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Spectral induced polarization survey applied to gold mine exploration

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The induced polarization (IP) method has been used for the exploration of metallic ore deposits with sulfide minerals such as sphalerite, pyrite, galena, and so on. This method makes use of the capacitive action of the subsurface to locate zones where conductive minerals are disseminated within the host rock. But the IP method has problems with EM coupling and high-power currents that make it difficult to obtain high-quality data in field sites. To address these problems, we have developed an inversion algorithm and field survey techniques using the spectral induced polarization (SIP) method. In this study, we examined the applicability of SIP survey to determine the boundaries of subsurface mineralization and hydrothermal alteration associated with epithermal Au-Ag deposits. A SIP survey was carried out over a wide tuff area, including an area where the silicified zone had been identified from the results of geological and borehole investigations. The survey lines were installed across the silicified zone, and dipole-dipole configurations were used, with electrode spacing of 20m. The transmitter and receiver cables were isolated, and current and potential electrodes were used in stainless steel and non-polarized electrodes, respectively. The data on each survey line were obtained from three frequencies, 0.125 Hz, 1 Hz, and 8Hz. From the survey results, we could image the 2D electrical resistivity and phase difference distributions for each survey line. The boundaries of the silicified zone by hydrothermal alteration were defined by a high resistivity of 500 ohm-m, and the Au-Ag bearing quartz veins by mineralization of the epithermal deposits were defined by a high phase difference of 60 mrad.