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Late-Pleistocene geomorphological and geochronological history of the former Patagonian Ice Sheet in north-eastern Patagonia (43°S)

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The former Patagonian Ice Sheet was the most extensive Quaternary ice sheet of the southern hemisphere outside of Antarctica. Against a background of Northern Hemisphere-dominated ice volumes, it is essential to document how the Patagonian Ice Sheet and its outlet glaciers fluctuated throughout the Quaternary. This information can help us investigate the climate forcing mechanisms responsible for ice sheet fluctuations and provide insight on the causes of Quaternary glacial cycles at the southern mid-latitudes. Moreover, Patagonia is part of the only continental landmass that fully intersects the precipitation-bearing southern westerly winds and is thus uniquely positioned to study past climatic fluctuations in the southern mid-latitudes. While Patagonian palaeoglaciological investigations have increased, there remains few published studies investigating glacial deposits from the north-eastern sector of the former ice sheet, between latitudes 41°S and 46°S. Palaeoglaciological reconstructions from this region are required to understand the timing of late-Pleistocene glacial expansion and retreat, and to understand the causes behind potential latitudinal asynchronies in the glacial records throughout Patagonia. Here, we reconstruct the glacial history and chronology of a previously unstudied region of north-eastern Patagonia that formerly hosted the Rio Huemul and Rio Corcovado (43°S, 71°W) palaeo ice-lobes. We present the first detailed glacial geomorphological map of the valley enabling interpretations of the region's late Quaternary glacial history. Moreover, we present new cosmogenic 10Be exposure ages from moraine boulders, palaeolake shoreline surface cobbles and ice-moulded bedrock. This new dataset establishes a high-resolution reconstruction of the local LGM through robust dating of five distinct moraines limits of the Rio Corcovado palaeo-glacier. Our results demonstrate that, in its north-eastern sector, the Patagonian Ice Sheet reached its last maximum extent during MIS 2, thus contrasting with the MIS 3 maxima found for the southern parts of the ice sheet. We also present geomorphological evidence along with chronological data for the formation of two ice-dammed proglacial lake phases in the valley caused by LGM ice-extent fluctuations and final glacial recession. Furthermore, this dataset allows us to determine the timing and onset of glacial termination 1 in the region. Finally, our findings include the reconstruction of a proglacial lake drainage and Atlantic/Pacific drainage reversal event caused by ice sheet break-up in western Patagonia. Such findings have significant implications for climate fluctuations at the southern mid-latitudes, former Southern Westerly Winds behaviour and interhemispheric climate linkages during and following the local LGM. They provide further

evidence supporting the proposed latitudinal asynchrony in the timing of expansion of the Patagonian Ice Sheet during the last glacial cycle and enable glacio-geomorphological interpretations for the studied region.