Modeling Ore Texture and Mineral Liberation Using 3D Voronoi Diagrams

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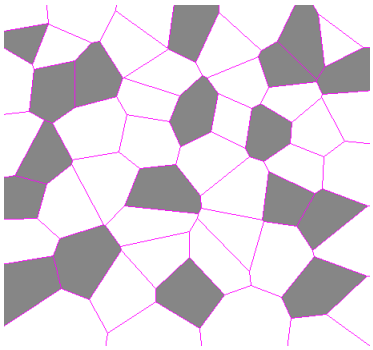
Abstract

In this paper, we present a combined stochastic geometry model for mineral liberation of two-phase ore under fragmentation in breakage process. The texture modeling of unbroken ore with solid grains and its interaction with artificial fracture pattern are considered on the base of simulations with the 3D Voronoi diagram (VD) and the Poisson polyhedra mosaic (PM). An algorithm was developed and implemented to generate the VD of ore texture overlaying with PM fracture pattern to predict expected liberation spectra as bivariate grade-size distribution of polyhedral fragments.

Three types of breakage mechanism are examined: i) random crushing planes; ii) cracking within waste matrix or gangue phase that has very low hardness and iii) preferential disintegration along grain contacts on boundaries of Voronoi polyhedra (Figure 1). Also, the model of mineral liberation is compared with stereological measurements for ore sample sections from linear and areal methods of scanning electron microscopy.



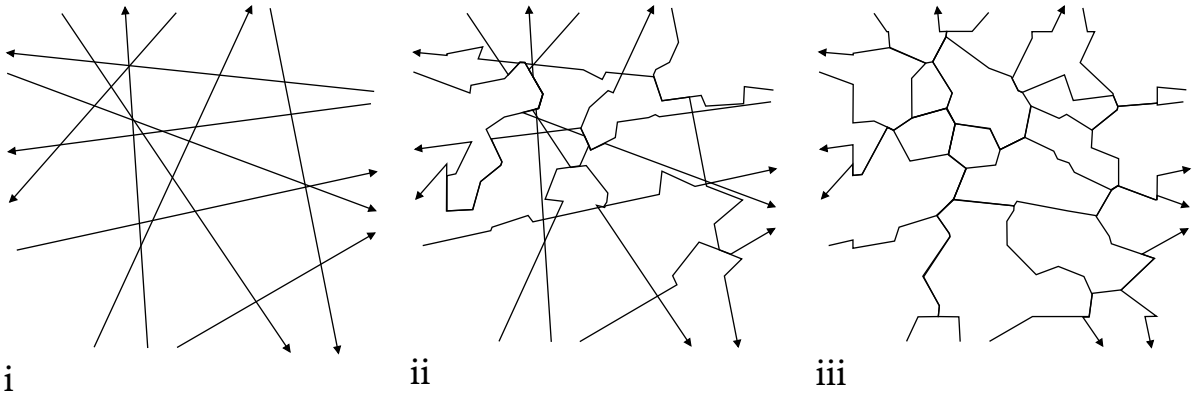


Figure 1. Illustration of Poisson fracture patterns in sections: i) random crushing planes; ii- cracking within waste matrix phase that has very low hardness; iii- preferential disintegration along boundaries of Voronoi polyhedral grains

The developed approach provides a reliable 3D VD/PM model to predict particle compositions in ore ground products before mechanical size decrease operations and could be applied for advanced geostatistical mapping and reserve estimation of mineral deposits.