Biofilms as the “ecosystem engineers”: the microbiological mediation of intertidal sediment behavior

Xindi Chen

*Department of Hydraulic Engineering, Tsinghua University*

*Beijing, China*

The term “ecosystem engineering” emerged in the 1990s, which commonly refers to the activities of larger organisms like mangroves. However, while people think that bigger organisms generate bigger potential engineering effects, there may be microscale organisms who can result in significant impacts on the ecosystems through their number rather than their size. Currently, cohesive extracellular polymeric substances (EPS) generated by microorganisms have been widely reported to increase the threshold for sediment erosion by flowing water, which is known as “biostabilization”. However, most observations of this phenomenon have been taken under steady flow conditions. In contrast, we present how EPS affect the bed movement under wave action, showing a destabilization of the system. We demonstrate a complex behavior of the biosedimentary deposits, which encompasses liquefaction, mass motion, varying bed formations and erosion, depending on the amount of EPS present. Small quantities of EPS induce higher mobility of the sediments, liquefying an otherwise stable bed. Bed with larger quantities of EPS undergoes a synchronized mechanical oscillation. Our analysis clarifies how neglecting even low content of EPS can result in inaccurate prediction of the bed stability and coastal safety under wave action. The risk of bed liquefaction is expected to pose potential threats to wetlands where microbial communities occupy habitats while the production of EPS is much higher. The misinterpretation of the vulnerability of wetlands when exposed to waves could put the existing ecosystems at risk, considering that these ecosystem services are valued at about US$10,000 per hectare.