

ドームふじ氷床コア中の宇宙線生成核種による Blake エクスカーションの高精度検出

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Reconstruction of the Blake geomagnetic excursion using the cosmogenic nuclides in Dome Fuji ice core

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English abstract

Cosmogenic radio nuclides (CRN) are produced in upper atmosphere as a result of interactions between cosmic rays and the atmosphere (Yokoyama et al. 2005; Matsumoto and Yokoyama, 2013). Various geological archives including ice and sediment cores record geomagnetic variations in the past as the signal of CRN flux changes that can be used as a fingerprint of Earth's magnetic field variations. Reconstructions of leads and lags of global climate events in the past with regards to the various climate forcing is a key to understand the mechanisms (cf., Yokoyama and Esat, 2011) yet it is difficult for the period older than the 50,000 years ago due to the limit of radiocarbon dating (Yokoyama and Esat, 2004). Paleo-magnetic stratigraphy is one of the solutions and geomagnetic excursions can be used to overcome this difficulty. Here we reconstruct the Blake excursion occurred during the last interglacial (ca. 120 ka). CRN are measured using accelerator mass spectrometry (AMS) and clear increases in their concentrations are seen in Dome Fuji ice core obtained from East Antarctica. Dating was done precisely employing N₂/O₂ dating technique (Kawamura et al., 2007) and distinct several peaks are able to be used for tie points for various core samples not only ice cores in both hemisphere but also for sediment samples in different latitudes. In this presentation, we also introduce various important implications using this time markers that is determined first time in the world using ice core CRN.

日本語

高精度年代決定は地球科学の研究を行う上で極めて重要な要素のひとつである (Yokoyama and Esat, 2004)。放射性炭素はその中でも、過去 5 万年間の年代決定に幅広く用いられてきている (Matsumoto and Yokoyama, 2013)。また、過去の気候変動の多地域情報の前後関係を知ることは、気候システムの理解の深化の上で重要である (Yokoyama and Esat, 2011)。地球磁場は、過去に何度かのエクスカージョンと呼ばれる不安定な状態を経験している。エクスカージョンは全球的にそのシグナルを残していることが予測されるため、過去の地磁気イベントを使った高緯度および低緯度の気候媒体同士の比較は、古気候学的に有用である。地球に入射してくる高エネルギー宇宙線と地球大気との相互作用で生成される宇宙線生成核種の生成率は、地球磁場強度の変動を復元することに利用可能である (Yokoyama et al.,

2005)。講演では東南極氷床ドームふじ氷床コア中の宇宙線生成核種の分析を行い、N2/O2法により高精度に年代決定された(Kawamura et al., 2007)氷床コアを用いて、最終間氷期におこったブレイクエクスカーションの世界で初めての検出についての成果とその重要性について報告する。

References

- Kawamura, K., Parrenin, F., Lisiecki, L., Uemura, R., Vimeux, F., Severinghaus, J.P., Hutterli, M.A., Nakazawa, T., Aoki, S., Jouzel, J., Raymo, M.E., Matsumoto, K., Nakata, H., Motoyama, H., Fujita, S., Goto-Azuma, K., Fujii, Y., and Watanabe, O. (2007), Northern Hemisphere forcing of climatic cycles in Antarctica over the past 360,000 years, *Nature*, 448, 912-917.
- Matsumoto, K., and Yokoyama, Y. (2013), Atmospheric $\Delta^{14}\text{C}$ reduction in simulations of Atlantic overturning circulation shutdown. *Global Biogeochemical Cycles* 27, 296-304.
- Yokoyama, Y., and Esat, T. M., (2004), Long term variations of uranium isotopes and radiocarbon in surface seawater as recorded in corals, *Global Environmental Change in the Ocean and on Land*, 1, 279-309.
- Yokoyama, Y., Aze, T., Murasawa, H., and Matsuzaki, H. (2005), Terrestrial cosmogenic nuclides as a tool for studying earth surface processes. *Journal of Geological Society of Japan*, 111, 693-700.
- Yokoyama, Y., and Esat, T.M. (2011), Global climate and sea level: enduring variability and rapid fluctuations over the past 150,000 years, *Oceanography*, 24; 54-69.