Research of Magnetic Parameters Effect in the Magnetotelluric Sounding

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Abstract

Magnetotelluric method (MT) is a geophysical method which is applied widely, has many advantages such as a large penetration depth, low cost, shielding from the high resistance layer, reflecting sensitively the low resistance layer, a very narrow range of the equivalence, high resolving power. It has been widely used in petroleum, natural gas, geothermal exploration; the probe of sedimentary basin tectonics, the earth's crust and upper mantle structure; monitoring resistivity changes of rocks deep underground to provide information of seismic precursor and earthquake preparation and so on. Based on the National Natural Science Foundation project, this article carried out some research to verify the extent of the impact of magnetic susceptibility changes in measured data which has a positive significance in reducing the inversion of magnetotelluric sounding of multiple solutions which is at the analysis of and processing rock magnetic parameters on the impact of magnetotelluric data.

The article firstly introduced the electrical conductivity and magnetoconductivity of rocks and minerals and the common resistivity and magnetic susceptibility sedimentary, metamorphic and igneous rocks and so on in details, and expressed the related and classic theories of magnetotelluric sounding, at the same while, briefly discussed the formula for the resistivity and magnetic susceptibility to magnetotelluric response.

The emphasis of this paper is on analyzing and studying two-dimensional magnetotelluric forward and inversion regarding to the magnetic parameters. In the forward , first of all, some related theory were introduced, and calculation formula which was deduced with both of the resistivity and magnetic susceptibility as the parameters for the two-dimensional magnetotelluric forward. And then this paper presented concretely the finite element method which was used, by which the two-dimensional forward calculation was achieved . According to the analysis and the comparison of the obtained data, the paper elaborated the impact of resistivity and

magnetic susceptibility on the magnetotelluric response. A conclusion shows that the resistivity values have a certain increase in the low-frequency band, and with the magnetic susceptibility becoming larger which have more substantial changes, the impact on the phase is relatively small, when the magnetic susceptibility is greater than a certain value. In the inversion, the paper firstly introduced a number of classic inversion method, focusing on the two-dimensional non-linear conjugate gradients method ,using Mora's the idea of calculating the sensitivity, according to NLCG algorithm component of the Polak-Ribiere ,in order to establish a minimum objective function, and give the solution process and description of calculation of observational data on the sensitivity of model parameters.

Finally, it is the magnetotelluric data processing software of MTSoft series (Wang Xuben, etc.) developed by Chengdu University of Technology of the Ministry of Education Key Laboratory that was used to improve the forward part of NLCG two-dimensional software program, including the change that magnetic permeability becomes either a constant or a variable from all parameters for the vacuum of the rectangular units in the previous region. Using the inversion procedure which has improved to calculate the experimental data and the measured data, analyse and compare the distributed images of the resistivity of which the magnetic parameters are constants and variables. And the conclusion from the comparative analysis is that the resistivity of rock plays a major role in magnetotelluric exploration, but it is best to consider the magnetization rate when the measured data is analysed accurately in the low-frequency part.Especially during the long-period magnetotelluric measurements and MT geographical exploration in the region containing high-magnetic material , the more attention should be paid to its impact.

Keywords: Magnetotelluric method　magnetic susceptibility　sensitivity