Recharge area of the Akinomiya geothermal field presumed from isotopic ratios of surface waters

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High temperature (200 to 350deg. C) geothermal fluids are obtained from the geothermal fields used for power generation. Oxygen and hydrogen isotopic ratio indicate that the bulk of the geothermal fluid must be of meteoric origin (Craig et al., 1956; Craig, 1963). Generally, the del D value of the geothermal fluid is similar to that of local meteoric water, while the del 18O value of the geothermal fluid is more positive than meteoric water. The enrichment of 18O in geothermal fluid relative to local meteoric water is caused by water-rock reactions (oxygen shift). Additionally, in case andesitic water mixes with geothermal fluid, deuterium and 18O are enriched relative to local meteoric water. Therefore, the isotopic composition of surface water is the basic data from which recharge area and contribution of magmatic fluid are examined.

The geothermal fluid in the Kakkonda field shows the del D value which is similar to that of surface water and the del 18O value which is more positive than local surface water (Takahashi et al., 2000). The geothermal fluid in the Mori field shows the del D and del 18O values which are enriched in the heavier isotopes, so that mixing of andesitic water is assumed (NEDO, 1993; Takahashi, 1994).

The Akinomiya geothermal field is located in Ogachi-machi, south part of Akita prefecture where Geothermal Development Promotion Survey was conducted from 1996 to 1999 by NEDO. The Wasabisawa geothermal field and Uenotai geothermal power plant are located to the northeast of Akinomiya field. The oxygen and hydrogen isotopic compositions were measured for the well discharge, spring water and surface water in this area (NEDO, 1996, 1997, 1998, 2001 ;Naka and Okada, 1992; Abe et al, 1979; Matsubaya and Uchida, 1990). The main survey area is the surface of the geothermal reservoir and the surrounding which is 3 to 4km distant from the reservoir.

The Akinomiya and Wasabisawa fields produced geothermal fluid of low del D value relative to the surface water. The del D values of geothermal fluids are -65 to -70 permil, while the most of the surface waters are -55 to -65 permil as a whole. A few surface waters, whose the del D values are similar to those of geothermal fluids, are candidates for the recharge water. They are located on the north and south of the reservoir. However, the whole area including the surface water of low del D values could not be the recharge area, since the surface waters showing del D more than -65 permil are located in the same area.

The geothermal fluids showing del D less than -67 permil seem to be produced from the surface water (del D more than -67 permil) by some process, such as boiling and phase separation under the reservoir temperature of Akinomiya and Wasabisawa fields (280 to 300deg. C). It is suggested that the geothermal fluid whose del D value is same as those of Akinomiya and Wasabisawa fields are produced from the water having higher del D value (-62 to -68 permil). The surface water showing del D more than -67 permil becomes the candidate for the recharge water.

Another point of view is that the recharge area would be larger than the surveyed area. The Akinomiya, Wasabisawa and Uenotai fields are located in the middle of Sanzugawa volcanotectonic depression (Utada et al., 1999) as a cluster. Oyasu and Akinomiya hot springs are discharge of the geothermal fluids and located to the northeast and southwest of the cluster along Minase River and Yakunai River, respectively. The surface waters showing relatively low and extremely low del D values (-66 to -67 and -79 permil) distribute in the Minase river basin. Then there is a possibility that these surface waters are recharge waters in this geothermal area. It is necessary to concern the area in Sanzugawa volcanotectonic depression and around the geothermal field as the recharge area and to survey larger area than past surveyed area.