

Characteristic of water quality and stable isotope in groundwater at Aizu district, western part of Fukushima prefecture

Shiho Yabusaki^{1*}, Yasuo Shimano², Kazuyoshi Asai³, Masaya Yasuhara⁴, Yuichi Suzuki⁵, Hiroshi Takahashi⁴, Akihiko Inamura⁴

¹Faculty of Symbiotic Systems Science, Fukushima University, ²Department of Art, Bunsei University of Art, ³Geo science laboratory, ⁴Geological Survey of Japan, AIST, ⁵Faculty of Geo-Environmental Science, Ritssho University

Aizu district, which is located at western part of Fukushima prefecture, has some different geology, that is volcanic area (Mt. Bandai, Mt. Azuma, Mt. Hiuchigatake and Numazawa) and non-volcanic area. In the volcanic area of Mt. Bandai, Mt. Azuma, Mt. Hiuchigatake, the andesite is distributed. In the Numazawa volcanic area, the rhyolite and dacite are distributed. In the non-volcanic area, the sedimentary rock, granite and accretionary prism spreads widely. Because the different geology is distributed in the Aizu district, it is thought that the water quality of groundwater and spring water is different in this area. For example, thus the igneous rocks (e.g. andesite, granite) include a lot of SiO₂, groundwater and spring water of these area includes highly-concentrated SiO₂. The research of water quality in large area of Aizu district has not been carried out. So, the objective of this study is to clarify the characteristics of water quality and stable isotopes in Aizu district.

The study area is 17 municipalities, which are Aizuwakamatu City, Bandai Town, Inawashiro Town, Kitashiobara Village, Kitakata City, Nishiaizu Town, Aizubange Town, Aizumisato Town, Yanaizu Town, Mishima Town, Kaneyama Town, Tadami Town, Showa Village, Shimogo Town, Tenei Village, Minamiaizu Town and Hinoemata Village. The investigation point for spring water is 70 points, groundwater is 3 points, river water is 12 points, lake water is 7 points and tap water is 2 points, it is 94 points in total. The EC, pH, water temperature and ORP were measured in each point. The water quality (Na⁺, K⁺, Mg²⁺, Ca²⁺, Cl⁻, NO₃⁻, SO₄²⁻, HCO₃⁻), SiO₂, stable isotopes of oxygen and hydrogen were analyzed for all samples, and stable isotope of carbon was also measured at some point.

The EC values is under 100 μ S/cm at many points. The pH indicates from the neutrality to the acidity. The water quality indicates the Ca-HCO₃ type or Na-HCO₃ type at most points. However, in Mt. Bandai area, Ca-SO₄ type is existed and dissolved materials is relatively large. Around or near Mt. Bandai, it is suggested that the water quality was affected by the volcanic gas and volcanic hot spring. Na-Cl type and other types slightly existed. Because the dissolved materials are low in the mountainous region, it is thought that the residence time in this area is relatively short. The SiO₂ concentrations are varied by a region because of different geology.

The average of $d^{18}\text{O}$ is -11.0 permil and $d\text{D}$ is -69 permil. The stable isotopes are relatively low in the Minamiaizu Town and Hinoemata Village. Minamiaizu Town and Hinoemata Village are located at inland with heavy snowfalls, so the stable isotope values decrease in these areas. The relation between stable isotopes and elevation is not clearly in the large area as Aizu district. However, the negative correlation between stable isotopes and elevation is existed around Mt. Bandai and Mt. Azuma area. For most point, the d-excess values are distributed from 15 to 25, it appears that d-excess values are affected by the origin of water vapor (i.e. Pacific origin or Japan sea origin). The local meteoric water line of Aizu district is $d\text{D} = 6.4d^{18}\text{O} + 1.3$ ($r^2 = 0.780$), the slope and intercept of y axis are lower than that of Craig's meteoric water line ($d\text{D} = 8d^{18}\text{O} + 10$). It is expected that the evaporation affects the stable isotopes in these area. And volcanic gas may also affect the stable isotopic ratios.

Keywords: Aizu district, groundwater, spring water, water quality, stable isotopes