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Spectrum Gamma Ray bore hole logging while tripping with the sea floor drill rig MARUM-MeBo

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The robotic Sea Floor Drill Rig MARUM-MeBo developed at the MARUM Center for Marine Environmental Sciences at the University of Bremen was used to retrieve long sediment cores at two sites in the northern South China Sea. Both sites are located in about 1000 m water depth in southeasterly and southwesterly direction of the Pearl River mouth, respectively. South East Asian Monsoon variability controls terrigenous material transport by rivers into the South China Sea. The Pearl River is one of the largest rivers of the region that discharges into the northern South China Sea. The terrigenous fraction of marine sediments of the northern South China Sea therefore provides an excellent archive for reconstructing past variability of the South East Asian Monsoon system.
In analogy to the drilling strategy within the Integrated Ocean Drilling Program IODP multiple holes were drilled in order to generate continuous spliced records at both sites. Overall the MARUM-MeBo drilled 374 m during 5 deployments with a maximum drilling depth of 80.85 m and an average core recovery of 94 %.
Here we present first results of bore hole logging conducted during 4 of the 5 deployments with a spectrum gamma ray (SGR) probe adapted for the use with MARUM-MeBo. This probe is an autonomous slim hole probe that is used in the logging while tripping mode. This method is especially favorable for remote controlled drilling and logging operation. The probe is equipped with its own energy source and data storage. The probe is lowered into the drill string after the target wire-line coring depth is reached and after the last inner core barrel has been retrieved. When the probe has landed on the shoulder ring at the bottom of the hole, the drill string is pulled out and disassembled. The probe, while being raised with the drill string, continuously measures the geophysical properties of the in situ sediments and rocks. Since the bore hole is stabilized during the tripping process by the drill string in the vicinity of the logging probe, logging while tripping can also be used for unstable bore hole conditions e.g. in unconsolidated sediments.
At both drill sites two profiles were measured during separate deployments of the MeBo. A close correlation of the profiles was observed at both sites. Natural gamma ray intensity varies between 38 and 91 API. The variations in natural gamma ray intensity are mainly attributed to changes in concentrations of potassium (0,5 – 1,6 %) and thorium (3,6 - 13,2 ppm), while the concentrations of uranium are fairly low (1,2 - 3,2 ppm). Clays are the main host minerals for thorium in marine sediments. Potassium may be incorporated both into clay and feldspar minerals. The variability in the natural gamma ray intensity can therefore be interpreted as an indicator of changes in terrestrial sediment input into the South China Sea.
The observation of severe variability of the K/Th ratio and its correlation with sedimentary calcium content measured by XRF-scanning points to the fact that not only changes in the amount but also changes in the composition of the terrigenous fraction is elucidated by the SGR bore hole logging and will help reconstructing past changes in the South East Asian monsoon system.