Modelling metal recovery by cokriging the feed and concentrate masses of metal

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# ABSTRACT

Geometallurgical modelling is increasingly being incorporated into mineral resource modelling and estimation as a means of increasing efficiency, decreasing operating costs and reducing risk in mining operations. There are many challenges in using conventional geostatistical workflows for geometallurgical modelling, such as dealing with non-additivity or compositional variables, highly heterotopic data sets, complex multivariate relationships among variables and the relatively low number of geometallurgical sample data. The mentioned challenges have affected directly on the studies in this area, as most of the studies are statistical-based rather than geostatistical-based, where generally machine learning techniques are used to predict geometallurgical response variables from assay data and mineralogy.

As metallurgical recovery is a non-additive variable, it cannot be estimated directly by kriging algorithms. To avoid this problem, the mass of metal in the feed and in the concentrate (both of which are additive variables) are estimated using variants of cokriging and recovery is then estimated from these two estimates. The methodology is applied to the Prominent Hill Iron Oxide Copper-Gold (IOCG) deposit in Australia. The mass of metal in the feed is available directly from abundant on-line assay analyses but the mass of metal in the concentrate is available from only a very limited number of laboratory-scale batch flotation tests for copper sulphide ores. Traditional approaches to predicting the mass of metal in the concentrate, such as simple and ordinary cokriging, for such heterotopic cases are described and discussed. A modified version of cokriging is introduced, in which the mean values are related by linear combinations with known coefficients, and its unbiasedness in predicting copper recovery is discussed.