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Thermodynamical model of the formation of ice rafts on aqueous, laminar, ice-dominated flows in Amazonian outflow channels on Mars

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We predict the lifetime of the ice that forms on the floods in the Amazonian outflow channels on Mars and therefore the duration of the ice-dominated flow stage within the channels. The freezing process is dependent on many factors affecting the heat balance at the surface of the ice and at the ice/water interface once the freezing process has begun. This work begins by reviewing the previous models of the stability of liquid water under the Amazonian environment. A new analytical model is proposed, developed upon the foundations of previous work, correcting some previous errors, and extending this work to incorporate some new concepts based on experimental findings of previous workers. The result is a refined model that considers both processes of freezing and sublimation, and which can provide an estimate of the lifetime of the ice. This lifetime is compared with estimates of the discharge duration in the channels. The model does not require the following assumptions that have been made in previous models: (a) high wind speeds, (b) constant ice surface temperature, (c) dry air above the ice surface. These conditions would be acceptable and easily incorporated, however, if the data suggest that they existed. Ice-dominated flows at the distal ends of the Amazonian outflow channels would have had longer durations than the water-dominated stage of the flows in the more proximal channel segments, and may account for the platy flows discussed by previous workers. Thickening of ice has two effects: (1) to reduce conductive heat loss, and (2) to reduce the rate of freezing. After the flow becomes laminar, both sublimation from the surface of the ice, and freezing

to the base of the ice, begin. Both processes therefore feedback into the system. If the body is completely frozen, then it becomes an ice sheet, comprising ice and rock. Eventually, after compaction, this can add to the thickness of the cryosphere.