Groundwater anomalies, hydrogeochemistry, and active structures related to the 2004 Niigata Chuetsu Earthquake

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We have shown many new anomaly areas and zones in temperature and electric conductivity of groundwaters related to the 2004 Niigata Chuetsu Earthquake, using the snow-melting wells (Sato et al., 2005). In this paper, we examine hydrochemistry and oxygen isotope geochemistry of the waters around the epicentral area, identifying the origin and hydrogeological processes.

The groundwaters around the epicentral area show various hydrochemical types as follows: Na-Cl, Na-HCO3, Ca-HCO3, Mg-HCO3, Na-SO4, Ca-SO4, and Na-Ca-HCO3 types. The groundwaters from the anomalous areas and zones are classified into five groups as follows: (1) high temperature, high electric conductivity, low oxygen isotope ratio and Na-Cl, (2) high temperature, high electric conductivity, low oxygen isotope ratio and Na- HCO3, (3) high electric conductivity, high oxygen isotope ratio and Na-Cl, (4) low temperature, low electric conductivity, low salinity and Na-HCO3, and (5) low temperature, low electric conductivity, low salinity and Ca-HCO3 groups. The difference of these groups represents differences in hydrogeology and flow system of the groundwaters along active faults in the Chuetsu area.

The seismic fracturing may have increased permeability and assisted groundwater flow. It is likely that these new anomalies of groundwater indicate the seismic fracturing near the surface along the Yukyu-zan active fault, its inferred southwestern extension to Ojiya City, and the inferred northern extension of the Muikamachi active fault. On the basis of the distribution of the anomalies, some buried active faults are inferred as follows: N-S trending fault in the downtown area of Ojiya City, WNW-ESE trending fault in the Kawaguchi area, and NNE-SSW trending fault in the Horinouchi area. The Torigoe and Katagai active faults were not activated during the earthquake.