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Deglaciation and glacial erosion: a joint control on magma productivity by continental unloading

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Glacial-interglacial cycles affect the processes through which water and rocks are redistributed across the Earth's surface, thereby linking solid-Earth and climate dynamics. Regional and global scale studies suggest that continental lithospheric unloading due to ice melting during the transition to interglacials leads to increased continental magmatic, volcanic and degassing activity. Such a climatic forcing on the melting of the Earth's interior, however, has always been evaluated without considering the additional continental unloading associated with erosion. Current datasets relating to the evolution of erosion rates are typically limited by temporal resolutions that are too low or span too short time intervals to allow for direct comparisons between the contributions from ice melting and erosion to continental unloading at the timescale of the late Pleistocene glacial cycles. Yet, they provide a fundamental observational basis on which to calibrate numerical predictions.

Here, we present and discuss numerical results involving synthetic but realistic topographies, ice caps and glacial erosion rates suggesting that erosion may be as important as deglaciation in affecting continental unloading, subcontinental decompression melting and magma productivity. Thus, the timing and magnitude of deglaciation and erosion must be characterized if the forcing of climate change on the continental magmatic/volcanic activity is to be extracted from the remnants of eroded volcanic centers. Our study represents an additional step towards a more general understanding of the links between a changing climate, glacial processes and the melting of the solid Earth.