

Classification of Au Systems in the Mazaruni Greenstone Belt, Guyana, Using Pyrite Trace Element Chemistry

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“Orogenic gold” is a widely applied generalized term that typically encompasses a variety of Au deposit types within greenstone belts, with the term (s.s.) representing the more common mesozonal lode-gold systems. Other syn-orogenic Au-deposit types, such as intrusion-related and/or porphyry-like Au systems (i.e., magmatic-hydrothermal) are becoming more widely recognized. However, classification of Au deposits into these types remains challenging due to some apparent similarities. Here, the geochemical signature of pyrite grains analysed via laser ablation- inductively coupled plasma-mass spectrometry (LA ICP-MS) is used to discriminate Au deposit types in the Mazaruni greenstone belt, Guyana. Plots of the pyrite LA data using the time-slice domain (TSD) protocol in Au vs Ag binary diagrams show distinct patterns: Type 1 deposits exhibit randomly dispersed Au:Ag ratios, whereas for Type 2 deposits data clusters at Au:Ag = 0.1, 1 or 100. Principal component analysis (PCA) on selected trace elements identified four significant components (PC1 - PC4). Notably, PC1 showed that elements with the highest loadings have similar charge and size, indicating probable substitution into the pyrite lattice based on these properties. K-means clustering on PC1 - PC4 defined four clusters. One cluster showed that Type 1 deposits are enriched in Cu, As, Se, Ag, Sb, Au, Pb, and Bi, whereas three clusters showed Type 2 deposits are depleted in these elements but enriched in Co, Ni, and Te. This methodology suggests that As, Se, Ag, Sb, Au, Pb, and Bi are plausible discriminators for differentiating Type 1 and Type 2 Au systems in the Mazaruni greenstone belt. Literature data and petrographic observations suggest Type 1 settings represents magmatic-hydrothermal Au systems, whereas Type 2 represents mesozonal lode-gold systems. Such data analytics approach on pyrite mineral chemistry could therefore assist in distinguishing Au deposit types and be broadly applicable to greenstone belts worldwide.