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CSAMT的多偶极子源特征与张量测量

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Characteristics of multiple sources and tensor measurement in CSAMT

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摘要 传统的可控源音频大地电磁法电偶源多为单偶极子源，这种源明显缺点是各分量存在明显的弱区，E_x、H_y强的区域， E_y、H_x弱，很难进行360°张角范围内测量和矢量测量.为了克服传统场源布极方式的缺点，本文介绍了由两个偶极子组成的“L”型源，推导了“L”型源各个分量的表达式，并通过一个简单均匀半空间的模型验证了表达式的正确性.通过对“L”型源与偶极子源的辐射花样图和电流矢量图详细对比可知，在CSAMT测量区内多偶极子源遵从矢量合成原则.在此基础上，设计了一种新的信号发射模式，在这种模式下可实现 360°张角范围内各分量不再存在明显弱区.在新的信号发射模式下，可解决矢量测量时信噪比不对等问题，并可减少张量测量时偶极源的布设次数.在“L”型源的基础上，还进行了张量测量的研究，在一个事例中，计算了倾子、二维判别指数、坐标系的旋转等，结果表明张量测量明显优于标量测量，标量测量一般只适用于一维情况，当地质结构呈现二维或三维性时，标量测量结果很有可能给反演结果带来误差.

关键词 多偶极子源， 张量测量， 可控源， 场源特征

Abstract: The traditional current electrodes arrangement in Controlled-Source Audiomagnetotellurics method (CSAMT) is "—"type, this arrangement has some significant disadvantages—there are weak areas for all components, E_y and H_x are weak in the area where E_x and H_y are strong. Moreover, it is hard to take the normal measurements in the field angle of 360 degree and tensor measurement. In order to eliminate these defects, an "L" type source was designed and the expression formula of each component in the source, which was verified through an experiment in a simple homogeneous semi-space, was presented in this paper. A newly designed signal emission model which avoids the weak area for each component in the field angle of 360 degree was developed subsequently. Tensor measurement with this new "L" type source and the calculation of tipper, complex skew as well as coordinate system rotation indicate that one can obtain better results by tensor measurement than by scalar measurement. The latter is supposed to be applicable in 1-D structure while might bring some bias in 2-D or 3-D geological structure.

Keywords Simultiple sources, Tensor measurement, CSAMT, Source characteristics

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