It is well established that bacteria are able to catalyze dissolution of silicate minerals. Bacteria may dissolve silicates for two different purposes. They may use certain elements that can undergo redox transitions as substrates for their energetic metabolism or they can leach nutrients, that are otherwise unaccessible in their habitat. The main mechanisms of bacterially mediated silicate leaching are acidic or basic catalysis and surface complexation. The main nutrients extracted are K, Mg, P and Fe. The only element significantly exploited as substrate for dissimilative energetic metabolism is iron. In order to leach iron as a nutrient, even extremely strong complexants (i.e. siderophores) may be employed. However, only moderate complexing agents can serve to obtain iron as terminal electron acceptor. The second possibility is to reduce iron directly in the crystal grid by means of the conductive nanofibres. The oxidative dissolution of silicates by chemoautotrophs is rare, in contrast to that of sulfides. Bacterial dissolution of silicates leaves morphological and geochemical signatures, but it is still problematic to recognize and interpret them. Although it is well-known that bacteria can dissolve most of the rock-forming minerals in diverse environments we are unable to quantify their contribution to the whole process. This fundamental question intimately related to global cycles of elements is one of the main challenges for contemporary geomicrobiology.