SEG 2024 Conference: Sustainable Mineral Exploration and Development

Do Mineral Systems Have Fingerprints? (Yes, and They Can Be Used to Find World-Class Orebodies!)

Paul Hodkiewicz, Bruce Hobbs, Alison Ord
University of Western Australia, Nedlands, WA, Australia

Recent advances in drill core scanning and downhole sensing technologies used in the mining industry provide continuous, high-resolution mineralogical, chemical, textural and petrophysical drill hole data. These objective data sets are inputs to a range of novel analytical and rock mass characterisation methods that allow mineral systems and orebodies to be ‘fingerprinted’ in ways that were not possible with more traditional, manual, subjective, and interval-based core logging codes. The novel analytical methods include recurrence analysis, probability distributions and entropy analysis, which can be used to characterise the distinct downhole signatures of mineral assemblages and chemical abundances associated with mineralisation. These non-linear analytical methods have been used widely in the medical and material sciences to distinguish between, for example, healthy and sick (cancerous) cells and organs, and high- and poor-quality manufactured materials. In economic geology, these methods highlight that mineral systems are non-linear and dynamic, open geochemical systems. More important, the methods can be used to distinguish well-endowed mineral systems from others. This presentation will demonstrate that these new, continuous downhole data sets and analytical methods reveal fingerprints and spatial patterns that can improve exploration targeting and orebody knowledge. Results can be used in mine planning and processing to deliver better inputs to integrated mining operations for the downstream customers of the orebody. This includes a better understanding of spatial geometallurgical characteristics of the orebody that will improve predictions of rock mass fragmentation, comminution, crushing, grinding, mineral processing and metal recoveries. The opportunity for the mining industry is to take advantage of this new orebody knowledge to discover new resources and to develop more efficient and lower footprint mining operations with lower energy and water requirements. Examples from orogenic gold, porphyry copper-gold, and magmatic-hydrothermal polymetallic mineral systems will be presented.