Magnetics is the most widely used geophysical method in hard rock exploration and magnetic surveys are an integral part of exploration programs for porphyry and iron oxide copper-gold (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 IOCG 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. Magnetic exploration models for porphyry and IOCG deposits have been developed to address these problems. Suites of magnetic models, based on realistic geological scenarios and informed by petrophysical data and magnetic petrological principles, illustrate the effects of local geological setting and allow plausible predictions of magnetic signatures of porphyry Cu and Cu-Au deposits and magnetic and gravity signatures of IOCG deposits. In future exploration the extra information provided by full magnetic gradient tensor surveys will allow better mapping of structural controls and zoning patterns within mineralized systems and produce better estimates of magnetic properties of rock units and alteration zones. Examples of improved definition of targets and better estimates of magnetizations provided by gradient tensor data will be presented.