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CORRESPONDENCE

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First discovery of fossil ice of 1000–1700 year B.P. *in Japan*

A fossil ice mass was found in the lower part of the Kuranosuke snow patch (lat. 36°35′ N., long. 137°37′ E.; 2700 m a.s.l.) in the northern Japan Alps, Japan. Radiocarbon dating of plant samples in the dirt layers within the ice showed that the fossil ice was formed 1000 year B.P. and before. This is the first discovery of such old fossil ice in Japan.

At present there are no active glaciers in Japan but there are many perennial snow patches in the mountain ranges of central Japan and Hokkaido (Higuchi and others, 1986). Kuranosuke snow patch, shown in Figure 1, is one of them, and it exists in a cirque formed during the ice age. The thickness of the ice mass is 30 m, possibly the thickest perennial ice in Japan (Yamamoto and others, 1986).

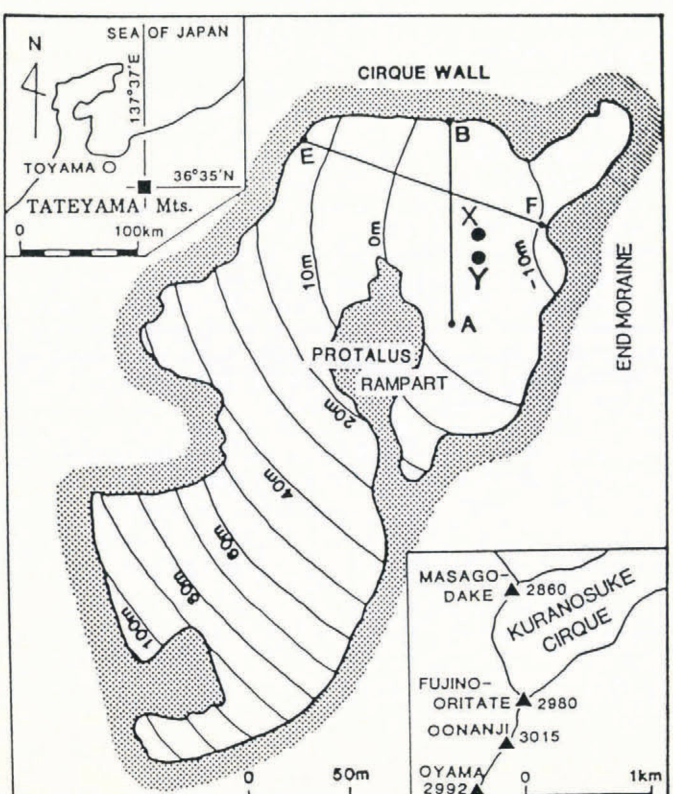

Fig. 1. Topographic map of the Kuranosuke snow patch in September 1983 and geographical maps. The shape and size in October 1979 were almost the same as in this figure. The contour lines represent the relative heights of the snow-patch surface. Lines AB and EF are measurement lines of impulse-radar sounding in September 1983. Y, vertical hole where the dating samples 1 and 2 were taken. X, position where the dating sample 3 was obtained.

The internal structure of the snow patch, which has been discovered by impulse-radar sounding (Yamamoto and others, 1986), is shown in Figure 2. There is an unconformity (u) at depths from 2 to 9 m nearly parallel to the surface, and it separates the ice mass into two parts (Yamamoto and Yoshida, 1987). Such internal structure of the lower ice is almost similar to that of cirque glaciers.

The age of formation of the lower ice was investigated by collecting plant samples for radiocarbon dating from the ice layer at the top and the middle of the lower ice using vertical holes which appear every few years (Yoshida and others, 1983). A piece of a twig (sample 1) and several fragments of pine needles (sample 2) were sampled within a dirt layer within the ice at 16 m depth (point P in Figure 2) in October 1979. A small twig (sample 3) was obtained just below the unconformity (point Q in Figure 2) by ice-core drilling in September 1986. These were the only three samples found in the ice which we could date.

The ages of the twig and the needles were obtained by radiocarbon dating using a Tandetron mass spectrometer with a 3 MeV tandem accelerator, which only needed approximately 5 mg of carbon (Nakamura and others, 1985). Samples from point P were dated at 1720 ± 170 year B.P. (sample 1) and 1480 ± 330 year B.P. (sample 2), respectively. The twig from point Q was also dated as 930 ± 270 year B.P. (sample 3), where 0 year B.P. is A.D. 1950, and the error is evaluated at the one standard-deviation level.

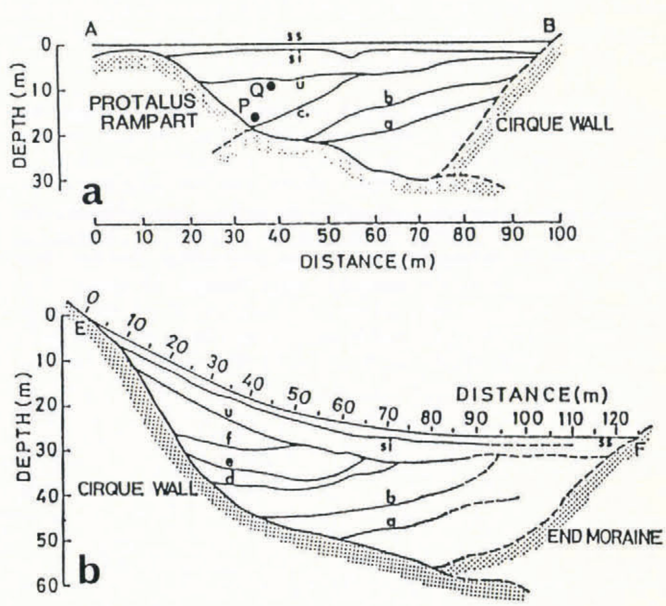

Fig. 2. A cross-section of the internal structure of the snow patch as revealed by impulse-radar sounding. (a) The cross-section along line AB in Figure 1. This line approximately parallels the north–south direction. The sampling position points P and Q are projected on to this plane and marked with a solid circle. The real position is about 15 m east of this plane. (b) A cross-section along line EF in Figure 1, which approximately parallels the fall line. Symbols: ss, snow-patch surface; si, snow/ice interface; u, unconformity; a–f; gravel layers (after Yamamoto and others, 1986).

Since all of the samples have been preserved in a fresh condition, these plants would seem to have been trapped in dirt layers in the ice immediately after falling. It is reasonable to consider that the age of the ice layer enclosing a dating sample is the same age as the sample. Therefore, it can be concluded that the lower part is fossil ice of a 1000 year period from 1700 to 1000 year B.P.

The reason for the existence of such an old ice mass can be considered as follows. First, melting at the bottom of this ice mass would be negligible, since the Kuranosuke snow patch is close to the lower limit of the discontinuous permafrost zone in this area. Secondly, melting at the upper surface of the fossil ice would occur only rarely, when the deep snow cover of the upper part had melted away.

Since the discovery of such fossil ice is quite important for study of the palaeo-environment of the mountain ranges in Japan, detailed investigations are now in progress. The authors wish to thank the Japanese Society of Snow and Ice for permission to use the figures already published in the *Journal of the Japanese Society of Snow and Ice*.

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