

## 灰岩裸露区检波器三自由度耦合系统理论的研究

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## Theoretical studies of the geophone coupling influence in the limest

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摘要

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### 摘要

中国南方海相碳酸盐岩沉积盆地的分布幅员辽阔, 地下油气等资源极为丰富, 但是由于大面积坚硬灰岩的出露, 给检波器带来了很大困难, 从而降低了地震采集资料的品质, 严重制约了该地区未来的油气勘探. 目前野外检波器耦合试验缺乏较为合理的指导, 带有较大的盲目性. 为此, 本文考虑到检波器与灰岩耦合时增加了耦合介质(石膏、泥饼等)的实际情况, 提出了检波器-灰岩-耦合介质的三自由度耦合系统的理论, 研究了耦合介质、尾锥和阻尼等耦合因素对检波器-灰岩耦合系统传输函数的影响规律. 发现检波器-灰岩耦合系统是具有三个谐振频率的谐振系统, 通过增加耦合介质的弹性模量、减小耦合介质的底面积和高度、选用介质密度较小的小尾锥的高度、增加尾锥的底面积等, 可以提高耦合谐振频率. 通过适当增加耦合系统的阻尼, 可以减小耦合系统的窄频带“滤波”的影响. 最后, 通过振动台实验初步验证了检波器-灰岩三自由度耦合系统理论模型.

关键词: 灰岩裸露区 检波器耦合 三自由度耦合系统 耦合介质 尾锥 阻尼

### Abstract:

There are extremely abundant oil and gas resources in the sedimentary basins of marine carbonate in South China. However, it is very difficult to make a good geophone coupling with the outcrop of hard limestone. And then the qualities of the seismic data are reduced. Now, geophone coupling test is largely blind due to lack of appropriate theoretical guidance. In this paper, in order to understand fully the transmission mechanism of geophone-limestone coupling system, considering that the coupling mediums such as gesso, clay and mud cake are used in field seismic data acquisition, we bring forward the theory of geophone-limestone 3-DOF (3-degree of freedom) coupling system based on vibration dynamic concept. The geophone-limestone coupling responses are computed when the parameters of coupling medium, geophone spikes and damping are considered. And we find that the geophone-limestone coupling system is a resonance system which has three resonance frequencies. The results show that the resonance frequency can be increased through increasing the elastic modulus of the coupling medium, decreasing the area of the underside and the height of the coupling medium, using spikes with lower material density, reducing the height of the spike and increasing the area of the underside. The results also show that the impact of the narrow frequency bands "band pass filtering" can be decreased by increasing the damping of the coupling system properly. Finally, we preliminarily verify the theoretical results of the geophone-limestone 3-DOF coupling system using shake table experiments.

Keywords: [Limestone outcrops areas](#) [Geophone coupling](#) [3-DOF coupling system](#) [Coupling mediums](#) [Geophone spike](#) [Damping](#)

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