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Variability of denudation rates in the eastern Pyrenees during the last glacial cycle

M. Delmas (1), M. Calvet (1), **Y. Gunnell** (2)

(1) Université de Perpignan, France, (2) Université Paris-Diderot, France
(magali.delmas@univ-perp.fr, calvet@univ-perp.fr, gunnell@univ-paris-diderot.fr)

This study presents a time-sliced estimate of glacial erosion by the Têt palaeo-ice field in the eastern Pyrenees during the last glacial cycle. A quantified mass balance of the well preserved glacial deposits was made possible by detailed geomorphological mapping and terrestrial nuclide dating of extant erosional and depositional landform sequences. The main stages of ice-cap growth and decline were defined in terms of chrono-sedimentary units each characterized by a volume of debris, a finite life span as active landforms, and a mappable source area. Erosion rates were expressed in two ways: as spatially averaged denudation rates (D) during the phases of (i) glacial advance to the line of maximum ice extension (MIE), (ii) post-MIE ice recession, and (iii) Lateglacial cirque readvance; and as cirque-wall recession rates (R) where moraines facies analysis indicated a supraglacial provenance of debris. Results indicate low erosion (D$\approx$0.05 mm$\cdot$yr^{-1}) during the ice advance phase, probably because of thin or passive ice over the low-gradient subglacial topography occurring at 2.2–2.4 km a.s.l., i.e. just above the late Pleistocene equilibrium-line altitude. Erosion rates peaked (D$\approx$0.6 mm$\cdot$yr^{-1}and R$\approx$2.4–4.5 mm$\cdot$yr^{-1}) during the main transition to ice-free conditions, when deglacial debuttressing promoted the rapid response of freshly exposed steep-slope systems to new equilibrium conditions. Lateglacial D values declined to 0.2–0.3 mm$\cdot$yr^{-1}, with indications of spatially variable R controlled by lithology. In this environment glaciers overall behaved more as conveyors of debris supplied by supraglacial rock faces in the mountain crest zone than as powerful modifiers of subglacial topography. This explains the widespread preservation of deep, in situ preglacial weathering profiles on relict Cenozoic land surfaces in the deglacierized

part of the eastern Pyrenees.