地球物理学报 » 2013, Vol. 56 » Issue (2) :696-706 doi:10.6038/cjg20130234
应用地球物理学

引用本文(Citation):
肖加奇, 张国艳, 洪德成, 杨善德.层状各向异性地层中三维感应测井响应快速计算及资料处理. 地球物理学报, 2013,56(2): 696-706,doi: 10.6038/cjg20130234

XIAO Jia-Qi, ZHANG Guo-Yan, HONG De-Cheng, YANG Shan-De.Fast forward modeling and data processing of 3D induction logging tool in layere anisotropic formation.Chinese Journal Geophysics,2013,56(2): 696-706,doi: 10.6038/cjg20130234

层状各向异性地层中三维感应测井响应快速计算及资料处理

肖加奇[1], 张国艳[1], 洪德成[2], 杨善德[2]*

1. 中国石油长城钻探工程有限公司, 北京 100176;
2. 吉林大学物理学院, 长春 130012

Fast forward modeling and data processing of 3D induction logging tool in layered anisotropic formation

XIAO Jia-Qi[1], ZHANG Guo-Yan[1], HONG De-Cheng[2], YANG Shan-De[2]*

1. CNPC Greatwall Drilling Company, Beijing 100176, China;
2. College of Physics, Jilin University, Changchun 130012, China

摘要

本文采用广义反射系数法推导了水平层状各向异性地层中电磁场的积分解析解,并利用快速汉克尔变换技术实现了三维感应仪器测井响应的快速计算.三维感应测井响应与地层水平电导率、垂直电导率和井斜角及仪器方位角同时有关,单一分量的测井曲线不能满足资料解释的需要.通过对仪器测量分量响应特征的考察,本文提出了一种基于组合量测井曲线的资料直观解释方法.数值模拟显示,交叉分量相关组合量可准确划分地层纵向边界,并可直观识别各向异性层;与单独分量相比,主分量相关组合量提高了纵向分辨率、减弱了与地层电导率参数的非线性关系.

关键词 三维感应测井, 各向异性地层, 水平层状介质, 直观解释

Abstract:

Using generalized reflection coefficients, we deduced a complete form of solution for the electromagnetic field in layered anisotropic formations. Those generalized reflection coefficients can be evaluated with recursion formula for each electromagnetic wave mode. A fast forward modeling is achieved through the Fast Hankel Transformation (FHT) method. The responses of a 3D induction logging tool are determined by the horizontal conductivity, the vertical conductivity, the relative dip of the formation and the azimuth angle of the tool, and a single component of the logging curve can't meet the need of data interpretation. Gaining insight into the response characteristics of the measurement components of a 3D induction tool, we developed a quick-look interpretation method by combining the measurement components in different ways. The processing results of numerically simulated data have shown the fact that the combination of the cross-components accurately outlines the boundary location and qualitatively recognize anisotropic layers, while the combination of the primary components enhances resolution and reduces nonlinearity relating to electrical parameters.

Keywords 3D induction logging, Anisotropy formation, Horizontal layered medium, Quick-look interpretation

Received 2012-10-14;

Fund:

国家十二五重大专项(2011ZX05020-004)电阻率多维成像测井技术与装备资助.