Assessment Of The Environmental Burdens Using Geophysical Techniques

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Use Of Geophysics For Environmental Burden Mapping

- Monitoring of environmental burden impact on geological factors of the environment in selected regions of the Western Carpathians (2000-2005, MZP SR, 140901/1136/Prj/SK)

- Use of remote sensing for monitoring the environmental burden impact on geological factors of the environment in selected regions (2008, MZP SR, 182/2003/7.2)

- **Monitoring of environmental burden at selected sites in Slovakia, part 6., geophysical services for the project (at present, MZP SR, NFP24140111461)**

Geophysical Survey Methodology:

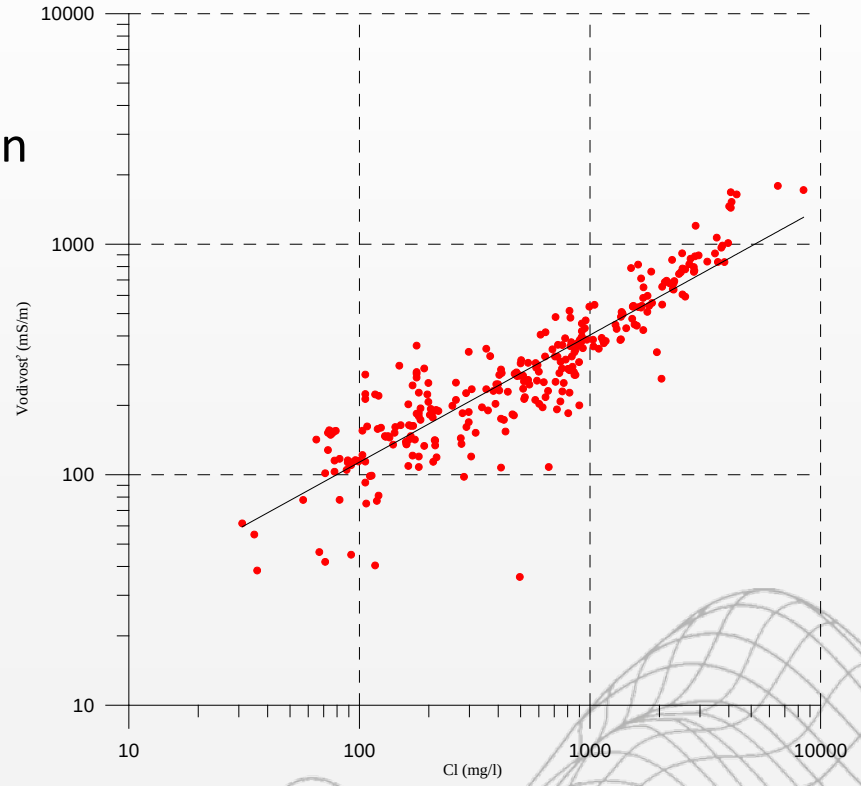
- Detailed review of all relevant archive documents, information, etc.
- On-Site research (site access, assessment of available survey options, etc.)
- General screening of the physical parameters and the survey itself.

Geophysical Methods Used:

- Electrical Resistivity Tomography
- Frequency Domain Electromagnetic Profiling
- Magnetic Profiling
- Ground Penetrating Radar
- Self Potential
- Mise-a-la-masse
- Radioactive Methods
- Borehole Seismic

Electrical Methods

Closely related to quality of the geology environment and mineralization of the ground water.



Phase I. – General Geophysical screening using FDEM Method

FDEM – Electrical currents are induced into subsurface conductors by an operator-held transmitter loop that radiates an electromagnetic field. As the EM energy encounters different subsurface materials, eddy currents are induced creating secondary EM fields. This secondary field is recorded at the surface by a receiver loop.

Frequency-Domain EM Profiling (FDEM)

Phase II. – Electrical Resistivity Tomography

ERT - Electrical Resistivity Tomography (ERT) uses an array of electrodes (typically 64) connected by multicore cable to provide a linear depth profile, or pseudosection, of the variation in resistivity both along the survey line and with depth. Switching of the current and potential electrode pairs is done automatically using a laptop computer and relay box. The computer initially keeps the spacing between the electrodes fixed and moves the pairs along the line until the last electrode is reached. The spacing is then increased and the process repeated in order to provide an increased depth of investigation.

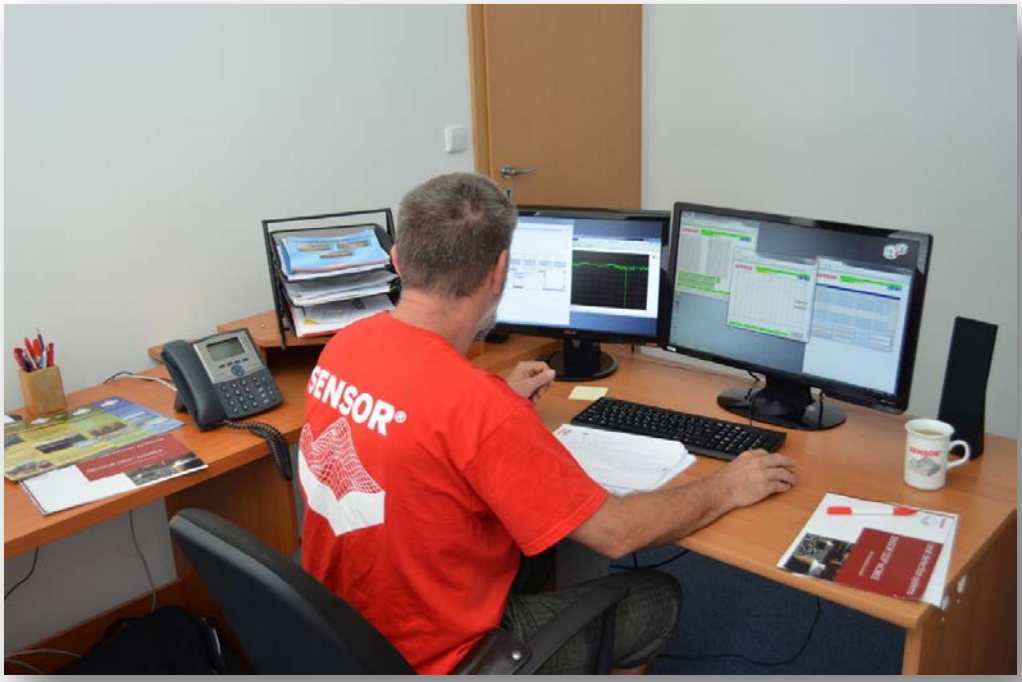
Electrical Resistivity Tomography

At selected profiles an electrode spacing is determined (according to target depth and resolution) and measurements are taken. This method was used at each site during this project

Data Analyses

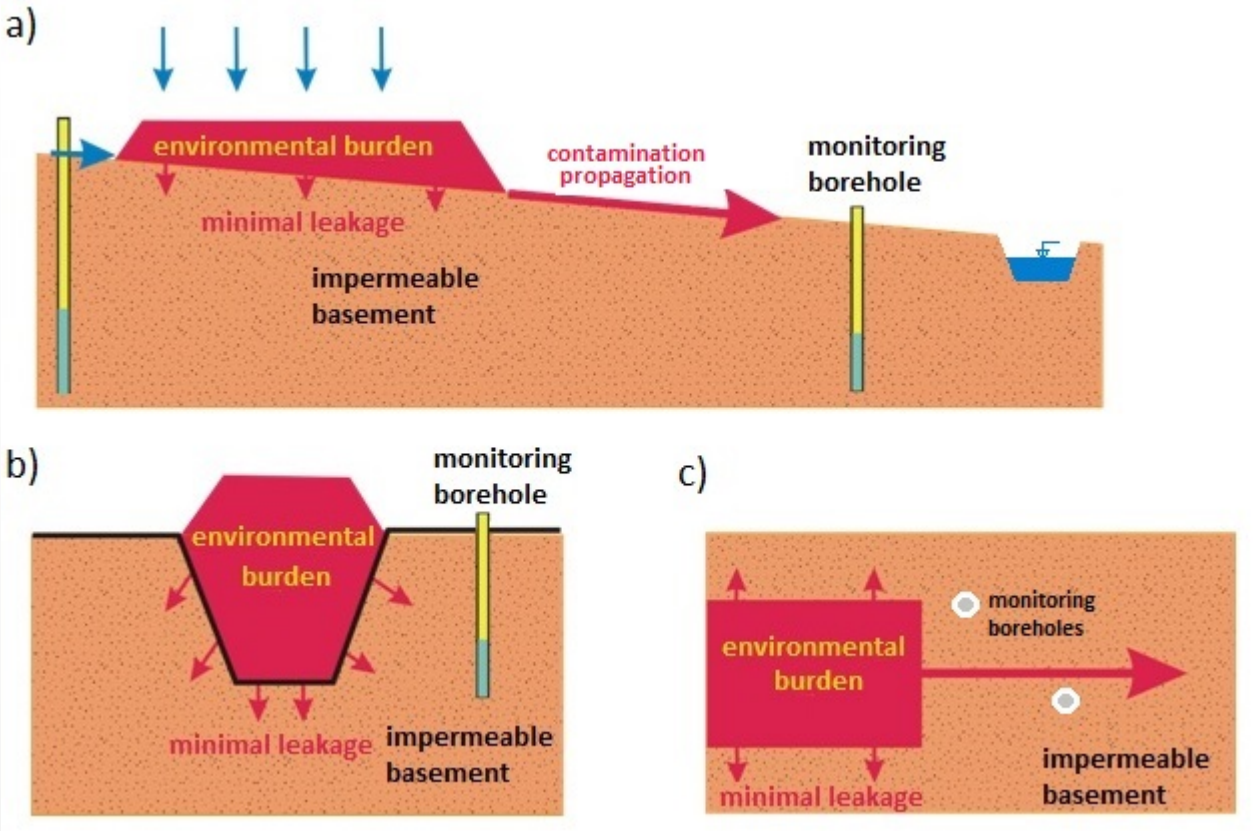
- Determine the extent of burden

- Burden impact analyses
  (time, space, chemical changes)



When evaluating collected geophysical data its appropriate to use conceptual models of the contaminant percolation

Concept Model A (Vybíral, V. a kol. 2008, Mikita, S. 2010)



Environmental burden with zero depth of the impermeable layer
a) model cross section b) front view c) top view

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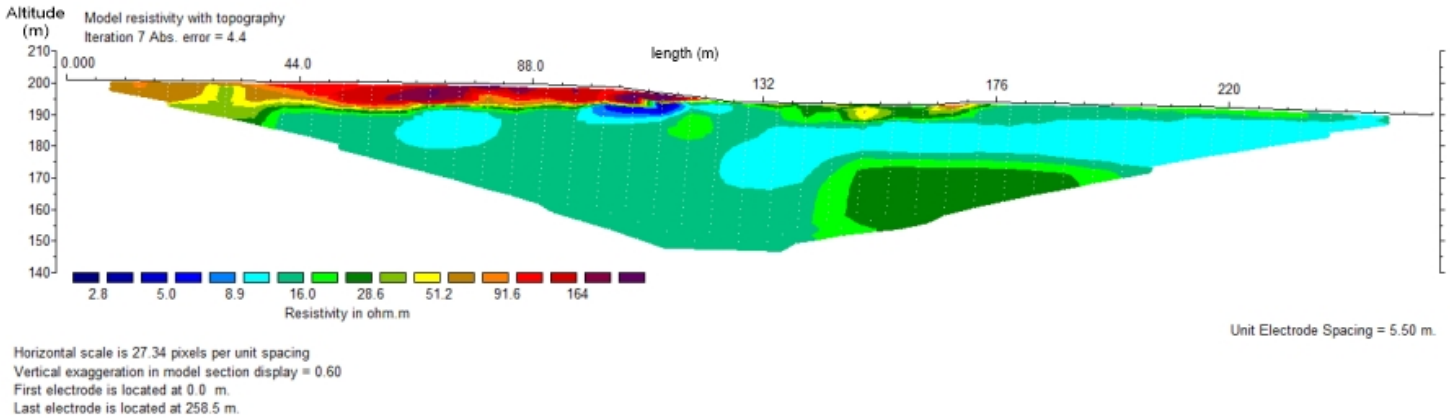
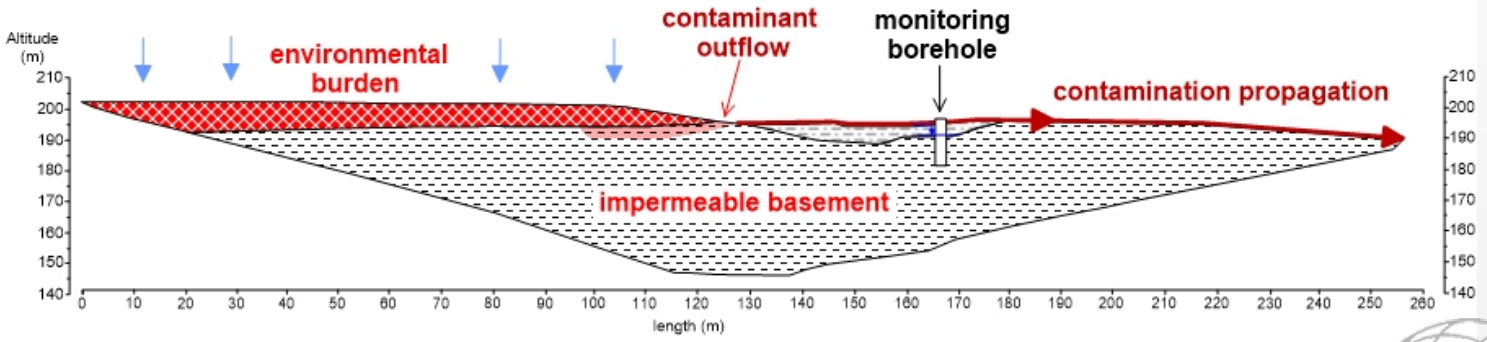
Inverse resistivity profile



Simplified geological interpretation



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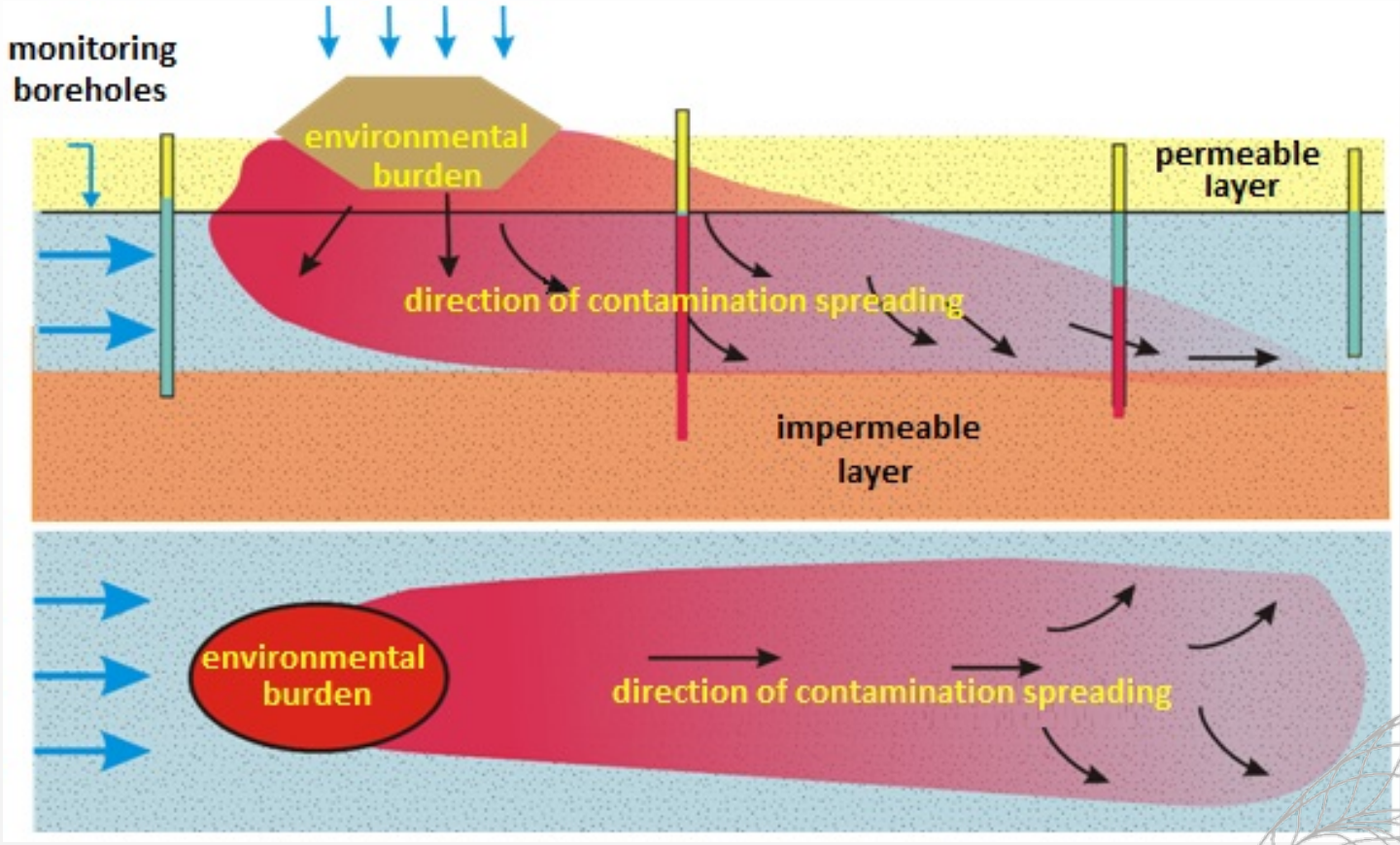
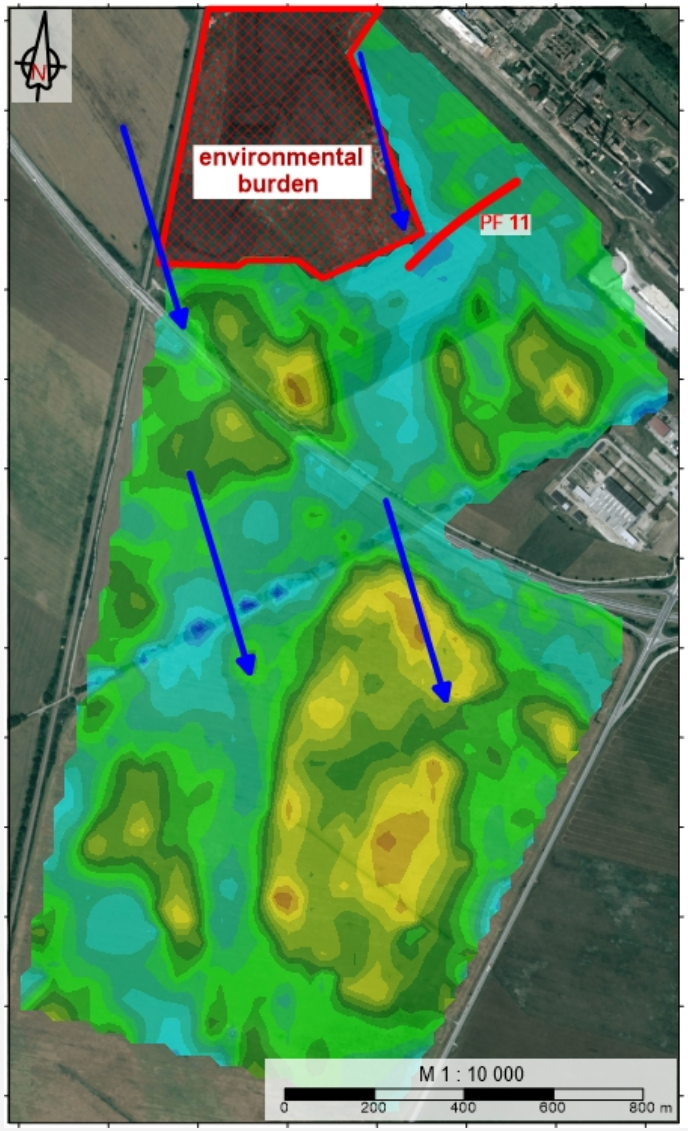
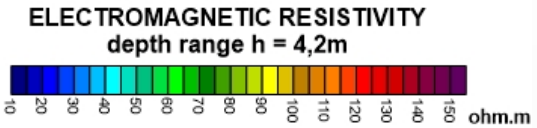
Concept Model B (Vybíral, V. a kol. 2008, Mikita, S. 2010)



Example of contamination spreading near landfill





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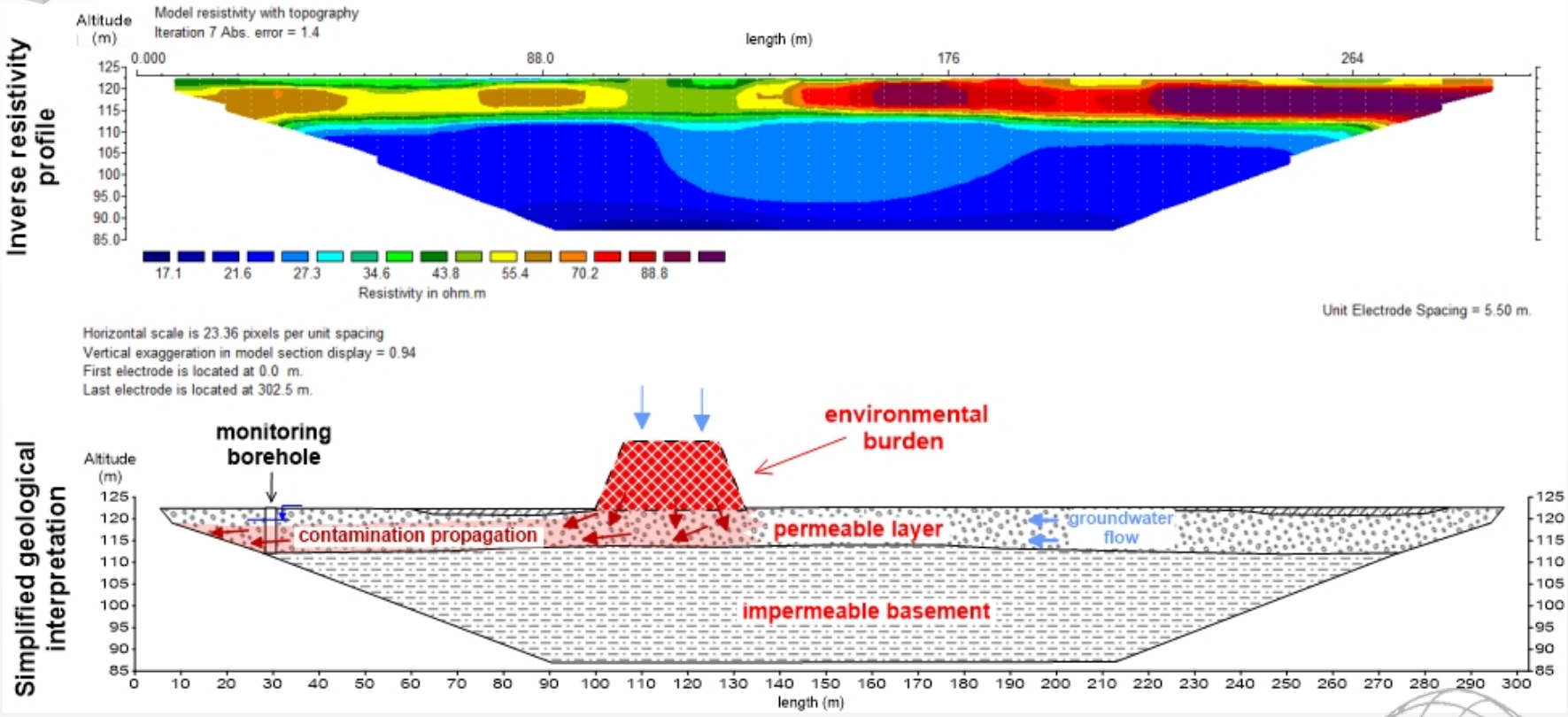
Inverse resistivity profile
Altitude (m)
Model resistivity with topography
Iteration 7 Abs. error = 1.4
length (m)
0.000
88.0
176
264
125
120
115
110
105
100
95.0
90.0
85.0
17.1
21.6
27.3
34.6
43.8
55.4
70.2
88.8
Resistivity in ohm.m
Unit Electrode Spacing = 5.50 m.
Horizontal scale is 23.36 pixels per unit spacing
Vertical exaggeration in model section display = 0.94
First electrode is located at 0.0 m.
Last electrode is located at 302.5 m.
Simplified geological interpretation
monitoring borehole
environmental burden
Altitude (m)
contamination propagation
permeable layer
groundwater flow
impermeable basement
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300
length (m)

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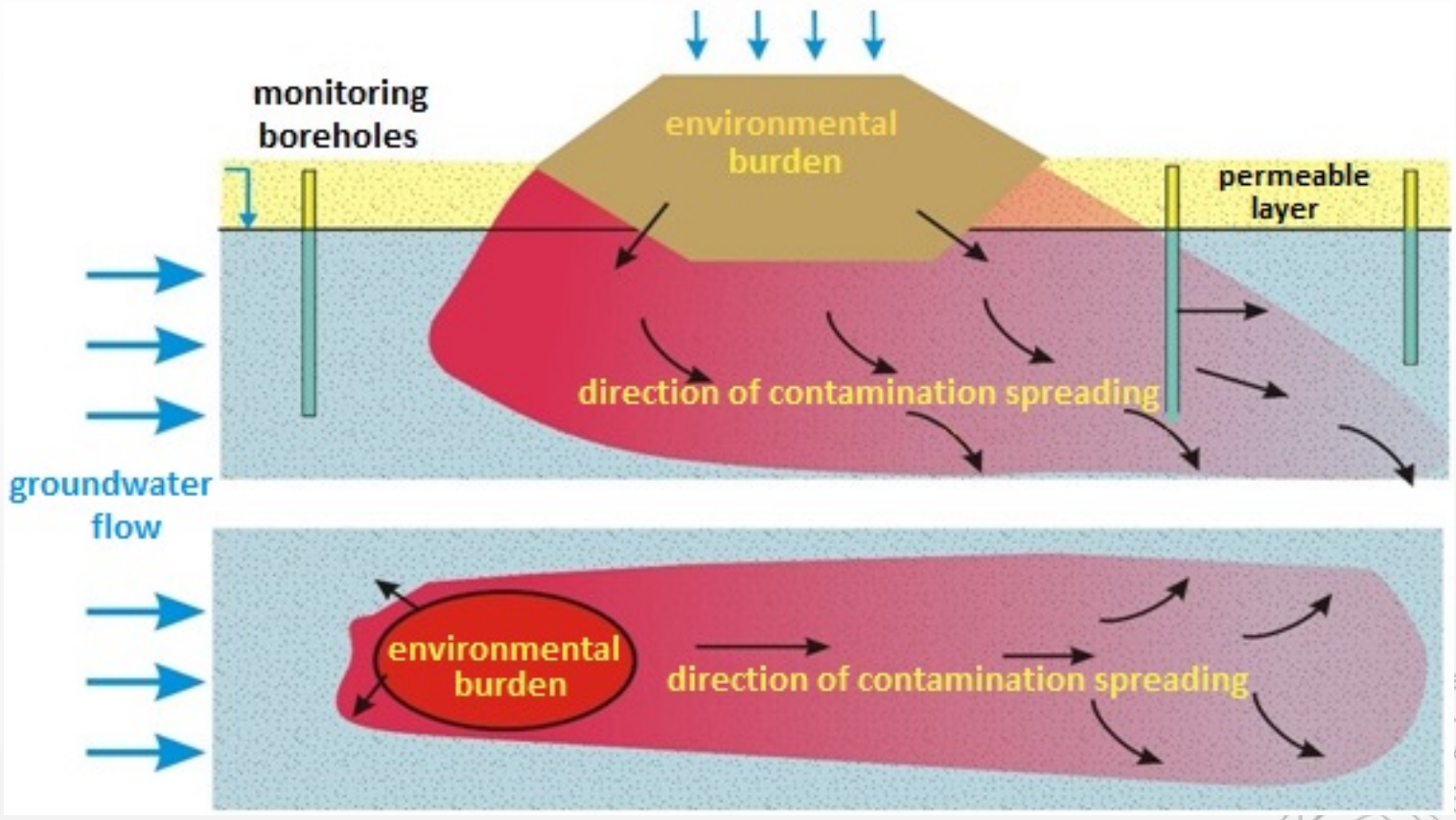
Concept Model C (Vybíral, V. a kol. 2008, Mikita, S. 2010)



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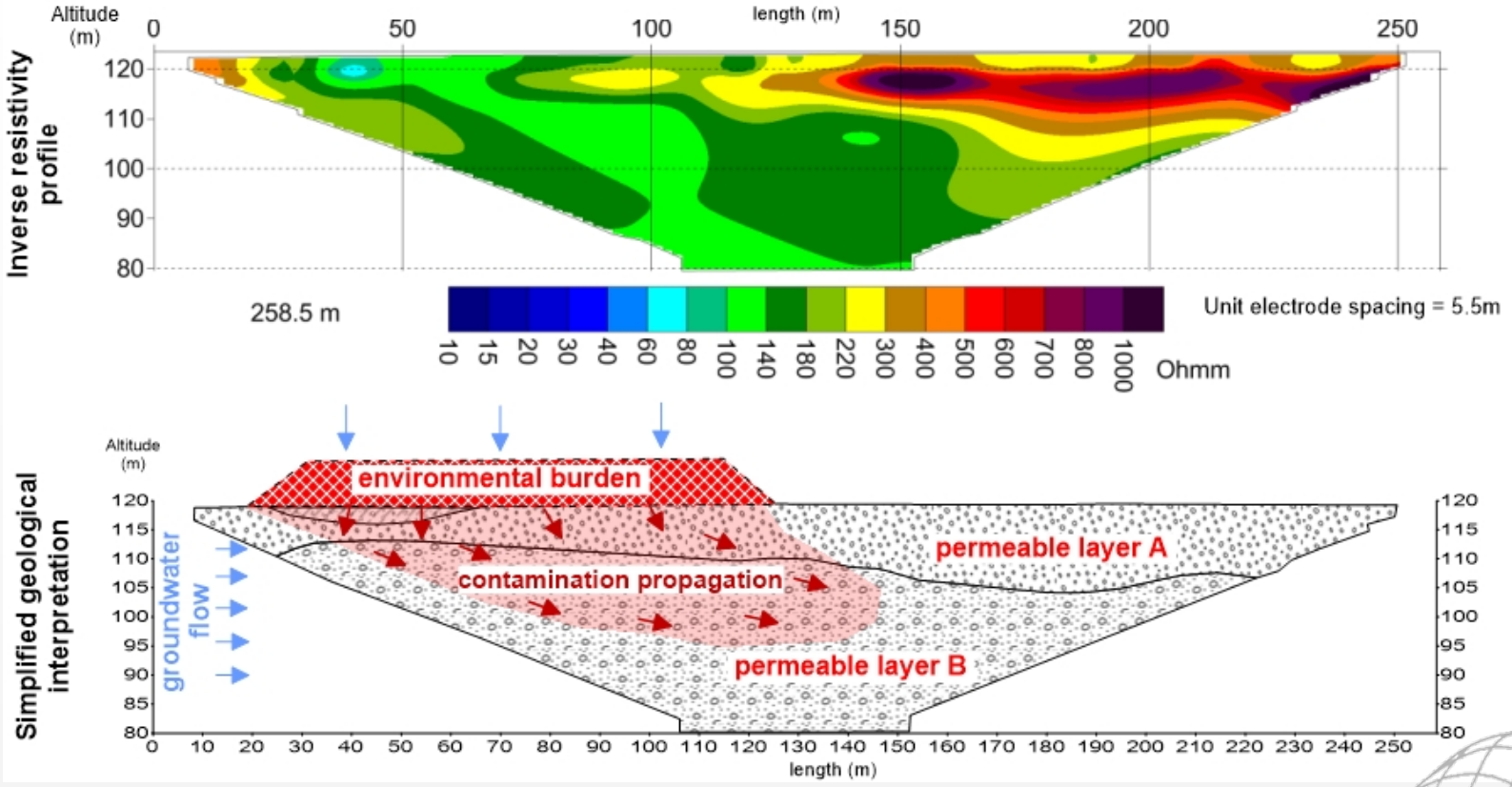
Inverse resistivity profile
Altitude (m)
length (m)
0
50
100
150
200
250
120
110
100
90
80
258.5 m
Unit electrode spacing = 5.5m
10
15
20
30
40
60
80
100
140
180
220
300
400
500
600
700
800
1000
Ohmm
Simplified geological interpretation
Altitude (m)
environmental burden
contamination propagation
permeable layer A
permeable layer B
groundwater flow
length (m)

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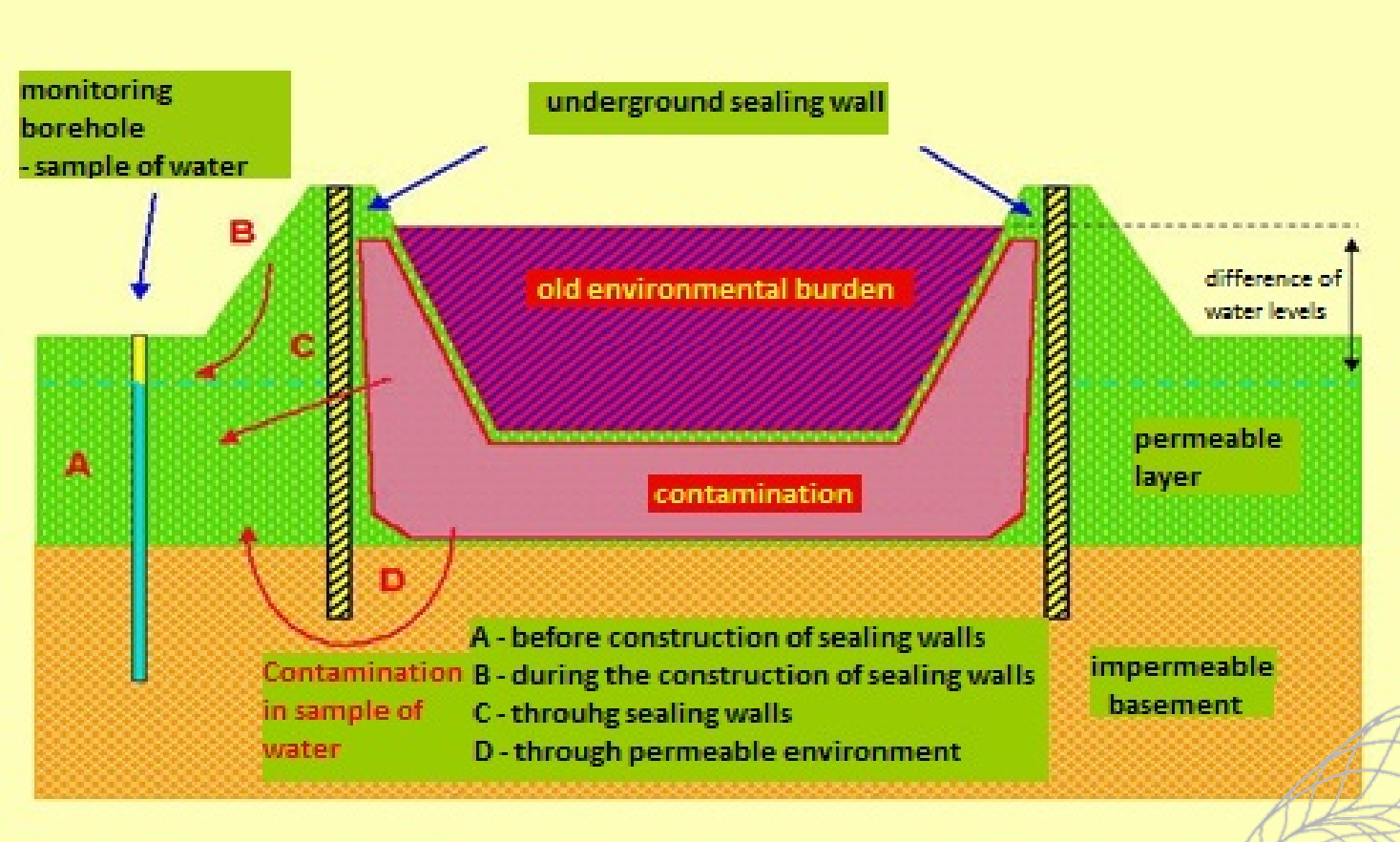
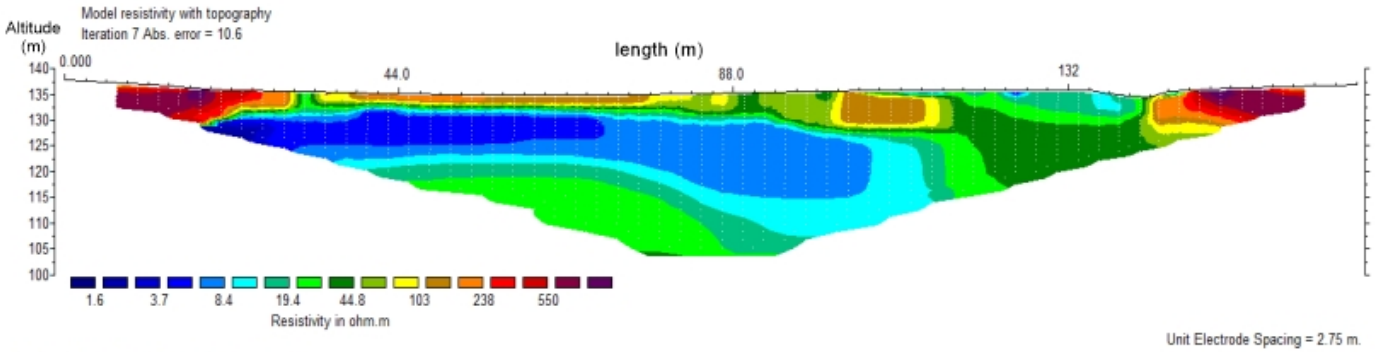
Concept Model D (Vybíral, V. a kol. 2008, Mikita, S. 2010)

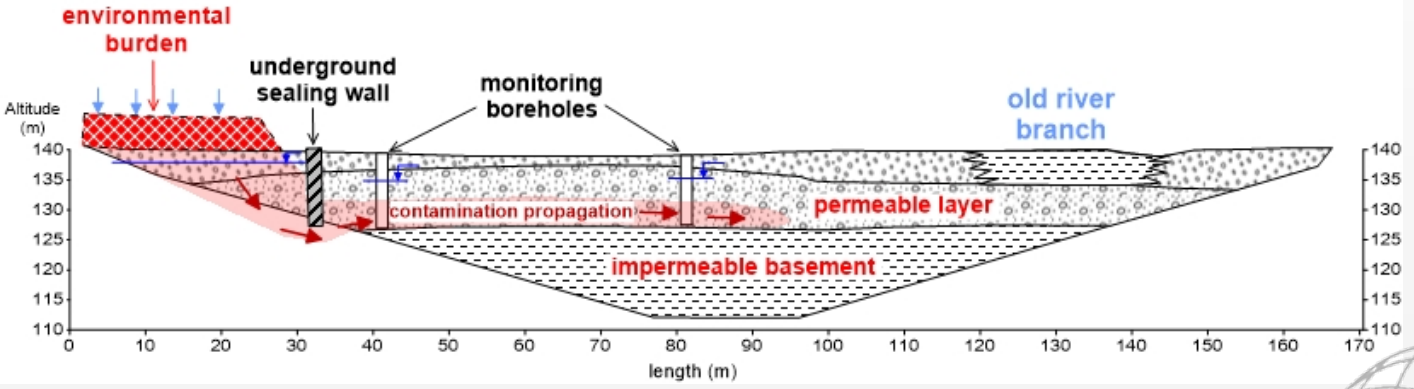


Example of contamination leaking through underground sealing wall

Inverse resistivity profile



Simplified geological interpretation



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