

Case study of the behavior of isotope in several hot-spring field

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1. Introduction

The behavior of oxygen and hydrogen isotope in geothermal field suggests the origin of fluids and the water rock interaction in fluid path. And there are various origins of high temperature hot springs in Japan, for example, separation from magma, heating meteoric water in the underground.

In this paper, we show the several samples of the isotopic analysis in high temperature hot spring fields including hot spring binary test field and we discuss the diversity of origin of the hot springs.

2. Examples of several hot spring fields

(1) Hachijo Island

There is a geothermal power plant (3.3MW) in Hachijo Island. To clarify hydraulic system, we measured oxygen and the hydrogen isotope ratio of the hot spring fluid, underground water as spring and the fluid at geothermal power plant. The isotope ratio of spring is similar as rain in Hachijo Island and the value of d is about 20 and hydrogen isotope ratio of spring is about -35 ‰. The hot spring fluid in Hachijo Island has two patterns. One is the origin of meteoric water due to similar isotope ratio as spring water. And another is the origin of seawater due to similar isotope ratio as seawater. The isotope ratio of fluid of geothermal plant is higher oxygen ratio than spring and hot spring water and this suggest that the origin of the fluid of geothermal plant is mixture meteoric and magmatic water.

(2) Matsunoyama hot spring field

In Matsunoyama hot spring field, the test of binary power plant is carried out using Takanoyu #3 hot spring fluid with about 100 °C and 10,000 mg/l Cl. The hydrogen isotope ratio is about -25 ‰ and oxygen isotope ratio is about 0 ‰ higher than meteoric water. And the isotope ratio of Matsunoyama #4 well with 2,000mg/l shows the mixture of meteoric water and Takanoyu #3. The origin of Takanoyu#3 is fossil salt water with methane gas and geo-pressure structure.

(3) Minami-Izu hot spring field

There is high temperature hot spring with about 100 °C and 10,000 mg/l Cl in Minami-Izu hot spring field, too. In this field the temperature and Cl concentration decrease eastern area. The isotope ratios of the several hot springs and underground water exist on the meteoric line. This suggest the origin of hot spring is meteoric water and the reason of temperature and cl concentration decreasing is mixture with low temperature meteoric water.

Keywords: hot spring, geothermal, isotope, meteoric water, fossil salt water