Late Pleistocene glacial history of the Black Forest, southern Germany, and implications for past atmospheric circulation patterns

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During the Late Pleistocene, an ice cap and its up to 25 km-long outlet glaciers temporarily covered the highest summit of the Black Forest, Feldberg (1493 m above sea-level) and the surrounding region. During deglaciation, the ice cap disintegrated into valley glaciers with independent accumulation areas. Valley glaciers finally evolved into cirque glaciers. Despite recent efforts, the chronology of Late Pleistocene glacier fluctuations in the Black Forest is not sufficiently understood. In particular, the timing of glacial re-advances or standstills at the end of the deglaciation remains largely unknown. The onset of glacier retreat from the Late Pleistocene maximum ice extent has hitherto not been successfully dated.

This study addresses these issues by applying ^{10}Be cosmic-ray exposure (CRE) dating to moraines at three sites. Newly acquired chronological data imply that glacier retreat from the moraines of the marine isotope stage (MIS) 2 maximum advance was underway by 21 ka at the latest when glacier recession in the Swiss Alpine Foreland had already begun. Recalculated ages for the Bavarian Forest suggest that glaciers in the Bavarian Forest and in the Black Forest might have withdrawn simultaneously from their MIS 2 maximum positions. Within the limits of available data, CRE ages suggest that glaciers in both regions attained their MIS 2 maximum extent when a westerly atmospheric circulation re-established over Central Europe. To confirm these hypotheses, additional data for the Black Forest is needed. Ages of moraines at two sites fall into the Lateglacial.

Glaciers and equilibrium line altitudes (ELAs) during moraine formation were reconstructed for paleoclimatic inferences. ELA-based reconstructions of paleoprecipitation for the youngest ice-marginal positions were undertaken with data from two independent summer temperature records. Unrealistically high annual precipitation during the Lateglacial would have been required to balance summer temperatures at the ELA. Even if all potential errors of the reconstruction are taken into account, it seems unlikely that glaciers still existed in the Black Forest after the abrupt rise in summer temperature at ~14.6 ka. Therefore, deglaciation was likely completed during this climatic event or before.