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## 基于动电效应的岩芯渗透率实验测量

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Experimental measurement study on rock permeability based on the electrokinetic effect

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摘要

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摘要 根据孔隙介质的动电耦合理论设计了一套岩芯渗透率测量系统. 实验采用交流锁相放大技术, 在低频12~42 Hz范围内完成了砂岩岩样流动电势和电渗实验, 得到了流动电势系数 $K_S$ 和电渗压力系数 $K_E$ , 进而计算出岩样动电渗透率, 对于中、高渗透率岩样, 测量得出的动电渗透率与常规气测渗透率差异较小, 两者具有很好的相关性. 实验表明, 动电测量可作为岩样渗透率测量的一种方法, 同时揭示了利用地层动电测井信号反演地层参数的可能性, 实验结果对于分析天然地震动电效应也有参考意义.

关键词: 动电耦合效应 渗透率 锁相技术 流动电势 电渗压力

Abstract: An experimental test system is devised to measure the rock permeability on the basis of rock electrokinetic effects. By employing the AC lock-in technique, the streaming potential and electroosmosis pressure experiments are conducted at the low frequency range between 12 Hz and 42 Hz. The streaming potential coefficient  $K_S$  and electroosmotic pressure coefficient  $K_E$  are obtained. The rock permeability is then calculated from these coefficients and the measured conductivity of the rock based on the electrokinetic theory. For the middle and high permeability samples, there are little differences between the electrokinetic permeability and gas permeability, and there is a good correlation between them. This experimental study not only shows that rock permeability can be measured with the electrokinetic technique, but also reveals the possibility to inverse the formation parameters from electrokinetic well logging signals. The electrokinetic experiments are also useful for the understanding of earthquake-excited electric field.

Keywords: Electrokinetic effects Permeability Lock-in technique Streaming potential Electroosmotic pressure

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