

Constraints on the magnitude and timing of post-LGM thinning at Siple Dome from thermomechanical flow modeling

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The measured depth-age and layer-thickness patterns in the Siple Dome ice core constrain combinations of ice thickness and accumulation histories, but do not (by themselves) permit a unique determination of these histories individually. Waddington and others (see abstract, this conference) demonstrate the tradeoff between various ice thickness and accumulation histories using a 1-D, transient, kinematic flow model. They find that a “reasonable” accumulation history at Siple Dome for the past ~25 ka requires thinning of <500 m taking place from ~16-2 ka bp, with a transient divide moving through the core site at ~4 ka bp.

Here, we take a different approach; we assume known accumulation-rate and surface-temperature histories (from M. Spencer and R. Alley, J. White and A. Schilla, respectively) and a divide migration history after 2 ka bp that is consistent with previous work (Nereson and others, 1998). These are used to drive a transient, thermomechanical-flow model (see Price and others, poster abstract, this conference) that explicitly accounts for transient thermal effects and the advection of internal layers through transient velocity fields. To fit the measured depth-age scale, we vary (i) the magnitude and timing of thickness changes and (ii) the timing of divide-flow initiation.

We find that a range of models fit the measured depth-age scale equally well, with more recent initiation of divide-flow requiring more thinning and vice versa. A further constraint is provided by comparing the measured and modeled layer shapes in the divide region; the more recent the initiation of divide flow, the smaller the “Raymond bump” amplitude and the depth of its maximum (e.g. Conway and others, 1999). The model that best fits both constraints is compatible with that inferred by Waddington and others; 400-500 m of thinning taking place from 7-2 ka bp, initiation of divide-flow between 4 and 3 ka bp, followed by divide migration after 2 ka bp.

The best fitting models require thinning at a rate of ~0.10 m/a for ~5 ka. This large rate of thinning appears to be coincident with significant grounding line retreat that took place after 7 ka bp (Anderson and Shipp, 2002). We discuss the potential implications of these observations with respect to the deglaciation history of the WAIS and, in particular, with

respect to the possibility for enhanced ice flow past Siple Dome during the Holocene (e.g. through the initiation of streaming flow or more vigorous streaming flow). ##### References:

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