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刘礼农, 张剑锋. 三维各向异性介质中的波动方程叠前深度偏移方法[J]. 地球物理学报, 2011, V54(11): 2906-2915, DOI: 10.3969/j.issn.0001-5733.2011.11.020

LIU Li-Nong, ZHANG Jian-Feng. Wave equation prestack depth migration method in 3D VTI media. Chinese J. Geophys. (in Chinese), 2011, V54(11): 2906-2915, DOI: 10.3969/j.issn.0001-5733.2011.11.020

三维各向异性介质中的波动方程叠前深度偏移方法

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Wave equation prestack depth migration method in 3D VTI media

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摘要

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摘要 基于三维VTI各向异性介质的频散关系, 构建波数项和空间项分离的单程波算子表达式, 以优化算法, 确定算子的待定系数, 实现广角逼近三维VTI介质的广义相移算子, 发展了可灵活处理强或弱各向异性介质的波动方程叠前深度偏移方法. 文中同时也针对其工业应用建议了三维VTI各向异性介质中可提高计算效率的频率相关变步长波场深度延拓算法及稀疏采样情况下可实现陡倾角构造正确成像的反假频波场延拓算法. SEG二维Hess VTI各向异性介质理论模型数据及野外数据集观测系统下的三维脉冲响应计算表明, 本文提出了一种具有工业应用潜力的三维各向异性波动方程叠前深度方法.

关键词: 波动方程 深度偏移 三维VTI介质 单程波方法

Abstract: Based on the 3-D dispersion equation for the transversely isotropic media with a vertical symmetry axis (VTI), we proposed one-way operators in the wavenumber-space domain such that the terms that contain spatial coordinates and the terms that contain wavenumbers are separated. The coefficients in one-way operators are determined using an optimization scheme for more accurately matching to the exact phase-shift operator with a wide-angle. The resulting 3-D VTI wave equation prestack migration algorithm can accommodate a wide range of anisotropy rather than the weak anisotropy. For its practical aspects, we also present a frequency-dependent varying-step depth extrapolation scheme for reducing the computational cost of wavefield depth extrapolation and an anti-alias one-way propagator aiming at imaging the steep dipped structures with 3-D sparsely sampling dataset in 3-D VTI media. The proposed 3-D VTI wave equation prestack migration scheme is demonstrated by SEG 2-D Hess VTI dataset and a 3-D migration impulse response with its layout resulting from the 3-D field data.

Keywords: Wave equation Depth migration 3-D VTI One-way wave equation method

Received 2011-04-28;

Fund:

自然科学基金重点项目(40930422)和国家科技重大专项(2011ZX05008-006)资助.

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链接本文:

<http://www.geophy.cn/CN/10.3969/j.issn.0001-5733.2011.11.020> 或 <http://www.geophy.cn/CN/Y2011/V54/I11/2906>

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