TO BE EXPLORERS

Hap McSween

Artist's conception of a Mars Exploration Rover on the Red Planet, courtesy of Cornell University

I'm old enough to have watched as the bodies in our Solar System were literally transformed from fuzzy telescopic objects into crisply imaged worlds shaped by more-or-less familiar geologic processes. This wholesale shift of a substantial quantity of scientific real estate, from astronomy to geology, has significantly expanded the reach of our discipline. It has been accomplished not only through remote sensing by orbiting and landed spacecraft but also by laboratory investigations of the elements, isotopes, and minerals that comprise extraterrestrial samples. These materials—meteorites and the presolar grains they contain, as well as returned samples from several bodies—add a critical dimension to planetary exploration, but they also allow glimpses of events and processes that occurred even before the planets formed. The cosmochemistry part of this unfolding story is the subject of this issue of *Elements*.

Nowadays, my students take the geologic transmutation of the planets for granted, although they still marvel that thin sections of lunar lavas look like terrestrial basalts and that mapping strategies they learn at geology field camp also work for Mars rovers. But I'm still awed by the realization that geoscientists are now doing science in locales that used to be the stuff of science fiction.

Discoveries about the abundances and fractionations of elements and isotopes that comprise extraterrestrial materials may not have quite the same allure as spacecraft missions, but they can be equally important. For example, cosmochemistry reveals unexpected details about the fusion of elements in stars, defines the age of our Solar System to four significant figures, and constrains the compositions of planetesimals that accreted to form the Earth. A bonus, for us, is that these kinds of discoveries require the tools and expertise of geochemists, mineralogists, and petrologists.

The geologic exploration of our cosmic neighborhood also pays dividends in understanding our own planet. The Earth's geologic evolution is but one grand experiment, run with one bulk composition under a particular set of physical and chemical conditions. Planetary comparisons allow us to assess the generality of our hypotheses. As expressed so well by the poet T. S. Eliot (*Four Quartets*):

We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time.

Geology would do well to take more advantage of the widespread interest that planetary exploration engenders. Consider this one example: A website describing the daily geologic activities on Mars of the Spirit and Opportunity rovers (http://marsrover.nasa.gov/home) got nine billion (!) hits in its first three months of operation. Who do you think was logging in so often? It was our children. And why is that important? The visibility of planetary exploration attracts students into technical pursuits, even though job opportunities in space science *per se* are limited. Geology students might decide appropriately to spend their careers on environmental and resources issues, but the exploration of other worlds may have captured their attention in the first place. Planetary exploration is expensive, to be sure, but I believe that it is a sound investment. The scientific discoveries it spawns are significant, and its technological spinoffs offer great economic benefits. But its lasting impact is really in motivating our children—they, after all, must become the next generation of scientists and engineers.

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