ROV Manipulator-Based Drilling for Deep Submergence Science

DESSC Presentation Dec. 2015

MOTIVATION:

US scientists currently have very limited access to benthic seafloor drill systems and the capability for sample recovery and creating borehole environments for experiments

There is a need for a small, multi-vehicle compatible sampling system that can collect oriented cores for a wide range of biogeochemical, petrological and geophysical studies in diverse seafloor terrains and rock types.

EXISTING TECHNOLOGIES:

Most current (2015) 'portable' drill systems are large, stand-alone drilling "ROVs" capable of drilling in water depths of ~200-3000 m, and most are designed for drilling in sediment although a few have proven capability for hard rock penetration.

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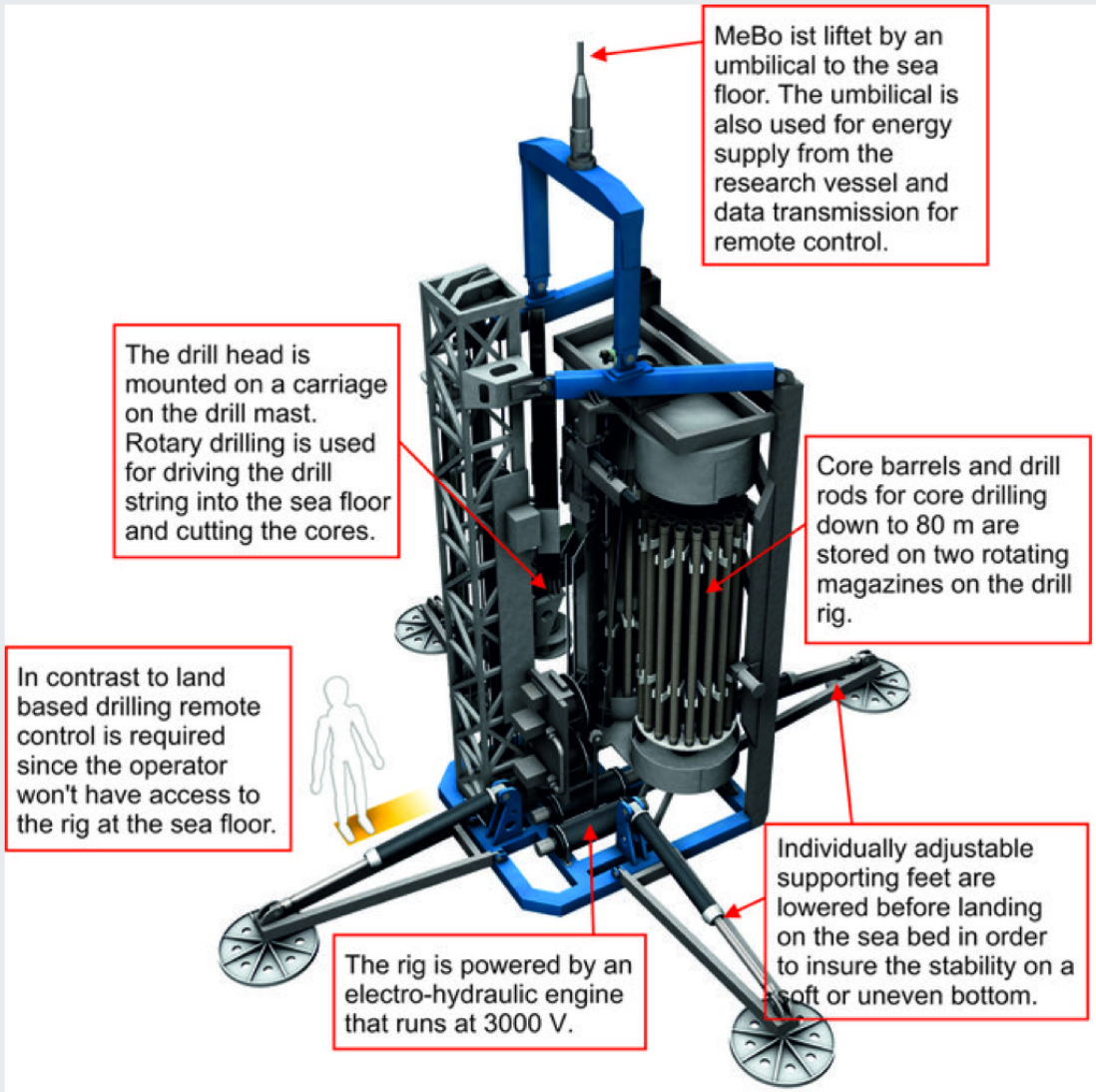
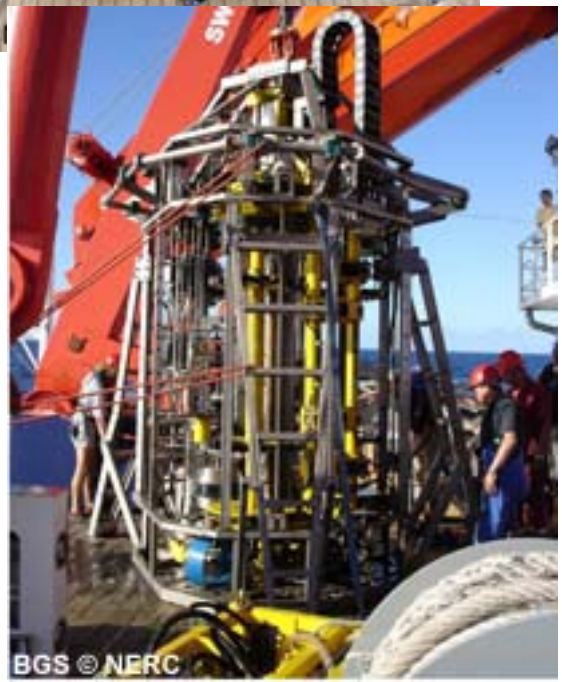
MARUM-MeBo70 drill rig



BGS Drills



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EXISTING LARGE, PORTABLE DRILLING SYSTEMS:

MARUM drill capable of operations to 2000 m water depth (80 m penetration into the seafloor)
https://www.marum.de/en/MARUM-MeBo70_drill_rig.html

BGS (British Geological Survey) rock drill
http://www.bgs.ac.uk/scienceFacilities/marine_operations/15m_rockdrill.html

Gregg Marine
http://www.greggmarine.com/marineequipment/seadrillequipment/aboutseadrill.html

Williamson & Assoc – WA drill
http://www.wassoc.com/ocean-engineering/drills

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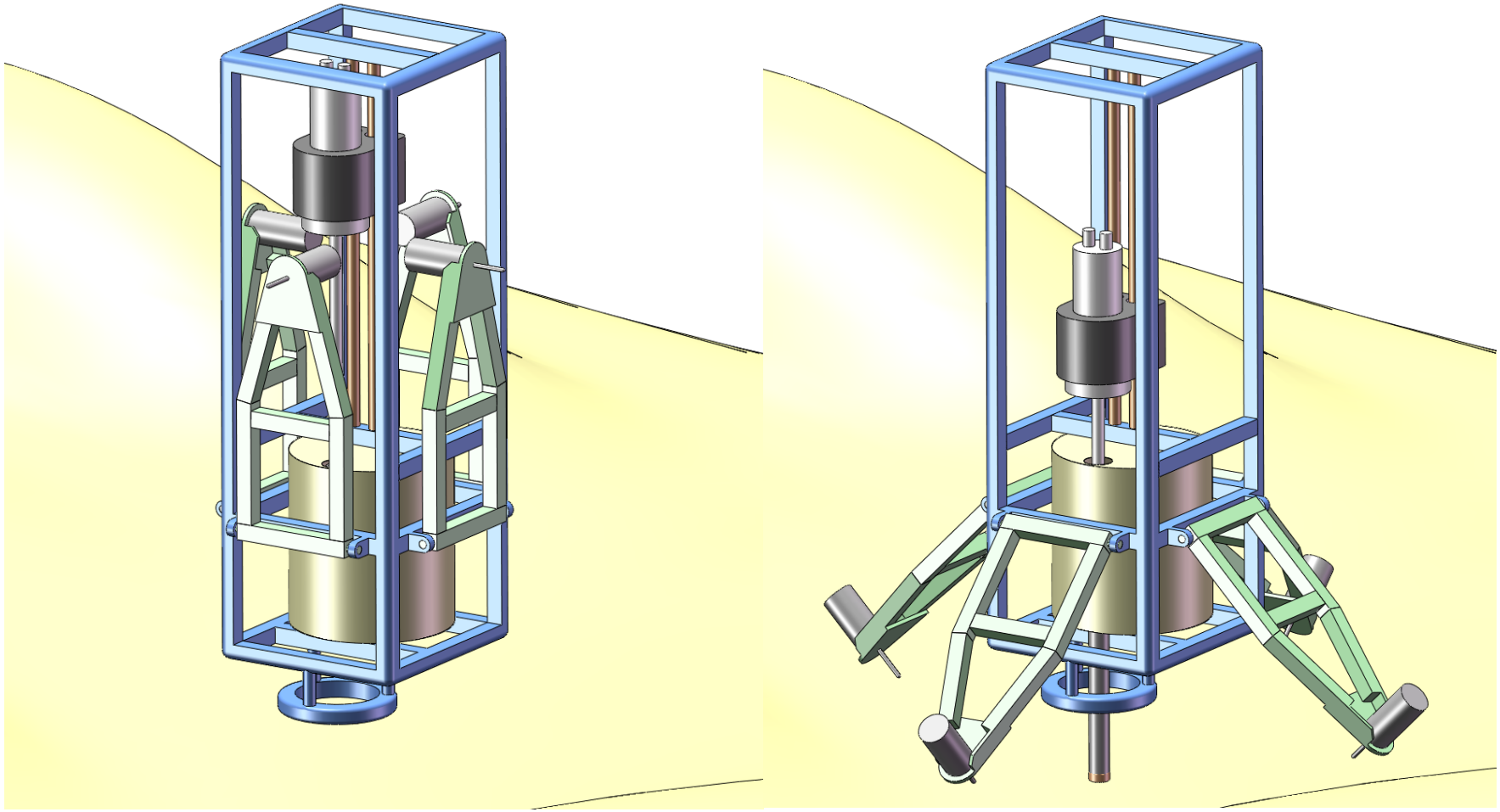

From D. Levitt proposal to NOAA OER (2012)
Design concept for a robotic core drilling system for use with human occupied and robotic submersibles.

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The drill system is designed to be handled by a manipulator, like the Titan 4, but with an anchoring system, which greatly reduces the reaction forces. The Cadtrak anchoring system makes use of 4 hydraulic deployable arms each with a small anchor drill at its tip.

The anchor drills consist of diamond-tipped ball-end drill bits for robust entry and exit from a drill hole. The arms are hinged at the end of a drilling frame and swing down to engage the rock. The anchor drills penetrate the rock by a small amount and when the arms are locked in place a stable drilling platform is created. The forces of engagement produced by the anchor drills are directed in opposition to each other, further minimizing the reaction forces on the manipulator.

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REQUEST FOR INTEREST IN DEVELOPING A CONCEPT 'WHITE PAPER' AND PROPOSAL TO DEVELOP A MANIPULATOR-BASED SMALL DRILL SYSTEM

Progress to Date:

NDSF – Alvin & Jason group leaders have provided hydraulic, electrical and data specs for each vehicle to help with conceptual design of a manipulator-based drill system

Fornari has contacted:

Honeybee Robotics (Kris Zacny, VP for Engineering)
Schilling Robotics (Tyler Schilling, President)
David Levitt (CTO, Spiral Water)

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To date several investigators have expressed interest:

Karla Hubbard – Oberlin College
Samantha Joye – U. Georgia
Ken Rubin – U. Hawaii
Masako Tominaga- UT-Galveston
Adam Soule – WHOI
Dan Fornari - WHOI

Next Steps…