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用于海底电导率填图的可控源时域电磁法

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摘 要： 对近十年来发展起来的海底电磁法作了综述，重点放在可控源时间域上。类似于航空电磁法可对陆地上的经济带进行电导率填图一样，可控源海底电磁法也可在数十米的范围内对海底进行电导率填图。海底的电导率通常远小于海水的电导率，理论研究表明可控源时域水平电偶极子及水平磁偶极子系统能用来精确地确定海底的电导率。这两种装置对两个半空间的响应会在时间轴上出现两个峰值。早期的第一个峰值在时间轴上的位置可以直接用来确定海底的电导率，代表了电磁波在海底的传播；而晚期的第二个峰值代表电磁波在海水中的传播，亦可用来确定海水的电导率。该文概述了可控源时域海底电磁法理论方面的主要研究成果， 同时也讨论了海底电磁法的仪器设备，特别介绍了多伦多大学物理系研制的时域水平磁偶极子及水平电偶极子海底观测系统。这些设备在浅海及洋中脊附近深海中的试验结果也在文中作了讨论。

关键字： 可控源 时间域 电磁系统 海底电导率填图

CONTROLLED SOURCE TIME-DOMAIN ELECTROMAGNETIC METHODS FOR SEA-FLOOR CONDUCTIVITY MAPPING

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Abstract: A review of recently developed marine electromagnetic methods with special attention focused on the time-domain has been made. The objective of the methods is to map the electrical conductivity of the sea floor over scale of several tens of meters. The methods are to the sea floor what the airborne EM methods are to the economic zone of the continental crust . The electrical conductivity of the sea floor is usually much less than that of the seawater above it. A theoretical study of the transient step-on responses of some common controlled-source, electromagnetic systems to adjoining conductive half-dipole and horizontal, in-line, electric dipole-dipole, are capable of accurately measuring the relatively low conductivity of the sea floor. The step response of those two systems to a double half-space model has two distinct parts. The position in time of the initial transient, due to diffusion of EM field in the sea-floor, is indicative of the conductivity of the sea floor, while at distinctly later times, a second characteristic of the transient is a measure of the seawater conductivity,

implying the propagation of EM wave in the seawater. Major results of theoretical studies on the time-domain marine EM methods are summarized. Marine EM instrumentation, especially the time-domain horizontal magnetic dipole-dipole system and horizontal electric dipole-dipole system which were designed and constructed in the Department of Physics of the University of Toronto, is given with applications to geotechnical studies on the shelf and deep ocean surveys near the mid ocean ridges.

Key words: controlled source time-domain EM systems sea-floor conductivity mapping