



**Figure 9.11.** The progressively slower oxidation rate of  $\text{Mn}^{2+}$  in the presence of spores that catalyze the reaction and become coated with oxidized manganese. The spore surfaces were initially bare of  $\text{MnO}_x$  and become progressively coated with time as concentrations of  $\text{Mn(II)}$  indicated in the figure were added. The symbols represent successive additions of dissolved  $\text{Mn}^{2+}$ . Original oxidation rates are about 10 times greater than the final rates, which approach rates similar to those observed on the surface of colloidal  $\text{MnO}_2$ . The solid Mn precipitate had an oxidation state of between 3 and 3.5. Experiments were performed in DOC-free seawater at 23°C, pH = 7.8 and  $[\text{O}_2] \approx 0.23 \text{ atm}$  (Hastings and Emerson, 1986).