
Sedimentary Record of Deglaciation and Debris-Flow Activity Along the Menoge River (Lower Arve Valley, Northern French Alps)

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Résumé

The Lateglacial period was marked by pronounced climatic fluctuations, which triggered major environmental transformations across mid- and high-latitude regions, particularly in glaciated mountain landscapes. In this context, the Arve Valley is a key area for reconstructing the Lateglacial deglaciation history of the Northern French Alp. However, in this region, the chronological framework of glacial dynamics remains poorly constrained. It is therefore essential to better define the chronology of the phases of glacial retreat during the Lateglacial period.

The deglaciation in the Arve Valley is newly investigated using a modern combination of approaches: geomorphological mapping using high-resolution LiDAR DEMs (LiDAR HD, IGN); sedimentological investigations based on field observations and borehole data; surface exposure dating of erratic boulders using cosmogenic ¹⁰Be; and numerical modelling using the recently developed IGM model (Instructed Glacier Model).

Here, we focus on the Menoge River, a key sector located at the confluence of the Arve and Rhône paleo-glaciers. This area preserves a well-developed set of sedimentological and geomorphological features offering critical proxies for deciphering the onset of deglaciation in this area. Eight outcrops and nine boreholes have been examined along a 3 km stretch and placed in their geomorphological context. Drone-based photogrammetry enabled 3D reconstruction of inaccessible sections while subsurface data from the BRGM (BSS database) complemented field observations. Sedimentary units were described, interpreted, and correlated across the section to reconstruct the depositional environments.

The stratigraphic succession reveals a clear pattern of glacial advance and retreat phases, recorded within a well-structured stratigraphic sequence. At the base, the first unit consists of sandy-gravelly sediments interpreted as fluvial deposits. OSL dating of this unit will confirm the chronological anchor. Higher in the sequence, debris-flow deposits overlie till levels, reflecting sudden mass-wasting events likely associated with rapid phases of glacial retreat.

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This high-resolution study refines the timing and dynamics of deglaciation in the lower Arve Valley, and highlights how sedimentary archives can record abrupt climatic shifts. These results offer valuable benchmarks for interpreting past environmental responses to rapid warming, and for better anticipating future extreme events.

Mots-Clés: Lateglacial, Northern French Alps, Glacial sedimentology, Glacial geomorphology, Deglaciation chronology