Navami Manangi

Calcite Production in Cyanobacteria

In order to manufacture concrete, limestone, along with other ground materials, must be heated at very high temperatures in kilns that are mainly fueled by coal. During the heating, the ground limestone is heated nearly to its fusion temperature, driving off carbon dioxide from the calcite, and only calcium oxide remains, which is later used in actually making the cement. However, the emissions from fossil fuel combustion and production of cement contributed to 3.4% of global carbon dioxide emission in 2000, and the number has only increased since then. Cyanobacteria are photosynthetic organisms can survive in a wide variety of environments and need very few resources to thrive and make calcite, an ingredient necessary in cement production. Cyanobacteria have the ability to concentrate carbon dioxide in proteinaceous compartments called carboxysomes. Carboxysomes are located inside cells and work to concentrate the CO2 and "fix" it to make sugars to use for cell survival. For this study, Synechococcus 7002 was the strain of bacteria that was used, including a mutant strain labeled ΔCCM. Through experimentation, a physiological condition was designed where the Synechococcus 7002 bacteria were able to produce calcites. Additionally, different carbonate precipitates were identified (vaterites and aragonites). It was determined that the CCM mutant could not grow in air because their carboxysome structures are unable to function, leading to cell death. CCM mutants grow astonishingly well in CO2 because the cells are equipped to survive in the presence of CO2 even without carboxysomes.