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Reconstructing past glacier extents in the Chilean Altiplano (18.5°-19° S) -Regional patterns and paleoclimatic implications

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In today's climate, glaciers are very rare in the western Altiplano, even on peaks above 6000 m. However, glacial landforms, especially moraines, are frequently observed, testifying to very different climatic conditions that favoured glacial advances in the past. Although other areas of the Altiplano have been widely considered in palaeoclimate reconstructions, the western Altiplano has often been overlooked. Here we present a detailed map of glacial landforms and a reconstruction of paleoglacier extents in the western Altiplano of Chile between 18.5° and 19°S. We reconstructed regional equilibrium line altitudes (ELA) for several moraine stages representing extensive past glacier advances in the region. During a prominent and ubiquitous 'Principal Moraine (PM)' stage, glaciers advanced from most peaks and all orientations to elevations down to 4000 m asl. Reconstructed PM ELAs along 90 valleys range from 4400 to 5000 m asl. The ELA distribution shows a strong aspect dependence at the western boundary of the Altiplano, with ELAs 300 m lower on west-facing glaciers than on east-facing glaciers. The coincidence of such a steep gradient with a prominent NW-SE ridge explains the topographic control on precipitation, and thus on glacier advance along the western boundary of the Altiplano. To the east, the ELAs of the peaks overlooking the Altiplano are comparable to those of the east-facing glaciers at the western Altiplano boundary but show little or no aspect dependence. Since increased moisture advection from the Amazon basin alone cannot explain this pattern, we suggest that westerly moisture associated with increased frequency of cold fronts and cut-off events has played an important role in glacier dynamics at this latitude. However, further research is needed to assess the relative role of both precipitation regimes on glacier dynamics in the westernmost Altiplano.

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