SEG 100 Conference: Celebrating a Century of Discovery

F14
The Mining Map of the Future

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Economic geologists are responsible for the discovery and development of new mines for satisfying the needs of humanity, with more and constraints to keep a habitable planet. The mining map is a representation of an equilibrium between the demand in minerals and the offer from production sites, including mines and mineral plants. In the next 50 years, could we define its main tendencies?

1. *Consumption* defines the nature, the quantity, and the location of the mining resources. In 2080, the electrification of transportation, the better management of energy, and a possible decrease in physical transportation for the most developed countries will increase the need for Cu, Al, and numerous strategic metals. Urban mining may contribute partly to the answer. As the largest mines have been always located in core economic countries whatever their geology, a shift of the production will occur toward the shore of the Indian Ocean, specialy East Africa, and along the new silk roads.
2. *Production* is moving toward lower grades and higher tonnages, implying newer types of mineral deposits. Following the Launay law (1913), we will exploit types of deposits closer and closer to source rocks. The integration of social and environmental externalities implies new classifications of minescapes, i.e., integrated mineral systems. The long-term tendency of hydrometallurgical processing will continue and could shift from factory to in situ processes, mobilizing catalysing biological processes. Costs and delays for production will increase because of the need to get social acceptability; they will be transmitted in fine to the consumers. Brownfield exploration will continue to be preeminent, as opening new mining districts by greenfield exploration will encounter more and more social and environmental opposition. The present frontier of development will be blocked by the conservation of the remnant wilderness. Present hydrocarbon-dependant countries will desperately shift toward new minerals resources. Artisanal-scale mining will remain an adjustment parameter.
3. *Transportation* of mineral resources will be governed by the geopolitical evolution of the world. Between 1945 and 2015, globalization had allowed construction of integrated value chains that led to maximization of the Ricardian specialization. Proximity to the world ocean was key for numerous metals. The ongoing deglobalization is developing continental value chains and increased state regulations. It will require the discovery of deposits near economic centers and along continental and oceanic roads. We could move from a Raleigh-Mahan oceanic geopolitical vision back to the McKinder-Radjell continental approach, increasing the growing world conflict potential.

These evolutions will impact economic geology. Our postmortem descriptive approach will need to be more explicative and consider the multiple steps of concentrations in a constructivist approach. The development of artificial intelligence already requires better organized sets of data for machine learning. New territories will offer new deposit types. Explorationists will used both empirical automatized approaches and process-based predictions and consider new geological environments, such as deep Proterozoic orogens.