



## **Quaternary glacial landforms and evolution in the Cantabrian Mountains (Northern Spain): a synthesis from current data**

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In Northern Iberian Peninsula are located the Cantabrian Mountains, a mountain system of 450 km length, reaching 2648 m in the Picos de Europa. It is an Atlantic mountain in the North slope, with a Atlantic Mediterranean transitional climate in the South slope. More than thirty-five massifs developed glaciers during the Pleistocene. Studies on glacial morphology are known from the XIX century and they have focused mainly on the maximum extent of glaciers. Nowadays there are detailed geomorphological maps, morphostratigraphic surveys and estimation of Equilibrium Line Altitude in different massifs and on different stages. During the last decade studies on glacial evolution and glaciation phases have been made, and the first chronological data have been published.

In this work we presents the reconstruction of the glacial evolution in the Cantabrian Mountains during the Pleistocene and Holocene, based on recent chronological data (30 dates made using OSL, AMS and C14) and morphostratigraphic correlations obtained by several research groups.

The number of reconstructed glacial stages varies among the different massifs, form one to four different stages. The highest massifs located in the central portion of the Cantabrian Mountains have the most complex glacial features, with at least four different moraine complexes stepped between the 400 m a.s.l in the Northern slope and 800 m a.s.l. in the Southern slope for the lowest moraine complexes, and the highest and youngest, located above 2100 m a.s.l.

An ancient glacial phase has been pointed to MIS 12 -more than 400 ka-, disconnected from the present day glacial morphology. During Upper Pleistocene three main stages have been identified. The first one, the local glacial maximum, could be prior to the LGM, as all dates refer to chronologies prior to 28-38 ka. Some authors locate this stage prior to 45 and 65 ka, during the 50–70 ka cold stage. It could be a wet stage, when the main fronts reached the Iberian Peninsula from the SW. The second stage is located to around 30 ka, and point to a dryer stage when glaciers was shorter but thicker. The third stage is located at 20-18 ka, contemporary from the LGM. Glaciers are located inside of glacier-shaped mountain valleys. A few moraine complexes located in the highest massif have been related to Lateglacial, coinciding with cold phases (Dryas) recorded in the Picos de Europa lakes and paleolakes. Finally, during the Holocene only small glaciers developed in the Picos de Europa, which have been assigned to LIA. Nowadays there are still glacial ice remains in four glacial cirques of Picos de Europa, close to the LIA moraines.