Marine Diatoms

Diatoms are unicellular microalgae responsible for about 20% of the world’s net primary production. They are also known for the species-specific design and ornamentation of their silica-based cell walls.

As a model organism we have selected Cylindrotheca closterium, isolated from the Northern Adriatic seawater. The unique characteristics of Cylindrotheca spp. cell wall are regions which are believed to be completely unsilicified. This makes them ideal candidates for studying structure and organization of organic and inorganic domains of cell wall. C. closterium is also considered as a main producer of long chain polysaccharide molecules in the northern Adriatic Sea and is associated with the formation of an enigmatic gel phase. Extracellular polysaccharide production by marine diatoms is a significant route by which photosynthetically produced organic carbon enters the trophic web and may influence the physical environment in the sea.

Quantitative Nanomechanical Maps at high resolution obtained by Peak Force Tapping AFM in seawater

Extracellular polymers (EPS) imaged using AFM contact mode in air

AFM imaging revealed the process of marine gel formation at the nanoscale, starting from the extracellular production of polysaccharide chains by this diatom, to gradual to multiplet entanglement of polysaccharide molecules into gel networks.

The C. closterium EPS represents a web of polysaccharide fibrils with two types of cross-linking: fibrils association forming junction zones and fibril–globule interconnections with globules connecting two or more fibrils. The globules are positively charged proteins whose function is intracellular packing of negatively charged polysaccharide fibrils.

CONCLUSION

This study highlights the capacity of atomic force microscopy (AFM) for quantitative nanomechanical mapping of diatom cell wall using a novel Peak Force Tapping AFM mode [1] and investigating diatom extracellular polysaccharides with a subnanometer resolution [2, 3].

REFERENCES: