宇宙線起源核種を用いた太陽活動研究の成果と今後の展望

宮原 ひろ子 [1]; 横山 祐典 [2]; 松崎 浩之 [3]; 永冶 健太朗 [4]; 北澤 恭平 [5]; 増田 公明 [6]; 村木 綏 [7]; 中村 俊夫 [8]
[1] 東大 理　地球惑星; [2] 東大　理　地球惑星; [3] 東大・原総センター; [4] 名大・STE; [5] 名大・STE; [6] 名大 STE 研; [7] 名大 STE 研; [8] 名古屋大・年測セ

Reconstruction of solar activity using the cosmogenic nuclides

Hiroko Miyahara[1]; Yusuke Yokoyama[2]; Hiroyuki Matsuzaki[3]; Kentaro Nagaya[4]; kyouhei Kitazawa[5]; Kimiaki Masuda[6]; Yasushi Muraki[7]; Toshio Nakamura[8]
[1] Dept. Earth & Planet. Sci., Univ. Tokyo; [2] Dept. Earth & Planet. Sci., Univ. Tokyo; [3] RCNST, Univ. of Tokyo; [4] STE, Nagoya Univ.; [5] STE,Nagoya Univ; [6] STEL, Nagoya Univ.; [7] STEL, Nagoya University; [8] CCR, Nagoya Univ.

The variations of cosmogenic nuclides in the past, reconstructed using the laminated materials such as the tree-rings and ice cores, have revealed a lot of new aspects of the Sun and its influence on climate. Decadal radiocarbon data back to more than 10,000 years ago have indicated that the Sun has ~80-yr, ~200-yr and the longer quasi cycles in its activity level, and that the Sun had experienced several prolonged activity minima as well as the Maunder Minimum in 17th century. Those minima might have caused several cold spells of the earth, often referred to as the Little Ice Age.

In order to see into the mechanisms of the occurrence of the prolonged sunspot activity minima and their influence on climate, we have conducted the measurements of radiocarbon content in Yaku-cedar trees with annual time resolution. The results show that the cycle lengths of the “11-year”/“22-year” cycles change according to the level of solar activity. We find that the actual lengths of the “11-year” and the “22-year” cycles were ~14 years and ~28 years during the Maunder and the Spoerer minima, and the lengths were shorter during the Early Medieval Maximum Period. These changes of the cycle lengths suggest that the several parameters related to solar dynamo such as the speed of the meridional flow and the rotation rate had been modulated during those events. The difference of the features of solar variation between the two types of grand solar minima, the Maunder-type (duration: ~80 years) and the Spoerer-type (duration: ~120 years), might be in the persistency of weakening. The lengthening of solar cycle is more significant and persistent during the Maunder Minimum, but is likely that the weakening of solar activity is intermittent during the Spoerer Minimum.

We have also started the measurements of beryllium-10 in the ice core from the Antarctica, aiming to detect the irregular and small variation of the GCRs at the very beginning of the Maunder Minimum. The measurements of beryllium-10 with annual time resolution would also make it possible to examine the long-term changes of the modulation of the GCRs in the heliosphere. In this paper, we will summarize our results obtained so far and discuss the outlook of the study using the cosmogenic nuclides.