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含激电效应的CSAMT一维正演研究

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1-D forward modeling of the CSAMT signal incorporating IP effect

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摘要 地电体对频率域电磁波激发源的响应为电磁感应和激电效应的综合响应.传统CSAMT法进行数据正反演时认为大地介质电阻率是与频率无关的实数，而实际上因为激电效应，地下可极化体的电阻率是一个与频率相关的复数.为推进二者总体响应研究，并扩展激电法的应用范围，同时提高电磁法勘探的精度，本文基于Dias模型，以复电阻率代替不考虑地电体极化效应的直流电阻率，对CSAMT场源一维层状模型进行了正演模拟，为提取CSAMT信号中所含激电信息提供理论基础.结果表明，考虑激电参数后，视电阻率及相位响应曲线出现明显异常（包括远场、过渡场、近场）；极化前后振幅比值异常峰值、相位差值异常峰值可直观体现激电异常；异常峰值与极化层层厚、埋深以及电阻率变化有连续的对应关系.认为从频率域电磁法信号中提取激电信息有乐观的前景.

关键词 CSAMT信号, 激电效应, 响应模型, 一维正演, 提取, 过渡场, 近场

Abstract: The response of geoelectric objects to frequency domain electromagnetic wave excitation source is the comprehensive response to both electromagnetic induction and induced polarization. Traditionally, the resistivity is considered as a real number parameter unrelated to the frequency when we do the data inversion of CSAMT signal. In fact, the resistivity of polarized layer is a plural number related to the frequency because of the IP effect. In order to promote the research on this comprehensive response, we add the complex-resistivity-models into the CSAMT signal, which will expand the application range of IP method; meanwhile, will improve the accuracy of CSAMT exploration also. Base on Dias-model, this paper studies the forward modeling of IP response with CSAMT 1D layered model of the earth, to provide the theoretical basis for extracting the IP information from CSAMT signal. The study results show that: the amplitude of apparent resistivity and phase curve show obvious anomalies after IP parameters is considered, this can be observed in far field, near field and transient field; meanwhile, there is a clear relationship between the peak value of the amplitude anomaly ratio and phase anomaly difference before and after IP parameters is considered for the corresponding frequencies, as well as between the peak values and the resistivity, depth, and thickness of the layer which have IP response also; therefore, the IP information extracted from frequency domain electromagnetic sounding has a good outlook.

Keywords CSAMT signal, IP effect, Response model, 1D forward, Extraction, Transient field, Near field

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