Donbas geoelectrical structure

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SUMMARY

Donbas was formed by Late Devonian rifting of the East European Craton. Then subsidence and sedimentation formed 15-km thick Carboniferous deposits. The next long event was folding. Then inversion lifted the folded Donbas and subsequent erosion exposed the Carboniferous coal-bearing strata. Dominated strike of the Donbas structures is WNW-ESE. Deep electrical conductivity was studied by the methods of magnetic variation profiling (MVP) and magnetotelluric sounding (MTS). The MVP data at long (5-180 min) periods reveal the intense Donbas electrical conductivity anomaly (DECA) which runs along the main anticline of the folded Donbas and continues in DDB and Karpinsky swell (Figure 1). Interpretation conducted according to ideas described in (Rokityansky 1982). DECA parameters obtained by **MVP**: Profile graphs of the anomalous field give an estimate of the maximum possible depth of the anomalous currents center h=18±2 km. Frequency response maximum T_0≈3600 s yields the total longitudinal conductance G = (8±2)×10^8 S×m. Mapping the anomaly axis (Figure 1) and effective width L=36 km estimation also reliably made by MVP. 70 **MTS** at periods 0.1-3000 s yield: the upper ≈0.5 km thick layer have, as a rule, resistivity in the range of 5—50 Ohm·m. Deeper low resistivity objects are located in two conductive stripes, which upper edge varies from 0.3 to 5 km. The stripes are parallel to the DECA axis and considered as part of DECA. A very large value of G leads to assumption that the anomalous body extends to considerable depth (Figure 2). DECA axis spatially coincides with intense (up to 90 mW/m^2) deep heat flow anomaly. This fact suggests that the nature of the DECA lower part can be a partial melting. Geoelectric results support the idea of the modern tectonic activation in Donbas developed by V.V. Gordienko.

Keywords: magnetotelluric sounding, magnetic variation profiling, folded Donbas

Methods

Anomalous currents in a conducting body arise due to local electromagnetic induction in this body and due to conductive redistribution of currents induced in the enclosing media on territories with the size of an external source. Conductive type usually dominates. Its anomalous field is the product of decreasing function of period (it is the impedance of the normal cross-section) by a non-decreasing function V (0<V<1) that describes the degree of the conducting body filling with anomalous currents. Frequency response of such product has a maximum T_O which is directly related to integral longitudinal conductance G and open possibility to estimate it (Rokityansky 1982, p.247-256, 294-297)

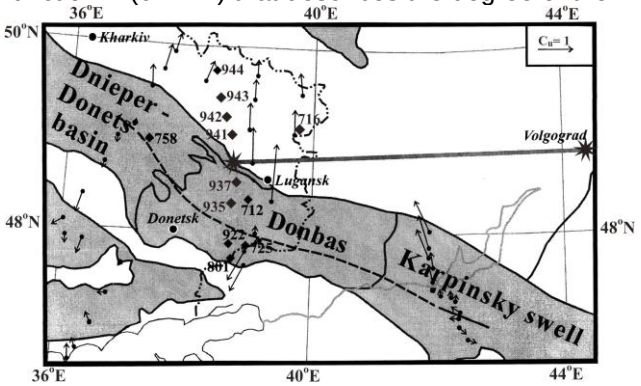

Figure 1. Donbas anomaly axis – dashed line. Arrows – induction vectors for periods 30-90 min. Rhombus – sites where impulses (±700 A, 800 kV, duration 100 s) from 473 km long line Volgograd – Donbas (grey line between stars) were recorded.

REFERENCE

Rokityansky II (1982) Geoelectromagnetic investigation of the Earth's crust and mantle. Berlin-Heidelberg-New York: Springer Verlag 381p.

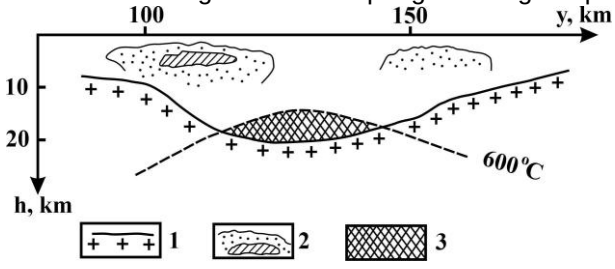

Figure 2. Model of the DECA cross-section assuming the well-conducting zone of partially molten rocks existence: 1 - surface of crystalline basement; 2 - two conductive stripes, oblique shading highlights resistivity less than 1 Om·m; 3 - zone of (partial) melting; dashed line - isotherm 600°C according to V.V. Gordienko.