Manganese commonly exists in two valence states, which are easily
interchangeable by chemical redox reactions. These are the soluble
Mn(II) ion, and the Mn(IV) ion, which is usually found as one of
several possible insoluble oxides or manganates (designated as
MnO₂). Oxidation is favored in alkaline (high pH) and
oxidizing (high Eh) environments, whereas reduction is favored by
acidic and reducing conditions. Bacteria can catalyze both oxidation
and reduction.

Sulfate-reducing bacteria (SRB) are very potent MnO₂
reducers by virtue of their sulfide production: H₂S reacts
rapidly with MnO₂ to yield Mn(II), elemental sulfur, and water.
In manganese-rich zones, Mn cycles rapidly if sulfate is present to
drive the reduction and the MnO₂ precipitates and sinks into
anaerobic zones. The production of sulfide (by organisms requiring
organic carbon compounds) to reduce manganese oxides might act to
couple the carbon and sulfur cycles in water bodies in which the two
cycles are physically separated. Iron has been proposed for this
provision of reducing power by (Jørgensen, 1983), but since MnS is
soluble and FeS is very insoluble in water, it is equally likely that
manganese rather than iron provides the electrons to the more oxidized
surface layers.

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