risk-based inventory of mining waste

EU legislation, assessment, methods and implementation

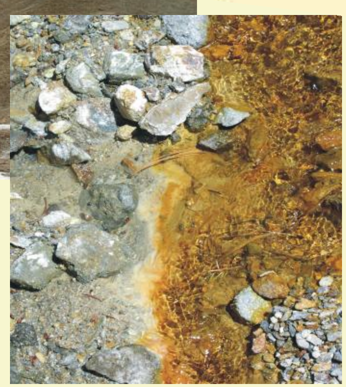
Gyozo Jordan

European Commission
Inventory of Closed Waste Facilities Working Group

Technical Adaptation Committee of Directive 2006/21/EC

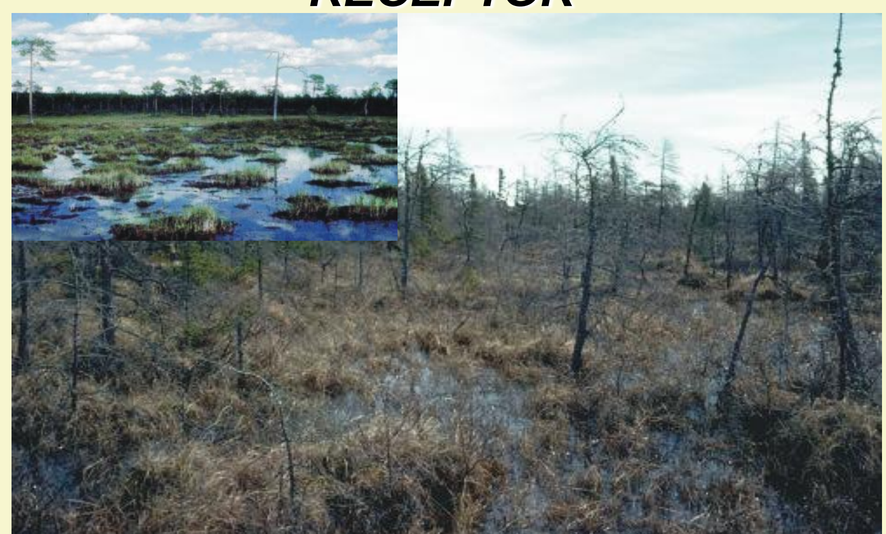
IMPACTMIN FINAL EVENT 27-28 November 2012, Luleå, Sweden

SOURCE



PATHWAY

RECEPTOR



MINE WASTE DIRECTIVE – INVENTORY

DIRECTIVE ***preparation***

FINAL February 2011

GUIDANCE DOCUMENT

FOR

A RISK-BASED PRE-SELECTION PROTOCOL

FOR THE

INVENTORY OF CLOSED WASTE FACILITIES

AS REQUIRED BY ARTICLE 20

OF

DIRECTIVE 2006/21/EC

INVENTORY OF CLOSED WASTE FACILITIES AD-HOC GROUP

A SUB-COMMITTEE OF

THE TECHNICAL ADAPTATION COMMITTEE

FOR

DIRECTIVE 2006/21/EC

Developed by

Gerry Stanley, Gyozo Jordan and Tamas Hamor with the support of Michel Sponar

2011

DIRECTIVE ***guidance***

Inventory and risk classification of closed mine waste facilities of Hungary

(Version №1)

MBFH–ELGI–MÁFI cooperation (10/2012)

Consigner:
Hungarian Office for Mining and Geology

Authors:
János Kiss
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The English translation was made on the basis of the Hungarian version as of 30/04/2012

30 April 2012, Budapest, Hungary

DIRECTIVE ***implementation***

A COMPLETE CYCLE

AJKA – 2010. October 04.

the solution: Risk Assessment

EU Mine Waste Directive (2006): risk-based inventory mine waste sites

(ARTICLE 20)

Contamination Risk=

(probability of contamination) x (significance of toxic impacts)

Risk Assessment (RA):

(1) hazard characterisation

(2) toxicity analysis

(3) contaminant transport

(4) exposure assessment

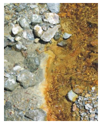
(5) risk characterization

(6) risk management

SOURCE –

mine & waste dump

PATHWAY –



water & sediment

RECEPTOR –

humans

ecosyst.

Risk Assessment – principles & conditions

1. Risk-based

- Source – Pathway – Receptor
- Risk ranking
- Major exposure rutes (SW, GW, AIR, DC)
- Uncertainty: high risk (precautonary principle)

2. Verification, Monitoring

3. Efficient – Tiered Approach

- Tier 0: pre-selection (screening)
- Tier 1: selection (ranking)
- Tier 2: assessment

Pre-selection

preliminary risk assessment

Tier 0.

Pre-selection *preliminary risk assessment*

GUIDANCE DOCUMENT

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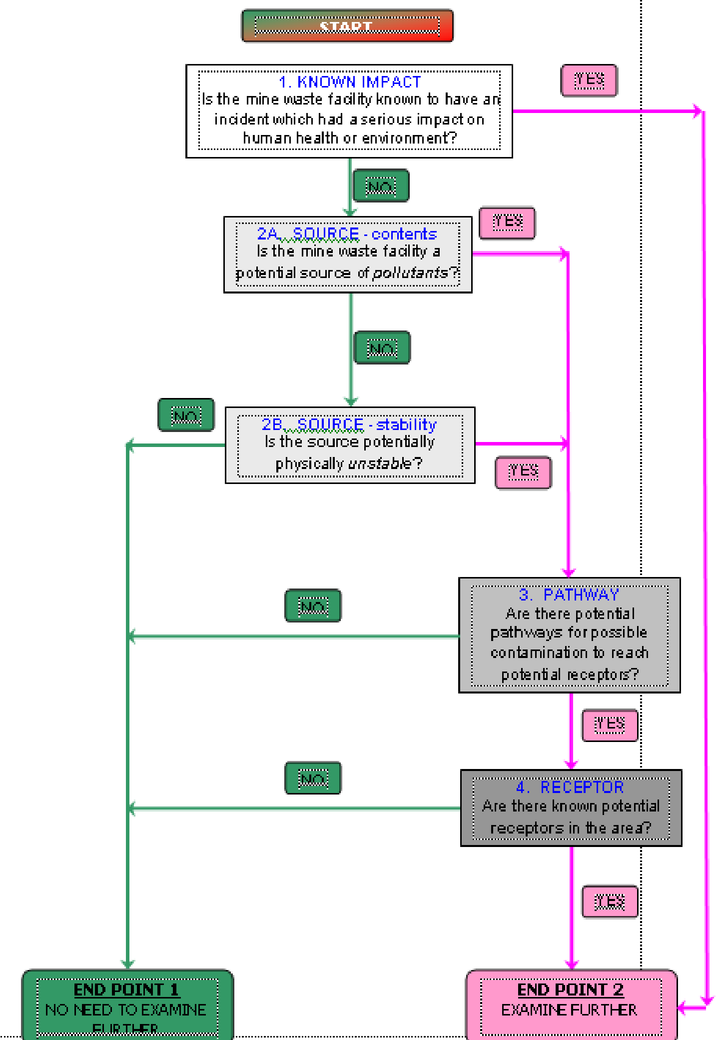
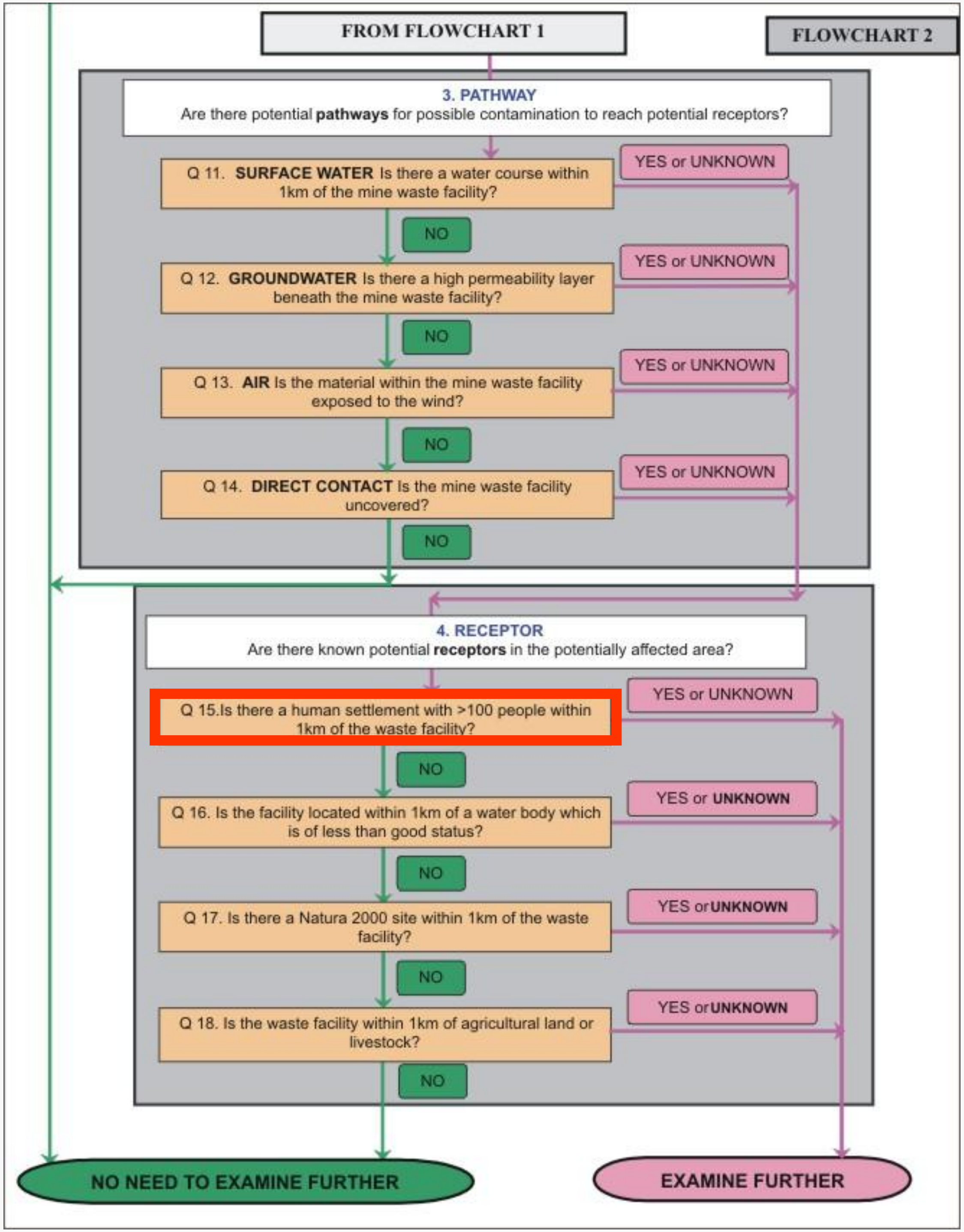
ANNEX I

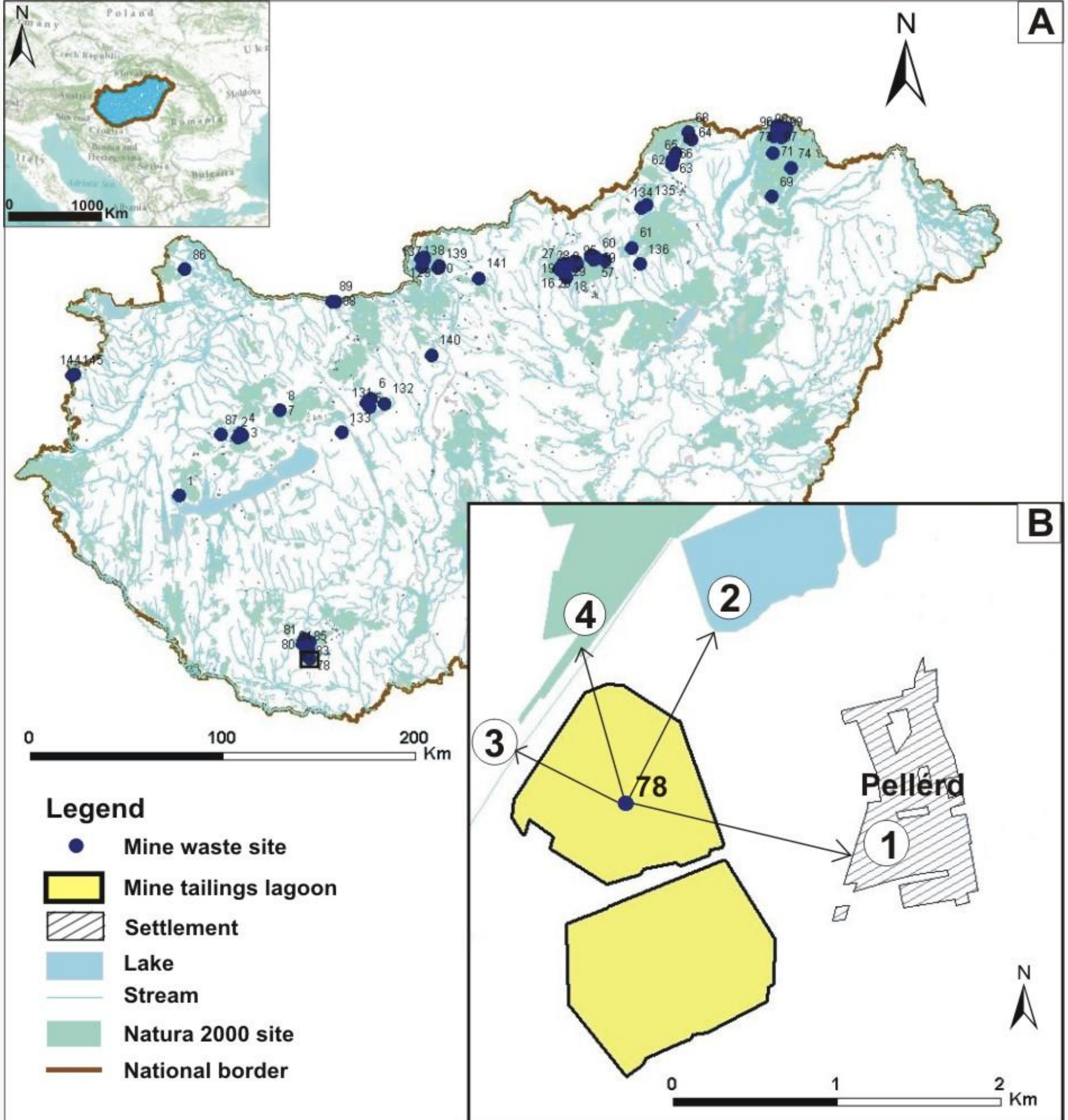
PRE-SELECTION PROTOCOL FLOWCHART

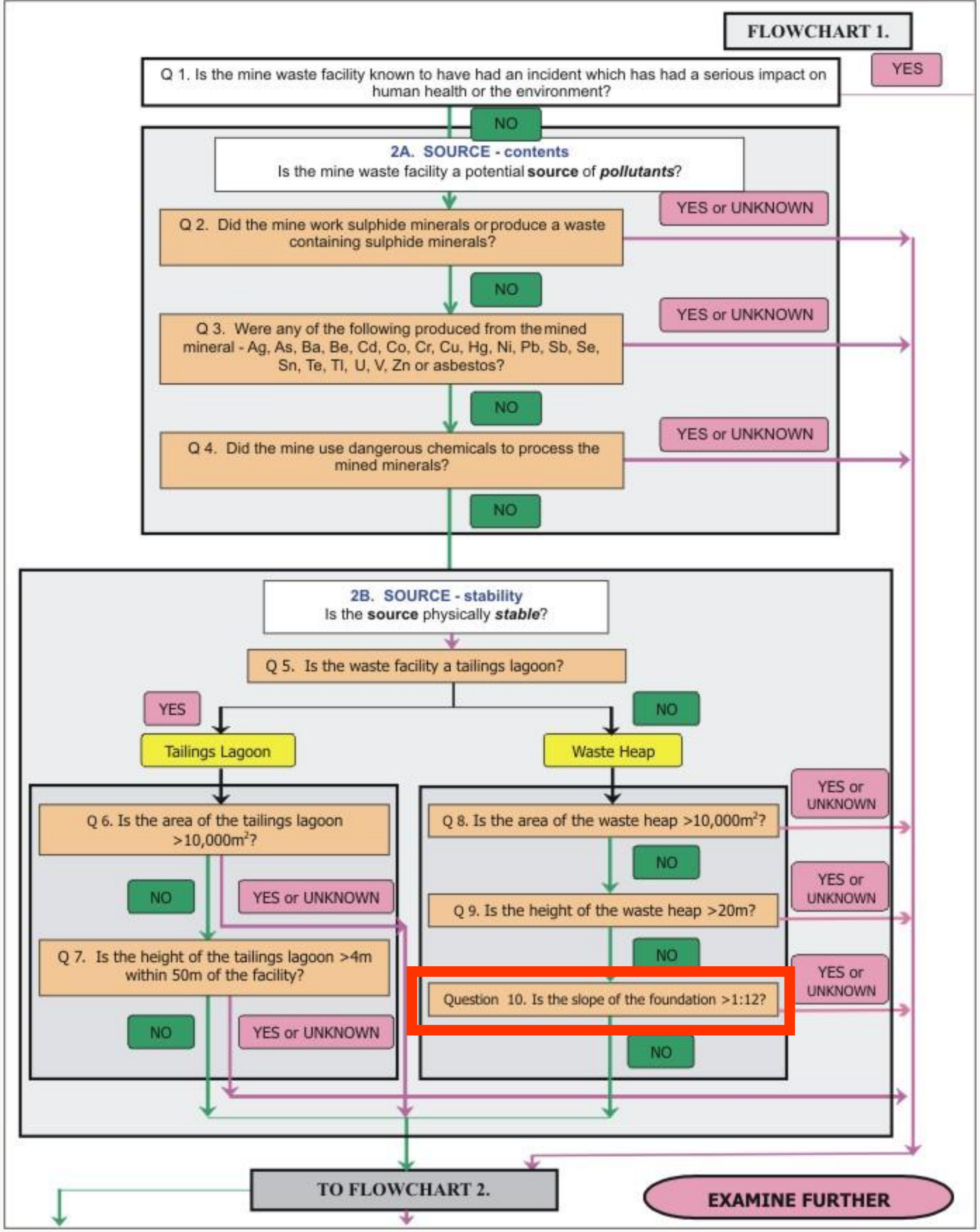


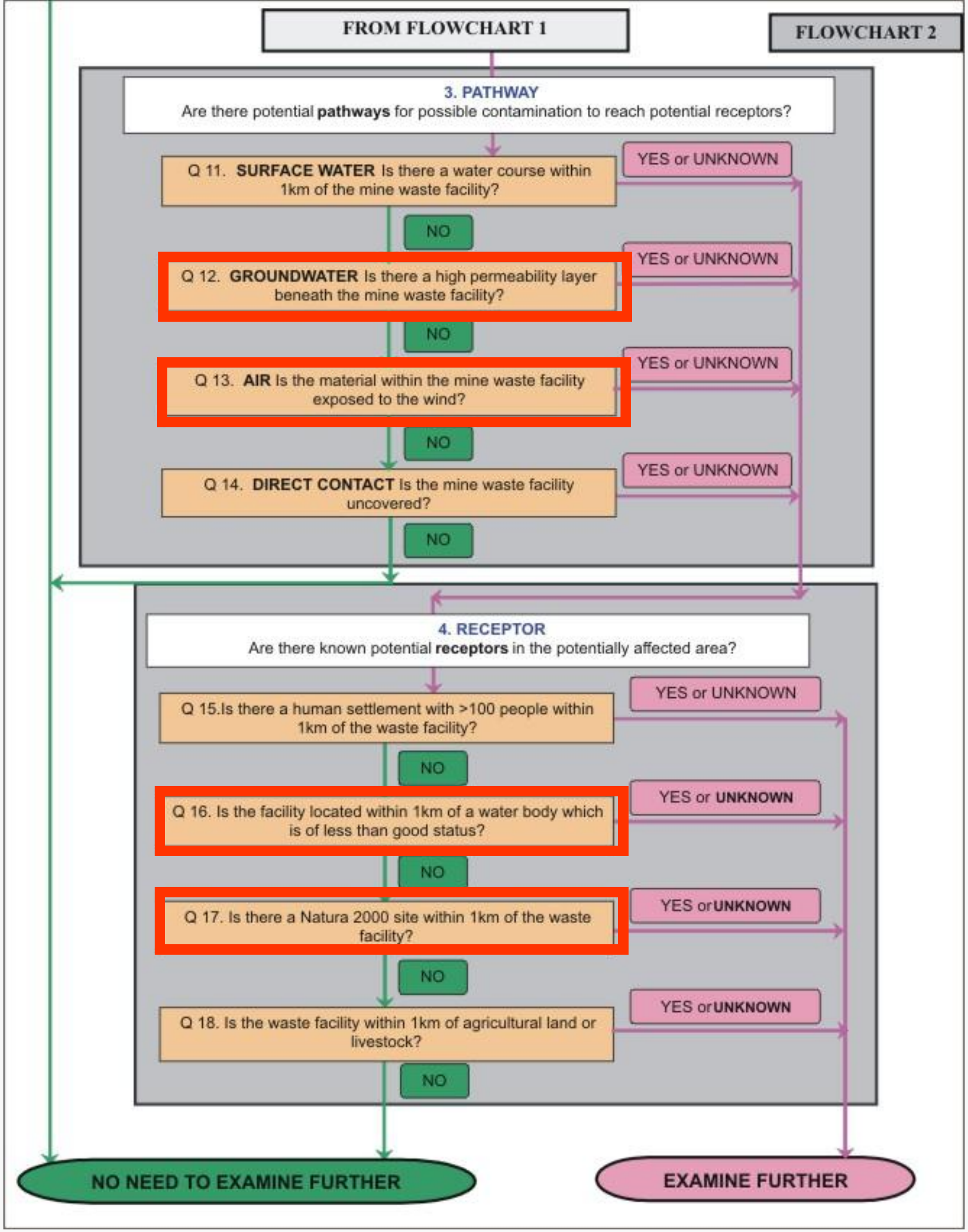
Pre-selection Protocol

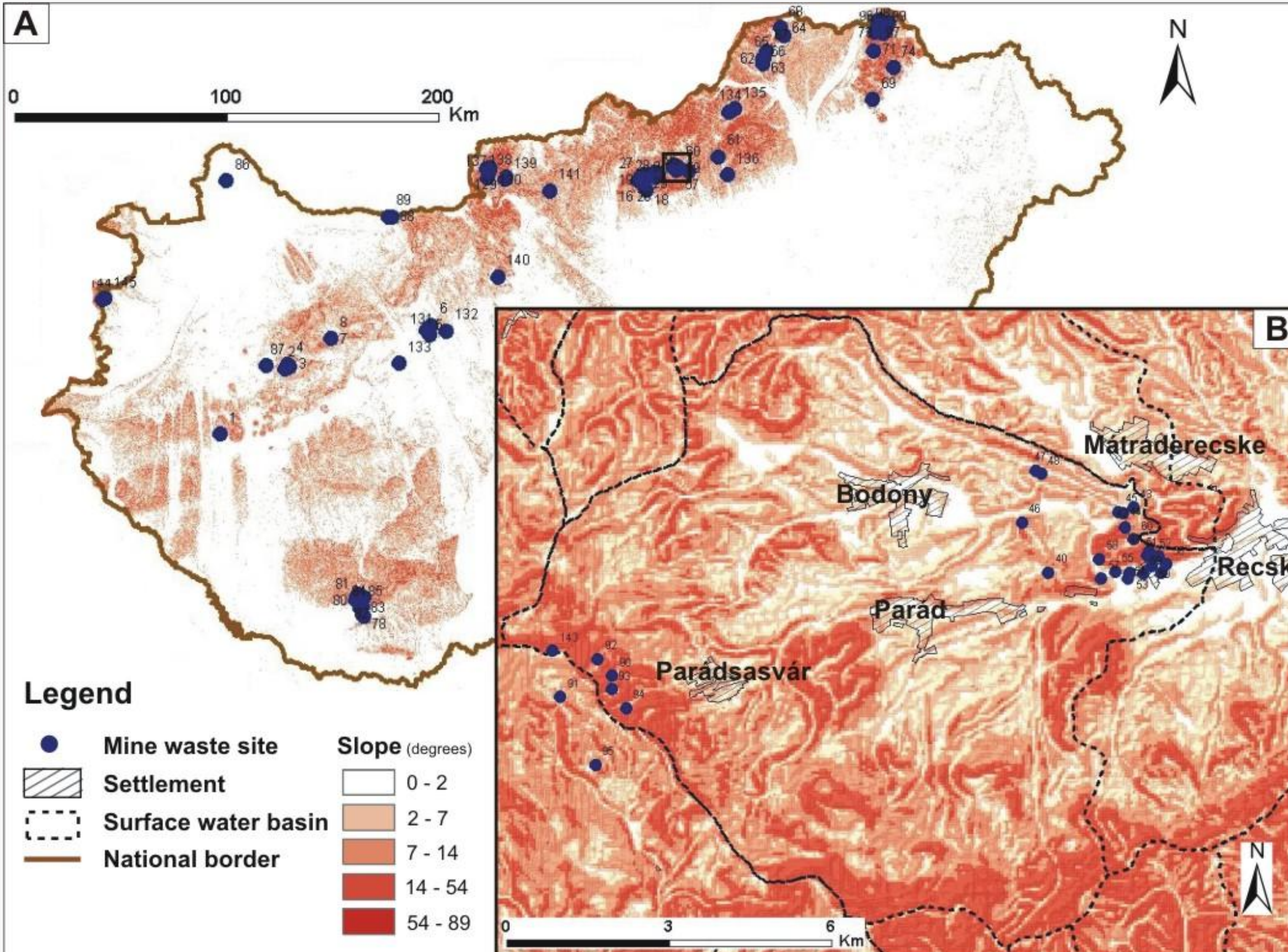
- ✓ 1 Known Impact
- ✓ 9 Source
- ✓ 4 Pathway
- ✓ 4 Receptor



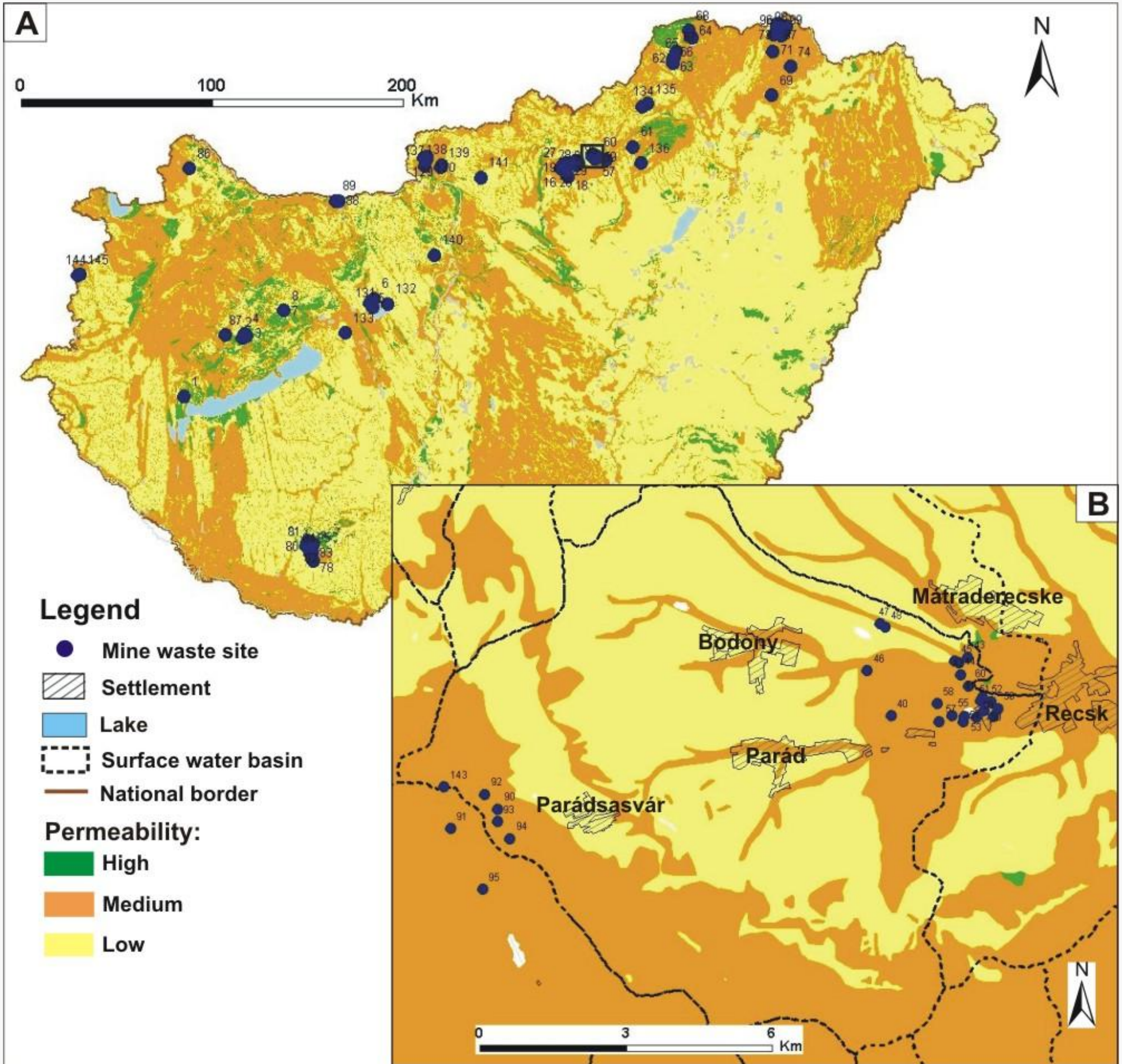

A
N
0
1000
Km
0
100
200
Km
Legend
Mine waste site
Mine tailings lagoon
Settlement
Lake
Stream
Natura 2000 site
National border
B
Pellérd
78
1
2
3
4
N
0
1
2
Km

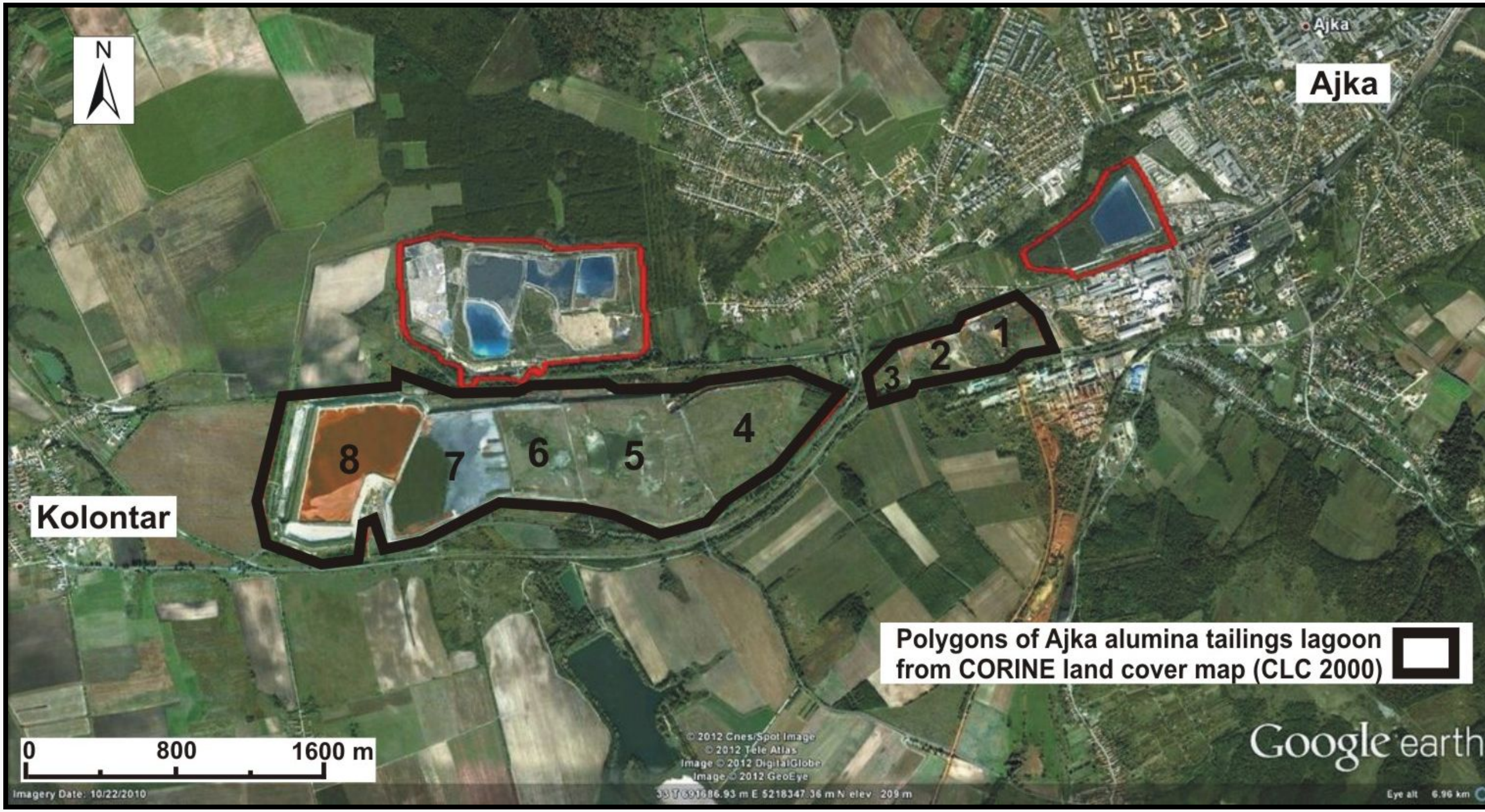

FLOWCHART 1.
YES
Q 1. Is the mine waste facility known to have had an incident which has had a serious impact on human health or the environment?
NO
2A. SOURCE - contents
Is the mine waste facility a potential source of pollutants?
YES or UNKNOWN
Q 2. Did the mine work sulphide minerals or produce a waste containing sulphide minerals?
NO
YES or UNKNOWN
Q 3. Were any of the following produced from the mined mineral - Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se, Sn, Te, Tl, U, V, Zn or asbestos?
NO
YES or UNKNOWN
Q 4. Did the mine use dangerous chemicals to process the mined minerals?
NO
2B. SOURCE - stability
Is the source physically stable?
Q 5. Is the waste facility a tailings lagoon?
YES
NO
Tailings Lagoon
Waste Heap
Q 6. Is the area of the tailings lagoon >10,000m²?
NO
YES or UNKNOWN
Q 7. Is the height of the tailings lagoon >4m within 50m of the facility?
NO
YES or UNKNOWN
YES or UNKNOWN
Q 8. Is the area of the waste heap >10,000m²?
NO
YES or UNKNOWN
Q 9. Is the height of the waste heap >20m?
NO
YES or UNKNOWN
Question 10. Is the slope of the foundation >1:12?
NO
TO FLOWCHART 2.
EXAMINE FURTHER

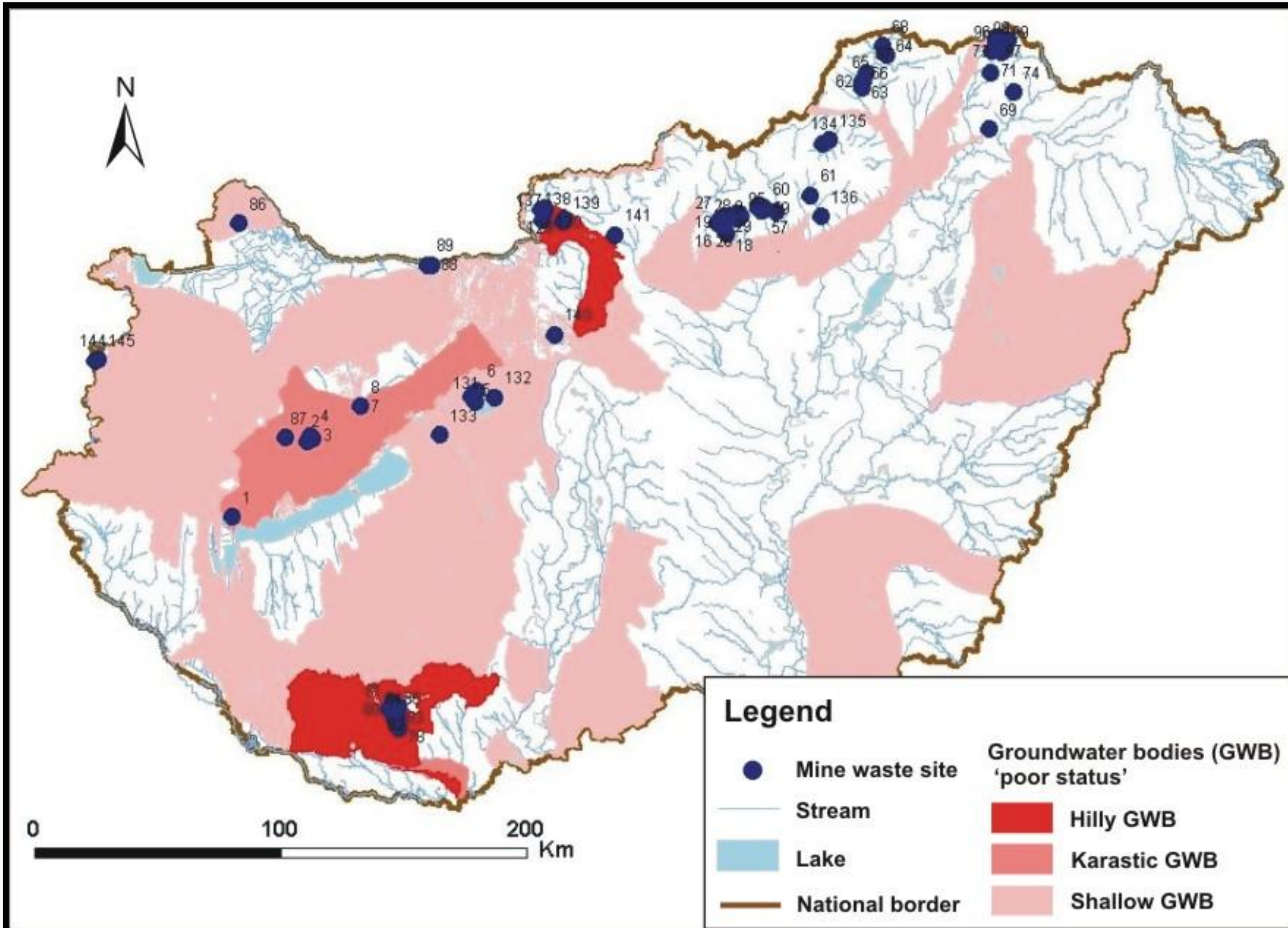

FROM FLOWCHART 1
FLOWCHART 2
3. PATHWAY
Are there potential pathways for possible contamination to reach potential receptors?
Q 11. SURFACE WATER Is there a water course within 1km of the mine waste facility?
YES or UNKNOWN
NO
Q 12. GROUNDWATER Is there a high permeability layer beneath the mine waste facility?
YES or UNKNOWN
NO
Q 13. AIR Is the material within the mine waste facility exposed to the wind?
YES or UNKNOWN
NO
Q 14. DIRECT CONTACT Is the mine waste facility uncovered?
YES or UNKNOWN
NO
4. RECEPTOR
Are there known potential receptors in the potentially affected area?
Q 15.Is there a human settlement with >100 people within 1km of the waste facility?
YES or UNKNOWN
NO
Q 16. Is the facility located within 1km of a water body which is of less than good status?
YES or UNKNOWN
NO
Q 17. Is there a Natura 2000 site within 1km of the waste facility?
YES or UNKNOWN
NO
Q 18. Is the waste facility within 1km of agricultural land or livestock?
YES or UNKNOWN
NO
NO NEED TO EXAMINE FURTHER
EXAMINE FURTHER



A
B
N
0
100
200
Km
3
6
Mátraderecske
Bodony
Recsk
Parád
Parádsasvár
Legend
Mine waste site
Settlement
Surface water basin
National border
Slope (degrees)
0 - 2
2 - 7
7 - 14
14 - 54
54 - 89


A
B
0
100
200
Km
N
Legend
Mine waste site
Settlement
Lake
Surface water basin
National border
Permeability:
High
Medium
Low
Mátraderecske
Bodony
Recsk
Parád
Parádsasvár
0
3
6
Km


N
Ajka
Kolontar
1
2
3
4
5
6
7
8
Polygons of Ajka alumina tailings lagoon from CORINE land cover map (CLC 2000)
0
800
1600 m
Google earth
© 2012 Cnes/Spot Image
© 2012 Tele Atlas
Image © 2012 DigitalGlobe
Image © 2012 GeoEye
Imagery Date: 10/22/2010


N
0
100
200
Km
Legend
Mine waste site
Stream
Lake
National border
Groundwater bodies (GWB) 'poor status'
Hilly GWB
Karastic GWB
Shallow GWB

VERIFICATION: Field Work & Observation

Selection

risk ranking

Tier 1.

Selection ***risk classification***

Specific parameters – REMEDIATION

- **Was there remediation?**
- **Is the remediation completed?**
- **Is the remediation successful?**

CLASS 'Z': ('**Z**agytározó' in Hungarian) **tailings lagoon**

1. Non-remediated
  1. Big facility (>10 000m^2)
    1. On steep slope (slope>5°)
    2. On flat slope (slope<5°)
  2. Small facility (<10 000m^2)
    1. On steep slope (slope>5°)
    2. On flat slope (slope<5°)

2. Remediated
  1. **B**ig facility (>10 000m^2)
    1. **O**n steep slope (slope>5°)
    2. On flat slope (slope<5°)
  2. Small facility (<10 000m^2)
    1. On steep slope (slope>5°)
    2. On flat slope (slope<5°)

CLASS 'M': ('**M**eddőhányó' in Hungarian) **waste heaps**

1. Non-remediated
  1. **B**ig facility (>10 000m^2)
    1. On steep slope (slope>5°)
    2. On flat slope (slope<5°)
  2. Small facility (<10 000m^2)
    1. On steep slope (slope>5°)
    2. On flat slope (slope<5°)

2. Remediated
  1. Big facility (>10 000m^2)
    1. On steep slope (slope>5°)
    2. On flat slope (slope<5°)
  2. Small facility (<10 000m^2)
    1. On steep slope (slope>5°)
    2. On flat slope (slope<5°)

TAILINGS				RANKING
Without remediation	Big ($>10000\ m^2$)	Steep d>5		
		Flat d<5	Korpáshegyi vörösiszap zagytározó, Neszmély	1
	Small ($<10000\ m^2$)	Steep d>5		
		Flat d<5		
Remediated	Big ($>10000\ m^2$)	Steep d>5	Száraz-pataki flotációs zagytározó, Gyöngyösoroszi	2
			Régi flotációs zagytározó, Recsk	3
			Bence-völgyi flotációs zagytározó, Gyöngyösoroszi	4
		Flat d<5	Ajkai vörösiszap zagytározó	5
			MÉV I. zagytározó, Pellérd északi	6
			MÉV II. zagytározók, Pellérd déli	7
			Almásfüzitői Ny-i vörösiszap zagytározó	8
			Mosonmagyaróvári vörösiszap zagytározó	9
			MÉV Perkoláció II. üzem zagytározó, Kővágószöllös	10
			Almásfüzitői K-i vörösiszap zagytározó	11
			MÉV Perkoláció I. üzem zagytározó, Kővágószöllös	12
			Úrkúti mangániszaptározó	13
			Új flotációs zagytározó, Recsk	14

Results *web presentation*

Bánta bánya	
Bánta bánya	
NÉV	Bánta bánya
TELEPÜLÉS	Várpalota
MWF	19-156
EOVY	578146
EOVX	205894
ISMERT VESZÉLY	NINCS
ANYAGTARTALOMVESZÉLY	VAN
STABILITÁSVESZÉLY	VAN
TERJEDÉSVESZÉLY	VAN
VESZÉLYEZTETETTSÉG	VAN
VIZSGÁLANDÓ?	IGEN
ELŐSZŰRÉSI KÓD	11201220
REKULTIVÁLT?	NA
TELJESEN?	NA
SIKERESEN?	NA
TERÜLET (ha)	1,5
DŐLÉS (fok)	6
SZŰRÉSI KÓD	1010116

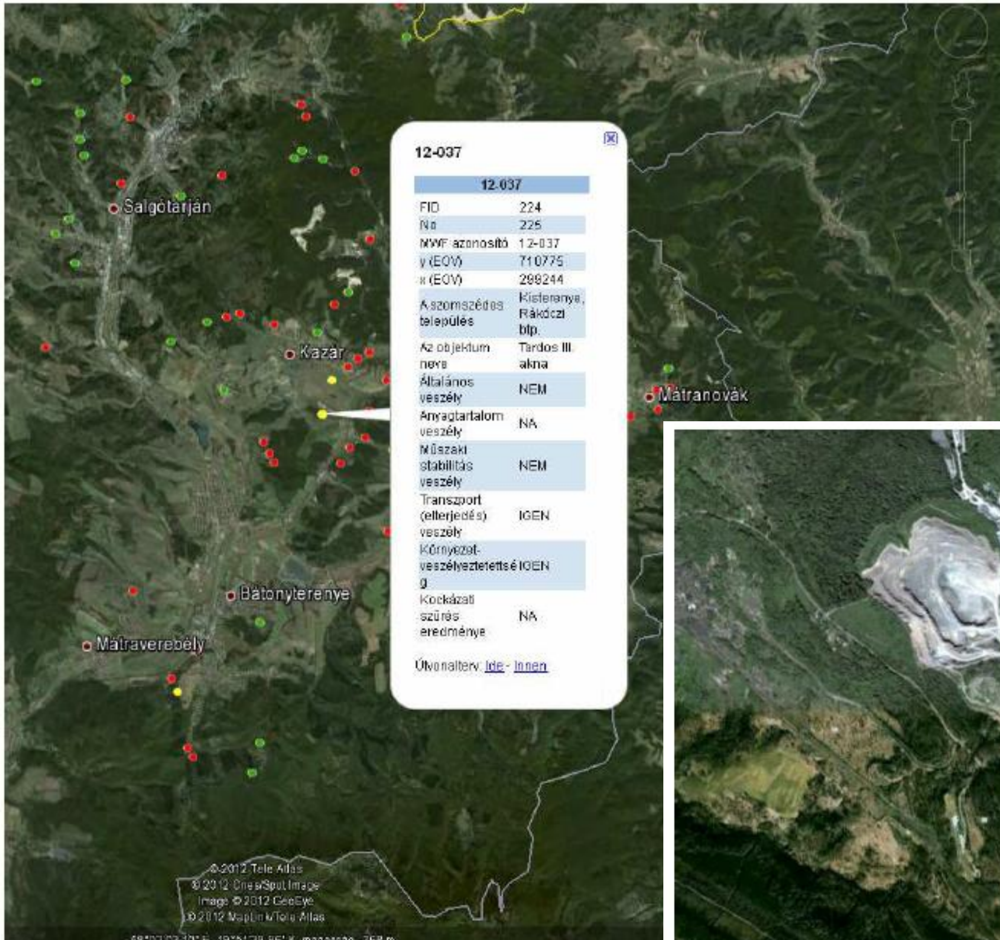


Figure 1: Internet presentation of pre-selection results by means of

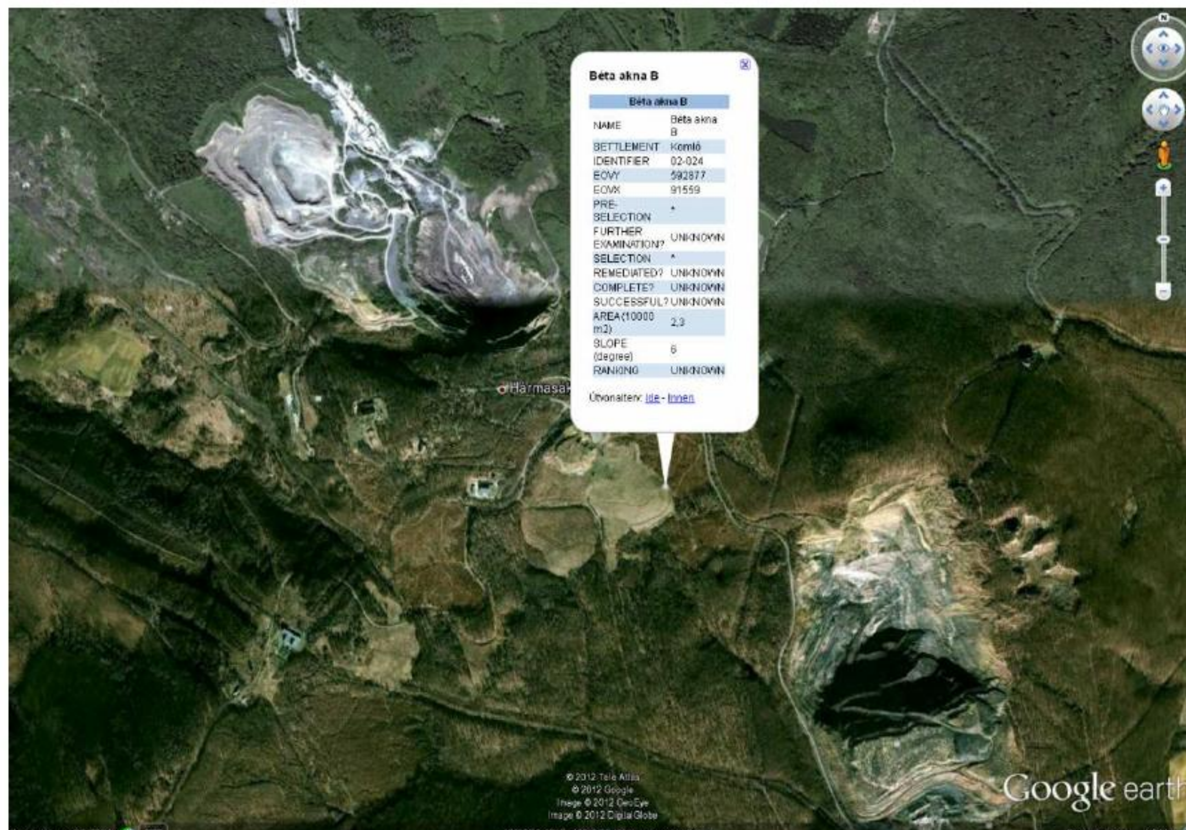


Figure 2: Internet presentation of pre-selection and selection results by means of maps.google.com KML format (April 2012)

HUNGARIAN OFFICE OF MINING AND GEOLOGY

Inventory and risk classification of closed mine waste facilities of Hungary

(Version №1)

MBFH–ELGI–MÁFI cooperation (10/2012)

Consigner:
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Authors:
János Kiss
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The English translation was made on the basis of the Hungarian version as of 30/04/2012

30 April 2012, Budapest, Hungary

Figure 2: Internet presentation of pre-selection and selection results by means of maps.google.com KML format (April 2012)

2.3. Internet representation of the results

The internet representation of the results is realized with the KMZ/KML file format that can be visualized with the Mozilla, Internet Explorer or other browsers and with the „maps.google.com" website. The following link is used:

http://maps.google.com/maps?q=http://econym.org.uk/gmap/example1.kml,

where the „example1.kml" is the file for representation.

Another possibility is the application of a GIS server like the MBFH server where the developed GIS system can be accessible for external users. The official MBFH permission for this has been released and it is under development at the present.

3. Results

The basic database for the inventory of closed mining waste facilities, developed from the various databases of landscape wounds, the mines databases and the waste heaps and tailing ponds database, contains **16 451** records. Only a small fraction of this, about **1 689** facilities are known as closed mine waste facilities, i.e. waste heaps and tailings ponds. The risk assessment and ranking of these facilities had to be carried out. The work proceeded from the hazardous facilities towards the less hazardous facilities. Out of the 1 689 mine waste facilities, **463** facilities can be regarded as potentially harmful according to the assumed non-inert or toxic material content at the date of the Internet publication on 01 May 2012. Field verification including the measurement of the exact geographical location has been accomplished for these facilities.

SCIENTIFIC RESEARCH

GEOCHEMISTRY, MODELLING, DECISIONS Research Group

COMPETITIVE FUND PROJECTS *3 EU, 1 international*

1. **EU TECHNICAL ASSISTANCE IN TURKEY PROJECT**
   risk-based inventory for the Mine Waste Directive

4. MOROCCO-HUNGARY BILATERAL PROJECT
climate zones: mine contamination mobility

1. CONTAMINATION RISK ASSESSMENT (RA)

a decision support tool

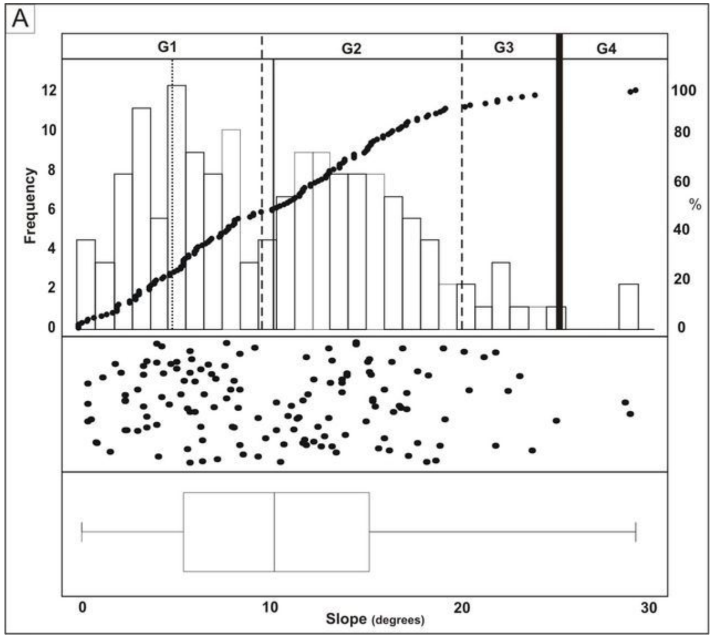
comparing the key parameters of some recognized Pre-screening RA methods for mine waste

FACTORS	RA methods / Key parameters	EU Pre-selection Protocol	HRS, US EPA 1992	US AIMSS, Poineer, 1994	EU PRAMS, EEA 2005	HMS, Irish EPA 2009	Di Sante et al., 2009	Bradhurst, 2010	Fan et al., 2010	Turner et al., 2011	Wang et al., 2011	Pizzol et al., 2011	Ranking
		X	X	X	X	X			X	X		X	8
		X		X	X	X		X			X	X	7
		X	X	X	X	X						X	6
		X		X	X	X		X					5
			X		X		X		X		X		5
		X			X	X				X			4
					X	X						X	3
		X						X					2
		X						X					2
		X					X						2
		X	X	X	X	X	X			X	X	X	9
		X	X	X		X	X		X			X	7
		X	X	X		X			X			X	6
		X		X	X	X	X		X				6
		X		X	X	X				X		X	6
		X		X		X							3
		X			X	X							3
		X			X							X	3
		X			X								2
												X	1
		X	X	X	X	X	X	X	X			X	9
		X	X	X	X	X	X				X	X	8

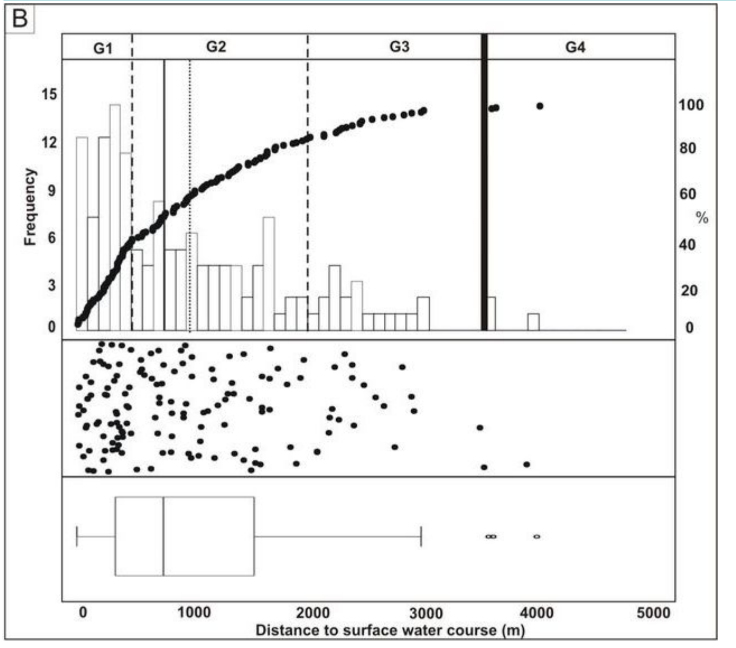
Table 3. Summary statistics of the Pre-selection Protocol responses of Q1-18, showing the number of YES, NO and UNKNOWN (U) responses in the EU and local thresholds (Median-based) and the percentage of certain to uncertain (U%) responses for each question.

Pre-selection Protocol		Number of Sites	EU thresholds		Local thresholds (Median-based)		Local thresholds (Highest group)		U	U %
			YES	NO	YES	NO	YES	NO		
Impact	Q1	145	19	126	19	126	19	126	0	0
Source	Q2	145	101	40	101	40	101	40	4	3
	Q3	145	126	15	126	15	126	15	4	3
	Q4	145	7	138	7	138	7	138	0	0
	Q5	145	9	136	9	136	9	136	0	0
	Q6	9	9	0	9	0	9	0	0	0
	Q7	9	4	2	4	2	4	2	3	33
	Q8	136	34	92	34	92	34	92	10	7
	Q9	136	9	115	9	115	9	115	12	9
	Q10	136	110	26	74	62	2	134	0	0
Pathway	**Q11**	145	64	81	73	72	144	1	0	0
	Q12	145	120	25	120	25	120	25	0	0
	Q13	145	35	110	35	110	35	110	0	0
	Q14	145	28	117	28	117	28	117	0	0
Receptor	**Q15**	145	45	100	73	72	141	4	0	0
	Q16	145	28	117	73	72	142	3	0	0
	Q17	145	131	14	91	54	142	3	0	0
	Q18	145	84	61	73	72	142	3	0	0

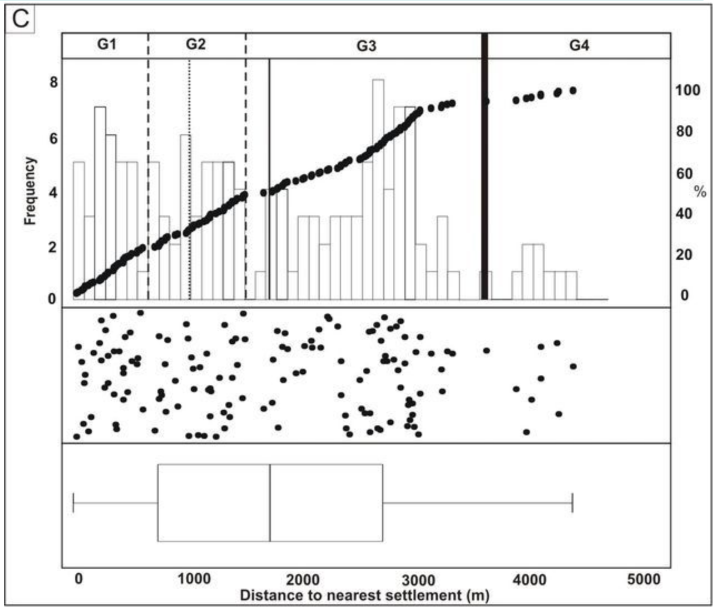
Q10: topographic slope



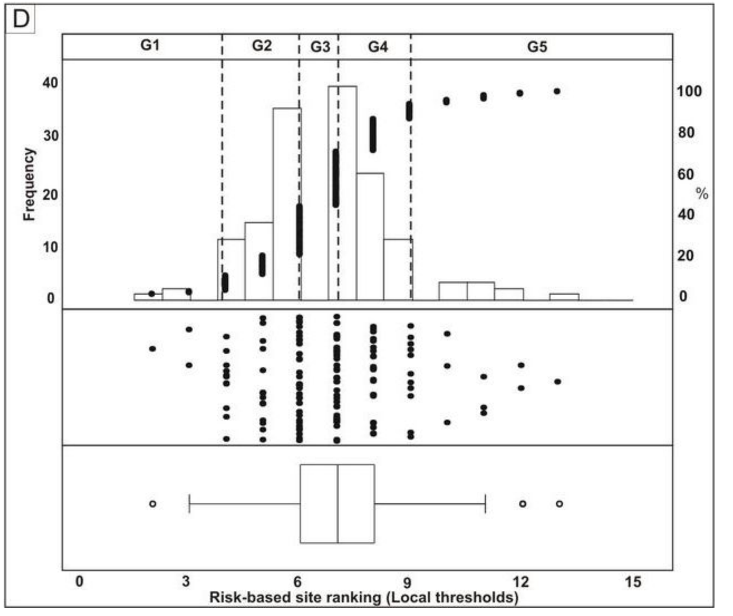
Q11: distance to surface water course



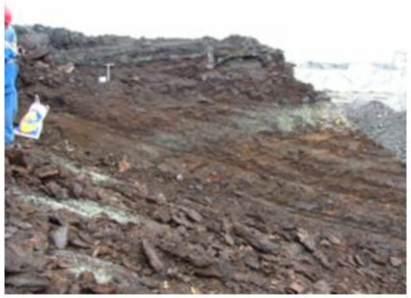
Q15: distance to settlement



Risk-based site ranking (local thresholds)

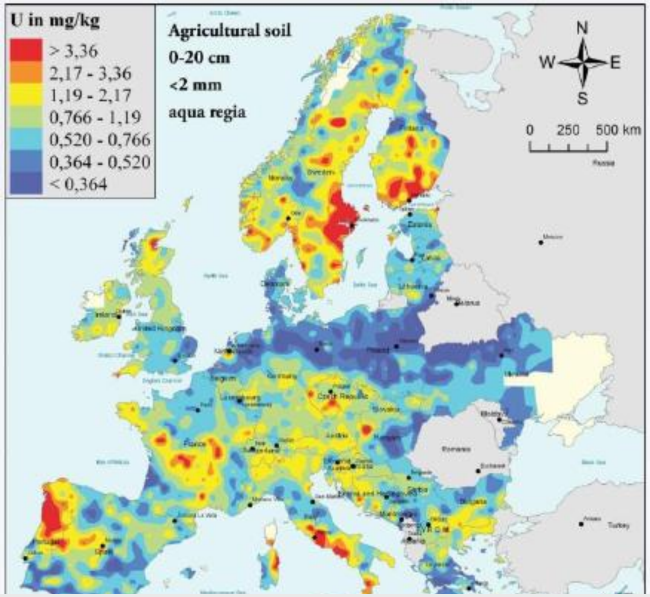


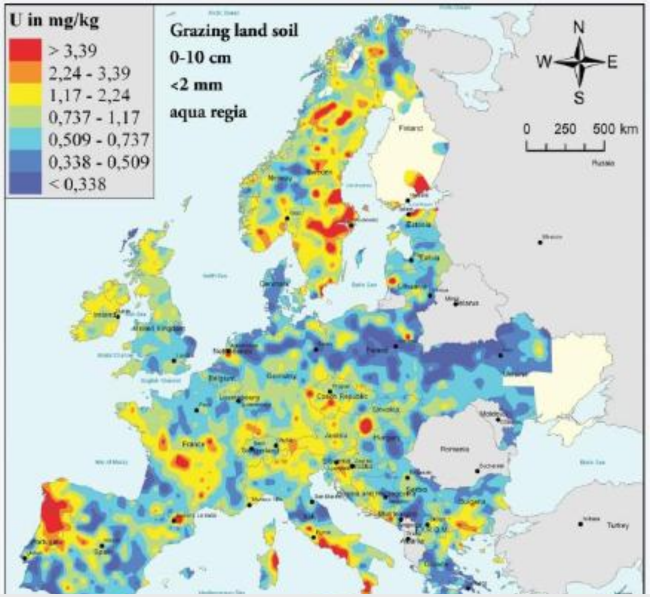
2. INERT MINING WASTE
geochemical classification in Hungary



1. GEMAS PROJECT
geochemical mapping of soils in Europe

2211 samples: agricultural soil, 2118 samples: grazing land soil (32 countries)





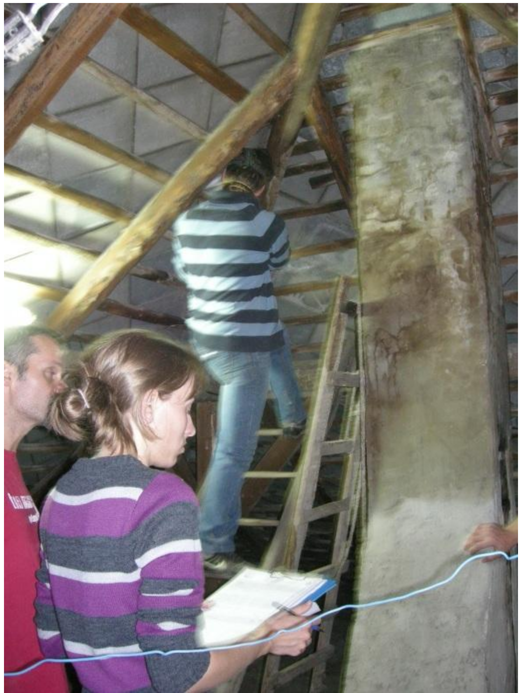
C. Reimann, P. Caritat, The GEMAS Project Team (***G. Jordan***), 2011. New soil composition data for Europe and Australia: demonstrating comparability, identifying continental-scale processes and learning lessons for global geochemical mapping. Science of Total Environment (in press)

4. URGE PROJECT

urban geochemistry in Europe

urban soil geochemical survey

4. URGE PROJECT
urban geochemistry in Europe
attic dust geochemical survey



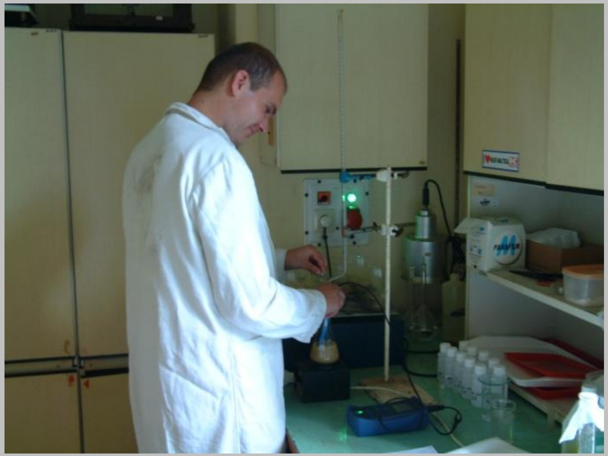
2. CONTAMINATION MOBILITY
field & lab leaching tests

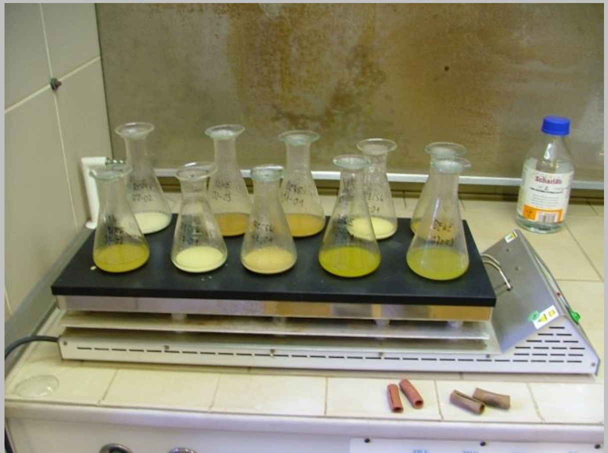
ANC, EPA 1310, EPA 1320, TCLP (EPA 1311), NAG and ABA tests for mine waste toxic element mobility assessment

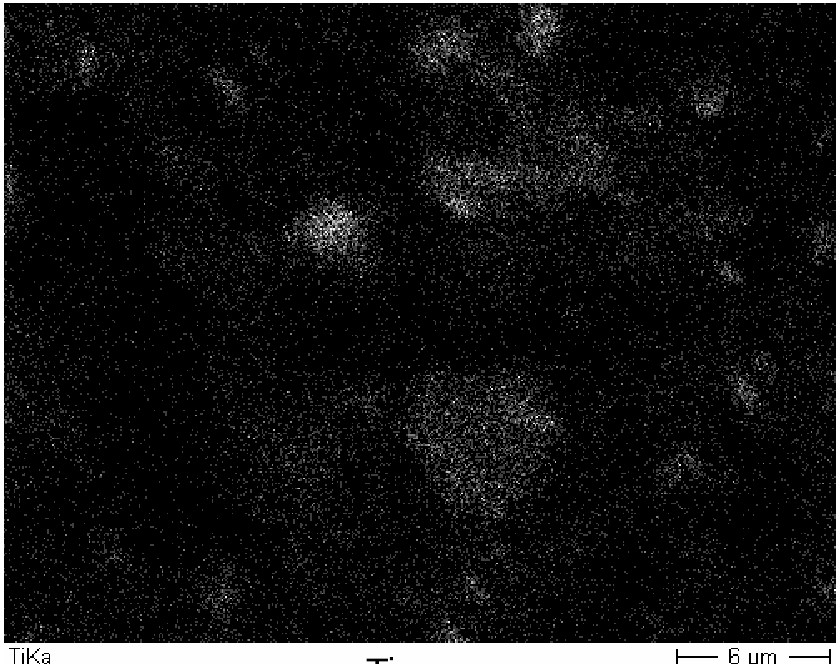
2. CONTAMINATION MOBILITY

field & lab leaching tests

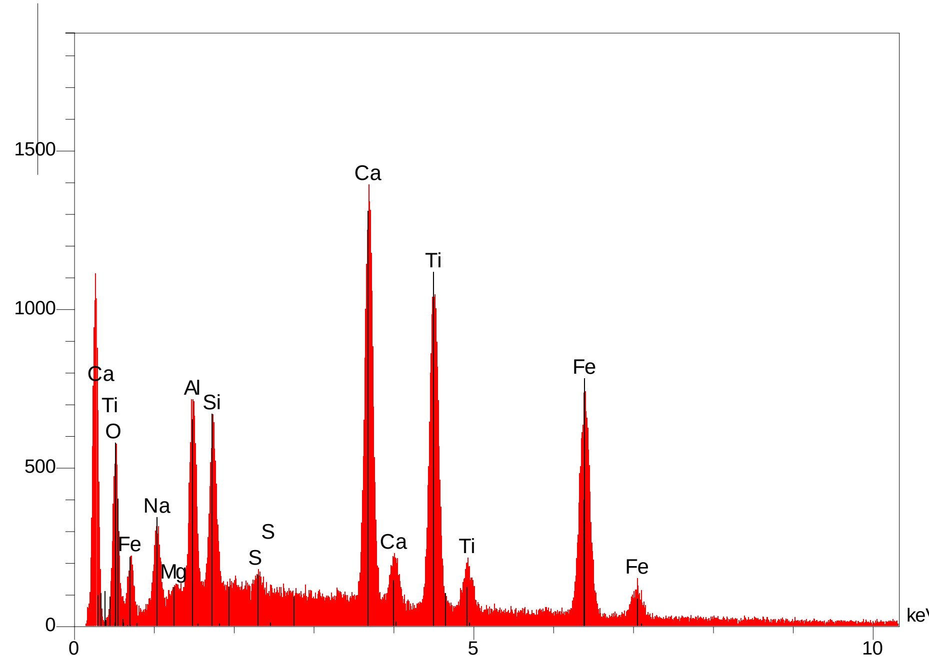
ANC, EPA 1310, EPA 1320, TCLP (EPA 1311), NAG and ABA tests for mine waste toxic element mobility assessment.



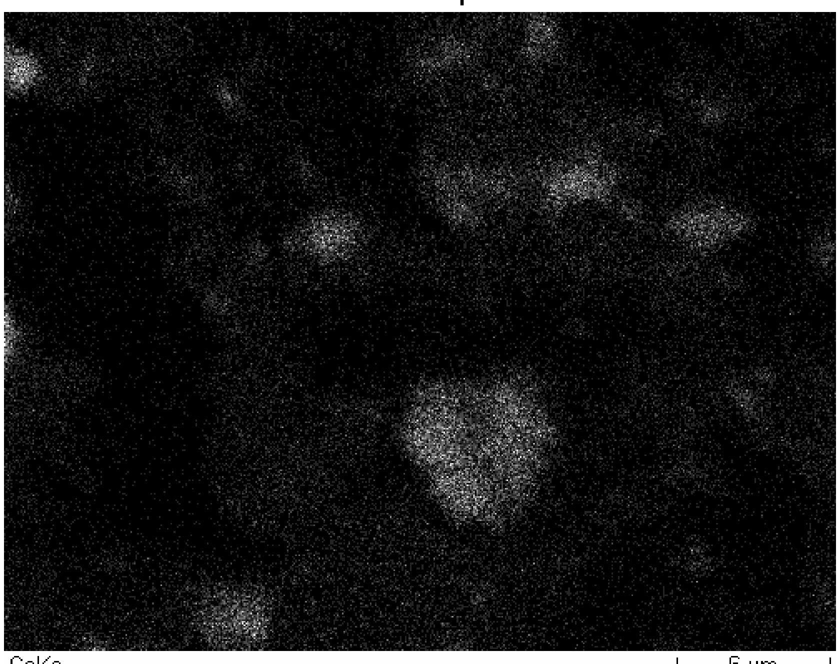




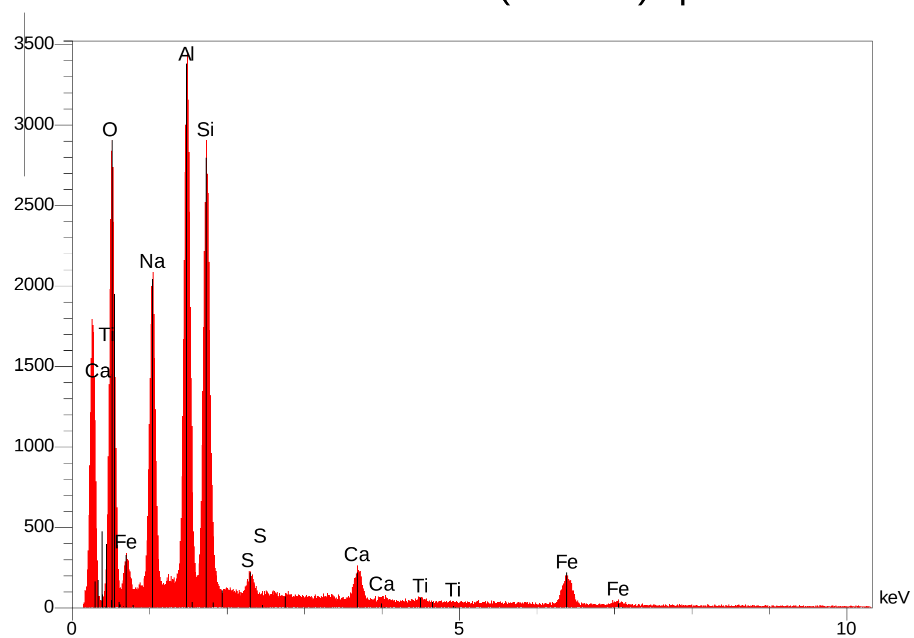
Ti map



Perovskite (CaTiO3) spektra



Ca map

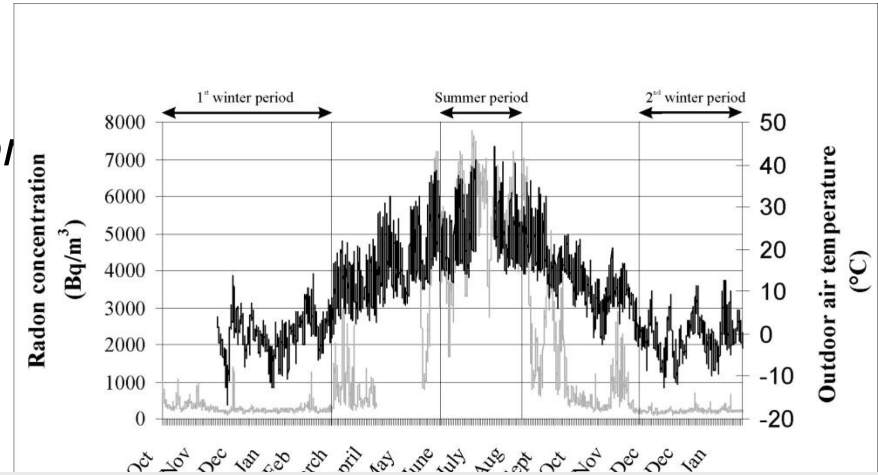


Cankrinite ((Na2,Ca)4[(AlSiO4)6) spektra

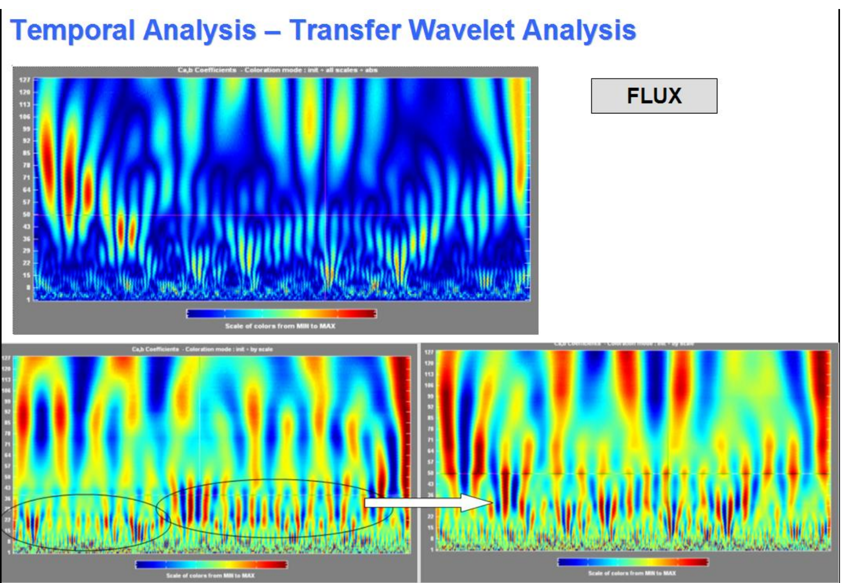
3. CONTAMINATION TRANSPORT
transport & reaction modelling
geochemical reaction modelling

7. TIME SERIES ANALYSIS

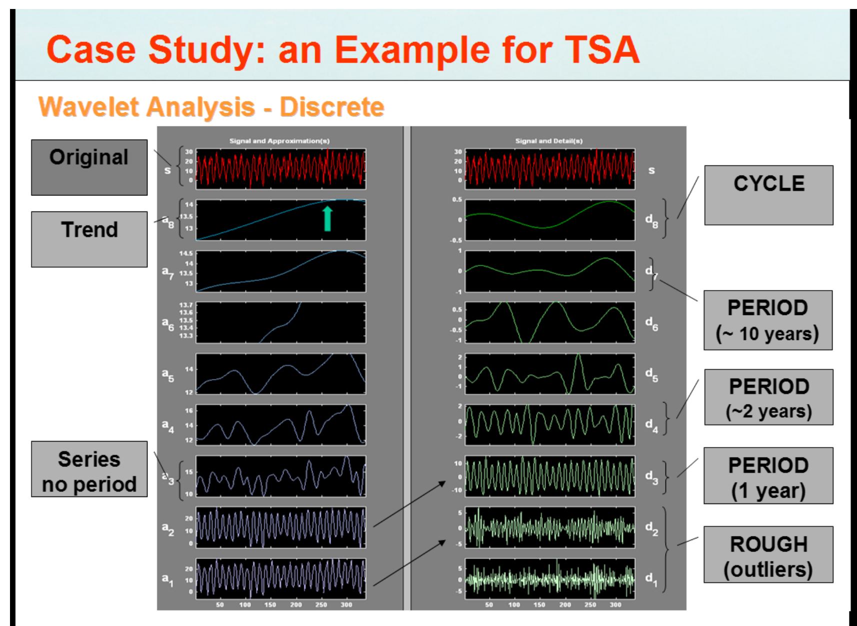
environmental dynamics & prediction



H. Nagy, Z. Szabó, ***G. Jordan***, C. Szabó, Á. Horváth, A. Kiss, 2011. Time variations of 222Rn concentration and air exchange rates in a Hungarian cave. Isotopes in Environmental & Health Studies (in press)



Vavelet Transform: I/O Sediment Flux Extremes binary signal)



RESEARCH PROJECTS *16 projects*

4. CONTAMINATION DEPOSITION

human & ecosystems

Human & Ecosystem health: <u>MEDICAL GEOLOGY</u>

4. CONTAMINATION DEPOSITION

human & ecosystems

Ecosystem receptors: *FLOODPLAIN GEOCHEMISTRY*

9. CATASTROPHE RESPONSE

RED MUD spill in Ajka 2010

MOBILE GIS TECH
development and application