Biochemical Oxygen demand in the Keno reach of the Klamath River, Oregon, USA

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Sites in the 21 miles of the Klamath River from Link River Dam to Keno Dam have been classified as having "very poor" water quality status by the Oregon Water Quality Index [1]. A large load of algae enters the river from Upper Klamath Lake, just upstream, and this reach experiences elevated ammonia, pH, and chlorophyll in summer. Dissolved oxygen concentrations exhibit large variations spatially and temporally, from 200% saturation to anoxia/hypoxia, even at the river surface.

To determine oxygen demand rates for modeling [2], a series of 30-day biochemical oxygen demand (BOD) experiments were conducted with water from five mainstem sites and one major tributary. Samples were collected between late June and early September, 2007, from near the surface and, at some sites, 1 m from the bottom. Most were unfiltered, but a subset were coarse filtered (210 µm pore size) to examine the effect of removing large particulate matter. Water samples were incubated in the dark at 20 °C for at least 30-days, with regular measurement of dissolved oxygen concentration and reaeration if necessary. Samples were treated to inhibit nitrogenous demand, thus allowing measurement of carbonaceous BOD; a subset was not treated, measuring total BOD. Nitrogenous demand was determined by difference.

In the incubations, oxygen demand was typically high in the first several days and decreased over time, though after 30-days, most samples were still consuming oxygen. Data were fit with a modified BOD curve to obtain BOD values and oxygen consumption rates.

To investigate factors contributing to oxygen demand, relationships between BOD and other water quality constituents were examined. These included filtered and unfiltered nitrogen and phosphorus, particulate carbon, dissolved organic carbon, chlorophyll *a*, phaeophytin, and bacteria, phytoplankton, and zooplankton enumeration. These analyses will contribute to model development and consideration of management options.

[1] Mrazik (2007) ORDEQ., DEQ07-LAB-0047-TR, 13 p.
[2] http://or.water.usgs.gov/proj/keno_reach

Green rust is a precursor to magnetite: Direct evidence from an *in situ* diffraction study

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Nanoparticulate magnetite (MT) is a major end product of the dissimilatory reduction of ferric oxyhydr(oxides) in non-sulfidogenic anaerobic environments. MT formation is often driven by the reaction of microbially generated Fe(II) with ferrihydrite (FH) and may proceed via intermediate phases such as lepidocrocite and green rust (GR). Although this process is known to control the mobility and fate of contaminants, the kinetics, mechanisms and pathways for MT formation are poorly constrained. Furthermore, a mechanistic understanding of how Fe(II) induced secondary mineralization affects biogeochemical processes in anoxic environments is also not well known.

In this study, the first direct *in situ* evidence of the occurrence of GR-sulphate as an intermediate phase during Fe(II) induced transformation of FH to MT is reported (Fig.1). The transformation was characterized using time-resolved synchrotron-based Energy Dispersive X-Ray Diffraction (ED-XRD). Reacting a Fe(II) solution with FH at pH 9 and at two Fe^{2+}/Fe^{3+} ratios (0.5, 1) under oxygen-free conditions, showed intermediate GR formation with the maximum intensity reached after 6 minutes (inset Fig. 1). The onset of MT growth coincided with the start of GR consumption, indicating that MT growth occured at the expense of GR. The observation of GR as a transient phase even at an Fe^{2+}/Fe^{3+} ratio of 0.5 (MT stoichiometry) reveals a novel pathway for MT formation.

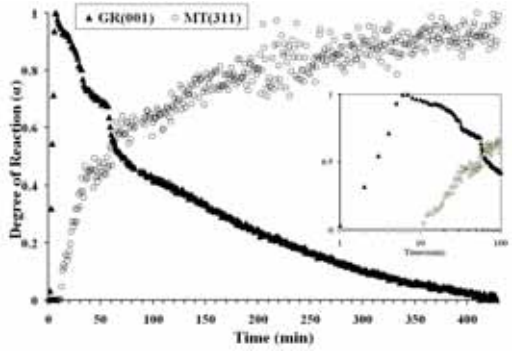

Figure 1: Reaction progress (α) for the GR (001) and MT (311) XRD peaks with inset showing the fast initial GR growth. Reaction conditions:(Fe^{2+}/Fe^{3+} = 1, pH 9).