

The impact of on mineral surfaces metal-contaminant redox cycles

SCOTT FENDORF^{1*}, AND PETER S. NICO²

¹Stanford University, Stanford, CA, USA, fendorf@stanford.edu
(* presenting author)

²Lawrence Berkeley National Laboratory, Berkeley, CA, USA,
psnico@lbl.gov

Introduction

Redox reactions have a controlling influence on the cycling of numerous elements within surface and subsurface environments. Mineral surfaces are particularly critical conduits for redox reactions that both invoke and catalyze electron transfer processes, and which do so at rates that often rival (or even exceed) biologically mediate reactions. Here we examine the role metal (hydr)oxides play in the oxidation-reduction of elements ranging from arsenic to nitrogen to uranium within surface and near-surface environments.

Results and Conclusions

Of the various oxidizers in soils and sediments, Mn(III/IV) oxides are classically the strongest oxidant present; they serve as facial oxidants of most redox active metals and metalloids. While we generally do not consider solid-solid electron transfer processes, the rapid rates of oxidation imposed by Mn oxides for species such as Cr(III) allow even sparingly soluble solids (e.g., chromite) to undergo oxidation through a solubility minimum. In contrast to Mn, Fe can serve as a potent reductant as Fe(II) or an oxidant as Fe(III). For metals with close redox couples to Fe(III)-Fe(II), such as U(VI)-U(IV), the specific form of the Fe(III) mineral along with reaction conditions determine whether Fe serves as a reductant or oxidant. In other cases, such as with Cr(VI), Fe(II)-bearing solids and surfaces serve as dominant reductants. Collectively, metal (hydr)oxides have a critical impact on the redox state of a wide-range of elements within soils and sediments.

A reevaluation of early Cambrian ocean redox conditions through the iron geochemical studies of the lower Hetang black shales in South China

LIAN-JUN FENG^{1*}, CHAO LI², JING HUANG¹, HUA-JIN CHANG³,
CHAO-FENG LI¹, QI-RUI ZHANG¹, XUE-LEI CHU¹

¹ Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China

feng.lian.jun@gmail.com (* presenting author)

² State Key Laboratory of Biogeology and Environmental Geology, China University of Geosciences, Wuhan 430074, China
chaoli@ucr.edu

³ School of Life and Geography Sciences, Qinghai normal university, Xining 810008, China
changhuajin@163.com

The widespread organic-rich shales during the early Cambrian in South China were always regarded to be deposited in persistent euxinic conditions suggested by the enrichment of redox-sensitive trace elements and narrow distribution of small-size pyrite framboids [e.g. 1].

In this study, iron speciation and ratios, widely applied redox proxies, clearly reveal that the black shales of the lower Hetang Formation were predominantly deposited under anoxic and ferrous iron-rich (ferruginous) water columns with some intermittent intervals of euxinia in contrast the previous interpretation of persistent euxinia. These observations suggest that the anoxic and ferruginous conditions during early Cambrian may have been more prevalent than generally recognized.

[1] Zhou and Jiang. (2009) *Palaeogeography, Palaeoclimatology, Palaeoecology* 271, 279-286.