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The last deglaciation in New Zealand ; revisiting the Misery moraines at Arthur's Pass in the Southern Alps of New Zealand

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Recent debate on mid-latitude New Zealand glaciation has focused on reconstructing paleo-climate conditions leading into the (global) Last Glacial Maximum and subsequent deglaciation dynamics during the last termination. Paleo-environmental evidence coupled with reliable glacial chronologies supporting a Southern Hemisphere glacial readvance commensurate with Younger Dryas timing (∼11.5-12.5 ka) showing similar cooling as observed in the Northern Hemisphere has also been hotly debated. Many New Zealand lake and pollen records suggest a minor cooling or hiatus in warming during the period from ∼14.5 – 12.0 ka which pre-dates YD onset and is more commonly associated with the Antarctic Cold Reversal (ACR) (14.7 - 13.0 ka). Achieving the required sub-millennial temporal differentiation using in-situ cosmogenic exposure dating comes with numerous difficulties. The Arthur's Pass Moraine complex, deposited by an alpine glacier advancing out of the Otira Gorge splaying east and westward over the divide of the Southern Alps in New Zealand (∼950 masl), exhibits a full post-LGM glacial chronology. The moraines consist of multiple cross-valley terminal, lobate and discontinuous latero-terminal moraines up to 3 kilometres down valley from the proximal Misery moraines at the outlet of Otira Gorge. Within the gorge towards the headwall only 1 km up-valley from the Misery sequence, no other moraines are evident. We have determined paired 10-Be and 26-Al exposure ages from 58 greywacke samples taken from all major moraines, including repeat sampling from the Misery moraines. The new exposure ages show that the Arthur's Pass moraine system spans a period of 19.5 ka to 12.0 ka (Putnam local NZ production rate) with mean recessional moraine ages in chrono-stratigraphic sequence. The overall timing of deglaciation after peak LGM conditions is similar to that observed at down-valley terminal positions of the larger outlet river systems of the Rakaia, Waimakariri and Rangitata Valleys. Exposure ages from the Misery sequence are commensurate with ice retreat during the ACR and early YD suggesting that a late deglacial readvance (or stillstand), as evidenced at the Misery moraine site, was marginal in comparison to ice volume during the LGM and that it also preceded the NH major YD cooling on average by ∼1ka. Cores from two intermorainal bogs (Lances and Misery Tarns), separated by ∼1 km and constrained by the terminal Dobson and Misery moraines, have been taken for paleo-climate study. Radiocarbon basal dates will be used to deduce a new New Zealand calibration for 10Be and 26Al production rates to validate the NZ local (Putnam) production rate.