

Integration of Geophysical Methods for Blind ore Bodies Exploration

*Dr. Evgenii Ermolin
President of GM-Service*

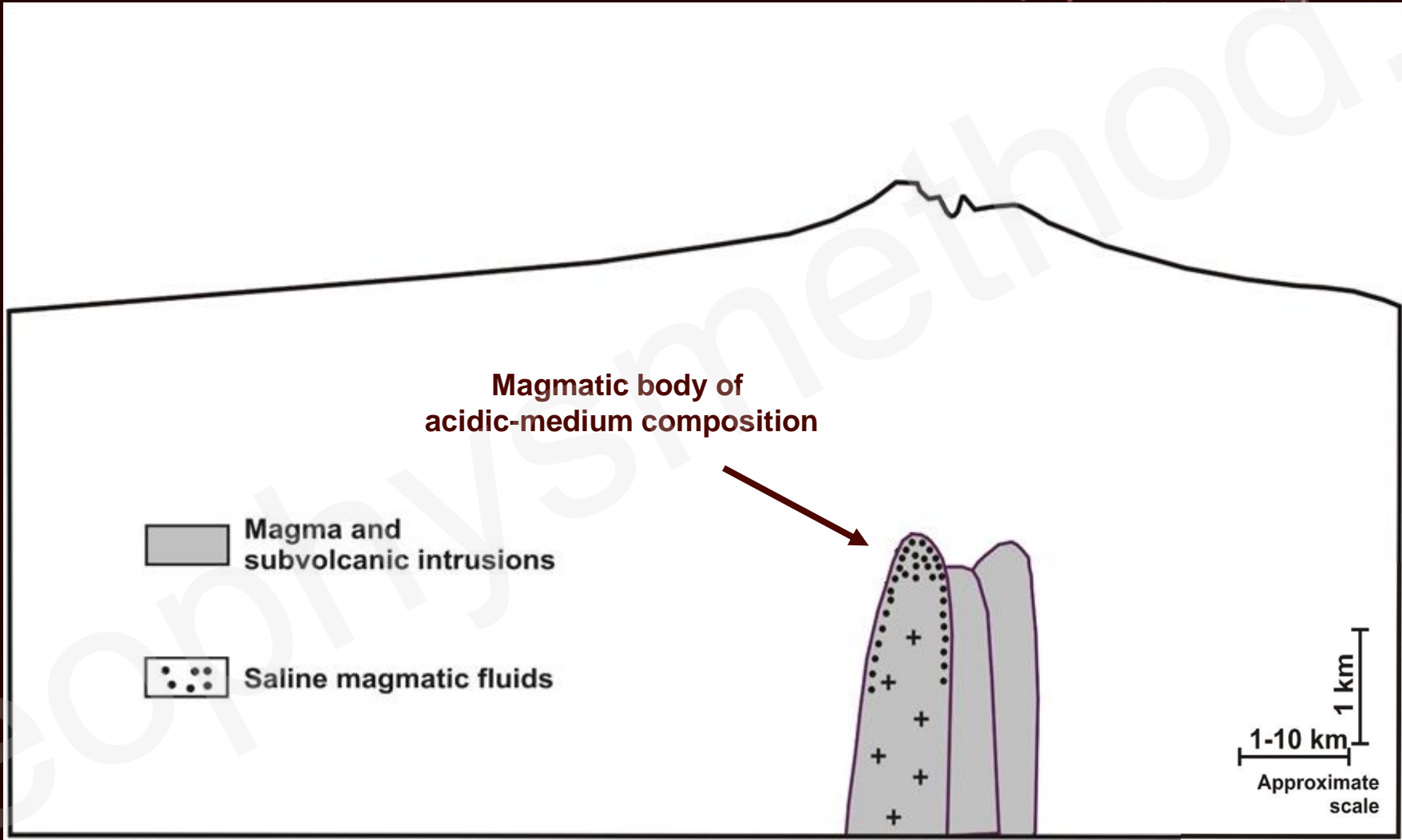
Presentation plan

- Geological-genetic model of epithermal gold-silver deposit

- The case of an increase in reserves to the group of LS-epithermal deposits

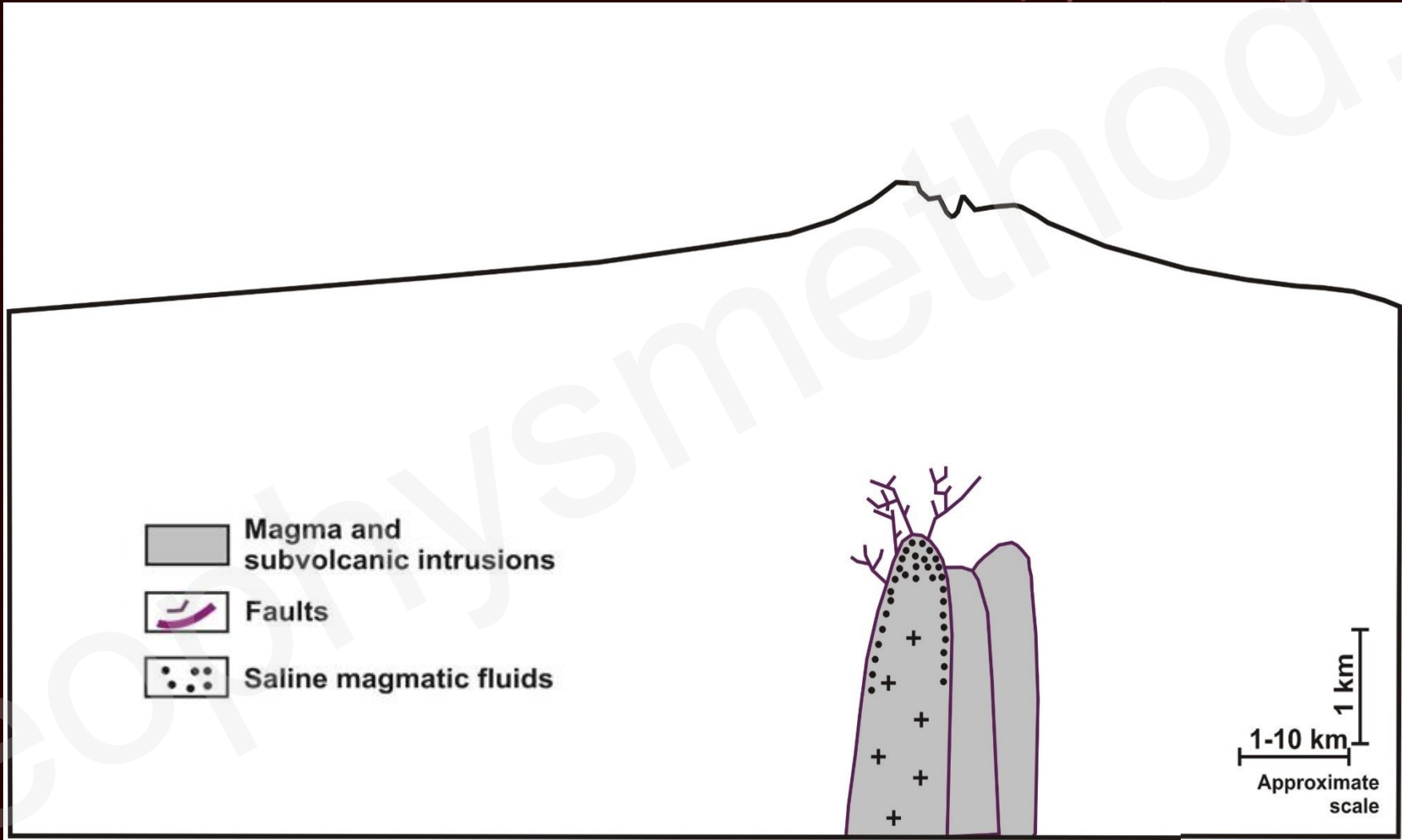
- The case of discovery an IS-epithermal body for a small budget

Geological-genetic model of epithermal deposit



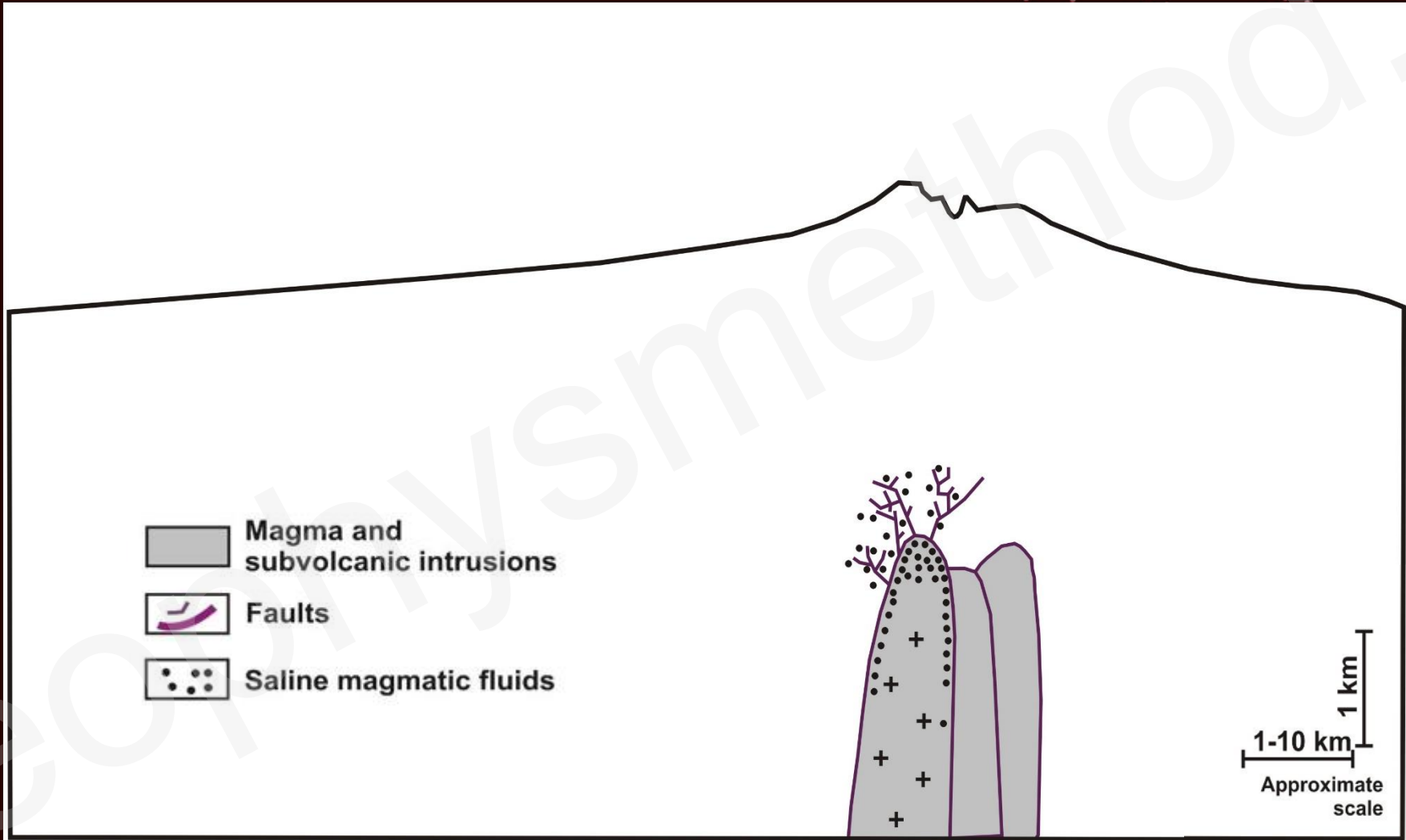
(By Hedenquist et al. 2000, modified by Ermolin and Savichev 2018)

Geological-genetic model of epithermal deposit



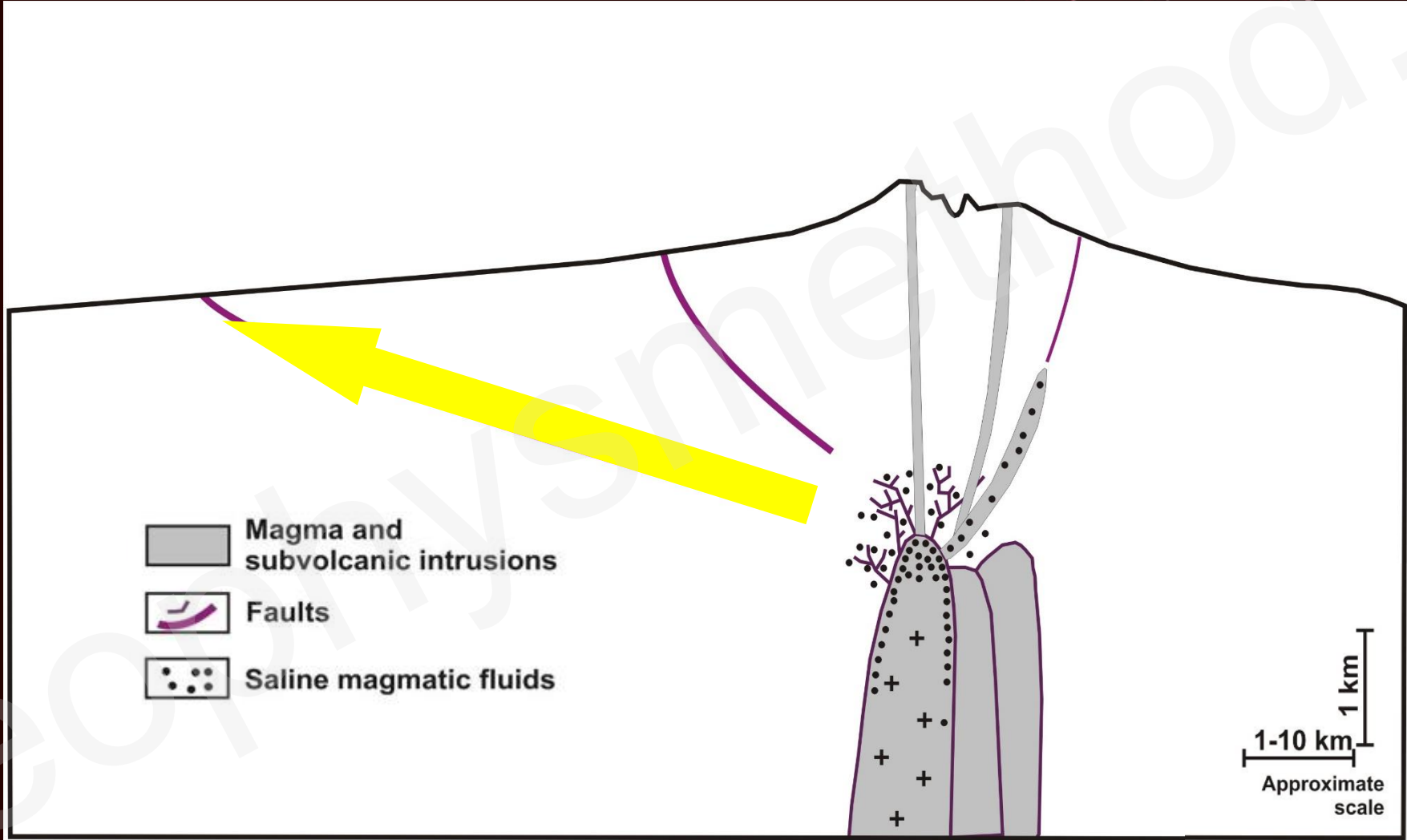
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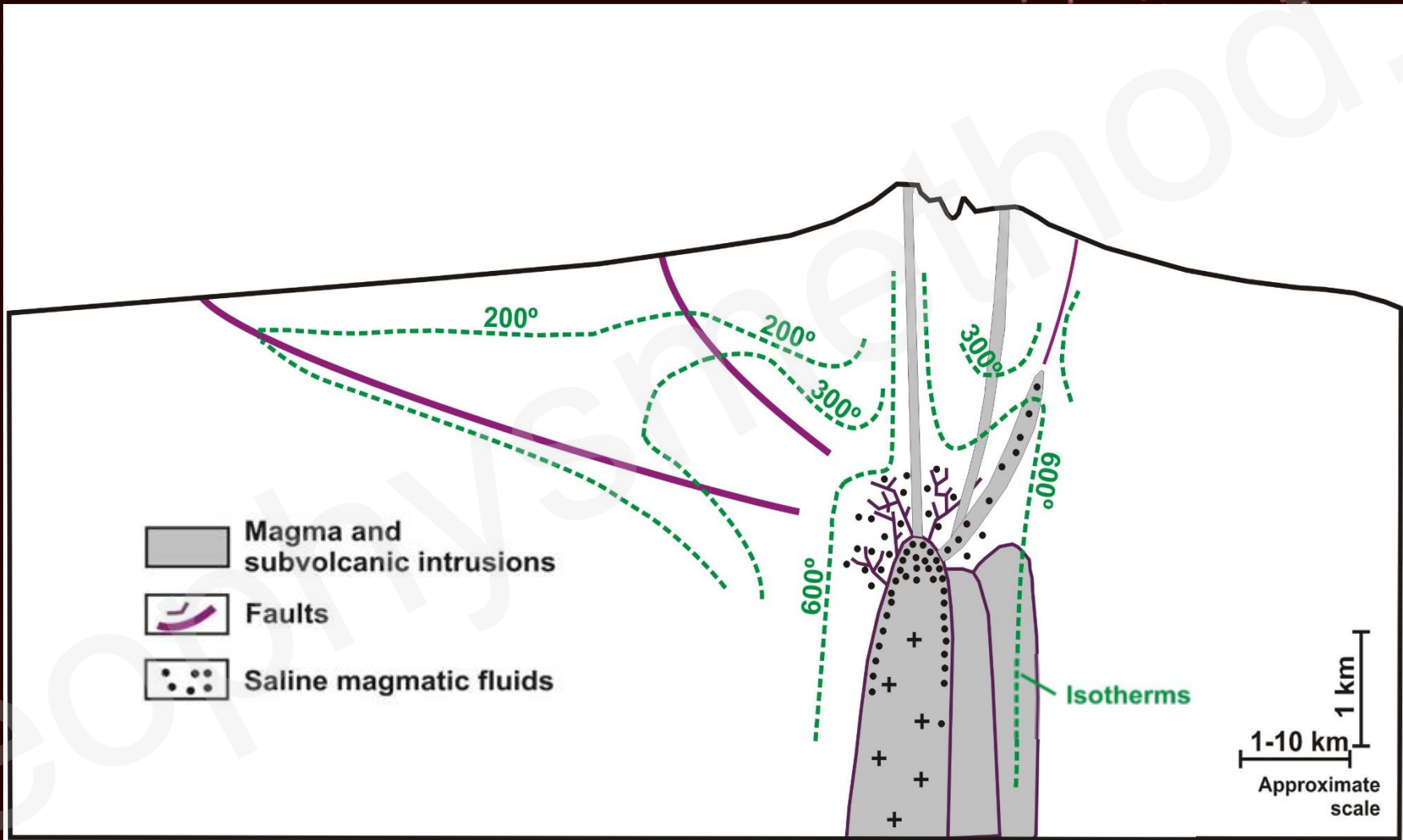
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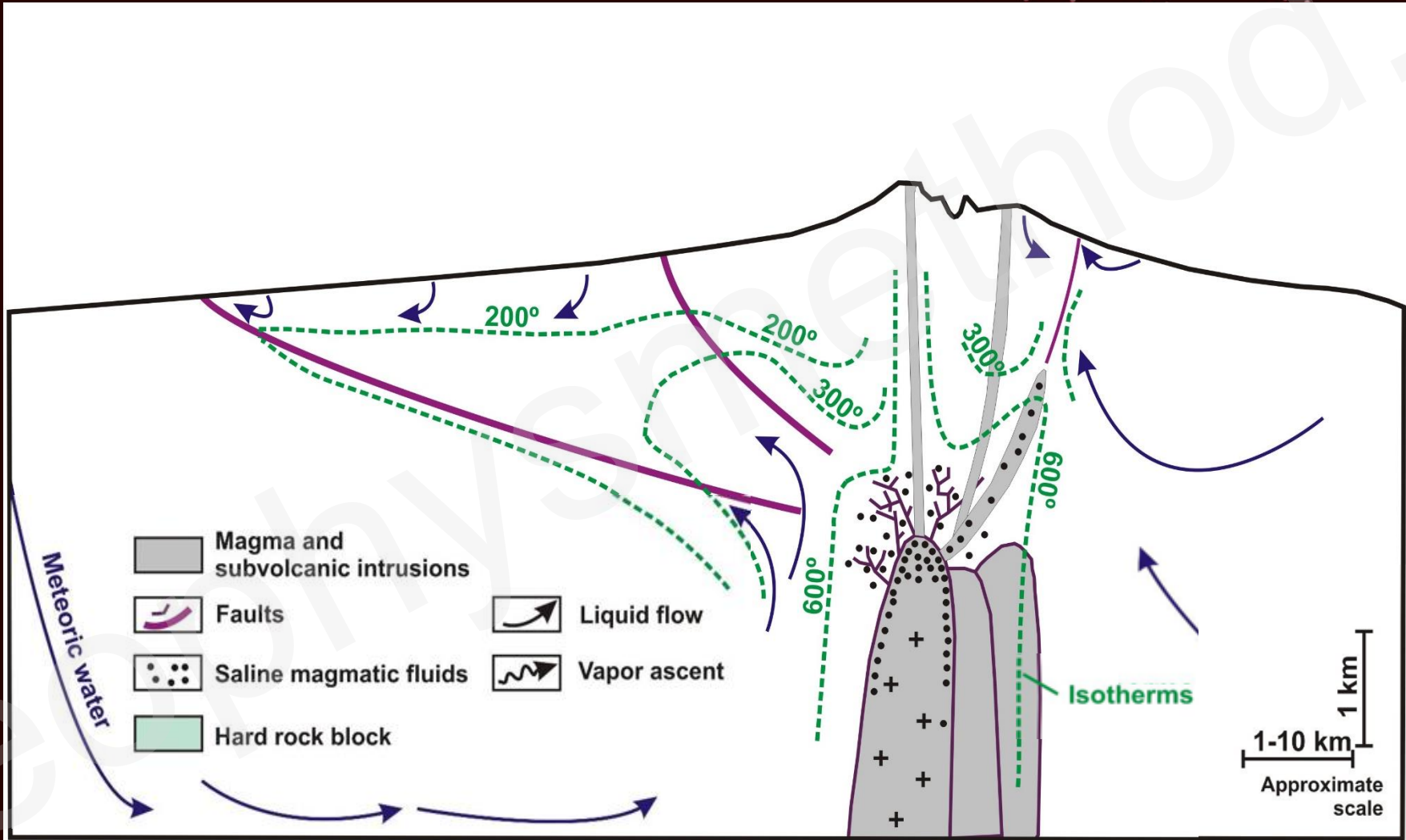
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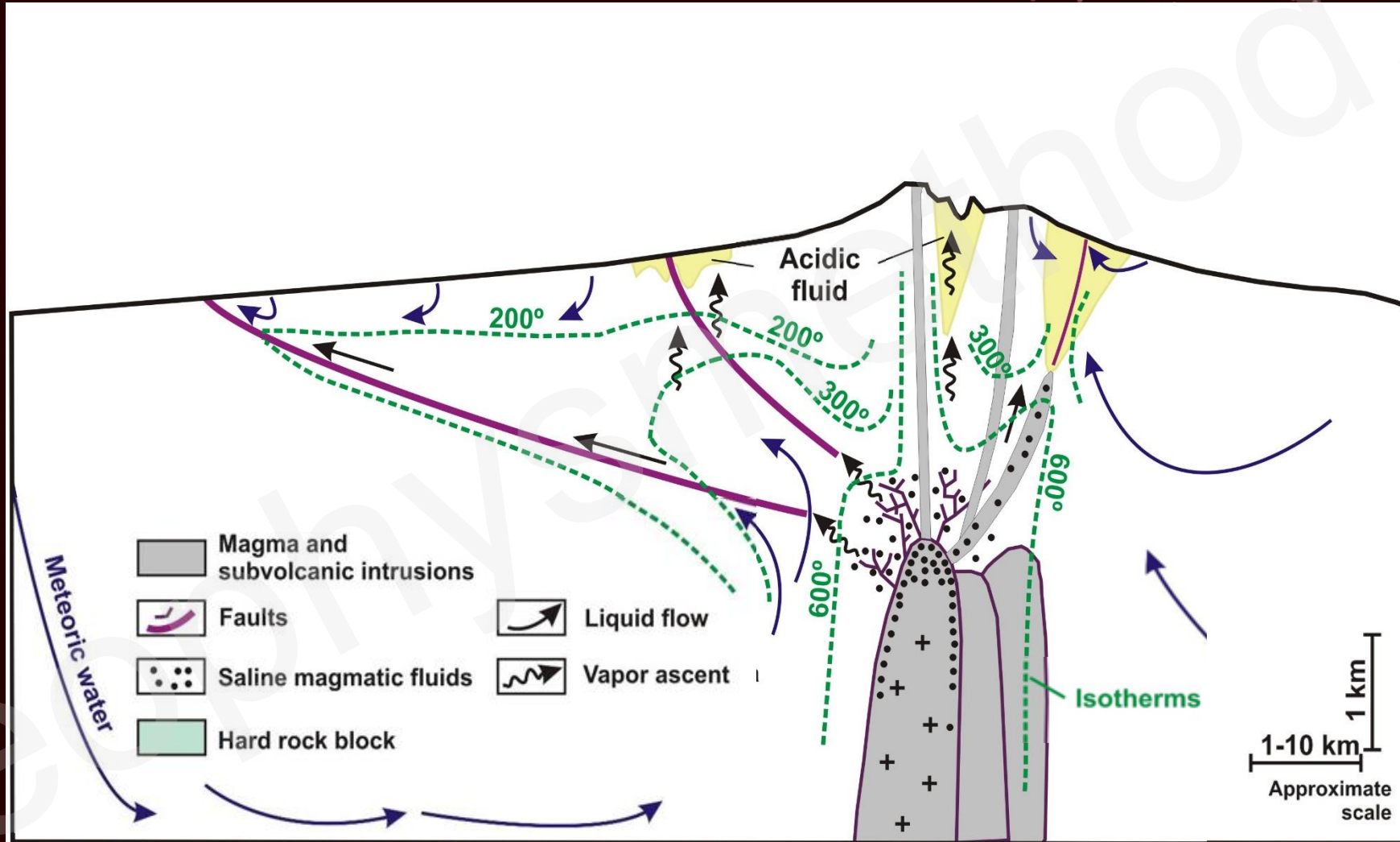
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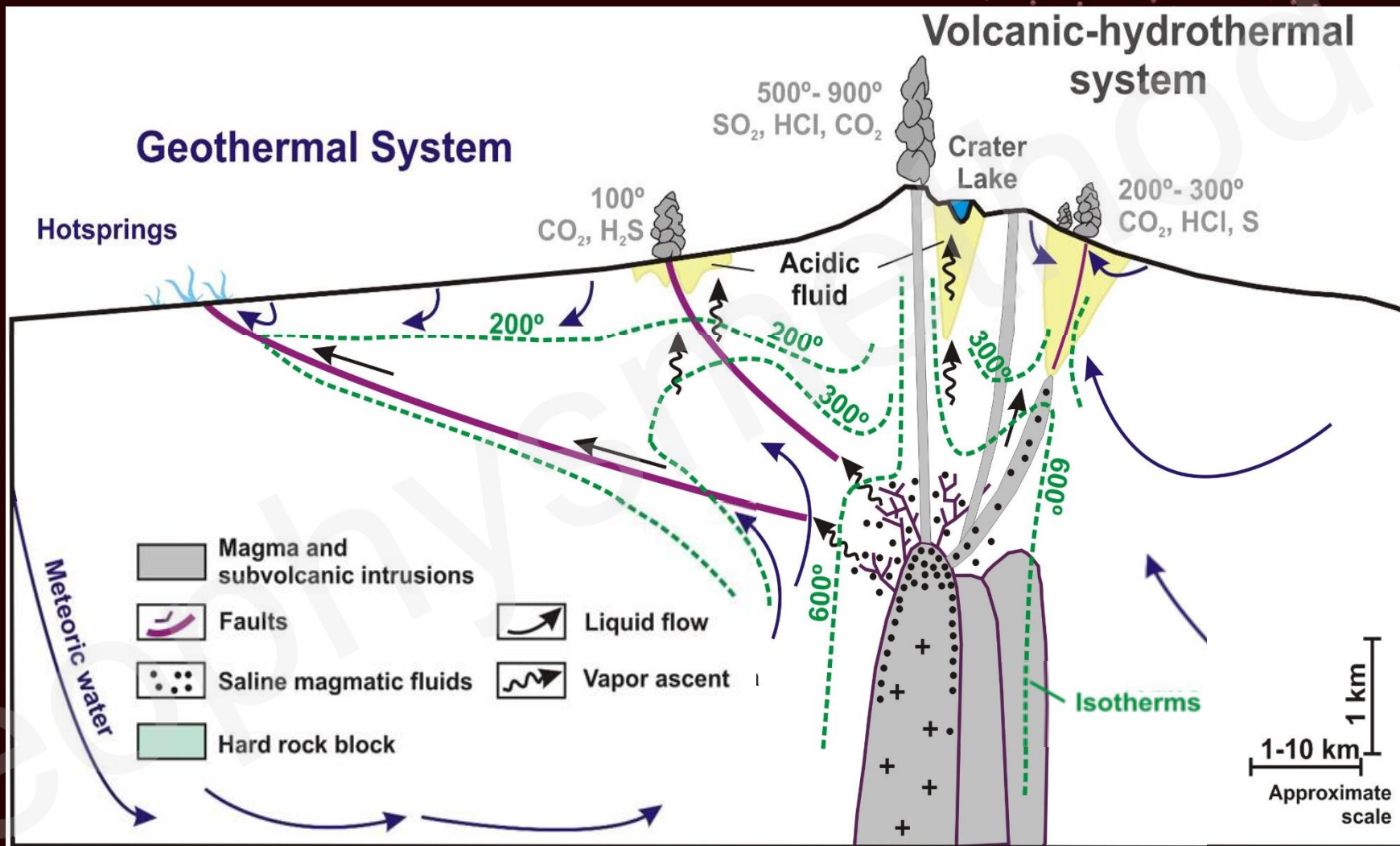
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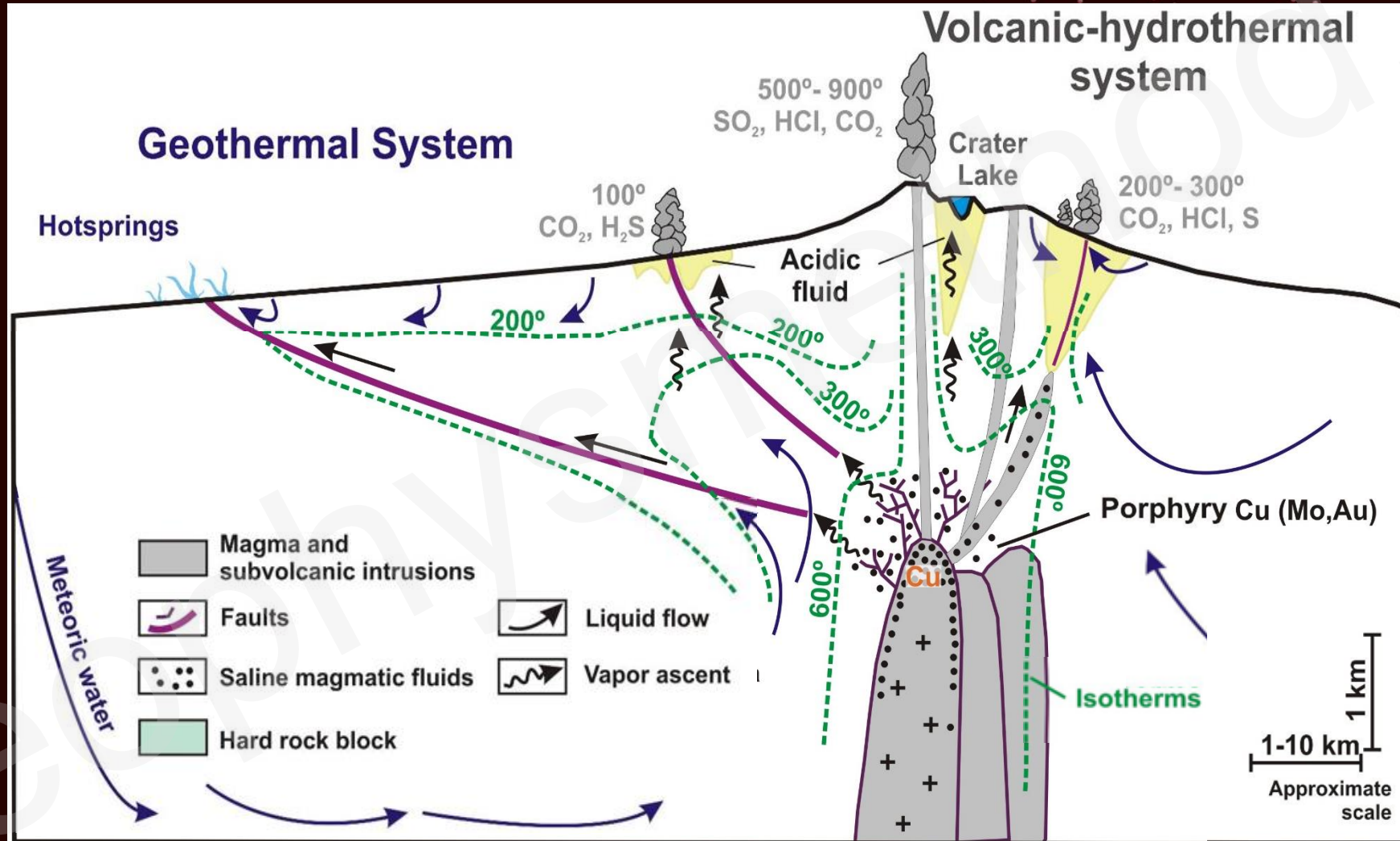
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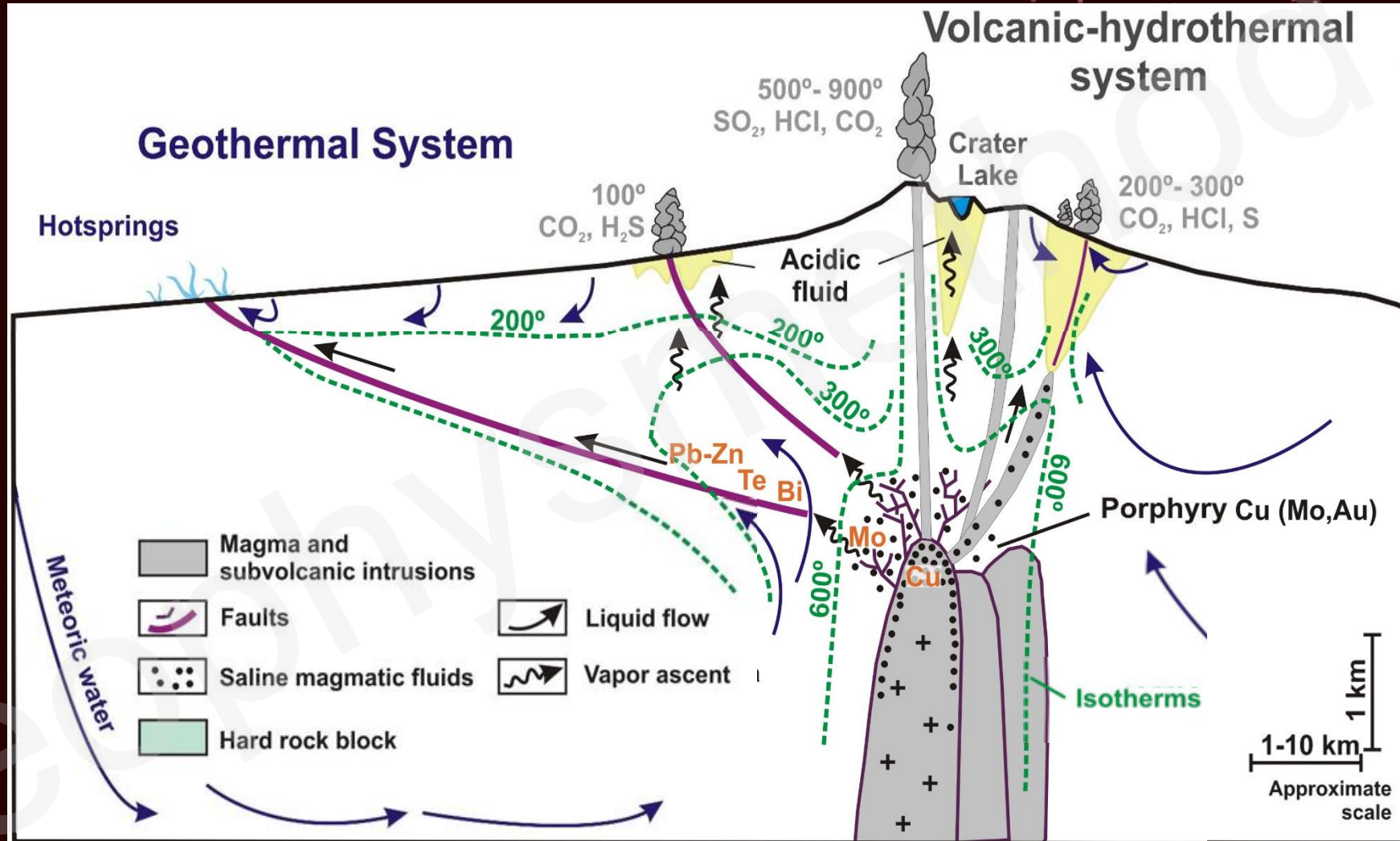
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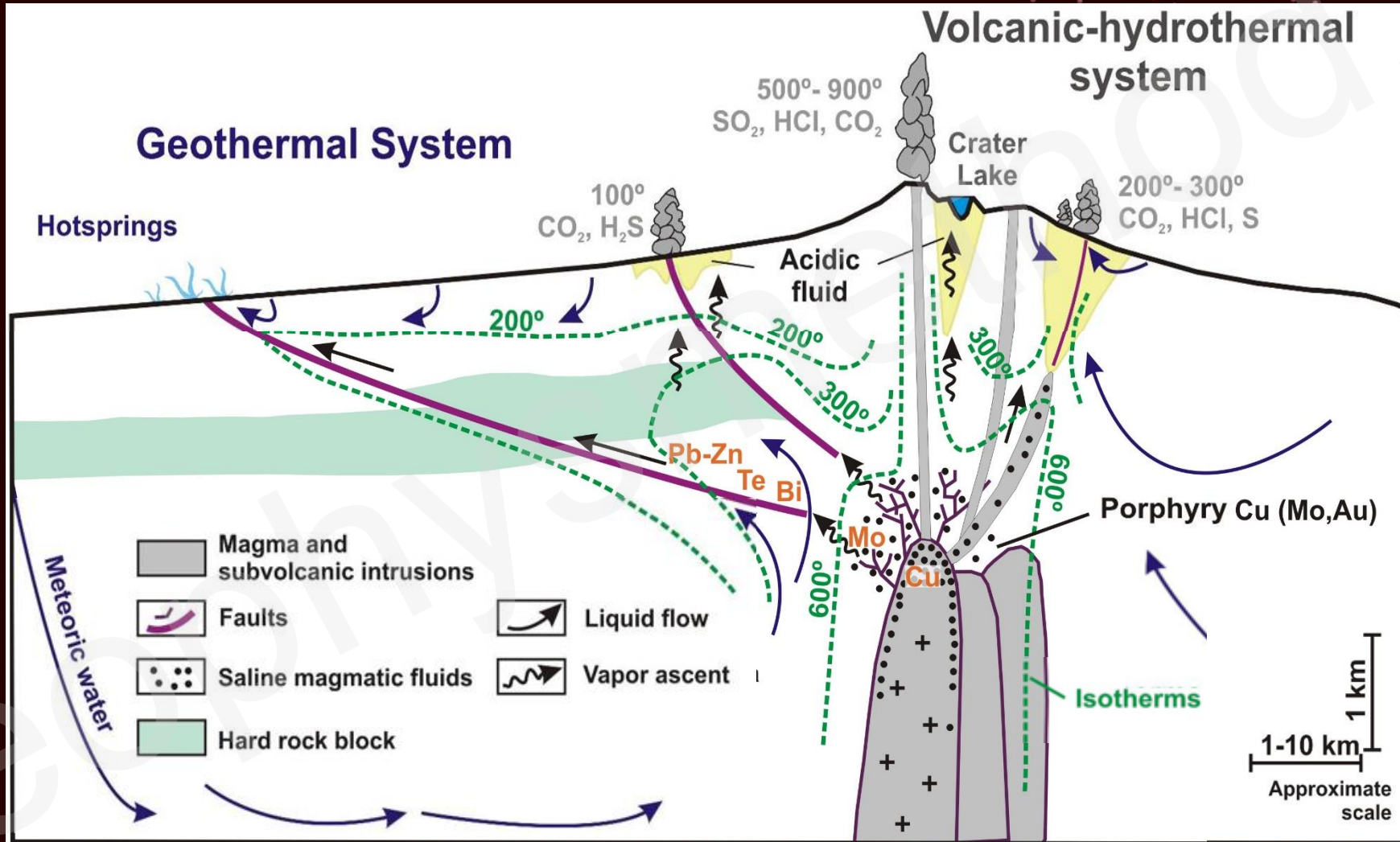
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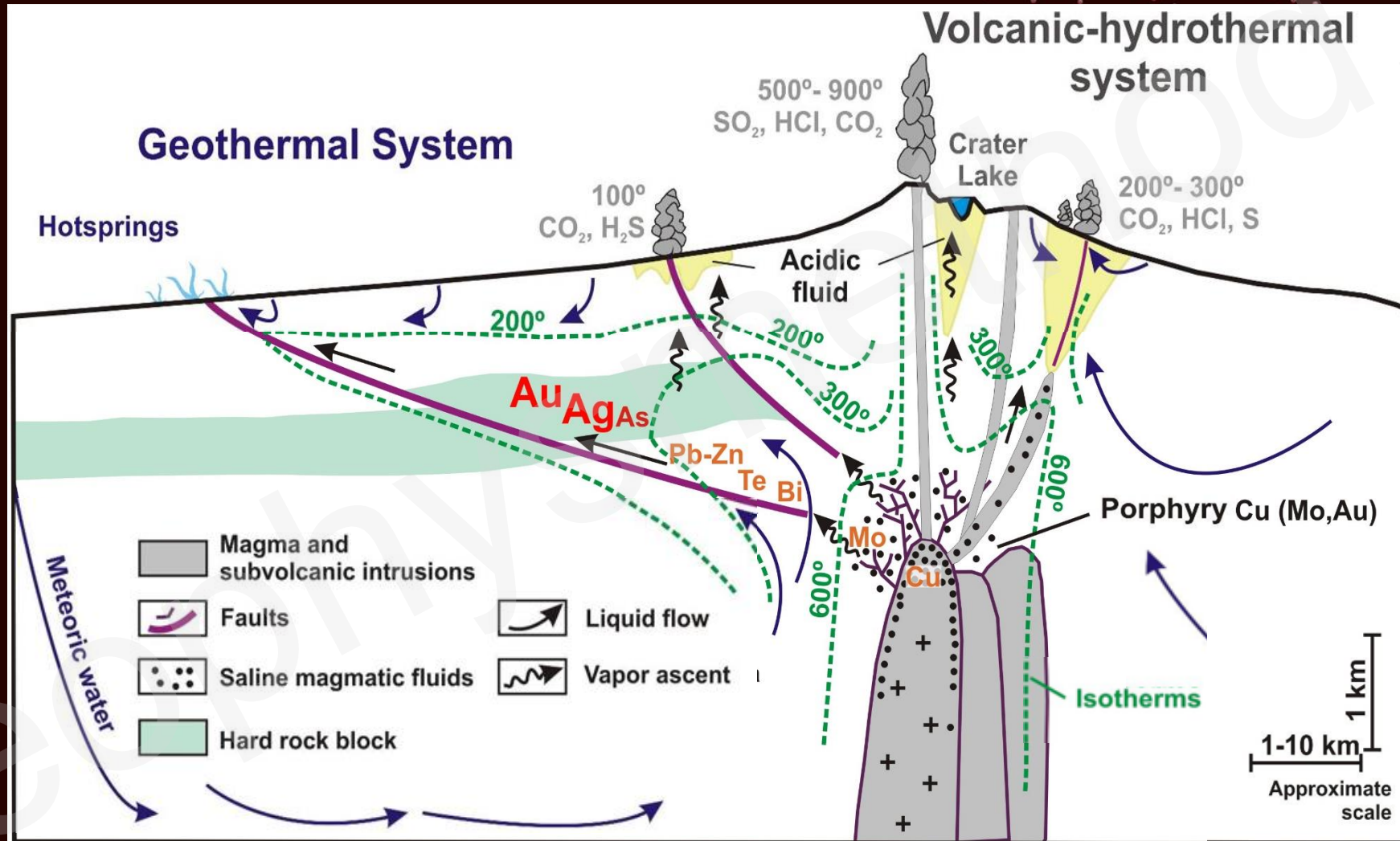
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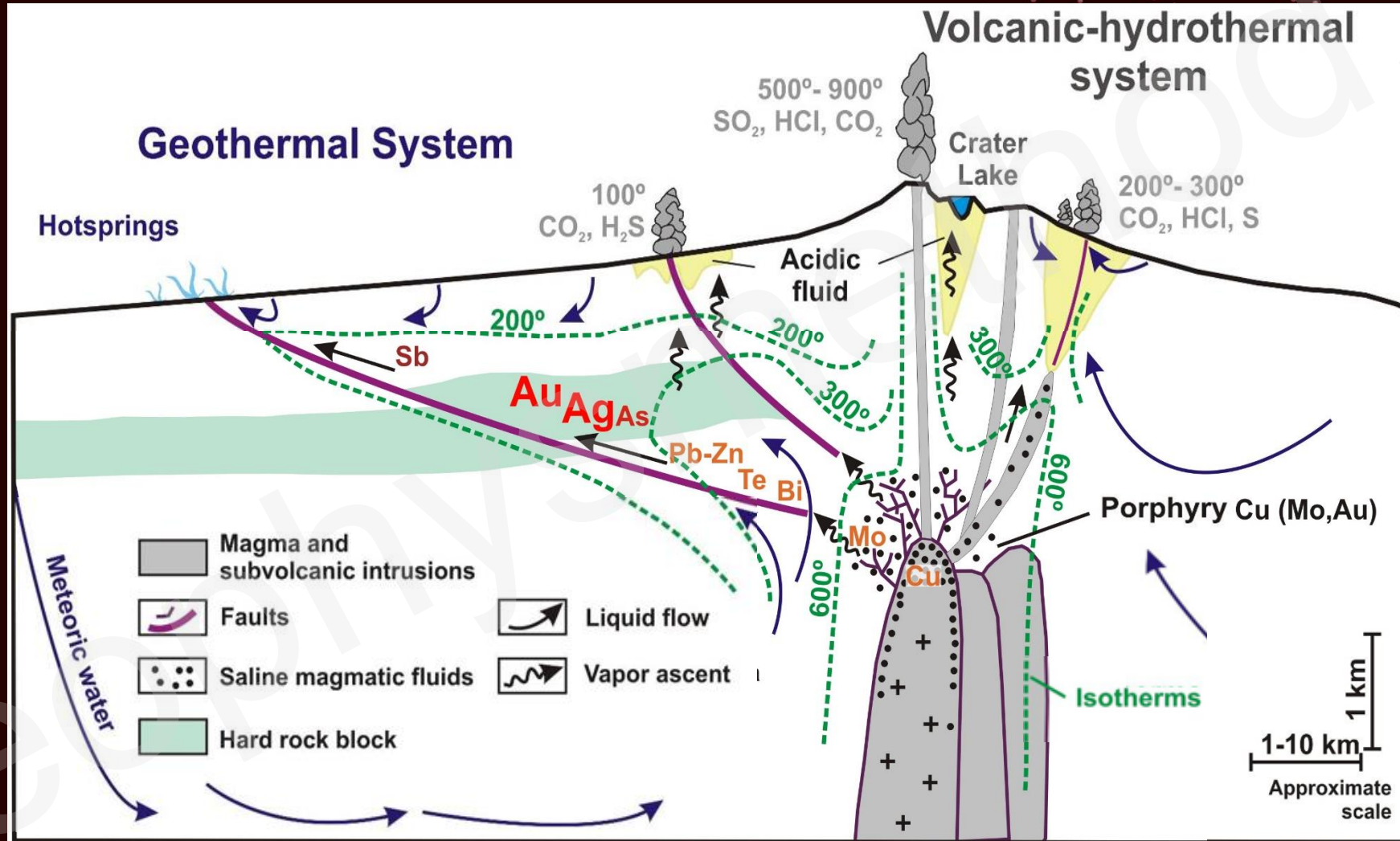
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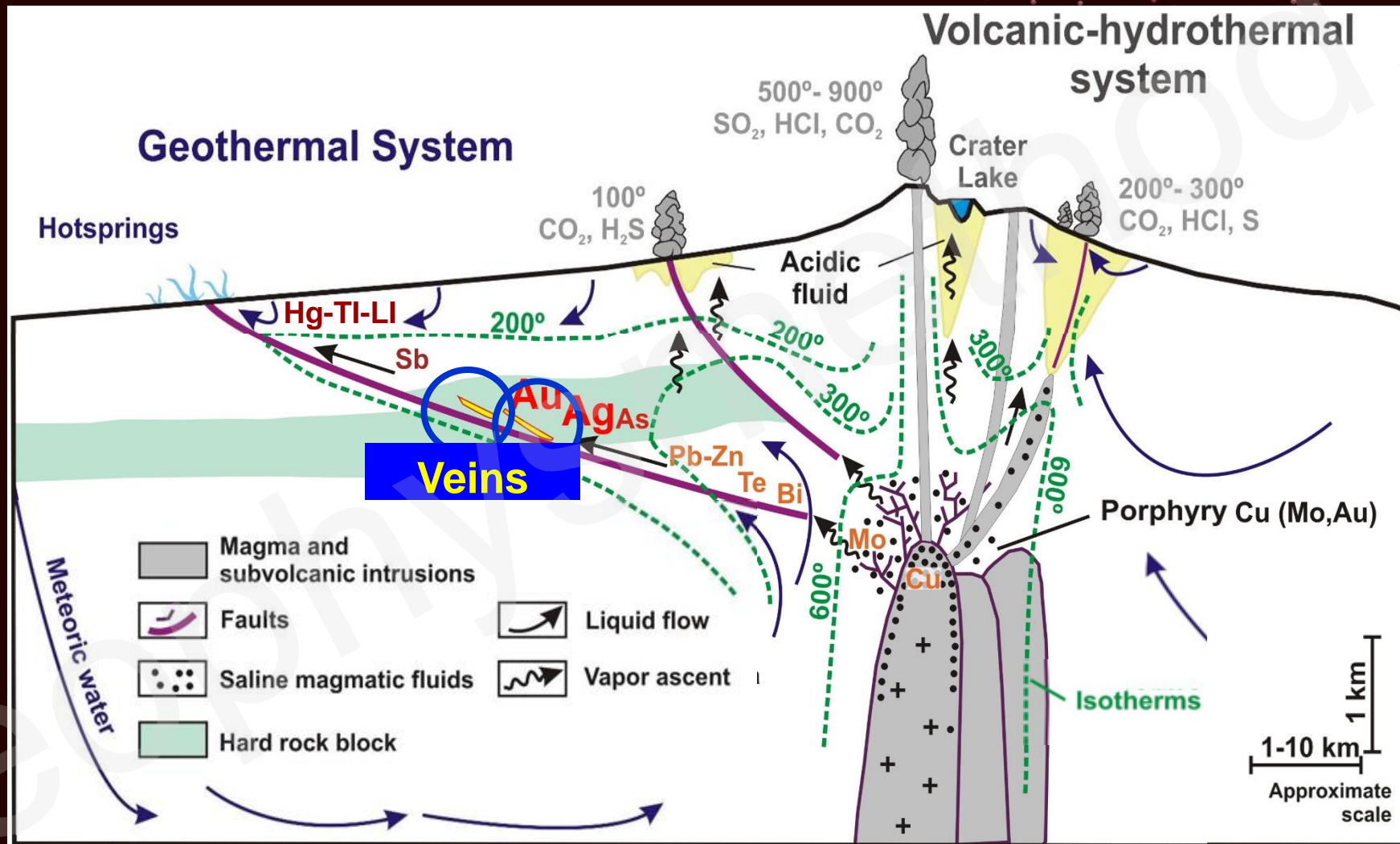
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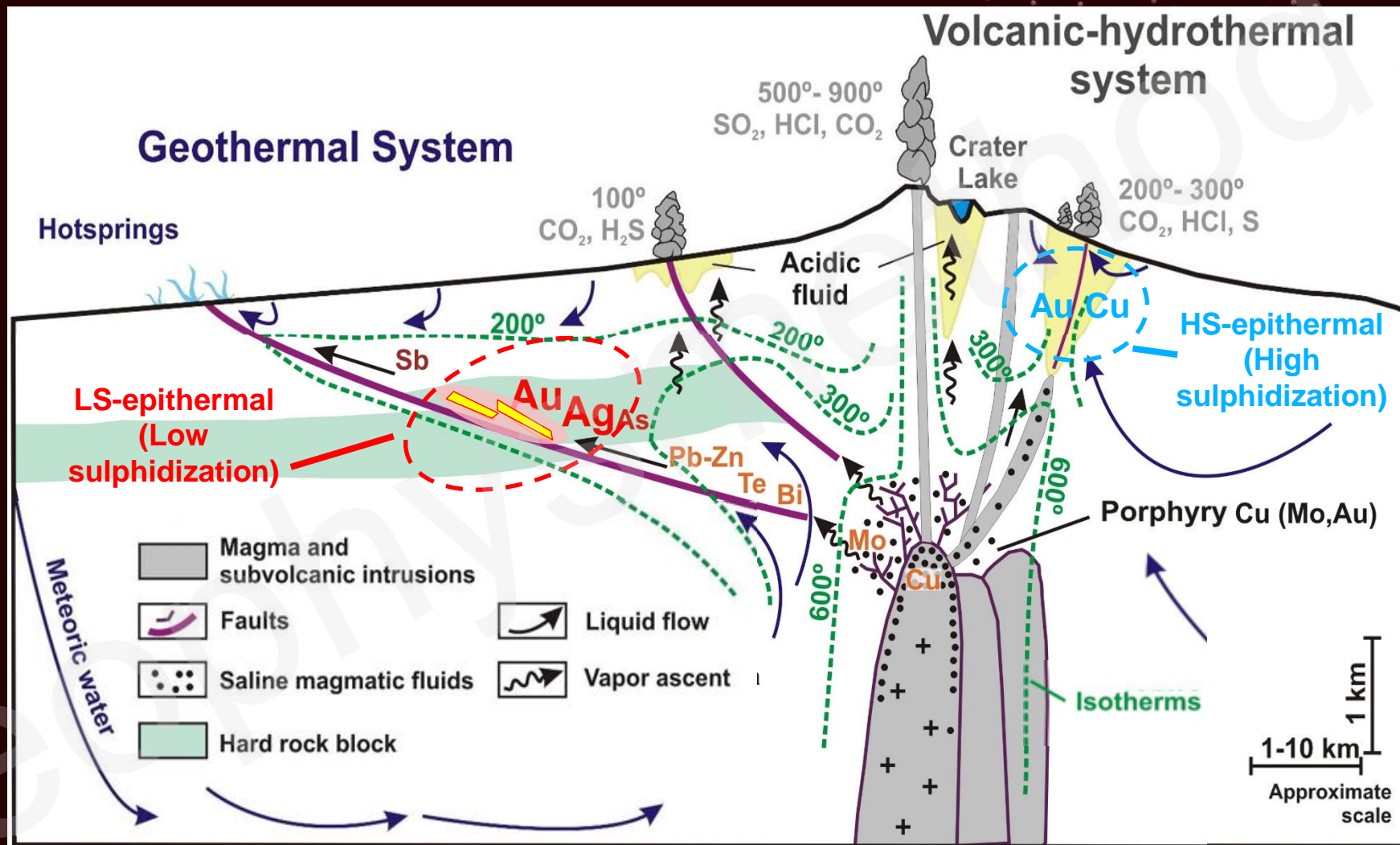
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Geological-genetic model of epithermal deposit



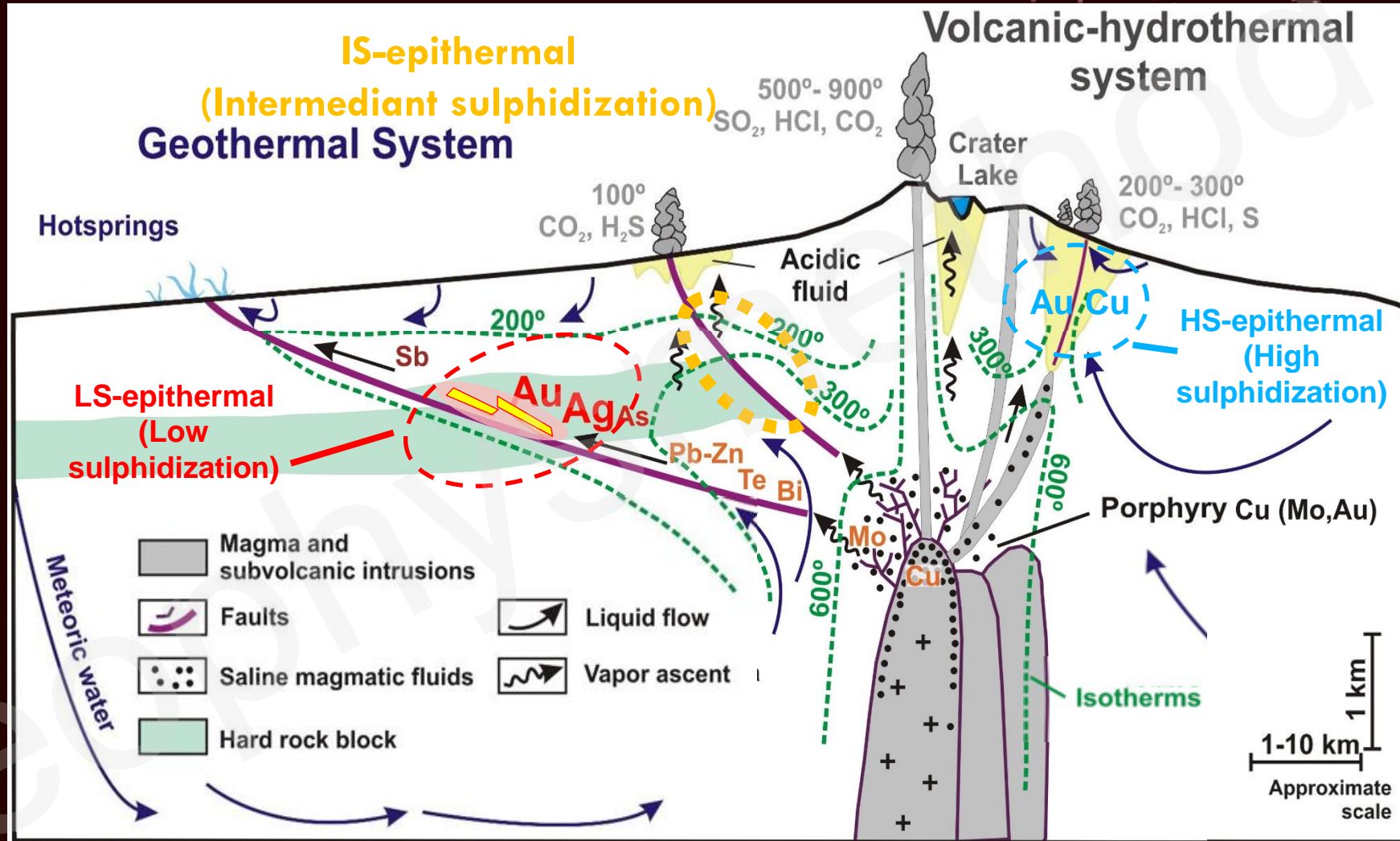
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Geological-genetic model of epithermal deposit



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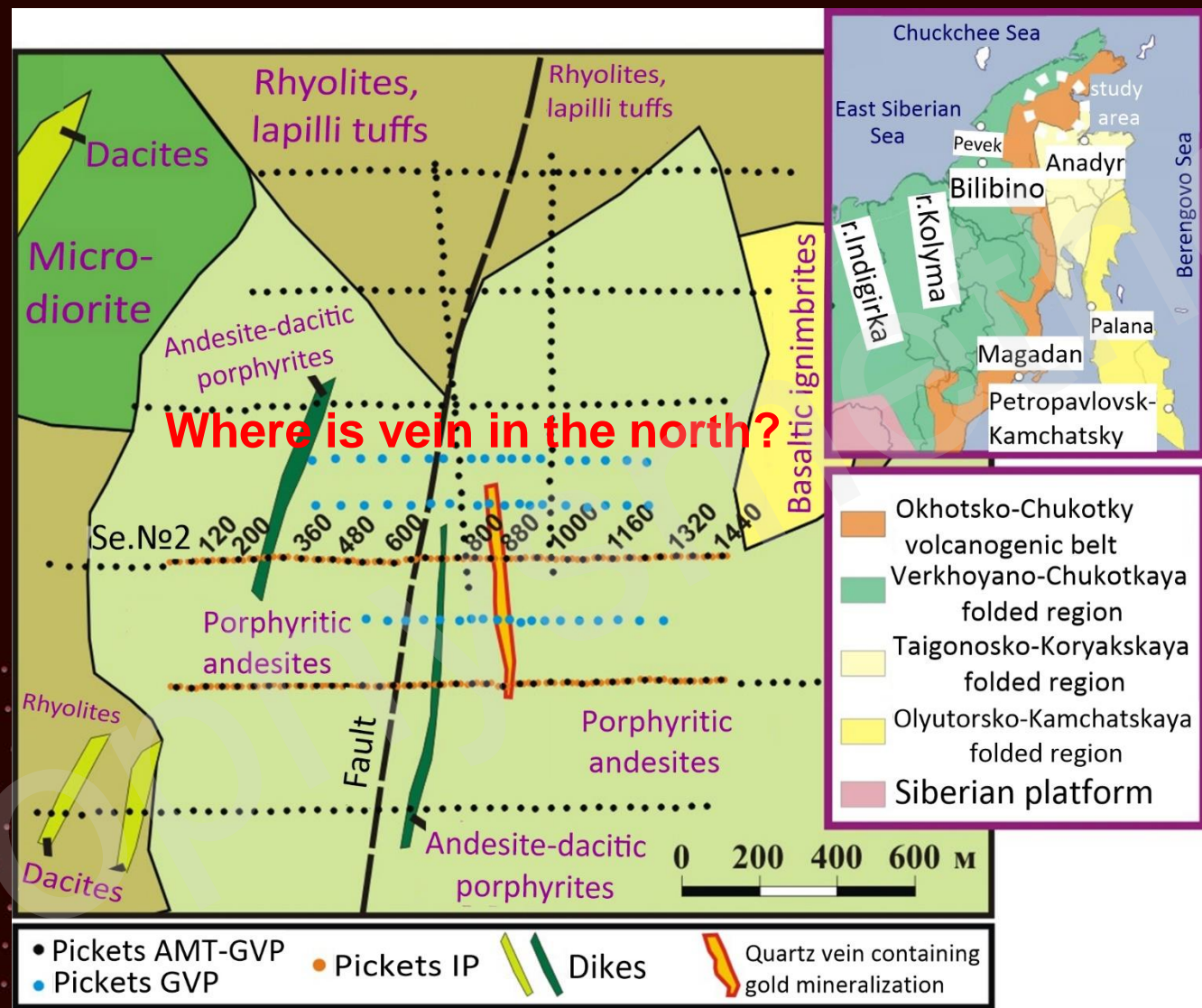
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- The case of discovery an IS-epithermal body for a small budget

Geological scheme of the work site



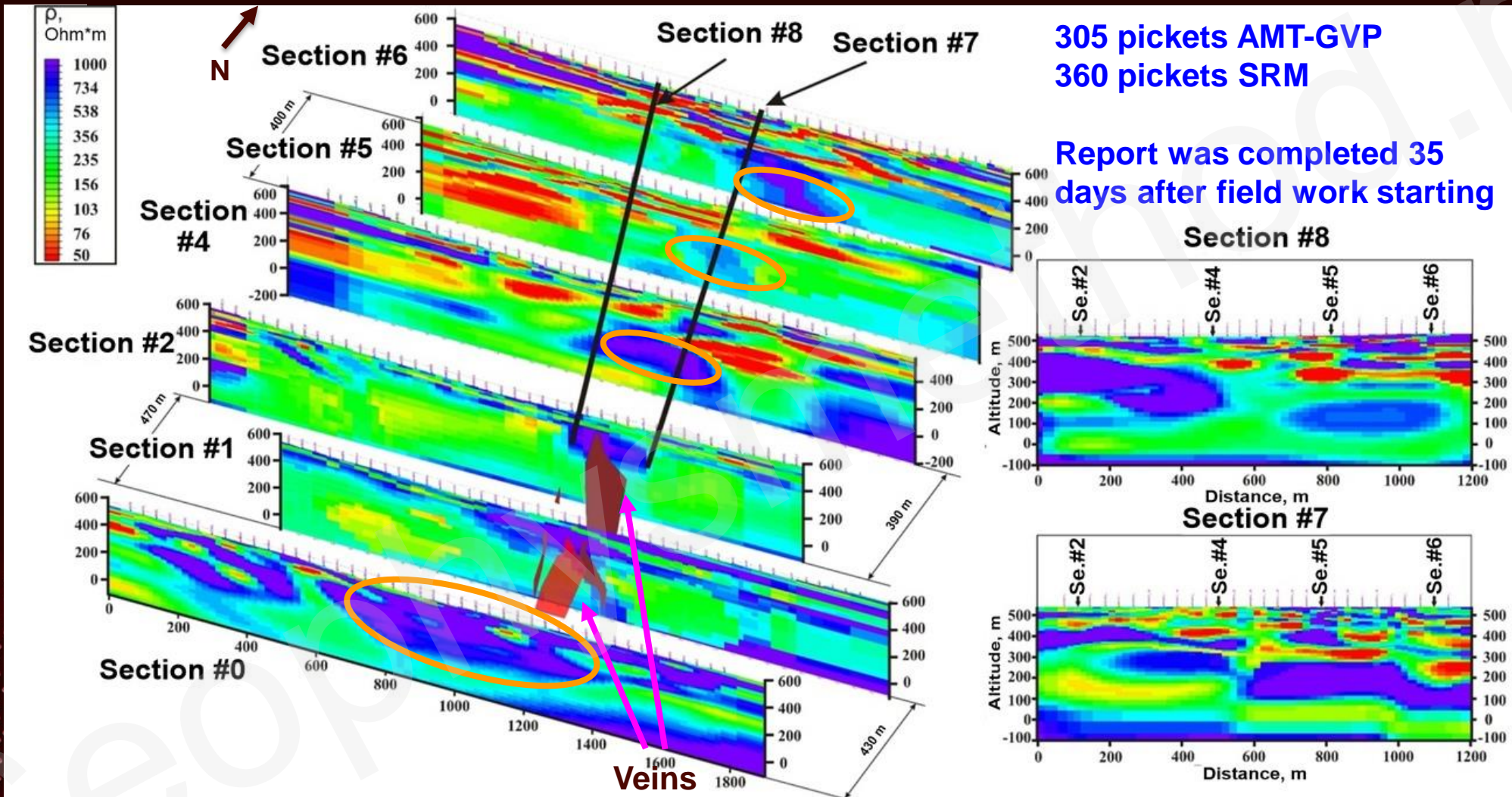
Where is vein in the north?

**Depth of the upper edge of the vein:
120-150 meters**

**Vein thickness:
3 meters**

**Gold grading:
up to 30 g/t**

3D visualization of geoelectric sections

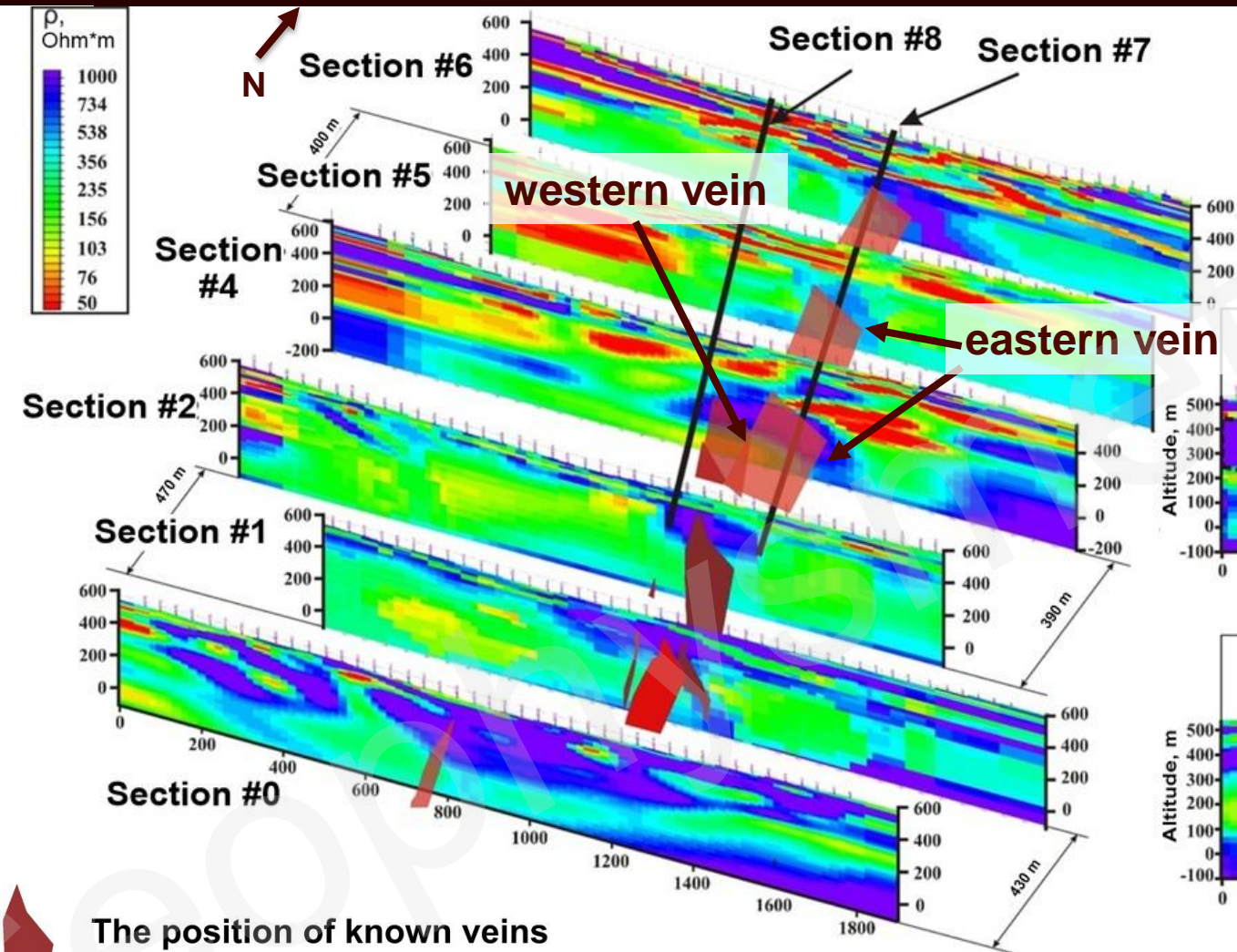


305 pickets AMT-GVP
360 pickets SRM

Report was completed 35 days after field work starting

2D inversion (RMS less than 3% for all sections)
TE and TM mode (amplitude and phase) from 10 000 Hz to 30 Hz
Tipper: 10 000 – 1 000 Hz

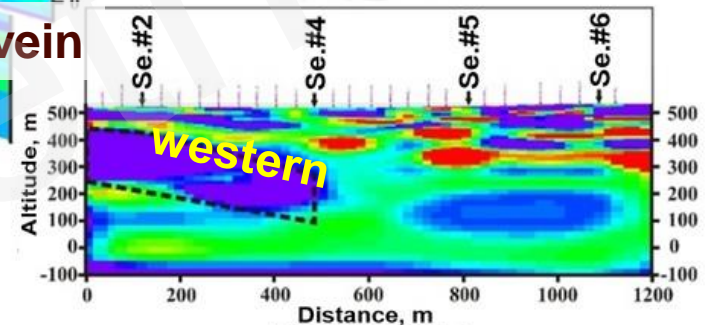
3D visualization of geoelectric sections



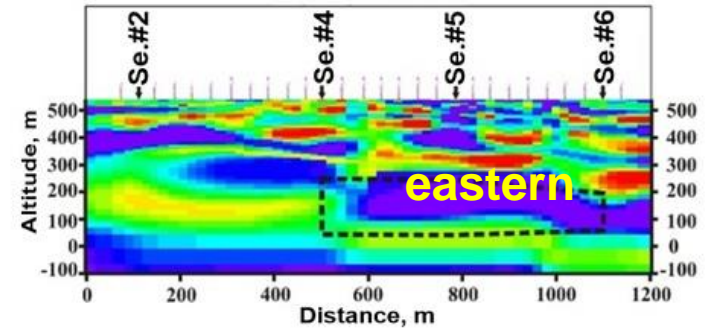
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Section #8



Section #7

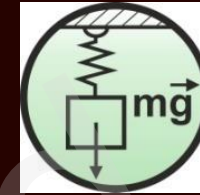


The position of known veins (before the works of AMT-GVP)

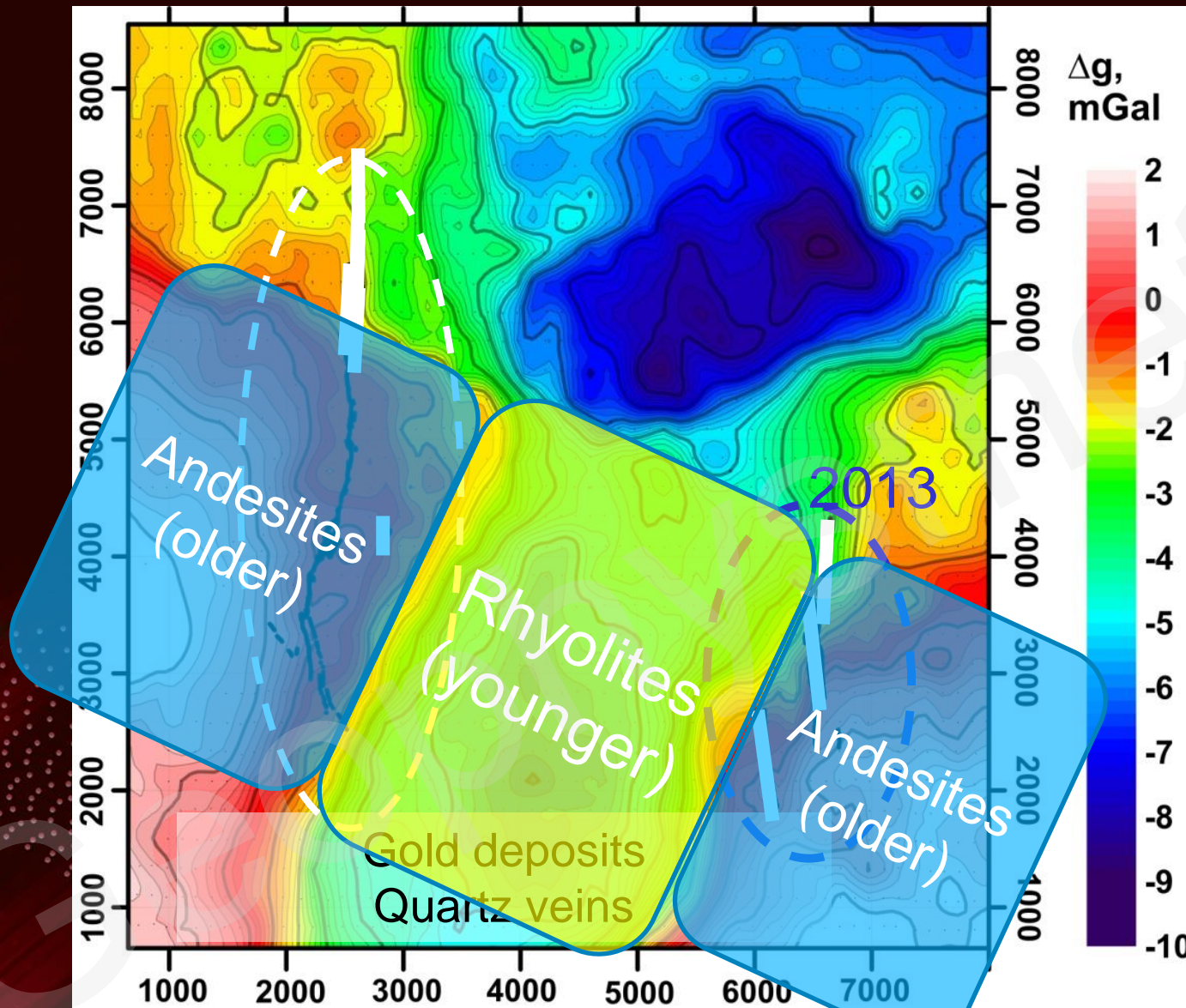
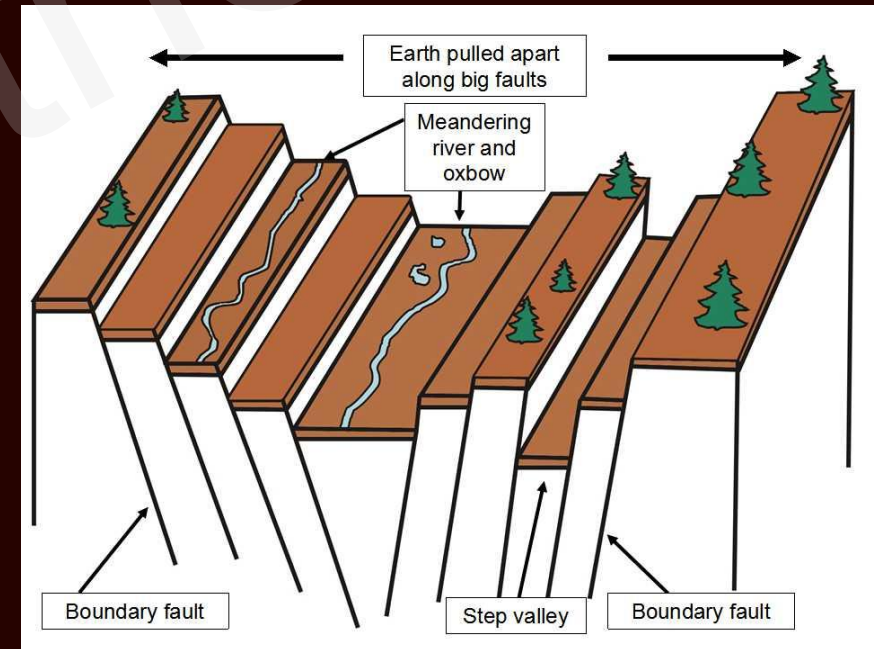
The position of the veins detected after the work of AMT

52. Ermolin E., Ingerov O., Savichev A., Smirnov M. The physico-geological model of the epithermal Au-Ag deposit (Chukotka) on the basis of the integration AMT investigations // Abstract, 24th EM Induction Workshop. Helsingør, Denmark. 12-19 August 2018.

Reflection of the rift structure on the gravity map

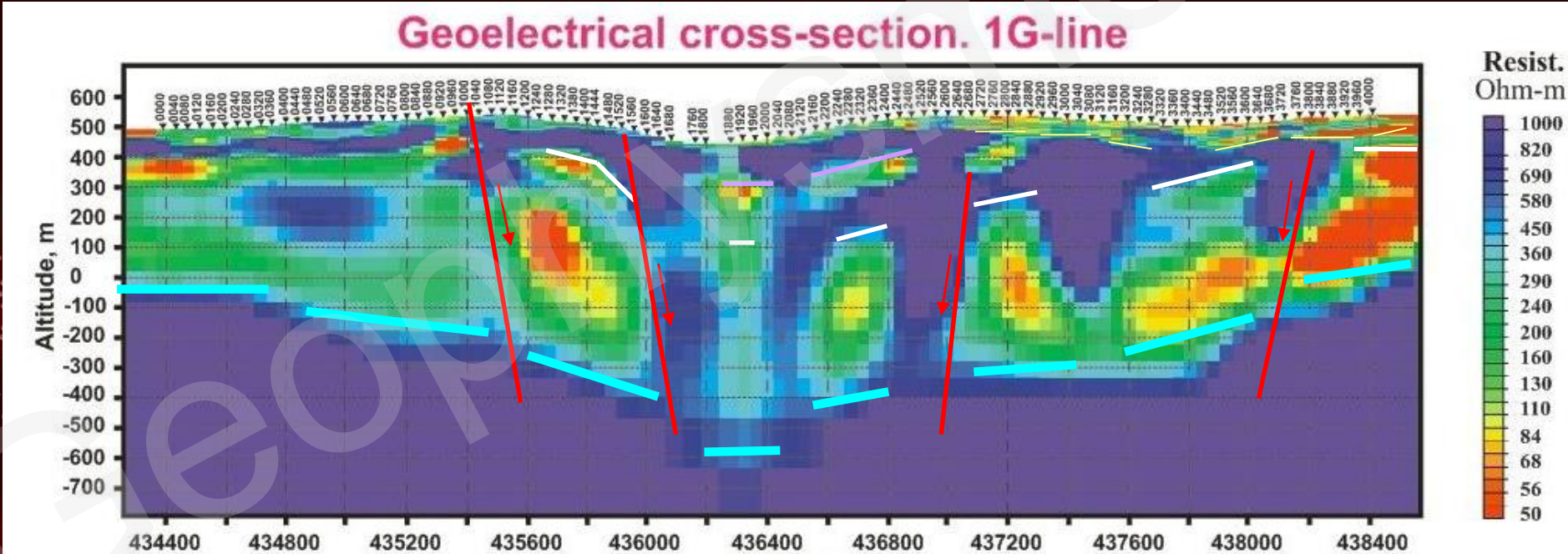
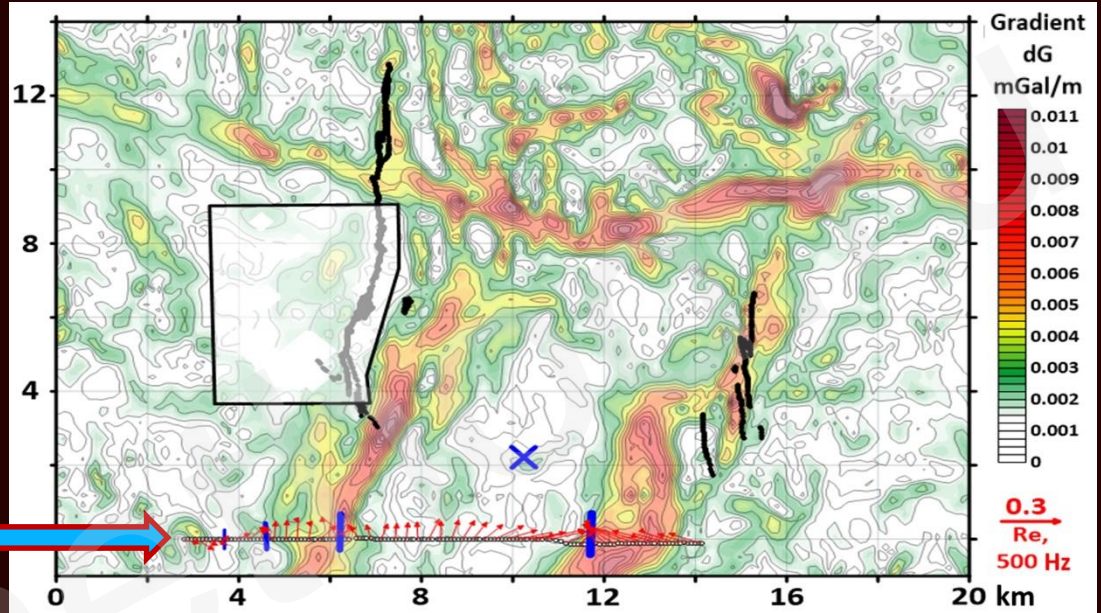


Rift

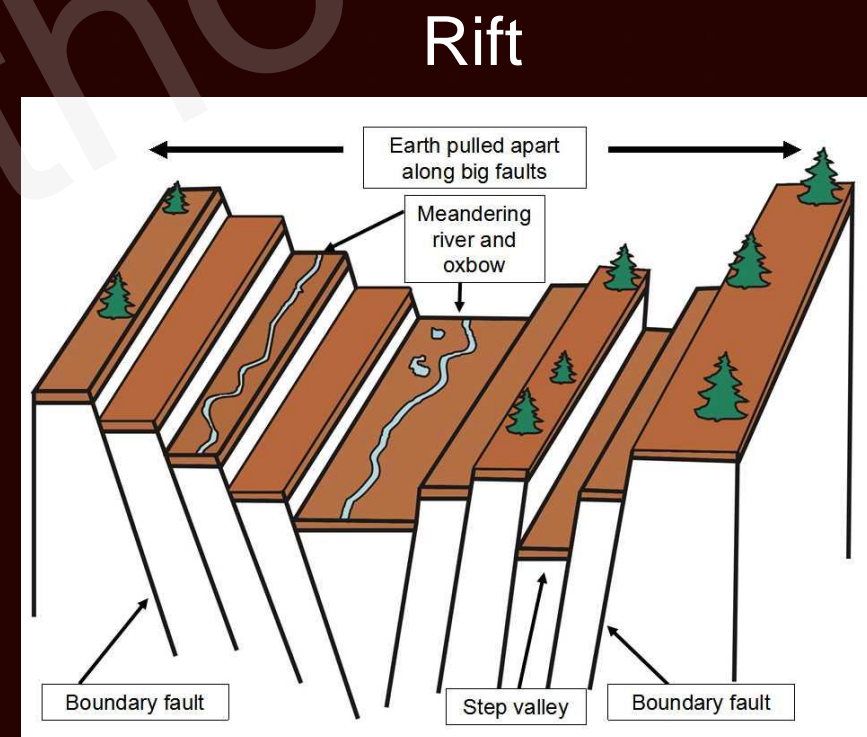
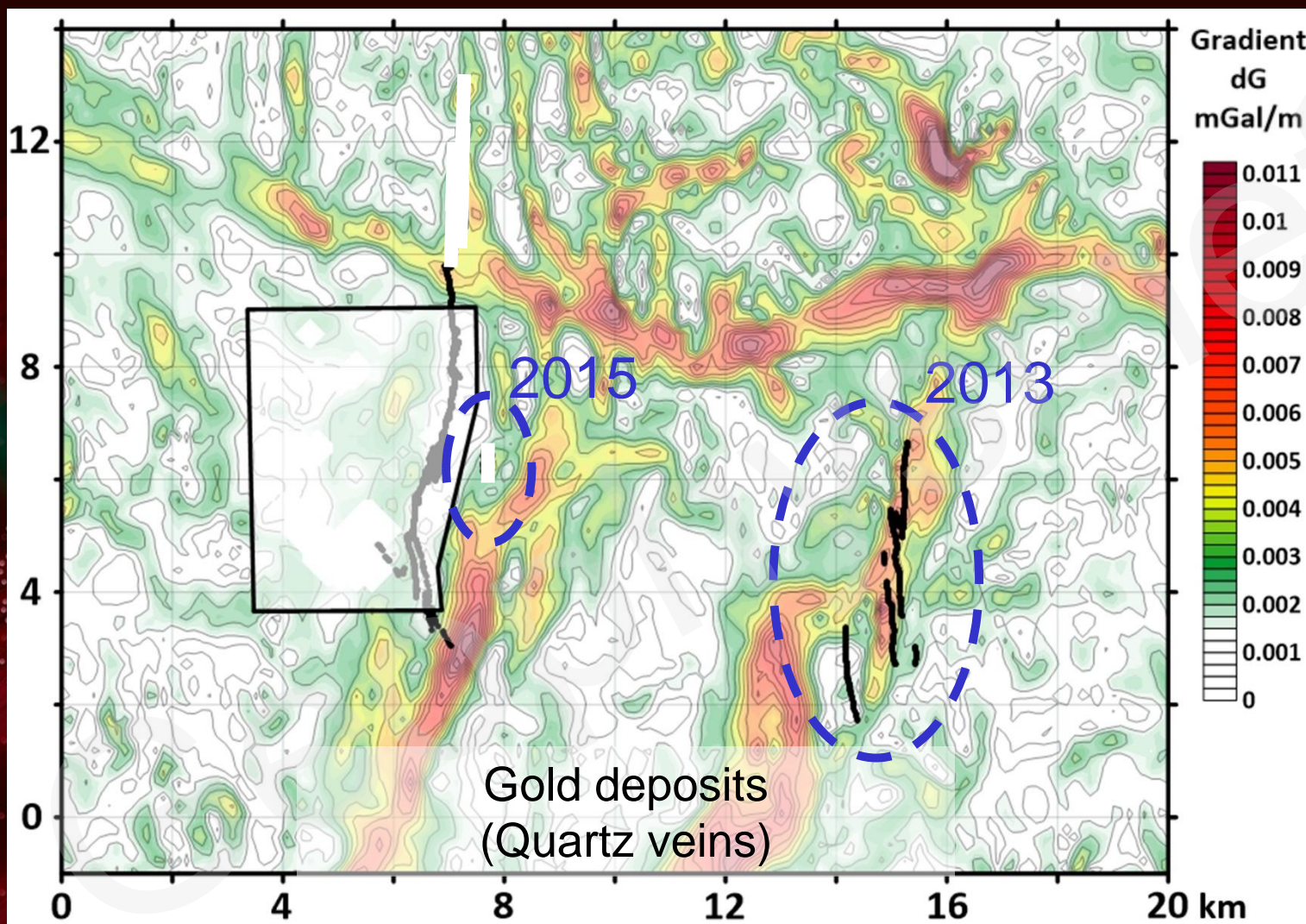
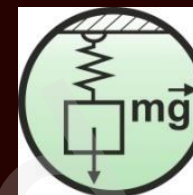


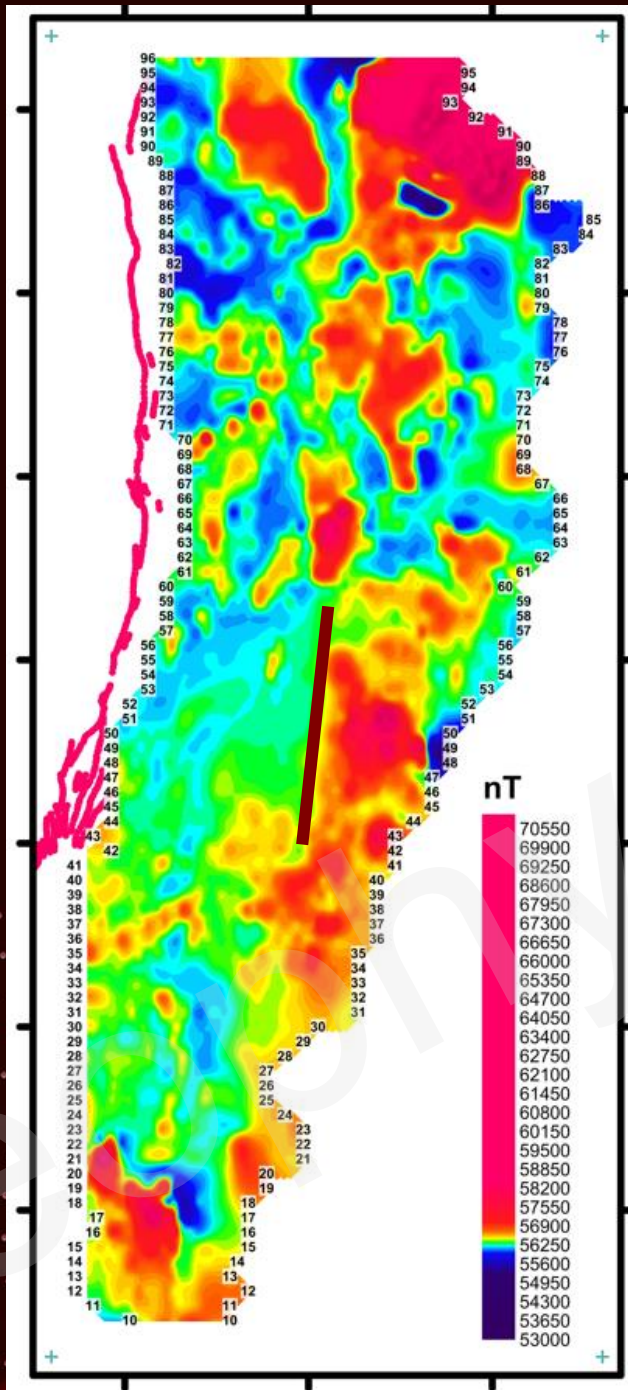
The method of magnetotelluric and magnetovariation sounding made it possible to amplify the the rift structure

AMT section



Reflection of the rift structure on the gravity map





Lineaments of gravity and magnetic field scheme

Legend

Gravity lineaments

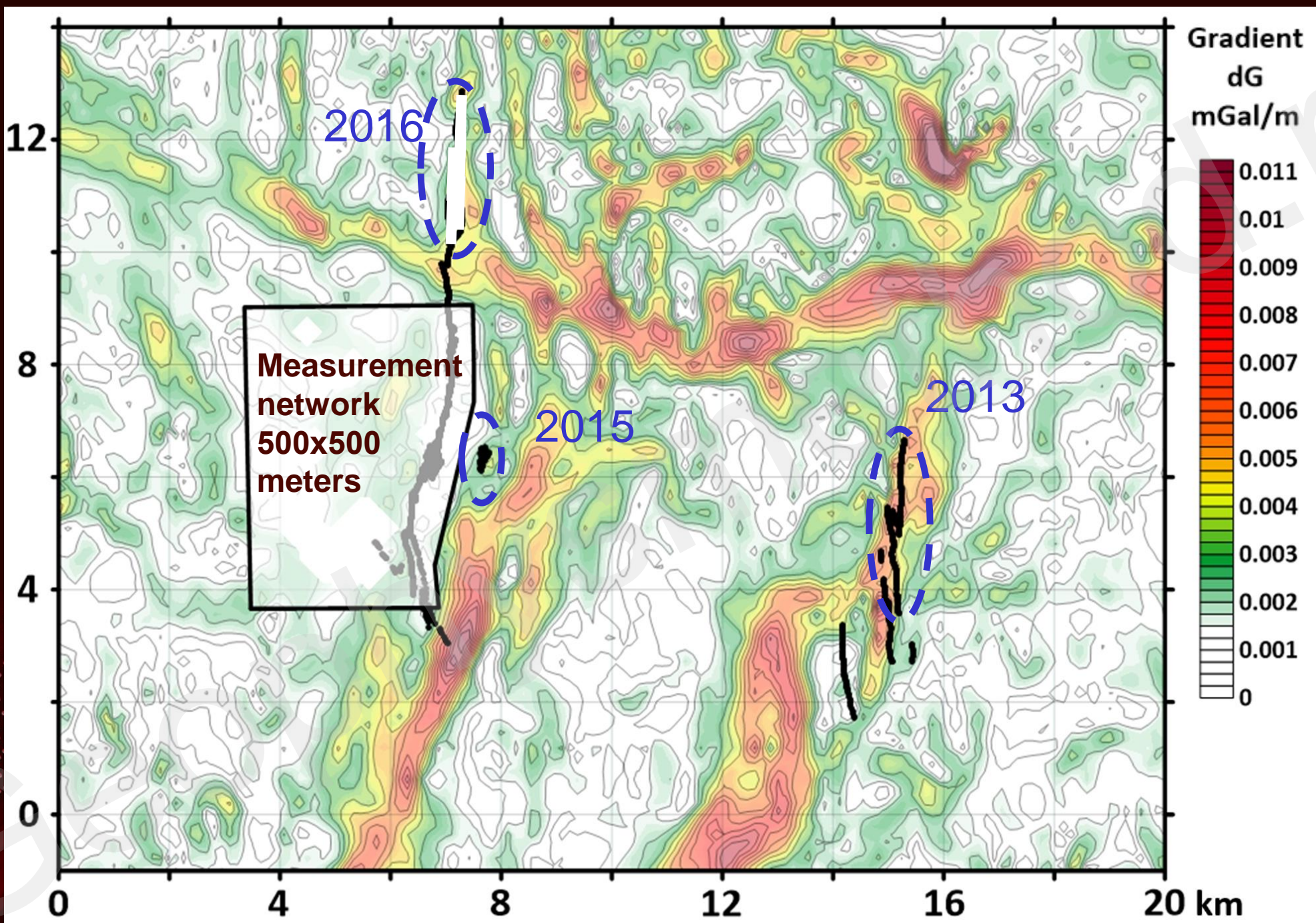
- Gravity gradient zones (I, II, III ranges)
- Gravity local anomalies zones

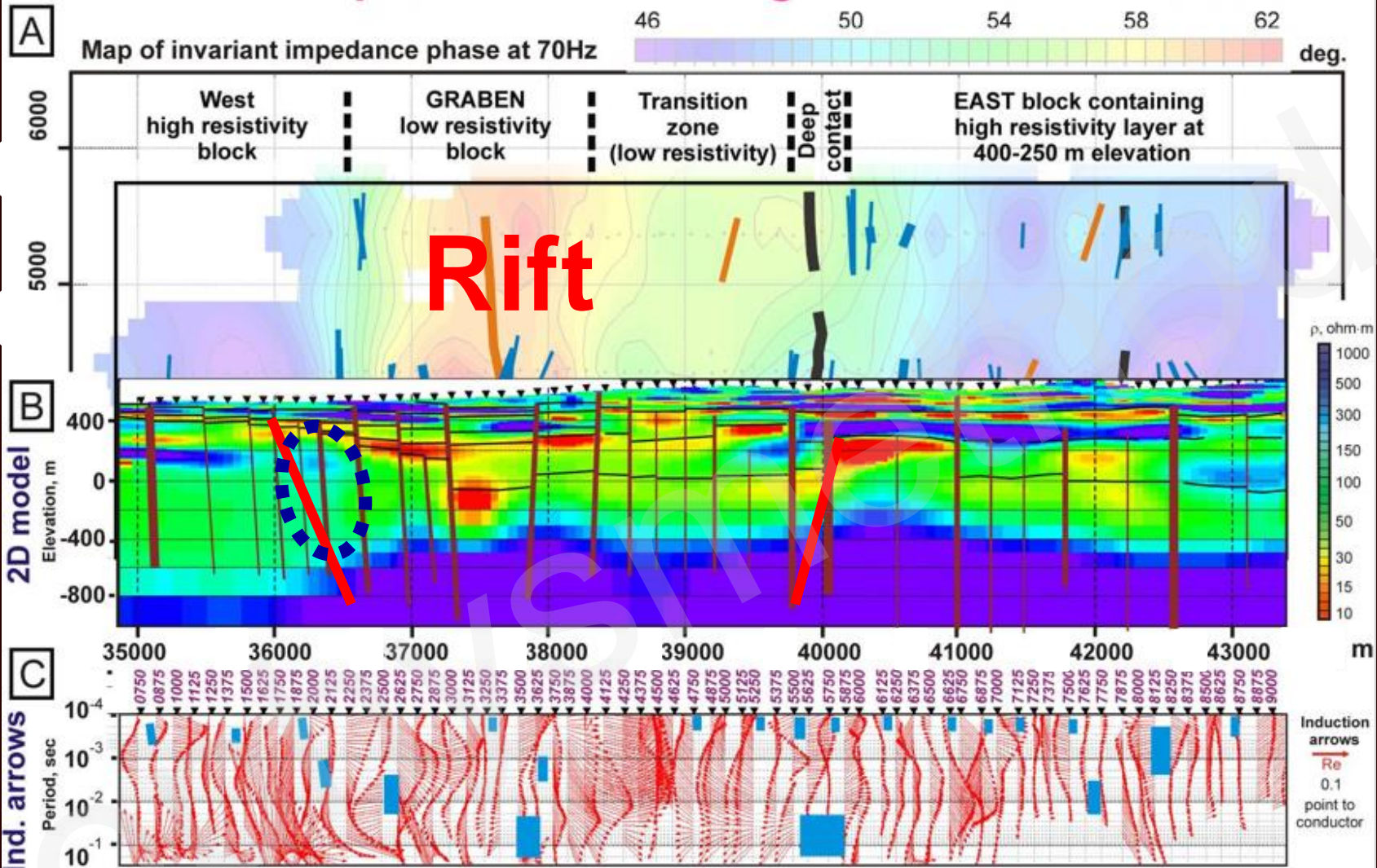
TMI lineaments

- Contacts position. Difference in magnetic field character (I, II range).
- Pseudogravity high gradient zones (structures possible position)
- Negative magnetic field anomalies axis position (I and II range)
- Known vein gold position

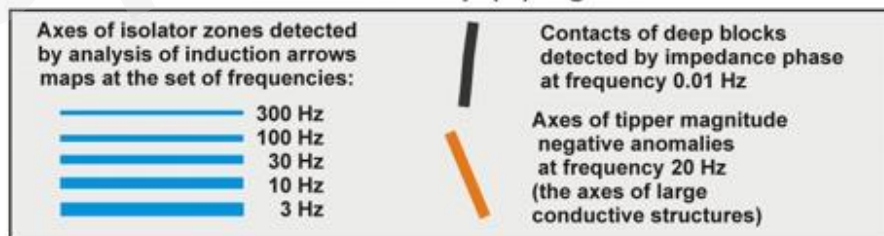
Scale, km

0 0,2 0,4 0,6 0,8

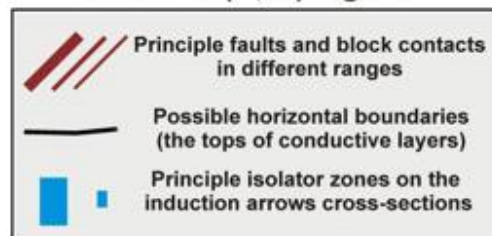


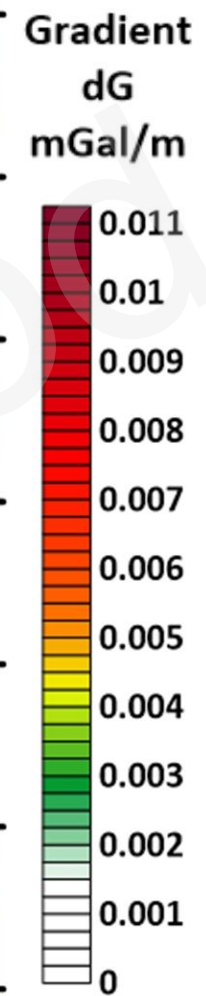
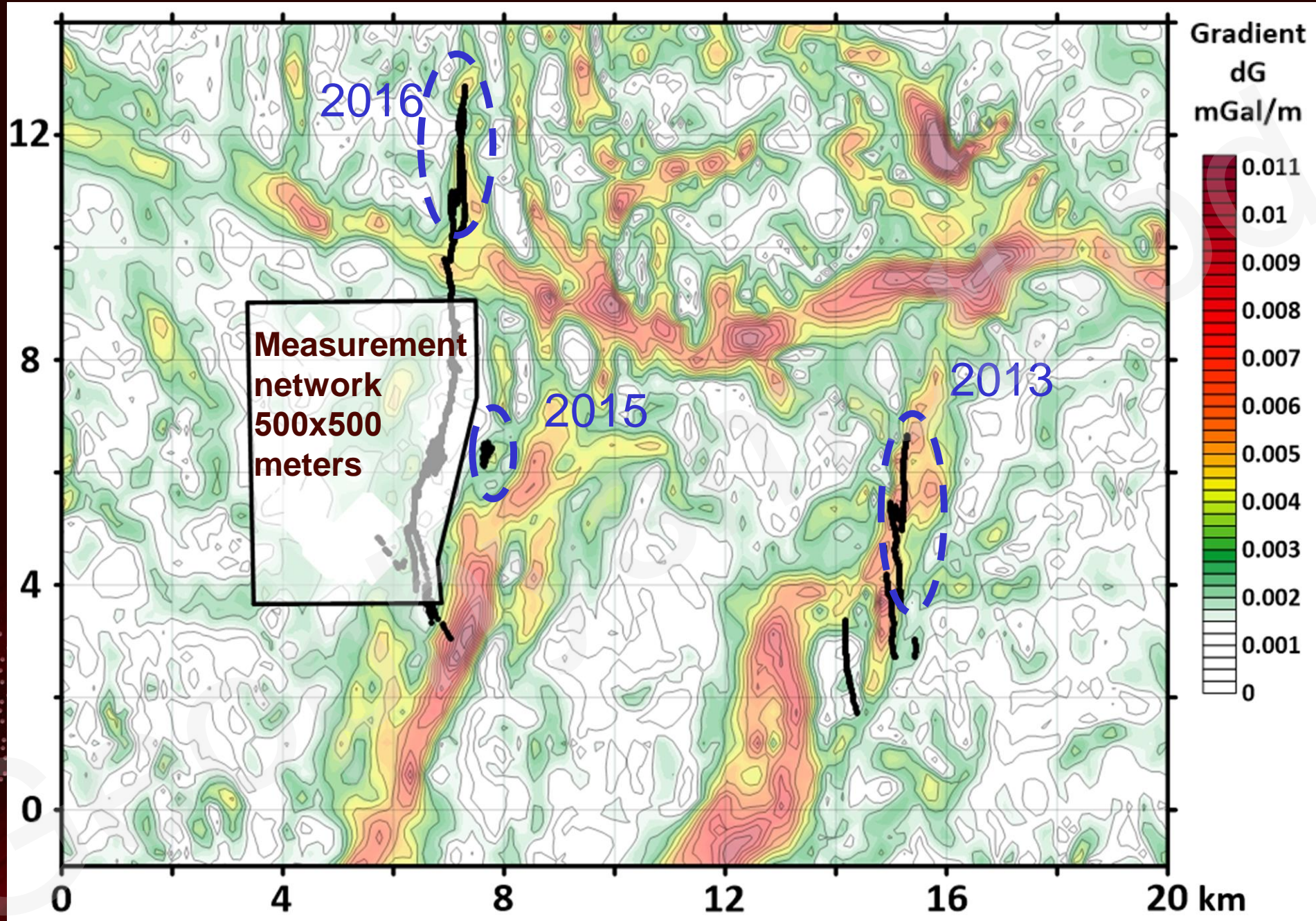


Structural map (A) legend



Sections (B, C) legend





Measurement
network
125x250 meters

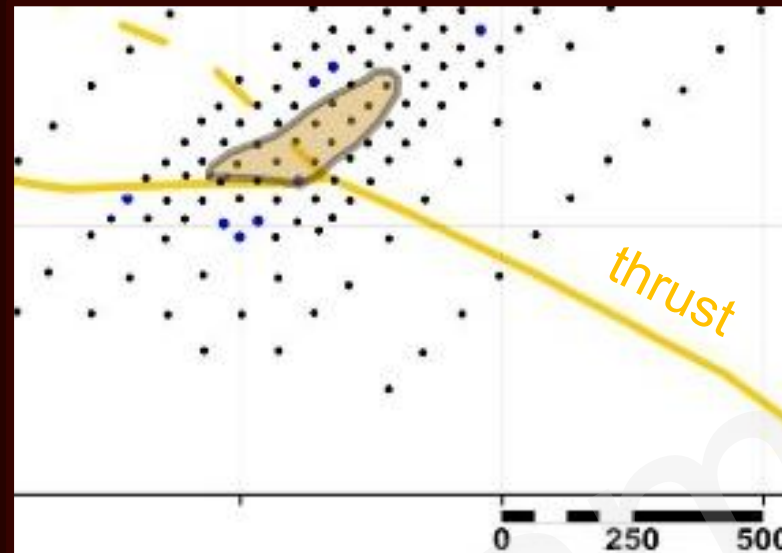
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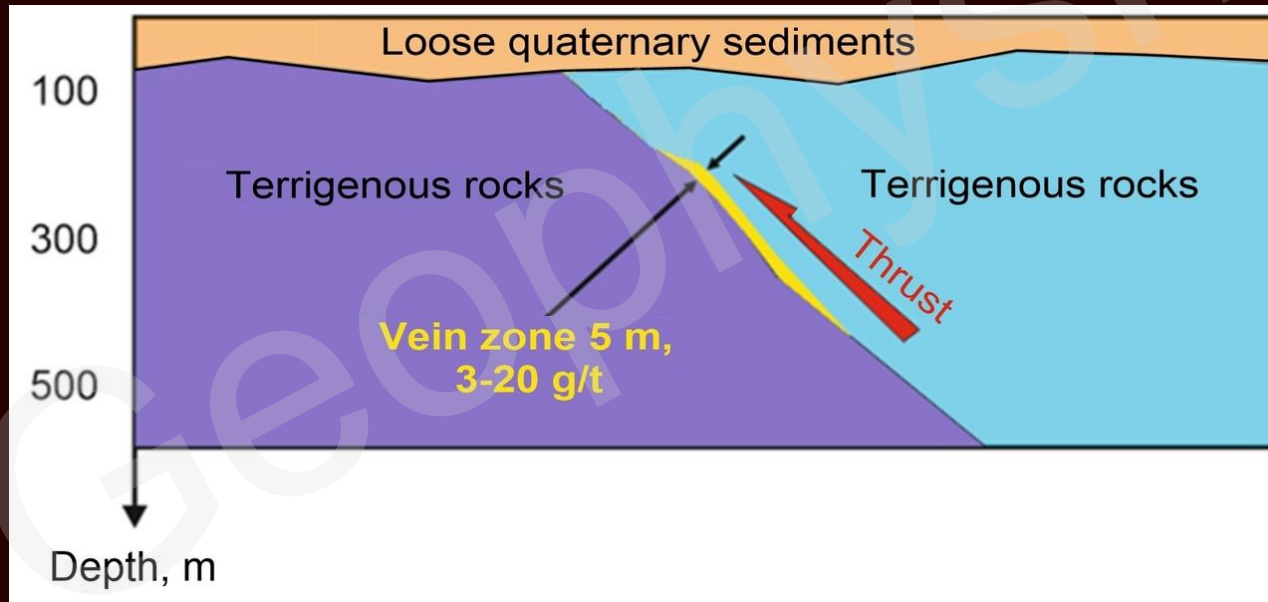
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Map



Section

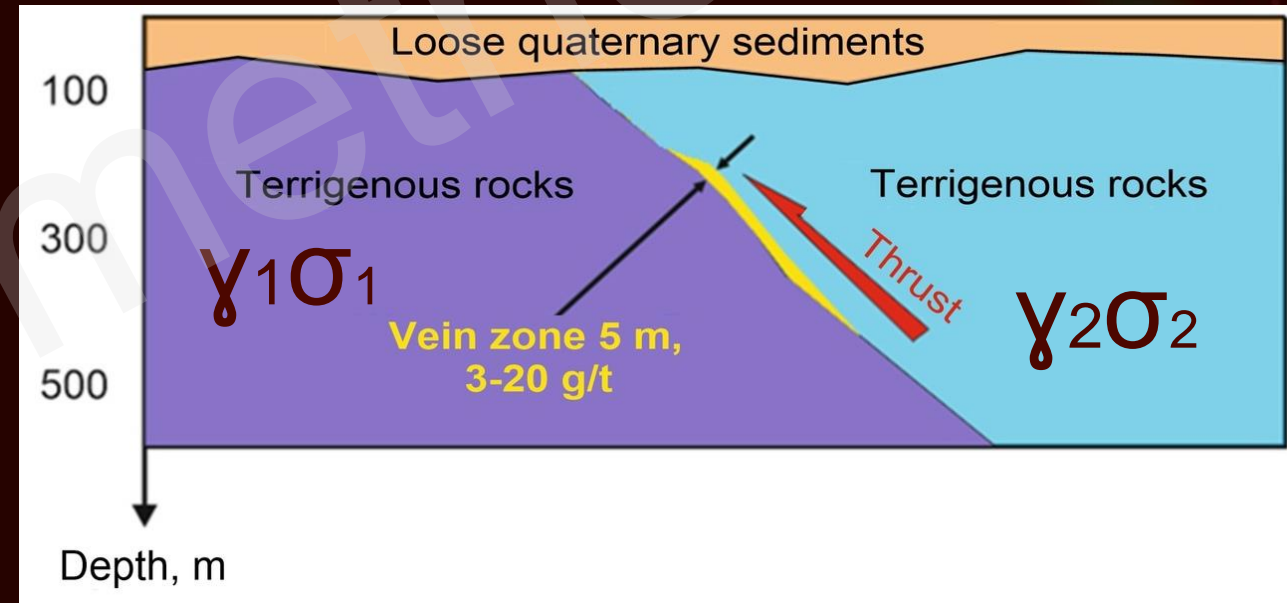


Purposes:

- perform research with a minimum budget;
- assign the position of drilling exploratory wells.

Depth of the upper edge of commercial vein is 170-250 meters

- Drafting of technical task :
- ✓• The study of a priori information
- The winter stage of work:
 - land magnetic exploration;
 - land gravity exploration;
 - forecast.
- The summer stage of work:
 - AMTS;
 - resistivity method and IP.
- Drilling results.



The winter stage of work

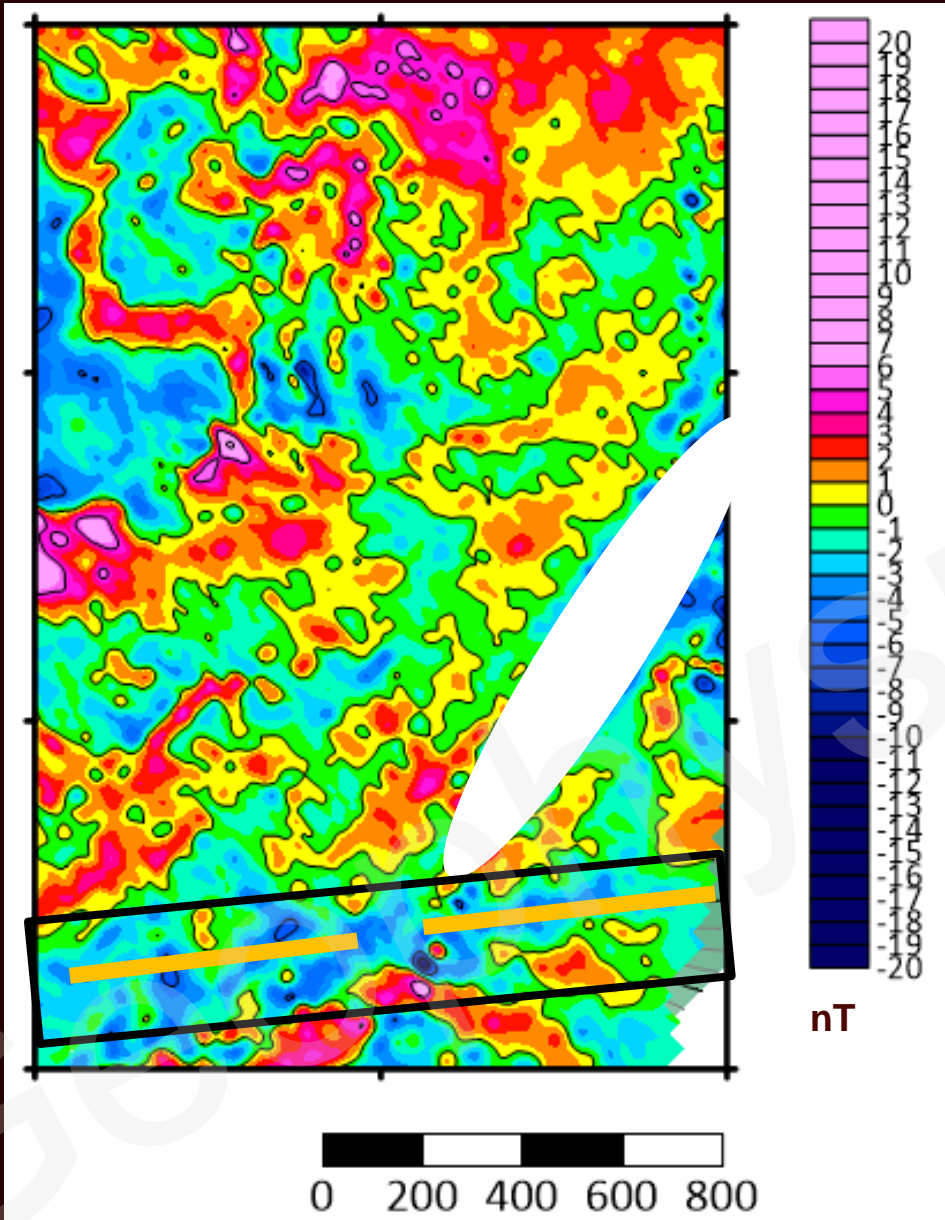
Land magnetic exploration



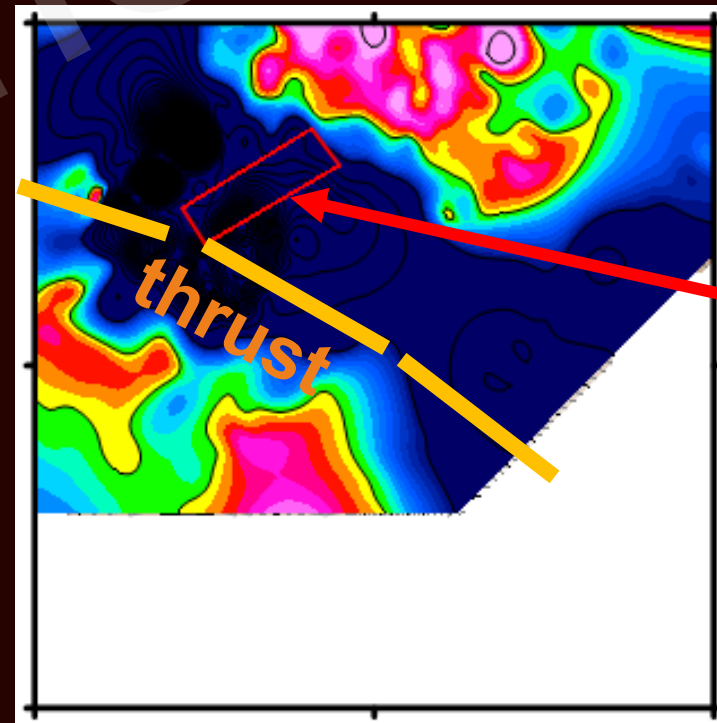
Land gravity exploration



Magnetic anomaly map



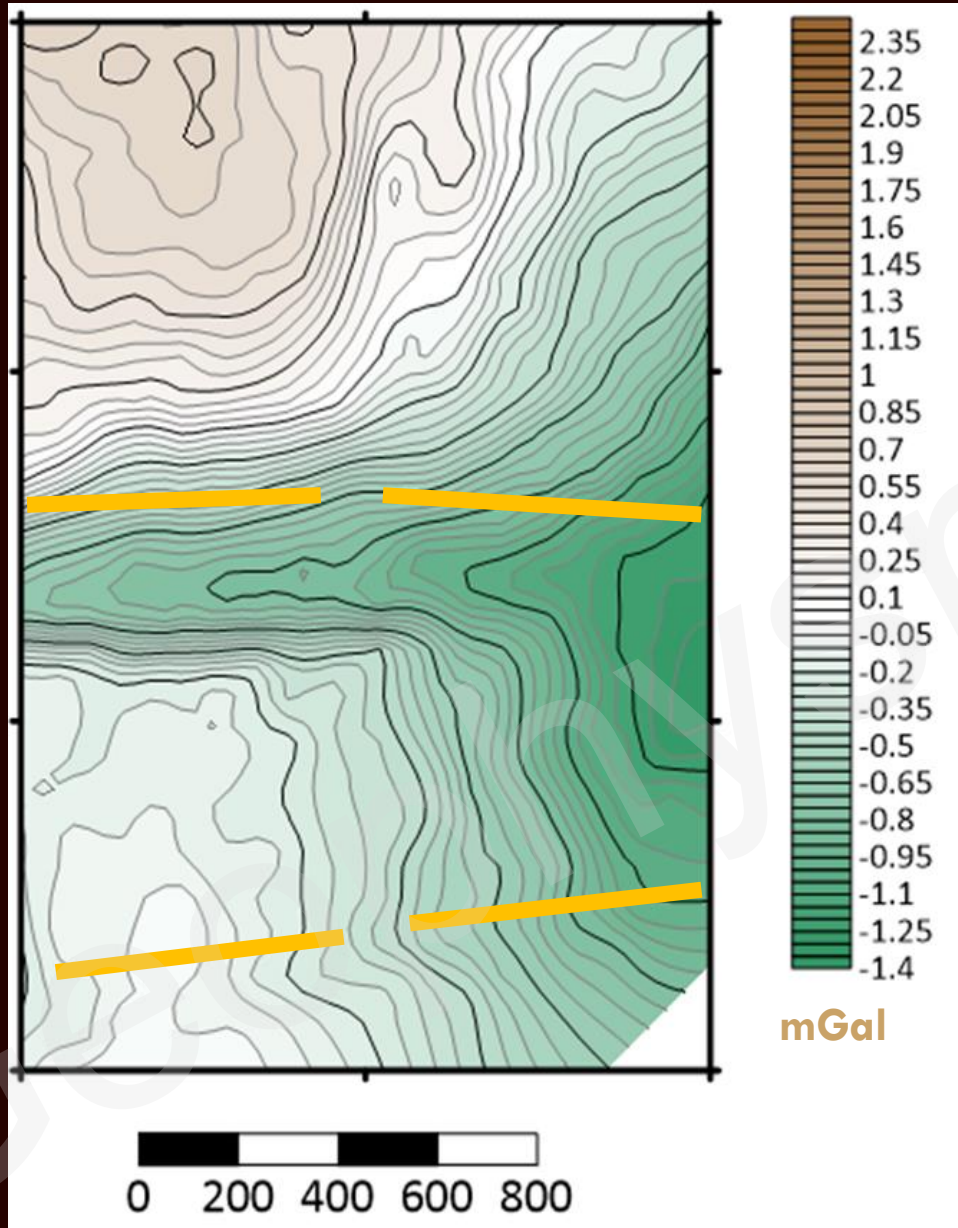
+4 nT
-4 nT



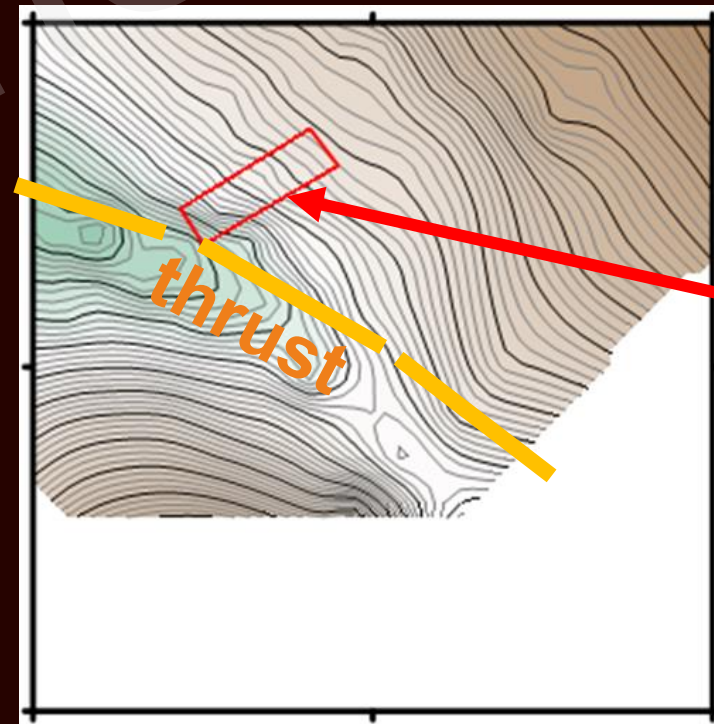
The
reference
object

Bouguer gravity anomaly map

(ILD-2.45 g/cm³)

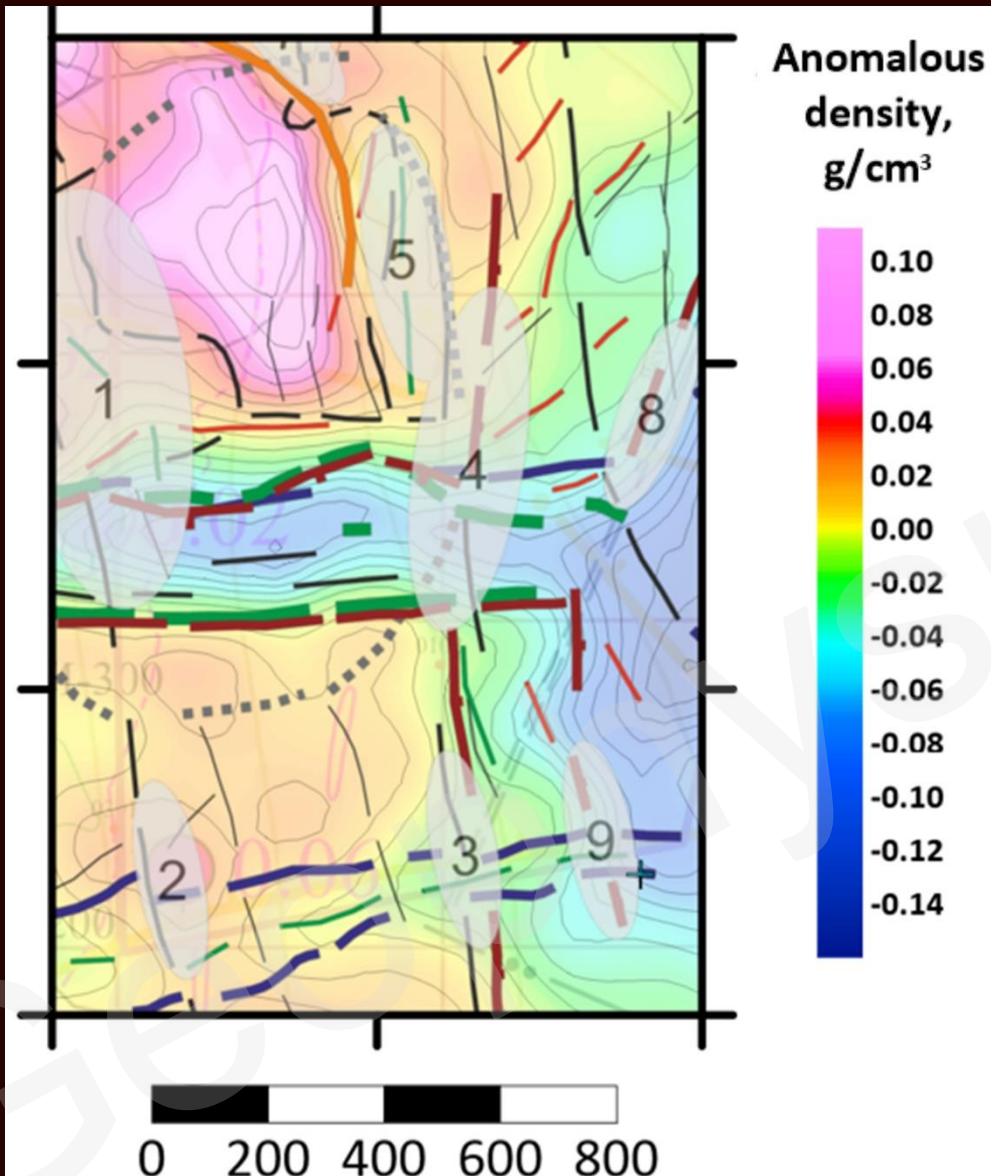


Network: 50x50 m
SD: 0.013 mGal
Equipment : CG5, DGPS



The
reference
object

The results of the standard interpretation



Symbols of lineaments

Gravitational field lineaments

- Gradient zones (boundaries of the I and II rank blocks)
- Local negative anomalies of the I rank
- Local negative anomalies of the II rank

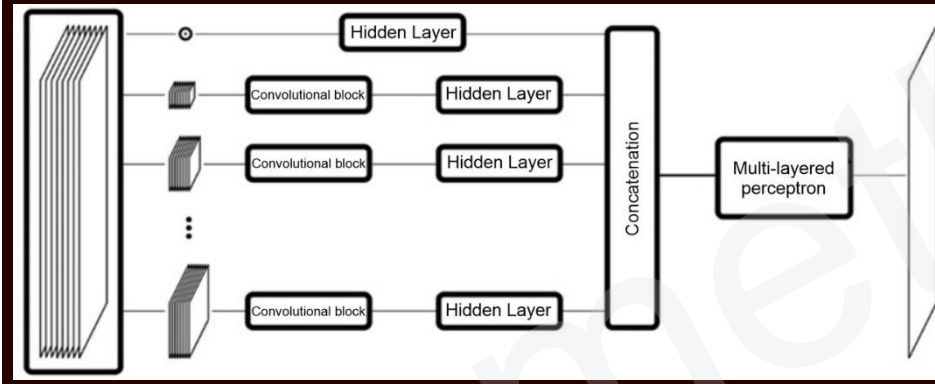
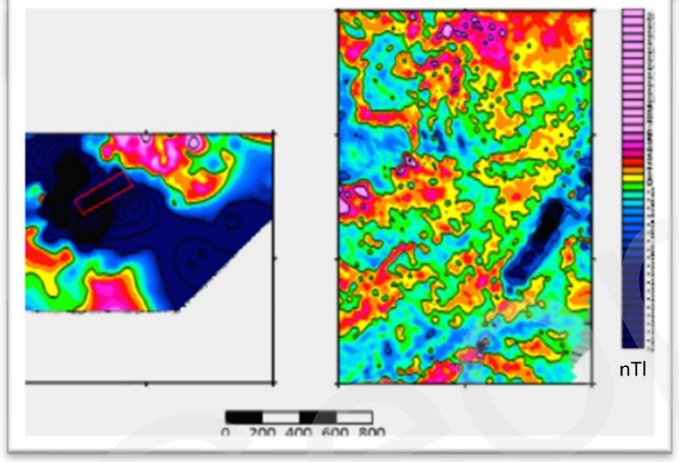
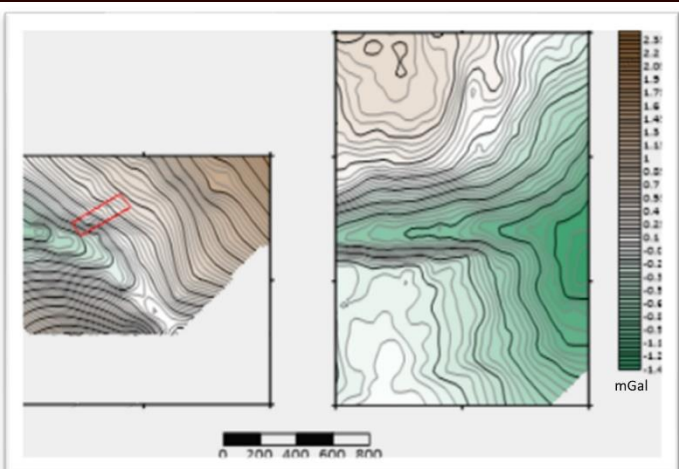
Magnetic field lineaments

- The boundaries of changing the nature of the field of the I and II rank
- The boundaries of changing the nature of the field of the III rank
- Boundaries of the proposed tectonic zones
- The zone of the general low level of the anomalous magnetic field

Relief lineaments

- Lineament analysis
- 3D inversion (ZondGM3D)

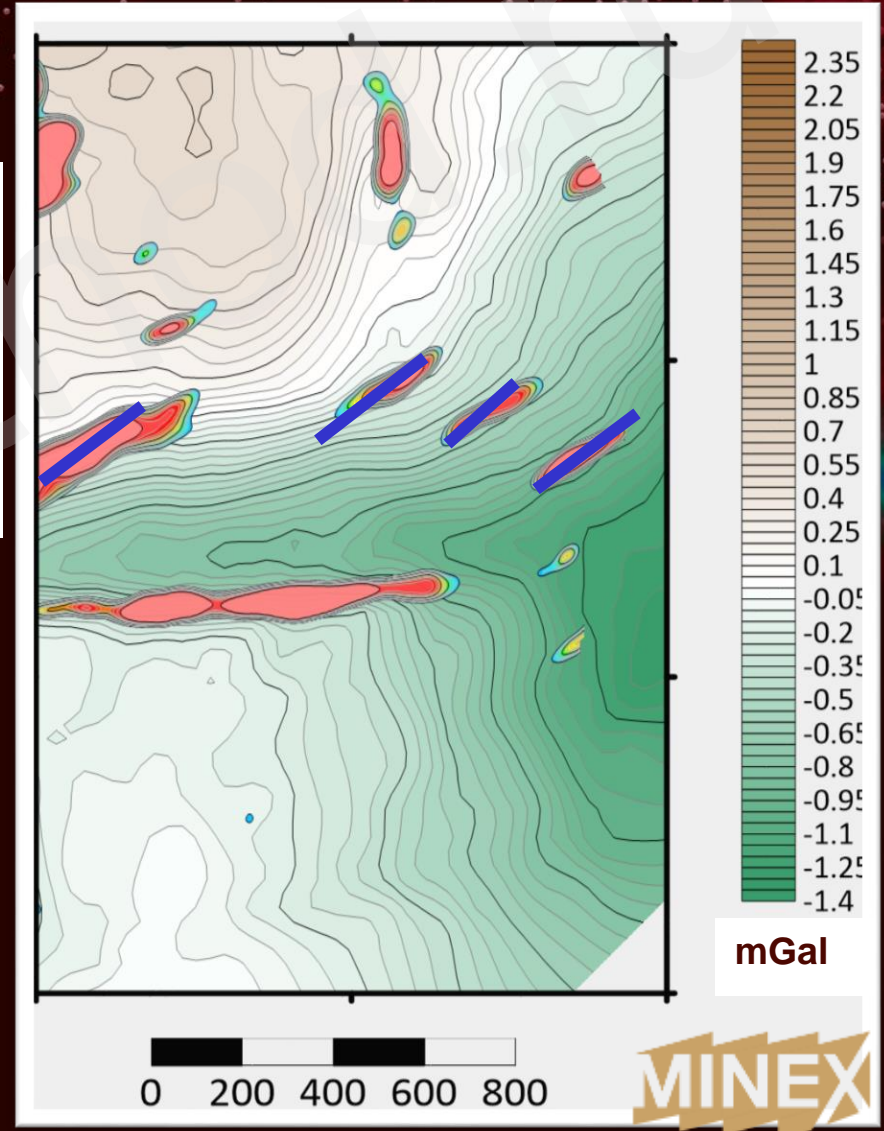
Formalized geological forecast using machine learning methods *



The block diagram of a neural network



The formalized forecast based on magnetic and gravity exploration data



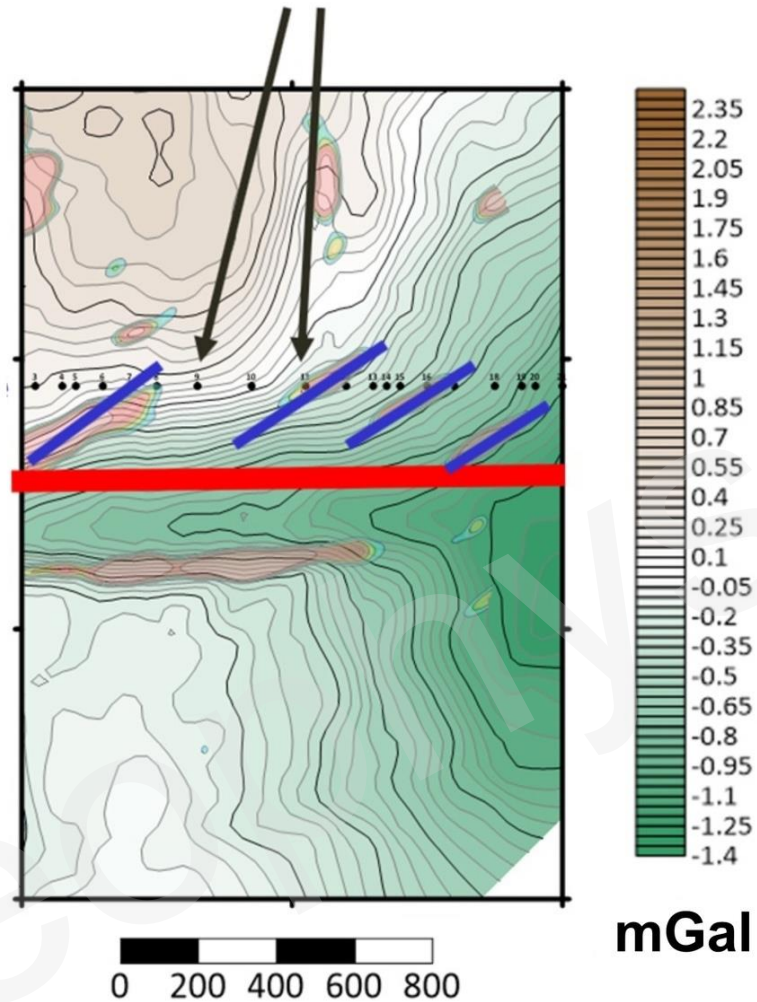
* More information about the algorithm: GeophysMethod.ru

Stages of work

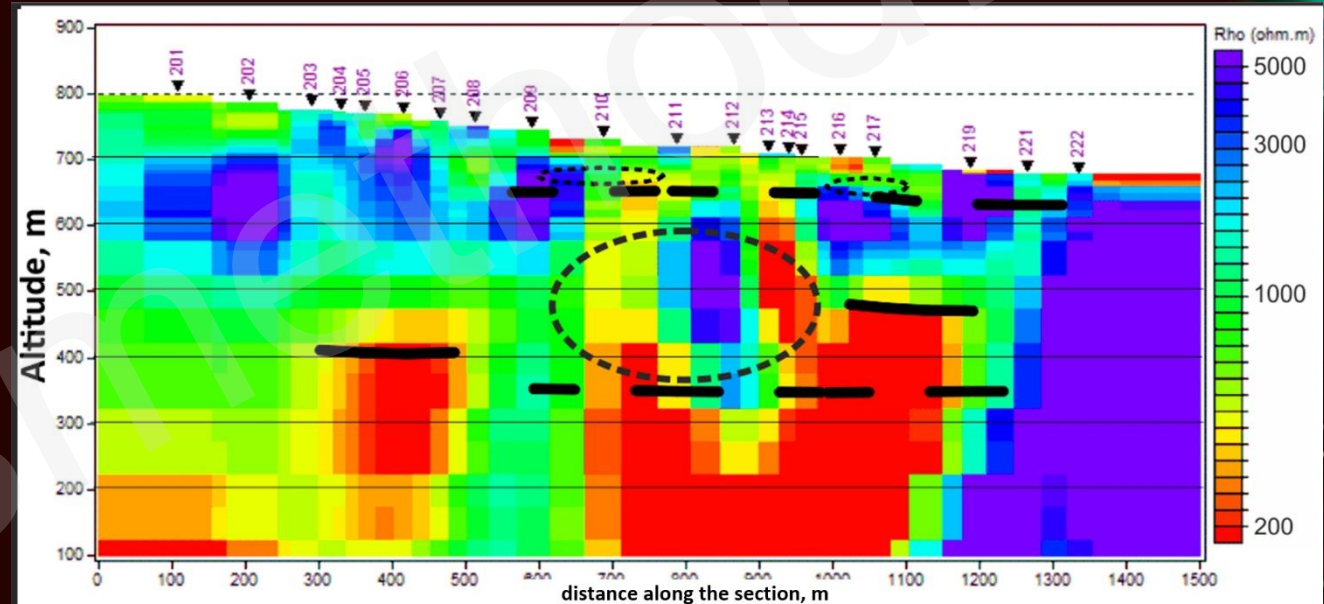
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Sensing points

Proposed
ore zones
thrust



Goelectric section based on the results of inversion of AMT-GVP data

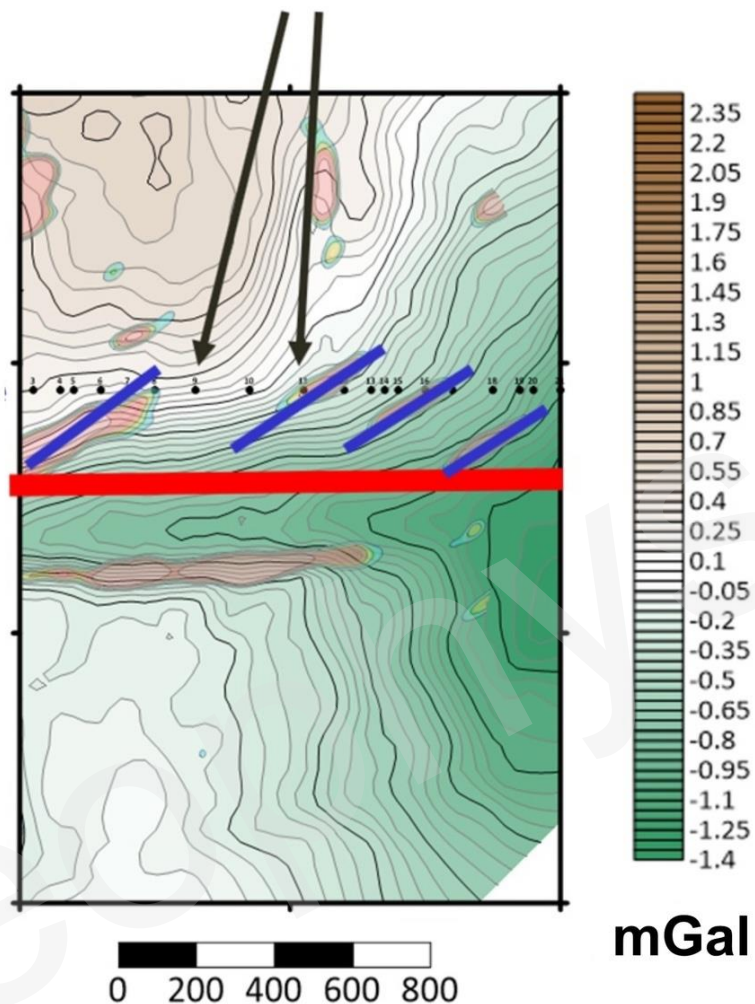


An anomaly of polarization with an amplitude of 4% (Indicator of sulfide mineralization)

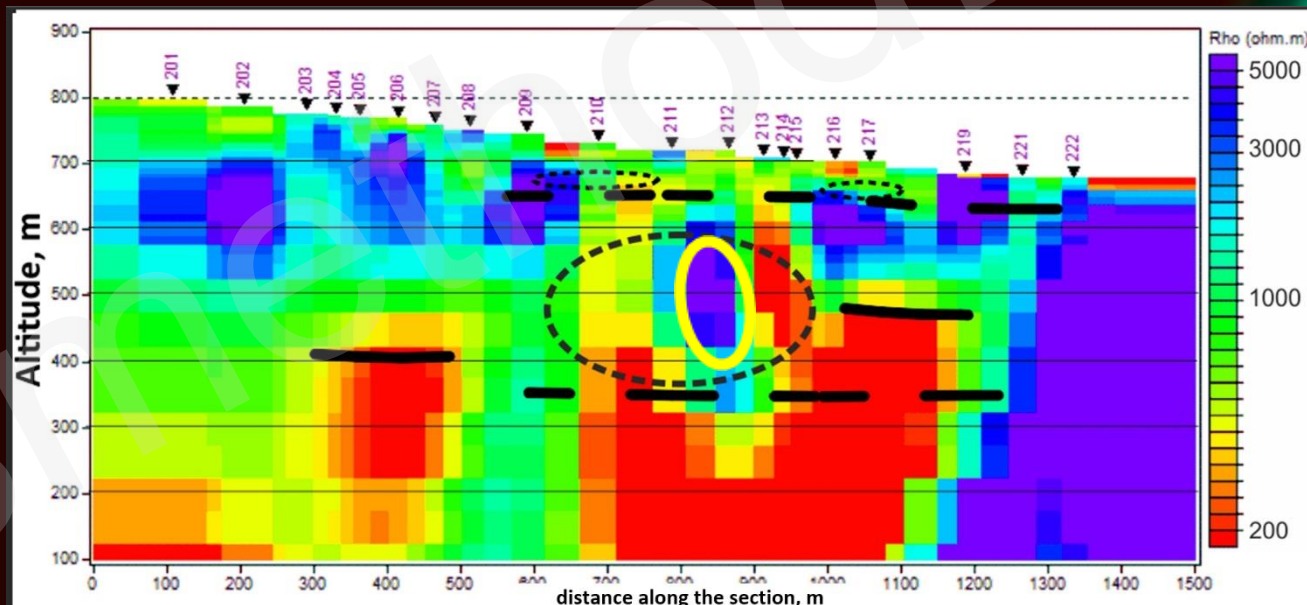
The area recommended for drilling


Sensing points

Proposed
ore zones
thrust



Goelectric section based on the results of inversion of AMT-GVP data

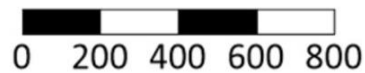
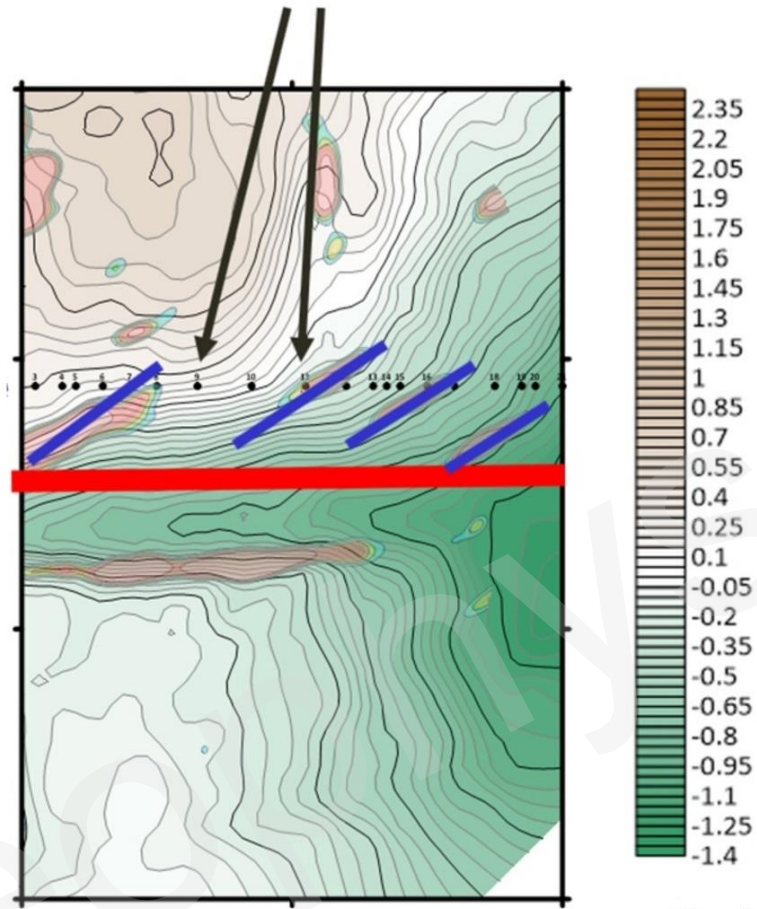


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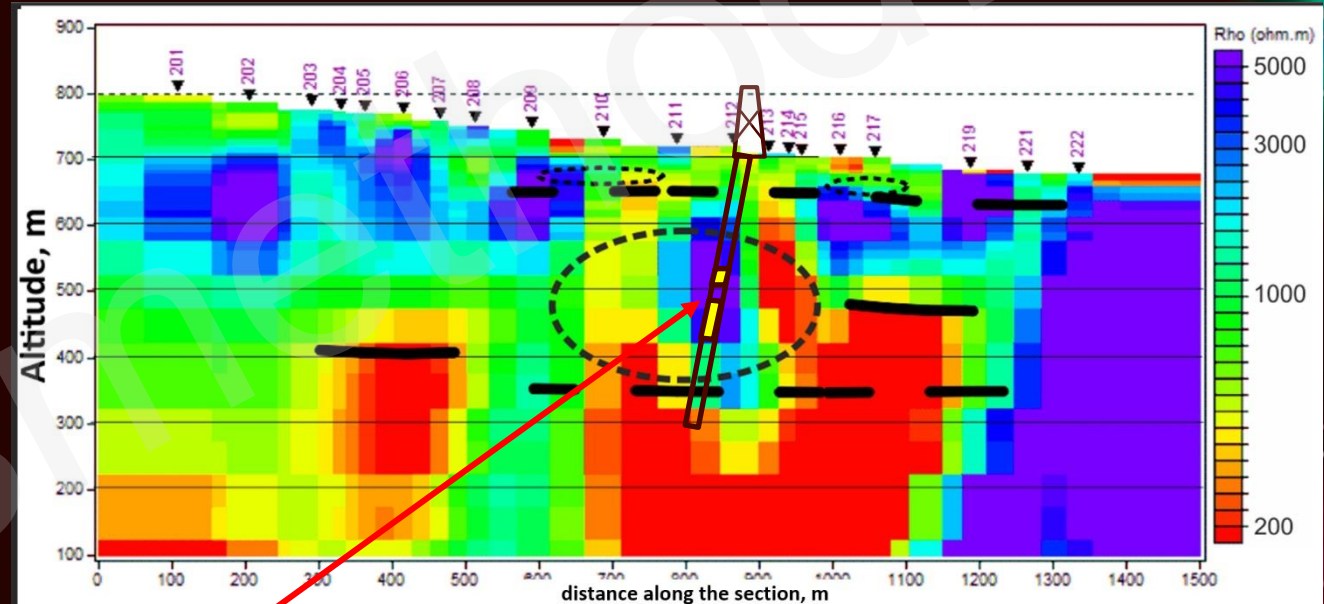
Sensing points

Proposed ore zones
thrust



mGal

Goelectric section based on the results of inversion of AMT-GVP data

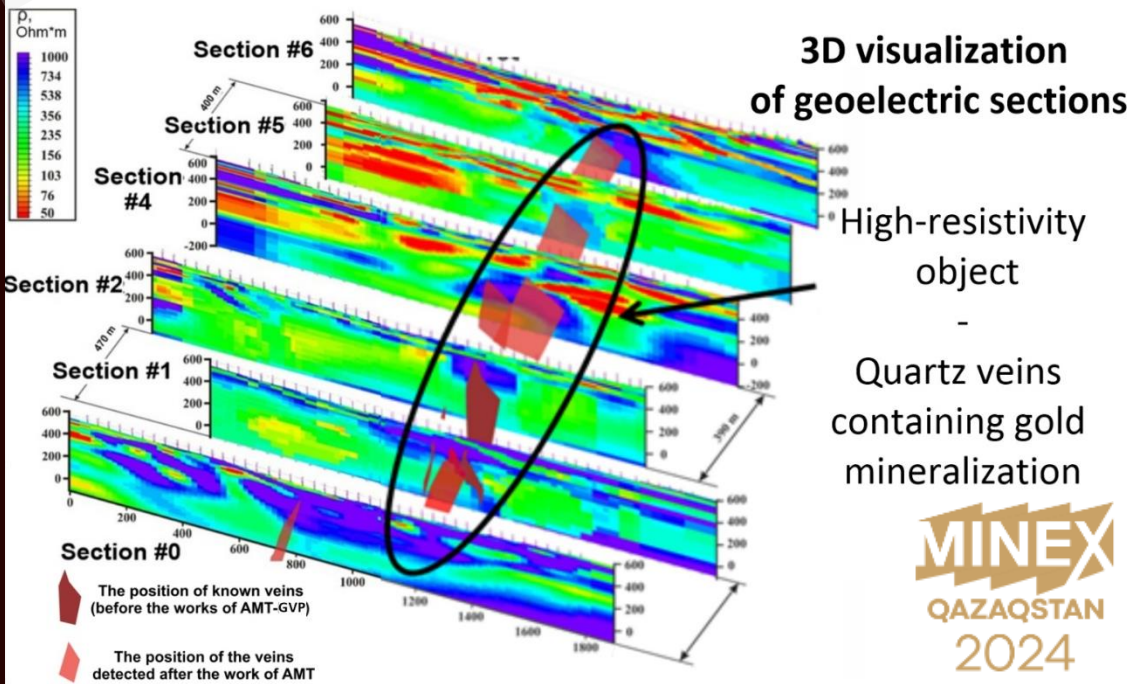
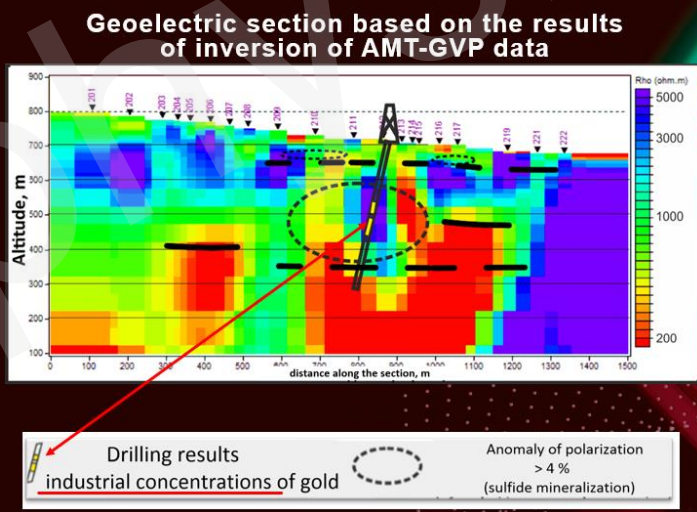
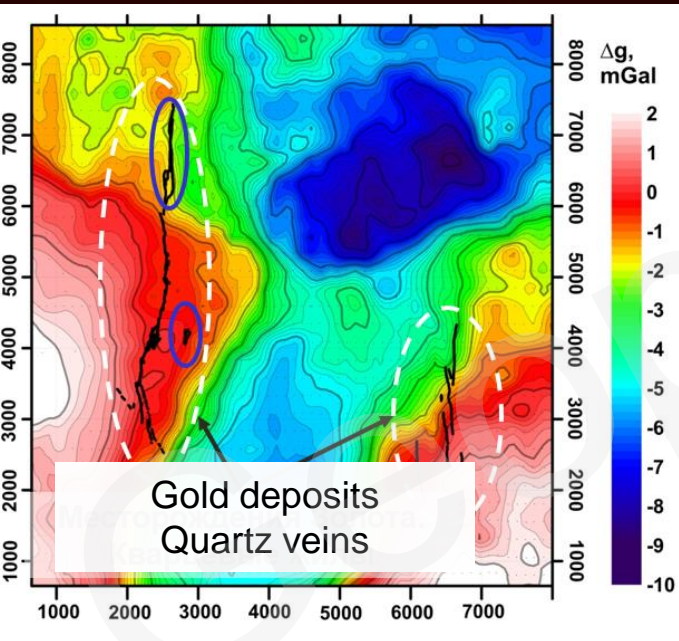
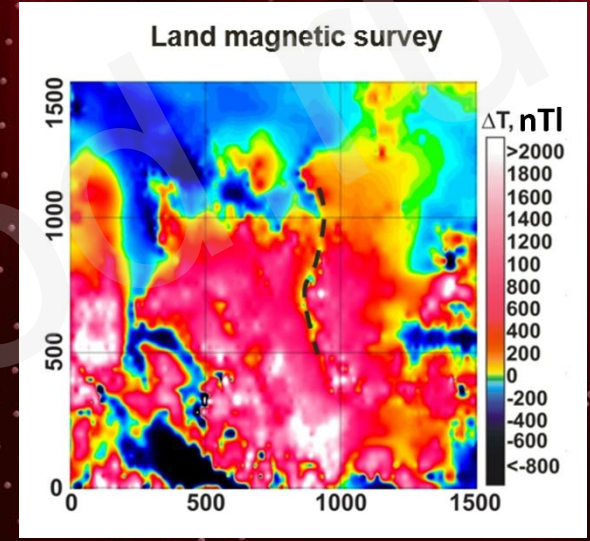
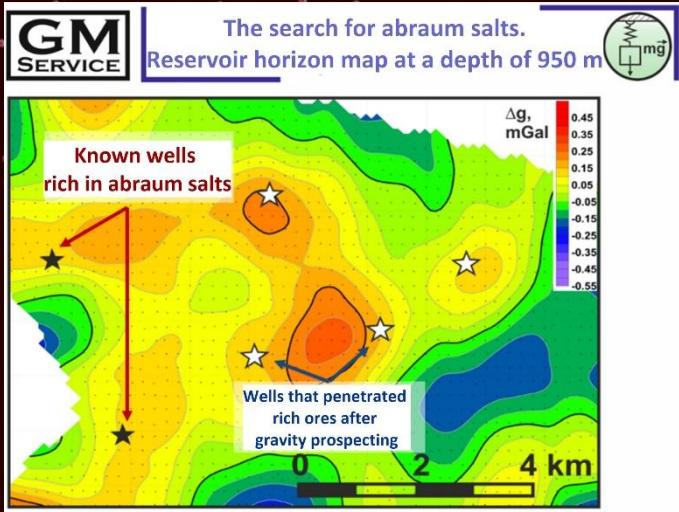


Drilling results
industrial concentrations of gold

Anomaly of polarization > 4% (sulfide mineralization)

What unites the cases of real discoveries in the practice of GM-Service?

- 1 – understanding the model of the deposit (development of a physical-geological model);
- 2 – detailed technical specification development must be made by highly qualified specialists (geologists and geophysicists);
- 3 – freedom of creativity.



Geophysics&Geology for any task
Regional Scale Surveys
Studies along Geotransect Search for new mining provinces and regions
Exploration & Prospecting
Gold ore deposits Copper-porphyry deposits Rare earth elements Polymetallic deposits Chromite deposits Diamond deposits
Oil and gas
Exploration and prospecting of potential oil and gas structures Delineation of reefs, salt domes, and paleo valleys Identification of hydrocarbon alteration zones Monitoring of oil and gas fields.
Groundwater
Lithogeochemical survey
Processing and interpretation of geophysical data
Electrical methods Magnetic survey Gravity survey Gamma spectrometry Formalized geological prediction

Thanks for attention!



Service Geological Geophysical Company

195274, Russian Federation,
St. Petersburg,
Prosveshcheniya Ave,
53,b. 1, lit. A, sq. 195.



010000, RK, Kazakhstan,
Akmola region, Nursultan,
Dostyk str. 20, office 302



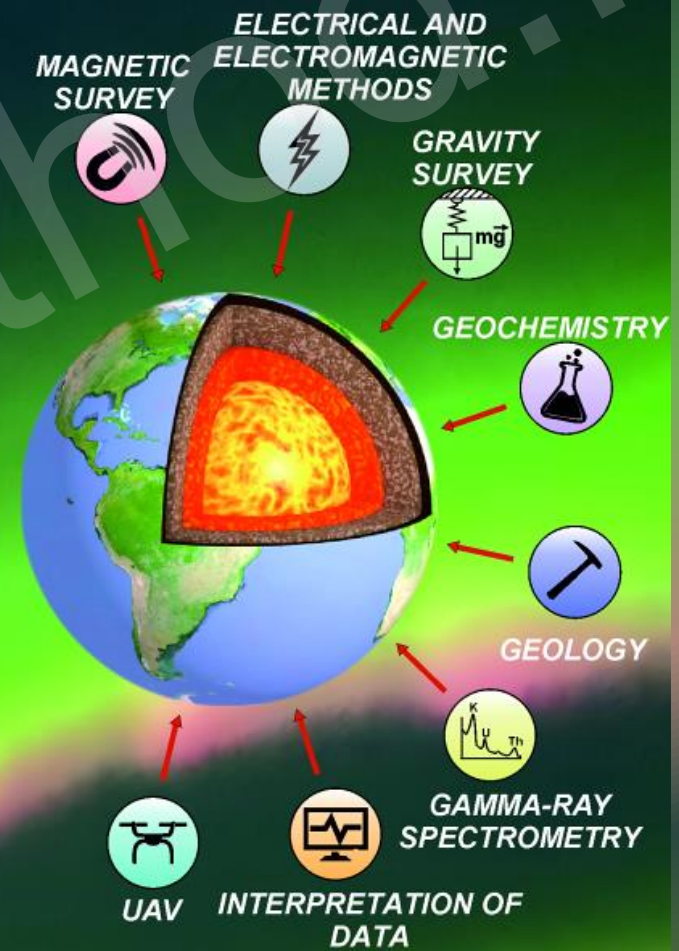
+7 (911) 792-05-71



GeophysMethod@gmail.com



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