

DO WE NEED MORE APPLICATIONS OF GEOCHEMISTRY?



Bruce Yardley

Last year, Rod Ewing wrote a Triple Point column on the theme "Is Geochemistry Important," in which he made a compelling case for the importance of mineralogy and geochemistry in the modern world. For my first foray as a Triple Point editor, I would like to take his topic in a different direction and question how effective we are at recognising the practical use of geochemistry (and of course mineralogy).

All scientists hope that their work will prove of lasting value to humanity in some way or other, although there is some doubt as to whether this wish is always fulfilled. The Earth sciences deal with some of the most challenging aspects of the world we live in, and there is an enormous amount of popular curiosity about the topics we investigate, from the origins of the planet to the human impact on it. However, as well as being interesting to the public, Earth scientists are useful: resource geology, for example, has underpinned every civilisation that has left a record, and doubtless many that have not. So where does geochemistry/mineralogy belong in the pantheon of useful sciences? We have little doubt that what we do is important and valuable, but is that reflected in industry's demand for graduates?

I fear that all too often geochemistry research is not seen as of great economic or social value, and our good students are much more likely to continue in research than be offered jobs in industry. The world of applied geochemistry is quite small relative to academic geochemistry, and the interface has become less porous with time. Is this a situation that we should try to change, or does it just reflect the way of the world? I began to appreciate the scale of the differences between geochemistry and some other areas of the Earth sciences when I served on the Council of the Geological Society of London. I was taken aback to discover that the GSL has about 9000 members, of whom academics make up a tiny proportion and industry scientists the vast majority. By contrast, the Geochemical Society has around 3000 members worldwide, most from academia and government. So not only are there a lot more geologists and geophysicists than geochemists, but a far higher proportion of geology and geophysics graduates become industrial practitioners than go into research. Does this mean that what we do has less value to the outside world than we suppose? Does a little geochemistry go a long way? Or is the world just slow to respond to modern advances in geochemistry?

Perhaps the answer to all three of these questions is "yes". Some years ago I attended a small mineral deposits meeting with several excellent presentations on the origins of gold deposits. I asked a senior geologist from Rio Tinto how important this research would be for his company. The response was that, although gold deposits are the subject of a high proportion of ore deposits research, they made only a small contribution to the company profits. Most of the profits came from mining iron ore, which is the subject of rather little geochemical research. Before we all get too excited about the potential of iron ore research, remember that if a deposit can be evaluated by geophysics and the ore-rich zones identified remotely, then understanding why it is there, however intellectually satisfying, is unlikely to have a commercial impact until the resource is almost exhausted. As far as inorganic geochemistry is concerned, the view from the hydrocarbon industry is not so very different. There are some fields in this industry with problems which require an understanding of geochemistry, but it is not such a big issue that even

major oil companies have to employ a lot of inorganic geochemists. So a small amount of geochemistry can result in sufficient understanding to allow many industries to go their own way for quite a while. Geologists and geophysicists are needed on the ground all the time, not just during exploration but also to inform production strategies. On the other hand, most geochemists (those involved in geochemical mapping are an obvious exception) provide general concepts to develop exploration or production approaches, but at a level where ideas can be transferred without the need for the work to be repeated everywhere.

The main area where geochemistry is being used in a practical, day-to-day manner is in the environment. Detailed geochemical input is needed to deal with waste and groundwater issues, and each site has to be investigated separately. That means that geochemists have to be involved on a site-by-site basis. In many countries, it is difficult for researchers to get funded for academic research that is designed to repeat at a new location what has been done elsewhere, but applied science is exactly about applying basic research to specific new areas where it will be useful. Geochemistry will not mature as a major scientific discipline until a bunch of geochemists is doing exactly that.

But our community must also recognise and respect the importance of applications of geochemistry.

Should we conclude that too much geochemistry is too academic to be of practical use in the foreseeable future? Well, a lot of it certainly is, but I believe that there are industries that could benefit from geochemistry if they were more engaged with it. For example, a recent *Elements* issue concerned carbon dioxide sequestration. Here is a field which, despite the obvious chemical implications of injecting carbon dioxide into wet rocks, has proceeded happily at the level of engineering trials with relatively little geochemical input. Reservoir engineers develop plans for

injection with geochemical input at the chemical engineering level, but without a fundamental understanding of longer-term reactivity in the reservoir, despite the enormous impact that such reactions might have on storage capability and the risk of leakage. Such work is going on, but is seldom closely tied to what companies are doing today. Likewise, many examples of the application of geochemical and isotopic techniques to unravel environmental problems have been published, but this has not trickled down to routine practice and regulatory requirements.

If geochemistry is going to be used for the good of society, we must communicate what we do beyond our immediate academic circles, but we also need to understand the nature of the problems that industry deals with. Often their main concerns are with the quantities of materials present – the law of mass balance; on the other hand, many geochemists find it hard to see beyond the evaluation of approach to equilibrium – the law of mass action. Perhaps if we can engage better with real problems that industry faces, we may be able to show that geochemistry can make a difference. But our community must also recognise and respect the importance of applications of geochemistry. At present, our societies do not offer the level of professional support that practitioners need, and few societies whose names suggest that they embrace geochemistry or mineralogy as a whole give medals to people who work with practical applications. These are things we can do something about.

Bruce Yardley
University of Leeds