



Early Pleistocene glaciations in Patagonia dated by cosmogenic nuclide methods

Andrew Hein, Tibor Dunai, and Nicholas Hulton

University of Edinburgh, Geography, Edinburgh, United Kingdom (andy.hein@ed.ac.uk)

The glacial geologic record in Argentine Patagonia is well-preserved and spans more than one million years. The deposits provide a record of long-term terrestrial climate extremes at a key mid-latitude position in the Southern Hemisphere. Determining the age of deposits older than the Last Glacial Maximum has proved challenging due to, for example, the limit of radiocarbon age dating, the availability of associated lava flows for $^{40}\text{Ar}/^{39}\text{Ar}$ age dating, and the problems of erosion and exhumation with exposure age dating of moraine boulders. In a previous study, we demonstrated the stability of outwash terrace surfaces in the region by comparing exposure ages from gravels on these surfaces with exposure ages from associated moraine boulders. The moraine boulders consistently yielded younger exposure ages. It is unknown, however, if the apparent stability of outwash terraces in the valley is persistent over longer timescales. Here we present cosmogenic Be-10 and Al-26 surface exposure ages from outwash gravels associated with two of the oldest glacial sequences in the Lago Pueyrredón valley, 47.5° S, Argentina. The exposure ages from the oldest and most extensive outwash terrace give an age that is consistent with independent age constraints, obtained elsewhere by $^{40}\text{Ar}/^{39}\text{Ar}$ methods, for the 'Greatest Patagonian Glaciation'. Surface exposure ages from outwash gravels associated with a younger and less extensive ice limit indicate a glacial advance during or prior to Marine Isotope Stage 16. Boulders from age-equivalent moraines, with one exception, are consistently younger. The results indicate that our approach to directly dating old (i.e., pre-Last Glacial Maximum) glacial deposits is robust over the appropriate timescales. Thus, it may be possible to date the entire sequence of Quaternary ice limits in Argentine Patagonia with similar environmental conditions.