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VIEWS ARE NOW AVAILABLE ONLINE FOR THE PUBLIC TO READ, NOT JUST SEG MEMBERS, AS WE STRIVE FOR OUTREACH.

VIEWS I

They Who See the Most Rocks Win

MURRAY W. HITZMAN
(SEG President 2005)

(Currently on leave from Colorado School of Mines and traveling the world looking at ore deposits—among other things)

I have heard throughout my career as an economic geologist that "they who see the most rocks win." I concur strongly with this statement. But why exactly is this?

Earth science is as much a qualitative science as a quantitative science. We can (and do) utilize laboratory experiments to duplicate phenomena such as the crystallization of a magma, the metamorphism of a particular rock, or the reactions that take place as a hydrothermal fluid interacts with a specific wall rock. In each of these experiments we set boundary conditions that we believe are typical. Ore deposits by their very nature are commonly atypical geological occurrences, exceptional crustal anomalies, so that our experiments may not reflect what has really happened.

Continuous and long exposure to the reality of geology by examining the evidence—the outcrops and rock specimens, commonly from drill core—is the best way of ensuring that we do not become trapped in a particular paradigm.

Due to the inherent complexity of nature there are almost infinite outcomes of many geological processes. Take an example of volcanogenic massive sulfides (VMS), a deposit type that forms as hot, metal-bearing hydrothermal fluids derived from volcanic processes debouch into cold seawater. The physiochemical changes that take place result in rapid precipitation of sulfate, sulfide, silica, and commonly other minerals. The net result is generally the accumulation of a sulfide-rich mound. But there are many variables: temperature of the hydrothermal fluids, temperature of the ambient seawater, composition of the hydrothermal fluids (that may be dependent in part on the composition of the wall rocks through which the fluids migrated), composition of the seawater (changes through geologic time or changes due to ocean basin configuration), water depth at which the process occurs, whether the fluid mixing occurs at the ocean floor-seawater interface or within the uppermost ocean crust, ocean currents, relative salinity differences between the hydrothermal fluids and ocean water, and many other factors. Since most ancient volcanogenic massive sulfide deposits have been emplaced onto land via deformation, there is a range of metamorphic environments to which the deposits have been subjected.

The result of these myriad processes is that VMS deposits display a wide range of appearances. Yet, we have a broad model that can accommodate and explain this diversity. Development of this model required that geologists investigate a great number of occurrences spread throughout the world and across geologic time. It was really not until we saw these deposits forming on the sea floor in the late 1970s that the model for their formation really crystallized for many.

It is no accident that some of the currently most famous economic geologists seem to be perpetually in motion. Dr. Richard Sillitoe is perhaps the world's foremost authority on porphyry and epithermal-related ore systems.

Murray Hitzman (SEG 1978 F), recently at Axum, the ancient capital (1st to 5th cent AD) of northern Ethiopia. The large stela (obelisk) fell as it was trying to be erected; other intact stela are present. The stela are made from an amphibole-rich intrusive rock, probably syenite.

Murray W. Hitzman *has been the Charles Fogarty Professor of Economic Geology at the Colorado School of Mines since 1996. He served as President of the Society of Economic Geologists in 2005. Murray worked in the minerals industry from 1976 to 1993 doing primarily mineral exploration worldwide and was largely responsible for the Lisheen Zn-Pb-Ag deposit discovery in Ireland (1990). He worked in Washington D.C. (1993-1996) as a policy analyst in both the U.S. Senate and the White House Office of Science and Technology Policy. He is currently a director of several junior mineral exploration companies.*

This is due in no small part to the fact that he has visited and worked on literally many hundreds of such deposits around the world, ranging in age from Archean to recent (and continues to do so, over four decades on). Our 2010 SEG president, Dr. Jeffrey Hedenquist, is another world-renowned economic geologist, especially in the field of epithermal precious metals deposits. His expertise comes not only from lab bench experiments but also from long hours in the field, patiently examining outcrops from the jungles of Southeast Asia to the top of the Andes.

It is critical for young economic geologists (and older ones as well!) to see as many ore deposits as they can. Each deposit, if examined critically, will provide the means for them to test the models they read about in journals such as *Economic Geology* and determine if these models fit the reality that the rocks record. The more examples one sees and carefully considers, the better one is able to judge what they read and (if necessary) revise existing models or formulate new ones.

There is always a tension between knowing things in depth or more broadly. This is one reason that undertaking a master's or Ph.D. degree early in one's career, or working in industry in a particular mining district is important. Coming to grips with the messy details of a deposit or district is critical for having a real appreciation of how ore systems work. It is important to note that completing a master's or Ph.D. thesis with a well-defined problem that is field based and the problem answered through careful observation is no less worthy or significant than a lab or high-tech tool-based study. However, the in-depth understanding that comes through such work should be tempered by an appreciation of diversity derived from looking at a variety of deposits of similar style as well as different deposit types.

"They who see the most rocks win" is the reason that successful economic geology programs in academia include numerous field excursions as part of their curriculum as well as classroom- and lab-based learning. It is also the reason that successful exploration and mining companies encourage their geologists to go on field trips to other deposits led by groups such as the Society of Economic Geologists.

Economic geology is endlessly fascinating to me precisely because I am continuously surprised by what I see in the field—places where I see things that I have seen before, either in other localities or in other portions of geologic time, and places where I see new things that do not fit my prior experience and prejudices. The ability to keep an open mind and be receptive to both the familiar and the new is what marks a good explorationist.

Young (and old) economic geologists—get out in the field and look at the rocks! Not only is it the right thing to do—it's the fun thing to do and the reason many of us got into this business to begin with. SEG