

Isotopic and hydrogeochemical studies of springs and groundwater in the Higashi-Hachimantai area, Iwate Prefecture

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The purpose of this study is to understand hydrogeochemistry of springs and groundwater in the Higashi-Hachimantai area, Iwate prefecture, Northeast Japan, which is located on northern flank of Iwate volcano and southeastern margin of Hachimantai volcanic groups. Spring, ground and river water samples were collected in and around study area, and major dissolved ions and stable isotopes of O, H, C and S of these samples were measured.

Dissolved ion content of most water samples in study area is larger than that in surrounding area. Major chemical compositions of water samples were divided into two types on the boundary of Matsu River through the central part of study area. One is a Ca-HCO₃ (Iwate) type water in Kanazawa district at the southern part of the river and another is a Ca-SO₄ (Hachimantai) type water in Kashiwadai district at the northern part. The groundwater samples of Iwate and Hachimantai types are also different from each other in d-excess value which ranges from 14.6 to 16.4 in the former and from 17.7 to 21.0 in the latter. This means that the springs and groundwater of Kashiwadai district are recharged on the Hachimantai volcanic groups and those of Kanazawa district are recharged on the Iwate volcano, because the d-excess of meteoric water in the Northeast Japan have higher value in the Japan Sea (west) side and it gradually declines toward the Pacific Ocean (east) side. Thus the groundwater in study area is divided into two types such as Iwate (Ca-HCO₃) type in southern part and Hachimantai (Ca-SO₄) type in northern part.

The d¹³C values of dissolved inorganic carbon (DIC) in spring and groundwater samples were widely ranging from -20.1 to -5.7 per mil, and those of Iwate type groundwater have higher values compared to other water samples. This could be interpreted as a result of the effect of volcanic CO₂ gas to DIC in groundwater, because it is not necessary to consider the influence of marine carbonate minerals in study area. Therefore, bicarbonate-rich Iwate type groundwater in the Kanazawa district is formed by dissolving volcanic CO₂ gas to the groundwater recharged on northern slope of Iwate volcano.

The d³⁴S values of dissolved sulfate in water samples were different in southern and northern parts of study area as well as major chemical composition and d-excess. The d³⁴S values of two water samples in Kanazawa district were higher values of +10.0 and +12.3 per mil, while those of two water samples in Kashiwadai district were lower values of -1.6 and -2.6 per mil. The former high values should be derived from volcanic sulfur species, such as SO₂, as Iwate type groundwater is affected by volcanic gases. On the other hand, the latter low values seem to be produced by sulfide minerals such as Fe₂S, as Aka River which is an acid river containing acid mine drainage from Matsuo mine located on about 4km northwestern part of study area, has lowest d³⁴S value of -6.2 per mil. Therefore, sulfate-rich Hachimantai type groundwater in Kashiwadai district is formed by the oxidation of sulfide minerals caused by the groundwater recharged on the Hachimantai volcanic groups around the Matsuo mine. According to the measurement of flow rate in the Aka River carried out west and east sides of study area and the difference between ground and river water chemistries, the infiltration water from the river would not contaminate the groundwater.