Bio-mediated Fixation of Carbon Dioxide in Basaltic Rocks.

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Microbial mats and biofilms associated with carbonate minerals occur in basaltic sea caves and on cliffs on the island of Kauai, Hawaii. In the caves, microbial mats grow on the ceilings and walls in the photic zone of several open caves where fresh water seeps out of the rock. Electron microscopy showed that the mats are dominated by cyanobacteria and heterotrophic bacteria. All the microbes showed copious amounts of extracellular polymeric substances, which are often rich in Mg, Si, and Ca, which have been leached from the basalt and concentrated and bound from solution. Minerals tend to form and concentrate within, or around, these dense matrices of extracellular polymers. Microenvironments with geochemical conditions favorable for mineral formation likely exist as a result of the mucilaginous extracellular material and the development of bacterial microcolonies. Photosynthesis and bacterial decay of organic matter can alter the pH within the mats and lead to carbonate precipitation. The mineralized microbialites showed stromatolitic laminations, consisting mainly of calcite, aragonite and kerolite. In addition, thin coatings rich in magnesite, hydromagnesite and monohydrocalcite surround the microbialites on the rock surfaces. These coatings are likely inorganic in origin, possibly formed from CO_2 degassing and evaporation. This combination of inorganic and biological processes can explain the occurrence of the minerals in these caves. Thus, CO_2 is being fixed in subsurface rocks. Similar subsurface biogeochemical processes may prove to be advantageous and exploitable in the geological disposal of CO_2-rich flue gas from power plants.