

PREDICTIVE MAGNETIC EXPLORATION MODELS FOR PORPHYRY COPPER AND IRON-OXIDE COPPER-GOLD DEPOSITS

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Magnetics is the most widely used geophysical method in hard rock exploration and magnetic surveys are an integral part of exploration programmes for porphyry and IOCG deposits. However, the magnetic signatures of these deposits are extremely variable and exploration that is based simply on searching for signatures that resemble those of known deposits is rarely successful.

A number of well-known geological models of porphyry and epithermal deposits are routinely used in exploration, even though most deposits fail to match the idealised models closely, due to post-emplacement tectonic disruption, asymmetric alteration zoning due to emplacement along a contact between contrasting country rock types, and so on. The variability of magnetic signatures of these deposits reflects strong dependence of magnetic signatures on local geological setting. Post-emplacement tilting of mineralized systems and dismemberment by faulting are very common and drastically modify the geophysical signatures. Burial of a deposit by younger sedimentary or volcanic rocks also modifies the anomaly pattern. Conversely, exhumation and partial erosion of the system produces a very different magnetic signature. In older deposits, metamorphism can substantially modify the magnetic mineralogy of the deposits and host rocks, with concomitant changes in the magnetic anomaly pattern.

Suites of magnetic models, based on realistic geological scenarios and informed by petrophysical data and magnetic petrological principles, illustrate these effects and allow plausible predictions of magnetic signatures of porphyry Cu and Cu-Au deposits and magnetic and gravity signatures of IOCG deposits, based on provincial and local geological settings. A classification scheme for magnetic signatures of porphyry deposits has been developed, based on these models and on a database of geological, petrophysical and geophysical characteristics of deposits from many provinces around the globe. This database, and the atlases of known and predicted signatures produced during this project, have been used to develop refined exploration criteria for porphyry and IOCG deposits.

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