WE'VE COME A LONG WAY

Tim Drever

The theme of this issue makes me think back on the relationship between geochemistry and soil science and how it has evolved. When I started working on weathering processes and clay mineral formation back in the 1960s, there was remarkably little communication between geochemists and soil scientists. From a geochemist's perspective, soil scientists (with a few very notable exceptions) were not interested in the same set of questions as us. They were concerned with nutrients and organic matter, whereas geochemists studied silicate mineralogy and major element chemistry. We had little interest in nutrients and paid almost no attention to biology. Geochemistry, in this context, was an inorganic science. Furthermore, to geochemists, the terminology of soil classification, in the United States at least, seemed an impenetrable barrier. As an extreme example, I was involved in a PhD thesis in France many years ago on the subject of chemical weathering. A boundary was drawn at 60 cm depth below the ground surface. Below 60 cm was the proper domain of the geology department; above 60 cm was the realm of soil science/geography, and the student was not supposed to discuss it or present data from it.

How things have changed in the last two decades! We have all become aware that this compartmentalization was a barrier to scientific understanding and that geochemists need to become involved with issues of environmental sustainability. The idea that we could put biology in a separate compartment and more or less ignore it now looks ridiculous. Much of the impetus for this change of attitude came from rising concerns about environmental issues. Concern over acid deposition ("acid rain") in the 1980s and 1990s forced us (and funded us) to study, understand, and integrate all the processes that occur as rainwater passes through soil and into streams and lakes. Geochemists, soil scientists, geomorphologists, hydrologists, plant ecologists, microbiologists, environmental engineers, and numerical modelers came together to try to fit the pieces of the puzzle together. I say "try" because we still have a long way to go. Funding agencies (NSF in the United States and corresponding agencies in Europe) have recognized the need and, commendably, funded programs such as the Critical Zone Observatories (*Elements*, October 2007) to foster this integrated approach. The barriers between the disciplines are fading and we are all widening our horizons. In fact the concept of "disciplines" is fading: where does geochemistry end and microbiology begin?

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This issue of *Elements* exemplifies some of the involvement of geochemistry and mineralogy in environmental issues of critical importance. Geochemistry and environmental chemistry have become intertwined over the years. Contaminant migration is strongly affected by adsorption on mineral surfaces. Our understanding of surfaces, adsorption processes, and contaminant migration on the field scale comes largely from the geochemical/environmental chemistry community, and geochemical codes such as MINTEQ and PHREEQC are the workhorses for modeling contaminant migration.

Another important topic is the adhesion of microbes to mineral surfaces: will microbes stay in place or be transported by infiltrating water? What electron acceptors and donors are present and how reactive are they? We need expertise in both mineralogy and microbiology. Geochemists and mineralogists have become deeply involved in environmental questions, and we should become more involved, particularly in projects that bring together the various disciplines involved in understanding Earth surface processes. The future habitability of our planet depends on understanding and managing its surface layers.

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