The Emergence and Continuing Evolution of Geometallurgy: What Every Economic Geologist Should Know About Improving Project Value

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The emerging discipline of "geometallurgy" is not new but has become increasingly recognized over the last decade as a discrete and high-value activity. Geometallurgy involves a quantified and spatially constrained approach to ore characterization in terms of relationships to critical processing performance attributes, mine optimization, and valuation. These attributes typically include blasting, crushing, grinding, liberation, and recovery. Related issues include tracking deportment of deleterious elements, providing inputs into environmental management, and improving energy efficiency. Incorporation of geometallurgical parameters into resource modeling supplements traditional geology and grade-based attributes, which enables a more holistic approach to economic valuation and optimization of mineral production. Key outcomes are improved forecasting, reduced technical risk, and enhanced economic optimization of mineral production with links to sustainability. A more descriptive function-based definition of geometallurgy could be "orebody knowledge fit for manufacturing purpose."

Geometallurgy complements but does not replace existing approaches to design and optimization of mining and mineral processing operations. Detailed geometallurgical models that reflect inherent geological variability aim to reduce technical risk associated with the design and operation of mines. This approach is particularly important in feasibility as a precursor to design where physical access to and knowledge of an ore deposit is limited and evolving. Geometallurgical information is also an essential input into flow sheet design and equipment sizing, facilitating improved forecasting and optimization of plant performance over life of project.

Geometallurgy requires integration across a wide range of existing disciplines and can be referred to under a variety of descriptors. It includes aspects of process mineralogy, mine geology, metallurgy, process control, resource modeling, geostatistics, and mine planning. Although "geometallurgy" is a widely used term with discrete positions and, in some cases, departments in major companies, there is no accepted definition of its scope or accredited code of practice. Given the current downturn in the industry, many of these emergent departments have been cut back, with increasing pressure for geometallurgy to define a value proposition around sustaining core business.

It is important to recognize that geometallurgy has a number of functions (and value propositions) related to the evolution of a mining project from discovery through feasibility and design, to commissioning, operation and, ultimately, closure related to both ore and waste characterization. There are major differences in geometallurgical prerequisites for supporting mine design and equipment sizing in feasibility or expansion, versus forecasting and optimization of production. At production scale, the role of geometallurgy is primarily focused on defining feed variability for forecasting and steady state blending purposes. The benefits relate to risk management around maintaining performance against plan, but it is often difficult to define a clear value proposition around risk minimization.

During the commodity price cycle boom maximization of throughput and steady state blending out of feed variability became dominant operational imperatives. In the current price cycle challenge, there is increasing recognition that feed variability can be exploited to improve productivity, providing new opportunities for generating geometallurgical orebody knowledge, which can be used to transform project value. Examples will be given of these new opportunities which have relevance and application even at the discovery stage. There are things every economic geologist should know about using geometallurgy to improve project value.