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Borehole logging and temperature measurements with the MARUM-MeBo sea bed drilling technology: Recent developments and scientific applications

Tim Freudenthal¹, Michael Riedel², and Heinrich Villinger³

¹University of Bremen, Marum Center for Marine Environmental Sciences, Bremen, Germany (freuden@marum.de)

²GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany (mriedel@geomar.de)

³University of Bremen, Department of Geosciences, Bremen, Germany (vill@uni-bremen.de)

The MARUM-MeBo sea bed drilling technology is developed since 2004 at the MARUM Center for Marine Environmental Sciences at the University of Bremen (Freudenthal and Wefer, 2013). Presently two drill rigs are in operation for drilling and coring down to more than 70 m (MARUM-MeBo70) and 200 m (MARUM-MeBo200), respectively. The robotic drill rig with the required drill tools is deployed on the seabed, where the drill string for conducting coring is assembled during the drilling operation. In addition to wireline core barrels a temperature probe can be used for measuring formation bottom hole temperature at discrete drilling depths by pushing the probe about 15 cm into the base of the bore hole. The temperature is logged for about 10 – 15 minutes in order to allow for dissipation of the frictional heat generated during pushing and equilibration to formation temperature. When the temperature measurement is completed, the probe is recovered out of the drill string and the drilling operation can be continued.

The trip out of the drill string after reaching the target drill depth can be used for logging of the geophysical properties within the borehole and the adjacent formation. A memory logging tool is lowered into the drill string with the sensor part penetrating through the drill bit. When the drill string is tripped out the probe is raised together with the drill string inside the borehole and conducts the geophysical measurements. This method called “logging while tripping” is especially suitable for unconsolidated sediments and logging in unstable borehole conditions, since the drill string stabilizes the borehole above the sensor part during the logging operation. For the MeBo drill rigs we have spectrum gamma ray, magnetic susceptibility, dual induction and acoustic probes available. The latter is also equipped with a temperature sensor for measuring borehole temperature.

In this presentation we show examples from MeBo drilling campaigns where core drilling, borehole logging and formation temperature measurements were combined. A focus of this presentation is the analysis of borehole temperature measurements during trip out. We investigate how geothermal flux and lithological changes (i.e. thermal conductivity) influence the bore hole temperature measurement by modeling the temperature evolution within the borehole during drilling and trip out.

References:

Freudenthal, T and Wefer, G (2013) Geoscientific Instrumentation, Methods and Data Systems, 2(2). 329-337. doi:10.5194/gi-2-329-2013