American Mineralogist, Volume 83, pages 1399–1408, 1998

Formation of Fe-silicates and Fe-oxides on bacterial surfaces in samples collected near hydrothermal vents on the Southern Explorer Ridge in the northeast Pacific Ocean

DANIELLE FORTIN,[1,*] F. GRANT FERRIS,[2] and STEVEN D. SCOTT[2]

[1]Department of Geology, University of Ottawa, Ottawa, Ontario, K1N 6N6, Canada
[2] Department of Geology, E.S.C., University of Toronto, Toronto, Ontario, M5S 3B1, Canada

ABSTRACT

Samples collected in low-temperature (2–50 °C) waters near hydrothermal vents of the Southern Explorer Ridge, in the northeast Pacific Ocean, contained fine (<500 nm) Fe- and Mn-oxide and Fe-silicate particles coating bacterial surfaces. Partially to totally mineralized bacteria, along with bacterial exopolymers, were covered with a mixture of poorly ordered Si-rich Fe-oxides (possibly ferrihydrite), Mn-oxides, and Fe-silicates (possibly nontronite). Minerals occur as very fine (2–20 nm) granular material, fine (20–100 nm) needles and sheets, small (200–500 nm) nodules and filaments (i.e., mineralized exopolymers). Under saturation conditions, we infer that bacterial surfaces provided nucleation sites for poorly ordered oxides and silicates. The formation of Fe- and Mn-oxides was likely initiated by the direct binding of soluble Fe and Mn species to reactive sites (like carboxyl, phosphate, and hydroxyl groups) present within the bacterial cell wall and the exopolymers. Fe-silicate formation involved a more complex binding mechanism, whereas metal ions, such as Fe, possibly bridged reactive sites within the cell walls to silicate anions to initiate silicate nucleation.