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Research Article

INTEGRATION OF THE GEOPHYSICAL METHODS FOR STUDYING FILTERING ON THE EXAMPLE OF THE TUPOLANG WATER RESERVOIR

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ABSTRACT
In this article the possibility of application of geophysical methods, such as an electrotomography and a seismic tomography, in connection with filtering emergence, presumably, from the Tupolang water reservoir is considered.

Keywords: *Electrotomography, Seismic Tomography, Inversion Models, Electrical Resistivity, Induced Polarization Potential, Seismic Layer*

INTRODUCTION
Since the year of 1983, geological works are conducted on the river Tupolang near the settlement of Gisarak, located approximately 60 km to the northeast of Denau. The first stage of a water reservoir with a capacity of 80 million m^3 was entered in 1988. In 1999 the stone and earth-fill dam increased the volume of a water reservoir with a capacity of 100 million m^3. In 2018 on completion of works on building of a dam upto a mark of 965m on a crest, with a capacity of 500 million m^3, during filling a water reservoir, there was seen filtering of water from the left board of a dam according to the Obichnargaz canal located below a dam.
One of the traditional methods of research on filtering processes is the hydrological method which is labor-consuming, unproductive and, often, insufficiently resolved in space. As a result of rare network of hydrological observations the accuracy of definition of location and geometry of zones of filtering becomes unclear. Among possible options there are solutions of this task. Use of complex geophysical methods is attractive for a number of reasons. First, existence of processes of filtering leads to emergence in surrounding space of anomalies in a number of physical fields. The complex research and the analysis of the physical fields given on set, the most sensitive to processes of filtering of water through reservoir boards, allows to receive more reliable and versatile assessment of parameters of filtering. Secondly, there is an opportunity to make observations of physical fields in the contactless way in the sense that measurements are carried out on a day surface (Lyahovitski *et. al.,* 1989). This circumstance allows to overcome a number of technical difficulties at measurements and it is essential to increase productivity of researches and consequently, to increase space and temporary resolution of researches.

MATERIALS AND METHODS
Electrotomography
The electrotomography is the whole complex technique including both a technique of field observations, and technology of processing and interpretation of field data. Its feature is repeated use, that is feeding and measuring same, fixed on a profile, observations of provisions of electrodes. It leads to reduction of total number of working provisions of electrodes at essential increase in density of measurements in comparison with a normal method of vertical electric sounding. Such approach allows on the one hand, to work with the modern high-performance equipment, and on the other hand, to apply effective algorithms of modeling and inversion (Bobachev *et al.,* 2007; Griffiths, 1993). Interpretation of data of an electrotomography is carried out within two-dimensional models. It essentially expands a circle of the tasks solved by electrical sounding investigation, through a research of the environments considerably differing from "classical" horizontally layered. Application of two-dimensional electrical sounding

investigation is reasonable at all detailed (scale 1:2000 more largely) geophysical surveys - at engineering-geological and hydrogeological researches (Loke *et al.,* 1996).

For carrying out electromagnetic sounding in the territory of the Tupolang water reservoir the modern multielectrode geophysical system for electric sounding of M.A.E was used. The X612-EM72 model (Italy), with use of 72 electrodes. The computerized X612-EM72 station measures electrical resistivity ρ and the induced polarization potential.

Measurements were taken with use of arrangement of Wenner-Schlumberger (Lyahovitski *et al.,* 1989), (with number of measurements 1025 and lasting record about 2.5 hours). The rating of electrode installation - the geometrical parameter of the unit defining depth of a research made about 43 m. In order to avoid loss of useful information upon transition from one side to another, it is necessary to do overlapping 2/3 from the maximum length of active arrangement (48 electrodes), on condition of use of all 72 electrodes (3 braids). The obtained field data are presented in the form of pseudo-cuts of the seeming resistance which are constructed without a relief.

Data processing of an electrotomography was carried out in two steps. At the first stage inversion of field data with the help of the Res2dinv program was carried out (Edwards, 1977). For regularization of an algorithm of inversion it uses models with smooth change of electrical resistivity and polarization. At the second stage, to check results of automatic inversion manual selection of 2D model with use of the program of modeling of "ie2dp" is carried out (Loke, 1996).

Seismic surveys

Field measurements were taken with use of the 24-channel high-frequency digital seismic Laccolith station - 24MZ. Frequency range of the station makes 20-2000 Hz, record duration to 6 sec., the maximum number of accumulation - 64 blows. Registration is digital. Works as method of the refracted waves with registration of longitudinal Vp of waves. Length of the seismic parking is 46 m, a step between geophones of 2 m. A step between points of excitation of 23 m, the number of points of excitation on one seismic parking of 5 pieces with use of the counter and making-up system of observations. The maximum length of a hodograph is 69 m, a way of excitation of elastic waves - shock. Geophones vertical SV-20P geophones for Vp were used. The method of the refracted waves was carried out lengthways on the right board of "Obichnargaz" canal (Belousov *et al.,* 2014).

RESULTS AND DISCUSSION

Results of the electrotomography

Since the profile consists of 2 stands, each with a length of 355 m, the total length of the profile, taking into account the overlap when stitching files, is about 500 m. After process of a stitching of files the summary section with a general extent of 475 m (Fig. 1) was compiled. The analysis, the processed field material of an electrotomography, showed a big differentiation of electric properties of the studied environment as in lateral and in vertical directions.

Results of data processing of seismic exploratory researches by method of the refracted waves and a seismic tomography

The seismic section by results of MPV is received on the basis of the software of "RadExPro" (Ginodman *et al.,* 2013), (Fig. 2). On this section are selected two seismic layers and one refracting border. The first seismic layer is presented by quite dense rocks with a velocity from 475 to 698 m/s. Power of this layer fluctuates from 5 to 12 within pickets 0-260 and 0,5-2 within pickets 270-460. Also within this layer there are high speeds (880-1376m/c) speaking about over consolidation or about water saturation within pickets 50-90, 160-210, and also limits of pickets 430-460.

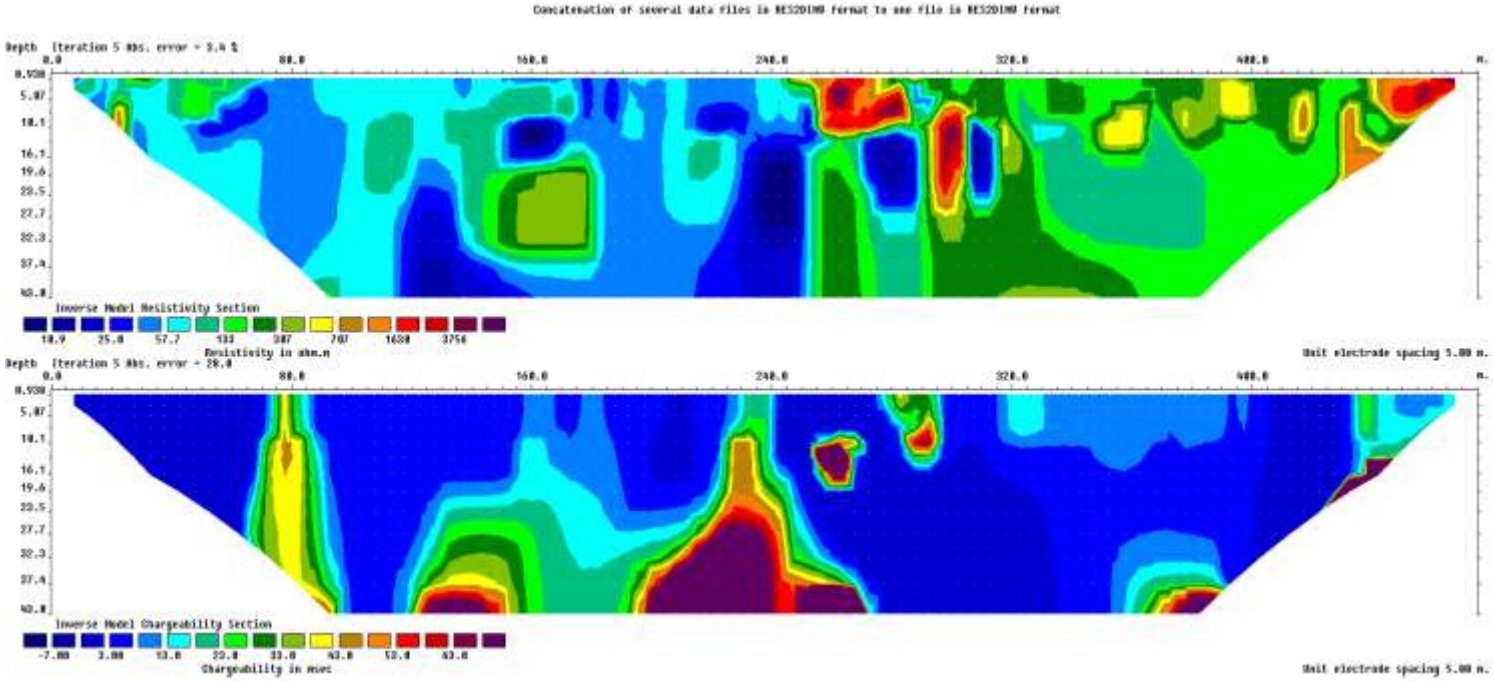

Figure 1: Inversion models on PR-I in the direction with SV on the SKID, 475 m long put from 2 parking with arrangement of Wenner-Schlumberger. *a) a section of resistance by results of 2D inversion of data; b) a polarization section by results of 2D inversion of data.*

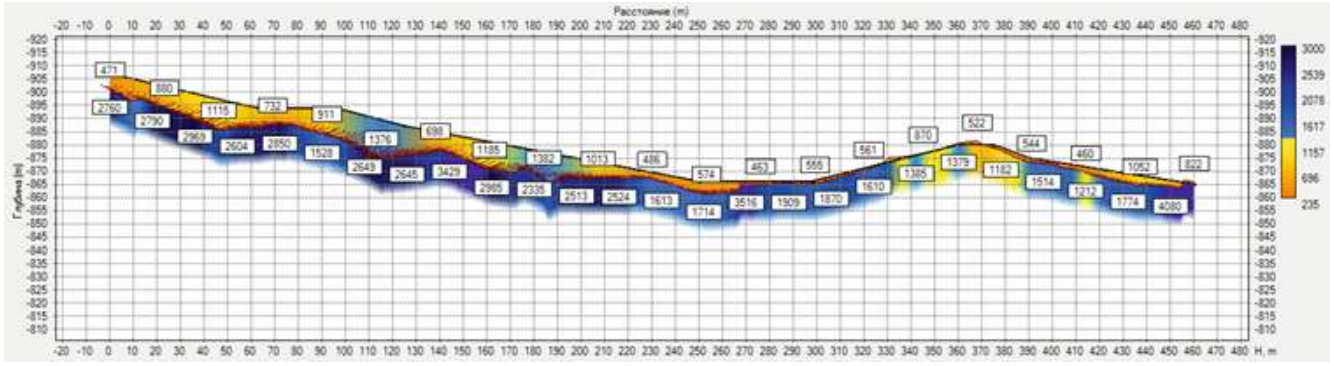

Figure 2: Seismic section

The second seismic layer has high speeds of distribution of longitudinal waves from 2649 to 4080 m/s which indicates about availability of bed rocks. Also around pickets 300-440 there are low velocities (1182-1774 m/s) indicating about water saturation existence.
The received section was successfully exported to the ZondST2D program intended for transformation of this section in seismic-stratigraphic section, giving a detailed picture of velocities (Romanov, 2013; Ginodman *et al.,* 2013), (Fig. 3).

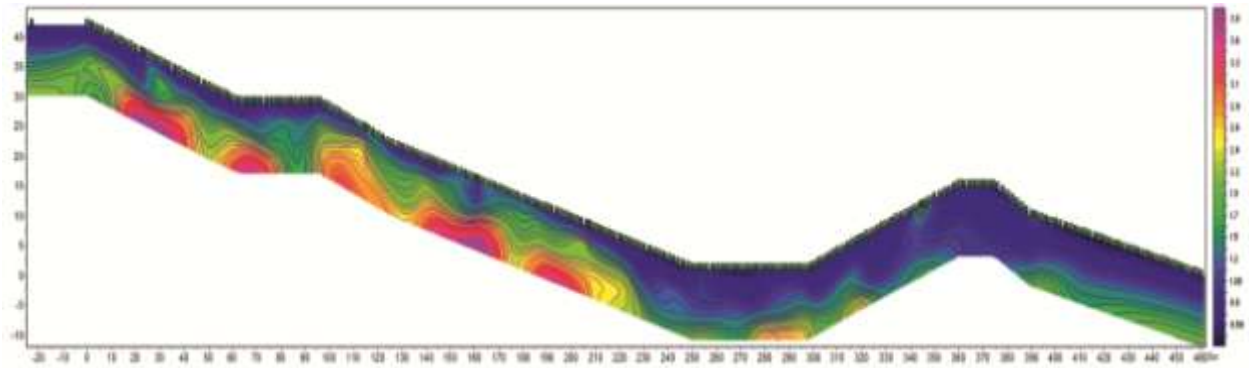

Figure 3: Seismic tomographic section

This section is presented by contours of velocities from 0.5 to 3.8 km/s judging by data of a section within pickets 0-10, 40-50, 90-100 120-140, 170-180, 210-460 there are abnormally low speeds indicating about existence of zones of filtering in limits above the listed pickets. Due to this technique it was succeeded to reveal even more water-saturated zones.

CONCLUSIONS

After analyzing the results, we made the following conclusions: At a stage of complex interpretation of geophysical results we combined two sections by two geophysical methods "Electrotomography" and "Seismic tomography". At combination of cuts it was succeeded to reveal several zones of preferential possible watering (a filtering zone).
Zone-1: with PK-65 on PK-95 the abnormal zone and by results of a seismic tomography and an electrotomography is allocated. This zone is presented by low values of resistance 25-30 Om*m that in electroinvestigations the water zone can mean. As for a seismotomography within these pickets the speed of distribution of seismic beams of high 1350-1700 m/s that corresponds to watering, and cracking zones.
Zone-2: with PK-100 on PK-155, within this abnormal zone there are also low values identical to previous one.
Zone-3 with PK-193 on PK-280, within which anomalies in all three parameters of polarization are high 63%, resistance low 30-35 Om*m and speeds of distribution of seismic waves high are marked out.
Zone-4 from the PK-360 on PK-400 in limits is allocated the last abnormal zone giving high polarizability of 55% low resistance 25-40 Om*m and high speeds of seismic beams of 1300-1650 m/s.
Thus, due to a complex of geophysical methods and three geophysical parameters (specific electrical resistivity, polarizability, speed of seismic beams) it was succeeded to allocate 4 zones corresponding to zones of filtering of water on the left board of Obichnargaz canal.

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REFERENCES

Belousov AV, Sergeev KS, Safiulin RI (2014). Possibilities of processing various types of waves recorded in engineering seismic surveys. *Journal Instruments and Systems for Exploration Geophysics* **47** (1) 86–93.

Bobachev AA, Yakovlev AG, Yakovlev DV (2007). Electrotomography is a high-resolution direct current electrical intelligence. *Journal Engineering Geology* **9** 31-35

Edwards LS (1977) A modified pseudo-section for resistivity and IP. *Geophysics* **42** 1020-1036.

Griffiths DH, Barker RD (1993). Two-dimensional resistivity imaging and modelling in areas of complex geology. *Journal Applied Geophysics* **29** 211–226.

Ginodman AG, Golosov VP, Granit BA (2013). Experience in the study of shallow-depth objects by seismic exploration *Bulletin of Moscow State University* 77.

Lyahovitsky FM, Khmelevskoy VK, Yashenko ZG (1989). Engineering geophysics. Moscow: "Nedra", 252.

Loke MH, Barker RD (1996). Rapid least-squares inversion of apparent resistivity pseudosections by a quasi-Newton method *Journal Geophysical Prospecting*. **44** (1) 131–152.

Loke MH, Barker RD (**1996).** Practical techniques for 3D resistivity surveys and data inversion techniques *Journal of Geophysical Prospecting* **44** (3) 499–524.

Manshtein YuA, Balkov EV, Panin GL, Manshtein AK, Beloborodov VA Electrotomography: equipment, methods and application experience *Electronic Resource* Available: http://www.nemfis.ru/etom.pdf.

Romanov VV (2013). Possibilities for increasing the resolution of refracted wave seismograms (MRW). *Journal Seismic Technology* **4** 67–73.