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PROBLEMS IN INTERPRETATION OF RESISTIVITY SOUNDING DATA, DISTORTED BY GEOLOGICAL NOISE.

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The traditional resistivity sounding method deals with isolated sounding sites located casually on profile or area of investigation and executed with logarithmic step in distance growth. This technology has very restricted possibilities. Therefore it has begin to exchange practically simultaneously in different countries into new sounding technology, called multi-electrodic sounding, or resistivity tomography, electrical imaging, etc. Its main advantage - more dense survey along profile - is clear visible, while the other - overlapping system of measurements is not so evident. Our group in MSU began to apply multi-electrodic resistivity sounding to overcome distorting influence of geological noise. From the end of the 80-th we have been working in areas with high resistivity contrast along both vertical, and horizontal direction. Such sounding data have different features of distortions or differences from response for horizontally layered models. At that period we developed theory of distortions of DC electric field by deep and near-surface inhomogeneities (Electrical..., 1994) and software to establish VES data distortion with the help of various indicators, noticeable on VES curves. We have found, that more than 70 % of all VES curves are distorted. That means, that the distortions are practically constant features of resistivity sounding.

Carrying out the large volumes of VES field data and their interpretation (up to 1000 VES sites a year) we analyzed misfit errors of VES curves interpretation. The average value of misfit error (average RMS or $\sqrt{D}$, where D is dispersion) consists 8-12%, that seems rather high value and needs to be explained. The theory of interpretation (Tarhov et al., 1982) says that the total dispersion of geophysical field includes technological and geological dispersions:

Dtotal = Dtechnol + Dgeol.

Dtotal can be estimated on background dispersion of geophysical. Indirectly it is possible to estimate this value on misfit error. Dtechnol can be estimated on control measurements, and according to the instruction on resistivity method RMS measuring error should not exceed 5%. In practice measuring error depends on accuracy of measuring instrument (which does not exceed 2%) and on accuracy of electrodes' arrangement (which does not exceed 1-1.5%). Thus, the main factor of the

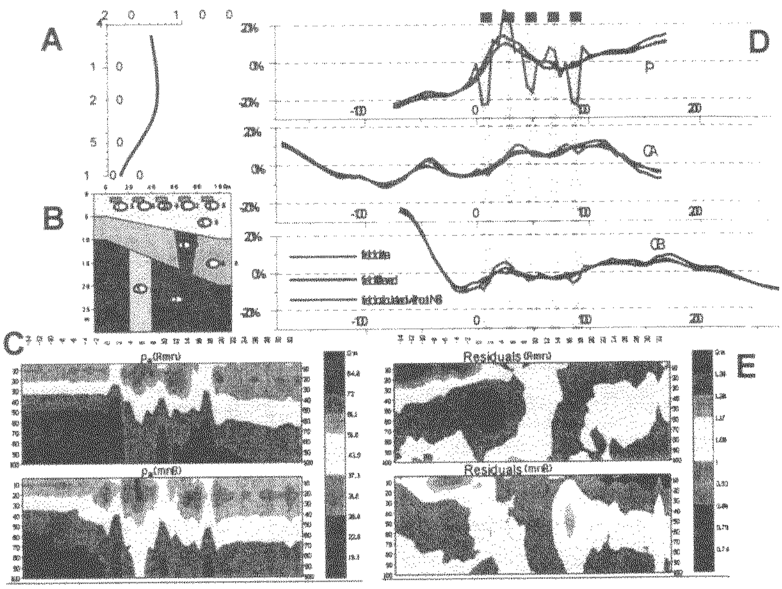

Fig.1. Median algorithm. B - model; C - ρ_a fields for AMN and MNB arrays; A - horizontal layering component; D - components P, CA, CB before and after separation into local and regional parts; E- residuals.

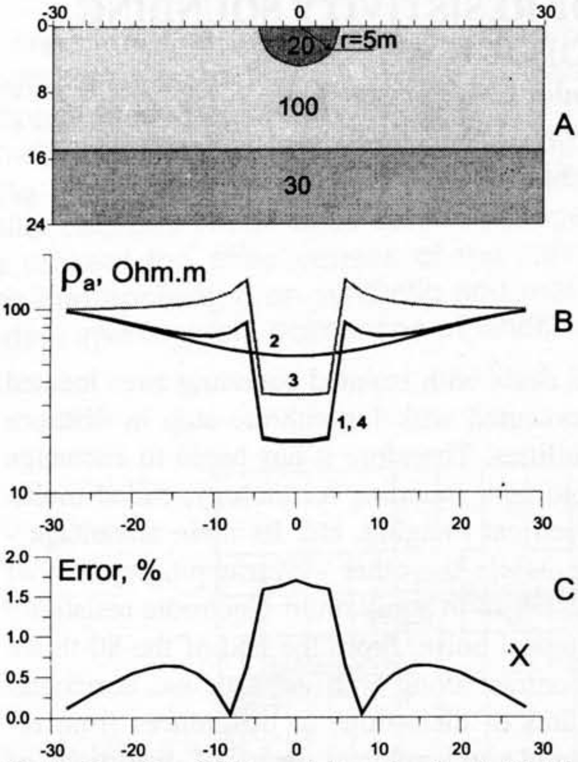

Fig.2. Results of 2D modeling to check Blokh rule. A - model, B - ρ_a fields for the total model (1), layered model (2), half-spherical body (3) and 2+3 combination; C - difference between modeling field for the total model and for that received according to Blokh (1971).

differences between Dtotal and Dtechnol is geological noise Dgeol from near-surface inhomogeneities - NSI. The influence of near-surface inhomogeneities is analogous to "broken glass" or wavered see surface, prevented from clear seeing deeper objects through them. That is why we tried to investigate NSI influence, their typical anomalies and possibility of geological noise canceling from sounding data (Electrical..., 1994).

After canceling distortions with Median algorithm, we can fulfill VES data interpretation with much greater accuracy. Both on modeling and experimental data we established, that after canceling distortions the error of interpretation becomes appreciably reduced. The misfit error for practical data interpretation decreases in 4-5 times from 8-12% up to 2-3%. It gives great improvement of VES quality and narrowing of equivalence principle limits. After removal of distortions caused by NSI the interpretation accuracy comes nearer to accuracy of the used instrument. That in turn give us possibility to apply more precise measuring instrument.

Median algorithm works in three stages. First stage - includes decomposition of ρ_a field, measured on multi-electrodic technology into components: horizontal layering, P and C effects (more exactly - P and C components) and residuals. At the second stage each component is separated into regional and local parts and local part is canceled. At the third stage the total ρ_a field is reconstructed without local P and C effects and slightly smoothed and then its 1D or 2D interpretation begins. The processes of decomposition and then separation need additional check. In reality different components in the total model have non-linear links, but we apply linear transformations for their decomposition. We tried to check the correctness of these operations by two ways: by analysis of components, receiving from Median algorithm (fig.1) and by direct modeling ρ_a fields from partial model components and then by creation of the total model using I.M.Blokh (1971) rules (fig.2). He formulated the rule for combination of simple anomalies into complex anomaly by adding components in logarithmic space transformed before to equal resistivity of surrounding. For near-surface inhomogeneities above deep structures linear approximation seems to be rather correct (fig.2). Canceling geological noise give us a great chance to raise VES data quality and accuracy of their interpretation.

$$\frac{\rho_a^{\Sigma}}{\rho_1^{\Sigma}} = \frac{\rho_a^{anom1}}{\rho_1^{anom1}} \cdot \frac{\rho_a^{anom2}}{\rho_1^{anom2}} \cdot \ldots \cdot \frac{\rho_a^{anomN}}{\rho_1^{anomN}}.$$

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