Incorporation of core log information in electrical resistivity tomography: the case of the Lontzen-Poppelsberg ore deposit (Belgium)

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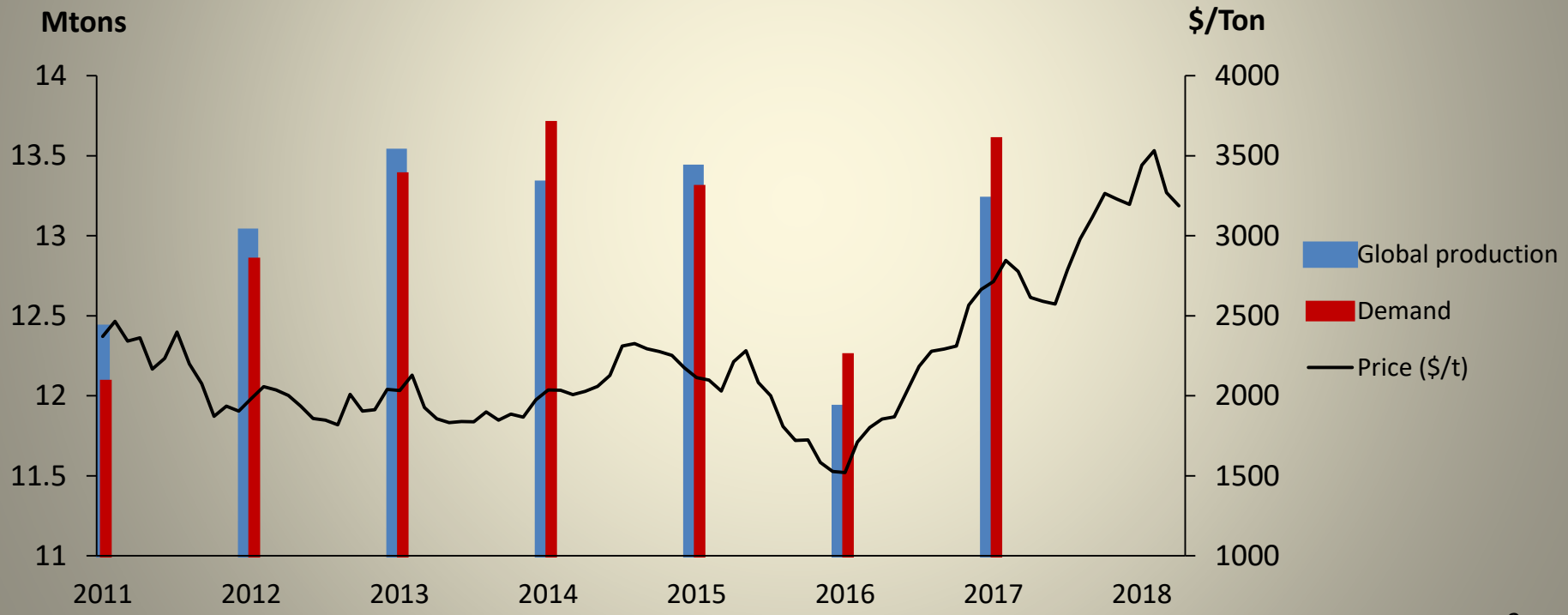
Deficit of 400 ktons of refined zinc in 2017



Challenge in zinc exploration

New discoveries

- <Size
- Mineralogy
- Geometry
- <grade
- >depth

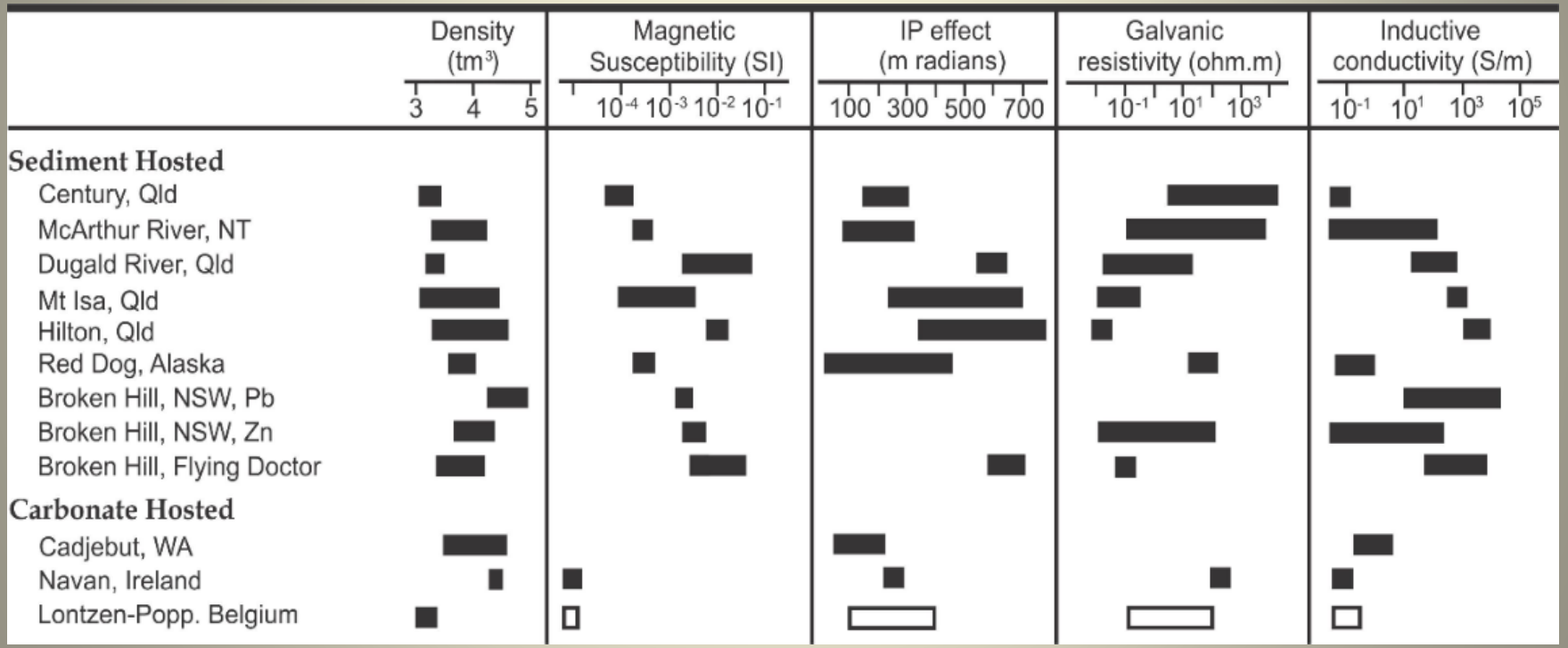
Sphalerite is hard to prospect

One of the most resistive sulphide

Density < other sulphides

Non-magnetic

Geophysics on Zn ore deposit



Modified after Bishop et al. 1999

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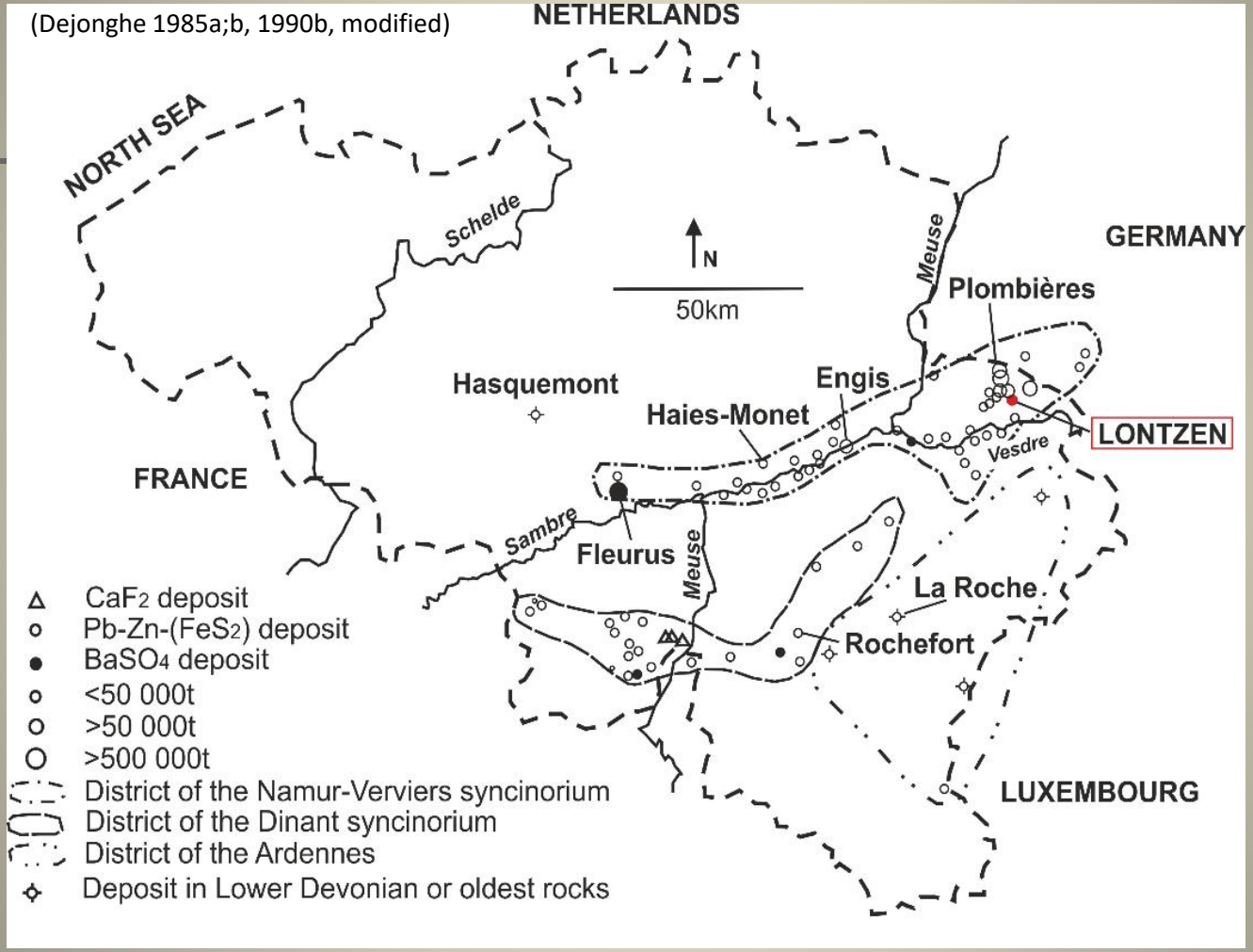
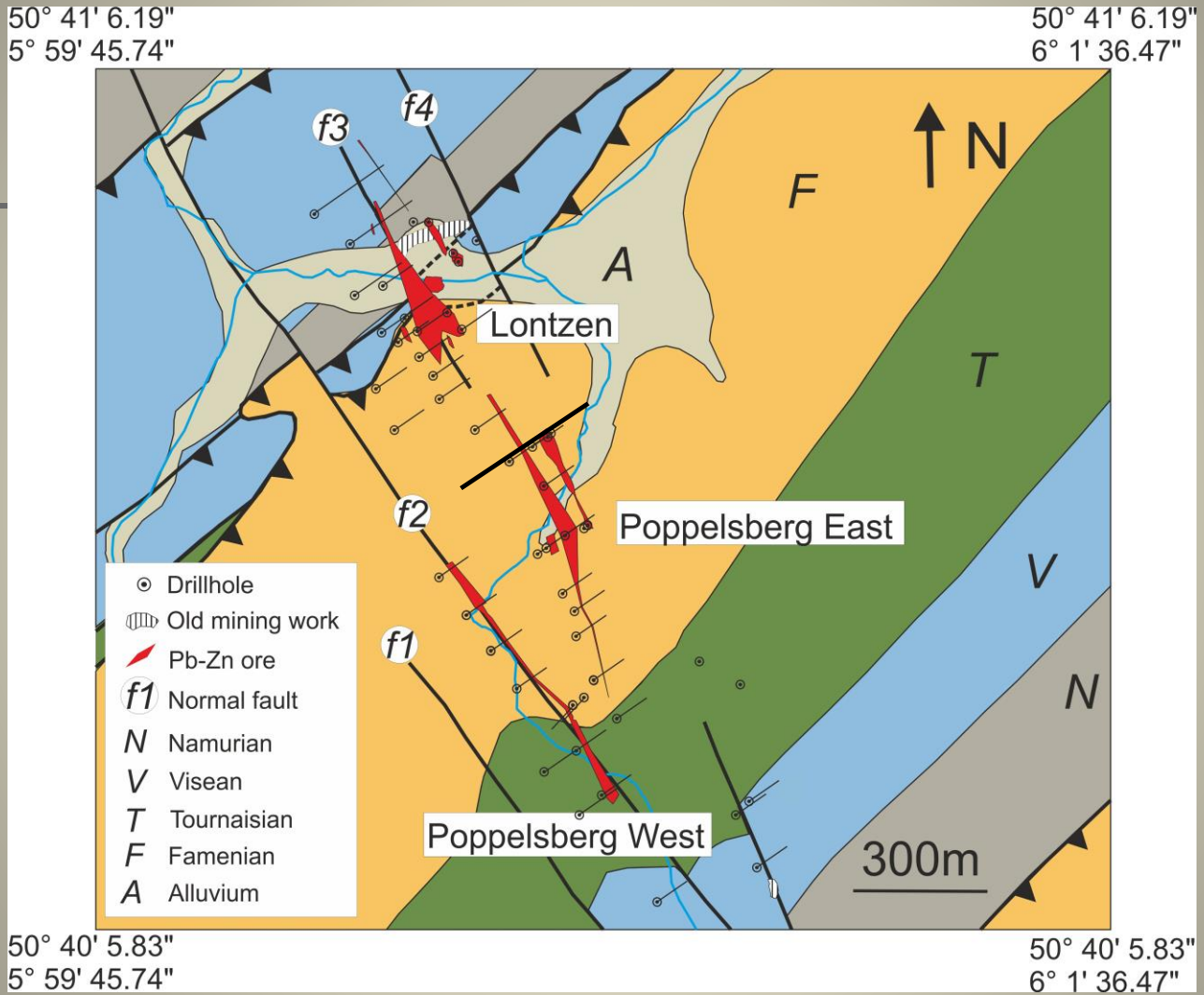
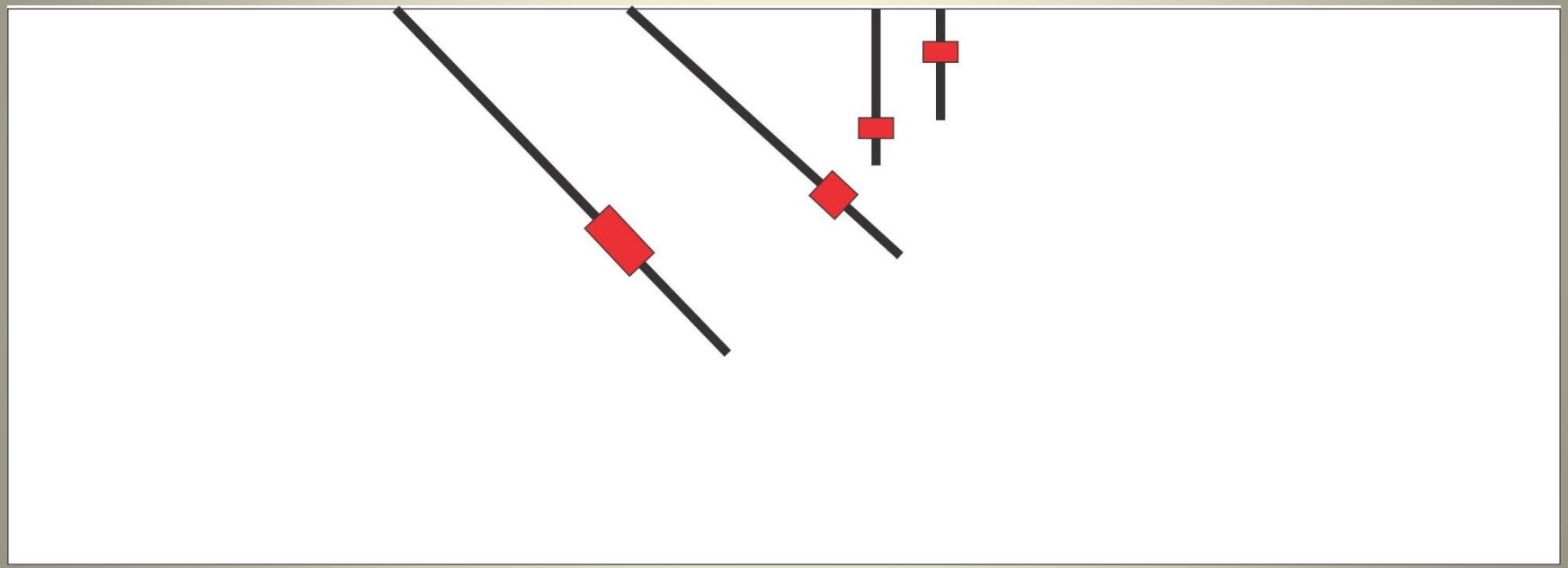
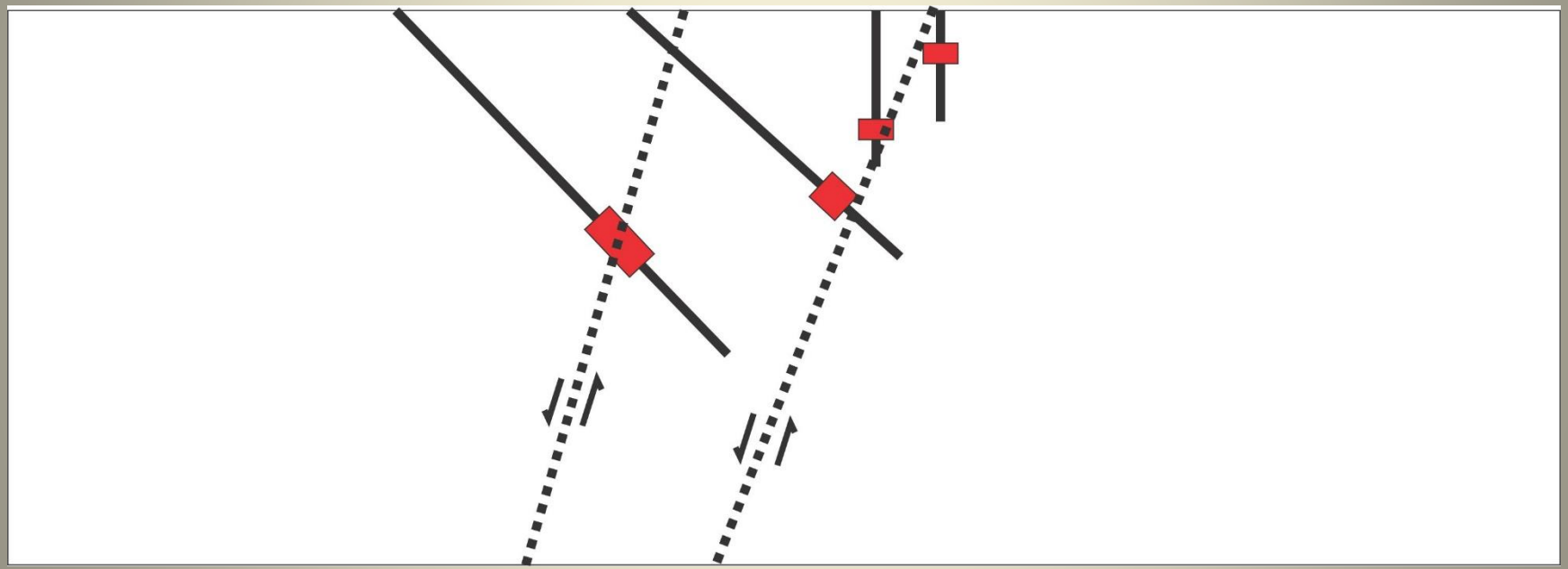
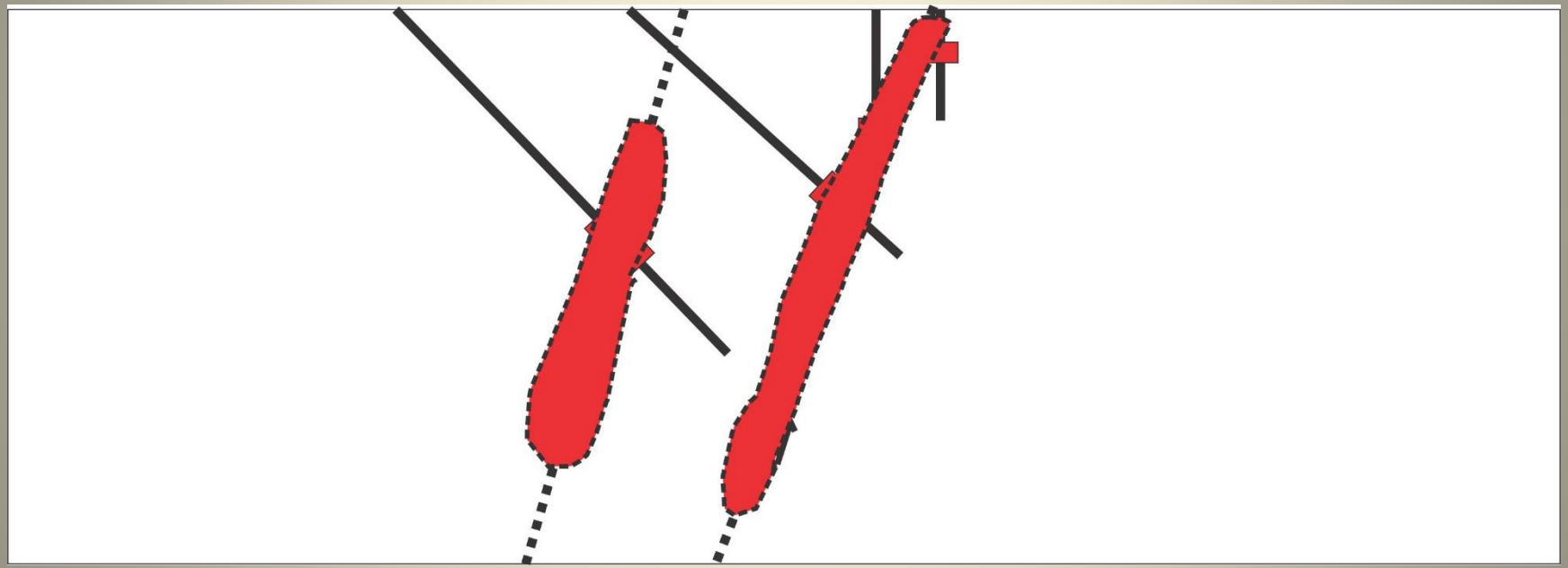
(Dejonghe 1985a;b, 1990b, modified)

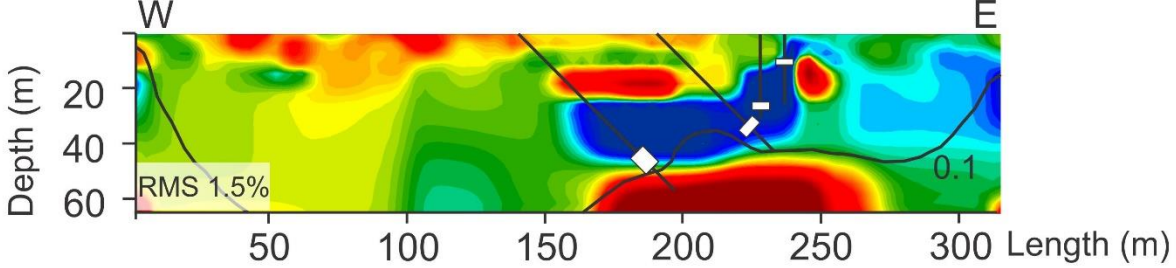


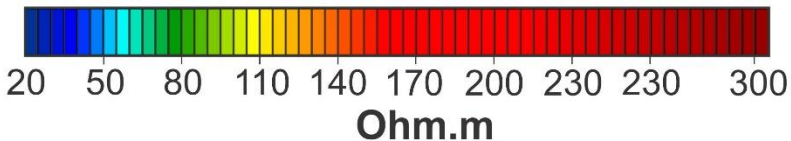

50° 41' 6.19"
5° 59' 45.74"
50° 41' 6.19"
6° 1' 36.47"
f3
f4
F
N
A
Lontzen
T
f2
Poppelsberg East
V
f1
N
Drillhole
Old mining work
Pb-Zn ore
f1 Normal fault
N Namurian
V Visean
T Tournaisian
F Famenian
A Alluvium
Poppelsberg West
300m
50° 40' 5.83"
5° 59' 45.74"
50° 40' 5.83"
6° 1' 36.47"

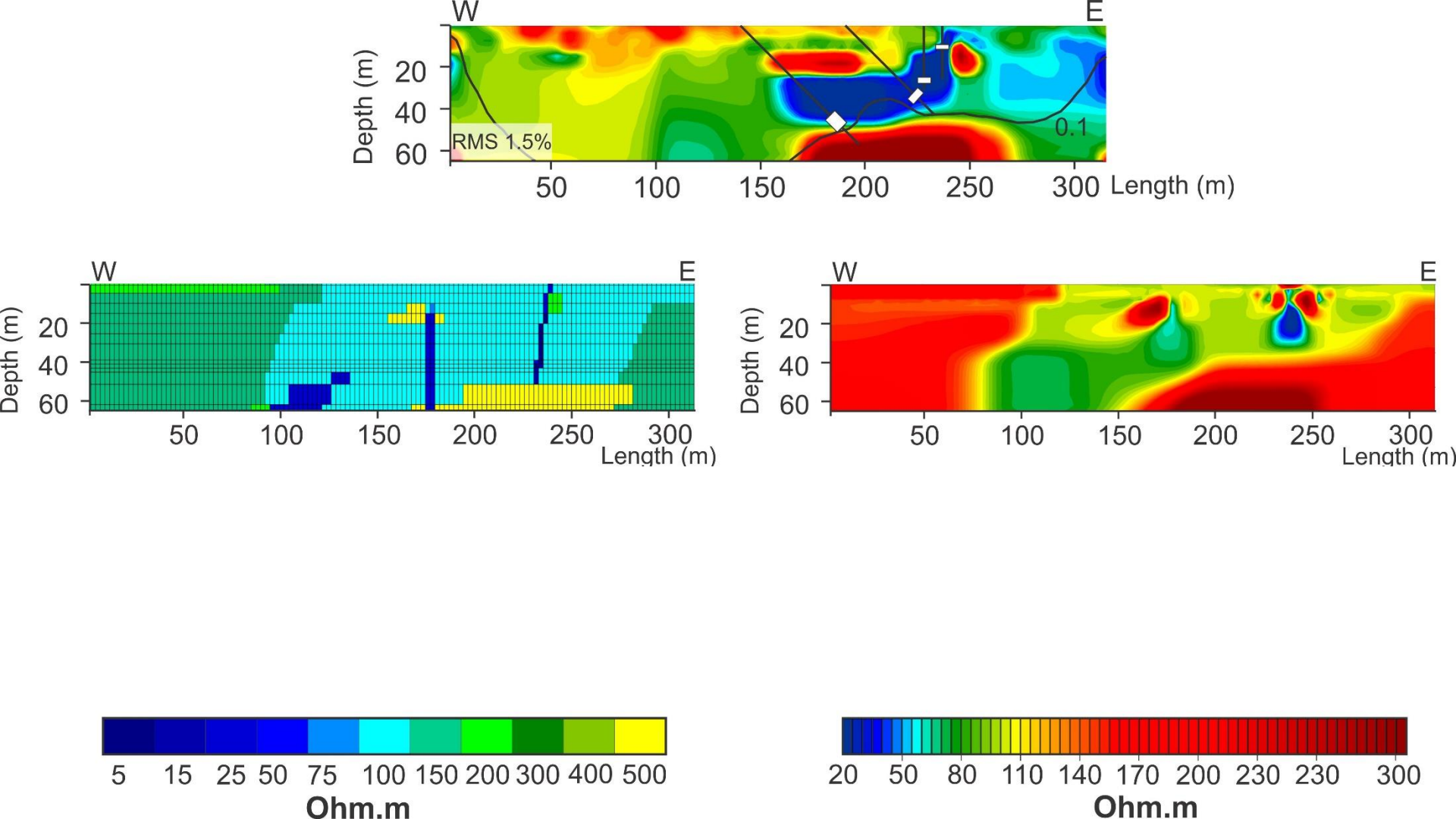


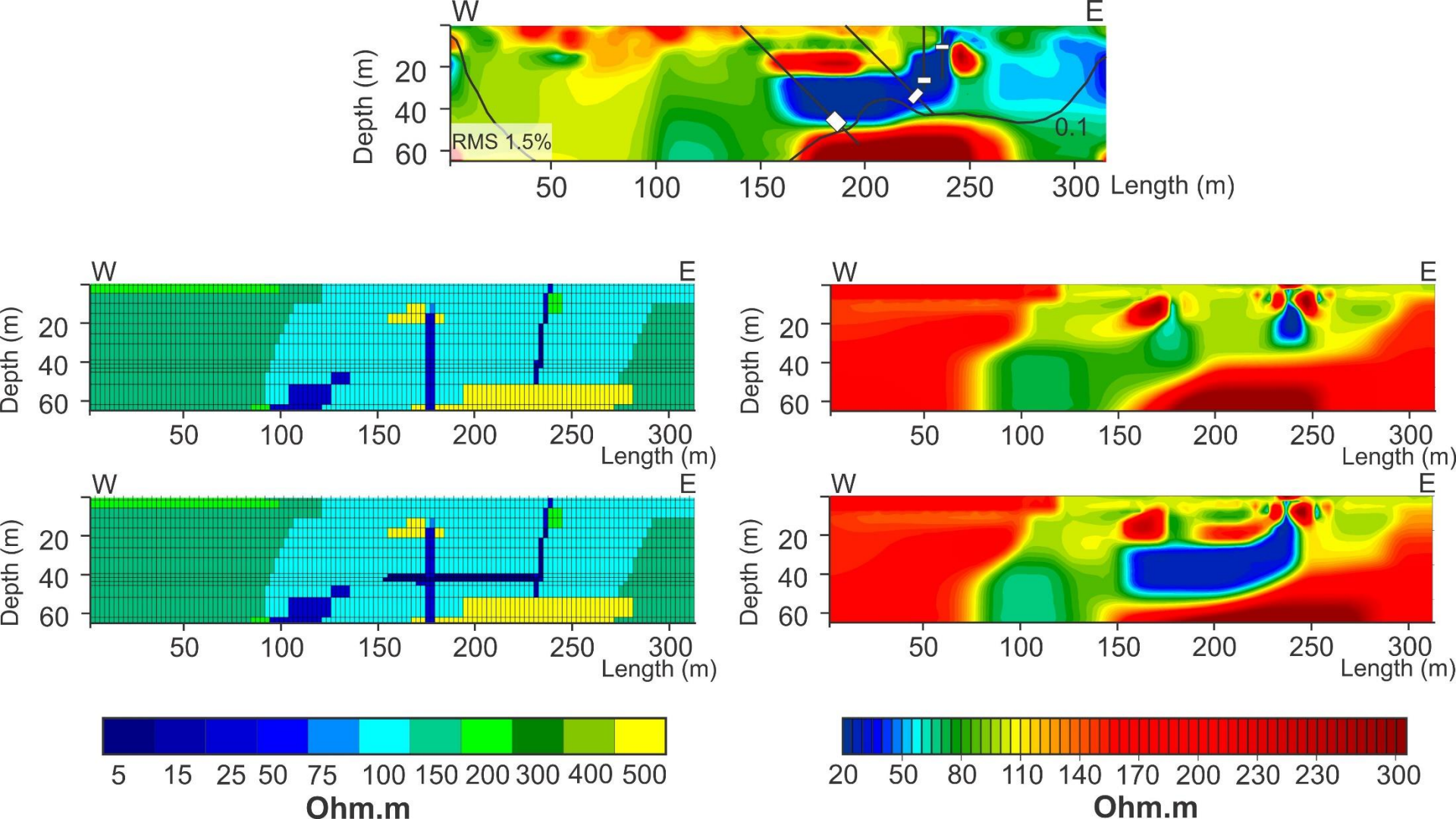


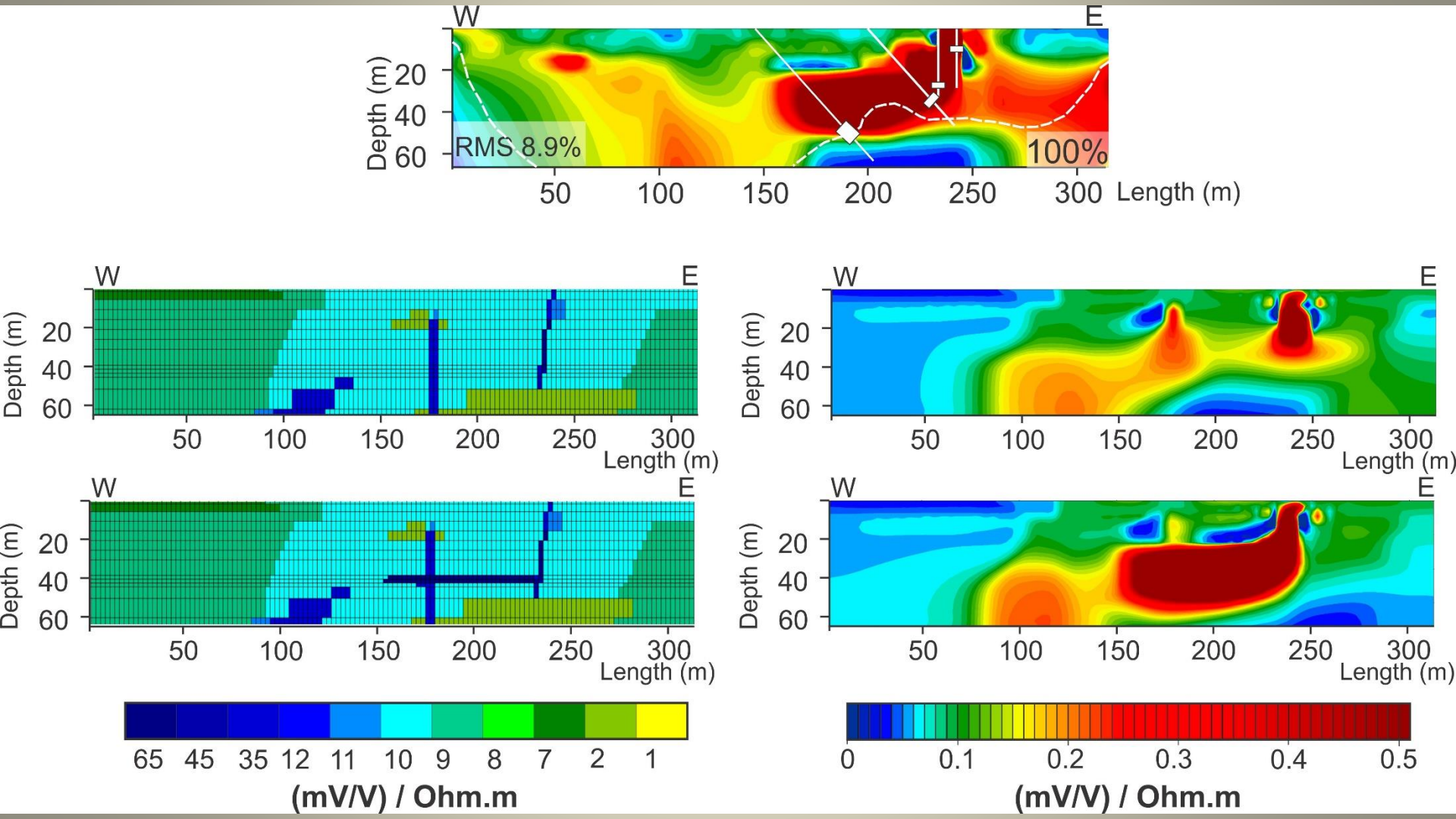



W
E
Depth (m)
20
40
60
RMS 1.5%
0.1
50
100
150
200
250
300
Length (m)

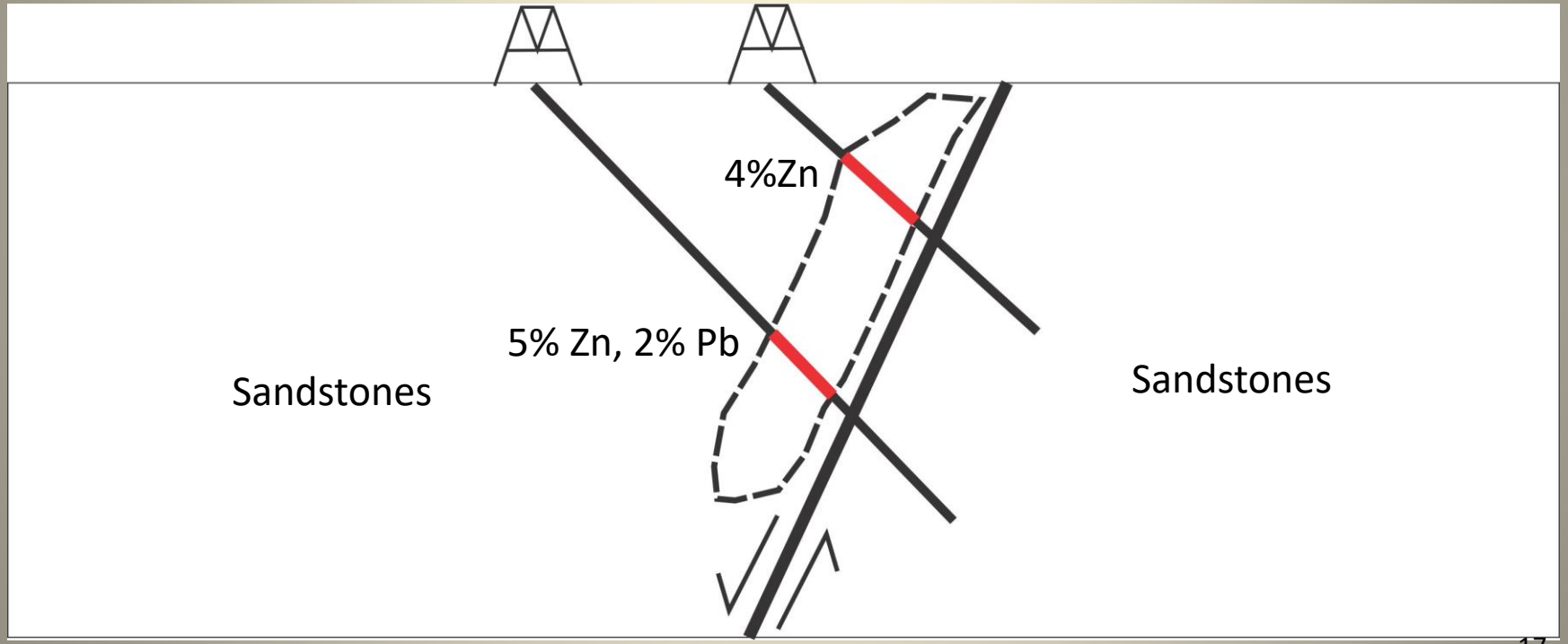

20
50
80
110
140
170
200
230
230
300
Ohm.m


W
E
Depth (m)
20
40
60
RMS 1.5%
0.1
50
100
150
200
250
300
Length (m)
W
E
Depth (m)
20
40
60
50
100
150
200
250
300
Length (m)
W
E
Depth (m)
20
40
60
50
100
150
200
250
300
Length (m)
5
15
25
50
75
100
150
200
300
400
500
Ohm.m
20
50
80
110
140
170
200
230
230
300
Ohm.m


W
E
Depth (m)
20
40
60
RMS 1.5%
0.1
50
100
150
200
250
300
Length (m)
5
15
25
50
75
100
150
200
300
400
500
Ohm.m
20
50
80
110
140
170
200
230
230
300
Ohm.m


W
E
Depth (m)
20
40
60
RMS 8.9%
100%
50
100
150
200
250
300
Length (m)
65 45 35 12 11 10 9 8 7 2 1
(mV/V) / Ohm.m
0 0.1 0.2 0.3 0.4 0.5
(mV/V) / Ohm.m

Incorporation of prior information



Incorporation of prior information

Mineralogy	Resistivity (ohm.m)	Chargeability (mV/V)
Sphalerite+ galena (10%)+ pyrite/marcasite ore	10	30
Sphalerite + galena ore (10%)	20	20
Sphalerite ore (10%)	50	15

Inversion parameter

Inversion using CRTomo inversion code (Kemna 2000)

$$\Psi(m) = \|W_d(d - f(m))\|$$

Incorporation of prior information

$$\Psi(m) = \|W_d(D - f(m))\|^2 + \lambda(\|W_m(m - m_0)\|^2 + \propto \|m - m_0\|^2)$$

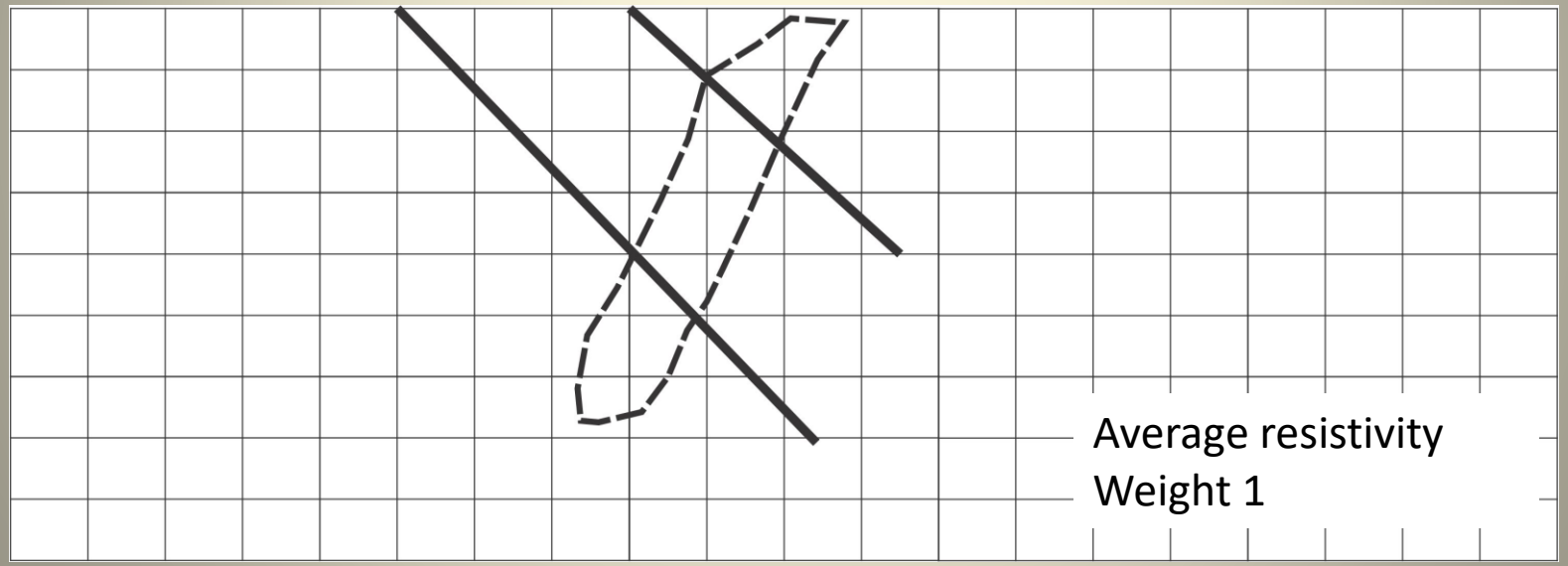
Smoothness-constraint inversion

Reference model inversion

Incorporation of prior information

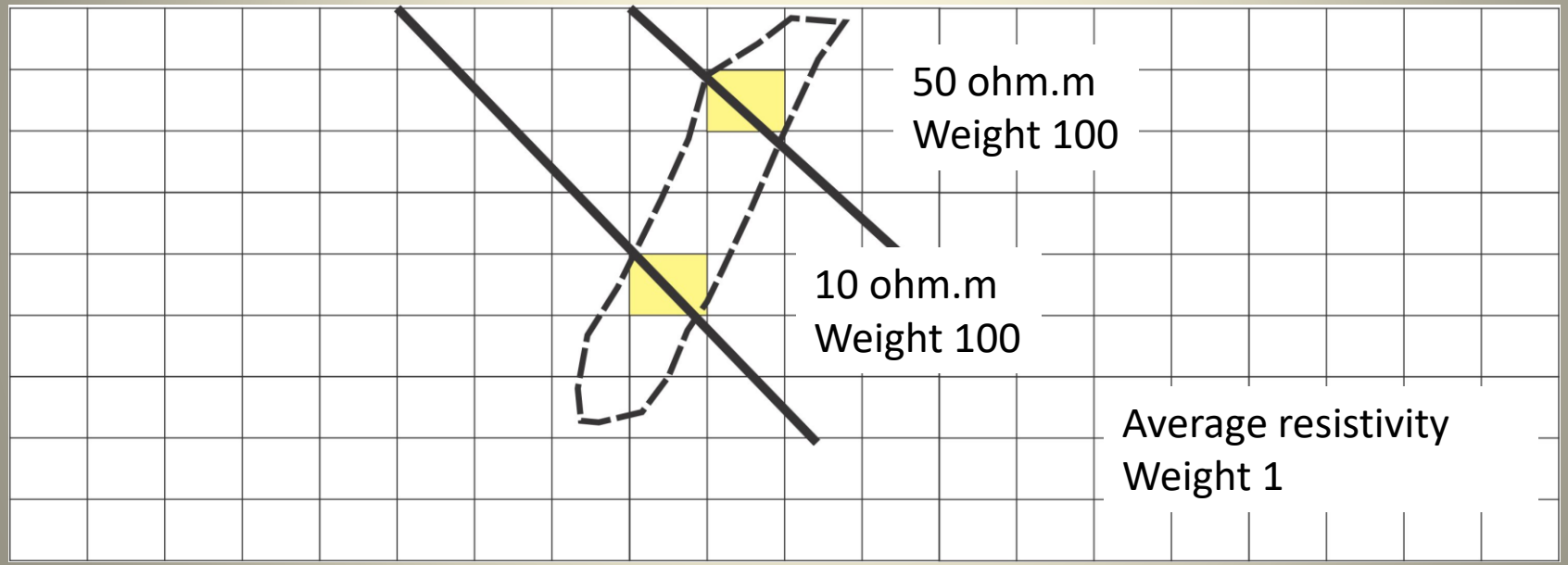
Step 1: Gridding

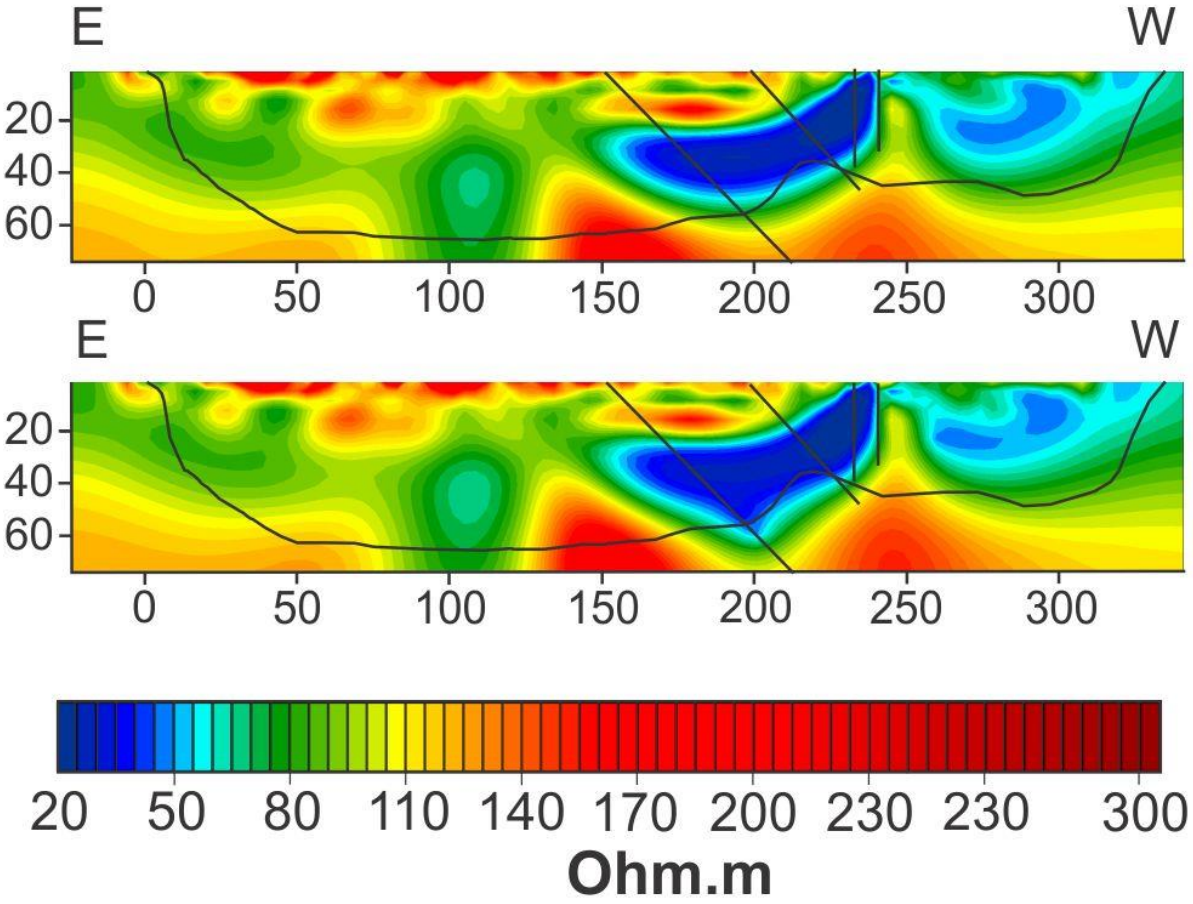
Inversion using reference model with average resistivity and weight for each cell

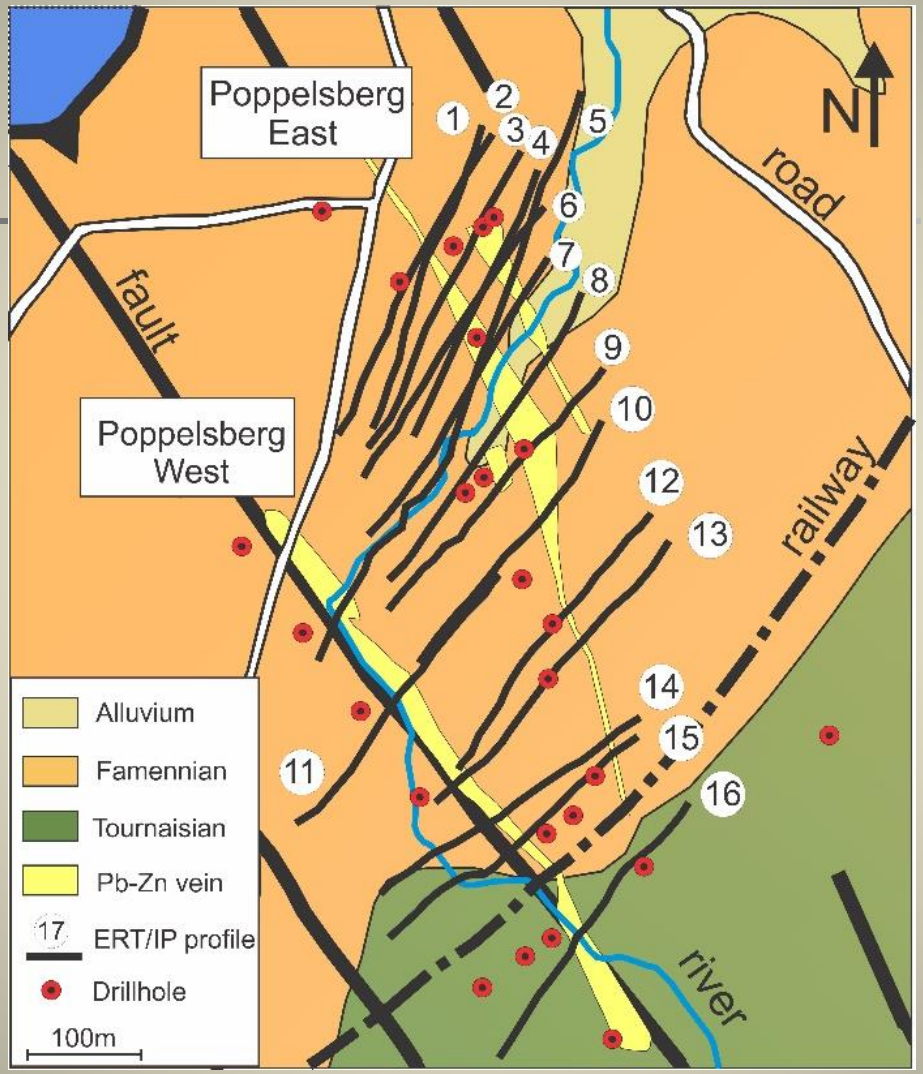


Incorporation of prior information

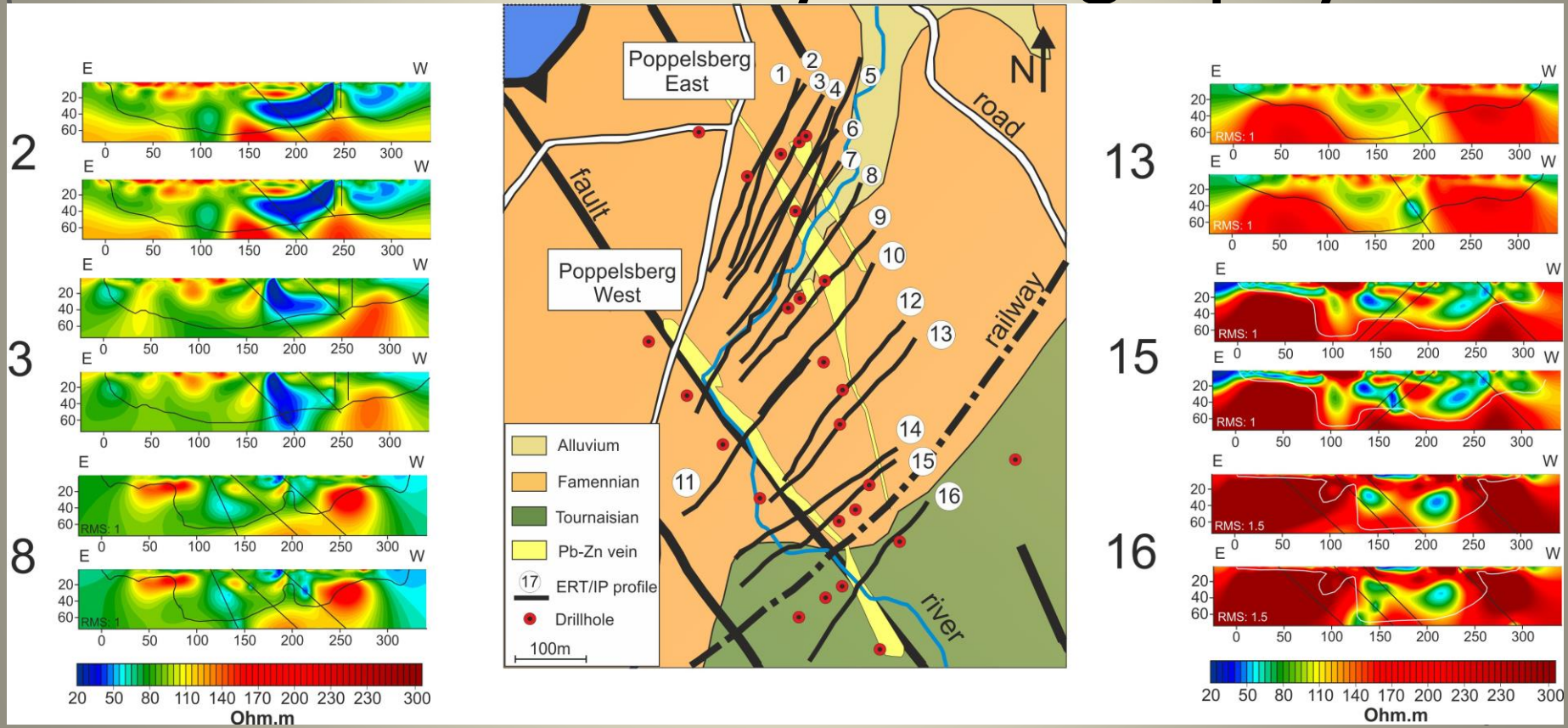
Step 2: Inversion using reference model with average resistivity + constraints




E
W
20
40
60
0
50
100
150
200
250
300
E
W
20
40
60
0
50
100
150
200
250
300
20
50
80
110
140
170
200
230
230
300
Ohm.m


Poppelsberg East
Poppelsberg West
fault
road
railway
river
N
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Alluvium
Famennian
Tournaisian
Pb-Zn vein
17
ERT/IP profile
Drillhole
100m

Electrical Resistivity Tomography



Incorporation of prior information

+

- Include ponctual reliable data in the model
- Decrease the number of mathematical solutions
- Local modification of the solution
- Reliable info beyond the DOI limit

-

- No petrophysical information about mineralization
- Ponctual information
- Projection of the data on the grid

Conclusion

- Constraints improve quality of the signal especially beyond the DOI at depth
- Improve the structure of the mineralization
- Weight and prior value have locally big impact (no petrophysical info)
- Careful with emplacement of the drill
- No geological info insert because of faults

Questions?