An Artificial neural network (ANN) as solute geothermometer

Mark Vollmer, Lars Yström, Fabian Nitschke, Thomas Kohl
Karlsruhe Institute of Technology (KIT), Division of Geothermal Energy & Reservoir-Technology

1 Motivation

Solute geothermometer are constantly developing from conventional element ration to multicomponent applications for reservoir temperature estimation. For increasing geochemical data size and complex coherences within the fluid chemistry, deep learning algorithm of artificial intelligence are beneficial.

2 Method

- The net was trained and validated with high-quality data from Iceland (62 samples)
- The best performing ANN:
  - 7 neurons in in the input layer (geochemical input parameters)
  - 70 neurons in the hidden layer
  - 1 output neuron (temperature estimation)

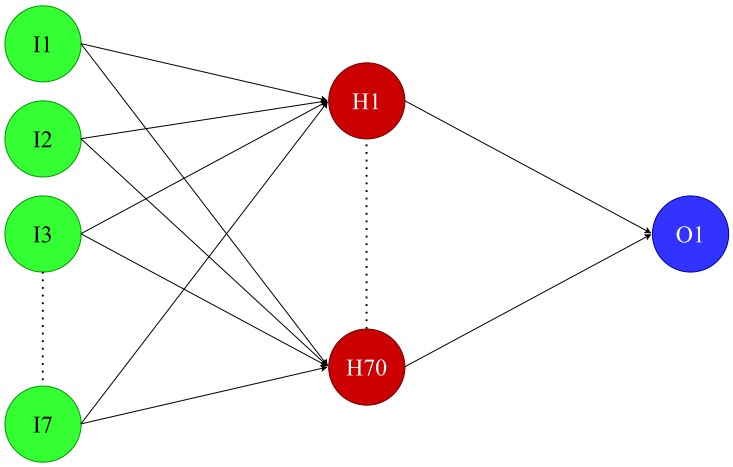

Fig. 1: Schema of ANN solute geothermometer structure

3 Result

The coefficient of determination R^2 of the ANN is 98.2%. With a root mean squared error of 12.5 Kelvin and the mean absolute percentage error of 6.8 % between measured and predicted reservoir temperatures.

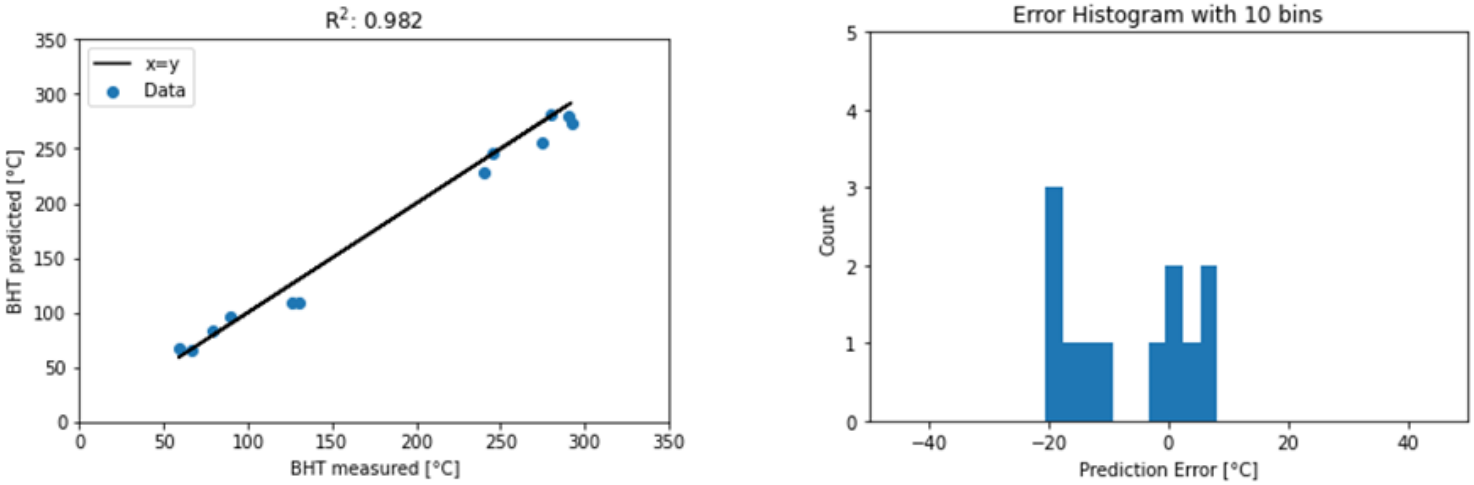

Fig. 2: Regression of the ANN between predicted and measured bottom hole temperature (right diagram). And the error histogram of a test dataset (blue points) in the left picture.

4 Conclusion

A precise reservoir temperature estimation is obtained by a simple standard geochemical fluid analysis.
In contrast to existing geothermometers, the ANN solute geothermometer is easy-to-handle, fast and can be applied on huge datasets. In addition, there is no need for mineralogical knowledge of the geothermal reservoir.