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Induced Polarization Responses of the Specimen with Sulfide Ore Minerals

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Basic data of the physical properties of the rocks is required to effectively interpret geologic structures and mineralized zones in study areas from the geophysical data in the field of subsurface investigations and mineral resources explorations. In this study, the spectral induced polarization (SIP) measurement system in the laboratory was constructed to obtain the IP characteristics of the specimen with sulfide ore minerals. The SIP measurement system consists of lab transmitter for electrical current transmission, and GDP-32 for current receiver. The SIP system employs 14 steps of frequencies from 0.123 to 1,024 Hz, and uses copper sulfate solution as an electrolyte. The SIP data for system verification was acquired using a measurement system of parallel circuit with fixed resistance and condenser. This measured data was in good agreement with Cole-Cole model data.

First of all, the experiment on the SIP response was conducted in the laboratory with the mixture of glass beads and pyrite powders for ore grade assessment using characteristics of IP response of the rocks. The results show that the phase difference of IP response to the frequency is nearly proportional to the weight content of pyrite, and that the dominant frequency of the IP response varies with the size of the pyrite powder.

Subsequently, the specimens used for SIP measurement are slate and limestone which were taken from drilling cores and outcrops of skarn ore deposits. All specimens are cylindrical in shape, with a diameter of 5 cm and a length of 10 cm. When measuring SIP of water-saturated specimens, the specimen surface is kept dry, tap water is put into the bottom of sample holder and a lid is closed. It is drawn that the SIP characteristics of the rocks show the phase difference depends on the amount of the sulfide minerals. The phase difference did not occur with frequencies applied in the absence of sulfide minerals in the rock specimens. On the contrary, the rock specimens containing sulfide minerals such as galena, sphalerite, pyrrhotite, chalcopyrite, pyrite show large phase differences with frequencies applied. In particular, the slate specimens with skarn Pb-Zn show high IP responses to the frequencies applied since the specimens contain high amount of the sulfide minerals. The specimens of other rocks in the skarn ore deposits, on the other hand, do not provide the detectable IP responses since the rocks consist mostly of silicate minerals. The phase difference derived from the frequency applied was converted to the data for ore grade since the phase of SIP response shows high relationship with the ore grade.