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Present-day subglacial erosion efficiency inferred from sources and transport of glacial clasts in the North face of Mont Blanc

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The efficiency of erosional processes is classically considered from detrital composition at the outlet of a shed that reflects the rocks eroded within the shed. We adapt fluvial detrital thermochronology (DeCelles et al., 2004) and lithology (Attal and Lavé, 2006) methods to the subglacial streams of the north face of the Mont Blanc. The lithology of this area is composed by a ∼303 Ma old granite intruded within an older poly metamorphic complex (orthogneisses). In this study,we use macroscopic criteria (∼10 000 clasts) and Ur/Pb dating of zircons (∼500 datings of sand grains) to determine the provenance of the sediment transported by the glacier and by the sub-glacial streams. Samples come from sediments collected around the glacier (above, below or laterally), from different bedrocks sources according to the surface flow lines and glacier characteristics (above or below the ELA; temperate or cold), and from different subglacial streams.

A comparison between the proportion of granite and orthogneisses in these samples indicates that: 1) the supra load follows the flow lines of the glacier deduced from SAR images correlation and the displacement pattern excludes supra load mixing of the different sources; 2) the transport by the glacier does not mix the clasts issued from the sub-glacial erosion with the clasts issued from supraglacial deposition, except in the lower tongue where supraglacial streams and moulins move the supraglacial load from top to bottom; 3) the erosion rate beneath the glacier is very small: null beneath the cold ice but also very weak beneath the greatest part of the temperate glacier; the erosion increases significantly beneath the tongue, where supraglacial load incorporated at the base favors abrasion; 4) the glacial erosion rate beneath the tongue remains at least five time smaller than the erosion rate coming from non-glacial area.

According to our results, we demonstrate that the glaciers of the Mont-Blanc north face protect the top of Europe from erosion.

DeCelles et al., 2004, Earth and Planetary Science Letters, v. 227, p. 313-330.

Attal and Lavé, 2006, Geol. Soc. Am. Spec. Publ. (S.D. Willett, N. Hovius, M.T. Brandon and D. Fisher, eds.), 398, p. 143-171.