1 SEARCH FOR GEOTHERMAL HEAT SOURCES

STAGES, TASKS, RESULTS AND INTEGRATION OF TVT IN THE SEARCH FOR ENDOGENOUS GEOTHERMAL HEAT SOURCES.

At the regional and detailed stage of research, the identification of anomalous heat sources in the formation of geothermal deposits is carried out.

Genesis of formation of the geothermal deposits, associated with the development of the heterogeneous structure of the Earth's crust (rift and volcanic structures) is being established.

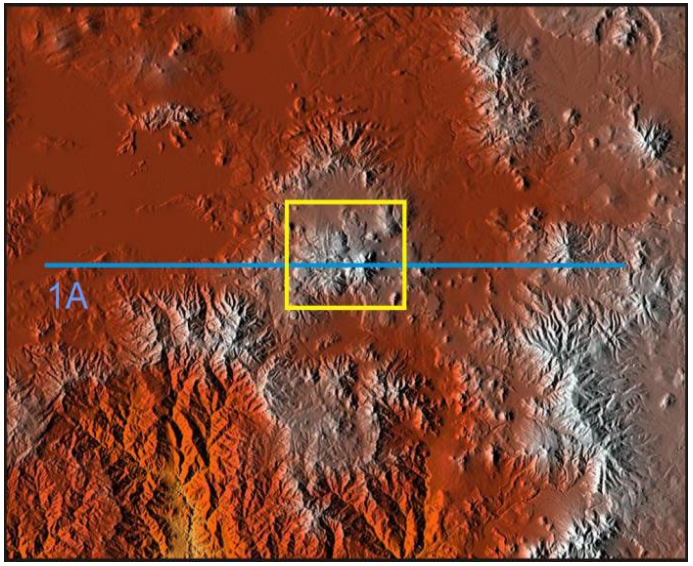
Numerous maps, sections and models of block-fault structures are formed with a classification of heterogeneities in shape, heat flow and hypocenters of the anomalous thermal field in predicting the migration and accumulation of free water, and the preservation of hydrothermal local sources at different deep levels.

Recommendations are made for optimizing further exploration work with reference to endogenous hydrothermal vents in depth and in geographic coordinates WGS-84.

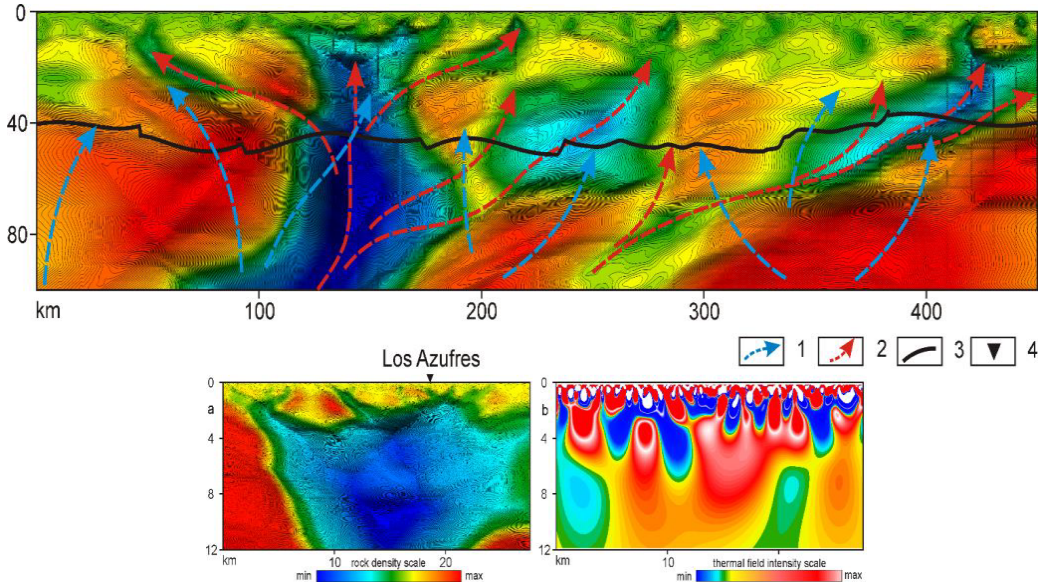
2 SEARCH FOR GEOTHERMAL HEAT SOURCES

REGIONAL ANALYSIS OF THE THERMAL FIELD OF THE CRUST TO DETERMINE THE GENESIS OF HYDROTHERMAL VENTS. MEXICAN VOLCANIC BELT, LOS AZUFRES CALDERA.

View of models of asymmetric natural structures



2R -TVT regional profile, lithosphere model, caldera Los Azufres in Michoacan



Hydrothermal vents originate in the lower part of the Earth's Crust as a result of tectonic phenomena. As a result of migration to the surface, they concentrate in newly formed chambers of different levels.

Natural conditions arise under which the sources of the field can be located inside the decompacted zones of tectonic faults. This behavior of the field controls the outflows of deep thermal waters to the day surface.

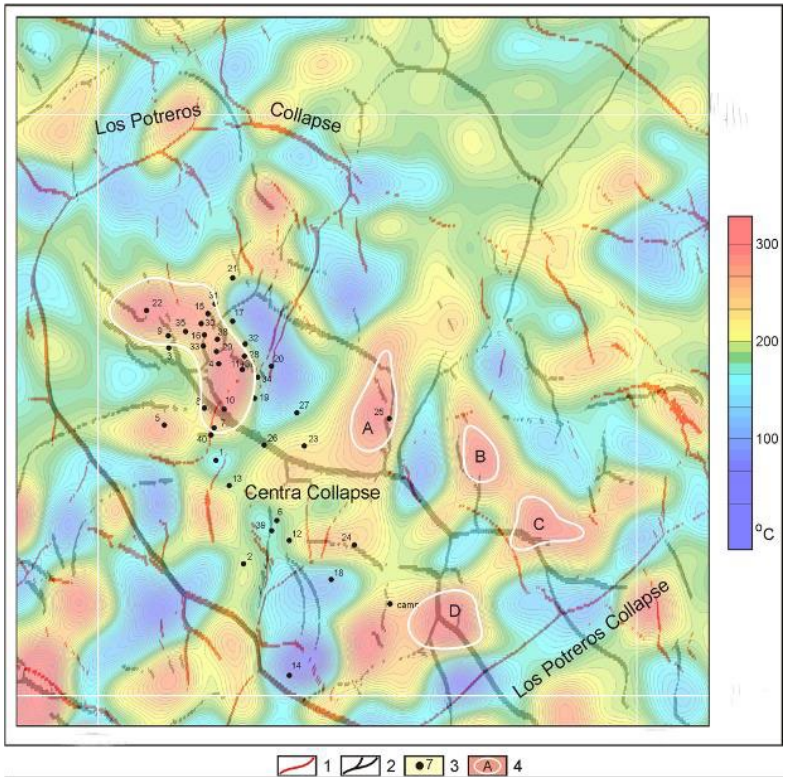
Legend:
(a) block-fault structures; (b) heat sources; 1 – heat flux direction;
2 – fluid migration channel; 3 – Moho boundary; 4 – caldera Los Azufres.

The thermal field controls the most important tectonic properties — the rheological state of substances, which makes it possible to systematize natural deformations in real environments.

3 SEARCH FOR GEOTHERMAL HEAT SOURCES

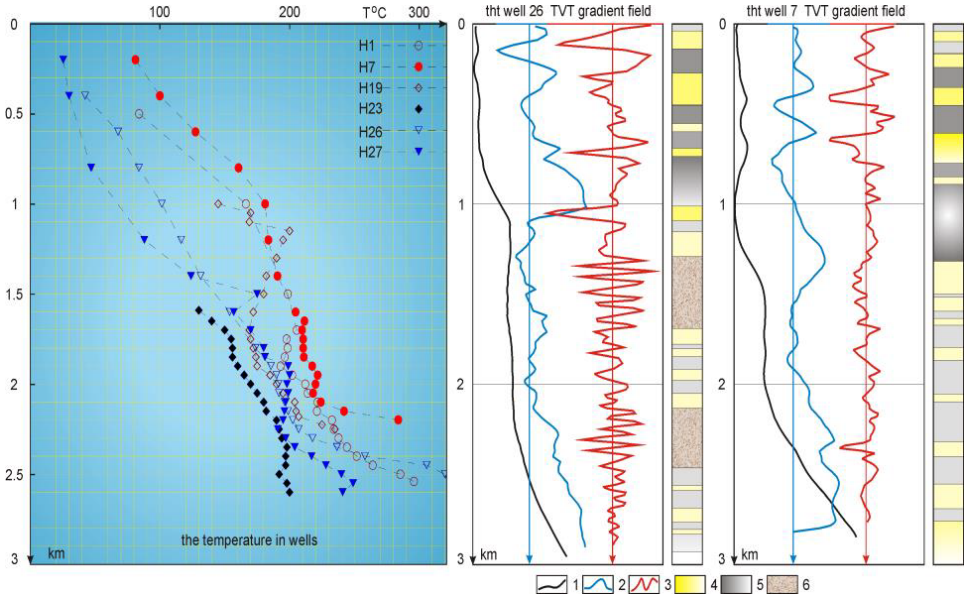
IDENTIFICATION OF NEW GEOTHERMAL SOURCES, ANALYSIS OF THEIR TEMPERATURE CHARACTERISTICS. MEXICAN VOLCANIC BELT, LOS HUMEROS CALDERA.

Map of the zoning of Geothermal Sources in the Los Humeros caldera, the depth interval 1600-1800 m, with overlying the axis of homogeneity and tectonic disturbances.



Legend:
1 - fault, 2 - axis of the structure, 3 - well location, 4 - contour of a NEW prospective geothermal heat sources (A, B, C, D areas)

Temperature Characteristics for the wells 26 and 7 of Los Humeros caldera



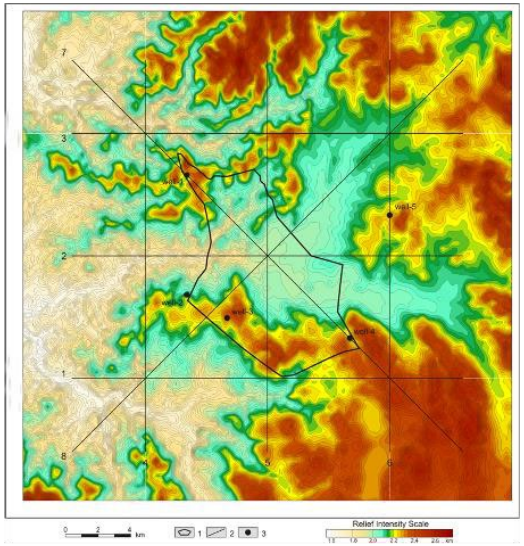
Legend:
the integral (1) and differential (2, 3) charts of TF homogeneity; dense (4) and decompressed (5) layers of the section; intense fracturing zone (6)

The given temperatures along the wellbore and the depths of anomalous layers make it possible to quantitatively compare with the TVT data. The values of well 12 at depths over 1640 m at T = (210 - 300o C) fall into the temperature chamber according to the Landsat-8 TVT.

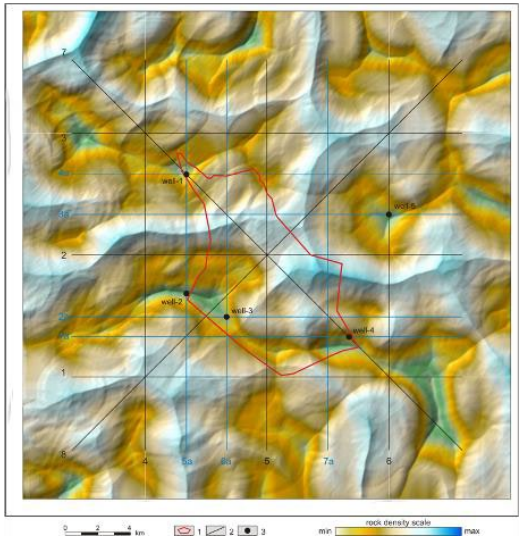
4 SEARCH FOR GEOTHERMAL HEAT SOURCES

DETAILING THE PROSPECT AREA FOR DRILLING RECOMMENDATIONS. ZONE TAMAZULAPAM DEL PROGRESO, MEXICO

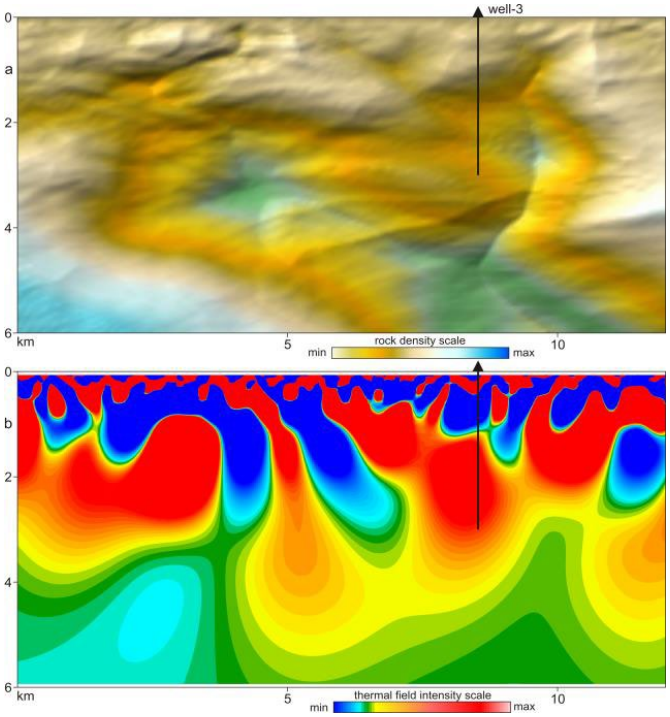
Terrain model



Map of local block-fault structures at a depth of 1,8 km



Fragment of the model of block-fault structures (a) heat sources (b) along the profile



Legend:
1 – contour of verification area, 2 – TVT profile, 3 –location of the well

There are two zones of local heat sources of different intensities on the area. Of greatest interest is the high priority zone, with the location of wells 2, 3 and 4. Medium priority is the zone within well No 1. The central part of the Tamazulapam del Progreso site corresponds to a low intensity of the thermal field and a weak perspective.

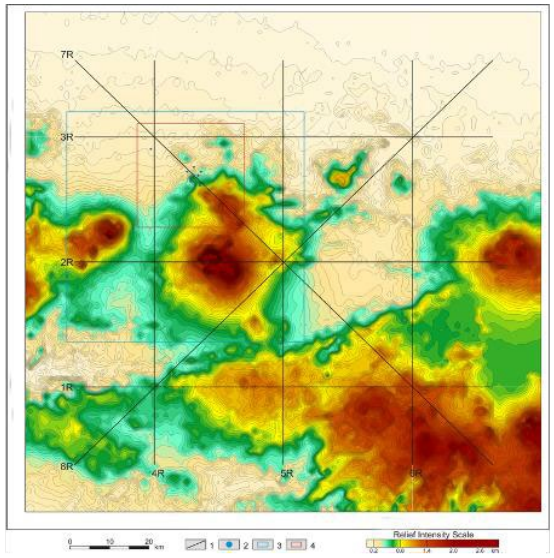
The fault system plays the role of supply channels for high-temperature fluids to the surface, with the creation of multidirectional crossflows in permeable media and the accumulation of fluids in porous media in the form of multi-storey chambers.

The temperature level of the fluid in the zones of decompaction of the medium is mainly preserved and retained by the trap of dense rocks.

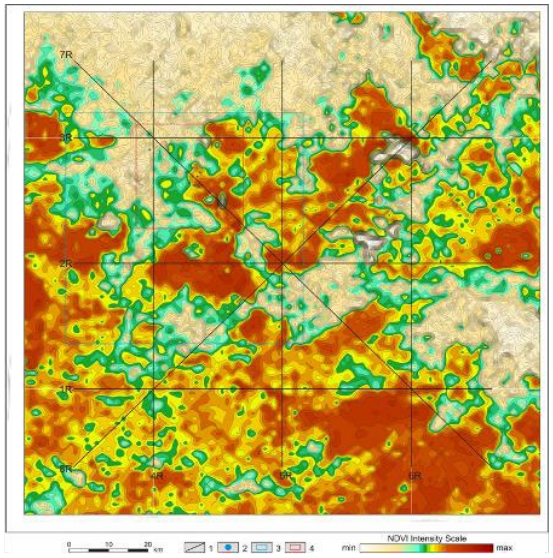
5 SEARCH FOR HYDROTHERMAL SPRINGS

IDENTIFICATION OF REGIONAL FEATURES OF THE GEOTHERMAL LEVELS OF THE LITHOSPHERE. JAVA ISLAND, INDONESIA

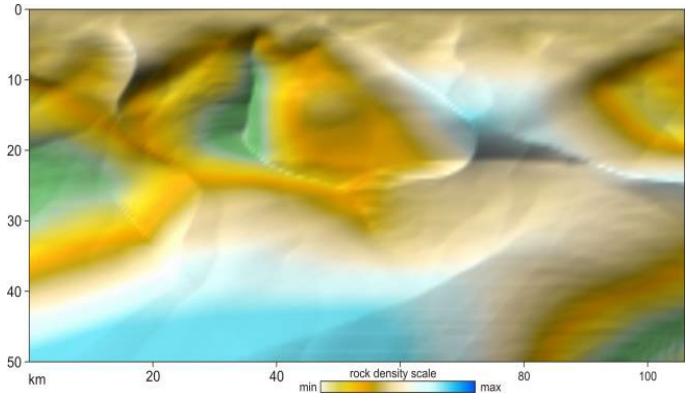
Regional Terrain Model



Map of the abnormal Normalized Difference Vegetation Index image field, MODIS



Models of block-fault structures of the volcano along profile 2



The structure of the Volcano has a vertically ascending central axis, which is represented by rocks of the greatest decompaction with a width of about 17 km and penetration to a depth of 24 km. The thermal field reaches its maximum values up to a depth of 16 km.

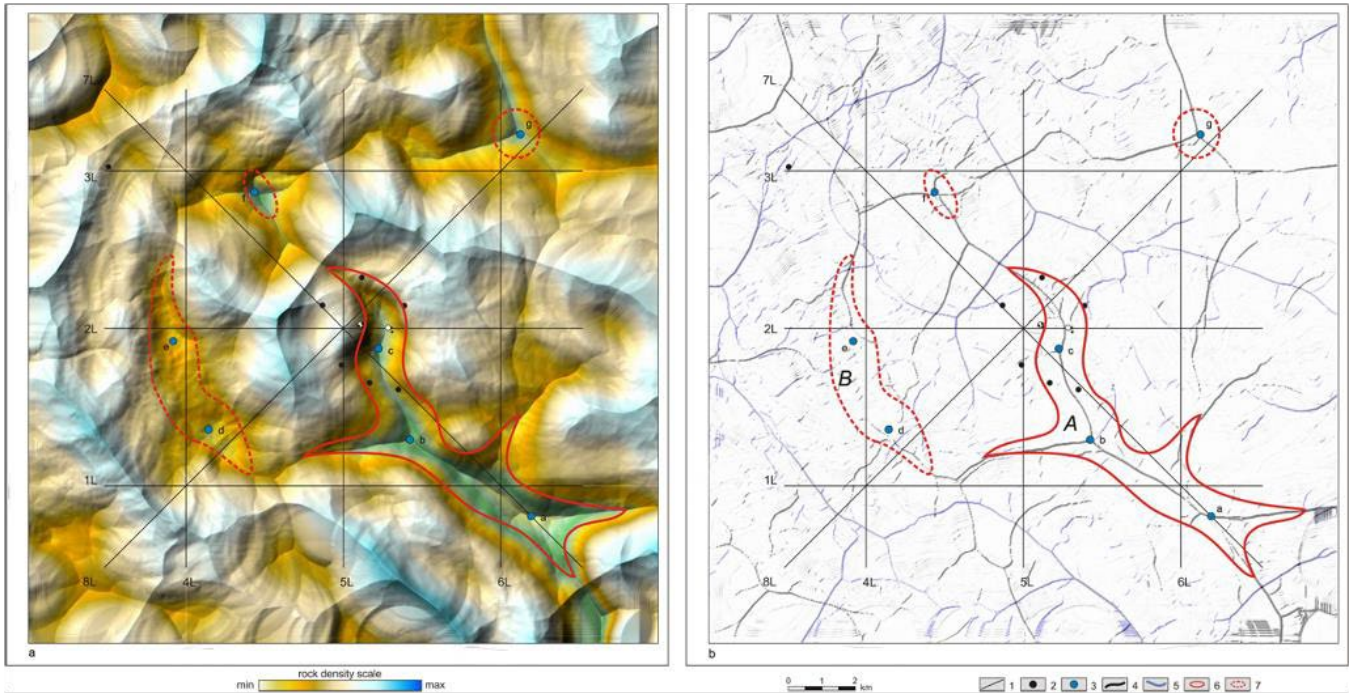
Legend:
1 – TVT profile, 2 – location of the well, 3 - contour of a large area, 4 - contour of a small area

Geothermal levels of the lithosphere are subdivided into a number of horizons, which are deciphered by numerous zones with variable horizontal boundaries. Regional interfaces between the media in the thermal field are the boundary at a depth of (35 - 42) km and at a depth of (18 - 22) km. By their shape, they are reflected in the models of block-fault structures by field gradients with division into geothermal floors.

6 SEARCH FOR HYDROTHERMAL SPRINGS

OUTLINING AND DETAILING PERSPECTIVE AREAS. JAVA ISLAND, INDONESIA

Maps of integral block-fault structures (a) and anomalous hydrothermal zones at a depth of 1,5 km (b)



Legend:

1. TVT profile,
2. hydrothermal springs,
3. planned hydrological well,
4. fault zone,
5. axis of the structure,
6. high prospects for prospecting deposits,
7. conditionally perspective zone

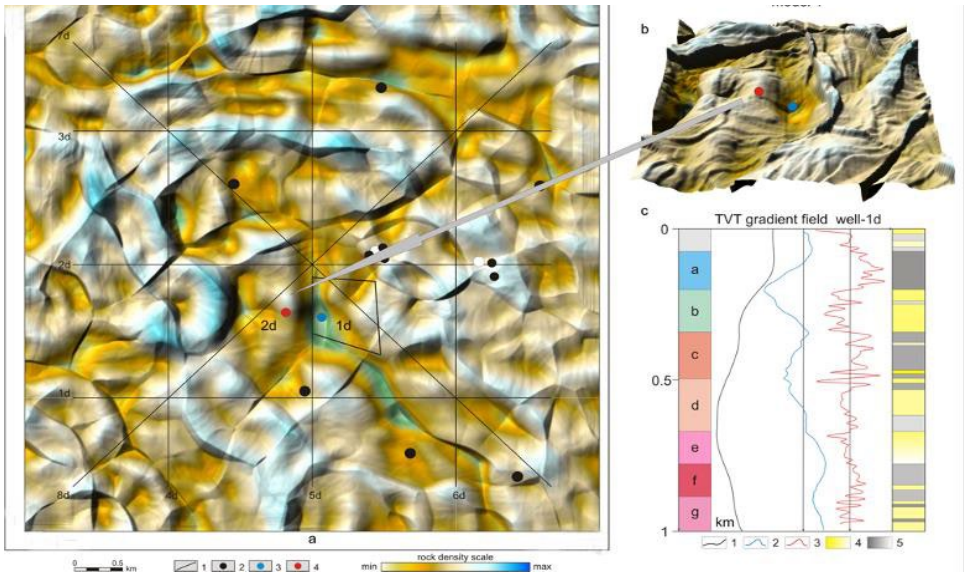
The physical state of the environment in the marginal part of the research area (wells **d, e, f, g**) at depths of 1.2–1.8 km does not create high pressure and anomalous thermal regime with a critical temperature for the boiling up of endogenous fluid (steam formation at depth). Anomalous hydrothermal effect is to be expected in the high priority zone with well locations **a, b, c.**

The temperature level of the fluid, formed in the zones of decompaction of the medium of 120–280 meters, is retained by a cover of dense rocks. There are no spectral signs of high temperature fluid emerging on the day surface.

7 SEARCH FOR HYDROTHERMAL SPRINGS

ANALYSIS OF GRADIENT ZONES OF HEAT FLOW, DRILLING RECOMMENDATIONS. JAVA ISLAND, INDONESIA

Map of local block-fault structures in the depth interval (180–280) meters (a) and volumetric model of the differential field of the anomalous zone (b), characteristics of sedimentary cover layers in well 1d



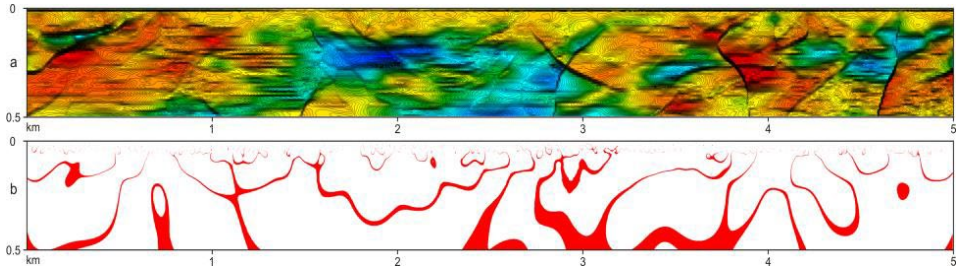
Legend:

1. TVT profile;
2. location of known hydrothermal springs;
3. recommended hydrological well 1d;
4. location of selenide 2d deposit in sedimentary cover.

Legend:

TVT plots - integral (black), gradient (blue) and differential (red) density of the medium;
(a – h) - geothermic floors

Profile 5d



Ascending gradient zones of heat flow near the earth's surface become thinner and become less intense. This image indicates a low concentration of ore elements (selenides) in the near-surface sedimentary layer.