Research and Development of Seafloor Shallow-hole Multi-coring Drill

Buyan Wan1,2 Guang Zhang1 Xiaojun Huang2
1. School of Resources & Environment, Wuhan University of Technology
   Wuhan, Hubei, China
2. Ocean Mining Department, Changsha Institute of Mining Research
   Changsha, Hunan, China

ABSTRACT

In order to solve the problems of low efficiency, high cost and bad representativeness of sample in using conventional seafloor rock core drills to carry out deep sea CRC investigations, A new type of “Seafloor Shallow-hole Multi-coring Drill” was developed in China, which is able to obtain up to 3 rock cores on one deployment. This paper describes the basic design, specifications and operation principles of the drill, and introduces in detail some of its important components such as the specially designed multi-coring mechanism, the battery powered hydraulic system and the underwater and surface control system. The results and their analyses of the drill’s multi-coring tests in lab and in Pacific Ocean are also given in the paper.

KEY WORDS: Drill; Core; Seafloor; Multi-coring; drilling rig; Cobalt-rich–crust;

INTRODUCTION

Cobalt-Rich Crust (CRC) is an important kind of mineral deposits existing on deep sea floor. In order to carry out CRC investigations, China has developed a series of “seafloor shallow-hole rock core drills” since 2000. These drills can work on sea floor at up to 4000M water depth, obtaining a 0.7—1.5M long rock core per deployment. The major disadvantages of these drills are their low efficiency and high cost, for several deployments have to be performed at a single investigation point in order to get enough number of rock cores. A possible solution is to develop a new type of seafloor multi-coring drill which can obtain several rock cores on one deployment. Therefore in 2003, Changsha Institute of Mining Research (CIMR) began to research on this new type of drill, and succeeded in 2005. The newly developed “Seafloor Shallow-hole Multi-coring drill” is something similar to that of a wireline coring drilling tools, which can be inserted into and pulled out of the drilling tools without any screwing and unscrewing operations.

Basic design of the drill

The configuration of the drill is shown in Fig.1. It consists of 5 major parts: the frame, the drilling mechanism, the inner core tube changing and storing mechanism, the power and hydraulic subsystem, the monitoring and control subsystem.

The drill can be launched from an investigation vessel to the seafloor via an armored co-axial umbilical cable. Since high speed digital communication is possible via the armored co-axial umbilical cable, the drill can be remotely monitored and controlled in real time, but the armored co-axial umbilical cable used doesn’t have enough electricity transmission capacity, so the drill has to be powered by rechargeable batteries.

The most difficult and innovative part of the drill is its multi-coring mechanism. Generally speaking, to realize multi-coring, the drilling tools should be removable and changeable, and usually a very complicated mechanism is needed. In this drill’s design, in order to simplify the multi-coring mechanism, only the inner core tube in the drilling tools is made removable and changeable instead of the whole set of drilling tools being made removable and changeable. And in order to accomplish this, the inner core tube assembly is designed something similar to that of a wireline coring drilling tools, which can be inserted into and pulled out of the drilling tools without any screwing.