

720,000-year records of Antarctic and oceanic temperatures related to solar forcing and CO₂

*Ryu Uemura¹, Hideaki Motoyama², Valerie Masson-Delmotte³, Jean Jouzel³, Kenji Kawamura², Kumiko Goto-Azuma², Shuji Fujita², Takayuki KURAMOTO^{2,10}, Motohiro Hirabayashi², Takayuki Miyake², Hiroshi Ohno^{4,2}, Koji Fujita⁵, Ayako Abe-Ouchi⁶, Yoshinori Iizuka⁷, Shinichiro Horikawa^{7,5}, Makoto Igarashi², Keisuke Suzuki⁸, Toshitaka Suzuki⁹, Yoshiyuki Fujii²

1. University of the Ryukyus, 2. National Institute of Polar Research, 3. LSCE, CEA-CNRS, 4. Kitami Institute of Technology, 5. Nagoya University, 6. The University of Tokyo, 7. Hokkaido University, 8. Shinshu University, 9. Yamagata University, 10. Fukushima prefectural center for environmental creation

The δD temperature proxy in Antarctic ice cores varies parallelly with CO₂ through glacial cycles with a puzzling asynchrony. To understand the mechanisms responsible for this association, precise and well-dated records of Antarctic and Southern Ocean temperature are needed. Here, we performed multiple isotopic analyses on an Antarctic ice core and reconstructed the records of temperature variations at this Antarctic site and the oceanic moisture source back to 720,000 years before present, which extend the longest records by 300,000 years. We found that (1) Antarctic temperature is affected by large variations in local insolation that are induced by obliquity. At the 41-kyr obliquity periodicity, the CO₂ variations display higher coherence with ocean temperature than Antarctic temperature. (2) At the obliquity periodicity band, changes in annual mean insolation were followed by changes in Antarctic temperatures, CO₂, and oceanic temperatures with phase lags. (3) the magnitude of the phase lag is minimal during low-eccentricity periods, suggesting that secular changes in the global carbon cycle and the ocean circulation modulate the phase relationship among temperatures, CO₂ and insolation.

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