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On the effects of divide migration, along-ridge flow and basal sliding on isochrones near an ice divide

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Radar layer geometry in divide areas is strongly influenced by the operation of the Raymond effect, which causes upwarping of the layers as a consequence of the non-linear rheology of ice. The detailed geometry of these layers is known to produce a record of change in the cryosphere: of local thinning, of the age of formation of the divide, and has been surmised to provide information about lateral motion of divides. Such lateral motion can be caused by changes in flanking ice-streams, and the divide area thereby contains a record of ice stream dynamics.

It has also been suggested that large perturbation of divide position will obliterate the cumulative effects of the operation of the Raymond mechanism, leading to the disappearance of Raymond bumps. Since the Raymond effect has a strong influence on the age-depth relation in ice cores, knowledge of whether its operation is localised (leading to strong bump formation) or distributed is crucial in the interpretation of ice cores.

The detailed evolution of ice divide radar layer geometry remains poorly understood. Employing a full thermomechanically coupled transient model, we qualitatively explore the effect of divide migration on radar layer geometry. Certain qualitative features emerge which are compared with field examples from Roosevelt Island and Siple Dome. These can be used to infer history of cryosphere change, in particular in areas distant from the usual sites of geological dating. Constructing such a picture of glacial change over extended periods provides a crucial quantitative context to modern observations of change.

There remains uncertainty about the influence of sliding on the operation of the Ray-

mond effect. Under certain conditions, the existence of sliding can damp or eliminate the operation of the Raymond effect. If this is generally true, then dating of ice divides may simply be a date for the freezing of the divide bottom. We show that sliding does not necessarily eliminate the formation of bumps, and dates of divide formation are likely to be dates for the location of the ridge at a particular spot.