**BIOFILM-CATENAE IN SANDY TIDAL FLATS AND THEIR INFLUENCE ON PHYSICAL SEDIMENT DYNAMICS.** N. Noffke, Old Dominion University, Ocean, Earth & Atmospheric Sciences, Norfolk, Virginia, USA, nnoffke@odu.edu

Microbial influences on marine sediments are generally understood as biogeochemical processes generating stromatolites. However, interaction of microbial mats with physical sediment dynamics plays also an important role [1]. In sandy settings, this biotic-physical interaction gives rise to highly characteristic 'microbially induced sedimentary structures - MISS'. The structures do not resemble at all stromatolites, but come in 17 main groups. They occur in siliciclastic tidal flats, sabkha and dune deposits since 3.2 billion years ([2]; [3] ; [4]. MISS have opened a new window for the exploration of early life on Earth. They may also serve as biosignatures for the search for life on Mars, especially in sandy aquatic deposits.

Modern microbial mats are constructed predominantly by cyanobacteria. The prokaryotes are excellently adapted to their environment. This presentation discusses, how benthic cyanobacteria respond to the long-term pattern of physical sedimentary processes.

Along transects from the low to the high water lines of the tidal flats, different types of microbial mats establish [5]; [4]. In the lower intertidal zone, biofilms overgrow the sands. Main biofilm-formers are coccoid cyanobacterial groups. In the upper intertidal zone, thin, endobenthic microbial mats develop. The mats are composed by the highly mobile filamentous species *Oscillatoria limosa*. In the lower supratidal zone, thick, epibenthic microbial mats can be found. These mats are formed by *Microcoleaus chthonoplastes*, a filamentous cyanobacterium well adapted to long periods of subaerial exposure. Such lateral successions are termed 'biofilm-catenae' [5].

Quantitative measurements documented that biofilms do not affect sedimentary processes. Biofilm-coated sand grains are swirled around by constant turbulence. The photoautotrophic cyanobacteria escape the lethal burial, because the microbial-mineral aggregates stay longer in suspension than non-colonized grains. They do not induce MISS. Endobenthic microbial mats stabilize sandy substrates 3 – 5 times compared to sterile sand. If buried, this cyanobacterium escapes quickly, and reestablishes a mat layer within a few hours. Epibenthic microbial mats stabilize sand up to 12 magnitudes.

The response by benthic cyanobacteria to the hydraulic conditions was quantified in field experiments using a portable MANZENRIEDER flume chamber [6].

This experiment produces a water current that crosses the microbial mat surface. A digital system analyses the first release of sand grains from the mat surface, the start of erosion of the microbial mat. The effect of the microbial mat on biostabilization of the sandy deposits was illustrated in a Shield's diagram. Endobenthic microbial mats colonize the uppermost millimeter of the sandy tidal surface and reduce the erosive forces of the currents significantly. The mat-covered sand withstands currents of up to 0.90 cm/s. The biostabilization effect is caused by the lower degree of roughness of the mat-interwoven depositional surface. Epibenthic microbial mats cover the tidal sands like a carpet. Their smooth surfaces reduce the erosive forces up to magnitudes of 12. As a consequence, such thick mats withstand currents of up to 1.60 m/s. This biostabilization effect prevents the direct influence of turbulent waters on the sand grains. This microbial effect can be expressed by a simple modification of the Shield's relation for sediment movement:

$$Q = r u^*2 / (rs - rf)\ g\ \underline{Dn},$$

where $u^*$ is the shear velocity; r$f$ is the density of fluid; r$s$ is the density of sediment; $g$ is the gravity constant; $D$ is the actual grain diameter under the influence of biostabilization; and $n$ is the exponent to which $D$ is raised for the data to comply to the Shield's relationship. The results suggest to modify the quantification of physical sediment dynamics for the study of natural environments. With respect to Earth history, the quantification of those sedimentary processes allows to rise the hypothesis, that cyanobacteria have been at least 2.9 Ga around [7].

**References:**

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