# ニューラルネットワークを用いた葛根田地熱地域の比抵抗構造を基にした温度及び浸透率分布の推定

# Resistivity-Based Temperature and Permeability Estimation of the Kakkonda Geothermal Field, Japan, Using a Neural Network

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Estimation of temperature distribution around a geothermal field is important to understand a geothermal system. Previously, temperature distributions were successfully estimated by a neural network based on temperature logs and magnetotelluric (MT) data (Ishitsuka et al., 2018). This method firstly learns the relationship between three-dimensional locations, resistivities and temperatures by a neural network or neural kriging. Then, the optimized neural network is used to estimate temperature distribution based on a resistivity structure obtained by the MT method. On the other hand, not only temperature but also permeability are important physical parameters to evaluate a geothermal system. In this study, we developed a method to estimate permeability distribution as well as temperature distribution by a neural network and neural kriging. The methodology was applied to the Kakkonda geothermal field, Japan. Permeability along a well is not generally measured. Therefore, to create a training data of permeability, we estimated permeability along a well based on porosity deduced from resistivity log using Archie’s law. Temperature-dependence of the resistivity of water was corrected at the processing. In addition, we assumed that the salt concentration at each depth was equal to the salt concentration of the collected fluid inclusion. Subsequently, the porosity was converted into the permeability by the Kozeny-Carman equation.
We then estimated temperature and permeability distribution around the Kakkonda geothermal field. For training data, we used temperature logs and the estimated permeability logs using resistivity profiles at the 7 wells (Hanano and Kajiwara, 1999). To estimate temperature distribution, we used the resistivity structure by Yamaya et al. (2017) using the MT method.
As for the result, the temperature rising was estimated in the deep part, and the point where the high-temperature fluid is considered to be rising from the geothermal reservoir was estimated. The permeability showed a high value, especially in the low resistivity part. The accuracy of the estimated temperature and permeability distribution was evaluated by comparing temperature data measured beneath a depth of 3100 m of WD-1 well. As a result of accuracy verification, neural networks showed the smallest temperature error when the number of the intermediate layers was 2, and the permeability error was the smallest when the number of the intermediate layers was 9. Both the temperature and the permeability of neural kriging were smaller than those of neural networks. Although further development of the methodology to increase the accuracy of the estimation is required, our results demonstrated the effectiveness of our neural network approach to estimate permeability as well as temperature distribution around a geothermal field.
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