MOLECULAR-SCALE OBSERVATIONS OF THE INTERACTION OF ORGANIC MOLECULES WITH MINERAL SURFACES.

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Organic molecules present in surface waters are known to affect the rates of dissolution and crystal growth of minerals. Molecules which form very stable complexes with cations in solution enhance dissolution rates, and such chelators have been used as industrial solvents for otherwise very poorly-soluble salts. On the other hand, molecules which form strong surface complexes may also act as inhibitors for crystal growth or modifiers of growth morphology. Again this has been exploited industrially. The example described here will be the 'barite scale problem' in off-shore oil wells when injected sea water (SO4-rich) mixes with formation water (often containing Ba and some Ra) and forms a highly insoluble barite scale deposit which reduces the yield of the well. Strategies which involve both dissolution and inhibition of scale will be discussed. The action of organic molecules on mineral surfaces can be observed on a molecular scale by Atomic Force Microscopy and experiments will be described which show the mechanism of dissolution and inhibition under such conditions. Computer simulation methods can be used to design organic molecules with specific surface interactions. The organic molecules used industrially have functional groups very similar to organic species in natural waters. The consequences of growth inhibitors to the supersaturation of natural waters with respect to crystallisation will be discussed.