Constraints on the Timing of the Last Deglaciation of Antarctica

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We summarize published terrestrial cosmogenic nuclide (TCN) and ^{14}C ages from Antarctica to constrain the timing of the last deglaciation. The only direct constraints on deglaciation of the East Antarctic Ice Sheet (EAIS) come from TCN ages, but because these are based on single boulders, they are subject to large uncertainties. After screening published single-boulder TCN ages for obvious uncertainties related to erosion or cosmogenic nuclide inheritance, we conclude that all but two of the remaining TCN ages indicate deglaciation of the EAIS was underway between 13 and 15 ^{10}Be ka, with younger ages possibly indicating subsequent ice-sheet thinning. Deglaciation of the Antarctic Peninsula is poorly constrained by five single-boulder TCN ages as being well underway by ~10 ^{10}Be ka. Radiocarbon ages on organic matter in marine sediments from west of the peninsula suggest that deglaciation from the maximum extent on the continental shelf may have begun as early as 19 ka, but the large uncertainties associated with bulk marine ages from Antarctica preclude an accurate assessment of this timing. The oldest TCN age constraining deglaciation of the WAIS is 14.4 ± 1.5 ^{10}Be ka, but like all other TCN ages from Antarctica, this age is for a single boulder. Most of our information on the chronology of the Antarctic ice sheet comes from the extensive radiocarbon dating from the Ross Sea sector of the WAIS, particularly that from Taylor Valley. The ^{14}C age on the oldest delta that formed in this glacial lake in Taylor Valley (28.25-28.77 cal ka; QL1708) provides a limiting minimum age for the local last glacial maximum (LLGM), whereas the ^{14}C age on the youngest reworked marine shells in glacial deposits (28.80-29.39 cal ka; TO1980) provides a limiting maximum age for the LLGM. We use the maximum range defined by these two ^{14}C ages (28.25-29.39 cal ka) as the uncertainty for the onset of the LLGM.

We use several lines of evidence from dating of the Taylor Valley geomorphic record to identify termination of the LLGM in the Ross Sea. (1) The youngest ^{14}C age (14.7-15.1 cal ka; AA-20667) constraining the time of the LLGM ice margin at the Hjorth Hill moraine provides a limiting maximum age for retreat from the moraine. (2) Two ^{14}C ages on algae that grew in a glacial lake that formed following ice-margin retreat from the Hjorth Hill moraine provide limiting minimum ages for this retreat (14.8-15.2 cal ka; AA-13576, and 14.9-15.2 cal ka; AA17342). (3) The glacial lake in Taylor Valley permanently dropped below ~80 m after 13.9-14.7 cal ka (AA-17314) (^{14}C age on youngest high-elevation delta) and before 13.9-14.1 cal ka (QL1707) (^{14}C age on oldest low-level delta after permanent drop). (4) Lacustrine deposits occur in a stream exposure cut into the moraine deposited by the LLGM ice margin on the floor of Taylor Valley, with a ^{14}C age requiring deglaciation from the moraine before 14.3-14.8 cal ka (AA17333). (5) Glaciolacustrine sediments containing dropstones occur along the distal side of the valley-floor threshold moraine, indicating that the ice margin was at the moraine. The youngest ^{14}C age from this unit (13.6-14.7 cal ka; QL-1794) provides a limiting maximum age for retreat from the moraine. Given these dating constraints, we assign an error for the termination of the LLGM (13.9-15.2 cal ka) based on the youngest limiting maximum ^{14}C age for ice-margin retreat (13.9-14.7 cal ka (AA-17314) and the oldest limiting minimum ^{14}C age for ice-margin retreat (14.9-15.2 cal ka; AA-17342).