Solar cycle around the 9-10th century indicated by the radiocarbon content in tree-rings

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In this paper, we report the feature of the solar cycle during the 9-10th century indicated by the radiocarbon content in tree-rings. Radiocarbon is produced in the earth's atmosphere mainly by the galactic cosmic rays, which are modulated by solar wind and the interplanetary magnetic field. Generally, intense solar activity results in a decrease of the production rate of radiocarbon, while weakening of solar activity brings an increase. The radiocarbon is oxidized to form carbon dioxide and circulates within the carbon cycle. Some of them are absorbed into trees by photosynthesis. Long-lived trees, therefore, retain the information on solar activity, and enable us to investigate the variation of solar cycle in the past.

In the previous paper, we have measured the radiocarbon content in Japanese cedar trees and have clarified the characteristics of solar cycle during the prolonged sunspot minima, so called the Spoerer and Maunder minima. The length of the eleven-year cycle had been stretched by a few years and it was suggested that the cycle length has an inverse correlation to solar activity.

We therefore, measured the radiocarbon content around the the 9-10th century and investigated the variation of the eleven-year solar cycle during this period. Solar activity around this period is speculated to have been relatively high compared to the recent 600 years. As a result, it was revealed that the variation of radiocarbon content has periods of about 8-9 years and 16-18 years, suggesting that the cycle length of the eleven-year cycle had been significantly shortened.

The results of the measurements indicate the dynamic variation of the eleven-year cycle depending on the change of solar activity.

In this paper, we also examine the variation of reconstructed temperatures since the 9th century and discuss the influence of the eleven-year solar cycle on the earth's climate.