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Integrated Geophysical Investigations of the Uranium Deposit in the Okcheon Metamorphic Belt in Korea

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Integrated geophysical techniques including refraction seismic, electrical resistivity, and SIP (Spectral Induced Polarization) methods were conducted for uranium exploration in the test bed of the Okchoen Metamorphic Belt, located 20 km south of Daejeon city, Korea. It has been reported that the low grade uranium-bearing formations of graphitic coal were found in the outcrops within the dark gray slate formation in the site. The main objectives of the study are (1) to investigate the geological structures of the coal-bearing slate formation with uranium ore minerals, and (2) to provide the basic information of the geological structures to select drilling location(s) of the uranium anomalous zones in the site. The geology of the site consists of age-unknown coal and metasediments (mostly slate formations), limestone interbeded within the slates, and intrusion of cretaceous quartz porphyry of the acidic dikes. The slate formations including interbedded uranium-bearing graphitic coal layers shows the strike of N40∼60E and dip 50∼60 toward northwest direction in the site. The conceptual geophysical model of the uranium-bearing coal slate was constructed for geologic structure of the site, consisting of very high-angled formation with low density/resistivity anomalies due to interbedded coals, and with high IP response due to the presence of mineral pyrite, based on the geologic and geochemistry investigations of the study area. On the contrary, the other slate formations show the geophysical properties of relatively high density/resistivity, and low IP response due to the absence of sulfide minerals. The results of the refraction seismic survey showed the low velocity (or density) zones due to uranium-bearing graphitic coal slate formation on the seismic data. High IP response was detected due to sulfide mineral within coal-bearing slate formation on the SIP phase data obtained from the site. In addition, the low resistivity anomalies with very high angles were detected due to interbedded uranium-bearing graphitic coal layers on both numerical resistivity modeling using initial conceptual model and field resistivity data. The results of the integrated geophysical investigation are in good agreement with the geological and geochemical study results, and were employed for drilling investigations in the survey area. In order to probe the uranium-bearing ore body, one location of concern with low density/resistivity anomalies and with high IP response was selected for drilling of 300m depth, based on the geological, geochemical, and geophysical investigations. The drilling operation has penetrated uranium-bearing graphitic coal layers interbedded within dark gray slate formation in the site. The development of the investigation techniques for uranium exploration is an ongoing project in KIGAM (Korea Institute of Geoscience and Mineral Resources). The integrated geophysical investigation techniques including the construction of the conceptual geophysical model and the selection of appropriate geophysical methods, based on the geological and geochemical results were useful for the uranium exploration in this study and can be applied to other sites of uranium-bearing ore deposits.