Reconstruction of the ice sheet history based on glacial geomorphology and surface exposure dating on the Soya Coast, Lützow-Holm Bay, East Antarctica

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The retreat history of the East Antarctic Ice Sheet (EAIS) since the Last Glacial Maximum is important for the identification of forcing mechanisms for ice sheet behavior, constraining models that seek to predict the future trajectory of the ice sheet, and for estimating rates of sea-level change. Geomorphological studies and surface exposure dating (SED) will provide direct evidence of the timing and the history of ice retreat on coastal oases and nunatak regions in East Antarctica. Recent studies have reported retreat ages based on SED in the southern part of Soya Coast, Lützow-Holm Bay, East Antarctica. However, the retreat processes of the ice sheet remain unclear, because reported ages are only from four locations and insufficient geomorphological consideration. Here we report evidence of rapid retreat of the EAIS during the early-mid Holocene based on the geomorphological observation and SED of the Soya Coast (Skarvsnes, Skallen, and Telen). Samples from 29 erratics and three bedrock surfaces were analyzed for SED. The ages of erratic from Skarvsnes are predominantly in the range 6–9 ka, whereas bedrock ages are 14 and 21 ka. On the other hand, the ages of erratic from Skallen are predominantly in the range 5–8 ka, the ages of the bedrock is 7 ka agree within a range of erratics ages. From our dating and geomorphological results, we indicated that the ice sheet experienced rapid surface lowering at least 400 m a.s.l. while flow direction had changed by bedrock topography during the early-mid Holocene (5–9 ka). The differences in exposure ages derived from bedrock and erratic taken from the same location suggest inheritance in the ages of the bedrock acquired during ice-free periods prior to the last deglaciation, which is consistent with geomorphological features (=reflect the different conditions of the basal ice sheet). The potential mechanism of the rapid retreat of the EAIS in these areas is thought to be the marine ice sheet instability due to an inflow of the warm circumpolar deep water via the deep submarine valley. Our results demonstrate rapid ice sheet thinning as a consequence of marine ice sheet instability may lead to ice surface lowering of hundreds meters. We emphasize the ocean-ice sheet interaction is even more important for understanding the mechanisms and improving predictions of future fluctuations of EAIS.

Keywords: East Antarctic Ice Sheet, Glacial geomorphology, Surface exposure dating

