

### 多极子声波测井在低孔低渗气层中的数值研究

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收稿日期 2007-3-10 修回日期 2007-6-20 网络版发布日期 2007-12-20 接受日期 2007-12-20

**摘要** 现有的天然气勘探中的测井技术,在评价低孔低渗气层时遇到诸多难题,本文引入了一种新的气藏评价方法,即利用多极源激发的模式波的幅度来识别气藏,并对此方法进行了数值验证.以Biot多孔介质理论为基础建立了低孔低渗含气储层计算模型,数值计算了多极子声源在充液井孔中激发的频散曲线、衰减曲线以及全波列波形.结果表明,挠曲波和螺旋波的衰减系数与相速度相比,对孔隙中的流体性质更敏感,且随着多极源级数的增加和工作主频的提高,挠曲波和螺旋波的衰减系数的变化程度明显增强;在偶极子和四极子激发的全波列波形中,可清晰的观测到对地层孔隙流体不敏感的地层横波,在这种情况下,可以通过对比波列中地层横波和频散的弯曲波(或螺旋波)幅度来识别气层.

**关键词** [多极声波测井](#),[低孔低渗](#),[气层](#),[衰减](#)

**分类号** [P631](#)

**DOI:**

### Numerical study on acoustic multipole logging in the gas-bearing reservoir with low porosity and permeability

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Received 2007-3-10 Revised 2007-6-20 Online 2007-12-20 Accepted 2007-12-20

**Abstract** The logging responses to complex gas reservoir with low porosity and low permeability are not obvious, so it is difficult to evaluate the gas reservoir with conventional logging data and methods. So a new method that is validated by numerical calculations is introduced in this paper. The reservoir is modeled by isotropic porous medium based on Biot and homogenization theories, and the propagation characteristics of the mode waves excited by the multipole sources (dipole and quadrupole) in a fluid-filled borehole are numerically simulated. The results show that the attenuation of mode waves is more sensitive to the reservoir pore parameters than the phase velocity; and the sensitivity of the attenuation to the gas saturation can be improved with the increase of the multipole series or the excitation frequency. It is much better to apply the attenuation coefficient than the phase velocity in identifying gas reservoir.

**Key words** [acoustic multipole logging](#) [low porous and permeable reservoir](#) [gas zone](#) [attenuation](#)

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