Surface chemistry of the magnetite-water interface: control over silica adsorption

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The widespread abundance of silica in natural waters and its affinity for other mineral phases makes the study of mineral-silica-water interfaces particularly relevant: adsorbed silica can react with foreign ions, serving as adsorbent; its structure is susceptible to evolve following dissolution-condensation reactions, eventually developing porosity and affecting fluid transport properties, weathering reactions and the fate of contaminants in the environment. The interactions of the dissolved silica with the mineral surface will be controlled by the surface chemistry of the latter, besides other environmental factors [1]. In this work we have characterized silica uncoated and coated magnetite (Fe_3O_4) nanoparticles to determine surface properties and silica binding and polymerization. Magnetite stoichiometry is investigated with Mössbauer and X-ray diffraction; surface charge is characterized by potentiometric acid-base titrations; and atomic force microscope provides information about surface morphology. Furthermore, combining the information gained from adsorption isotherm experiments and vibration spectroscopy, we are able provide insights on Si binding and precipitation mechanisms at iron oxide surfaces.
Our findings help to understand the complex surface behavior of nanoscale iron oxides and the structure-reactivity relationships of Si-coated mineral surfaces.

[1] Kanematsu,M., Waychunas, G., Boily, J.-F. *Environ. Sci. Technol*. 52, (2018) 1827−1833.