Geophysical Research Abstracts
Vol. 15, EGU2013-2480, 2013
EGU General Assembly 2013


# Stable isotope evidence for carbon transformations in the water column and the sediments of the tropical Beibu Gulf, South China Sea

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The depositional environment of the Beibu Gulf is highly complex, and sediments are formed under dynamic changes in hydrodynamics and sediment sources. It is an ideal natural laboratory to study biogeochemical transformation processes and its responses to changes in hydrography and depositional conditions in a tropical shelf environment. In the present study, several water column profiles and a number of short (MUC) and long (GC) sediment cores were taken during a joint German-Chinese expedition with R/V Sonne (Cruise 219; December 2011) in the Beibu Gulf. The sampling stations may be separated into three different depositional zones, namely Northern Coastal Beibu Gulf with sandy sediment, Delta Deposits in Vicinity to Qiongzhou Strait affected by strong currents, and Central Beibu Gulf with stable depositional environments. We measured the geochemical composition and carbon isotope composition of DIC in the water column and pore waters. In the sediments, the TOC, TIC, TN and TS contents, the C isotope composition of organic matter (OM), and the C and O isotope composition of carbonates were analyzed to follow the fate of organic matter during pelagic and benthic transformations. Pelagic OM transformations are already demonstrated by stable isotopes in the water column. The carbon isotopic composition of pore water DIC give further evidence for the mineralization of mainly marine OM with minor or no contributions from methane at most sites. The coupled pore water profiles indicate that sulfate reduction is the most important source for the DIC added to the pore waters. No correlation was observed between TOC contents and net sulfate reduction rates for the investigated sites. Lithostratigraphic marker and 14C age in different depositional zones indicated sedimentation rate plays an important role in determining the preservation and pathway of organic decomposition. In the central Beibu Gulf, where higher sedimentation rates dominate, pore water profiles exhibit the characteristic pattern for anaerobic methane oxidation (AOM). In the sulfate depletion zone, the isotopic composition of DIC is accordingly more negative than the corresponding organic matter. Pore water profiles at the western-most sites indicate a freshening with depth, which may be due to an impact by paleo-freshwaters or SGD. The transformations in the sediments lead to conditions that allow for carbonate mineral diagenesis. C and O isotope allow further for the identification of diagenetic carbonate transformations. Carbonates seem to be dominated by calcite but minor dolomite is found, too.
Acknowlegements: The study was supported by BMBF (BEIBU project), GMGS, and Leibniz IOW. We further acknowledge the cruise leaders D. Schulz-Bull and J. Waniek, and the captain and crew for support.