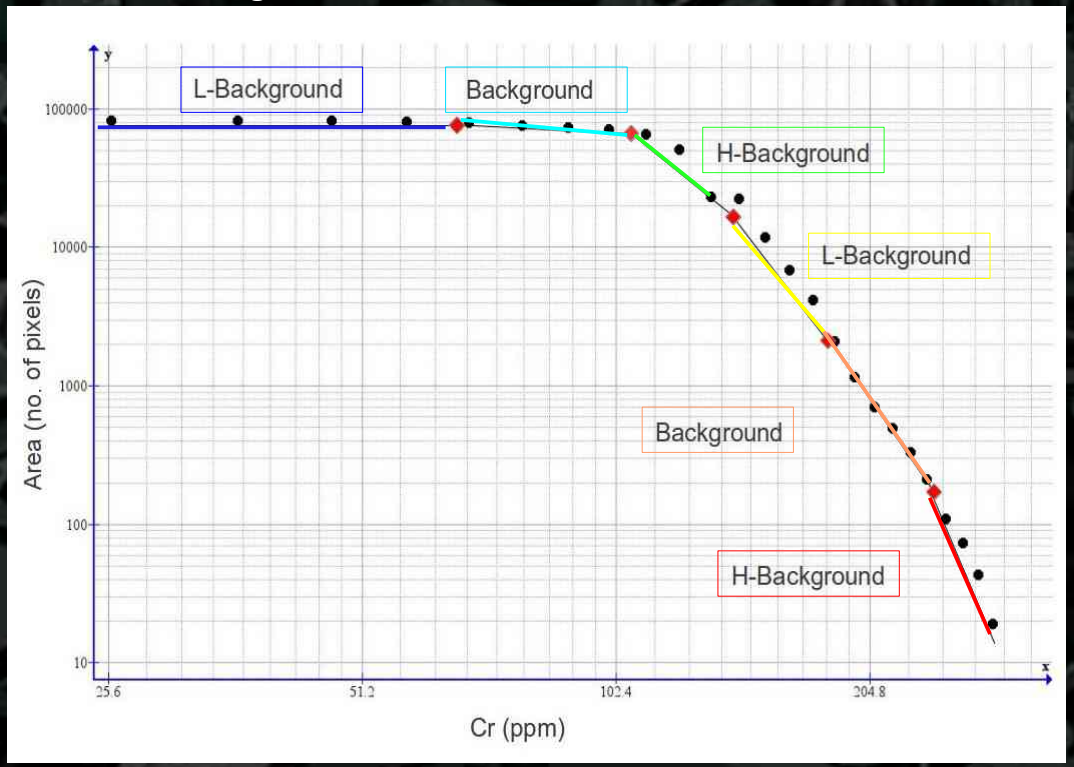
- Carranza (2009) modelled geochemical landscapes as discrete fields by attributing stream sediment geochemical data to their sample catchment basins and then mapped geochemical anomalies by application of C-A fractal method.



"Analysis and mapping of stream sediment geochemical anomalies: should we logratio-transform the data?". Carranza, 2007.

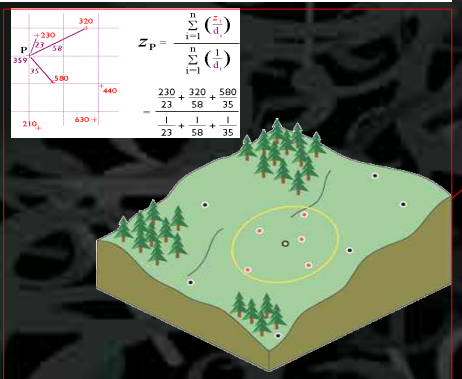
Log-log plot of point values: C-A method of continuous field model

In this study, the C–A fractal method (Cheng et al. 1994), was adopted in mapping of anomalies in the continuous and discrete field models of stream sediment geochemical landscapes using classes defined from analysis of empirical frequency distributions of point stream sediment geochemical data.

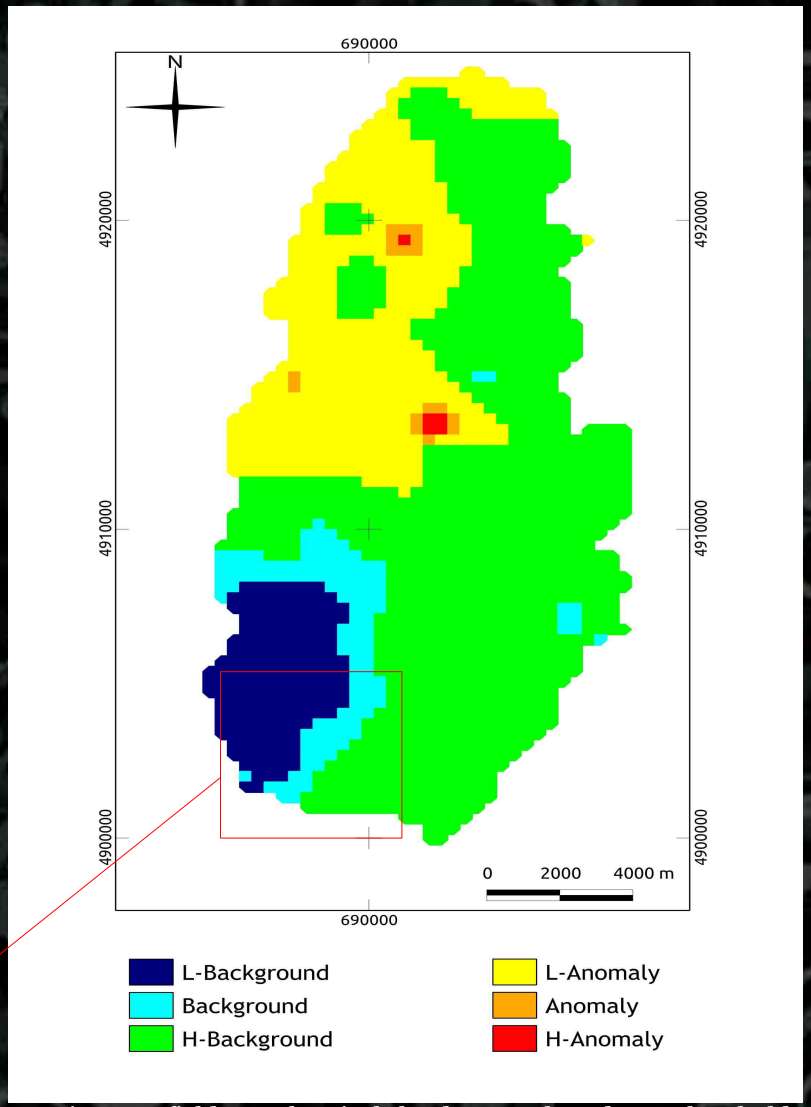


25 – 70	Low Background
71 – 94	Background
95 – 132	High Background
133 – 187	Low Anomaly
188 – 229	Anomaly
230 – 287	High Anomaly

Treshold values obtained by fitting of log-log graph

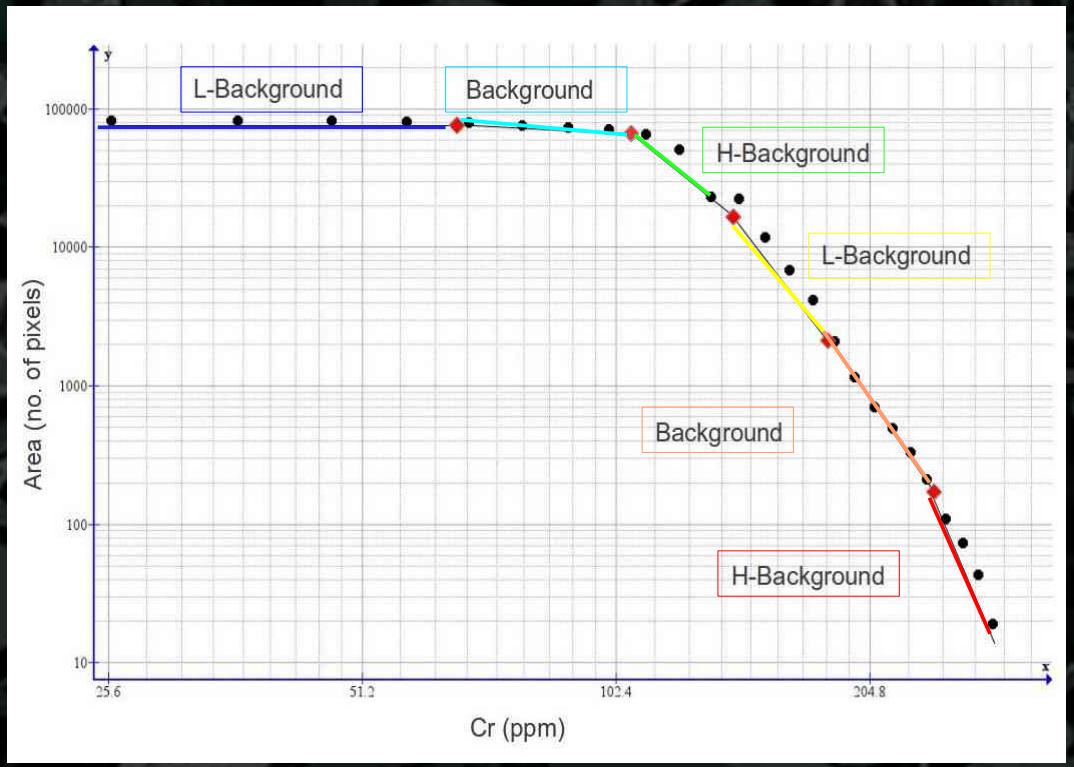


IDW Interpolation



Continuous field geochemical landscapes based on threshold values obtained via C-A analysis of concentration contours of point values.

Log-log plot of point values: C-A method of discrete field model



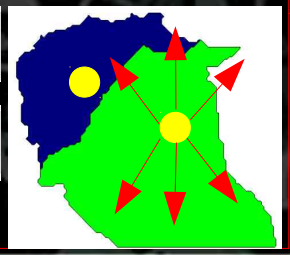
25 – 70	Low Background
71 – 94	Background
95 – 132	High Background
133 – 187	Low Anomaly
188 – 229	Anomaly
230 – 287	High Anomaly

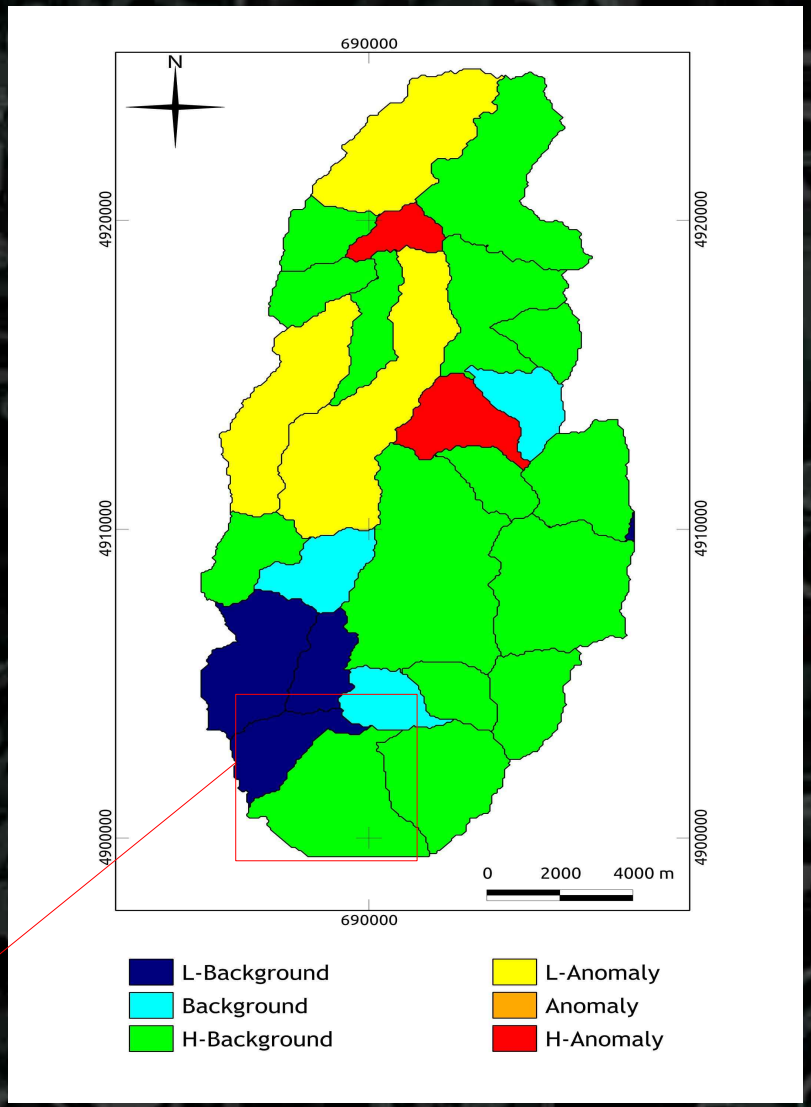
Treshold values obtained by fitting of log-log graph

Cr value of sample extended to catchment basin area

Bacino	Cr(ppm)
1	55
2	116

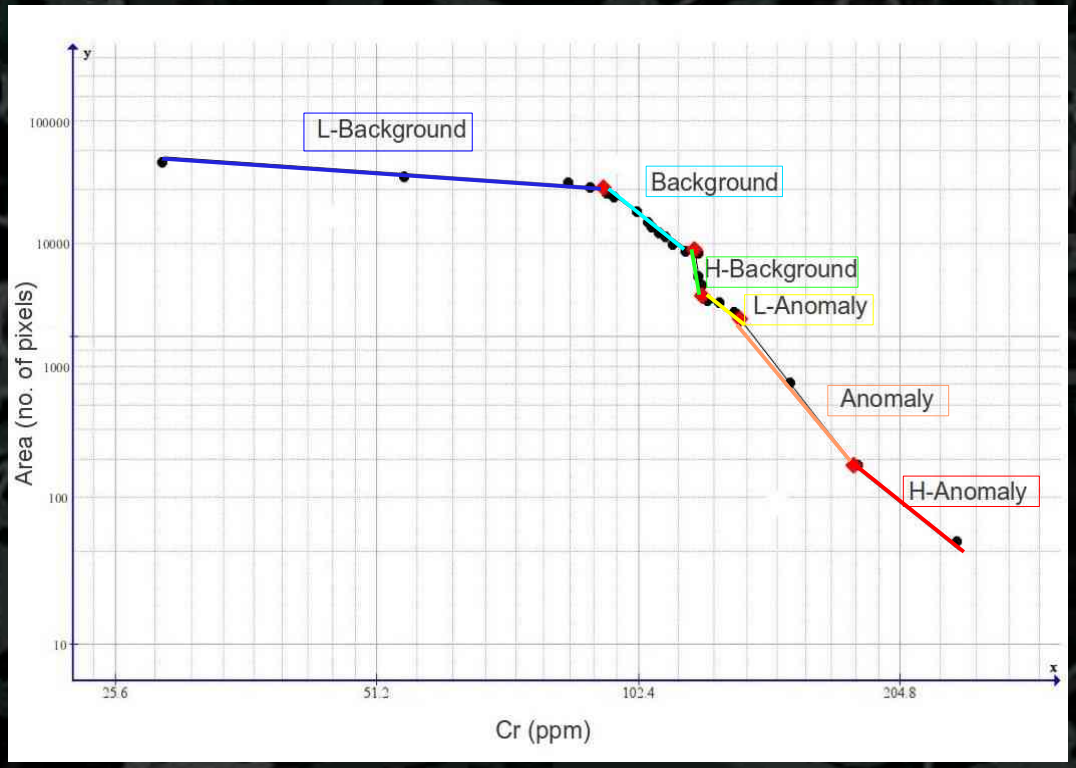
Sample	Cr(ppm)
1	55
2	116





Discrete field geochemical landscapes based on threshold values obtained via C-A analysis of concentration contours of point values.

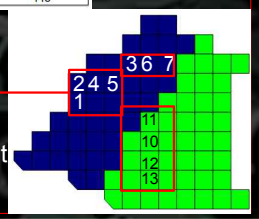
Log-log plot of pixel values: C-A method of discrete field model



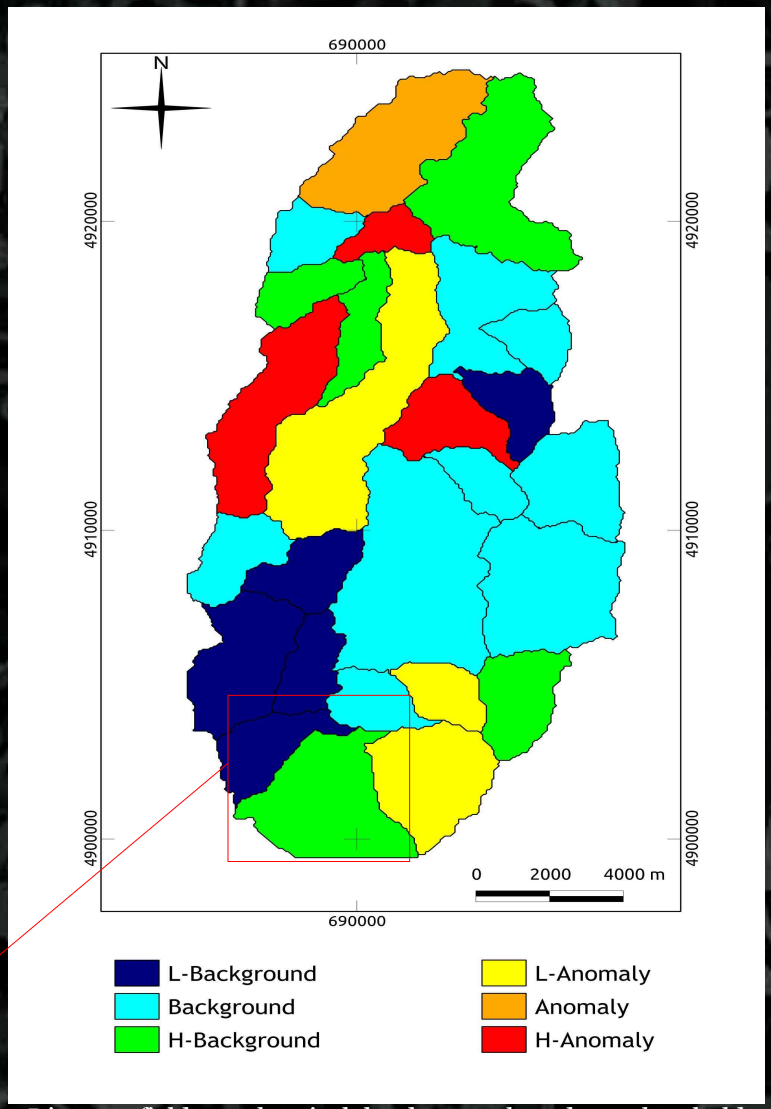
25 – 86	Low Background
87 – 117	Background
118 – 130	High Background
131 – 160	Low Anomaly
161 – 180	Anomaly
181 – 287	High Anomaly

Treshold values obtained by fitting of log-log graph

ID_pixel	Extension (m²)	Cr (ppm)
1	50	55
2	50	55
3	50	55
4	50	55
5	50	55
6	50	55
7	50	116
8	50	116
9	50	116
10	50	116
11	50	116
12	50	116
13	50	116
14	50	116
15	50	116



Sum of catchment basin pixel



Discrete field geochemical landscapes based on threshold values obtained via C-A analysis of concentration contours of pixel values.

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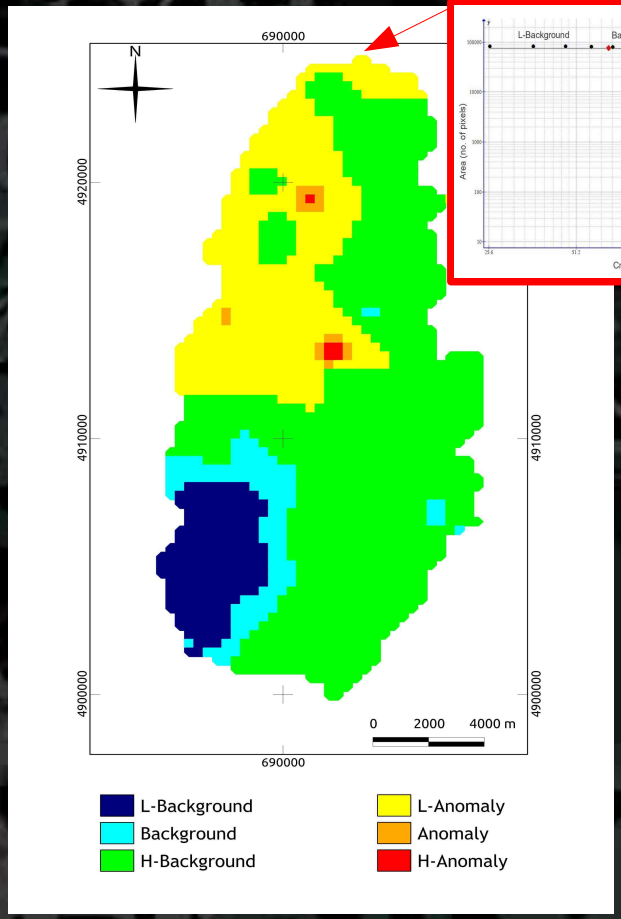
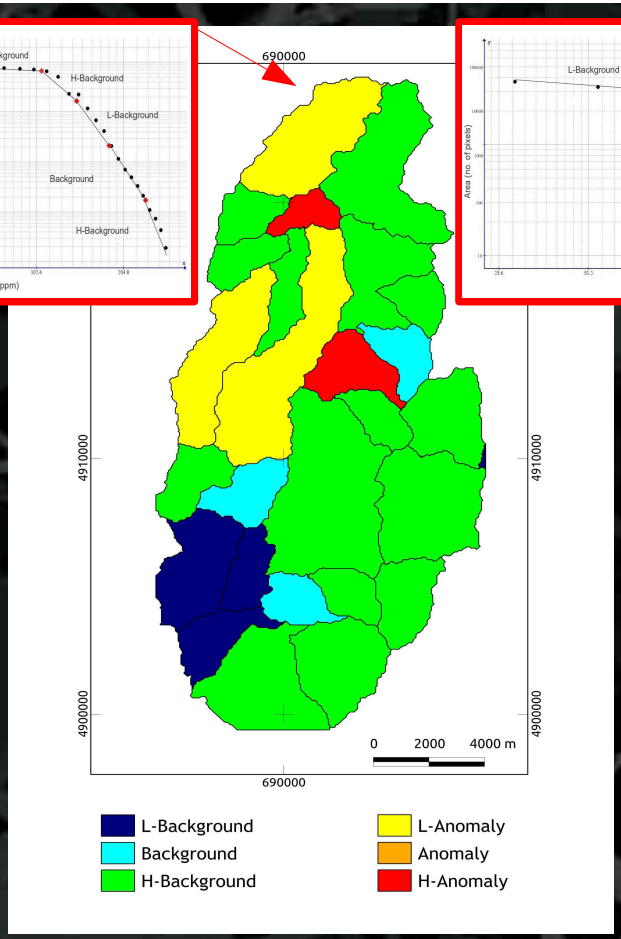
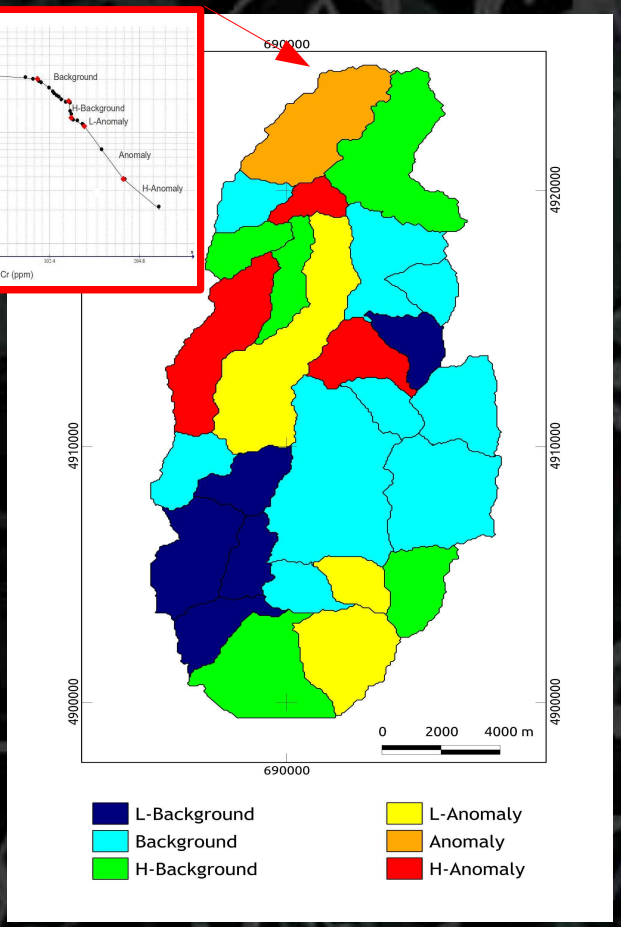
Geochemical variable	Range of concentration values in geochemical landscapes		Interpretations
	Continuous field models	Discrete field models	
Cr	25 - 70	25 – 86	Low background
	71 – 94	87 – 117	Background
	95 – 132	118 – 130	High Background
	133 – 187	131 – 160	Low anomly
	188 – 229	161 – 180	Anomaly
	230 – 287	181 – 287	High anomaly



Continuous field geochemical landscapes based on threshold values obtained via C-A analysis of concentration contours of point values.



Discrete field geochemical landscapes based on threshold values obtained via C-A analysis of concentration contours of point values.



Discrete field geochemical landscapes based on threshold values obtained via C-A analysis of concentration contours of pixel values.

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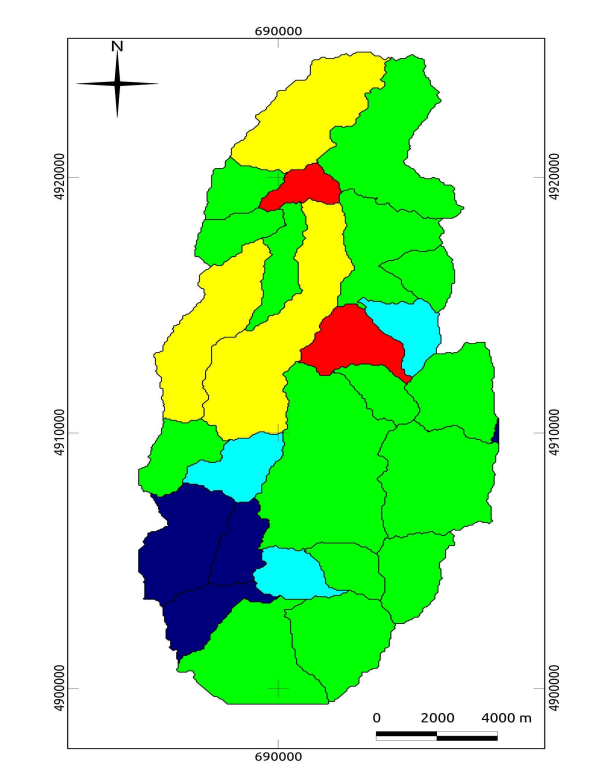
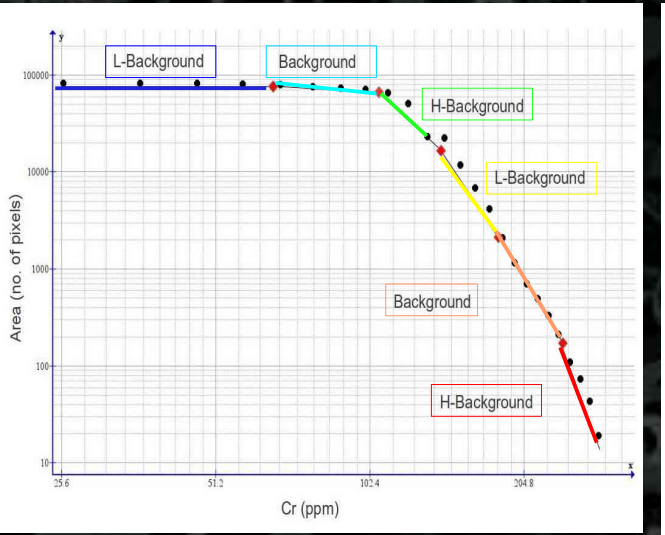
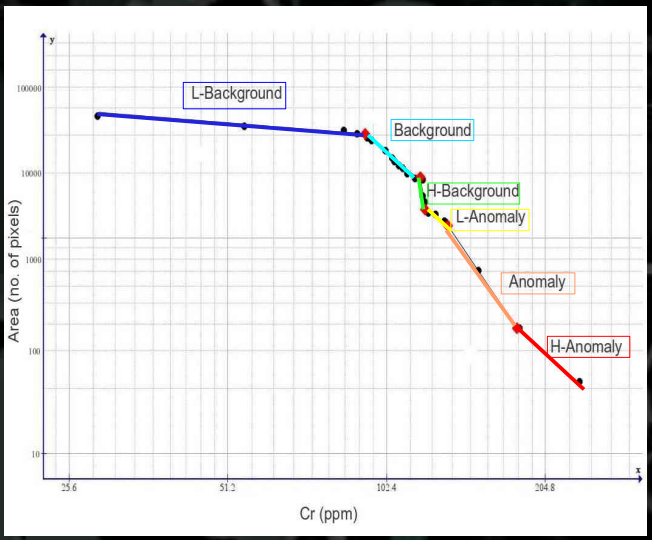
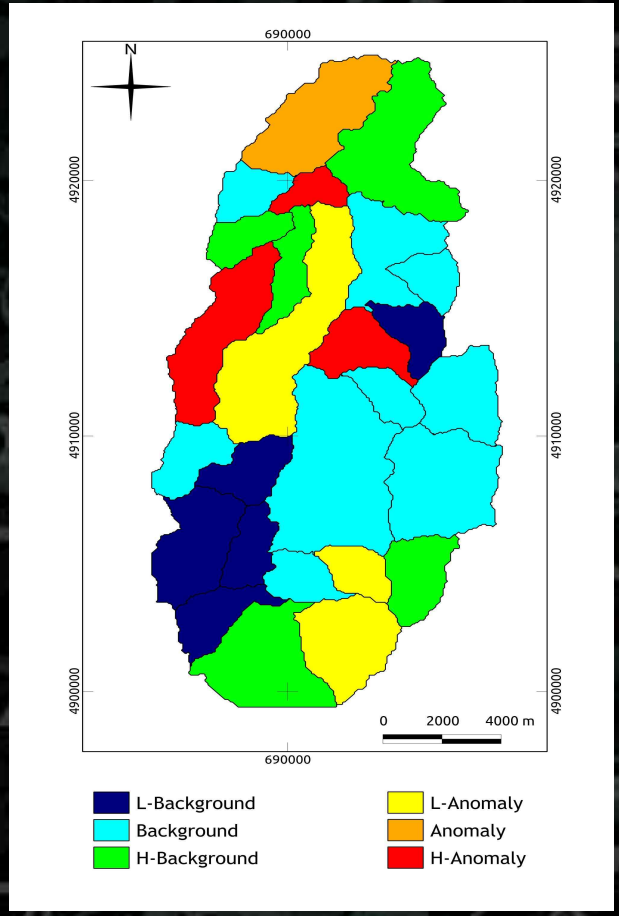
Which are the best threshold values between discrete field geochemical landscape ?









25 – 70	Low Background
71 – 94	Background
95 – 132	High Background
133 – 187	Low Anomaly
188 – 229	Anomaly
230 – 287	High Anomaly

25 – 86	Low Background
87 – 117	Background
118 – 130	High Background
131 – 160	Low Anomaly
161 – 180	Anomaly
181 – 287	High Anomaly

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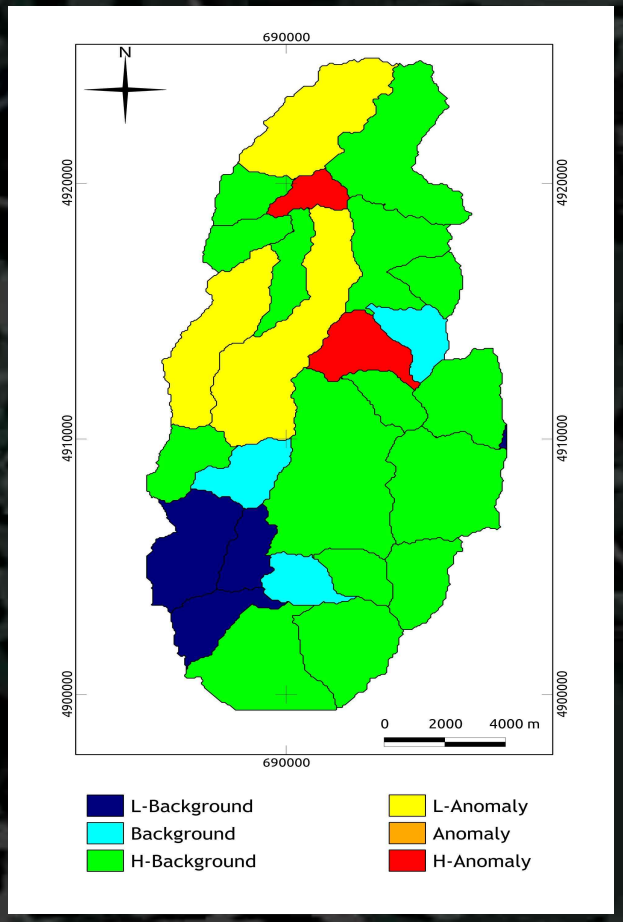
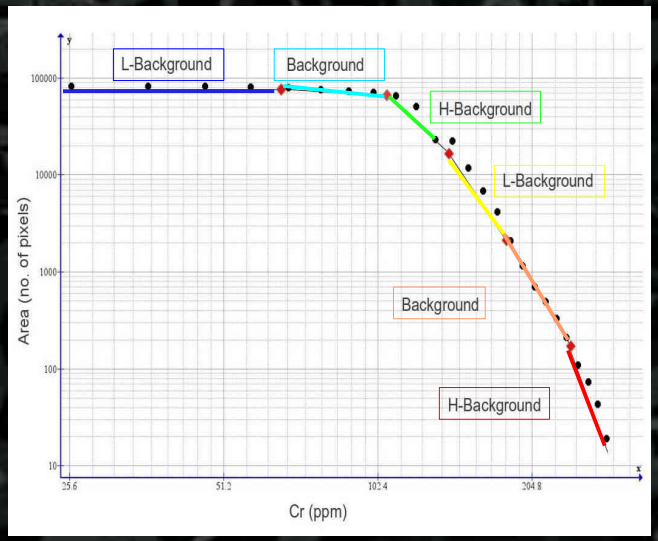
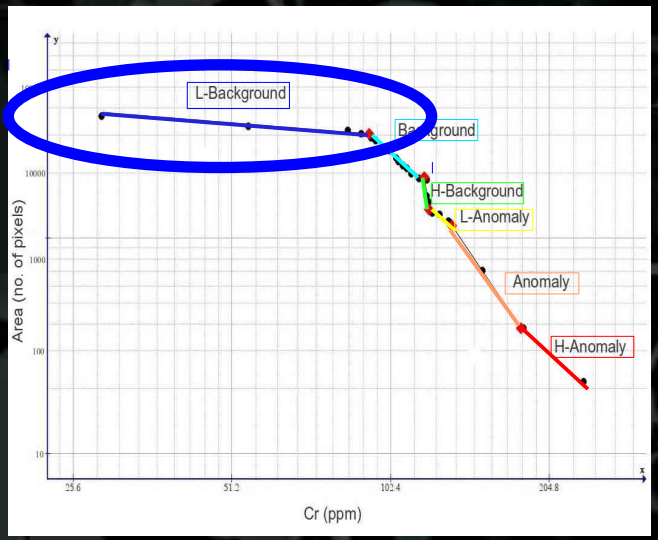
Increase in Low Anomalous values

Point values

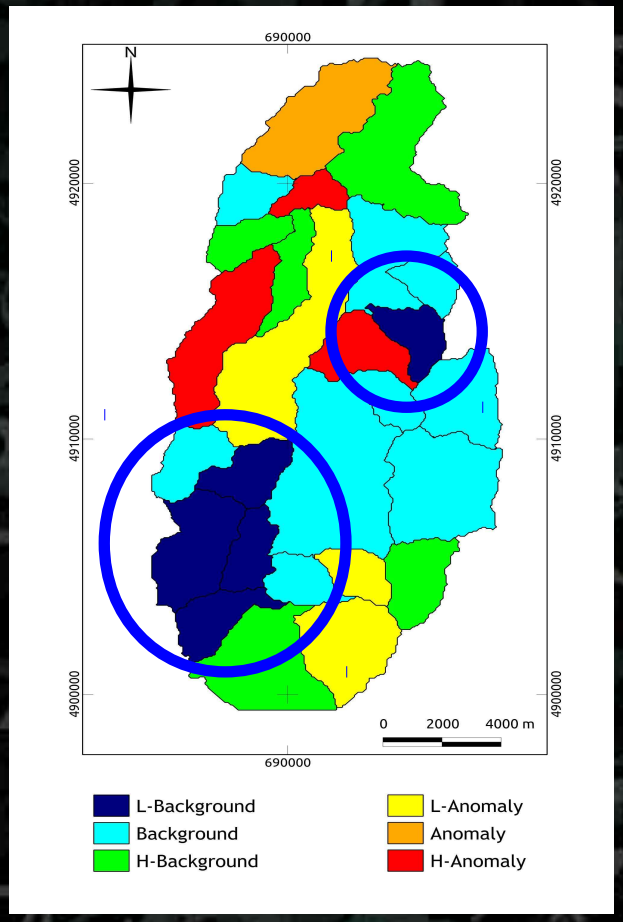






25 – 70	Low Background
71 – 94	Background
95 – 132	High Background
133 – 187	Low Anomaly
188 – 229	Anomaly
230 – 287	High Anomaly

Pixel values



25 – 86	Low Background
87 – 117	Background
118 – 130	High Background
131 – 160	Low Anomaly
161 – 180	Anomaly
181 – 287	High Anomaly

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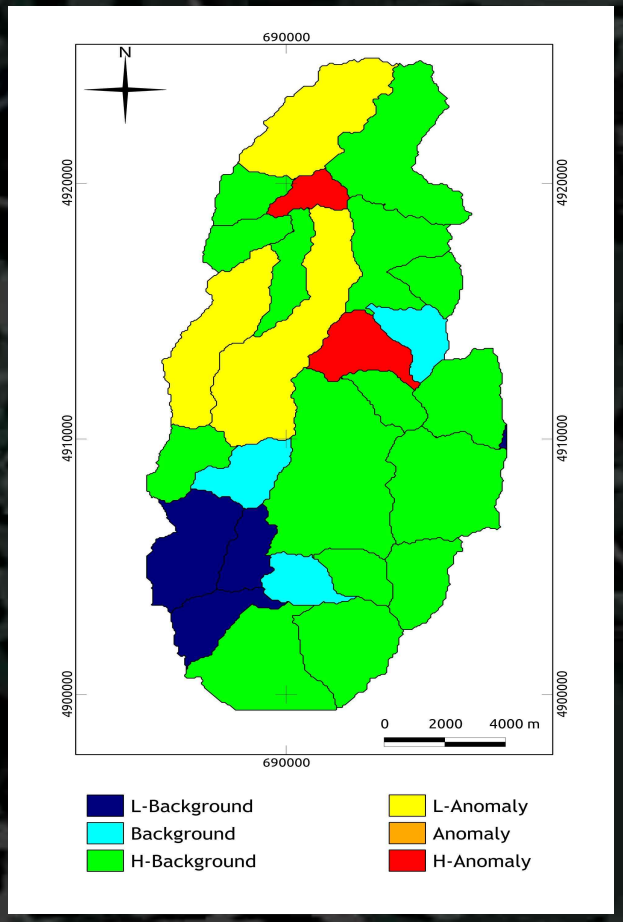
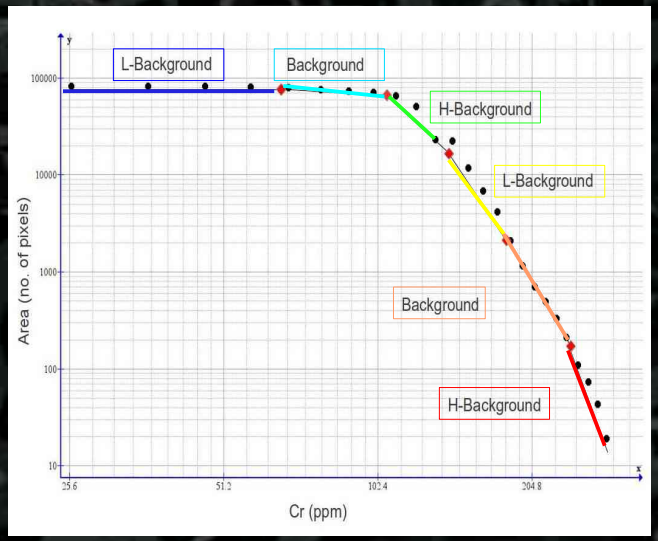
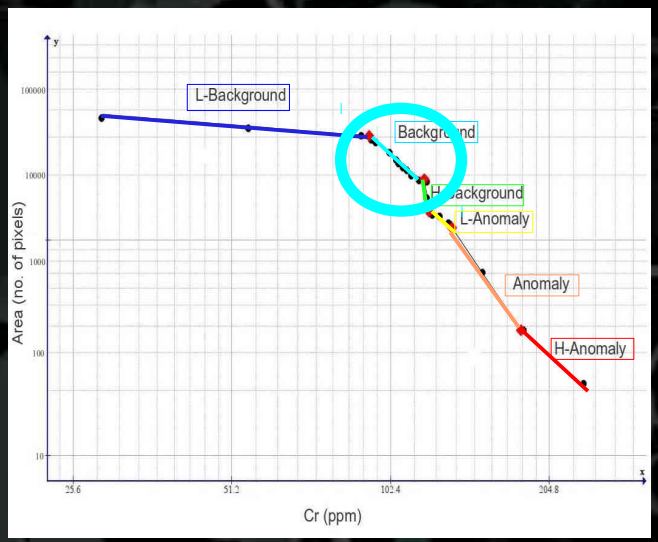
Increase in background treshold values

Point values

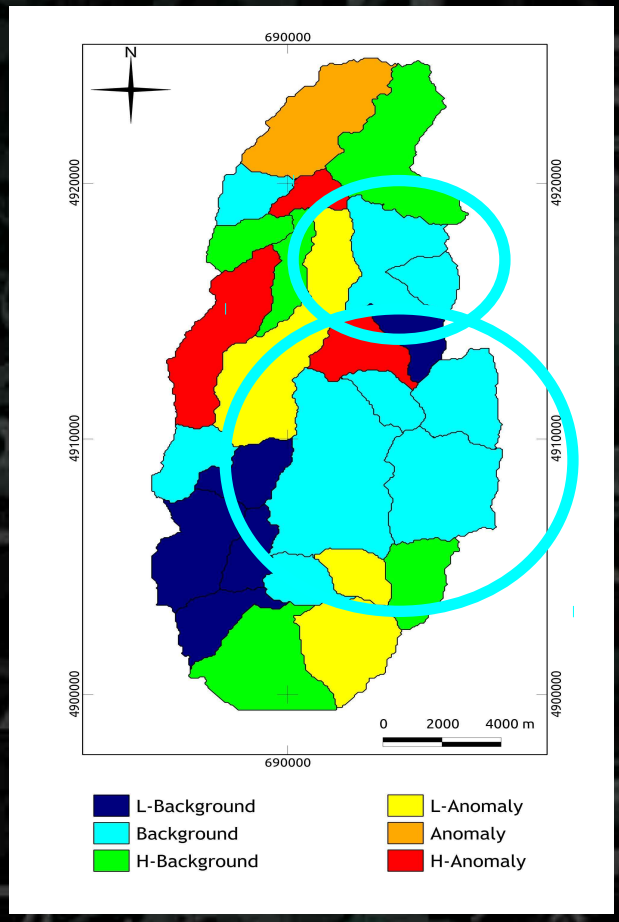






25 – 70	Low Background
71 – 94	Background
95 – 132	High Background
133 – 187	Low Anomaly
188 – 229	Anomaly
230 – 287	High Anomaly

Pixel values



25 – 86	Low Background
87 – 117	Background
118 – 130	High Background
131 – 160	Low Anomaly
161 – 180	Anomaly
181 – 287	High Anomaly

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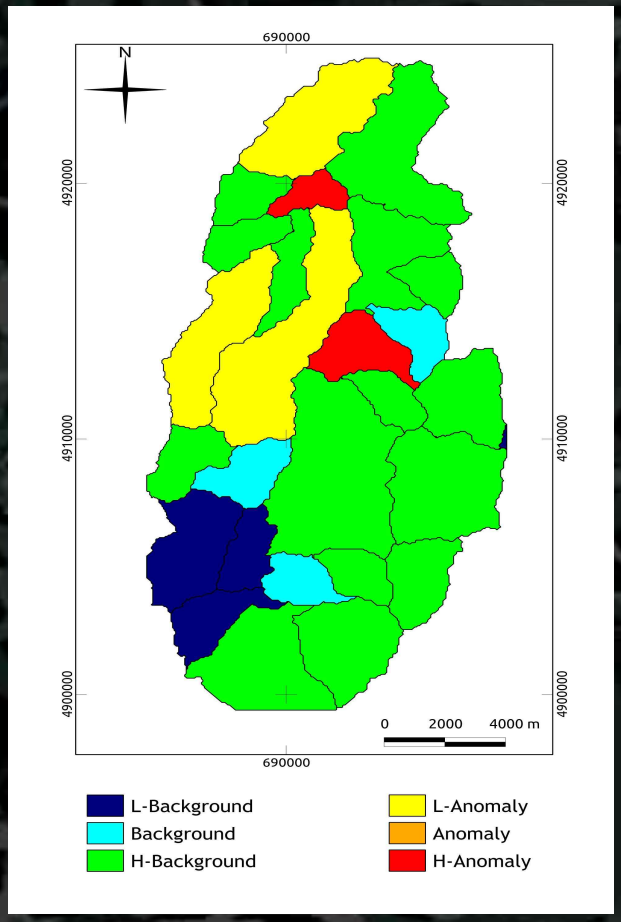
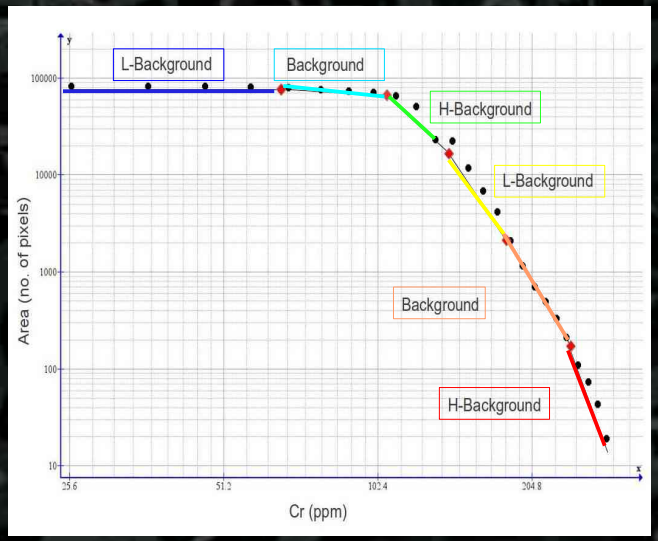
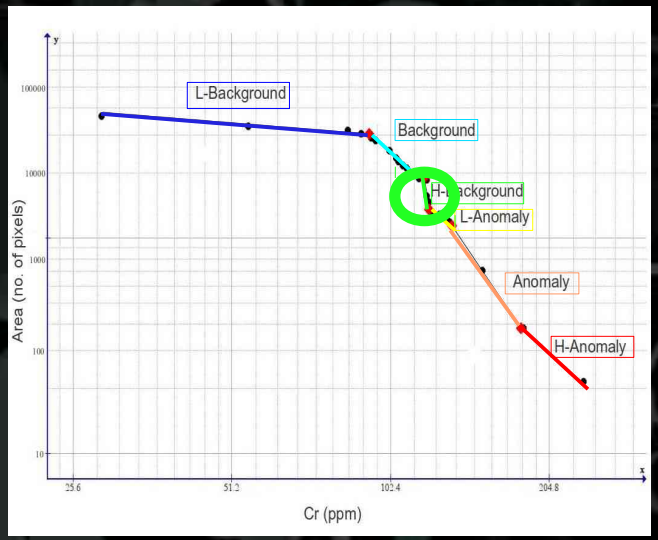
Decrease in High Anomalous values

Point values

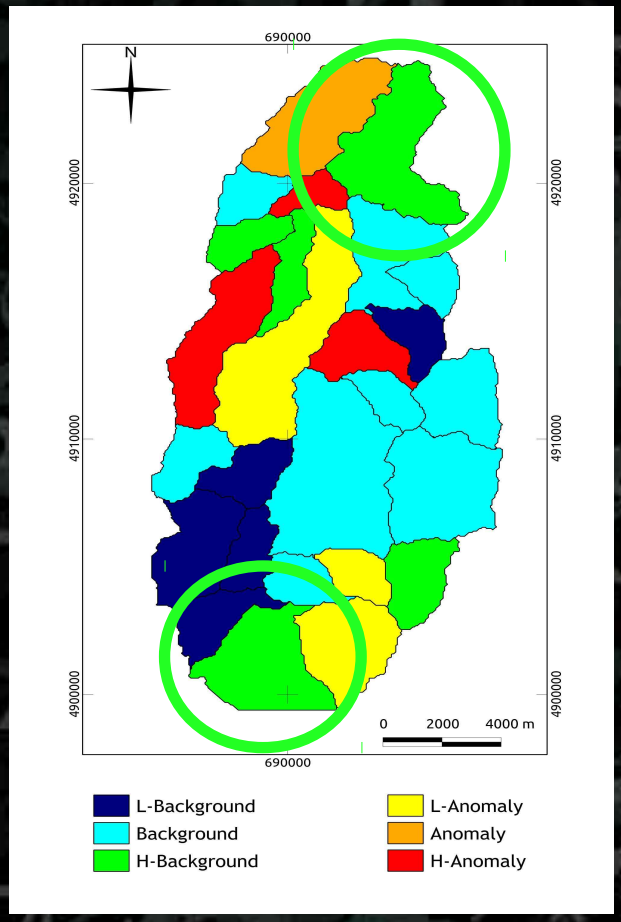






25 – 70	Low Background
71 – 94	Background
95 – 132	High Background
133 – 187	Low Anomaly
188 – 229	Anomaly
230 – 287	High Anomaly

Pixel values



25 – 86	Low Background
87 – 117	Background
118 – 130	High Background
131 – 160	Low Anomaly
161 – 180	Anomaly
181 – 287	High Anomaly

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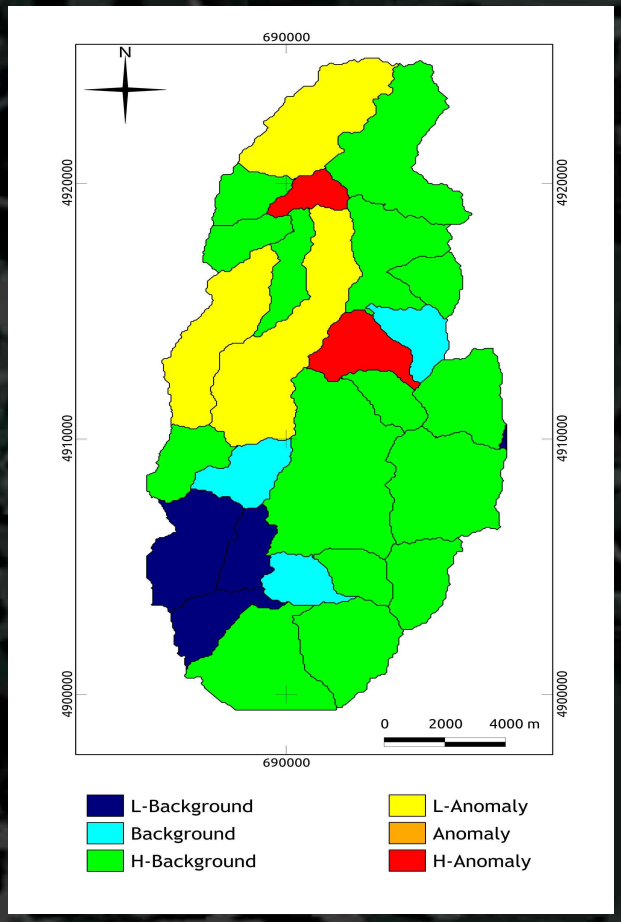
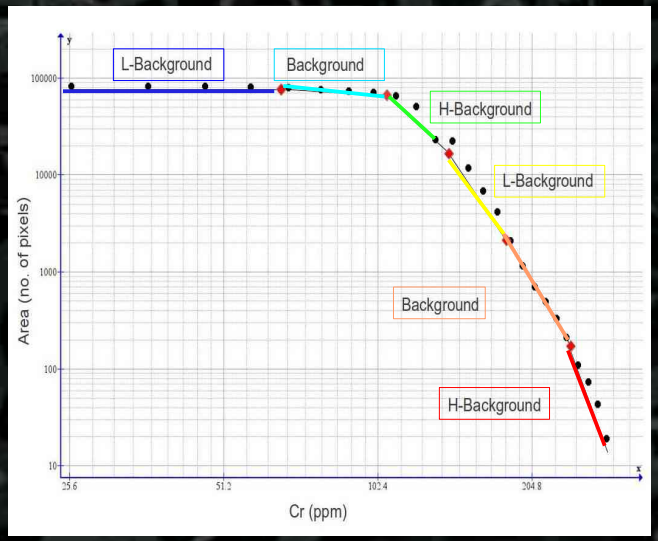
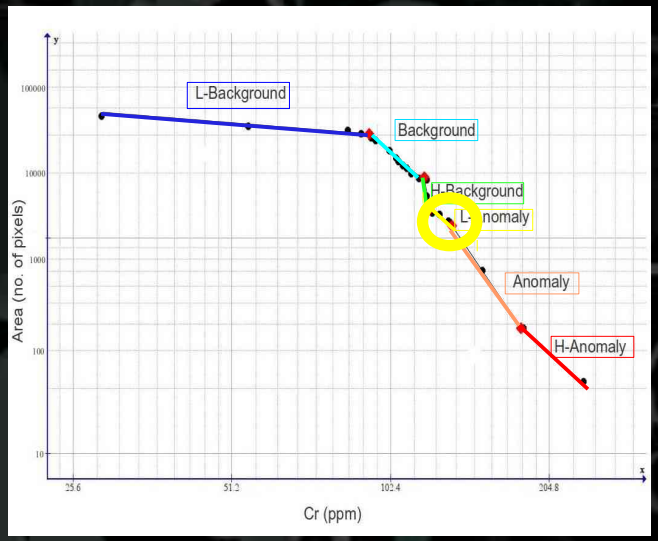
Restriction of low Anomalous range

Point values

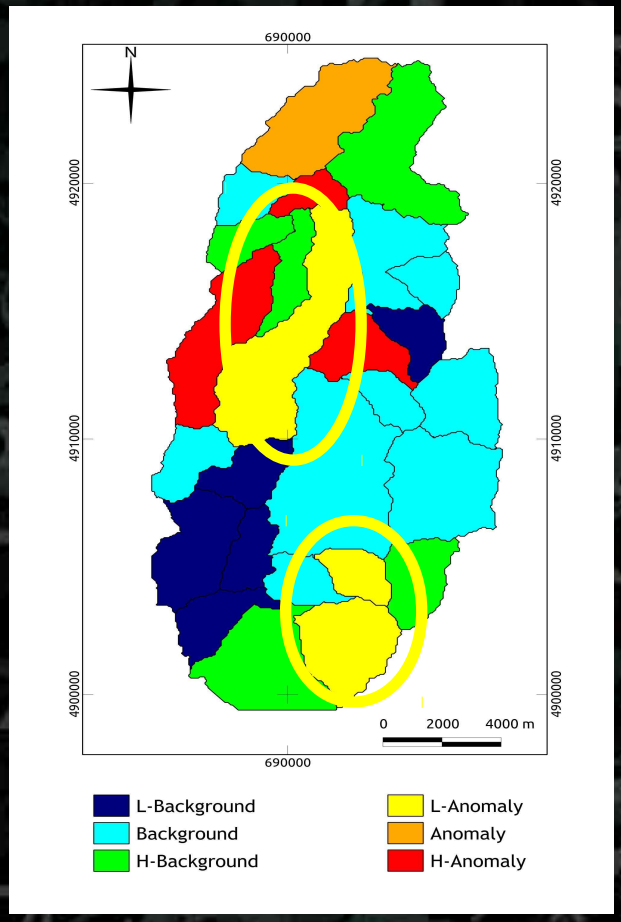






25 – 70	Low Background
71 – 94	Background
95 – 132	High Background
133 – 187	Low Anomaly
188 – 229	Anomaly
230 – 287	High Anomaly

Pixel values



25 – 86	Low Background
87 – 117	Background
[illegible]	High Background
131 – 160	Low Anomaly
[illegible]	Anomaly
181 – 287	High Anomaly

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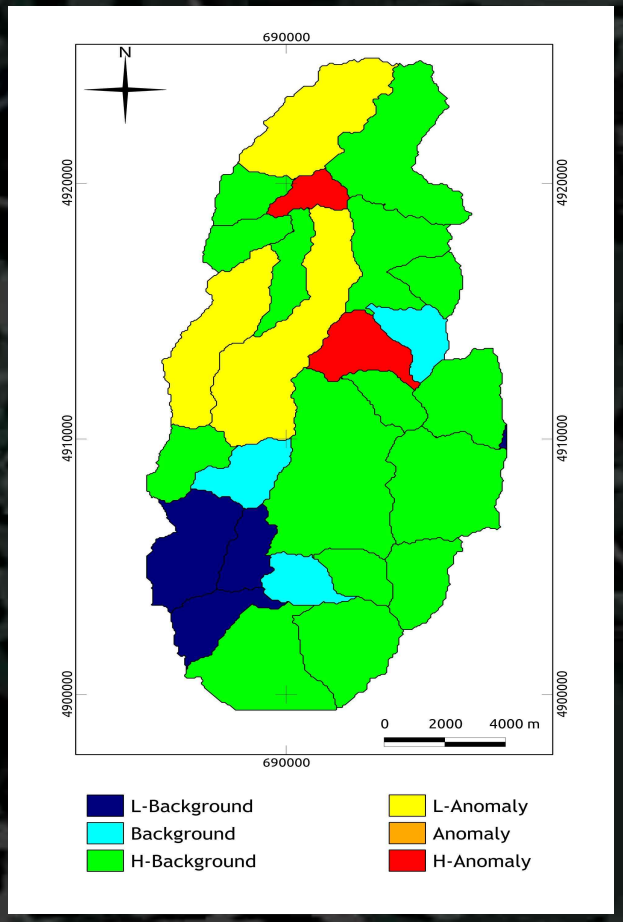
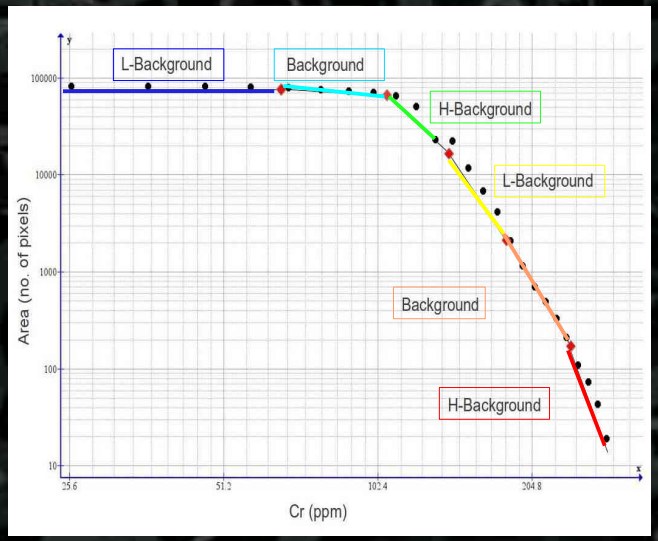
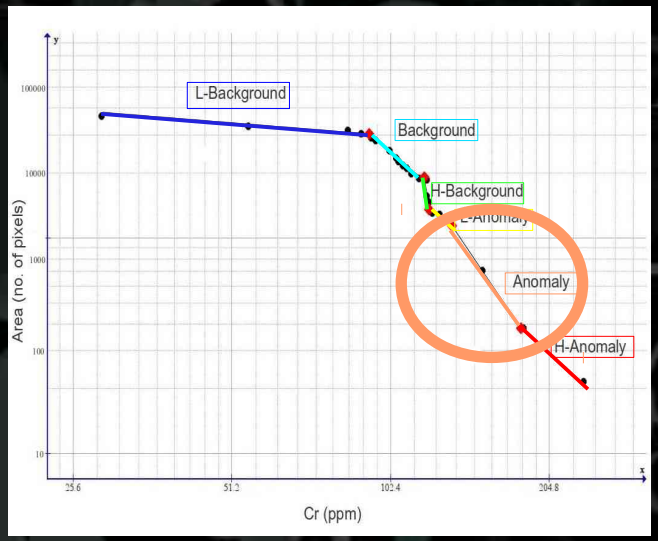
Decrease in threshold values of Anomaly (161 vs 188)

Point values

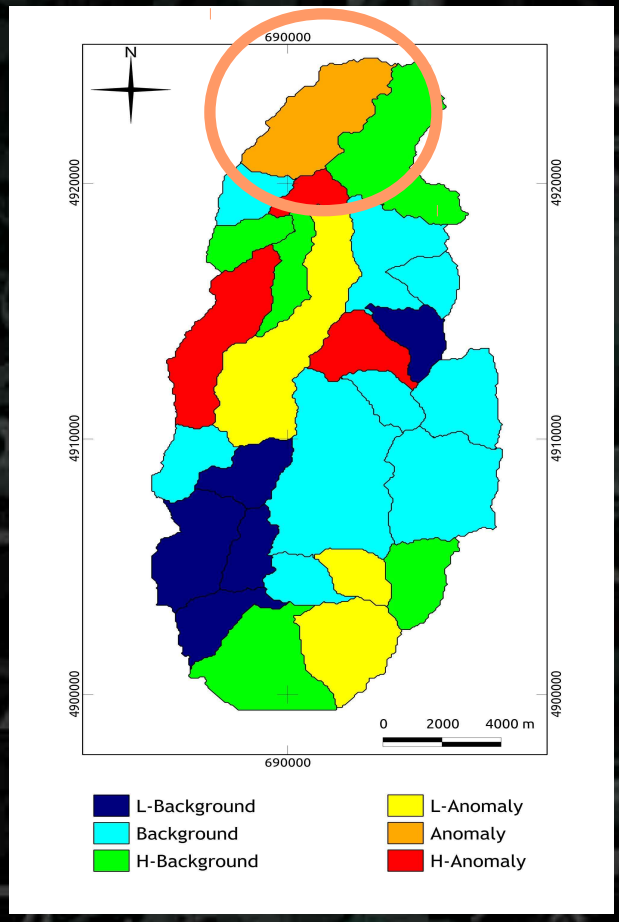






25 – 70	Low Background
71 – 94	Background
95 – 132	High Background
133 – 187	Low Anomaly
188 – 229	Anomaly
230 – 287	High Anomaly

Pixel values



25 – 86	Low Background
87 – 117	Background
118 – 130	High Background
[illegible]	Low Anomaly
161 – 180	Anomaly
[illegible]	High Anomaly

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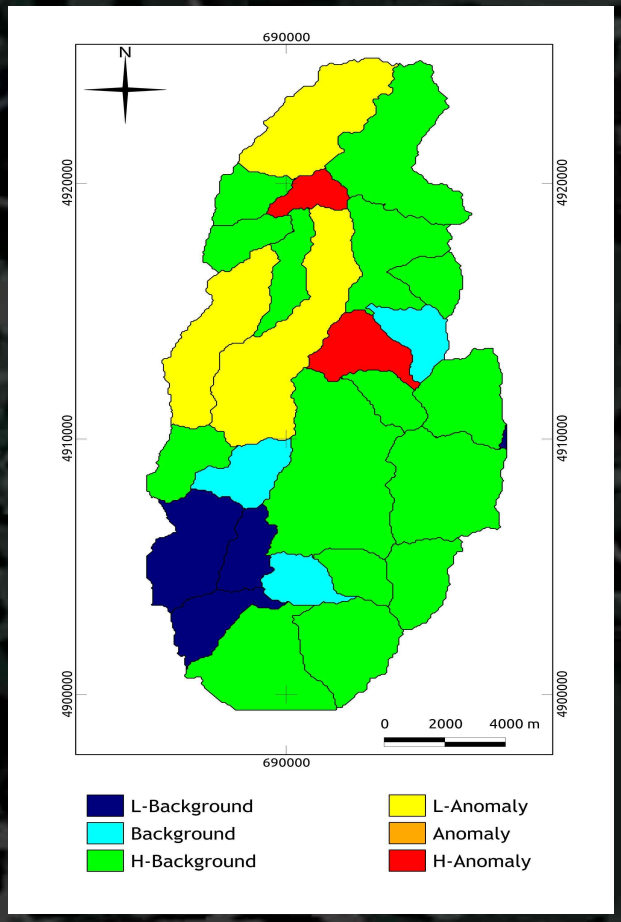
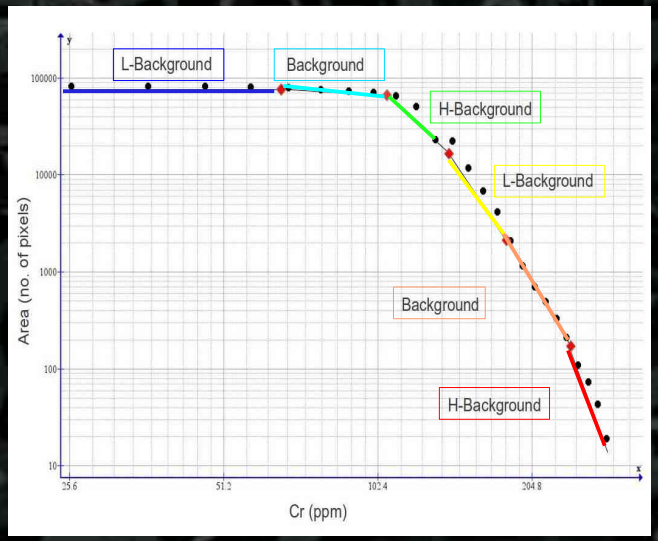
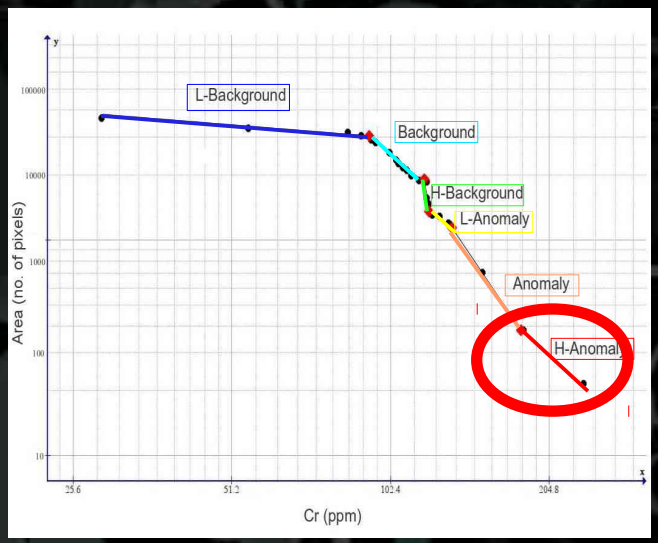
Decrease in threshold values of High Anomaly (181 vs 230)

Point values

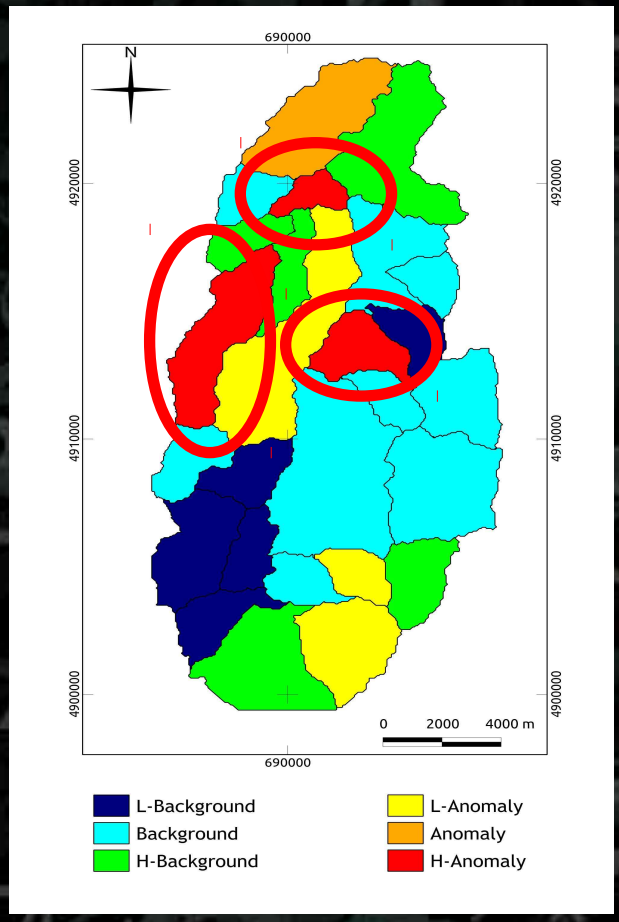






25 – 70	Low Background
71 – 94	Background
95 – 132	High Background
133 – 187	Low Anomaly
188 – 229	Anomaly
230 – 287	High Anomaly

Pixel values



25 – 86	Low Background
87 – 117	Background
118 – 130	High Background
131 – 160	Low Anomaly
[illegible]	Anomaly
181 – 287	High Anomaly

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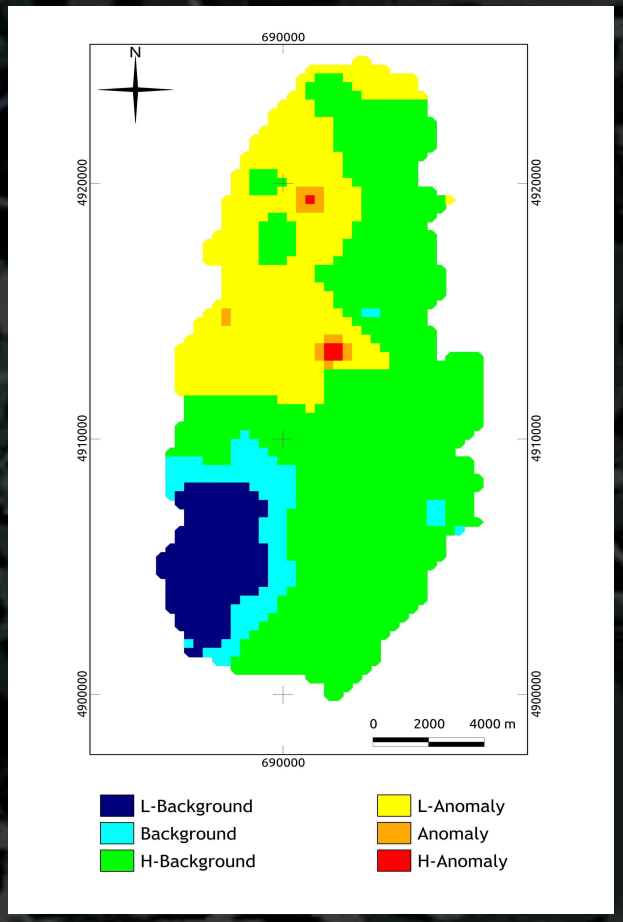
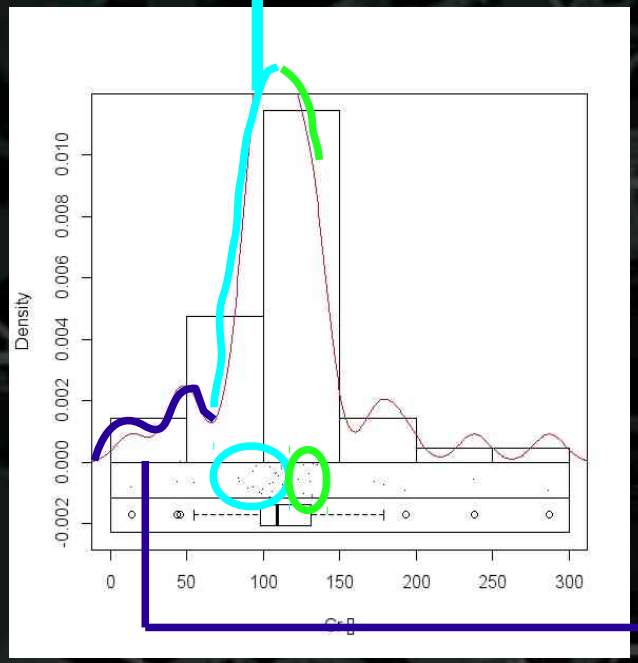
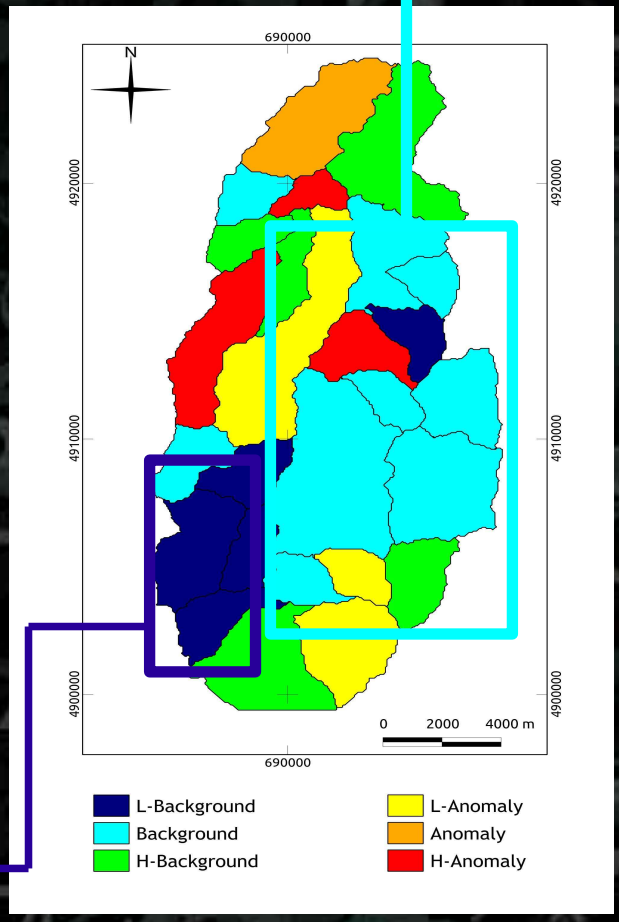
Continuous field model VS Discrete field model

Best Correspondance between frequency distribution and spatial distribution of basin's concentration







25 – 70	Low Background
71 – 94	Background
95 – 132	High Background
133 – 187	Low Anomaly
188 – 229	Anomaly
230 – 287	High Anomaly

25 – 86	Low Background
87 – 117	Background
118 – 130	High Background
131 – 160	Low Anomaly
161 – 180	Anomaly
181 – 287	High Anomaly

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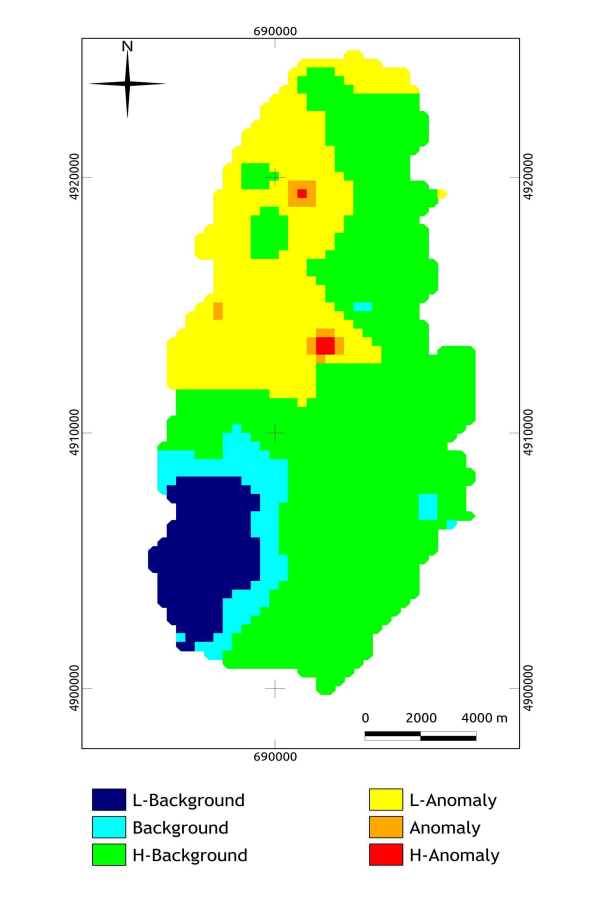
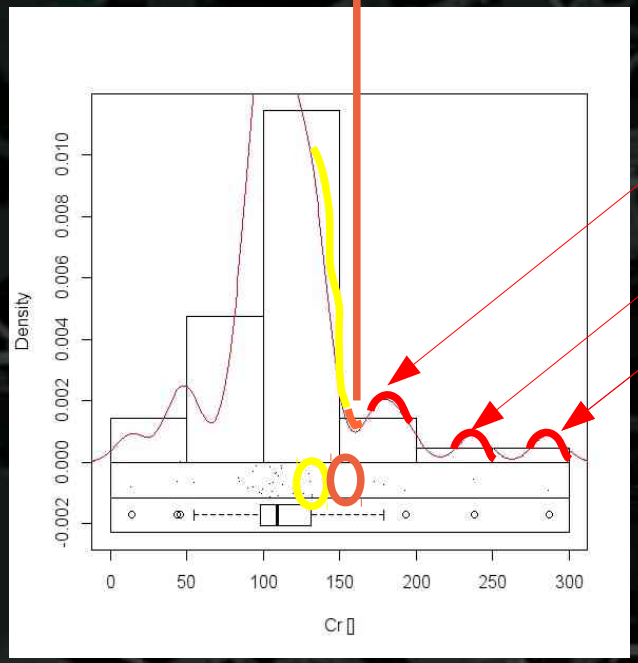
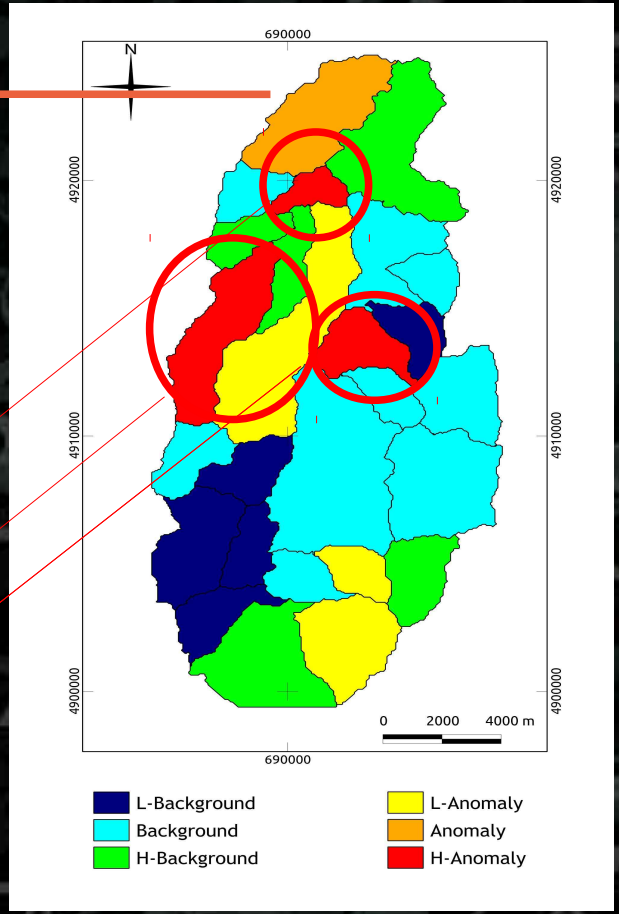
Continues field model VS Discrete filed model

Best Correspondance between frequency distribution and spatial distribution of basin's concentration



25 – 70	Low Background
71 – 94	Background
95 – 132	High Background
133 – 187	Low Anomaly
188 – 229	Anomaly
230 – 287	High Anomaly





25 – 86	Low Background
87 – 117	Background
118 – 130	High Background
131 – 160	Low Anomaly
161 – 180	Anomaly
181 – 287	High Anomaly

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Conclusions:

Catchment-based discrete field modelling of stream sediment geochemical landscapes is preferable to continuous field modelling.

- The former respects the zone of influence of each stream sediment while the latter does not.
- Discret field model determines thresold values compareble to the thresold values established by law
- There is a better correspondance between frequency distribution and spatial distribution of basin's concentration.
- The weight of extreme values (low and high anomaly; low and high background) decreases.

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