# Application of Machine Learning for Domaining of a Ni Laterite Deposit

*Catley, J*[1]*, Gomes, C*[2] *and Lopes, R*[3]

1. Senior Resource Geologist, SLR Consulting Ltd, London UK WC1R 4QH. Email: jcatley@slrconsulting.com
2. Senior Geostatistician, SLR Consulting (Canada) Ltd, Edmonton Alberta T6B 3H9. Email: cgomes@slrconsulting.com
3. Managing Principal Resource Geologist, Geostatistics, SLR Consulting (Canada) Ltd, Toronto Ontario M5J 2H7. Email: rlopes@slrconsulting.com

Keywords: Nickel laterite, machine learning, domaining

## ABSTRACT

To support a client's initiative to process mineralized limonite from an ongoing nickel saprolite mining operation in Indonesia, SLR developed an updated geological model making use of both supervised and unsupervised machine learning techniques. A subset of the drill hole database consisted of recent drilling supported by a wide assay suite, for which the geological domain had been reliably logged. The remainder of the database contained less reliable logging and partial assay coverage.

SLR applied an unsupervised Gaussian Mixture Model classifier within the saprolite and bedrock portion of the full dataset to determine a potentially transitional subset, fitted using selected assay variables, and standardized depth down-hole. A supervised eXtreme Gradient Boosting classifier was trained on the reliable domain coding, with selected assay variables, standardized depth down-hole, as well as indicator variables for colour and grain size, and the transitional indicator. SLR predicted domains for the older portion of the database using the fitted model. To better represent geochemical populations within the limonite, two sub-domains were established using a further unsupervised Gaussian Mixture Model classifier, based on selected assay variables and standardized depth down-hole. Custom post-processing routines were developed to establish the expected stratigraphic sequence in all holes and to fill non-predicted intervals. Domain boundary wireframes were constructed implicitly using the natural topographic surface as a guide, incorporating points generated in Python to ensure that wireframes avoided drill hole intercepts where contacts were not observed. An estimated contact depth was assigned for holes terminated within the upper domains, based on a Nearest Neighbour estimate of unit length from adjacent drill holes.

This workflow resolved issues with historical data reliability by applying patterns observed in more reliable recent data, and effectively managed drill holes which did not encounter the full stratigraphy.