A "non-CHONS" stable isotope view on weathering and hydrology

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The past 15 years have witnessed a remarkable expansion in our knowledge of "non-CHONS" stable isotope systems (that is, stable isotope systems other than Carbon, Hydrogen, Oxygen, Nitrogen or Sulfur). The metals and metalloids studied thus far having demonstrated isotopic variability span the periodic table, vary from major to trace element abundances in natural materials and have a broad range of geochemical affinities and behaviors. Highly precise stable isotope measurements for these elements are currently obtainable using multi-collector ICPMS, TIMS and SIMS instruments, potentially allowing efforts at cross-platform validation of data accuracy. In surveying the rapidly building literature on the topic, it is becoming increasingly clear that we have spent as much effort determining why the "non-CHONS" stable isotope systems behave as they do in our laboratory and field-based experiments (e.g. the focus on distinguishing equilibrium from kinetic isotope effects, biotic from inorganic controls, natural from anthropogenic signals) as we have in using the isotopes to tell us unique information about the systems we are studying. Now that we have gained a broad understanding of isotope fractionation mechanisms and their implications for natural isotope distribution patterns for at least some of the non-CHONS stable isotope systems, the time is ripe to concentrate on demonstrating and promoting the utility of these systems for understanding Earth processes such as physical and chemical weathering and their intricate linkage to hydrology. In the broad realm of weathering and hydrology research, the greatest attention has been directed to the Li, B, Mg, Ca, Fe and Si stable isotope systems and each seems to have found one or more particular testable niches (e.g., Li isotopes to distinguish silicate from carbonate weathering, Ca isotopes to discern biotic influences on global flux calculations, Fe isotopes as a (paleo)redox proxy and potential biosignature). More recently, additional redox proxies such as U, Tl and Cr stable isotopes and tracers of biological processing such as Sr and Ba stable isotopes have been explored. This presentation will highlight some new directions for linked weathering/hydrology research in which the non-CHONS stable isotope systems can play a key role, as well as some of the challenges remaining as we move these stable isotope systems from "non-traditional" to the mainstream.

The societal impact of urban and environmental geochemistry: Pathways to success

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Taken together, the fields of urban and environmental geochemistry represent a relatively new, broad and important branch of geochemical research. Given the obvious, that urban and environmental geochemistry focuses on where people live, it could be expected that ever-expanding scientific endeavors in this field would have considerable impact on policy, regulatory decision making and public perception of the importance of sound science. There are many examples of "success stories", where sound science and pursuasive communication has resulted in changes in the way we do business as a society (e.g. implementing limits on stack emissions in response to the effects of acid rain, regulating sulfate loading in the Everglades to limit methylation of mercury, encouraging green space in urban areas to lessen impacts of hydrologic rerouting). On the other hand, the ongoing debate over the validity of climate change science as a driver of policy implementation reveals that scientists are not always the best communicators when forced to defend their science to non-scientists. Because science is complicated and has a language all its own that can be difficult for non-scientists to grasp, it is important that research results having policy implications be carefully communicated to the people charged with making and implementing policy. In this regard, the scientific logic and approach must be beyond question and implemented without bias toward a particular position or outcome. However, possible outcomes should be anticipated and potential solutions considered. Results need to be communicated at an understandable level, keeping the message on target but as simple as possible. And scientists need to stand their ground, letting the science speak for itself. Perhaps most importantly, we need to make sure that policy experts are invited to participate in our scientific conferences and workshops and to make presentations outlining their needs and perspectives, thus allowing the conversation to begin early in the process of developing regulatory policy. This presentation will showcase a collection of success stories in which urban and environmental geochemical research has influenced policy at the local, national and international level, and will attempt to identify the underlying pathways to that success.

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