Geochemical study of the Uchinomaki hot spring within Aso caldera: time series change before and after the Kumamoto Earthquake

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The Uchinomaki hot spring is located in the north end of Asodani that is the northern part of Aso caldera floor. Some of the hot springs became disabled to pump up hot water after the 2016 Kumamoto earthquake, whereas spontaneous hot spring emanation from some other hot spring wells was recognized. Water emanation from open fissures developed in a rice paddy was also observed at three locations around the Uchinomaki hot spring area. As occasion of these drastic changes in water discharge, horizontal sliding of a kilometer-scale geologic block caused by vibrations from the earthquake was proposed based on a geophysical study (Tsuji et al., 2017). If it is the case, a reservoir of the Uchinomaki hot spring has not be affected by the earthquake and accompanying ground deformation. Actually, new wells drilled just beside abandoned ones have been successfully restore pumping hot spring waters. In order to provide supporting evidence for the geophysical study, we conducted chemical analysis of hot spring waters.

More than 30 water samples were collected from the Uchinomaki hot spring and adjacent areas. After measurement of temperature, pH, electic conductivity and oxidation-reduction potential, the water sample was filtered with a 0.45 um disk filter and stored. Chemical analysis was conducted by ICP-OES for cations (Na^{+}, K^{+}, Ca^{2+}, Mg^{2+}, Fe^{2+}), ion chromatography for anions (Cl^{-}, SO_4^{2-}), and alkalinity tiration for carbonate (HCO_3^{-}). Isotopic composition of hydrogen and oxygen was determined by Wavelength-Scanned Cavity Ring-down Spectroscopy.

Time series change before and after the earthquake in hot spring water chemistry from the Uchinomaki area was not recognized. Their chemical composition was characterized by SO_4-rich signature, which is commonly observed in groundwater within Aso caldera. Groundwater collected from the area on the southside of the Uchinomaki area is known as “Akamizu” from its high Fe concentration associated with high SO_4 concentration. In this study, the Uchinomaki hot spring waters showed Na+K-rich signature, whereas Akamizu groundwaters showed Ca-rich signature. The difference in cation composition would be attributed to that Uchinomaki hot spring and Akamizu groundwater have distinctive reservoirs.

The most vigorous emanation from a rice paddy was observed at the southwest side of the Uchinomaki hot spring area, which is in accordance with that the geophysical study demonstrates westward movement of the horizontal sliding. The emanated warm fluid showed Fe-rich and Ca-rich signature that is similar to chemical composition of the Akamizu groundwater. The horizontal landslide is likely not to have affected the fluid reservoirs but caused significant change of surface groundwater pathways in wide area around the Uchinomaki hot spring.

Keywords: Aso caldera floor, Hot spring reservoir, Horizontal slide

