

Multi-laboratory Comparison of Sequential Metals Extractions

CAROL BABYAK^{1*}, JENNIFER N. GABLE², KWOK-CHOI PATRICK LEE³, WILLIAM J. ROGERS⁴, ROCK J. VITALE⁵, AND NEIL E. CARRIKER⁶

¹Appalachian State University, Boone, North Carolina, United States, babyakcm@appstate.edu (* presenting author)

²Environmental Standards, Inc., Valley Forge, Pennsylvania, United States, jgable@envstd.com

³Tennessee Valley Authority, Muscle Shoals, Alabama, United States, plee@tva.gov

⁴Tennessee Valley Authority, Muscle Shoals, Alabama, United States, wjrogers@tva.gov

⁵Environmental Standards, Inc., Valley Forge, Pennsylvania, United States, rvitale@envstd.com

⁶Tennessee Valley Authority, Chattanooga, Tennessee, United States, necarriker@tva.gov

Abstract

Following the December 2008 rupture of a coal fly ash retaining pond at the Tennessee Valley Authority (TVA) Kingston Fossil Plant near Harriman, Tennessee, a comprehensive monitoring effort was initiated to evaluate impact of the release on the surrounding aquatic environment. The sequential extraction procedure developed by Querol et al [1] was utilized by TVA's contracted laboratory and by Appalachian State University (ASU) researchers to evaluate bioavailability of ash-related trace metals in sediments impacted by the release.

Sediment samples collected in 2009 were split and submitted to ASU and to TVA's contracted laboratory for sequential extraction and subsequent metals analysis. This paper presents a comparison of the laboratories' data using the same method.

In 2011, several of the 2009 sediment sampling locations were revisited; these 2011 sediment samples were subjected to sequential extraction by ASU following the same procedure as used for the 2009 samples. This paper also includes comparisons of the data for the 2009 and 2011 sediment samples collected at similar locations.

In 2011, TVA collected and homogenized surface sediment samples in bulk quantities at several locations for several purposes. Sub-samples were submitted to ASU for sequential extraction; these samples were air-dried prior to extraction and between extraction steps. TVA also submitted these surface sediment samples to TVA's contracted laboratory for sequential extraction; these samples were not dried prior to or during the extraction process. A third part of this paper compares sequential extraction data generated with and without drying prior to and during extraction.

Conclusion

This paper evaluates interlaboratory precision for the Querol et al. sequential extraction method; presents temporal trends in bioavailability for several locations; and evaluates the impact of the sampling, handling, and extraction environments on metals leaching during the sequential extraction process.

References

[1] Querol, X., Juan, R., Lopez-Soler, A., Fernandez-Turiel, J.L., Ruiz, C.R. (1996). *Fuel* **75**, 821-838.

Electron transfer and atom exchange among Fe and Mn phases

JONATHAN E. BACHMAN^{1*}, DREW E. LATTA², MICHELLE M. SCHERER¹, AND KEVIN M. ROSSO³

¹The University of Iowa, Civil and Environmental Engineering (*jonathan-bachman@uiowa.edu)

²Argonne National Laboratory, Biosciences (dlatta@anl.gov)

³Pacific Northwest National Laboratory, Chemical and Material Sciences (Kevin.Rosso@pnl.gov)

Fe and Mn are both common redox-active metals in environmental systems, and Fe-Mn redox chemistry is an important consideration when predicting fate and transport of contaminants. Recent work has shown that electron transfer and atom exchange occurs between aqueous Fe(II) and Fe(III) oxides and results in extensive recrystallization both with and without secondary mineral formation [1]. It is unclear, however, whether similar redox processes occur among Fe and Mn phases that might result in incorporation and release of Fe in Mn oxides, or conversely, incorporation and release of Mn in Fe oxides. Furthermore, it appears unknown whether the reaction of aqueous Mn(II) with Mn oxides leads to similar atom exchange and recrystallization as has been observed for the reaction of aqueous Fe(II) with Fe(III) oxides [2].

We are exploring the mechanisms driving the redox reactions of Mn(II)/Fe-oxides, Fe(II)/Mn-oxides, and Mn(II)/Mn-oxides using ⁵⁷Fe Mossbauer spectroscopy and isotope tracer approaches. We have found that Mn-incorporated in goethite is released in the presence of aqueous Fe(II), similar to what has recently been demonstrated for Ni in goethite [3]. These experiments will provide a more fundamental understanding of the reactivity at mineral-water interfaces, in addition to providing a model for trace metal incorporation and release in Mn and Fe oxides.

[1] Gorski and Scherer (2011) *Aquatic Redox Chemistry*, **1071**, 315-343. [2] Handler *et al.* (2009) *Environmental Science & Technology* **43**, 1102-1107. [3] Friedrich *et al.* (2011) *Geology* **39**, 1083-1086