Category and Session number: OA13
Preferred Mode of Presentation: Poster

Long-term periodic variation of solar activity detected from lacustrine laminated diatomite of the Middle Pleistocene

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Millennial-scale productivity cycles are present in Middle Pleistocene (ca. 500 Ka) diatomite at Hiruzen, Okayama, Japan. The diatomite consists of alternating couples of laminae which make up an annual band, "varve." These thickness variations reflect climate-related changes in diatom productivity. We detected 11-year sunspot cycles by spectral analysis of laminae-thickness variations from these continuous 8,000-year series of varves.

Several studies imply that solar-activity controls the global climate system over longer-term intervals. This possibility is supported by the correlation of the Little Ice Age and the Maunder sunspot minimum (Schonwiese et al., 1994), and by millennial-scale cycles in the variation of atmospheric 14C production (Stuiver et al., 1991). The discovery of worldwide millennial-scale oscillations in climate, so called "Dansgaard-Oeschger cycles" and "Heinrich events" have also been reported (e.g. Grootes et al., 1993). Solar variations are thought to be one of the causes of millennial-scale climate oscillations, but this idea has lacked supporting evidence until now.

We applied wavelet analysis to the time series of 11-year-cycle spectral intensity obtained by FFT to extract long-term solar variations from the varve data more clearly. The result shows millennial-scale cycles of 900 and 2,000 to 2,300 years (Fig. 1) and implies that millennial-scale changes in the solar activity have caused millennial-scale oscillations in global climate.

Keywords: varved diatomite; wavelet analysis; solar activity; Pleistocene;

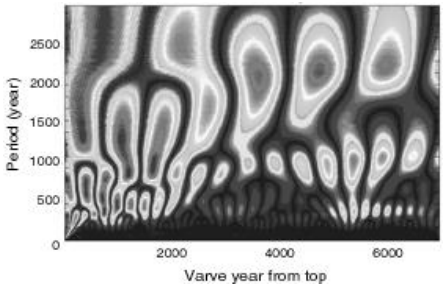

Figure 1. Wavelet analysis to the time series of 11-year-cycle spectral intensity obtained by FFT. The result shows millennial-scale cycles of 900 and 2,000 to 2,300 years

References

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