Supporting Information

Pore-scale characterization of biogeochemical controls on iron and uranium speciation under flow conditions

Pearce, C. I.[1*], Wilkins, M. J.[1], Zhang, C.[1], Heald, S. M.[2], Fredrickson, J. K.[1] and Zachara, J. M.[1]

[1] Pacific Northwest National Laboratory, Richland, WA 99352, USA

[2] Argonne National Laboratory, Argonne, IL 60439, USA

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*Corresponding author: MS K8-96, Phone (509)371-6380

E-mail: carolyn.pearce@pnnl.gov

Micromodel Fabrication.

The micromodel was fabricated in a silicon wafer involving the following steps: first, the micromodel design pattern including a 2 × 1 cm^2 pore network with grain diameters of 300 μm, pore spaces of 180 μm, pore throats of 35 μm, two inlet and an outlet channels (Figure S1) were prepared in AutoCAD and printed to a soda lime photomask. A prime grade silicon wafer 100 mm in diameter, 500 μm in thickness (Virginia Semiconductor Inc., Fredericksburg, VA) spin coated with a thin photoresist (PR) layer was placed under the photomask and exposed to UV light for 20 s. The area of PR exposed to UV was weakened and removed by a developer solution; the unexposed PR remained on the surface protecting the area underneath. Next, the exposed area of silicon wafer was etched to 35 μm depth by inductively coupled plasma-deep reactive ion etching (ICP-DRIE) method. The remaining PR was removed using a PR stripping solution. The inlet and outlet ports were drilled through the wafer using a 1.25 mm diameter diamond plated press drill. The finished wafer was thoroughly cleaned using acetone, isopropanol, a piranha solution (H_2SO_4: 30% H_2O_2 in 3:1 ratio) and deionized (DI) water. To seal the flow channel, an anodic bonding method was used to bond the wafer to a Pyrex glass wafer 100 mm in diameter and 500 μm in thickness (Sensor Prep Service, Elburn, IL). Finally, nanoport connectors (IDEX, Oak Harbor, WA) were attached to all inlet and outlet ports on the back side of silicon using epoxy adhesive through a thermal bonding procedure. The micromodel was cleaned using a basic solution (NH_4OH:H_2O_2:H_2O = 1:1:5) prior to use.

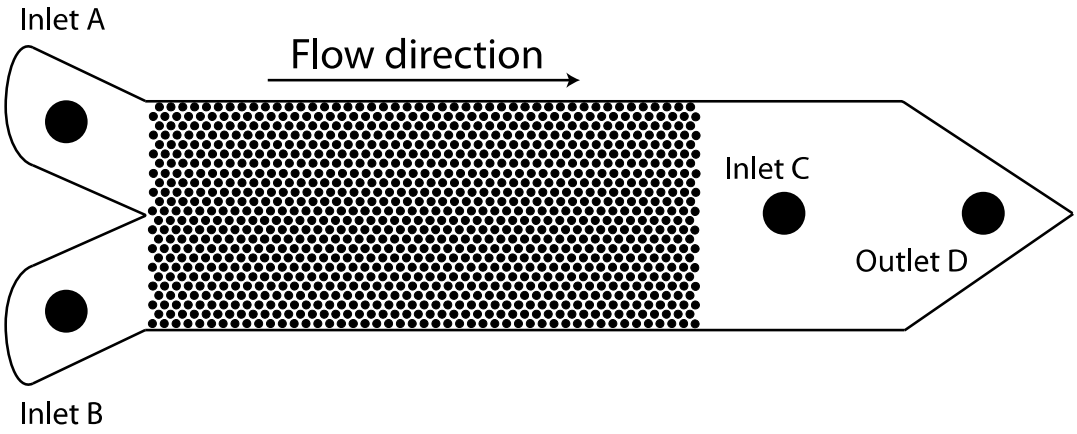

Figure S1. Schematic of the micromodel setup, with two inlet ports (A and B) generating a mixing zone down the center of the homogeneous pore network. Port C was used as an inlet for acid injection during Fe(III) precipitation and port D was the outlet.

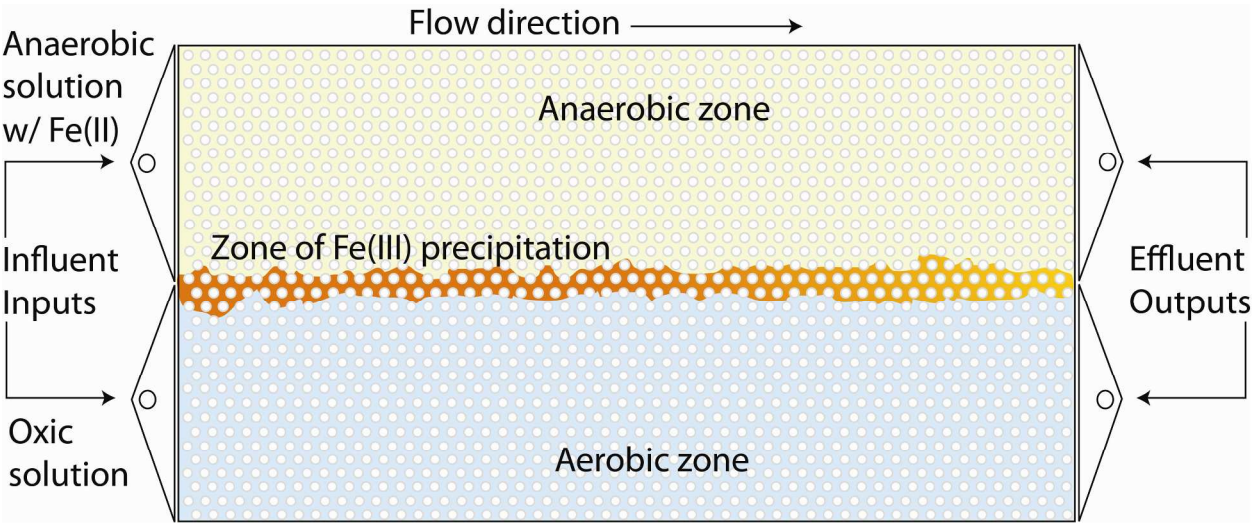

Figure S2. Schematic of Fe(III)-oxide mineral precipitation; Anaerobic synthetic ground water containing $FeCl_2.4H_2O$ (15mM) was added through on inlet and oxic synthetic ground water was added through the other inlet generating a zone of Fe(III) precipitation down the center of the homogeneous pore network. The transverse width of precipitate was limited by the extent of transverse mixing.