Pergamon

Geochimica et Cosmochimica Acta, Vol. 64, No. 4, p. 763, 2000

0016-7037/00 $20.00 + .00

PII S0016-7037(99)00417-2

Citation for presentation of the 1999 F. W. Clarke Award to André M. Scheidegger

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I am indeed pleased and honored to introduce the 1999 recipient of the F. W. Clarke Medal, André M. Scheidegger, a research scientist at the Paul Scherrer Institute in Villigen, Switzerland. André is a native of Switzerland. He received his diploma in Chemistry from the Swiss Federal Institute of Technology (ETH) in Zurich in 1989, and his Ph.D. in 1993 in soil chemistry from the ETH where he studied under the tutelage of Professors Hans Sticher and M. Borkovec.

I first met André at a NATO Advanced Study Institute Workshop in 1992 in Maratea, Italy. It was indeed a fortuitous meeting for me, and ultimately our program at the University of Delaware. André joined my environmental soil chemistry research group in the fall of 1993. I knew early on that he was a gifted young scientist. Not only is he a first-rate experimentalist and theoretician, but his interpersonal skills are truly outstanding. He quickly became a favorite among my group of doctoral students, other postdoctoral fellows and visiting scientists. His mentoring of my graduate students will have a lasting effect on their careers and lives.

André's research at the University of Delaware dealt with the rates and mechanisms of metal sorption reactions at the mineral/water interface using a combination of macroscopic and molecular scale techniques. Previous studies using x-ray absorption fine structure (XAFS) spectroscopy and other techniques had shown the formation of metal hydroxide precipitate phases on mineral surfaces. These phases often formed at metal surface loadings far below a theoretical monolayer coverage, and in a pH range well below where metal hydroxide precipitates would be expected to form according to the thermodynamic solubility product. However, the precise structure, stability, and formation mechanism(s) of the multinuclear phases were not known and they were referred to as metal-hydroxide-like structures.

In two seminal papers (Scheidegger et al., 1997; Scheidegger et al., 1998), Dr. Scheidegger, using XAFS, definitively identified the metal-hydroxide like structures as mixed metal-Al hydroxide phases. The phases: formed on an array of phyllosilicates and gibbsite; were identified as tacovite-like, a natural occurring mixed Ni/Al hydroxide mineral of the hydrotalcite group; and formed on time scales of minutes in some cases and increased in size as time progressed. It was postulated that dissolution of Al from the mineral structure was driving the formation of the mixed metal-Al hydroxide phases, and macroscopic data showed there was often a correlation between metal uptake and Si dissolution.

These results are pioneering in a number of ways and have stimulated further research by geoscience groups around the world. Clearly, contrary to previous thinking, André's research has shown that adsorption and precipitation/nucleation processes can occur simultaneously over time scales of only minutes. Moreover, the precipitate phases occur on a number of sorbents that are ubiquitous in the natural environment under reaction conditions that are often common.

Recent studies in my group have conclusively shown that mixed Ni-Al hydroxide precipitate phases occur on natural soil clays, and on heterogeneous soils that contain a plethora of inorganic and organic components. Our group and others have found that hydrotalcite phases also occur with other metals such as Co and Zn, and a recent study in France showed that mixed Zn-Al hydroxide phases have been found in an industrially contaminated soil.

The formation of mixed metal-Al hydroxide phases can have major effects on metal stability and release. Research by our group and that of Gordon Brown's at Stanford has shown that metal release is greatly impeded as "aging" of the precipitate phases increases. Thus, the formation of mixed metal-Al hydroxide precipitates could be an important mechanism for sequestration of metals in the subsurface environment.

In short, Dr. Scheidegger's research is cutting-edge and has far-reaching impacts on our understanding of speciation, bioavailability, and fate of toxic metals in the environment. The originality and significance of Dr. Scheidegger's research was elegantly summarized by a world-class geochemist who supported Dr. Scheidegger's nomination for the Clarke Medal: "Dr. Scheidegger has changed forever the way we think about water-rock sorption/desorption reactions. His most recent paper in GCA (Scheidegger et al., 1998), and others before it, will result in a complete re-evaluation of these processes. He has proven, using direct time-resolved spectroscopic probes, that much of the past foundations of this field, determined macroscopically, must now be called into question and seriously re-evaluated."

Members of the Geochemical Society, and the Association of Geochemists, I am pleased to introduce André M. Scheidegger.

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