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Application of Electrical Resistivity Survey for Detecting the Skarn Ore Body

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Recently the korean government has tried to investigate the possibility of reopening for some closed metal mines as the interest in the redevelopment of closed mines increases due to rapid increase in the price of most of metals. Based on the fact that mineralized zone are generally more conductive than surrounding rocks, electrical resistivity survey among several geophysical surveys has been applied to investigate metallic ore bodies. In this study, we examined applicability of electrical resistivity survey to detect the ore bodies at the field site in the skarn mine, located in the northeast of the Korean Peninsula. In this study, basic data of the physical properties of the rocks are required to effectively interpret geologic structures and mineralized zones from the field electrical resistivity data in the subsurface investigations. The various rock specimens of outcrops and drilling cores are collected from skarn mine area and the physical properties of these specimens were measured by using electrical resistivity measurement system. The measurement system for electrical resistivity employs four electrodes system with two electrical current and potential electrodes, respectively. The electrical resistivities of the rock specimens were strongly influenced by mineral compositions of these ore bodies dominated by calc-silicates associated with ore minerals of sphalerite, galena and chalcopyrite, as well as sulfide gangue of pyrrhotite. Especially, the rock specimens with pyrite show high density and magnetic susceptibility since they contains iron component. The 2-D electrical resistivity survey was carried out in order to detect the skarn ore bodies in the region, considering limestone distribution confirmed from geological reconnaissance. The survey line crossing the boundary between limestone and slate formations was selected with line length of 975 m and with electrode space of 25 m. The electrode layout used is the dipole-dipole and modify pole-pole configurations. The resistivity measurements were taken using a large number of electrodes installed on the survey line. These electrodes were connected to the main unit of the resistivity measurement using connection cables, and the potential difference was measured according to the electrode arrangement installed. The software DIPRO was used to determine a 2-D resistivity model of the subsurface data obtained from the electrical resistivity survey. In this automatic analytical method, the forward modeling subroutine was used to calculate the apparent resistivity values, and the non-linear least-squares optimization technique was used for the inversion algorithm. According to inverted resistivity distribution, the higher resistivity zone develops very deep since the fresh bedrock of porphyry granite exists down to the depth. The lower resistivity zone also develops at the boundary between limestone and slate layers. From this low resistivity zone, it is proven that the skarn mineralized zone is distributed in the boundary of the limestone formation, this results agree with the measured physical properties of the rocks and boring histograms in this area. Based on the study results, the electrical resistivity survey used is an effective technique to detect skarn ore bodies.