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THE OPTIMIZED MODELING OF RESISTIVITY AND IP DATA INFLUENCED BY TOPOGRAPHIC DATA AND CHANGING THE INVERSION PARAMETERS IN ORDER TO PROSPECT Pb AND Zn IN SHAZAND REGION, IRAN

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ABSTRACT *The studied area is one of the Pb and Zn mine indices in central Iran zone. According to the pre-studies, there is a massive Pb and Zn deposit in the mentioned area. In this paper, the effect of inversion factors and topography on the final model of resistivity and IP data is considered. Some of these factors are: Elimination of Bad Point, Utilizing the Shorter Width Blocks in Inversion Problem, Damping Factor, Resistivity Model Smoothing, Confining the Resistivity Variations, Decreasing the Lateral Blocks Effect.*

INTRODUCTION

Geophysical methods have always the effective and determining role in metallic ore prospecting. The most important property of these methods is their potential capability for representative information about subsurface variations of one deposit. According to studies which contain resistivity and induced polarization (IP) methods that carried out by Department of Exploration of Institute of Geophysics, Tehran University, one massive Pb and Zn deposit is exist in Shazand area.

In this paper, by using numerical modeling results related to recorded IP and resistivity data, we achieved a worldwide conclusion in this region and subsequently, it enables us to represent the applicable suggestions about the same deposits.

The obtained resistivity and IP models are strongly depended to data quality, measurement geometry and selection of inversion parameters, (C. Hauck and D. V. Muhll, 2003).

Inversion of measured apparent resistivity data carried out by Res2Dinv. This software is based on Least Square method (Loke and Barker, 1995). The least square equation has form as bellow:

$$p = (J^T J + \lambda C^T C)^{-1} J^T g$$

Where p is Distortion of model, J is a matrix that contains the sensitivities of data points related to one individual model parameters and g is difference vector that include difference between measured and calculated apparent resistivity (Loke and Barker, 1995); The C matrix, perform as a smoother filter that minimize undetermined components of the inversion problem and produce a smooth model. The parameter λ determines the weight between calculated and observed data in order to smooth resistivity model. This equation is solved iteratively with changing J and g, until RMS of g becomes less than desired measurement accuracy (Loke and Barker, 1995).

THEORY

Induced polarization is an electromagnetic method that uses electrodes with time-varying currents and voltages to map the variation of electrical permittivity (dielectric constant) in the Earth at low frequencies. Induced polarization is observed when a steady current through two electrodes in the Earth is shut off: the voltage does not return to zero instantaneously, but rather decays slowly, indicating that charge has been stored in the rocks. This charge, which accumulates mainly at interfaces between clay minerals, is responsible for the IP effect. This effect can be measured in either the time domain by observing the rate of decay of voltage, or in the frequency domain by measuring phase shifts between sinusoidal currents and voltages. The IP method can probe to subsurface depths of thousands of meters. In nature, the induced polarization (IP) effect is seen primarily with metallic sulfides, graphite, and clays. For this reason, IP surveys have been used extensively in mineral exploration especially in Pb and Zn deposits. As with electrical resistivity surveys, vertical or horizontal profiles can be generated using IP. IP is affected by changes in surface relief and lateral changes in resistivity. The electrode array length is about 10 times greater than investigation depth.

Induced polarization is the capacitance effect, or chargeability, exhibited by electrically conductive materials. Time-domain IP is done by pulsing an electric current into the earth at one or two-second intervals through metal electrodes. Disseminated conductive minerals like Pb and Zn deposits in the ground will discharge the stored electrical energy during the pulse cycle. The decay rate of the discharge is measured by the IP receiver. The decay voltage will be zero if there are no polarizable materials present. Generally, both IP and resistivity measurements are taken simultaneously during the survey. Survey depth is determined by electrode spacing. The final report products are similar to those of resistivity surveys.

Examples

In this section the Resistivity and IP model obtaining from Inversion, of course with and without consideration of the changing Inversion factor and topography correction besides offering the best site for drilling, along one of the profiles are illustrated below:

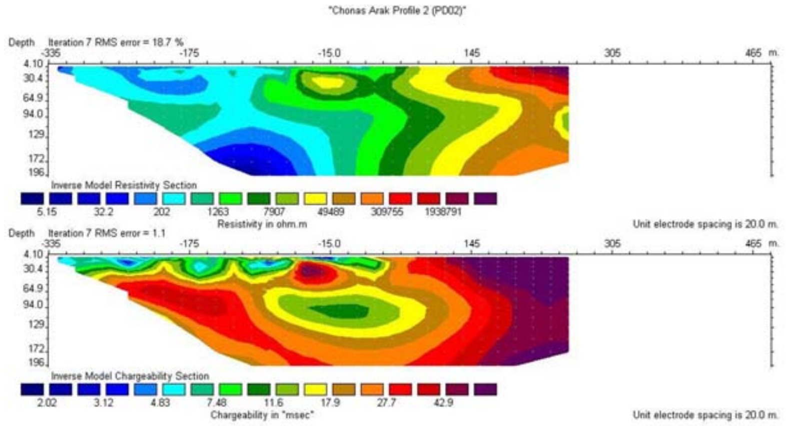

Figure-1. IP and Resistivity models of pole-dipole profile without Topographic correction and changing Inversion parameters.

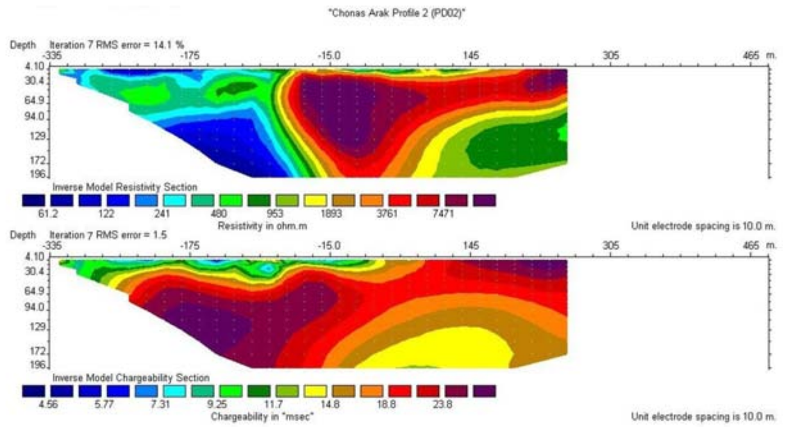

Figure-2. IP and Resistivity models of pole-dipole profile without Topographic correction and with changing Inversion parameters.

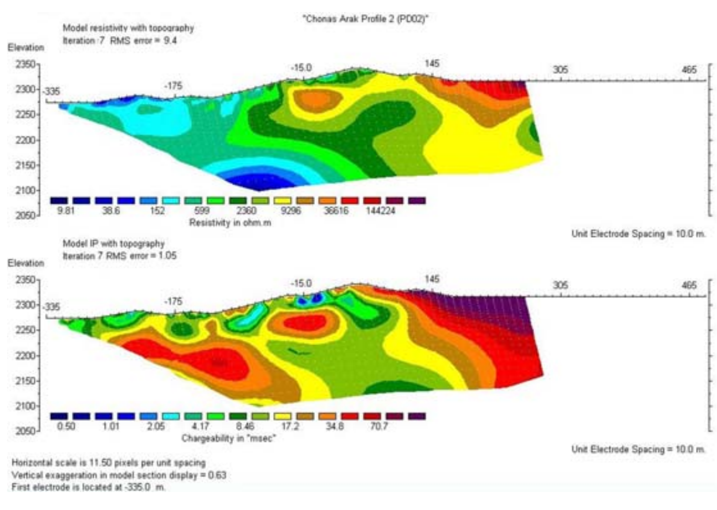

Figure-3. IP and Resistivity models of pole-dipole profile with Topographic correction and without changing Inversion parameters.

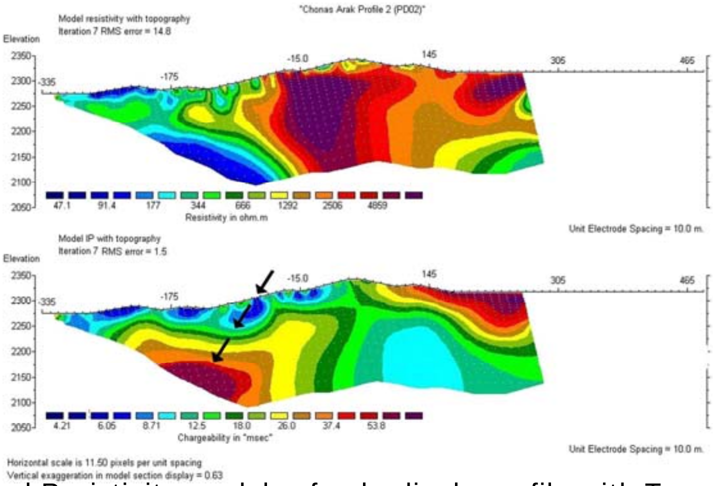

Figure-4. IP and Resistivity models of pole-dipole profile with Topographic correction and changing Inversion parameters. Bold arrows show the best site for exploration drilling.

CONCLUSIONS

The Inversion parameters play a vital role in producing the final model; especially in the case of noisy data. In the regions with rough topography, ignorance of topographic corrections causes the extension, movement or elimination of IP and Resistivity Anomalies or generating the pseudo-anomalies. On the other hand, current study indicates that unrestricting of Resistivity variations has an undesirable effect on final model even more than topographic effects. According to final IP and Resistivity models that are shown in figure 4, we suggest the existence of a metallic ore deposit in lower left part of this figure which to be extracted, a borehole has to be drilled along the arrows shown in the figure. With attention to geological evidences a shale alternate with lime folding was seen in the studied area that this alternative sequence shown itself as a low Resistivity area between two high Resistivity Anomalies in the upper right section of the figure 4, which indicates the presence of shale in that area.

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