

Development of a heat source exploration simulator using thermoluminescence and complex geothermal exploration in the southern Yuzawa area, Akita Prefecture

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Thermoluminescence (TL) is a method to evaluate the thermal effects of mineral (quartz) exposure based on thermoluminescence phenomena. The TL intensity is expected to vary depending on the temperature and time the minerals are exposed to, and the geothermal structure can be estimated by comprehensive consideration of TL data, altered minerals in the target area, and geophysical information (Nunohara et al., 2021). In this presentation, a thermoluminescence (TL) geothermal survey method is conducted in the southern part of Yuzawa City, Akita Prefecture, Japan, and the usefulness of the TL is confirmed with reference to the results on alteration minerals and geological maps. After that, we will discuss the geothermal resources in this area based on the combined results of these data.

The Sanzu River Caldera is distributed around this area, and in this caldera, there are basement rocks of Pre-Tertiary granitic and metamorphic rocks from the lower part of the caldera, and the Doroyu and Torageyama Formations are distributed in the upper part. In particular, the Torageyama Formation is composed of partially melted tuff and is widely distributed in this area. Above the Torageyama Formation, the Sanzu River Formation, the Kabutoyama Formation, and the Takamatsudake Volcanic Rocks are distributed. In this survey, geological investigations were conducted mainly around Toragewasa, Yunomatazawa, Akayumatazawa, Oyasuzawa, Kotoridanizawa and Otoridanizawa from the Minase River basin.

The TL measurement results showed that low TL values were observed at Mt. Cochlea, the Minase River basin, and near Akayumatazawa in the vicinity of Otoridanizawa. In particular, the values around Cochlea Mountain and the Minase River are low, suggesting a strong thermal influence. The TL is also low in the vicinity of intrusive rocks and the acidic alteration zone called Kawarage jigoku in this area. This suggests that the TL is a good reflection of geological anomalies. The TL reflects the thermal influence of the last 1-2 Ma, and the formation time of each layer is 2-4 Ma for the Sanzu River Formation and less than 1 Ma for the Takamatsu volcanic rocks. Therefore, the andesites of the Takamatsudake Formation reflect the current thermal influence, while the Sanzugawa Formation is considered to have undergone a recovery of TL values with time as well as the current thermal influence. Thus, it is suggested that each layer of Cochlea Mountain has a different formation time, which is well reflected in the TL.

The alteration minerals can be roughly classified into acidic, neutral, and alkaline alteration minerals. In the western part of this area, alkaline alteration zones were found in Yunomatazawa, and acidic alteration zones were found in Cochlear Mountain. Pyrophyllite was found in the middle reaches of the Minase River, and it can be assumed that there was strong acidic alteration in this area. In this area, acidic and alkaline alteration minerals are distributed locally, while neutral alteration minerals are distributed over a wide area. In other words, there is a correlation between thermoluminescence behavior and hydrothermal alteration.

The gravity map of this area shows that the area where pyrophyllite was found has high gravity. In summary, geothermal resources can be considered to exist in the middle reaches of the Minase River and Cochlear Mountain. In addition, coupled numerical model of TL decay kinetics and heat conduction source will be proposed. That numerical simulation can enable to estimate semi-quantitative model of

heat source and its evolution.

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