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Constraining the timing of West Antarctic Ice Sheet changes using East Antarctic ice cores

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The position of large ice bodies could leave chemical and isotopic fingerprints in ice core records through affecting local environmental and meteorological conditions. Thus, Ice cores in turn hold the potentials to document past ice sheet behaviors. For example, the S27 ice core, drilled in the Allan Hills Blue Ice Area of East Antarctica, is located in Southern Victoria Land ~80 km away from the present-day northern edge of the Ross Ice Shelf (RIS). The S27 core is therefore sensitive to the behaviors of RIS, and by extension, of the West Antarctic Ice Sheet (WAIS). The accumulation rate history of S27 covering the Last Interglacial (LIG) period between 129 and 116 thousand years before present (ka) is reconstructed on the basis of the ice age-gas age differences. Such differences are calculated from the ice chronology, which is constrained by the stable water isotopes of the ice, and an improved gas chronology based on measurements of oxygen isotopes of O_2 in the trapped gases. The peak accumulation rate in S27 occurred at 128.2 ka, near the peak LIG warming in Antarctica. Even the most conservative estimate yields an order-of-magnitude increase in the accumulation rate during the LIG maximum, whereas other Antarctic ice cores are typically characterized by a glacial-interglacial difference of a factor of two to three. We hypothesize that the exceptionally high snow accumulation recorded in S27 reflects open-ocean conditions in the Ross Sea, created by reduced sea ice extent and increased polynya size, and perhaps by a southward retreat of the RIS relative to its present-day position near the onset of LIG. The proposed ice shelf retreat would also be compatible with a sea-level high stand around 129 ka significantly sourced from West Antarctica. In the future, the timing of changes of WAIS and RIS could possibly be better constrained by an array of ice cores parallel to the Trans-Antarctic Mountain.