Glacier erosion rates from proglacial lake sediment records during the Last Glacial Maximum and Antarctic Cold Reversal in Patagonia

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Temperate glaciers are sensitive to climate variability and respond to local and regional influences by altering size, rates of flow and substrate incision – processes recorded within proglacial environments that preserve the product of glacial erosion. Interpreting the glacial sediment record with respect to climate, however, relies on a set of first order assumptions, including that as temperature and/or precipitation increase, sliding velocity increases, and with it subglacial erosion rates. Several lines of evidence, however, have recently challenged the dominant control by sliding on erosion rates, inherently questioning the ability to use sediment accumulation rates and their variations to derive long-term records of glacial response to climate.
Here we present retreat rates, sediment yields and erosion rates from proglacial lacustrine records in submerged glacial valleys in Patagonia during the Last Glacial Maximum (LGM) and the Antarctic Cold Reversal (ACR) using new high resolution seismic reflection data in Lago Argentino, a proglacial lake that drains eight major outlet glaciers of the Southern Patagonian Icefield (SPI). Sedimentary structures and stratigraphy observed within the lake include ice-contact and proximal deposits associated with Pleistocene readvances as well as the ice-distal signature of the retreating Argentino ice lobe. Sediment flux, sediment volumes, and erosion rates are calculated for the post-LGM retreat, ACR advance, and post-ACR maximum (post-ACRM) events. Erosion rates for the Argentino lobe of the late Pleistocene Patagonian Icesheet (PIS) are observed to vary with state of the ice (advancing vs retreating grounding line), rate of change of the grounding line position (i.e., retreat/advance rates), and timespan considered. Glacial erosion rates are highest during the post-ACRM retreat, averaging 2mm/yr over 770 yr, and Lateglacial basin-wide erosion rates decay exponentially with increasing timespan, with values comparable to other Patagonian tidewater and lake-terminating glaciers calculated over more recent time intervals.