

G7481

Magnetometry in geology and archaeology

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spring 2010



Geophysical methods



- magnetometry
- gravimetry
- seismic
- geoelectric
- georadar
- geothermic

Magnetic method

of geophysical survey



- principal: measuring the Earth's magnetic field and its anomalies
- observed units:
 - total magnetic field T [nT]
 - magnetic field gradient \square [nT/m]
 - magnetic susceptibility \square [$n \times 10^{-4}$]

Cesium magnetometer

SM-5 Navmag (Scintrex, Kanada)



Modes of measurements



- gradiometer
(magnetic field gradient ΔT [nT/m])
- variometer
(total magnetic field T [nT])

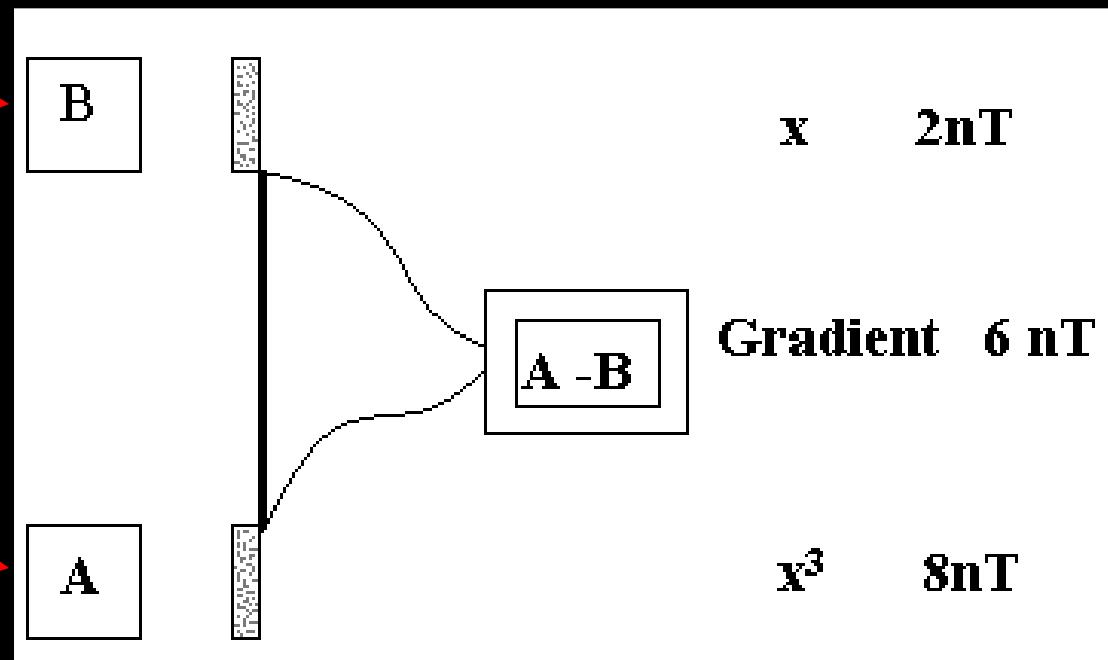
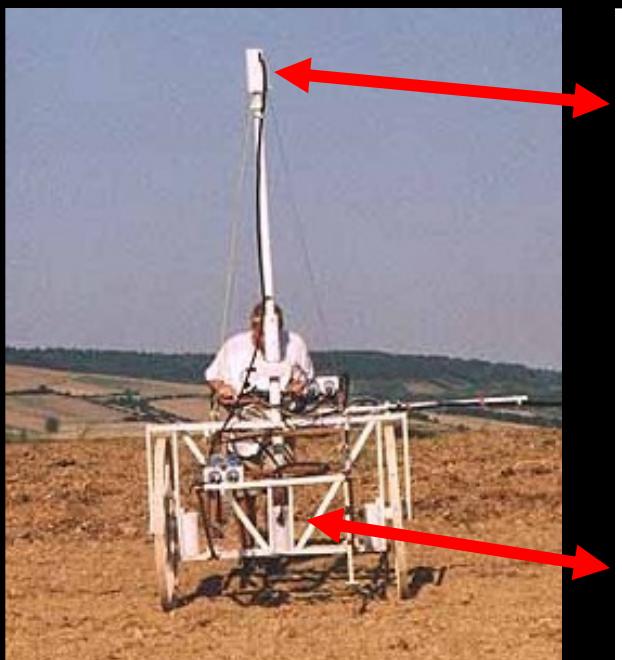


*Proton magnetometer PMG-1 fa
in gradient mode,
Geofyzika Brno*

Gradiometer

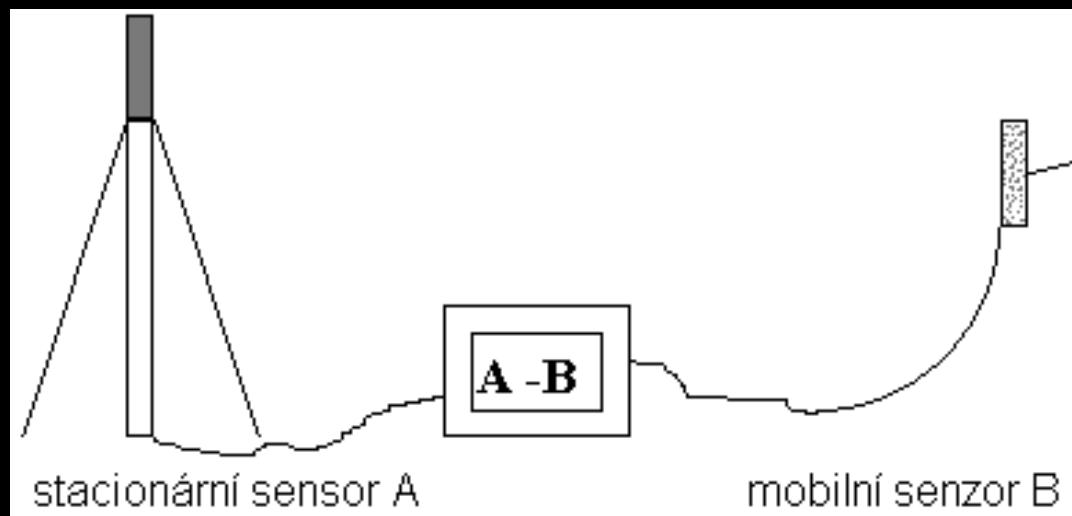


- two vertically placed sensors
- prevents the magnetic field variations error
- better for shallow objects and structures



Variometer

- data collected with only one sensor
- Earth's magnetic field variations error → necessity of correction



Application

of magnetic method



- geological structures mapping
- mapping buried ferrous metal objects and other burned structures

Magnetometry

in archaeology



- suitable:
 - countersunk objects
 - fireplaces, ovens, furnaces, ...
 - line objects (ramparts, trenches, palisades, ...)
 - identification of metal objects
 - detection of landfills and terrain formations

- less suitable:
 - communications
 - stone-made object (if is used the stone from the bedrock of the site)

Measurements types



- testing measurements
(suitability of the method)
- areal measurements
(several days long measurements)
- detail measurements
(the most interesting objects)

Presumption

of successful project



- physical contrast between the object and surroundings
- good state of objects insitu
- size, shape, orientation and count of objects
- relief and vegetation
- absence of structures, which are not in our interest
- climatic conditions during the measurement
- suitable combination of several geophysical methods

Magnetic method

of the geophysical survey



- the measurement runs in squares (often 50×50 m)
- suitable profiles orientation to the measured structure (best in N-S direction)
- density of recorded data up to $0,5 \times 0,15$ m (depend on our interest)



Magnetic method

field work



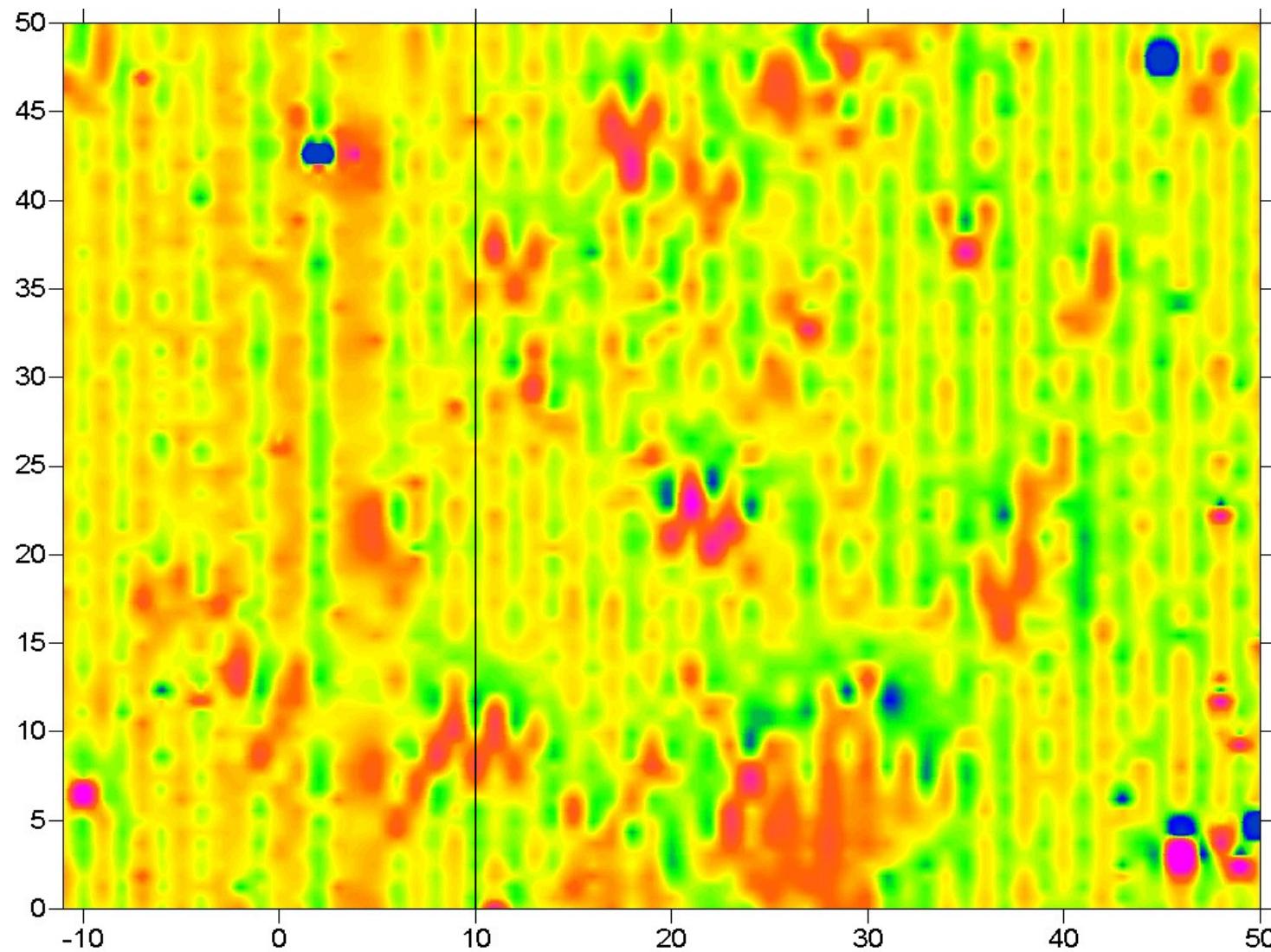
Magnetic method

interpretation

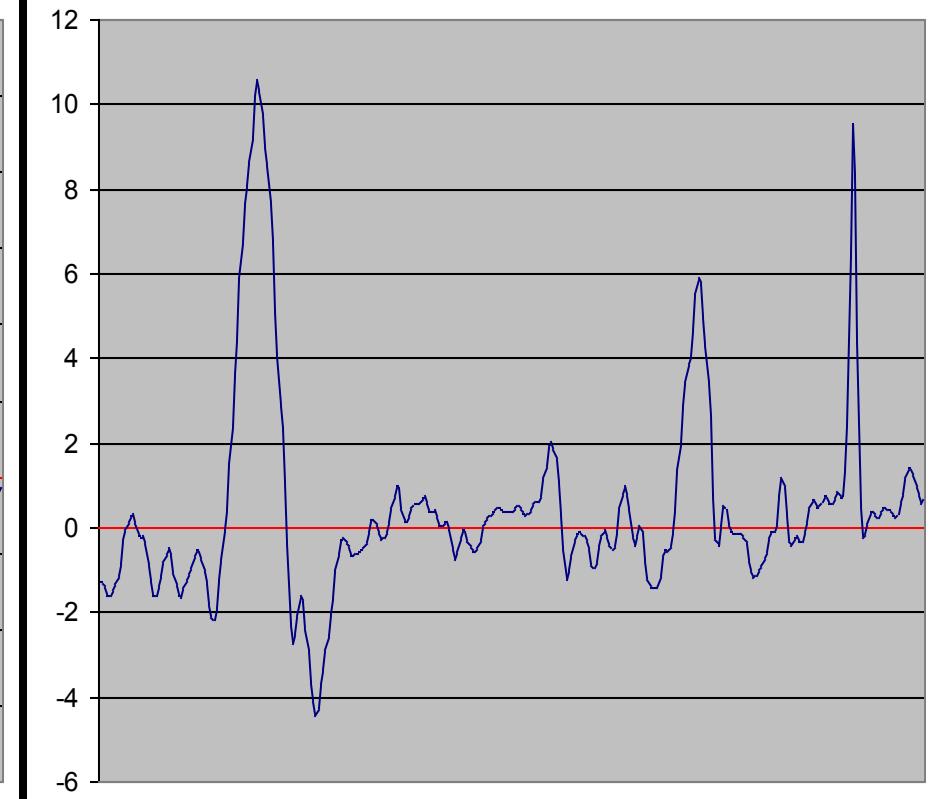
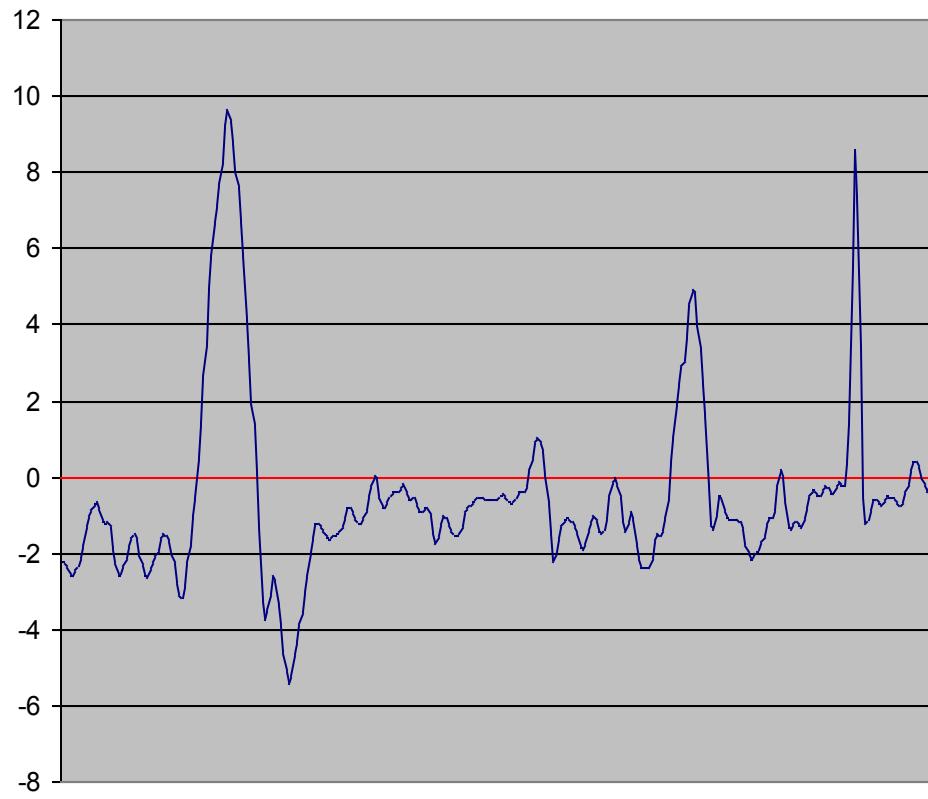


The image shows a screenshot of a software window titled "T1031D2006829 - Poznámkový blok". The window contains a menu bar with "Soubor", "Úpravy", "Formát", "Zobrazení", and "Nápověda". The main area displays a text file with the following content:

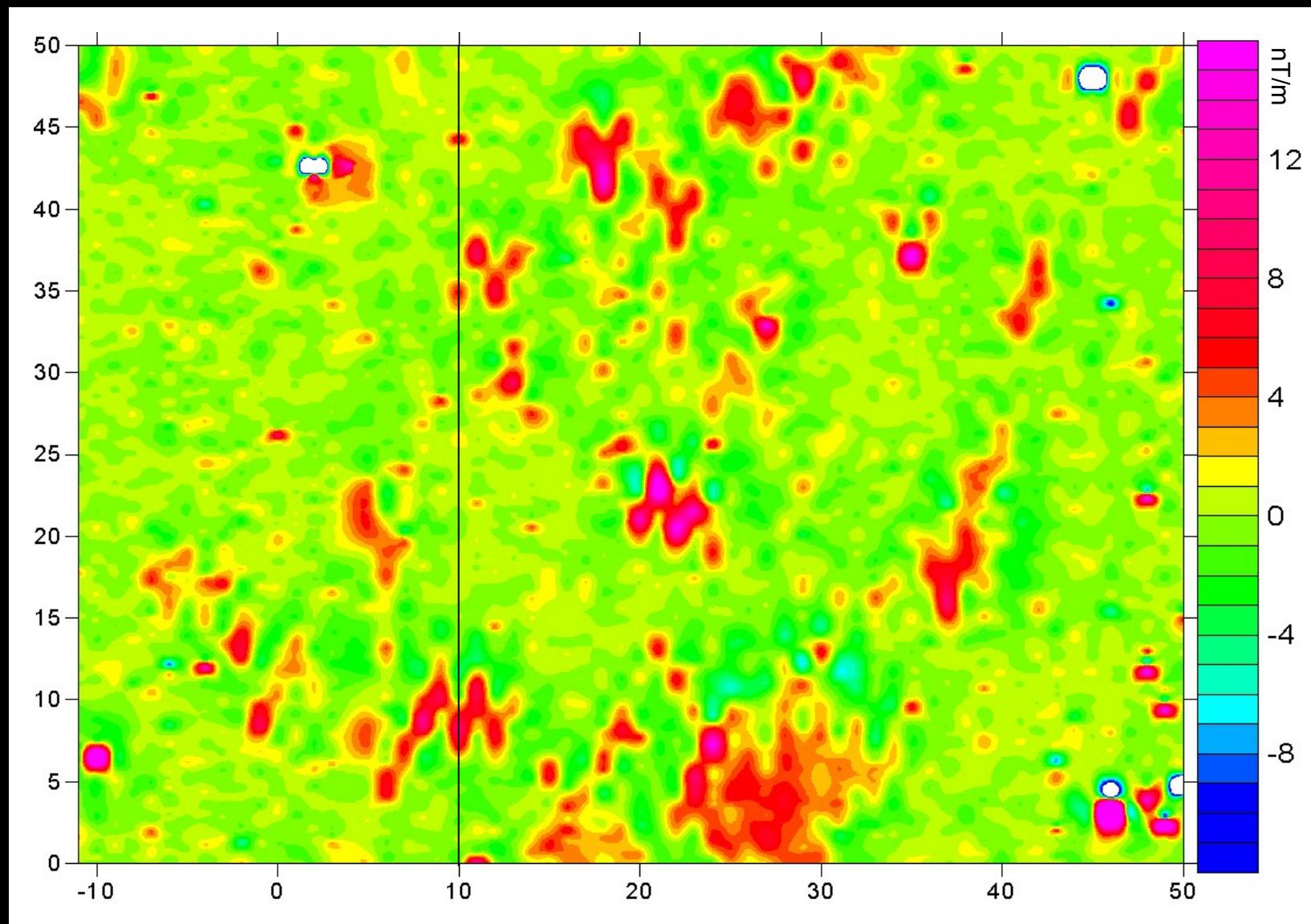
```
//===== SCINTREX SMART DEVICES =====
//NAVMAG Ver. 1.4
//Date----: 2006/8/29
//File Name-: \TempMag Data\T1031D2006829.txt
//Survey---: pohansko srpen/2006
//Operator--: vojtech sesulka
//Mode-----: Search
//Rate-----: 10
//Cycle Time: 1
//Base Field: 48000
//Band Width: 2
//GPS Offset: 1.5
//Grid Lat--: 43.7900705
//Grid Long--: -79.5036171666667
//Grid Alt--: 213.81
//Data Format: X/Line/Lat,Y/station/Long,H1,H2/Grad,Noise,Time
//=====
0.00000, *, 48701.84, 48700.39, 0.00, 10.53028
0.00000, *, 48701.84, 48700.40, -0.00, *
0.00000, *, 48701.84, 48700.43, 0.00, *
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0.00000, *, 48701.77, 48700.43, 0.00, *
```



Site: Němčice nad Hanou
Apparature: SM-5 Navmag (Scintrex, Canada)
Author: V. Šešulka
19/09/2006



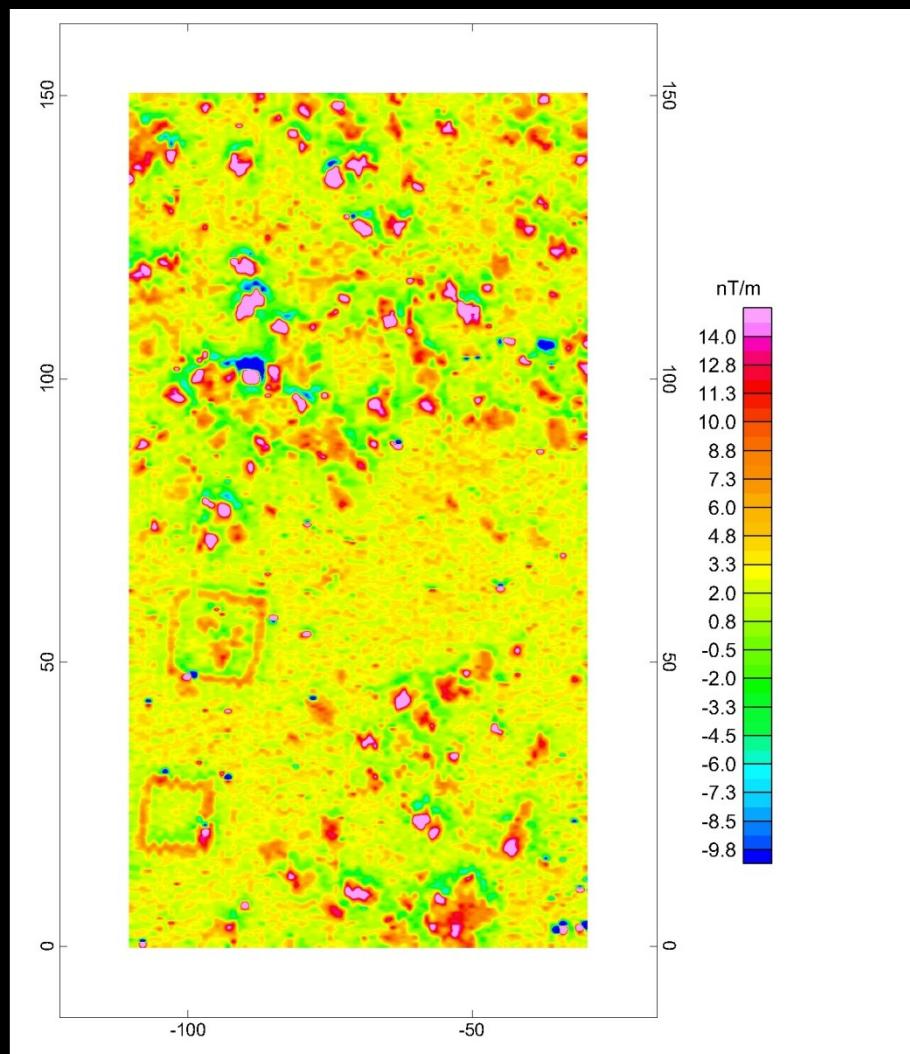
gradient T [nT/m] on the profile 10 before (left) and after (right) the median correction



Site: Němčice nad Hanou
Apparature: SM-5 Navmag (Scintrex, Canada)
Author: V. Šešulka
19/09/2006

Magnetic method

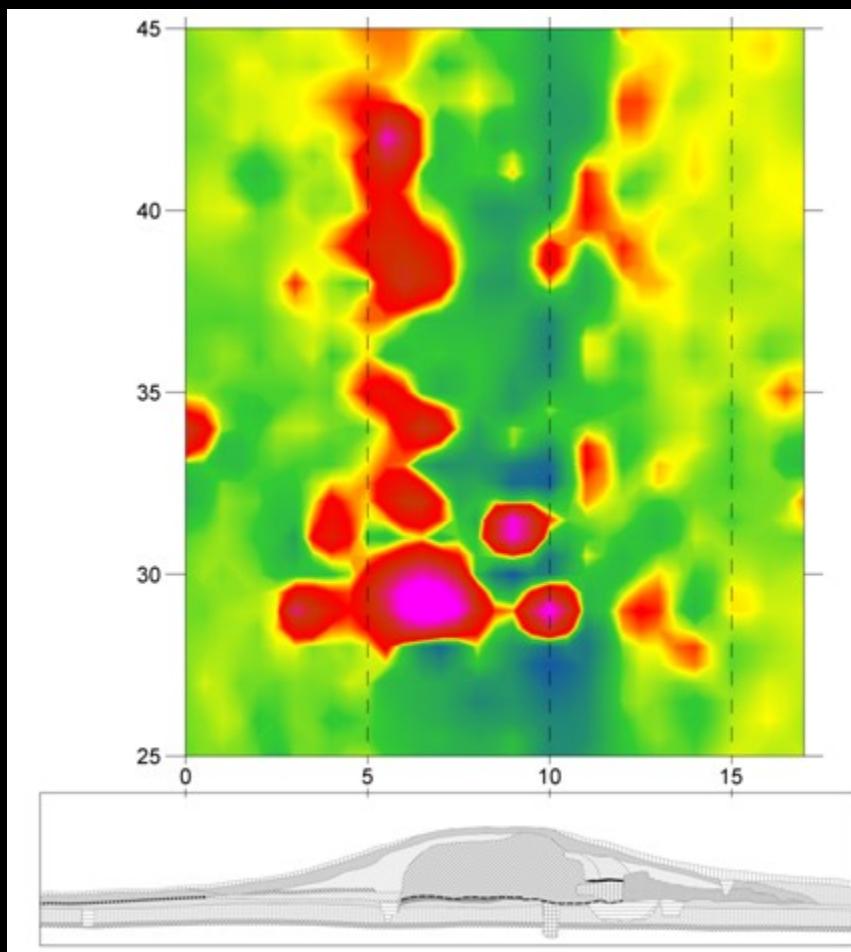
interpretation



Site: Pohansko near Břeclavi
Apparature: Smartmag – 4g
(Scintrex, Canada)
Author: R. Křivánek
19/09/2006

Magnetic method

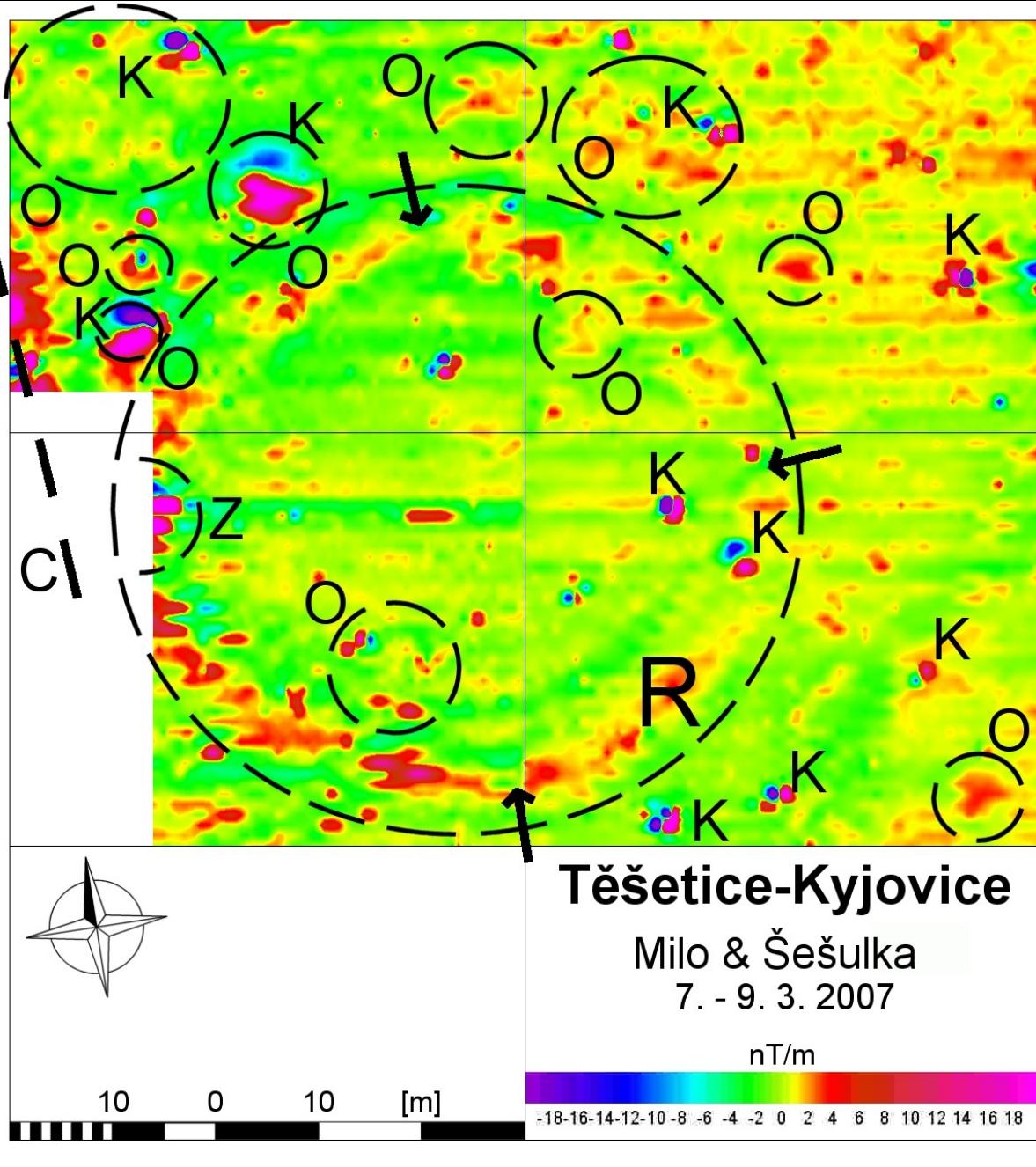
interpretation



Pohansko u Břeclavi - řez 18 (jižní profil)
legenda

—	Rošt	■	Kamenáční zeď
·····	Rozhraní mezi sedimenty po zániku osídlení a antropogenní vrstvou	■	Jílovitohlinité jádro hradiště
□	Povrchový humus	■	Nadložní vrstva uvnitř hradiště
□	Bahnitá náplava (středověká?)	■	Podloží
□	Destrukce čelní kamené zdi ze středních kamenů z vnitřní části hradiště	■	Propálenina u jižního profilu
□	Destrukce hradiště z velkých kamenů	■	Silnější propálenina u jižního profilu nad čelní kamen. zdi
□	Destrukce jílovitohlinitého násypu	■	Splach jílovitohlinitého jádra hradiště
■	Glej	■	Velkomoravská kulturní vrstva
□	H1	■	Zlatohnědá vrstva plná kostí
□	K1	■	Původní povrch A horizont
□	O1	■	Vrstva uhlíku pod splachem tělesa hradiště na již. profilu
□	Z1	■	Zuhelnatělé dřevo na UR56
□	Z2	■	Výplň "zábubu"

Milo & Šešulka – Pohansko near Břeclavi 28. 3. 2007
Comparison between the measured data and the cross-section across the rampart

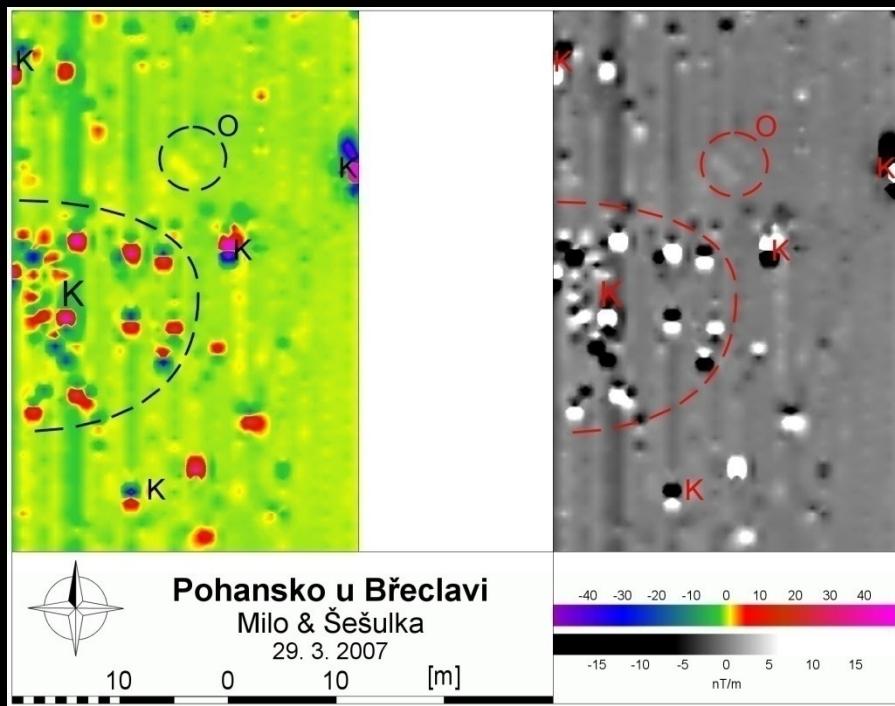


Milo & Šešulka
Těšetice-Kyjovice 7. 3. 2007

(R – roundel; O – object; K – metal; C – path; Z – earth-house)

Magnetic method

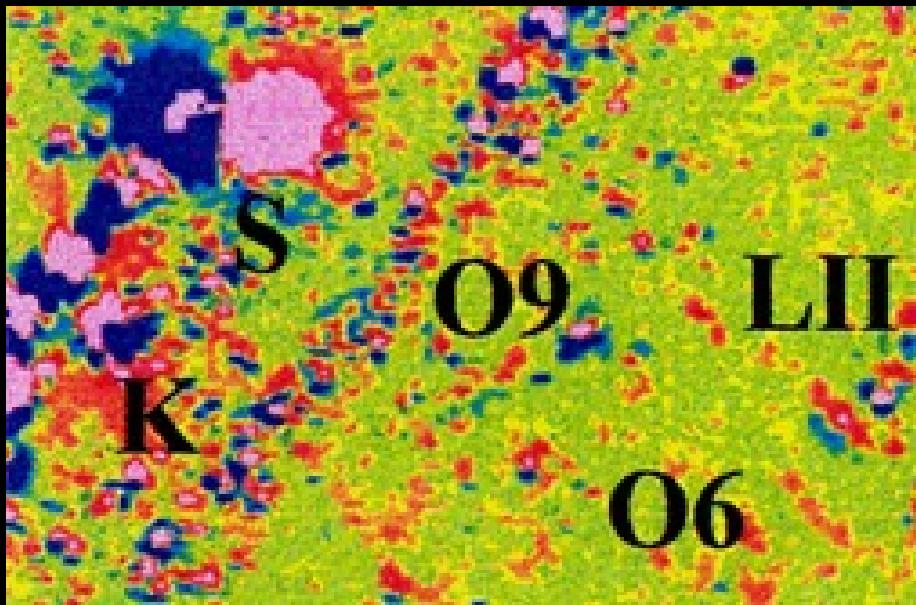
interpretation



Milo & Šešulka – Pohansko near Břeclav 29. 3. 2007
(O - object; K – metal)

Magnetic method

interpretation

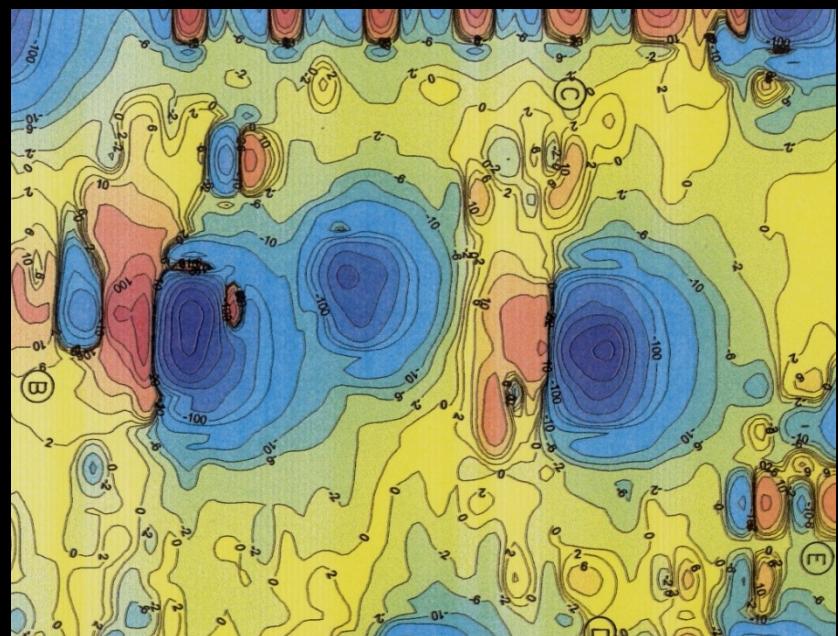


Site: Pohansko near Břeclav

Apparature: Smartmag-4g (Scintrex, Canada)

Author: R. Křivánek

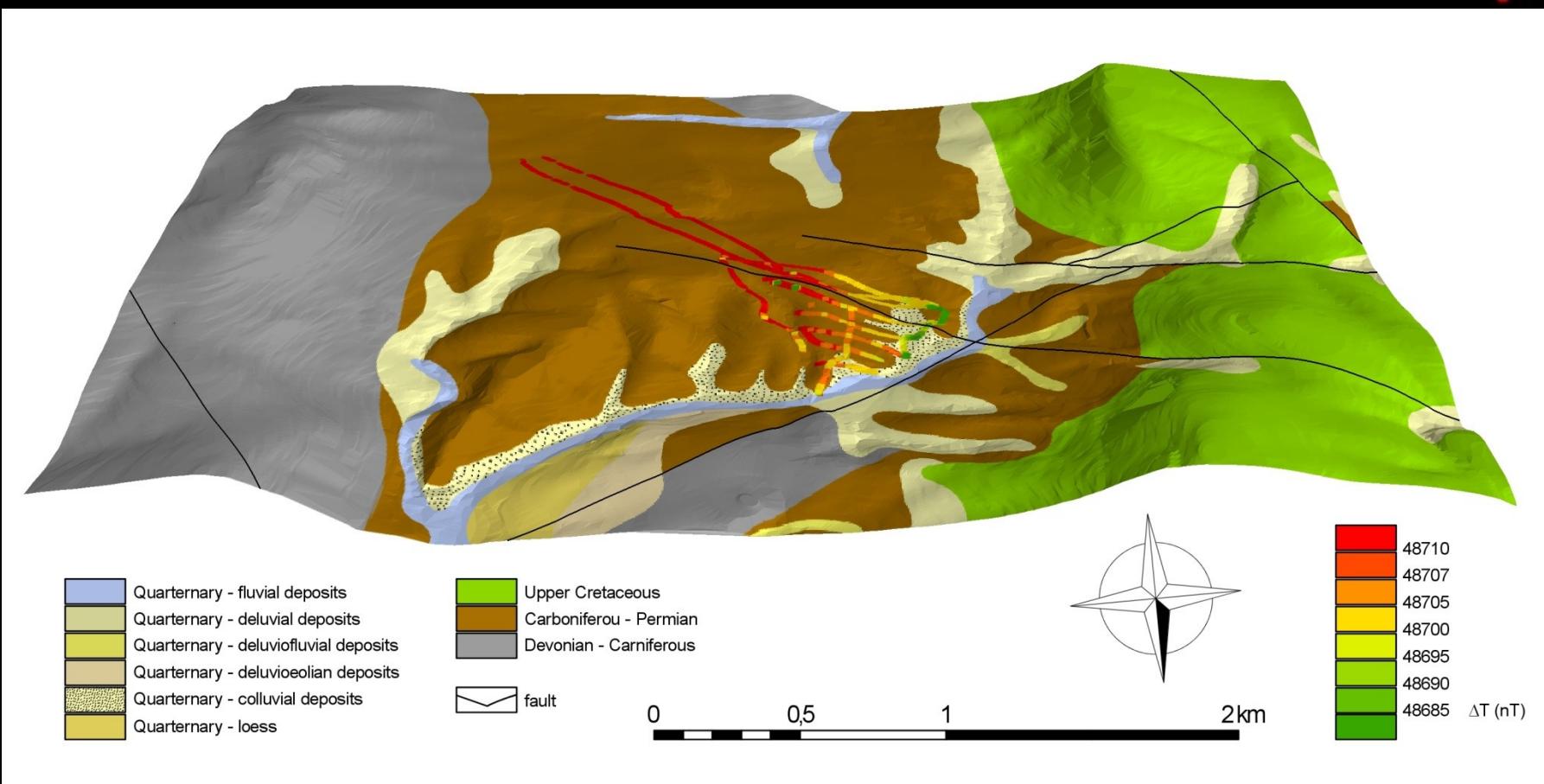
21/08/2001



T_z gradient map (Fous et al. 2000)

Magnetic method

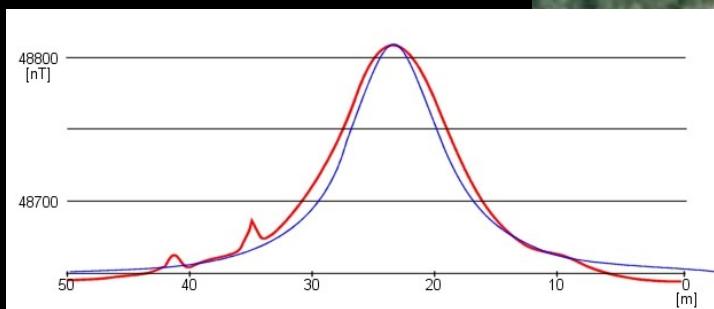
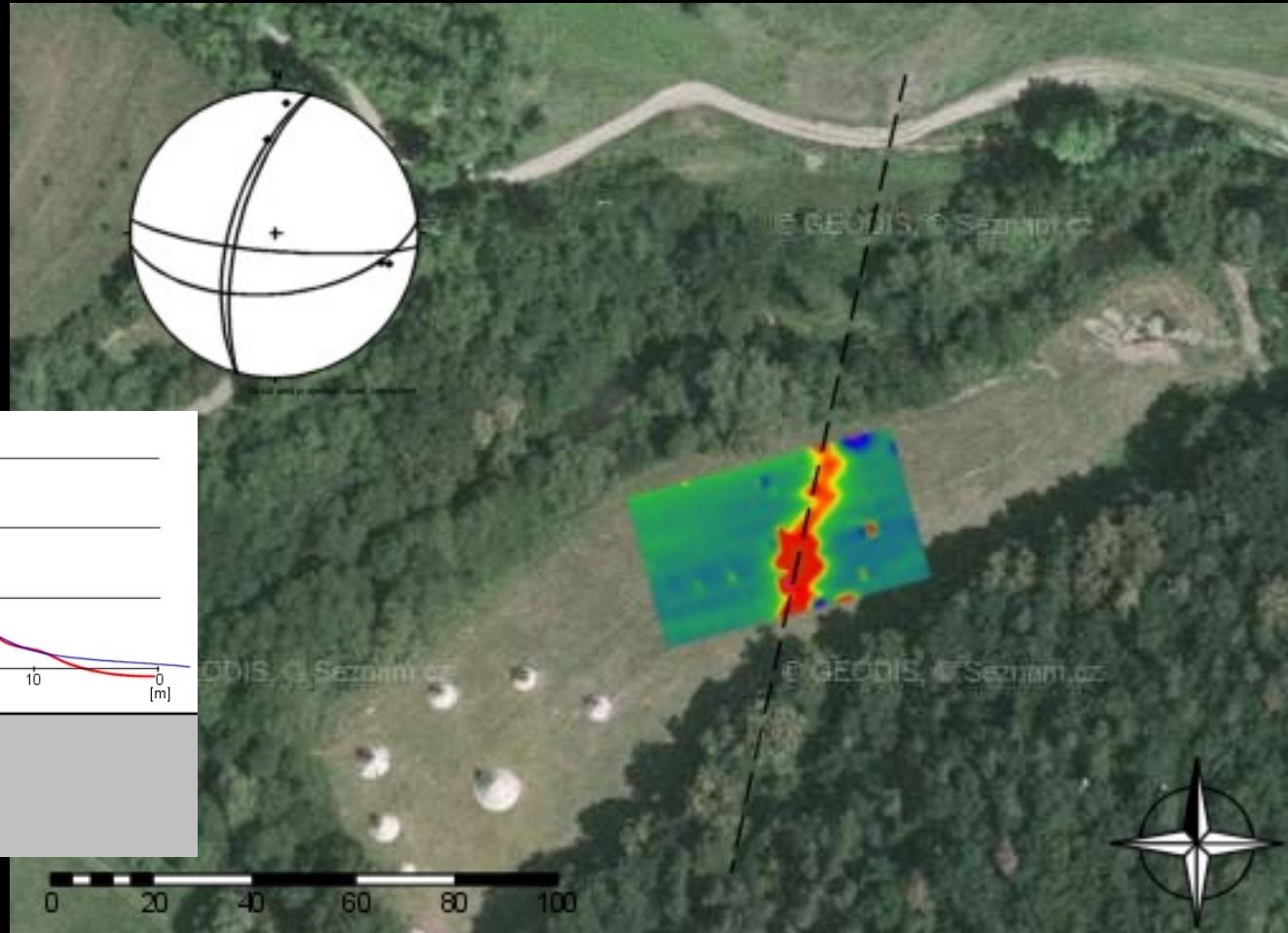
interpretation



Site Přední Arnoštov, author V. Šešulka

Magnetic method

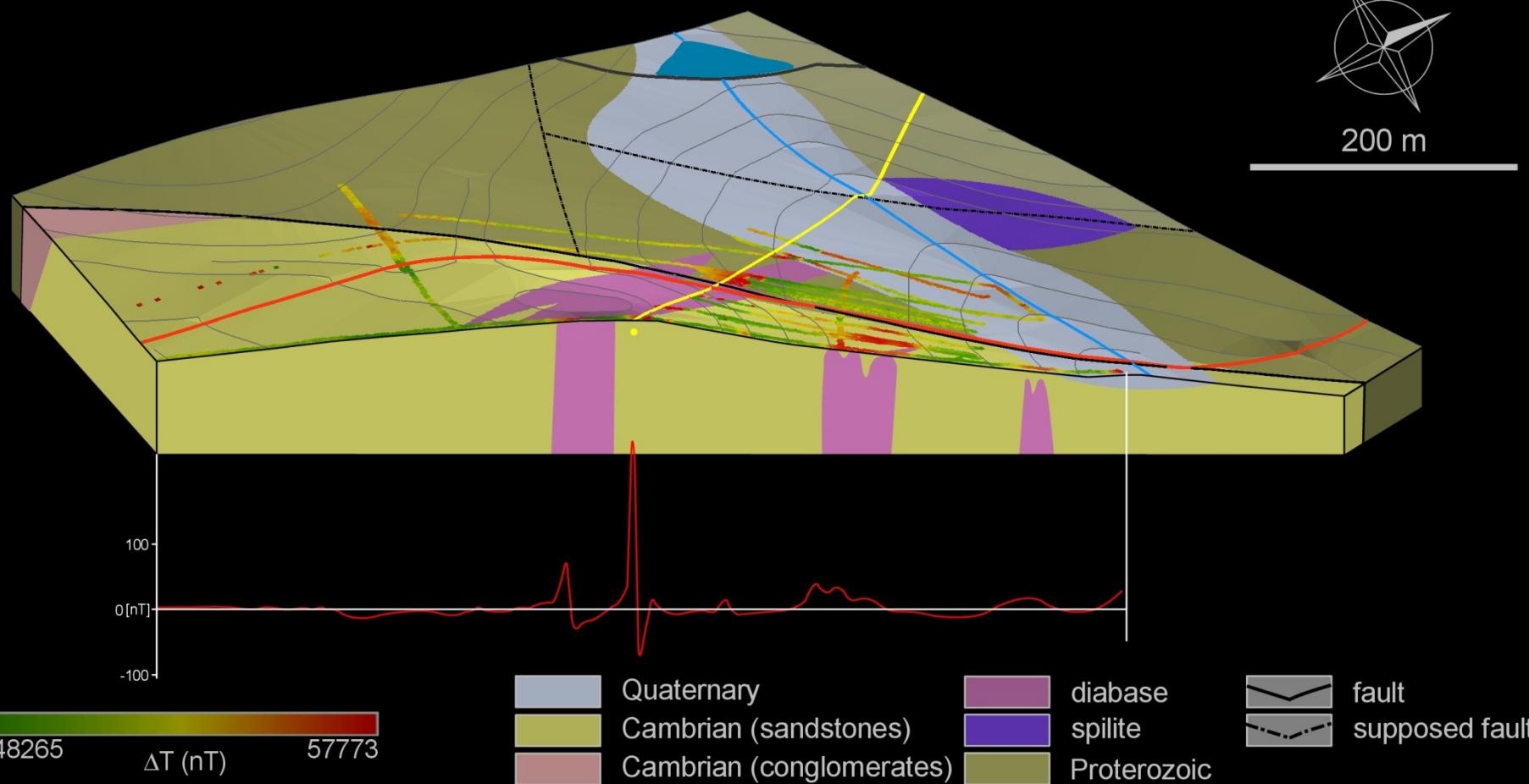
interpretation



Site Budkovice, author V. Šešulka

Magnetic method

interpretation

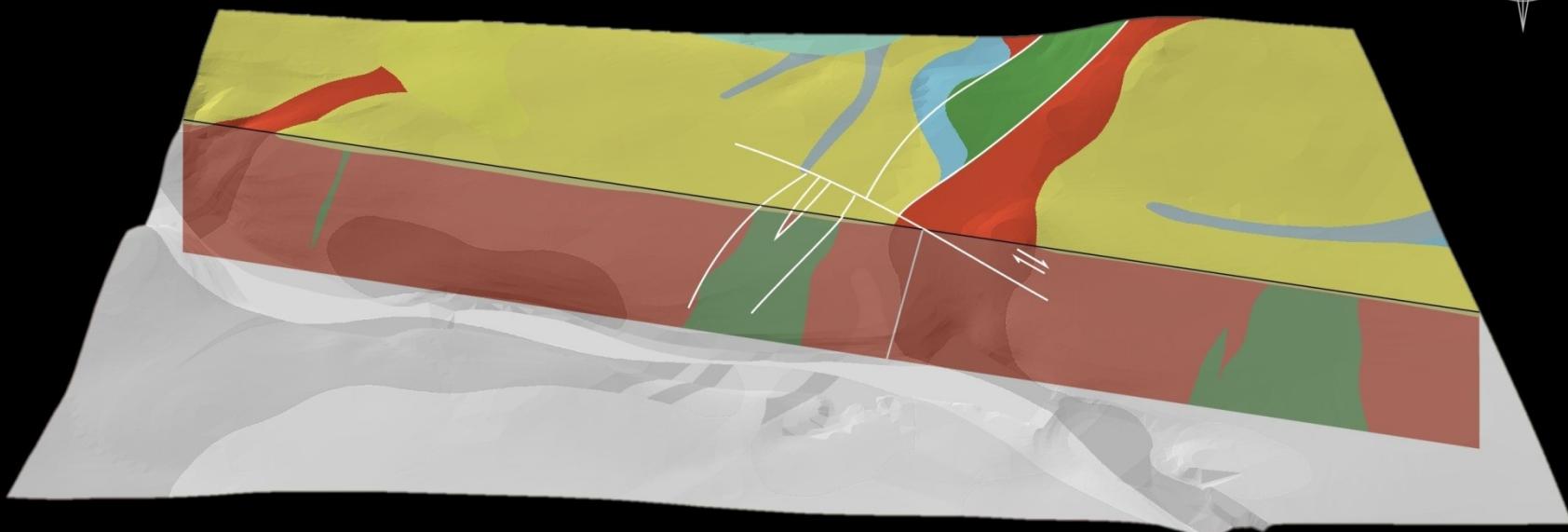
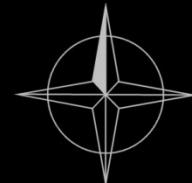


Magnetic method

interpretation



0,5 km



- Quaternary, fluvial sediments
- Quaternary, deluvio-fluvial sediments
- Quaternary, loess
- Quaternary, deluvial sediments

- diorite
- granodiorite
- granite

Site Těšetice-Kyjovice, author V. Šešulka

Literature

used and recommended



- Fous A., Hašek V. & Záhora R. (2000): Zpráva o archeogeofyzikální prospekci na akci Břeclav-Pohansko. – MS, závěrečná zpráva. Ústav archeologie a muzeologie FF MU v Brně.
- Hašek V. & Měřínský Z. (1991): Geofyzikální metody v archeologii na Moravě. – MSV. Brno.
- Křivánek R. (2002): Závěrečná zpráva o geofyzikálním průzkumu prováděném na základě HS č. 792/02 na lokalitě Pohansko, okr. Břeclav. – Archiv ArÚ. Praha. č.j. 7486/02.
- Křivánek R. (2004): Geofyzikální metody. – In: Kuna M. (ed.): Nedestruktivní archeologie. – Academia. Praha.
- Kuna et al. (2004): Nedestruktivní archeologie. – Academia. Praha.