



Different conditions and modes of glacial advances: Examples from the beginning of Termination I in the Eastern Alps

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In the classical concept of Alpine glacial stratigraphy defined by Penck & Brückner (1909), active glacier tongues receded into the Alps after the maximum extension during the last glaciation (Würm), nowadays called Last Glacial Maximum (LGM). According to this concept, refined by Mayr & Heuberger (1968), the Inn glacier had its first halt (stabilisation accompanied by end moraines) within the Alps in the area of Kitzbühel-Hopfgarten (Tyrol/ Austria). This halt was called the Bühl stadial.

During LGM, the ice stream surface was situated at an altitude of 1900 -1700 m asl in this area. Results of recent geological investigations of the Bühl type region (Reitner, 2005) however give a completely different picture of the glacial dynamics immediately after LGM. The following conclusions can be drawn from the findings:

1) The ice stream which had just experienced a rapid downwasting after LGM (~500 m reduction of ice thickness in the forefield of the Kaisergebirge) existed only as a stagnant, non-alimented ice body. Its decay proceeded without any recognizable disruption.

2) The small local glaciers showed two kinds of advances:

Mechanically induced glacier advance is exemplified by the glaciers of the southern slope of the Kaisergebirge. During LGM, those glaciers with accumulation areas in cirques were blocked in their lower valleys towards south by the dominant Inn glacier. In the course of downmelting they lost their blockade and started to advance, their tongues always terminating in ice dammed lakes with varying water levels and depths. They reached their maximum extent during the Lateglacial while the ice in the

forefield melted down to 700-800 meters below LGM ice surface level.

Climatically controlled oscillation is exemplified by the prominent advance of the Windau glacier up to 3 km over a proglacial kame terrace in an area which was already part of the Windau ice domain during LGM. This happened while the stagnant Inn glacier suffered a ~ 200 m loss of ice thickness (from ~ -1000 m to ~ -1200 m compared to LGM). A short-term climatic deterioration (- T and/ or +P), which resulted in a mass wave reaching only the tongues of smaller glaciers before a climatic amelioration started again, seems to be the best explanation for this differential glacier behaviour.

3) The continuing ice decay of ~ 700 m ice thickness (from 500 m to 1200 m below LGM ice surface level) under the conditions of high insolation and ubiquitous meltwater indicates a relatively short duration of this phase, possibly only 100-500 years. In addition, the extensive kame terraces and their sedimentary structures provide arguments for a rapid fill-up of the ice-free accommodation space and thus for a shortlasting period.

According to the chronostratigraphic framework of the Eastern Alps this “phase of early lateglacial ice decay” happened during Greenland Stadial 2c (21,2-19,5 GRIP kyr BP; Björck et al, 1998).

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