Magnetic properties for characterization and quantification of magnetite and hematite in apatite iron-oxide deposits at Blötberget, central Sweden

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Laboratory magnetic measurements can complement ore geological and exploration geophysical studies. Analysis of statistical relationships between magnetic properties and thin section analysis can prove useful for this purpose. A methodology is developed in the current study, with the aim to characterize the Kiruna-type REE-bearing apatite iron-oxide deposits at Blötberget in central Sweden. Twenty drill core samples, received from Nordic Iron Ore, were used for this study containing up to 81 weight percent (wt%) magnetite and up to 83 wt% hematite. Magnetic susceptibility measurements were carried out as a function of temperature, using an MFK1-FA susceptibility bridge. The measurements show that magnetite with strong susceptibility contribution overshadows the hematite contribution in the samples. Susceptibility drops are noticeable when crossing the Curie temperatures; 580^{o}C and 680^{o}C for magnetite and hematite, respectively. Although the bulk susceptibility of magnetite is several orders of magnitudes larger than that of hematite, the signals from the two phases are readily distinguishable from the drop in susceptibility across their respective Curie temperatures. The wt% magnetite, identified in thin sections, was compared with drop in susceptibility across the 580^{o}C. A linear relationship is identified between the magnitude drop in susceptibility and magnetite content with $R^2 = 0.73$. The same procedure was performed for hematite in 6, out of the 20, measurements. Thus another linear relationship with $R^2 = 0.81$ for hematite. A lower detection limit of 17 wt% hematite was identified when characterizing susceptibilities associated with hematite using this method, and the chosen sample size. This investigation illustrates that magnetic laboratory methods are useful to accurately quantify and characterize magnetite and hematite proportions in high grade iron mineralized bodies.