Multiscale variations of cosmogenic nuclides over the last 3 kyr: the decadal ^{10}Be record from the Dome Fuji 2001 shallow ice core revisited

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We analyzed cosmogenic nuclides over the entire depth interval of the Dome Fuji shallow ice core drilled in 2001 CE and obtained decadal ^{10}Be and centennial ^{26}Al records covering the past 3 kyr. The analytical procedures followed those of our previous works (Horiuchi et al., 2007a, 2007b, 2008) except for the calibration with the latest nominal value of the ICN ^{10}Be standard (Nishiizumi et al., 2007) we used.

The concentration and flux of ^{10}Be showed almost the same fluctuation patterns throughout the last 3 kyr, implying little meteorological influence on the ^{10}Be fluctuations. Moreover, the time variations of these ^{10}Be indexes agreed well with those of the ^{14}C production rate that was reconstructed from a standard tree-ring ^{14}C record (e.g. Usoskin and Kromer, 2005), but the former lagged slightly the later between 1000 BCE and 500 CE, where the ice-core chronology is not robust. Major increasing peaks of the both nuclides were found not only during the five famous solar minimums of the last 1 kyr (Oort, Wolf, Spörer, Maunder and Dalton; see also Horiuchi et al., 2008) but also at around 750 BCE (Homeric minimum: Martin-Puertas et al., 2012), 350 BCE, and 700 CE. These peaks can be connected to the solar minimums and considered as strong stratigraphic age-control points. Based on such major peaks, we tuned slightly the age model of the Dome Fuji ice core so as to match it to the ^{14}C/tree-ring chronology. As a result, we found a number of coincident spikes of ^{10}Be and ^{14}C, some of which might be caused by short-term cosmic-ray events like those suggested by Miyake et al. (2012, 2013).

Simultaneous variations between ^{10}Be and ^{26}Al were found throughout the past 3 kyr, although the time resolution of the ^{26}Al record is ten times lower than that of the ^{10}Be record. The average ^{26}Al/^{10}Be ratio was 1.95×10^{-3}, which is practically the same as the previous estimation (1.75×10^{-3}; Horiuchi et al., 2007b) based on a small number of samples and the previous (1.1 times higher) nominal value of the ICN ^{10}Be standard. This is the first time to show empirically covariation among the three cosmogenic nuclides ^{10}Be, ^{14}C, and ^{26}Al controlled by solar-activity changes.

From the same Dome Fuji shallow ice core, several climatic/environmental proxies were simultaneously obtained. Thus, we can directly compare those to the cosmogenic ^{10}Be and ^{26}Al proxies without any synchronization errors inevitable in a comparison between different paleo-archives. In this presentation, we will show a result of the comparison between the multiscale variations of the cosmogenic nuclides and those in the climatic/environmental proxies.

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