KRAUSE-MIRUS, ANDREAS (1991):

Initial establishment an development of a coastal hypersaline ecosystem in association with a microbial mat community: Microbial composition, water chemistry and sedimentation

An artificial open-air hypersaline pond populated by a juvenile benthic microbial mat was monitored over a three year's period. It could be shown, that both water chmistry and sedimentation patterns in the aqueous habitat were primarily controlled by the local microbial community.

Notably the balance of primary productivity and subsequent degradation show to take influence on accumulation rates of organic carbon and carbonates. The first three months following the onset of the experimental pond in june 1987 were characterized by a rapid proliferation of a juvenile microbial ecosystem made up mainly by pennaic diatoms and sulfate reducing bacteria, establishing primary production and corresponding dissimilatory breakdown of organic matter by sulfate reducers. The composition of the microbial community in the mat later shifted from the preponderance of diatoms to unicellular and filamentous cyanobacteria that came to successively dominate the mat with increasing maturity. The ensuing time span witnessed a revival of minerilization activity with a slightly increasing trend of sulfate reduction and primary production rates prevailing until the end of the monitoring period (May 1990). This stage of stable mat development was shown to be accompanied by a marked shift in $\delta^{13}C_{org}$ from signatures normal for marine environments toward isotopically heavy values typical for carbon-limited hypersaline (sabkha-type) environments, indicating increasing limitation in dissolved inorganic carbon available for photoassimilation combined with inefficient discrimination against ^{13}C during photoassimilation due to photoinhibition.

In all hypersaline environments studied for comparison with the main experimental pond, significant biogeochemical fluctuations were primarily observed during diurnal cycles. Extensive primary production during daytime in the form of cyanobacterial oxygenic photosynthesis results in a drastic and permanent deficiency in accessible inorganic carbon, which consequently restricts growth of the microbial mat. Moreover, elevated pH and subsequent carbonate precipitation intensify the drain on this limitation factor. The flux of atmospheric CO_2 into the system lowers the deficiency only inadequately during the night. Stable carbon isotope fractionation of this invading gas was shown to be close to 0 ‰, generally leading to lowest $\delta^{13}C_t$ (dissolved inorganic carbon) values along with highest influx rates into the water column during day. In the restricted volume of the sediment porewaters, $\delta^{13}C_t$ follows the inverse trend, revealing positive values especially during day, when the favored uptake of ^{12}C by autotrophic fixation is significant.