

## Geochemical study of geothermal fluid collected with a high temperature borehole fluid sampler

# Youko Miyoshi[1]; Shingo Kawamura[1]; Junichiro Ishibashi[2]; Masami Noto[3]; Takashi Okabe[4]; Masatake Sato[4]; Michinari Sunamura[5]; Katsunori Yanagawa[5]; Tetsuro Urabe[6]

[1] Earth and Planetary Sci., Graduate School of Sci., Kyushu Univ; [2] Earth and Planetary Sci., Kyushu Univ; [3] Kyudensangyo Co. INC.; [4] GERD; [5] Univ. Tokyo; [6] Earth and Planetary Science, Univ. of Tokyo,

Direct geothermal fluid sampling using a high temperature borehole fluid sampler was conducted on April, 2007 at a geothermal well in the Otari area in Nagano prefecture. The sampler had been developed by NEDO for the purpose of sampling without loss of gas species during the sample recovery. This study was aimed to evaluate availability for fluid sampling directly from a geothermal fluid feeder zone without microbiological contamination and geochemical alteration during the sample recovery. In this presentation, we report results of chemical and isotopic analyses of the collected geothermal fluid, and discuss the origin and fluid-mineral interaction.

In the Otari area, the Geothermal Development Promotion Survey was conducted for two years (FY2005 and FY2006). Three geothermal wells were drilled and investigated during the survey. Our study was conducted at one of them (OT-2), which was drilled to 1355 meters. We conducted two times of sampling at the depth of 588.3 m, because calcite scale was observed by a video camera logging just before the sampling. Prior to the direct sampling, we also collected two fluid samples at the well exit, where the geothermal fluid naturally flowed out. In addition to the geothermal samples, we collected 9 hot spring waters and 5 stream waters in the Otari area.

The first procedure for sample distribution from the sampler was gas extraction by expansion of gas component into a plastic syringe. After that, the fluid sample was drawn and transferred into a polypropylene bottle after filtration. Another aliquot was taken for pH and alkalinity determination, and for colorimetric analyses for silica and ammonium, which were conducted within 24-48 hours. Major anions were analyzed using an ion chromatograph, and major cations were analyzed by flame spectrophotometry and ICP-AES. Isotopic compositions were determined by mass spectrometric measurements.

Chemical composition of the geothermal fluid was Na-HCO<sub>3</sub> dominant, which was similar to that of the hot spring waters. However, the geothermal fluid was somehow enriched in Na and K, and depleted in Ca. The isotopic composition showed clear difference; the geothermal fluid had more positive delta-18O value and more negative delta-D value in comparison with the hot spring waters and the local meteoric water in the Otari area.

According to a result of a productivity test during the Geothermal Development Promotion Survey, two fluid feeder zones were identified in the OT-2 well. The shallower feeder zone was around 800m, which is occupied by the Kuruma group consists of sand stone, shale and dacite tuff. The deep feeder zone (below 1000m) was considered to originate from the serpentine layer. We tried estimation for geochemistry of these two geothermal fluids, based on chemical equilibrium between fluid and alteration minerals of each depth. Assuming that chemical composition of the shallow fluid is same as that of the hot spring water in the vicinity, we would estimate that it can contain little CO<sub>2</sub> because kaolinite was not observed as alteration minerals in any depth. This means that most of the CO<sub>2</sub> dissolved in the collected fluid must come from the deep fluid. We tried to find an adequate mixing ratio between the deep fluid and the shallow fluid so that the deep fluid equilibrates with minerals observed in the serpentine layer (serpentine, talc, magnesite) at temperature around 150 to 200 degree. We found that only mixing ratio from 1:3 to 1:5 can agree with above condition. This mixing ratio is accordance with the result of the productivity test which showed about 80% of the geothermal fluid originates from the shallow feeder zone, although our estimation was independently calculated. The report of the Geothermal Development Promotion Survey proposed hydrothermal fluid circulation related with magma of Kazehukidake volcano. This idea would be supported by the deep fluid that contains significant CO<sub>2</sub> and circulates within the serpentine layer.