

Simulation of the inactive methane seepage and multilayers of carbonate in Haiyang 4 Area in the Northern South China Sea

Methane seepage records the message of local carbon cycle and directly points to the deep hydrocarbon reservoir. The study of the seepage is significant to the exploration of hydrocarbon reservoir. The data from 5 sites, 7 gravity cores of cruise SO 177 in the Haiyang 4 Area, the Northern slope of the South China Sea conducted in 2004 has been investigated. The carbonates and distribution of solutes in interstitial water demonstrate the weak activity of seepage at all investigated sites. A numerical model was developed to simulate the distribution of solutes and the formation of authigenic carbonates. The model concentrations matched the field data. Local carbon cycling is dominated by anaerobic oxidation of biogenic methane to dissolved bicarbonate to solid calcium carbonate. The kinetic reaction rates and fluxes were also obtained. The low content of organic carbon (<1 wt%) in the surface sediments indicates that the biogenic methane originates from deeper strata from where it rises as gas bubbles to the surface. Our simulation results show that current methane fluxes account for <2 wt% of authigenic carbonate being precipitated in 600-800 cm sediment depth, which is below the observed increase in the cores. Hence, methane fluxes must have been higher in the geological past, e.g. during sea level low stands in glacial times. This is corroborated by several layers of carbonate shell debris possibly hinting at higher abundance of seep fauna during episodes of stronger methane seepage, whereas today seepage is more quiescent in the Haiyang 4 Area.