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Late Pleistocene ice-shelf, valley-glacier and ice-sheet interactions on Alexander Island, Antarctic Peninsula: implications for climatic and ice-volume changes

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Recent rapid warming across the Antarctic Peninsula has resulted in ice-sheet thinning, dramatic ice-shelf collapse, acceleration of ice-flow velocities and widespread glacier recession. Reconstructing past rates, volumes and magnitudes of cryospheric change, particularly with respect to the former configuration of ice sheets and ice shelves, and their response to changing oceanic and climatic regimes, is vital in providing a context for this change, in order to improve predictions of future ice-sheet behaviour, and to provide glacio-isostatic adjustment corrections for gravimetric measurements of contemporary ice loss. This research aimed to investigate valley glacier and ice-shelf interactions during the Last Glacial Maximum (LGM) and Holocene Epoch across George VI Sound and Alexander Island, western Antarctic Peninsula, an area with a well-preserved but poorly dated record. We identify four principal stratigraphic units: (1) a high-elevation drift with Alexander Island erratics only (interpreted as recording older advances of ice from the interior of the island), (2) a lower-elevation drift with exotic Palmer Land erratics (interpreted as ice-shelf moraine, representing incursions of George VI Ice Shelf onto Ablation Point Massif), (3) multiple overlapping sequences of valley glacier moraine and ice-shelf moraine, presumed to be Holocene in age, and (4) more recent processes and units, including frozen epishelf lakes, slope processes and alluvial fans. On-going cosmogenic nuclide dating on these sediments (in progress; 25 10Be exposure ages) has the potential to unlock the complex history and interactions of ice streams, valley glaciers and ice shelves in this area. This work will also provide the first long-term record of sea-level indicators, allowing the first estimates of glacial unloading, rates of uplift and ice-sheet thinning to be calculated. The Holocene record of the ice shelf, preserved in the younger ice-shelf moraines and in the overlapping sequence of ice-shelf and valley-glacier moraines in Erratic Valley, will assist not only in tying together limnological records from the epishelf lakes and the onshore geomorphological record, but will also allow inferences about Holocene ice-shelf collapse to be made. Dating these samples will provide a sensitive record of the geomorphological impact of Holocene climatic variations.