超臨界水貯留層からの熱抽出及びデータ可視化の検討
Evaluation of heat retrieval of super-critical water reservoirs and Visualization of Data

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1. Introduction

Geothermal energy is considered as one of the clean and sustainable energy sources, especially in Japan, where there are a lot of active volcanoes. Recently, NEDO is promoting studies of development of the Super-Critical water (SCW) for affording future energy demand. However, it is very difficult to simulate the thermal and kinematic behavior of SCW that have not been well investigated in the past. On the other hand, to investigate the feasibility of SCW power generation, it is necessary to understand roughly how much power SCW can generate. Hence, we evaluated it with the simplified simulations. To extract the energy from SCW reservoir, there are two ways, i.e. Direct-Use (DU) and Indirect-Use (IU) of SCW. DU is a way to produce and use SCW through no casing or single casing well. IU is a way to extract heat by exchanging heat between SCW reservoir and circulation water through dual casing well. The DU would be a more efficient to extract energy than the IU, although the IU may be superior to the DU in terms of problems such as deposition of Silica scale and corrosion of wells and/or plant piping system. In addition, for easy management of dataset and easy mutual understanding among people such as researchers, engineers and residents, we suggest that dataset should be managed by one platform and visualized by one visualization software.

2. Thermal simulation studies and visualization

Evaluation of heat retrieval from super-critical water reservoirs

First, we calculated the power generated by the DU based on the codes we developed and a commercial software WELLCAT from Landmark-Halliburton Co. that are one of well-used software applied for fluid behavior under high pressure and temperature conditions in the oil industry. The result of our simulation shows that the generation of 27MWe could be expected per well for about one year without any stimulation. Next, we evaluated the IU. The result is that 1.8MWe-6MWe can be generated in the condition that thermal convection is sufficiently developed.

Visualization of Dataset

We explain equipment and environment of visualization and platform using the latest IT technologies.

3. Discussion and Conclusions

The power obtained by the DU is 27MWe, however, the production period is short. Kasahara et al. (2018) indicates that SCW reservoir is intruded to ductile-like region from adjacent brittle zone. Brittle zone commonly has high permeability and developed convection of water. Therefore, it would be possible to make the water flow from the brittle zone to SCW reservoir by hydraulic fracturing. However, the water from brittle zone is expected low temperature, thus it is needed to make sure if the water could have enough heat. We obtained a result that the water is warmed enough, and it can be kept longer. In the IU case, although it is indicated that 1.8-6MWe can be obtained, they can be achieved only when the zone has sufficiently developed convection. However, as Kasahara et al. (2018) indicated, this region is ductile-like. Therefore, it is necessary to make convection zone from 3,800m to 5,000m depth for 1.8MW case and from 1300m to 5000m for 6MW case, although they may be very difficult. These evaluations are simplified and would not be able to explain the phenomena related with the SCW exactly. We need to develop simulators which can explain including behavior of SCW. In addition, to develop the simulators effectively, we also need to utilize test platform and visualization technologies.

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