Glacial-Interglacial History of the Transantarctic Mountains and the Southern Ross Sea Embayment

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Research into the glacial history of the Ross Embayment has concentrated on the northern half of the Transantarctic Mountains bordering the Ross Sea. This work has identified the general character of the most recent deglaciation (e.g. [1]), however details of the deglaciation further south are unclear. Additionally, very little is known about the southern Ross Seaȋs long-term glacial history over the past few million years. To improve our understanding of both the recent and long-term history of the southern Ross Embayment we are currently measuring cosmogenic nuclides in glacial deposits and bedrock samples collected in 2010-11 from mountains flanking Beardmore Glacier.

During the Last Glacial Maximum, ice draining into the Ross Sea at the mouth of Beardmore Glacier reached a maximum elevation of ~1050-1100 m. Initial Be-10 exposure ages from an elevation transect of glacial erratics on Mt Hope show that during the subsequent deglaciation, substantial ice loss occurred by or during the early Holocene, and that the grounding line had retreated to or past Beardmore Glacier by 7.5 ka. Substantial research in the northern Transantarctic Mountains and Ross Sea supports a rapid grounding-line retreat and deglaciation of the northern Ross Sea during this period. The data from Beardmore Glacier also agree with unpublished exposure ages from Scott Glacier [2] in the Southern Transantarctics, which show two episodes of rapid deglaciation at ~8 ka and ~6 ka separated by a few-hundred-year hiatus at ~7 ka. The deglaciation data is similar in timing and pattern to high-resolution eustatic sea-level data [3] suggesting that the observed sea-level rise was either caused by or the result of Ross Sea deglaciation.

To investigate the earlier glacial history of the southern Ross Sea we are measuring Be-10, Al-26, and Cl-36 in bedrock samples. These cosmogenic nuclides are produced in bedrock when it is exposed above glacier level; during glacial periods, they decay at different rates. At the base of Mt Hope, striated and glacially-carved bedrock suggest that subglacial erosion has removed the record of exposure during previous interglacial periods. In contrast, weathered bedrock higher on the mountain has survived prior glaciations and we expect it to retain a record of previous exposure. Although we cannot assign dates to specific glacial or interglacial periods, at each elevation we will determine 1) lower limits on the cumulative time exposed and cumulative time ice-covered during the past ~1-2 Myr, and 2) upper limits on the proportion of time each sample has been ice-free. Subglacial erosion may complicate the interpretation of these data. To distinguish the effects of erosion vs radioactive decay, we will measure Cl-36 produced in biotite by low-energy neutron capture in short bedrock depth profiles. In biotite, the Cl-36 depth profile is very sensitive to surface erosion, and will allow determination of erosion rates in the range of 0-2 m/Myr [4,5].

References:
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[3] Bird, M. I. et al., (2010) Geology, 38, 803-806.
[4] Liu, B. et al., (1994) Water Resour. Res., 30, 3115-3125.
[5] Phillips, F. M. et al., (2001) Chem. Geo., 175, 689-701.