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Subsurface imaging with EM migration of magnetic fields from multiple frequencies

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These days, the supply of water is facing a crisis due to the dramatic growth of population, industrialization, etc. As a result, the groundwater demand is becoming more and more stronger than before. Electrical prospecting is a method usually attempted for groundwater exploration, but setting the observation equipment in desert regions, where water shortage is a serious problem, causes us difficulty using this method there, since there is nothing that assures electrical contact between electrode and the earth. In these circumstances, some other methods that do not require any contact of electrode are needed. VLF or ULF is the method that satisfies the condition. However, none of these methods could provide information necessary to locate groundwater and it is strongly necessary to locate water head of survey areas. There is some shortcomings in the present processing of these VLF and ULF data. In this study, the phase-shift method, which is used in seismic migration, is applied to the horizontal magnetic components with multiple frequencies in order to image subsurface resistivity structures to locate groundwater. The survey is conducted more easily and shortly, if only the magnetic sensors above the surface are enough for estimating the structures. As in the seismic migration, both upward/downward imaging and the exploding reflector concepts can be applied to the horizontal magnetic components. The synthetic data examples show that the migration method is effective for imaging the conductive anomaly. However, it is necessary to select appropriate frequency bands in order to estimate correct subsurface structures. We conclude that this technique gives an approximate resistivity structures quickly and that the migration of magnetic components is expected to provide information on the subsurface. This method is also useful for geological interpretations and for an initial model of the more complicated inversion method.

Keywords: electromagnetic exploration, migration, apparent resistivity structure