Elucidation of the relationship between glacier melting water and water resources of mountain foothills using isotopic altitude effect in Mt.Kenya

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Mt. Kenya(5199 m) has a glacier on its top despite being on the equator. However, the glaciers of Mt. Kenya have been shrinking by recent global climate change, which is causing changes in the local ecosystems. In the area around Mt. Kenya, the rainfall can’ t stably supply water to farmland and daily life because the precipitation is less and its fluctuation is large. Coffee, tea, roses and so on have been produced by the availability of ground water derived from the mountain body in this area. However, the degree of the contribution of glacial melt water to the water environment of the area around Mt. Kenya has not been made clear.

The purpose of this study is to elucidate the condition of water environments of Mt. Kenya, assess the degree of the contribution of glacial melt water to the groundwater in Mt. Kenya and, ultimately, to estimate the impact of the ongoing reduction of the glaciers on the water environments in the local area. The sampling of glacial ice, spring water, river water, and rain water was done in the alpine and moorland areas(>3000m a.s.l.), and the sampling of river water was done in the foot areas(<3000m a.s.l.)in Mt. Kenya. The oxygen and hydrogen stable isotope ratios of these water samples were analyzed to confirm the altitude of source of both river water and spring water sampled in mountain foot(2000m a.s.l). I brought these samples back to Japan and measured oxygen and hydrogen isotope ratios.

We can figure out the high altitude effect that the higher-altitude rainfall of mountain indicates lower oxygen isotope ratio, from the oxygen isotope ratio of the rainfall sample in Mt.Kenya.
By the calculation of this high altitude effect, we were able to estimate altitude of source of spring and river water that are used at mountain foot. The oxygen isotope ratio of Thigedi river (altitude:1997m) was -3.089 ‰. I assign this value to the high altitude effect line (y = -469.35x +3630.4), it becomes 5080.2 (m). This altitude area is covered with glacier and a lot of snow. Therefore, these results suggest that the foot river water is more likely to receive the melting water of glacier and snow. On the other hand, the estimate of altitude of spring water (altitude: 1997m) is 5191.8 (m). It is suggested that a glacier and the snowfall of the mountaintop part greatly contribute to the spring of a mountain foot.

From the data of water level (1985 - 2016) of Naromoru River , it was confirmed that the amount of river water in the mountain foot tends to decrease. On the other hand, the rainfall in the high altitude zone does not show a large decreasing trend. Therefore, the decrease of the river water level at the mountain foot is considered to be affected by the recent rapid decrease of the glacier melting water.
Tritium, CFCs and oxygen isotope were also analyzed. The result of analysis indicates that it take 40-60 years since water of glacial area around 5000m in altitude was absorbed in the body of Mt. Kenya until it comes out as spring water in the mountain foot. The area of 5000m of Mt. Kenya had large glaciers 40-60 years ago. These results mean that the past (40-60 years ago) glacial melt water has come out to the present foot area. Consequently, the present glacial reduction of Mt. Kenya suggests that water volume of the foot area will decline in the future. It is expected that this decrease of water resource greatly affect the local agriculture and daily life in near future.

Keywords: East Africa, Glacier reduction, Water environment, Stable isotope

