

Reductive dissolution of hematite nanoparticles with ascorbic acid

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Iron oxides and oxyhydroxides, hereafter referred to as iron oxides, are commonly found in surface water, soils and sediments. Their dissolution behaviour is important because it influences the bioavailability of nutrients for plant growth and migration of pollutant metals and substances. In natural environments, reductive dissolution is the most important dissolution mechanism [1].

While the reductive dissolution of iron oxides has been an area of intensive study, little attention has been paid to the impact of mineral size upon this process. Nanoscale iron oxides are omnipresent in nature [2], and initial studies have found their size can influence chemical reactivity.

To further investigate the effect of iron oxide particle size upon chemical reactivity, we have studied the reductive dissolution of hematite by ascorbate using two types of nanoparticles with average diameters of 7 nm and 25 nm. Synthesized nanoparticles were characterized with powder-XRD, TEM, and BET surface area measurements. Reductive dissolution experiments were carried out in continuously stirred Nalgene bottles at 25 °C in the absence of light under approximately 1 atm nitrogen gas. Aqueous [Fe (II)] was measured by the ferrozine assay. The evolution of crystal morphology by reductive dissolution was examined by high-resolution TEM (FEI Titan 300). HRTEM revealed that the 7 nm hematite crystals are pseudo-hexagonal plates, and the 25 nm hematite crystals have diamond and rectangular shapes before dissolution. The relationship between dissolution rate determined from bulk solution chemistry and morphological evolution observed by HRTEM will be discussed.

[1] Sulzberger *et al.* (1989) *Marine Chemistry* **28**, 127–144.

[2] Hochella *et al.* (2008) *Science* **319**, 1631–1635.

Southern US Cordillera pre-magmatic zircons: Sounding a Cordilleran source region

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The western Mojave preserves a periodic Mesozoic arc built into a full thickness of continental crust with a protracted Proterozoic history. Plutons there contain abundant pre-magmatic (inherited) zircons from magma source rocks which preserve age and compositional information, measurable by SIMS. We utilize whole rock parameters such as SiO₂, Sr and Nd isotopic ratios, and geochronology as a guide in the exploration of this pre-magmatic zircon geochemical dataset in an attempt to elucidate variations in source age, rock composition, and processes, and how they are mirrored in upper crustal intrusions.

In the Mojave, the Cadiz Valley Batholith (77 – 73 Ma) is underlain by intermediate sized plutons and a compositionally heterogeneous mid-crustal sheeted complex of identical age. This structural framework is exposed in a tilted crustal section. Whole rock compositions indicate the upper crustal batholith and underlying intrusions are similar but larger volume intrusions were derived from relatively deeper, garnet-bearing crustal sources. Such dynamic source region processes may be elucidated through comparison of whole rock isotopic and pre-magmatic zircon chemistry.

Geochronology of pre-magmatic zircons revealed their ages correlate with known Proterozoic magmatic events but lack older framework rock zircons. Crustal melting would be unlikely to ubiquitously discriminate between these rocks, therefore we suggest a source of basaltic under-plates generated during Proterozoic magmatism. To investigate the magmatic compositions of source rocks, REE concentrations were calculated from pre-magmatic zircons using best known partition coefficients. Source rocks had dominantly flat MREE to HREE patterns suggestive of a basaltic composition, while some were HREE depleted, possibly indicating garnet in the original source for the underplated basalts. Whole rock isotopes suggest isotopically distinct crustal components, which contain zircon populations with distinctive REE signatures.