

### **Systematics and Mineral Systems: How Controlled Vocabularies Enable System Mapping for Sedimentary-Hosted Copper Systems**

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The mineral systems approach is widely applied in mineral exploration as a conceptual framework capturing the geological processes controlling mineral formation. Such models have been developed based on both empirical data and geological observations to define the essential components and processes during metallogenesis, including sources, pathways and architecture, drivers, ore deposition and preservation. The components are described in natural language and are variably translated into, or integrated with, geoscience datasets (maps, experimental data, geophysical datasets) and mappable proxies to generate predictions of mineral prospectivity. The challenge is to find internal consistency between concepts and data to test plausibility and identify uncertainties. This study applies a controlled vocabulary of consistently defined mineral systems concepts. Ore-forming processes and their relationships are described using standardised terms that enhance interoperability, analysis and systems understanding. Such an approach takes us toward the translation of mineral systems models into machine-readable formats, allowing conceptual validity tests of these models.

This study investigates the application of the mineral systems critical components controlled vocabulary in sedimentary-hosted copper systems, establishing knowledge graphs and system dynamics modelling to understand concepts, entities and relations. In the case of classic sedimentary-hosted copper systems, the understanding of these critical components is predominantly derived from world-renowned deposits, including the Kupferschiefer (Europe) and Katangan (Central African Copperbelt) deposits. Using this holistic approach to visualise and map the components relative to system dynamics and associated empirical data, we interrogate the plausibility of such conceptual models in Australian sedimentary-hosted copper systems and assess the intersection and overprinting of mineralising events in terranes that have often witnessed multiple episodes and styles of mineralisation during their geological evolution.