Petrophysical laboratory measurements of two ore formations in Southern Finland

Petrophysical laboratory measurements of mineralized samples and ores have been carried out on an orogenic gold deposit in Unimäki and a porphyry type Cu-Au deposit in Kedonojankulma in the Paleoproterozoic Häme belt of Southern Finland. The study areas were selected utilizing airborne geophysical data. The main aim of the study was to identify and characterize the alteration processes that are reflected in the physical properties of the rocks. As the known ore bodies are related to alteration zones and because detailed petrophysical investigations at outcrop scale can delineate differences between ore and host rocks, the applied methods have relevance to exploration.

The main measured petrophysical quantities are magnetic susceptibility, remanent magnetization (NRM), density and electrical conductivity. In addition, measurements on anisotropy of magnetic susceptibility (AMS) and magnetic mineralogy by rock magnetic tests form an essential part of the investigations. Additionally, in Unimäki the petrophysical properties were correlated with geochemical data from three drill cores.

Unimäki

In the Unimäki gabbroic occurrence (orogenic gold deposit) the highest magnetization values and electrical conductivities correlate with strong IP anomalies. Rock magnetic analyses show that in the samples of highest magnetization, which are believed to represent the most altered part of the deposit, the only magnetic mineral is monoclinic pyrrhotite with exceptionally high Curie temperature of 350–370°C. The less altered areas show dominance of magnetite. AMS directions are characterized by NW-SE striking, approximately vertically dipping magnetic foliations and vertically plunging magnetic lineations. Geochemical correlations of the three borehole cores show that the occurrence of gold is only weakly correlated with other heavy metals. From petrophysical parameters, gold is best correlated with inductive conductivity, consistent with the occurrence of pyrrhotite.

Kedonojankulma

In the Kedonojankulma quartz-plagioclase porphyry occurrence (porphyry type Cu-Au deposit), the induced and remanent magnetizations are slightly higher in the altered auriferous shear zone than in the less altered host rock. According to rock magnetic tests, in the altered zone the only magnetic mineral is monoclinic pyrrhotite with high Curie temperature of ca. 370°C, while in the host rock the main magnetic mineral is titanomagnetite. Based on AMS data the most altered quartz-plagioclase porphyry in Rusakkokallio also has the highest degree of anisotropy.