

# **Solving for a history of ice thickness in the southern Ross Sea Embayment using inverse methods and surface-exposure ages**

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Surface-exposure ages calculated from  $^{10}\text{Be}$  concentrations in erratics track the history of ice thickness along Reedy Glacier from approximately 17 kyr before present (B.P.) through the late Holocene. However, due to limited availability of glacially-derived material at accessible and appropriate sampling sites, surface-exposure ages from lateral deposits at Reedy Glacier provide only partial ice-thickness histories for a limited number of locations along the length of the glacier. Specifically, surface-exposure ages from nunataks near the mouth of Reedy Glacier provide a history of ice thicknesses that begins approximately 7 kyr B.P., several thousand years after the last glacial maximum (LGM) is thought to have occurred in West Antarctica. Thus, in order to constrain the LGM configuration of the West Antarctic Ice Sheet (WAIS), we set up an inverse problem to solve for the history of ice thickness at the mouth of Reedy Glacier.

An inverse problem occurs when there are data that are produced by a known physical process, but the initial conditions or the parameters governing that physical process are unknown. Inverse procedures require (1) a forward algorithm that simulates a known physical process, given a set of parameters, (2) a set of observations or data that are the result of the known physical process, (3) an inverse algorithm that calculates estimates of the data by iteratively running the forward algorithm using estimates of the model parameters. The solution to an inverse problem is the set of model parameters that are physically reasonable and that yield results from the forward algorithm that best fit the data at a defined tolerance.

In this inverse procedure, our data are known ice thicknesses at discrete points on the glacier at different times in the past. The forward algorithm is a numerical model that calculates ice thicknesses along the glacier, given a history of ice thickness at the mouth of the glacier. This history of ice thickness at the mouth of Reedy Glacier is our parameter set. Our inverse procedure finds the parameter set that (1) yields glacier surfaces that best match our surface-exposure-age data at a defined tolerance, and (2) is within a range of ice thicknesses that are physically reasonable. Preliminary results suggest that LGM ice thickness at the mouth of Reedy Glacier, in the southern Ross Sea Embayment, was between approximately 1000 and 1200 m above sea level.