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An interpretation of induced-polarization data collected in the Haenam area, southern part of Korea Peninsula, based on effective nonlinear inversion

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The Haenam area in the southern tip of Korean Peninsula, which experienced broad hydrothermal transition during the Late Cretaceous and Early Tertiary times and whose geology is composed of granitic rocks, quartz porphyry, andesite, rhyolite, tuff and sedimentary rocks, is known to have many clay–alunite and gold–silver deposits. For the investigation of new gold deposits near an existing gold mine, both electrical-resistivity and induced polarization (IP) surveys have been conducted based on dipole-dipole array with 10 m-electrode spacing. The survey line is set to be 200 m and nearly normal to the geological strike. Together with the surveys, an investigation borehole was drilled about 130 m away from the survey line, and coring has been conducted during the drilling.

For the interpretation of IP data, linear inversion of IP data based on approximate linearization has been conducted after making 3D inversion of electrical-resistivity data. The inversion result shows that area of high intrinsic chargeability complies with area of high-salinity, which is interpreted from the borehole data. However, the linear inversion has high chance to contain unwanted error during the inversion process since the inversion is based on the linearization approximation of a non-linear problem by assuming the value of intrinsic chargeability is very small. In this study, we first develop an efficient non-linear inversion algorithm to invert the IP data based on finite element method using tetrahedral elements. Then, we apply the developed algorithm to synthetic IP data and compare its results with those from existing IP inversion algorithms. Finally, we make non-linear inversion of the Haenam field data not only to interpret the data more precisely but also to compare its results with existing-interpretation results from linear-IP inversion. The analysis confirms that the non-linear time domain IP inversion reflects the geological characteristics in the survey area, complying with the logging data.