樹木年輪中の放射性炭素濃度分析による太陽活動および地磁気変動の復元について

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Reconstruction of solar activity and geomagnetic field intensity based on the carbon-14 content in tree rings

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The history of solar activity can be investigated by the proxy records such as carbon-14 content in tree rings and beryllium-10 in polar ices. Proxy based observations of solar activity in the past have revealed that the sun holds several quasi periods of a wide range of time scales. In order to clarify the mechanism of such long-term variations of solar activity, we have measured the carbon-14 content in tree rings with annual time resolution and have investigated the transitions of the behavior of the eleven-year solar cycle, which is the most fundamental cycle of solar activity, associated with the long-term variation of solar activity level at centennial to millennial time scales. As a result, we have found that the length of the eleven-year cycle varies depending on the level of solar activity, from ˜9 years to ˜14 years. The duration of the cycle tends to be longer as the level of solar activity becomes low. It has been also suggested that such variation of the length of the decadal solar cycle affects the periodicity of climate change.

The variation of carbon-14 content in tree rings also reflects the history of geomagnetic field intensity since incoming cosmic rays are modulated both by solar magnetic field and geomagnetic field. However, it is difficult to separate the signals of solar activity and geomagnetic activity in carbon-14 record especially for centennial to millennial time scales. In fact, there are a few scenarios for the long-term variation of solar activity level derived from carbon-14 record. We discuss the possibility to constrain the history of solar activity level based on the transitions of the length of solar decadal cycle, and to also derive some information on the variation of geomagnetic field intensity from the same carbon-14 record.