SEG 100 Conference: Celebrating a Century of Discovery

C1
Exploration and Mining – a World of Change

John F. Thompson
PetraScience Consultants, Vancouver, BC, Canada

Over the last one hundred plus years there have been remarkable changes in how and where we explore for minerals, and how we mine in an effective and responsible manner. For an industry not widely recognized for innovation, progress has been extraordinary albeit punctuated by periods of stasis. Three broad periods of change are discussed.

Rapid industrialization in the early part of the 20th century led to increasing demand for metals. Mining responded with the development of bulk mining – open pits, large equipment, and the flotation revolution. During this time the difference between geologists, miners and metallurgists was minimal – eminent men and women transgressed these roles although societal norms restricted women and those without stature. Mineral deposits were studied as critical geological environments related to physical and chemical processes. While there were several important contributors, Waldemar Lindgren was a leader.

Following the Second World War, metal demand surged again. Scientific and engineering advances during the war were transferred to the mining industry, for example solvent extraction to recover and process uranium, and the resulting development of SX-EW for copper. Researchers pursued new levels of experimental and theoretical thermodynamics contributing to the understanding of ore deposits. Simultaneously, earth science underwent the plate tectonic revolution, fundamentally changing our views on metallogeny, prospective terrains, and large-scale ore forming processes.

This period culminated (~1970-1990) with new comprehensive ore deposits models, some with revolutionary implications for processes and exploration (e.g., VMS, magmatic sulfide, porphyry and epithermal deposits). Exploration in these settings was supported by a wide range of new geochemical and geophysical tools. Studies on active systems – e.g., seafloor, geothermal, and weathering – contributed to our understanding of physical, chemical and biological processes related to ore formation. The fascination with new processes had a downside. At times, exploration pursued a panacea approach driven by the latest model or discovery – seafloor processes were widely invoked, while sinters, diatremes, shear zones and other phenomena were overused and promoted.

Post 1990s, societal scrutiny of mining led to an increased focus on efficiency, environmental and social performance, and innovation. At the same time, the exponential increase in the demand for metals ran counter to these efforts with increased production from massive low grade operations resulting in “less metal from more rock” and reliance on economies of scale. Exploration played its part with new discoveries, and systematic evaluation of mine environments. Significant technological advances at rock to micro-scales changed geochronology and improved analytical precision and detection with implications for research and exploration. The digital revolution supported rapid data collection, data analytics and modeling. Multidisciplinary, diverse research and exploration teams utilized numerous approaches, and while insight still came from individuals and new discoveries, panaceas disappeared.

Over the latter period, the world has seen upheaval from economic, societal and health challenges, combined with radical changes in data use and communication. The full ramifications for exploration remain to be seen, but as we enter a new period, there will be increasing demand for high quality mineral deposits that will deliver benefits across society.