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定向电磁波传播随钻测量基本理论及其在地层界面预测中的应用

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Physics of directional electromagnetic propagation measurements-while-drilling and its ap boundaries

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摘要 采用水平层状各向异性介质中的磁流源并矢Green函数计算定向电磁波传播随钻测量的幅度衰减和相位移.分析了定向的探测范围和对地层界面的灵敏性,研究了地层各向异性、地层相对倾角和接收天线倾角对定向测量的影响.计算结果表明,频线圈距越大、目的层和围岩层电阻率对比度越大,定向电磁测量的探测范围越大.随着接收天线倾角的增加,定向幅度衰减在接面时的变化更加明显,对地层界面的灵敏性增加.采用对称天线结构可消除定向测量信号在远离地层界面处对地层各向异性和倾角的依赖,实现对地层界面的准确预测.

关键词： 定向电磁波传播 随钻测量 地层界面 并矢Green函数 倾斜接收天线

Abstract： The amplitude-attenuation and phase-shift of directional electromagnetic propagation measu while-drilling are computed via the magnetic-current-source dyadic Green's functions for horizontally stra anisotropic media. The detection range and the sensitivity to formation boundaries of directional electror measurements are analyzed. The influence of anisotropy, formation dip angle, and receiver antenna's tilti on directional measurements is studied. The results have shown that the directional detection range will with decreasing frequency, increasing coil spacing and increasing resistivity contrast between target bec shoulder bed. The change of directional amplitude-attenuation will become more obvious with increasing antenna's tilting angle when the tool is approaching formation boundary, and thus the sensitivity to form boundaries will increase. The introduction of symmetrized antenna configuration can remove the depende directional signal on anisotropy and formation dip angle when far away from formation boundaries, and th formation boundaries can be accurately forecasted.

Keywords： Directional electromagnetic propagation Measurements-while-drilling (MWD) Formation boundaries Dyadic Green's functions Tilted receiver antennas

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