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Interpreting Machine Learning Neural Network Patterns of an Orogenic Gold Deposit, Yilgarn Craton, Western Australia

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Machine learning is creating value within multiple facets of the mining industry. The authors provide a high-level introduction to AI, machine learning, and deep learning; widely recognized as one of the most powerful forms of machine learning. They will introduce deep learning tools like convolution neural networks, how they are already applied, and the economic considerations necessary for determining when deep learning may be the right solution to de-risking complex block modelling problems.

The authors present the results from preliminary mineral resource modelling of an orogenic gold deposit. They demonstrate how statistically significant non-linear correlated elements are used as direct inputs to the resource model to assist the target element's grade prediction at every block and how its results compare with classical geostatistical techniques such as kriging. This shows that 1) existing techniques for finding correlations between assayed elements do not reflect the complex geology of the asset; 2) non-linear correlations that are difficult to model as simple mathematical functions are representative of geological patterns in a deposit; and 3) non-linear correlated assayed data fed as inputs increase the performance of the resource model as reconciled through blind tests.

It is demonstrated that the deep learning element models provide an enhanced de-risking tool for interrogating the gold block model by improving confidence that high-grade (HG) gold clusters exist (e,g, V, Cu, Ta, Te, U) and as to whether unmined HG gold mineralisation remains (e.g., As, Cu, Ta, Te), due to element substitution in gangue (e.g., green micas) and ore (e.g., sulfides and tellurides) minerals.

The authors hypothesize that the patterns revealed by the block models are the result of geological processes that generated the mineral deposit; that is, the primary hydrothermal processes that deposited economic concentrations of metals are overprinted by secondary physicochemical processes, resulting in these complex patterns.