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Late Pliocene and Early Pleistocene CO2 and CH4 from ice cores from the Allan Hills, Antarctica

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Currently, chronologically discontinuous ice cores from the Allan Hills Blue Ice Area (BIA), Antarctica, are our only direct insight into the atmospheric composition of periods beyond the continuous ice core record (800 ka BP). An accurate and precise greenhouse gas history beyond 800 ka would aid understanding of the mechanisms involved in the climatic transitions across the late Pliocene and early Pleistocene. Here we present carbon dioxide (CO_2) and methane (CH_4) results from a new core from the Allan Hills BIA (ALHIC1901). The bottom 25 m of ALHIC1901 contain 52 sampled depths with co-registered $^{40}Ar_{atm}$ dates (Shackleton et al. *in prep*), measurements of δD of ice, $\delta^{18}O_{atm}$, and concentrations of CO_2 and CH_4 in trapped air. Of these samples, 25 are older than the continuous ice core record, with ages from 821 ± 80 ka to 2700 ± 270 ka. The bottom meter contains ice from the Pliocene with ages from 2700 ± 270 ka to 4000 ± 400 ka. The carbon isotope ratio of CO_2 ($\delta^{13}C\text{-}CO_2$) was measured on 18 samples to examine the possibility of input of non-atmospheric CO_2 from oxidation of organic matter. Our results indicate that CO_2 and CH_4 levels were similar in the early Pleistocene to those found for the last 800 ka. A small decline of approximately 20 ppm is seen in CO_2 across the Pleistocene, and no secular trend is observed in CH_4. Pliocene-aged samples appear to contain a mixture of atmospheric CO_2 and CO_2 derived from respiration of organic matter at the glacier bed. Using an isotope mixing model we estimate that atmospheric CO_2 was lower than 350 ppm at ~3.1 Ma,