1 SEARCH FOR SOLID MINERALS

STAGES, TASKS, RESULTS AND INTEGRATION OF TVT IN THE SEARCH FOR ORE MINERALS.

At the local and detailed stage of research, the determination of geothermal features in the formation of deposits of ore minerals is carried out.

The genesis of the formation of ore fields, zones and ore bodies is established, taking into account deep and surface block-fault structures and sources of a local thermal field. Numerous maps, sections, geophysical models of block-fault structures and normalized parameters of the spectral brightness of the Earth's thermal field are formed when predicting ore zones and bodies.

Complexing of TVT with geophysical fields (litho-geochemistry, electrical prospecting, gravity and magnetometry) is carried out to rank ore bodies according to search priority conditions.

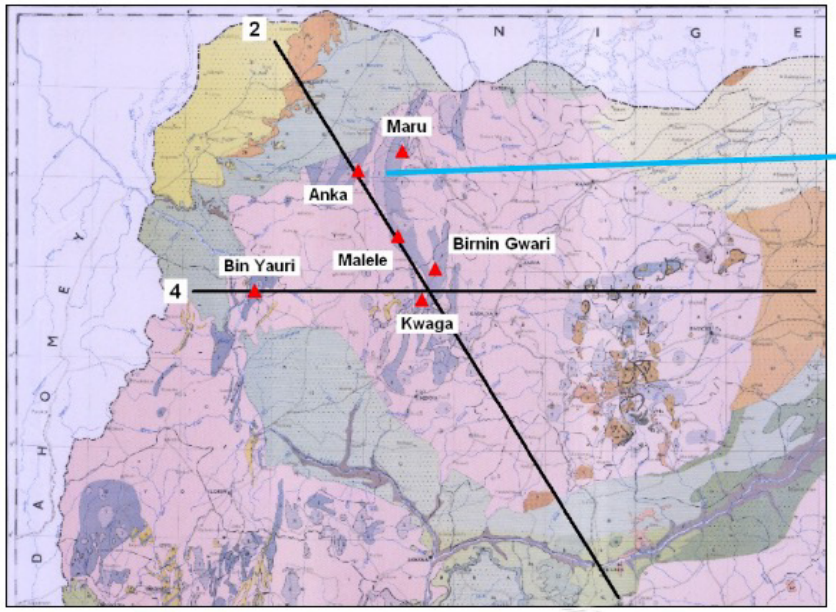
Volumetric analysis of ore zones and delineation of ore bodies (2.5D modeling) with an assessment of the predicted resources of individual areas (subject to the provision of the necessary a priori information).

Recommendations for further efficient exploration and production of ore minerals

2 SEARCH FOR SOLID MINERALS

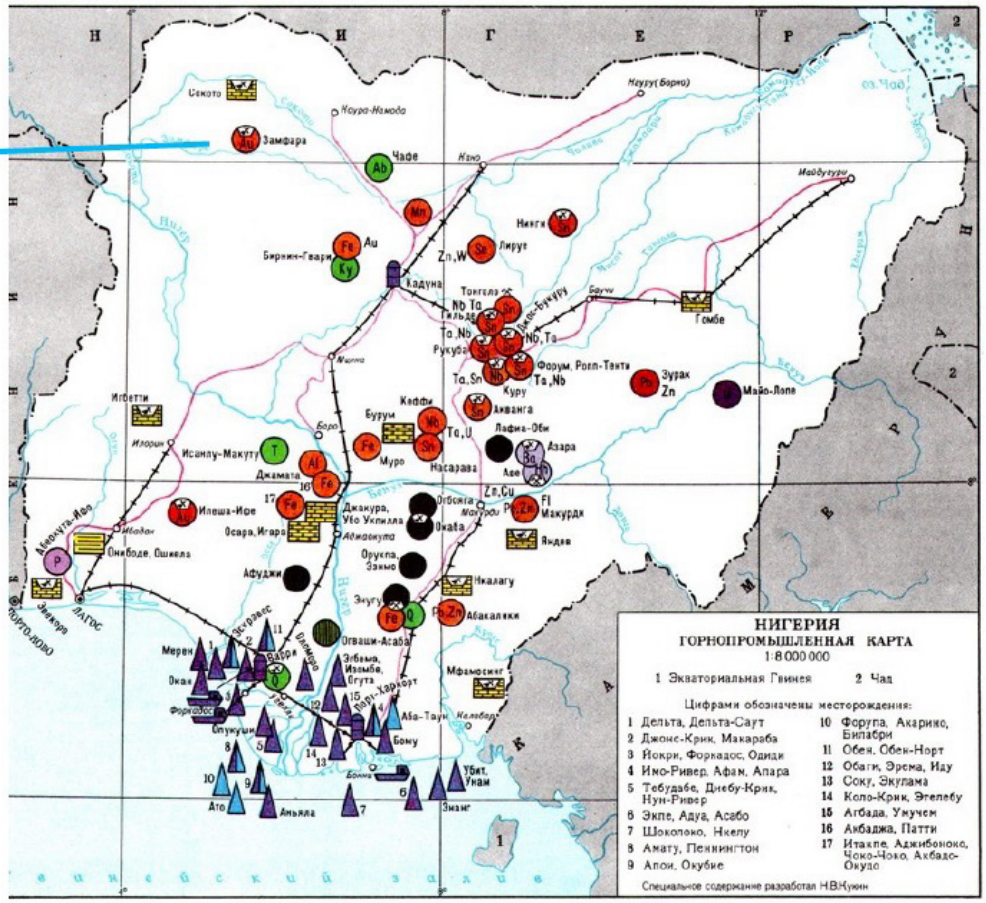
REGIONAL PROSPECTS ON GOLD EXPLORATION IN NIGERIA (1).

Geological Map



— The existing Gold deposits

Map of Mineral Resources, Nigeria



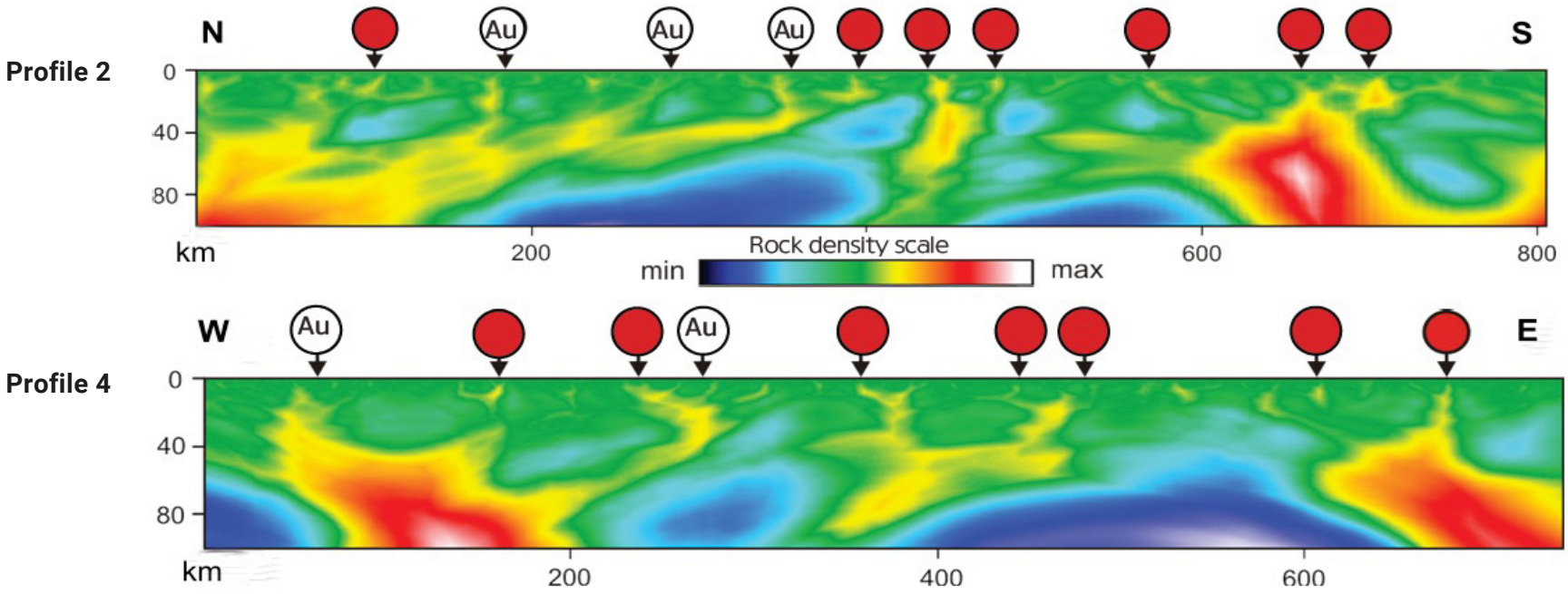
1. Main placer and bedrock Gold deposits of the region are located within “shale belt” in the north-west and south-west of Nigeria.

2. We made deep vertical TVT Profiles (sections of the lithosphere down to 100 km) through known gold deposits; indicated as Profile 2 and Profile 4 above.

3 SEARCH FOR SOLID MINERALS

REGIONAL PROSPECTS ON GOLD EXPLORATION IN NIGERIA (2).

TVT models of Lithosphere, vertical sections of block-fault structure



Au

Markers indicate locations of known gold deposits. As can be seen in the image, the places of known manifestations ideally coincide with the outcrops of homogeneous igneous geological structures of the lithosphere (red-yellow tree-like zones) containing polymetals (gold).

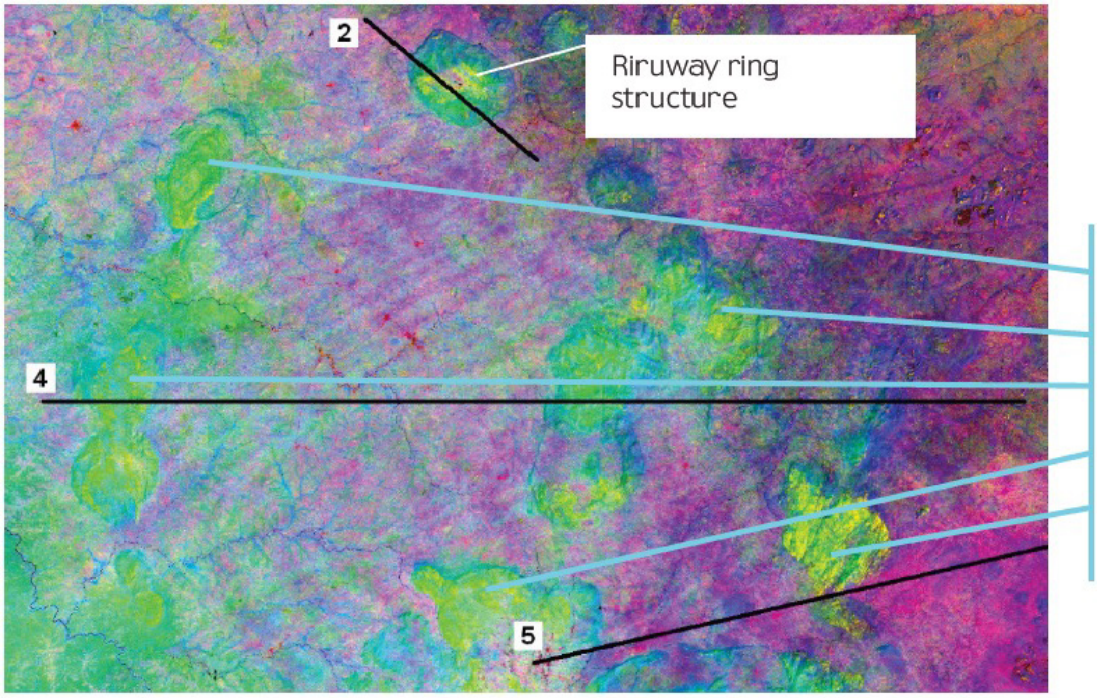
High perspective areas for discovery of NEW occurrences of polymetals (Gold).

Similar morphological structures indicate a high prospect of discovering new manifestations of polymetals (Gold).

4 SEARCH FOR SOLID MINERALS

REGIONAL PROSPECTS ON GOLD EXPLORATION IN NIGERIA (3).

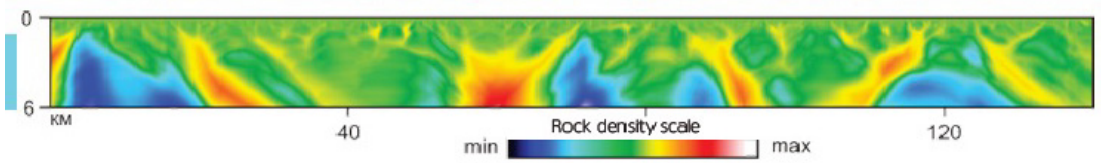
Prospective occurrences of solid minerals. Multispectral image «Landsat-7»



Deposits of polymetals are formed within zones of sulfide mineralization on the boundary of intrusion and sedimentary rock. TVT technology allows to locate such zones.

Green color indicate outcrops of intrusive formations (ring structures) **on the surface** which correspond to main occurrences of ore deposits of the region (gold, iron, copper, lead, diamonds).

Profile 4

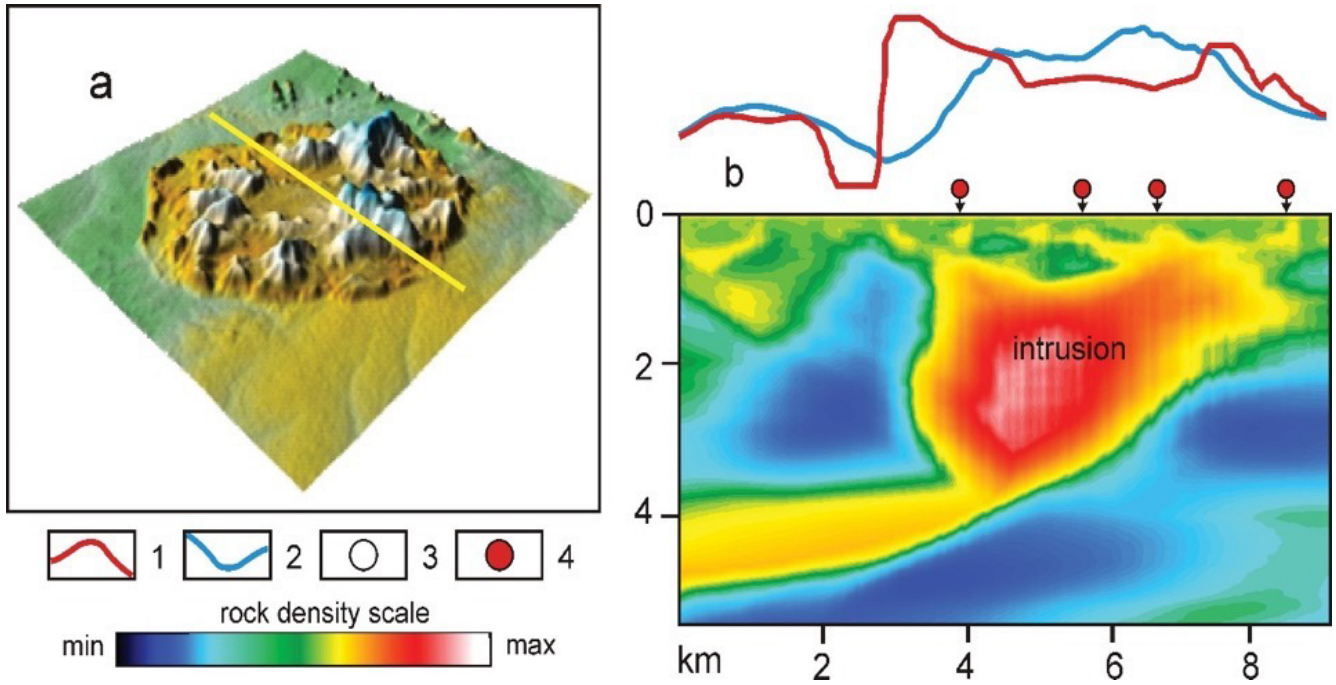


Vertical profile down to 6 km shows areas of **hidden intrusive formations** (colored red-yellow).

5 SEARCH FOR SOLID MINERALS

DETAILING OF RIRUWAY RING STRUCTURE, NIGERIA (4).

Model of the Ring structure Riruwai Younger Granite Complex (Nigeria).



Localization of the intrusive body at depth by TVT is confirmed by magnetic exploration data.

Model of the Ring structure Riruwai Younger Granite Complex (Nigeria).

Legend:
(a) Terrain relief and the location of TVT profile (yellow line).
(b) Intrusive structure model by TVT. Vertical TVT profile, block-fault structure.
1 - magnetic field intensity graph;
2 - change in the density of the medium at a depth of 1 km;
4 - promising zones of ore formation (areas of sulfide mineralization).

TVT technology helps to understand the genesis and the geometry of hidden intrusive formations during search for polymetal occurrences. TVT data are confirmed by other geophysical methods.

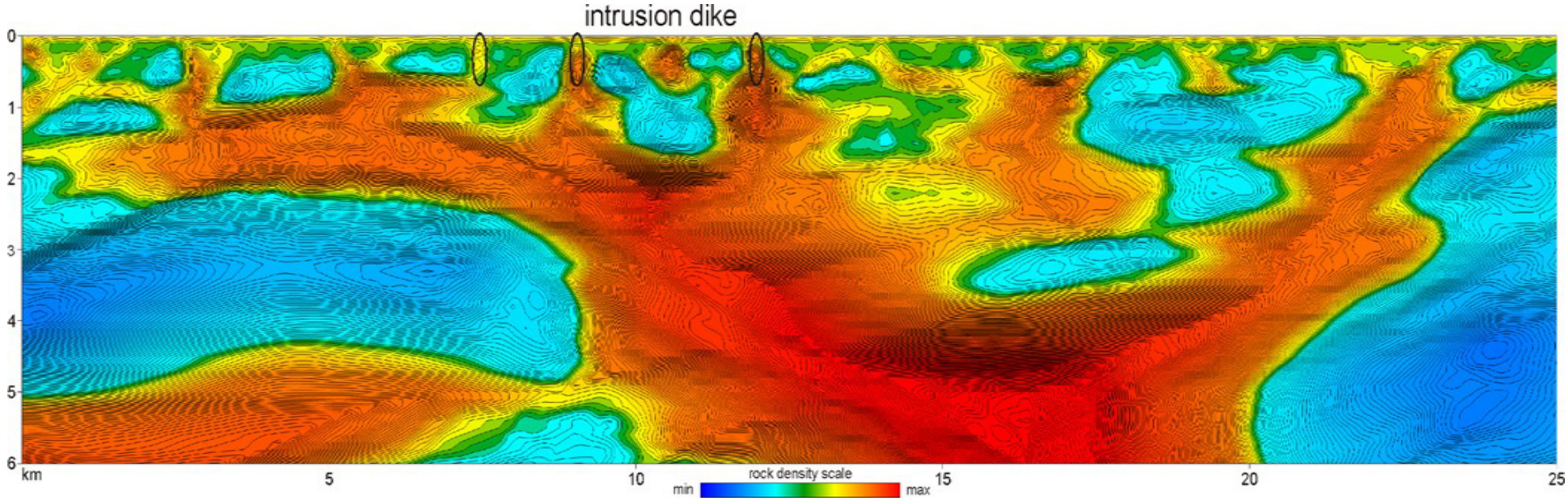
6 SEARCH FOR SOLID MINERALS

IDENTIFICATION OF INTRUSIVE FORMATIONS AND DIKES IN THE STUDY AREA, NIGERIA (5).

One of the prospecting signs during the study of the license area for the presence of prospects for solid minerals is the presence of **intrusive formations** and **dikes** that form **zones of sulfide mineralization.** These zones with high probability are the places of concentration of polymetallic ores, including gold, lead, silver, copper, zinc, etc.

Using TVT-technology algorithms we distinguish boundaries and contours of dike-type intrusions, the genesis of the formation of these structures, and we can also conduct their volumetric analysis, etc. Below are some examples from Nigerian studies:

TVT vertical Profile 1, block-fault structures. Profile length - 25 km, depth - 6 km

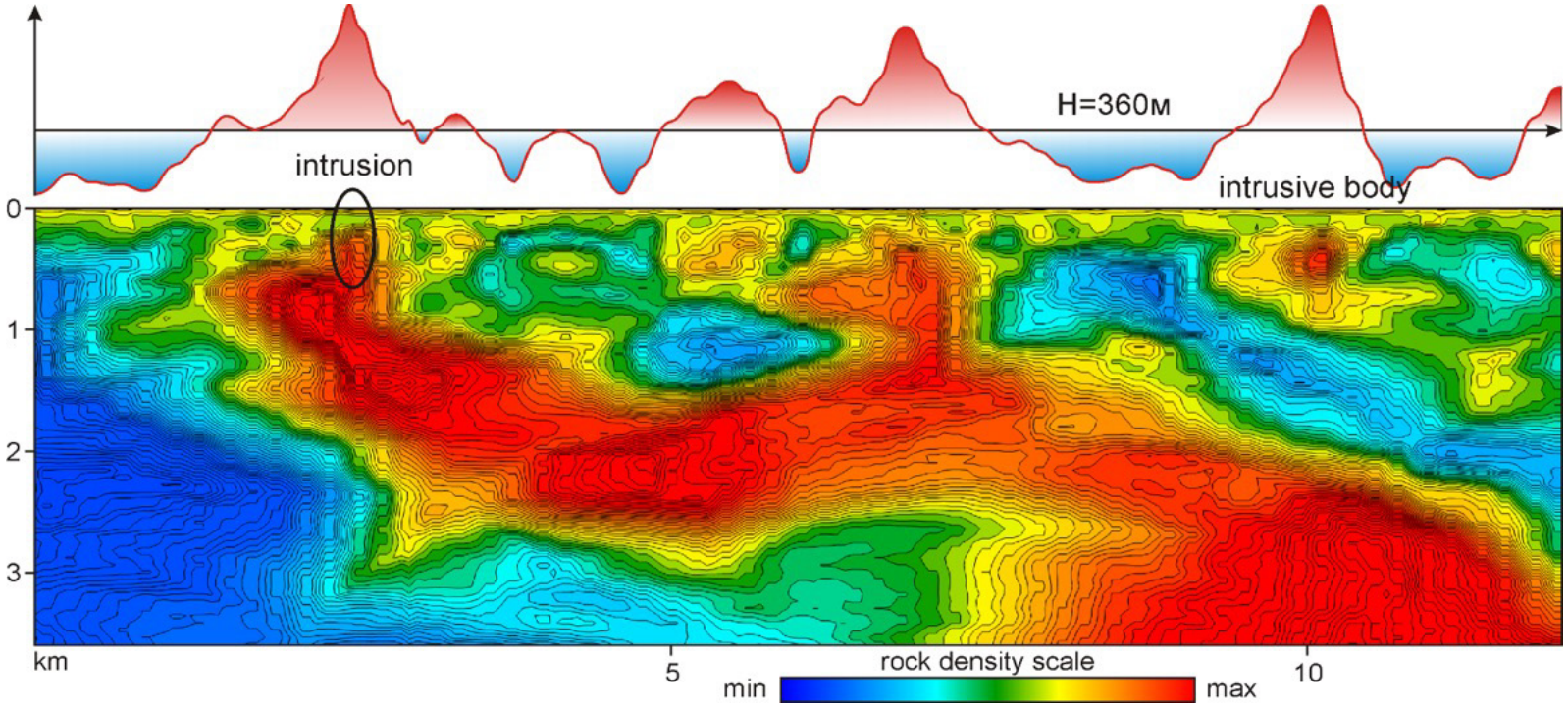


The profile clearly shows dense rocks (red and yellow color), as well as decompacted rocks / faults (blue color). In the upper part of the figure, an oval black outline marks intrusive dikes that are associated with the underlying mother igneous rocks.

7 SEARCH FOR SOLID MINERALS

ANALYSIS OF INTRUSIVE FORMATIONS AND DIKES IN THE STUDY AREA, NIGERIA (6).

TVT vertical Profile 2, block-fault structures. Profile length - 12 km, depth - 3.5 km



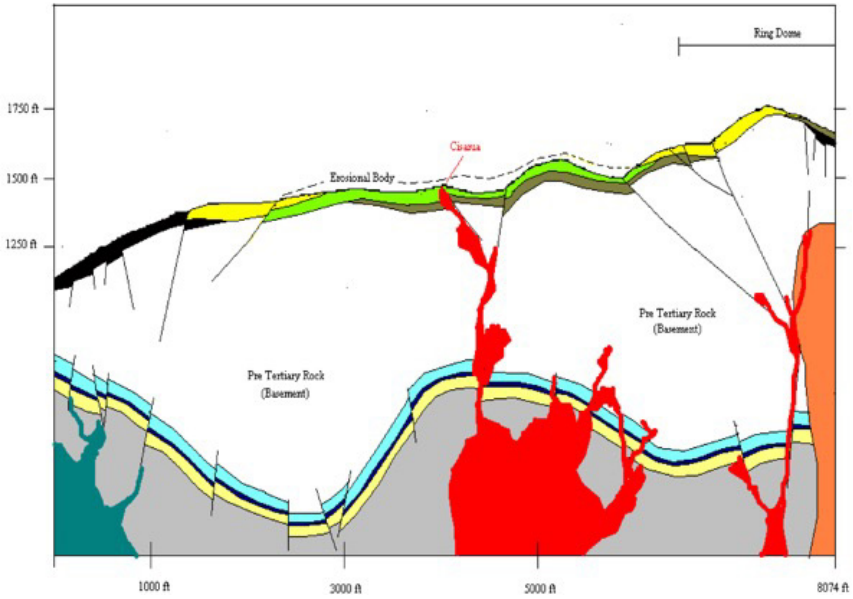
Intrusions of dense rocks elongated in the horizontal direction (PC 4-7 km) as well as spherical in shape (PC 10 km) are clearly observed in the upper part of the Crust. Intrusive bodies at various depths of the Earth's Crust are interconnected by weak values of the field intensities. Dense rocks in the section are colored red, decompacted rocks are blue.

In the upper part of the figure, for comparison with the section, a graph of the density of rocks is plotted for a depth of about 360 meters. The shape of the anomalous field makes it possible to evaluate the shape, power, and direction of the fall of the structure.

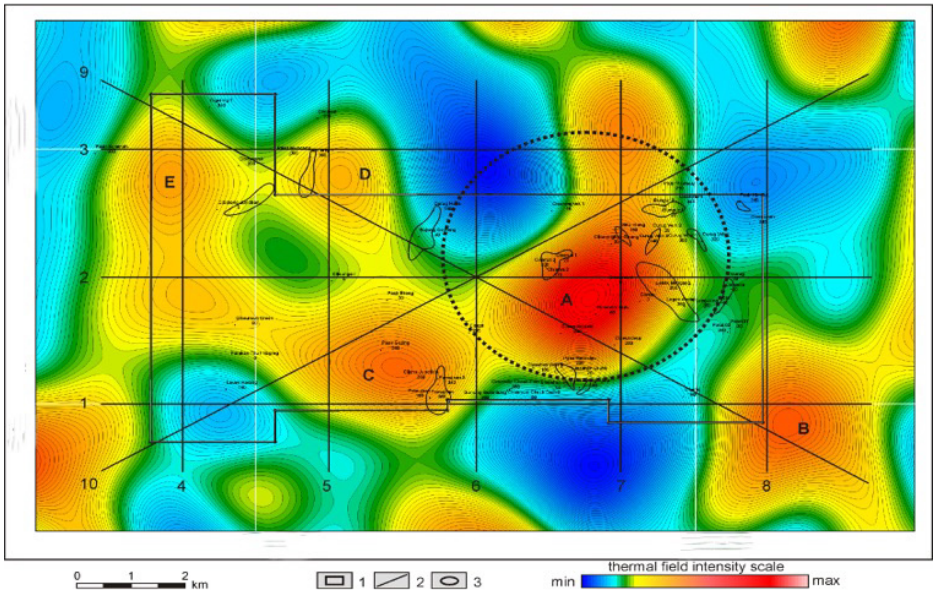
8 SEARCH FOR SOLID MINERALS

IDENTIFICATION OF ORE FIELDS AND ORE BODIES, INDONESIA, WEST JAVA (1).

The model of ore body formation on the site “SMK”, Bayah West Java



Map of local thermal field for the depth interval (3.0–4.2) km, according to Landsat-8



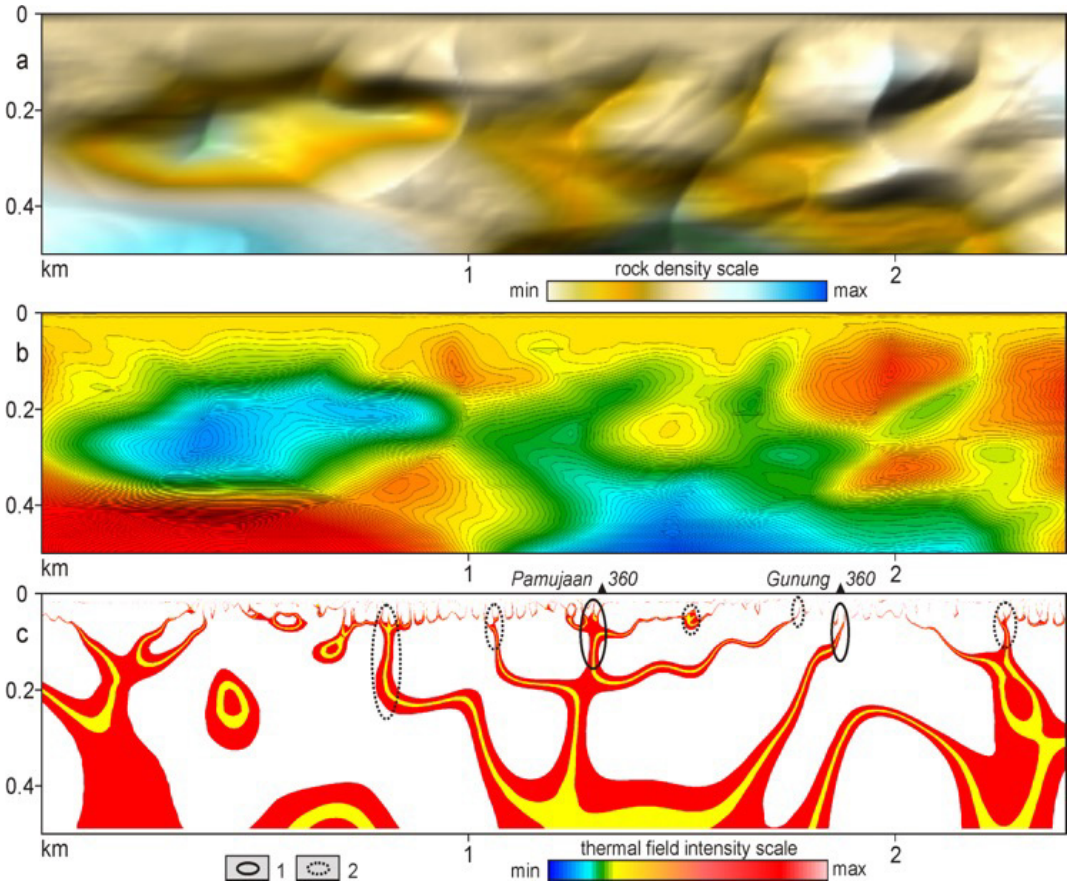
Sulfide deposits (Au, Ag, Cu, Pb, Zn) are one of the classes of hydrothermal ore deposits formed at shallow depths (up to 1–2 km), relatively low temperature (200–50° C) and at moderate pressure (V. Lindgren, 1907). Ore bodies in most cases have the form of irregular branching veins, stockworks. Ore-bearing cracks often communicate directly with the surface. As a result of natural processes, their destruction and dispersal of vein mineralization occur.

A deep sign for the search for ore structures are the Thermal Field areas, where the magnitude of the field gradient from deep sources reaches its maximum values. There are five local heat sources of different intensities in the study area. Of greatest interest is zone A (high priority), located in the area of intersection of two TVT profiles 2 and 7. Zones B and C belong to the middle priority. Zones D and E correspond with low field intensity and unidentified prospects

9 SEARCH FOR SOLID MINERALS

IDENTIFICATION OF MINERALIZATION ZONES AND PERSPECTIVE ORE DEPOSITS, INDONESIA, WEST JAVA (2).

Models of the integral field of block-fault structures in the volumetric (a) and color (b) images, gradient zones of the thermal field (c), by a fragment of TVT profile (zone C)



The location of known ore concentrations (Pamujaan and Gunung at a value of 360 units) coincide with the ascending gradient zones of heat sources. The morphology of the thermal field patterns made it possible to recommend new promising ore deposits.

The best conditions for the localization of mineralization are provided by zones of intersection of hidden faults, a system of small close faults, and a thin zone of fracturing. For this reason, weakly pronounced faults between blocks and areas of permeable faults, which are located at some distance from them, have a decisive influence. In such zones, the filtration flow — is low, a higher concentration of solutions is formed, and as a result, the localization of mineralization and related elements. The effect of the injection of ore-bearing solutions is marked by intense heat exchange with the host rocks.

Legend:

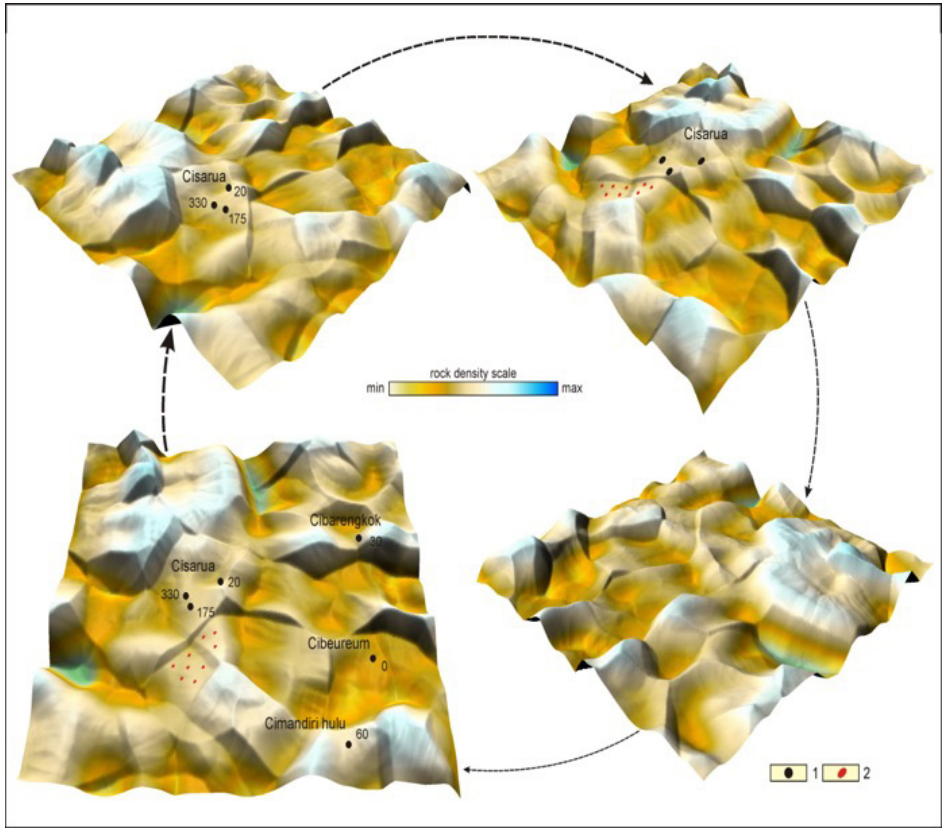
1 — Location of known ore concentrations (black solid line contour),

2 — Recommended perspective ore deposits (dotted line contour).

10 SEARCH FOR SOLID MINERALS

LOCALIZATION OF PROMISING ORE DEPOSITS ON DEEP VOLUMETRIC MAPS OF THE SITE, INDONESIA, WEST JAVA (3).

Volumetric model of the local field of block-fault structures in the depth interval 180–280 m of the high priority area (CALDERA zone A)



Legend:
1 – ore concentration location, 2 – recommended perspective zone

As an example, a map of block-fault structures of zone A is given. One can detect an **annular body (caldera)** on it, along the edges of which there are areas of maximum concentration of ore matter.

Local uplifts are the marginal part of the caldera structure and belong to the parent ore body.

From the TVT analysis and the location of geochemical samples of ore matter, the following conclusions were made:

1. The maximum values of ore matter fall into the arch of the dense structure and into the zones of the maximum gradient of the Thermal Field

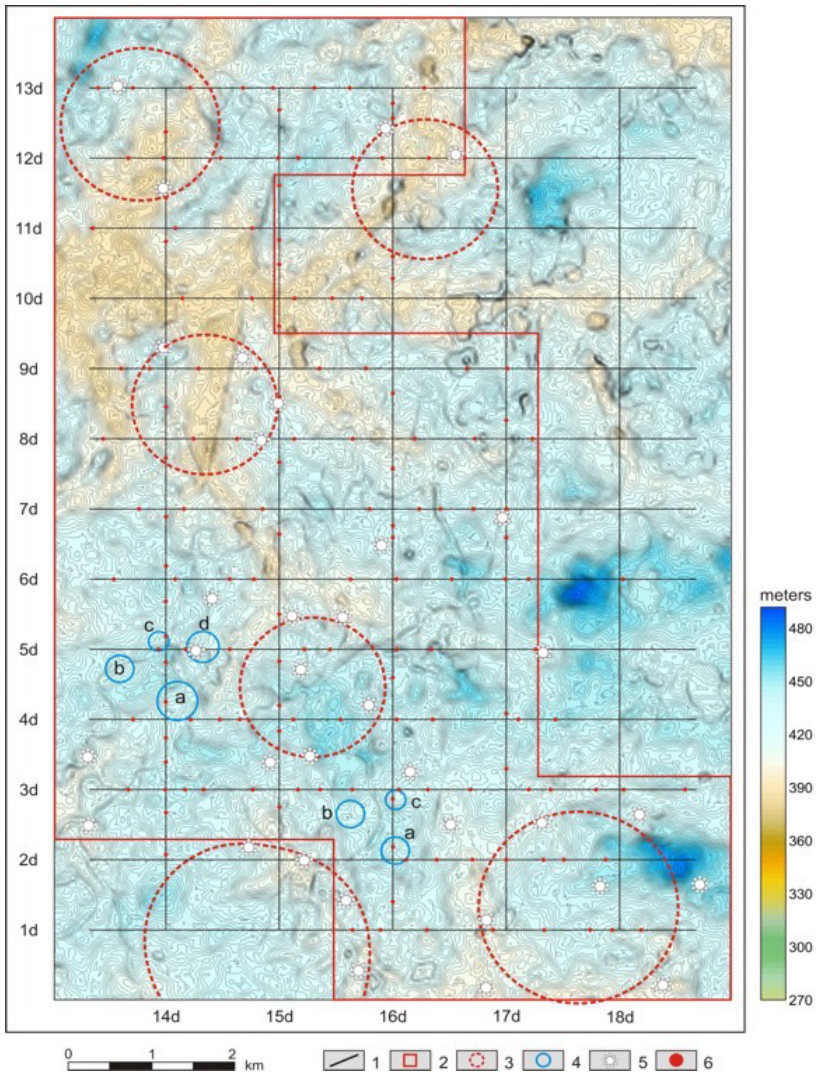
2. The sinuous shape of the gradient zones of the thermal field may indicate areas of search for ore concentrations

3. A detailed study of the thermal field of the sedimentary cover makes it possible to detail ore zones in plan and depth

4. Thermic signs are defined, which should be carried out regional and local zoning of the territory during the exploration of ore bodies.

11 SEARCH FOR SOLID MINERALS

IDETAILING PERSPECTIVE STRUCTURES FOR GOLD. GUINEA (1).



The resulting map with TVT data overlay. Highly promising areas of sulfide mineralization have been identified.

Table (example) – Geographical coordinates of the highly promising zone «AAA», according to the Landsat-8 image with a resolution of 30 meters

№	AREA	NORTH LATITUDE	WEST LONGITUDE	NORTH, PIX	WEST, PIX
1	a	1°11’11"N	4°44’44"W	111	444
2	b	2°22’22"N	5°55’55"W	222	555
3	c	3°33’33"N	6°66’66"W	333	666

Figure 1 — Terrain relief map of the licensed block with TVT results overlaid.

Legend:
1—detailed TVT profile,
2—contour of the surveyed plot,
3—ring structures,
4—gold mineralization perspective contour,
5—maximum QI value,
6—location of intrusive bodies

13 SEARCH FOR SOLID MINERALS

DETAILING PERSPECTIVE STRUCTURES FOR GOLD. GUINEA (2).

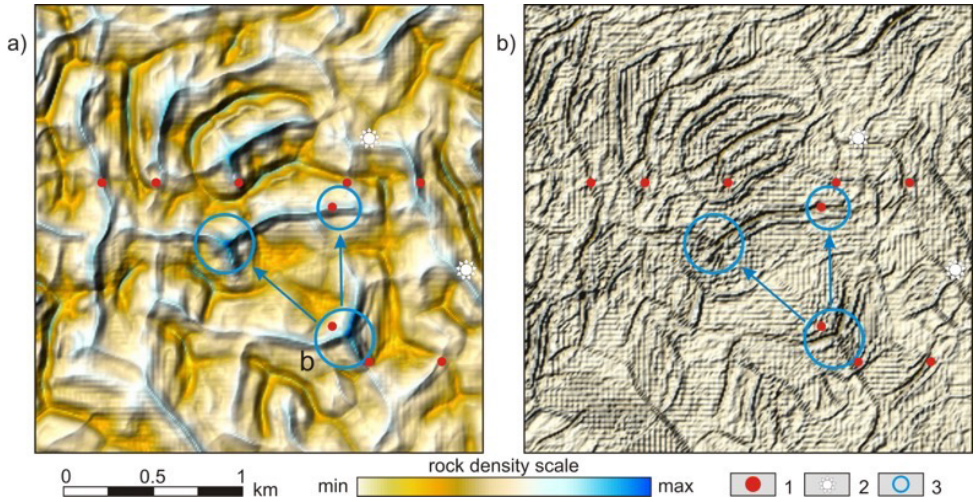


Figure-1. Fragment of maps of the integral (a) and differential (b) field of block-fault structures in the depth interval (30–50) meters of the detailing zone “AAA”.

Legend:
1 - location of intrusive bodies,
2 - maximum value of QI index,
3 - gold mineralization perspective contour.

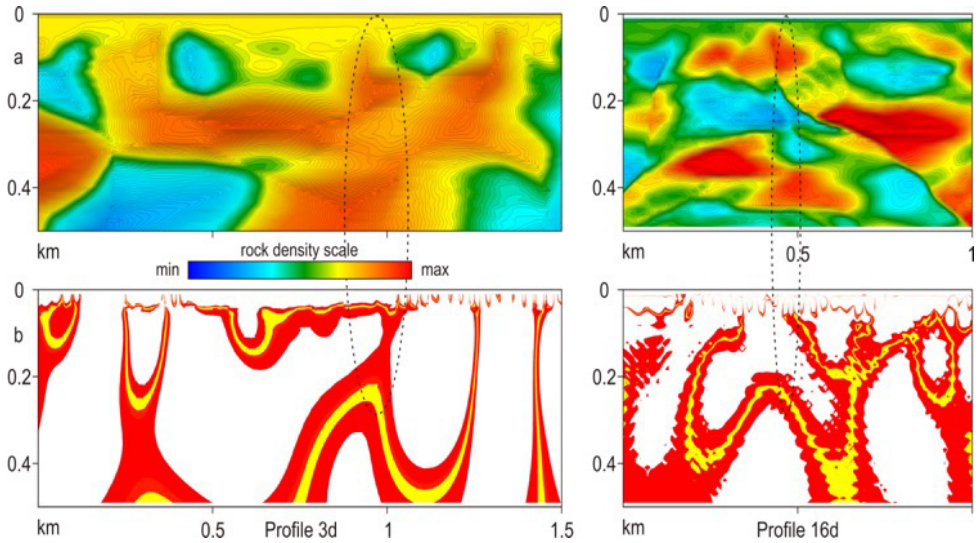


Figure-2.
Fragment of block-fault structures (a) and gradient zones of heat sources (b) along profiles 3d and 16d of the detailing zone “AAA”.

The morphology of the thermal field pattern made it possible to recommend three new promising ore deposits (see Fig.1, circled in blue). The upper part of the models has a high differentiation, decompaction zones appear, which turn into dense blocks.

The boundary between the structural forms of the section are plicative tectonic faults. Features of the structure of the models are supplemented with information about the change in gradient zones (see Fig.2).

14 SEARCH FOR SOLID MINERALS

DETAILING PERSPECTIVE STRUCTURES FOR GOLD. GUINEA (3).

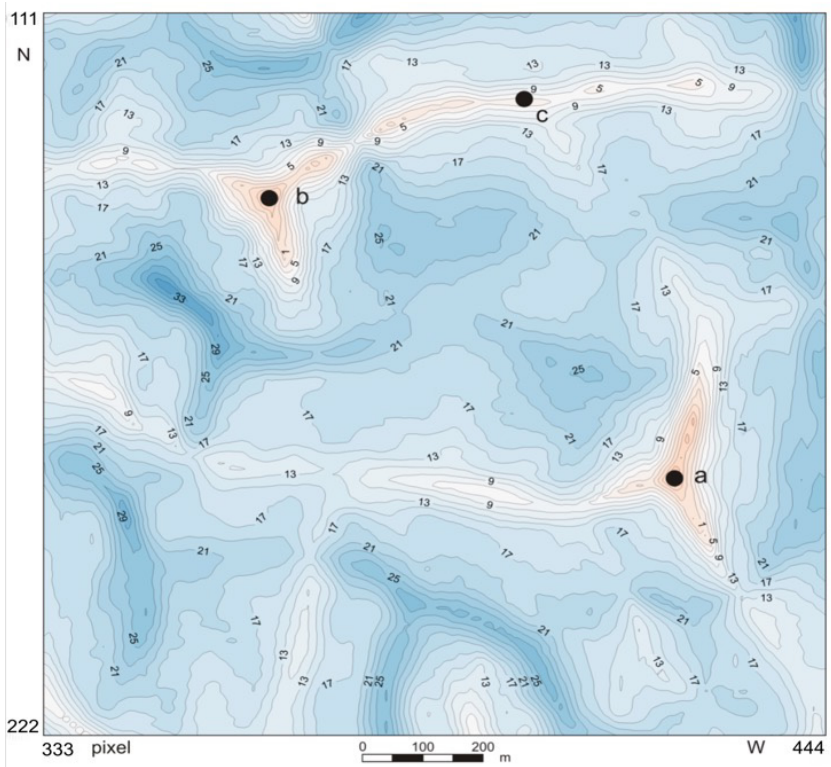


Figure 2 — Map of the **geometry of structural zones** in depth isolines (meters) during the search for gold mineralization of the detailing zone «AAA»

As a result of a detailed TVT analysis of prospective structures for Gold, we can obtain numerical data on their shape, thickness and extension in plane (see Fig.2). Using a priori information from the Customer's ground-based geochemical survey, we can carry out a predictive calculations of gold reserves in the prospective license areas. See the Table below for an example and form of presentation of such a calculation.

Table (as an example) - Estimation of predicted gold resources (zone “AAA”)

GOLD ORE ZONE	THICKNESS (m)	EXTENSION IN PLANE (m)	AZIMUTH	DIP	TONNAGE (`000t)	CONTAINED GOLD (kg)
a	99 55	333 (N-E) 444 (S-E)	77° 222°	66°–55°	4444 333	3550–2333 777–555
b	44 66	100 (N-E) 111 (S-E)	44° 222°	88°–55°	555 777	444–555 888–3333
c	77	222 (E)	66°	88°–55°	3333	2222–5555