MODELING ICE SHEET PERMAFROST INTERACTION AROUND THE SOUTHERN LAURENTIDE ICE SHEET

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The existence of permanently frozen ground has a major influence on the dynamics of an advancing ice sheet and the formation of landforms. Cooling early in a glacial cycle produced extensive permafrost. The insulation effect of the ice sheet after advancing over areas of permafrost led to a slow degradation of permafrost under the ice. Finally, warming after the LGM caused the disappearance of subglacial permafrost. Subglacial permafrost affects directly the evolution of basal temperature and subglacial hydrology, both critical conditions for the formation of landforms and fast flow instabilities. Surge-type flow instabilities may account for the relatively thin ice lobes, the dominant features around the southern margin of the Laurentide Ice Sheet (LIS).

Numerical experiments of the last glacial cycle of the southern LIS were performed with a permafrost model of the earth’s crust coupled with the three-dimensional thermomechanical UBC ice sheet model. This ice sheet model contains thickness evolution, ice flow, temperature evolution, and isostasy. The permafrost growth and decay is modeled solving the heat-transport equation for a mixture of sediment and bedrock with varying water and ice content. The transient permafrost condition beneath and peripheral to the ice sheet was analyzed for the last glacial maximum and the transition period to present climate.