Abstract for the general public

Carbon is a crucial element on our planet and represents the structural base of all the molecules in living organisms. The global carbon cycle counts on two main carbon forms: the so-called organic one associated with living organisms and the so-called inorganic one where the majority of carbon is in free form, which means that it is detached from living organisms and dissolved in the atmosphere and oceans. Organic and inorganic carbon reservoirs are connected by living organisms which, through photosynthesis, enable the conversion of inorganic to organic carbon and, through cellular respiration, enable the conversion of organic to inorganic carbon. Importantly, the two carbon “sinks”, called reservoirs, are connected through these two “flow channels”. While these are the two main contributions to the carbon biogeochemical cycle, it must be also considered a fraction of organic carbon stored as fossil fuels. This fraction should, in theory, remain stored underground and on the ocean's floors, but in reality, it is unnaturally introduced into the system by human activities through combustion processes, further contributing to the conversion of organic carbon into inorganic. As a consequence, the inorganic carbon reservoir increases, mainly in form of carbon dioxide (CO_2), which is released into the atmosphere and is mainly responsible for the greenhouse effect and the resulting global warming and climate change. Interestingly, another phenomenon called biomineralization also contributes to the biogeochemical carbon cycle, and although it appears to be very limited, it is rather an overlooked process of inorganic carbon fixation. This phenomenon is globally important, however, its contribution is currently underestimated and may represent an important hope for contrasting the problem of carbon emissions. Carbon biomineralization is extensively studied in several multicellular organisms and it occurs with different ecological aims (e.g., skeleton formation, environmental protection, etc.). However, there is a group of environmental photosynthetic bacteria that performs this process with aims that still remain elusive. This group of so-called cyanobacteria, through photosynthesis, contributes to the conversion of inorganic carbon to organic but they are also capable of biomineralization by converting inorganic carbon (in the form of CO_2) into crystalline mineral carbon such as Calcite or Aragonite. This process constantly takes place in aquatic environments, either marine or freshwaters, which are the main places where cyanobacteria growth and proliferate. It seems that the cyanobacterial biomineralization is mediated by the essential contribution of regularly organized structures present in the external surface of the cyanobacterial cell, the bacterial Surface layers or S-layers. The present project proposal intends to elucidate the role of the S-layer in biomineralization and understand the ecological reasons, hence the evolutive advantages, behind this biological process. Understanding this process will help to size its contribution globally by also providing important information on possible new CO_2 sequestration strategies against carbon emission and climate change.