



Application of Borehole SIP Technique to Sulfide Mineral Exploration

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In the study, SIP (Spectral Induced Polarization) well logging probe system was developed to rapidly locate the metal ore bodies with sulfide minerals in the boreholes. The newly developed SIP logging probe employed the non-polarizable electrodes, consisting of zinc chloride ($ZnCl_2$), sodium chloride ($NaCl$), gypsum ($CaSO_4 \cdot 2H_2O$), and water (H_2O), instead of existing copper electrodes, leading to eliminating the EM coupling effect in the IP surveys as much as possible. In addition, the SIP logging system is designed to make measurements down to maximum 500 meters in depth in the boreholes. The SIP well logging was conducted to examine the applicability of the SIP probe system to the boreholes at the ore mine in Jecheon area, Korea. The boreholes used in the SIP logging are known to have penetrated the metal ore bodies with sulfide minerals from the drilling investigations. The ore mine of the study area is the scarn deposits surrounded by the limestone or lime-silicate rocks in Ordovician period. The results of the SIP well logging have shown that the borehole segments with limestone or lime-silicate rocks yielded the insignificant SIP responses while the borehole segments with sulfide minerals (e.g. pyrite) provided the significant phase shifts of the SIP responses. The borehole segments penetrating the metal ore body, so-called cupola, have shown very high response of the phase shift, due to the high contents of the sulfide mineral pyrite. The phase shifts of the SIP response could be used to estimate the grade of the ore bodies since the higher contents of the sulfide minerals, the higher magnitudes of the phase shifts in the SIP responses. It is, therefore, believed that the borehole SIP technique can be applied to investigate the metal ore bodies with sulfide minerals, and that could be used to estimate the ore grades as a supplementary tool in the future.