Feltrin L, Bertelli M, McGaughey J, Morris WA, 2018, Assembling machine learning workflows to assist mineral exploration, Abstract, Society of Economic Geology, Keystone, USA

The advent of artificial intelligence with machine learning (ML) and its armory of analytic tools is rapidly changing the way industries operate and solve problems connected with multidisciplinary data and human interactions with the Earth. Machines, like humans, can identify patterns with the aid of automated classification, noise reduction, and signal reconstruction routines. Evolution in data pipelining, processing, and integration allows for extensive automation of data mining, fostering its role in complementing human search. We implemented these processes and studied their interactions to facilitate the discovery of zones, defined as discrete and similar portions of the footprint of ore deposits. We investigated the potential role of machines in detecting mineralogical transitions associated with ore deposit signatures. These research problems were solved partly with the combination of specialized ML algorithms derived from (1) cluster analysis, (2) association rule learning, and (3) graph theory. Each discipline solves, respectively, the mapping and simplification of the footprint into discrete zones in 3-D space, the identification of zone-specific associations of geochemical, geophysical, and petrophysical signals, and, ultimately, the visualization of a large number of these associations to allow inference concerning mineralogical variations occurring while moving across the ore deposit's footprint. This work parallels other industry successes, such as in genomics, where data-driven solutions are routinely applied in a process termed “bio-informatization of the body.” We propose plausible solutions regarding the “geo-informatization of ore deposits,” arguing that if properly organized, sets of ML algorithms can be useful in solving complex problems like ore deposit discovery. Our results identify a key role of ML in assisting the mineral exploration process in the difficult task of delineating subtle transitions related to an ore system, quantitatively and exhaustively, providing an avenue toward a more rigorous digitalization of footprints.

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