Cosmogenic exposure dating of the last glacial extension in western French Alps.

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According to paleoclimate proxies, two temperature minima occurred throughout the last ice age and correspond to the marine isotope stages MIS 4 and MIS 2. The Last Glacial Maximum (LGM) corresponds to the coldest period during MIS 2. In the European Alps, glaciers formed large foothill lobes reaching maximum extent during this period. OSL dating of glacio-fluvial deposits in front of the western French Alps glaciers reveals large ancient advances in the foreland during MIS 4 and the end of MIS 3. However, the extension of the LGM has not yet been recorded by chronological data. This study focuses on the foreland moraines of the western French Alps located about 20 km east of the city of Lyon. These numerous moraine ridges, well preserved in the piedmont landscape, are bounded to the north by the southern Jura and to the south by Miocene hills. In the study area, we sampled quartz-rich boulders to obtain exposure ages. We performed in-situ beryllium-10 (10Be) cosmogenic ages on quartz from 21 sampled boulders in order to reconstruct the palaeogeography of these glaciers during the LGM. 17 of the 21 samples give exposure ages between 23.81 ± 1.12 and 12.94 ± 0.85 ka, covering the LGM and Lateglacial periods. 4 outliers are much older or younger, involving pre- or post-depositional processes. The Lateglacial exposure ages are synchronous with the radiocarbon dates of the postglacial deposits and human occupations within the study area. The Lateglacial exposure ages are probably the result of exhumated erratic boulders following the degradation of moraines. These moraines are the remains of a glacial advance in the western French Alps during the LGM. Our results using new cosmogenic exposure ages on erratic boulders clearly show that during the LGM, the glaciers of the western French Alps reached the foothills again, where the palaeogeography of glacial extensions is complex. The old advances and the LGM extension are superimposed in the southern Jura and the Miocene hill areas. In the foreland plain, the LGM advance is less important than the old extensions (MIS4-MIS3). This new LGM palaeogeography of the western French Alps shows an interesting similarity with the western Italian Ivrea and Rivoli-Avigliana glacier lobes, sharing the same accumulation zone with the studied glaciers.

Key words: LGM, Glaciers, French Alps, Lyonnais, 10Be exposure ages, paleogeography