Estimation of the correlation between temperature and resistivity using ANN approach

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Accurate estimation of the underground temperature is essential for the resource evaluation of a geothermal reservoir. However, the quantity of temperature data measured in boreholes is usually limited and therefore the estimation of temperature distribution at depth is often difficult. Here, we have tried to indirectly estimate the underground temperature by geophysical data that depend on temperature, by applying the artificial neural network (ANN) approach.
By using ANN trained by geological and geophysical data, this study aims to estimate underground temperature by resistivity data obtained from magnetotelluric (MT) sounding. MT investigation can estimate resistivity of deep underground easily and reasonably. If we can estimate temperature of deep underground from MT data, for example, we can find a promising geothermal reservoir and decide the location for development of a geothermal power plant.
We chose the Kakkonda geothermal area, Iwate Prefecture, Japan, as a test site of this study. It is because the area is underlain by a high-enthalpy geothermal system, reaching 500℃ at 3700m depth. In addition, many drillings and 2D or 3D resistivity surveys were carried out before.
We educated the ANN by position, depth and temperature data from well logs and resistivity data from MT sounding. After that, we tested various ANN structures to verify output temperature with observed well log temperature. As a result, we obtained good agreement at up to about 2.4 km depth where we have a lot of drilling data and fine resistivity data. However, fitness was not good at deeper part because drilling data were limited and the resistivity structure had low resolution at this depth.

Keywords: Artificial Neural Network, Resistivity, Temperature

