

Evidence of permafrost environment during the Late Glacial in the southern Japanese Alps

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Glaciation in the Japanese Alps has been believed to act around the highest peaks until the end of the last glacial period, although the interpretation of some blocky deposits in the cirques has been questioned on their glacial origin and the data on absolute age corresponding to the Late Glacial are extremely limited. We found ¹⁴C ages showing the end of the Late Glacial from such blocky deposits around Mt. Ainodake (3189 m a.s.l.), southern Japanese Alps. Thus, the significance of this new data is discussed.

The summit of Mt. Ainodake is surrounded by cirques which were thought to be mostly formed during the Last Glacial Maximum. About 10-meter thick lobate deposit covered with an openwork bouldery layer lies on the eastern side of the northern cirque of Mt. Mibu (2999 m a.s.l.), a small peak composes the western shoulder of the summit area. The southern cirque of Mt. Mibu is completely filled with large boulders, and the bouldery deposit appears to overflow from the cirque, forming a pattern of ridges and furrows on the surface. The lower end of the deposit is fringed by steep slope 20 m in height. The characteristics of these deposits are identical to those of typical relict rock glacier, which indicates former permafrost environment whatever origin of the internal ice. Here, the northern deposit was named Mibu-north rock glacier and the southern one Mibu-south rock glacier.

Gully erosion made an outcrop on the front of Mibu-north rock glacier. Three samples for dating were collected from the boundary between the deposit and underlying bedrock. One sample was taken at the depth of 1.2 m on the frontal slope of Mibu-south rock glacier using a portable engine auger. The samples were dated on the basis of the ¹⁴C content counted by AMS.

The calibrated ages (within one standard deviation) of the samples from the Mibu-north rock glacier are 10661-10575 cal. yBP, 11215-11181 cal. yBP and 18027-17830 cal. yBP. Two samples indicate that the rock glacier advanced until the end of the Late Glacial to the beginning of the Holocene. The oldest age probably derives from lower (i.e. older) soil than the others. The sample on the frontal slope of the Mibu-south rock glacier shows the ages of 10241-10211 cal. yBP, which indicates the development of the soil in the beginning of the Holocene. Thus, the rock glacier reached at the present position at least until that time.

Rock glaciers flow down much slower than temperate alpine glaciers. Thus, rock glaciers are thought to take hundreds to thousands years to be a well-defined form. It means that the Mibu-north and -south rock glaciers were formed during the Late Glacial. In the Late glacial, permafrost was dominant even on the highest part of the southern Japanese Alps. A number of previous studies misinterpreted such deposits identical to rock glaciers as Late Glacial moraines in Japan. Thus, equilibrium line altitude for the Late Glacial has been overestimated.

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