Intensive observation of permafrost in the Kuranosuke Cirque of Tateyama Mountains in 2021

*Takumi Okada[1], Konosuke Sugiura[1], Kotaro FUKUI[2], Masahiro Hori[1]

1. University of Toyama, 2. Tateyama Caldera Sabo Museum

Permafrost exists at high latitudes, such as Siberia and Alaska, and at high altitudes, such as the Himalayas, and accounts for about 25% of all land area in the Northern Hemisphere. Permafrost itself is sensitive to the effects of climate change, and according to the IPCC Special Report (IPCC, 2019), permafrost temperatures are expected to increase, leading to widespread permafrost thawing. Therefore, it is an important topic to consider the impact of global warming on mountainous regions in the future. In this study, we investigated the permafrost in the Kuranosuke-Cirque in the Tateyama Mountain Range. In addition, we analyzed the recent temperature change in the alpine area around the North Alps using the mesh data of the average value for the past 30 years by the Japan Meteorological Agency, and discuss the relationship between permafrost and temperature in the mountain area. The survey was conducted on September 29-30, 2021, on a protalus rampart in the Kuranosuke-Cirque in the Tateyama mountain range. This site has been investigated in the past and permafrost has been found (e.g. Fukui, 2000; Fukui, 2004). Mesh data analysis was performed using annual mean temperatures of mesh climate values 2000 and mesh normal values 2010, and the results were drawn in QGIS. Field observations showed that the ground temperature was below 0.0˚C at depths of 1.0 m and below, and frozen ground was reconfirmed. This is the same depth as about 20 years ago. Ice masses were also found in the soil around the area where the ground temperature dropped below 0.0˚C. The frozen layer continued to a depth of 2.0 m, and is likely to continue deeper. The ground temperature in the active layer increased significantly compared to about 20 years ago. Considering the fact that the ground temperature at depths below 1.0 m was less than 0.0˚C just before the snowfall season, it is highly likely that this frozen layer will persist until the snowmelt season of the following year. Furthermore, the annual mean temperature calculated from the relationship between the annual mean 1.0 m ground temperature and the annual mean air temperature at 88 sites in Japan was -3.8˚C when the annual mean 1.0 m ground temperature was 0˚C, which was lower than the annual mean temperature around the Kuranosuke-Cirque area obtained from mesh anomalies. The frozen ground reconfirmed by this observation is not distributed over a wide area, but is considered to be sporadic. In order to clarify the cause of temperature increase in the active layer and to confirm the preservation of permafrost, multi-year observations and experiments to reproduce ground temperature profiles are necessary. Analysis of the JMA mesh data shows that the Hida mountain range has a larger temperature increase and decrease than the surrounding urban areas. In particular, there was almost no decrease in temperature in the surrounding urban areas. The northwest side of the mountain ridge showed a decrease in temperature, while the southeast side showed an increase in temperature. This may be due to the northwestern monsoon in winter and the decrease in snow and ice cover, but further analysis is needed.

Keywords: permafrost, Mt.Tateyama, ground temperature, Kuranosuke Cirque

