Geophysical Properties of Rocks from the Hauraki Goldfield (New Zealand), Supporting Continued Mineral Exploration

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ABSTRACT

A key factor in the success of any geophysical survey is a knowledge of the physical properties of the rocks. Data from formations in the exploration area are needed to design the survey and to model the results. In epithermal gold/silver deposits the contrast in rock properties between host lithologies, and different alteration zones can be subtle. To get the maximum benefit from geophysical surveys, and to extend the exploration into areas of cover, careful attention to contrasting rock properties can reduce the ambiguity in the geophysical response. Magnetic properties (susceptibility and remanence) can distinguish different volcanic rocks, and identify weathered and altered products. A combination of new and existing data in a national database (PETLAB) is used to identify the magnetic signature, and potential complications due to polarity reversals of Earth's magnetic field. In electrical and electromagnetic surveys the main rock property is resistivity. Measurements in the field and on core are far less common than for magnetic properties. In epithermal deposits where the geothermal fluids are no longer present in the system and temperatures have returned to background levels, the electrical properties are determined by the porosity of the rock, and the clay content and mineralogy. Density provides an complementary measure of porosity. Fresh volcanic rocks increase in density from ignimbrites (average porosity 23%) up to andesites (porosity less than 4 %). The basement rocks (metagreywackes and intrusives) have densities typical of the crustal averages (2.67 Mg/m^3). Airborne gamma-ray spectrometer surveys are widely used for mapping alteration zones. Volcanic rocks show a trend of increasing potassium content with decreasing silica content, associated with the process of fractional crystallisation from an intermediate melt. Superimposed on this trend are the effects of hydrothermal alteration that can change the potassium content, making gamma-ray spectrometry a potential exploration tool.