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# Classifying Copper-Molybdenum-Gold Porphyry Deposit Alteration using Magnetic and Spectral data

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Copper is one of the most important critical metal resources needed to achieve carbon neutrality with a projected increase in demand of >300% over the next half century from electronics and renewables.  Porphyry deposits account for most of the global copper production, but the discovery of new reserves is ever more challenging. Machine learning presents an opportunity to cross reference new and traditionally under-utilised data sets with a view to developing quantitative predictive models of hydrothermal alteration zones to guide new, ambitious exploration programs.

The aim of this study is to demonstrate a new alteration classification scheme driven by quantitative magnetic and spectral data to feed a machine learning algorithm. The benefits of an alteration model based on quantitative data rather than subjective observations by geologists, are that there is no bias in the data collected, the arising model is quantifiable and therefore easy to model and the process be fully automated. Ultimately, this approach aids more detailed exploration and mine modelling, in turn, reducing the extraction process carbon footprint and more effectively identifying new deposits.

Presented here are magnetic susceptibility and shortwave infrared (SWIR) data collected from the KazMinerals plc. owned Aktogay Cu-Mo giant porphyry deposit, eastern Kazakhstan, which has a throughput of 30Mtpa of ore. These data are cross referenced using a newly developed machine learning algorithm. Generated autonomously, our results reveal twelve statistically and geologically significant clusters that define a new alteration classification for porphyry style mineralisation. Results are entirely non-subjective, reproducible, quantitative and modellable.

Importantly, magnetic susceptibility measurements improve the algorithm’s ability to identify clusters by between 29-36%; enhancing the sophistication of the included magnetic data promises to yield substantially better statistical results. Magnetic remanence data are therefore being complied on representative samples from each of the twelve identified clusters, including hysteresis, isothermal remanent magnetisation (IRM) acquisition, FORC measurements, natural

remanent magnetisation (NRM) and anhysteretic remanent magnetisation (ARM). Through collaboration with industry partners, we aim to develop an automated means of collecting these magnetic remanence data to accompany the machine learning algorithm.