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## Coring Dynamics: Data Acquisition While Coring

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### Abstract

The Integrated Ocean Drilling Program (IODP) has developed an 8-1/4" instrumented drill collar with a 4-1/8" I.D. for routine use in the program's global coring program. An inductive data link to an instrumented core barrel has been added to acquire coring data in both core barrel and drill collar simultaneously while coring. The project consists of two independently engineered systems that interface downhole to exchange data and provide near real-time measurements made at the bit. The first component is the instrumented drill collar that measures weight-on-bit (WOB), torque-on-bit (TOB), annulus pressure, bore pressure, and annulus temperature at 1 Hz. The second component is the retrievable memory module which includes pressure and acceleration measurements and the data link system required to retrieve and store the data from the instrumented drill collar. The memory module can be fastened to the top of all standard IODP core barrels and will record the drilling dynamic data, while coring, via the inductive data link. The memory module and core barrel are returned to the rig floor using conventional wireline coring techniques which do not consume any additional rig time. Field testing has demonstrated that the concept is viable and that data can be reliably transmitted through the data link while coring.

### Introduction

The Integrated Ocean Drilling Program has made a concerted effort over the last 10 years to collect more information from the BHA to quantify the dynamics at the drill bit while coring and drilling. This endeavor is critical to the retrieval of high quality core and to ensuring the highest recovery of core in a wide range of water depths and lithologies. Continuous coring in IODP holes is performed by recovering the core barrel at regular intervals, typically every

9.5 m. The procedure is the same for advanced piston coring (APC) in soft sediments, and for the rotary coring bit (RCB) in harder formations. An empty core barrel is deployed to the bottom hole assembly (BHA), latched into the BHA, then advanced 9.5 m during coring. The core barrel is then retrieved by a wireline retrieval system which latches to the top of the core barrel. After reaching the rig floor, the core is removed for analysis and an empty core barrel is dropped in the drill string to continue the coring process.

IODP coring, drilling and logging operations occur without the use of riser and typically use sea water for circulation. Without a riser, measuring true depth between the kelly bushing and sea floor is complicated as there is no fixed reference to the sea floor. Accelerometers have historically been used to measure the ship motion, and through a double integration of the acceleration data, position could be estimated. The position data is critical in understanding ship's position relative to the bottom of the hole for maximum core recovery and core quality. The ODP and IODP have long utilized drill string heave compensation to counter the effects of ship heave on the cutting of core and the deploying of seafloor instruments. Improving coring results in the extremely difficult environments explored by the riserless drilling vessel of the IODP requires determining the effectiveness of the drill string heave compensator and also quantifying the dynamic conditions downhole using drilling dynamics data parameters such as drill pipe acceleration (Fig. 1) and hydrostatic pressure. The *JOIDES Resolution* routinely encounters waves on the sea surface that generate both vertical heave and torsional motions of the ship. Downhole observations of this motion in deep and shallow waters have been well documented (Goldberg, et al 2000). The effect of variations in weight-on-bit and drill string accelerations on the coring process has long been of concern to DSDP and ODP scientists (e.g. Kidd, 1979; Francis, 1981). Only within the last several years, however, has technology been developed that allows for the dynamic parameters of a drill string to be recorded both at the rig floor and at the drill bit while coring. The intent of this paper is to provide insight into how IODP has initially used simple devices and later developed more complicated devices to measure the forces acting on the BHA and borehole which affect the recovery of vital scientific data from the depths of the world's oceans.