Holocene climatic change record in the sediment core from Lake Richardson, East Antarctica

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In Antarctica, large-scale warming event in 2000~4000yrBP is widely reported event. In order to constrain the time scale of this event, 14C dating is essential. However, Antarctic samples have a general problem on 14C dating, called “reservoir effect”, whereby the correlation of various global events are disturbed by the introduction of older carbon into newer sediment. The aim of this study is to consider the impact of “external old age” using the sediment core sample from Lake Richardson, and clarify the paleoenvironment in surrounding regions.

Lake Richardson in Enderby Land, East-Antarctica, is a freshwater lake covered with ice. Sediment core was sampled in the center of the south-western segment of Lake Richardson during the Japanese Antarctic Research Expedition in 1997~1998. The core consists of clay with lamina and alternate dark and light laminas are observed entirely. From SEM observations, the lighter layers contain several species of freshwater diatom fructules, for example Achnanthes sp. The darker layer, depth 123cm and 131.5cm, contain spherical scale, showing similar features as that of chrysophyta cyst. $\delta^{13}C_{PBD}$ value of the organic carbon in lighter layer is 3‰ heavier than that of darker layer. The difference in $\delta^{13}C$ value is considered to be resulting from the selective uptake via photosynthesis. Thus, the alternating layers may represent enhanced and depleted biologic activity related to seasonal fluctuation.

^{14}C ages from the organic material in sediments have an abrupt change (6600yrBP) at a 50cm depth from the lake bottom, that is very old than the nearby depths (2500yrBP). On the other hand, it has a stable trend at 60~140cm depth. Moreover, ^{14}C age of the modern freshwater algae that sampled from the surface in Lake Richardson, is 830yrBP, that is, modern sample in Lake Richardson shows an apparent older ^{14}C anomaly. This indicates that the sediment core from Lake Richardson received the carbon reservoir effect and that at 60~140cm the reservoir effect is stable. However, at 50cm depth, the age is too old to explain without the source of continental ice sheet and melt water. This suggest that at 50cm depth, sediment was deposited during comparatively warmer condition. In addition, $\delta^{13}C$ value of the organic material from 160cm to 60cm show a decreasing trend from -18‰_-22‰. Combing the results presented here, it is suggested that the shift to negative value is due to the exchange between the dissolved CO_2 in the lake water and atmosphere, implying that the antarctic paleoenvironment gradually changed to warmer condition.

Heating the core

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The decay of radio-nuclides, in particular K, U and Th, have long been appreciated as important planetary heat sources. Their role as an internal heat source for the core is, however, more uncertain because of their strongly lithophile behaviour. Partitioning of K, Th and U into the metallic phase is obviously dependent on various chemical factors - most notably the metallic sulphur and oxygen content. Obviously, changing these chemical parameters may cause a concomitant change in the partitioning behaviour of other trace elements, with implications for planetary models.

In an effort to further constrain these possible models, we present a series of experiments performed at 30kbar over a wide range of fO_2 and fS conditions with a range of trace elements. We find that U, Th and K can enter the liquid sulphide in significant quantities.