8° Convegno Glaciologico Italiano (Bormio, 9-12 Settembre 1999), 20-21

Lateglacial glaciers and climate - an Eastern Alpine perspective

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The climatic history of the Late Würm ice age after the maximum (around 20.000 - 18.000 B.P.) is characterised by a considerable number of climatic fluctuations until climate recovered to present day values of temperature and precipitation during the early Preboreal. The entire period from the beginning of the recession from the maxima in the Alpine Foreland until the time, when the postglacial glacier extent was reached, is called the "Late Glacial".

In the table below, a very short overview of the present state of knowledge is given which is based on the work of numerous authors (e.g. H. Heuberger, G. Patzelt, M. Maisch, S. Ivy-Ochs and Ch. Schlüchter).

Bühl Stadial:
Type locality: Moraines near Kufstein and Kirchbichl, lower Inn valley.
Glaciers: Dendritic glacier system still intact, but clearly smaller than during LGM. Inn glacier ended near Kufstein at the northern margin of the Alps.
Snowline: Probably only slightly higher than during LGM
Age: ???
Climate: No direct evidence, probably very much like LGM

Steinach Stadial:
Type locality: Lateral moraines near Wipptaler Hof hotel at the mouth of Gschnitz valley above Brenner motorway.
Glaciers: Trunk valleys already ice free, probably large areas of dead ice or inactive ice in major tributaries, readvance of larger tributary valleys.
Snowline: Probably ca. 900 m lower than LIA
Age: ???
Climate: No direct evidence, probably warmer than LGM

Gschnitz Stadial:
Type locality: Prominent end moraine of local glacier near Trins in the Gschnitz valley, S of Innsbruck.
Glaciers: Large valley glaciers in major tributary valleys, some dendritic glaciers in the central Alps, clear readvance of many glaciers with sometimes prominent moraines.
Snowline: At the type locality S of Innsbruck 700 m lower than LIA (1900 - 1950 m).
Age: ca. 16.000-15.000 cal BP (surface exposure dating with cosmogenic radionuclides), clearly Pre-Bølling (^{14}C minimum ages)
Climate: Cold and dry (ca. -9 - -11 K colder than today, ca. 30% of present-day accumulation)

Clavadel Stadial (Senders Stadial):
Type locality: moraines at Clavadel near Davos (CH)
Glaciers: Many large valley glaciers in higher areas, cirque glaciers in low-lying cirques, sometimes very prominent moraines with large amounts of sediment.
Snowline: on the average 450 m lower than LIA, trend towards smaller values in drier areas and higher values in more humid areas.
Age: clearly Pre-Bølling (^{14}C minimum ages)
Climate: warmer than Gschnitz, but still cold and dry.

Daun Stadial:
Type locality: moraines in the inner Stubai valley SW of Innsbruck.
Glaciers: rather similar to Clavadel, but smaller; many readvances.
Snowline: 300 - 400 m lower than LIA.
Age: clearly Pre-Bølling (^{14}C minimum ages).
Climate: probably rather similar to Clavadel, perhaps slightly drier (?).
Note: Wherever a more or less complete preservation of moraines is possible, it is very difficult to draw a clear line between Clavadel and Daun. Perhaps these two stadials belong to one period of glacier recession which was interrupted by a series of readvances.

Egesen Stadial:
Type locality: moraines in the surroundings of Egesengrat in the inner Stubai valley SW of Innsbruck.
Glaciers: valley glaciers and cirque glaciers of varying size, large valley glaciers in higher areas. In many cases three distinct readvance periods.
Permafrost: Many rock glaciers, often in connection with later readvance periods Egesen II (Bocktentälli) and III.
Age: Younger Dryas (surface exposure dating with cosmogenic radionuclides), clearly older than Preboreal (^{14}C minimum ages, pollen analysis).
Snowline: ca. 200 m lower than LIA in the central valleys, up to 400 m lower than LIA in areas exposed to the W and NW.
Climate: Summers were ca. 3.5 K colder than today (timberline depression), precipitation was reduced by 30% in the central valleys, but rather similar or even 10% higher in areas exposed to the W and NW. General picture of Younger Dryas climate from various sources points towards much colder winters.

Kromer/Kartell Stadial:
Type locality: Moraines in the Kromer valley (Silvretta) and Ferwall (Moostal).
Glaciers: larger than LIA, but smaller than late Egesen.
Permafrost: rock glacier activity from Younger Dryas seems to have continued (?).
Age: probably early Preboreal (surface exposure dating with cosmogenic radionuclides).
Snowline: 60 - 90 m lower than LIA.
Climate: Probably closer to lower limit of Holocene fluctuations than to Younger Dryas climate.
Note: The Kromer/Kartell Stadial might as well be regarded as a Holocene glacier fluctuation.