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鮮新世－更新世の東南極氷床変動復元
Plio-Pleistocene reconstruction of East Antarctic Ice Sheet fluctuations

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Several major climatic transitions have occurred throughout the Plio-Pleistocene. The Pliocene climate optimum was a warm period, and is thought as very similar condition to the end of 21 century according to IPCC AR4. This warmth was ended by the late Pliocene transition that lead the climate to a colder and more glaciations in the Northern Hemisphere. The mid-Pleistocene transition marks the time when the periodicity of glacial-interglacial cycles varied from 41,000 years cycles to large-amplitude 100,000 years cycles. Since the above described climatic events are recorded in the benthic foraminifera oxygen isotopes, as is the measure of global ice volume primarily, strong link between cryosphere and global climate has been suggested. However little is known for the relationships in particular for the Antarctic ice sheet. The aim of this study is to reconstruct East Antarctic ice sheet (EAIS) fluctuation during the Plio-Pleistocne using exposure ages in various parts of East Antarctica, and to discuss the relationship between ice sheet fluctuations and global climate changes.

The concentration of *in situ* produced cosmogenic radionuclides (e.g. ^{10}Be, ^{14}C, ^{26}Al, ^{36}Cl) in quartz reflects the cumulative exposure time of the rock and provides the timing of final retreat of ice in the area. In the meantime, combinations of the nuclides can deduce further information in terms of nature of exposure histories, namely simple or complex exposure history for the sites. Isotopic ratios of two cosmogenic nuclides (e.g. ^{26}Al/^{10}Be ratio) can be used for these purposes and since this ratio indicates the erosional ability of ice sheet, we can reconstruct basal conditions of ice sheet in the past. For the case of warm-based ice sheets, the ice sheet basal temperature is above the pressure melting point and hence the bedrock surface is subjected to continuous erosion and resulted cosmogenic nuclides measurement exhibits a simple exposure history. In contrast, cold-based ice sheet cannot erode bedrock sufficiently enough to reset the exposure age ”clock” therefore inheritance of nuclides can be seen because of previous exposure ”memory”. The inheritance of nuclides as described above results in deviation of nuclide content from that predicted by both half-life and present day production rates. Compilations of the cosmogenic exposure ages from five ice-free areas of East Antarctica was conducted and re-calculated using new site specific production rates taken into account of realistic atmospheric pressure model in Antarctica since it deviates from standard atmospheric thickness significantly. I also added newly obtained ^{10}Be and ^{26}Al data for samples collected from Sor-Rondane Mountains, Droning Maud Land. The results indicate that the EAIS was thicker more than 600 m compare to the present, at least once prior to the 3 Ma. The EAIS had then become at least 400 m thinner from 3 to 1 Ma. Growth and decay of EAIS has repeatedly occurred with glacial-interglacial cycles during the Pleistocene epoch.

We successfully draw the picture of past fluctuations of EAIS throughout the Plio-Pleistocene. The EAIS was initially larger and more dynamic until 3 Ma and then it has become smaller as global climate cooled. Our direct evidence in terms of timing of ice sheet fluctuations together with previously published paleoclimate records suggest that inception of colder climate since 3 Ma inhibits active moisture transport to Antarctica that reduce the size of ice sheet. The relatively stable EAIS has become sensitive to changes in sea level namely EAIS has been dictated by variations in Northern Hemisphere Ice Sheets that is induced by Northern hemisphere high latitude insolation. Therefore global ice volume started to have 100,000 years cyclicities with larger amplitude between glacial and interglacial time since then due to relatively significant contributions from Antarctic ice sheet cased by sea-level changes.
Keywords: East Antarctica, ice sheet fluctuations, cosmogenic radionuclide dating, Pliocene climate optimum, Late Pliocene transition, Mid-Pleistocene transition