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用并矢Green函数的矢量本征函数展开式模拟随钻感应测井仪器的响应

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Simulating the response of induction logging-while-drilling tools by vector eigenfunction expansion formulae for dyadic Green's functions

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摘要 采用圆柱坐标系下完纯导电劈模型的磁流源并矢Green函数的矢量本征函数展开式计算钻铤V型槽内随钻感应测井仪器的响应.计算发现,V型槽张角的变化对电磁场不同分量的影响规律不同.若只采用传统的感应测井仪器,V型槽的张角可尽量小一些以最大限度地增加信号强度.若采用多分量感应测井仪器,需对V型槽张角的取值进行折衷考虑.由于在具有不同张角的V型槽内接收信号的强度不同,在对地层视电导率进行刻度时需根据V型槽张角确定标准值.计算还发现,电磁场不同分量对方位角的依赖程度不同,侵入带电导率对不同分量接收信号的影响程度也不同,因而不同分量接收信号的径向探测深度不同.

关键词: 随钻感应测井 V型槽 并矢Green函数 矢量本征函数 完纯导电劈

Abstract: The vector eigenfunction expansion formulae of magnetic-current-source dyadic Green's functions for a perfect electric conduction wedge model in cylindrical coordinate system are adopted to compute the response of an induction logging-while-drilling tool within the collar's V-shaped channel. It has been shown from computation that the influence of the change of the V-shaped channel's angle on different components of electromagnetic fields is different. If only a conventional induction logging tool is used, the channel's angle should be as small as possible in order to increase the signal's intensity fully. If a multi-component induction logging tool is used, the value of the channel's angle should be selected compromisingly. Since the received signal's intensity will change when the tool is in the V-shaped channel with different angle, the criterion should be set on the basis of the V-shaped channel's angle when calibrating the formation's apparent conductivity. It has also been shown that different components of electromagnetic fields rely differently on the azimuth angle, and that the influence of the invasion zone's conductivity on different components of the received signal is also different, thus the radial depth of exploration is different for different components of the received signal.

Keywords: Induction logging-while-drilling V-shaped channel Dyadic Green's functions Vector eigenfunction Perfect electric conduction wedge

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