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Spectral-induced polarization characteristics of rocks from Shinyemi deposit in Northeastern South Korea

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Contact metasomatism between carbonate and igneous rocks leads to the formation of skarn deposits, and ore minerals are abundant. Geophysical methods that visualize the distributions of physical properties have been utilized to determine lithological boundaries in ore deposits. In particular, spectral-induced polarization (SIP) is the most effective of those methods for mineral exploration because it can obtain not only the boundaries but also the abundance and grain size of ore minerals. It is crucial to characterize the SIP responses of in situ rocks for a more realistic interpretation. Thus, typical rocks composed of igneous rock, skarn rock, skarn ore, and carbonate rock were sampled from drilling cores in the Shinyemi deposit, which is one of the well-known skarn deposits in Northeastern South Korea. The purpose of this study was to characterize the SIP responses of rocks by laboratory measurements. The characterization was performed by evaluating spectra and IP parameters. The IP properties were acquired from equivalent circuit analysis using a circuit model based on the electrochemical theory, and the analysis results of this circuit model were relatively well fit compared with those of the traditional Dias and Cole-Cole models. The frequency responses below 100 Hz in the spectra and the chargeability values of the skarn rocks and ores containing magnetite were relatively strong and high, respectively, compared with those of non-mineralized igneous and carbonate rocks. Therefore, it is considered that these characteristics are dependent on the abundance of magnetite. In case of the skarn ores with high magnetite content, the resistivity values were significantly low and the relaxation time values were influenced by the grain size of magnetite. On the other hand, it is considered that the DC resistivity and the relaxation time values of the igneous and carbonate rocks are slightly related to the porosity and the grade of hydrothermal alteration, respectively.