^{10}Be variations since 1930 CE recorded in the H15 ice core from coastal East Antarctica

*Riko Yagihashi[1], Kazuho Horiuchi[1], Hideaki Motoyama[2], Takeyasu Yamagata[3], Hiroyuki Matsuzaki[3]

1. Graduate School of Science and Technology, Hirosaki University, 2. National Institute of Polar Research, 3. Micro Analysis Laboratory, Tandem accelerator (MALT), The University of Tokyo

Cosmogenic ^{10}Be is produced by a nuclear spallation reaction between galactic cosmic rays and nitrogen and oxygen in the upper atmosphere. After the production, ^{10}Be is immediately oxidized and falls onto the earth's surface, mainly attached to aerosols (Lal and Peters, 1967). Galactic cosmic rays incident on the upper atmosphere vary in intensity depending on the solar and Earth's magnetic fields, so the production rate of ^{10}Be also varies accordingly (Beer et al., 2012). Polar ice cores are ideal archives of ^{10}Be for studying past solar activity because the shielding effect of the Earth's magnetic field is virtually absent in the polar regions. In fact, ice cores from the Antarctic interior, such as the Dome Fuji ice core, have been frequently used to study past solar activity (e.g., Horiuchi et al. 2008; Miyake et al. 2018). For Antarctic coastal ice cores, however, such studies have been limited.

Here we present a ^{10}Be record from 1930 to 2012 CE with a resolution of less than one year, obtained from an ice core drilled at the coastal H15 site in Droming Maud Land, East Antarctica. The H15 site is located at latitude 69°04'10" S, longitude 40°44'51" E and elevation 1030 m, where a 32.01 m long ice core was drilled in 2013 (hereafter H15 ice core). The ice core chronology is based on annual layer counting using the oxygen isotope and chemical species profiles, constrained by SO_4^{2-} signals from stratospheric eruptions and tritium signals from atmospheric nuclear tests. Sample preparation for ^{10}Be analysis was performed at the Paleoenvironmental and Cosmogenic Nuclide Laboratory of Hirosaki University, followed by ^{10}Be determination using accelerator mass spectrometry at the Micro Analysis Laboratory Tandem Accelerator of the University of Tokyo. Additionally, the global ^{10}Be production rates from 1930 to 2012 CE were estimated from instrumental observations of cosmic ray intensity and sunspot number and compared with our ^{10}Be record.

The ^{10}Be concentrations ranged from 0.26×10^4 to 2.96×10^4 atoms/g, with seasonal to multiannual variations superimposed on a broad decadal oscillation. The decadal oscillation appears to be consistent with that found in the global ^{10}Be production rates, which is controlled by the 11-year solar cycle (Schwabe cycle). FFT analysis shows that both the ^{10}Be concentration and production rate time-series have a clear 11-year periodicity with almost equal relative amplitude and phase. We can therefore conclude that the ^{10}Be record from the H15 ice core faithfully preserves the variations in the production rate due to the 11-year solar activity cycle. On the other hand, the ^{10}Be concentration profile also shows seasonal to multiannual variations that differ from the 11-year periodicity, probably reflecting certain climatological and/or glaciological effects referred to as "system effects" (e.g., Abreu et al., 2013). Comparison with the chemical species records in the same H15 ice core may give us a clue to clarify in detail the causes of the higher frequency ^{10}Be variations.

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