Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

An Experimental Investigation of Ice-melting and heat transfer rates from submerged warm water jets upward impinging into ice-blocks as analogous for water-filled cavities formed during subglacial eruptions.. HAMIDREZA JAMSHIDNIA, MAGNUS TUMI GUDMUNDSSON, University of Iceland — Rates of energy transfer in water-filled cavities formed under glaciers by geothermal and volcanic activity are investigated by conducting experiments in which hot water jets (10- 90C) impinging into an ice block for jet Reynolds numbers in turbulent regime of 10000 -70000. It is found that heat flux is linearly dependent on jet flow temperature. Water jet melts a cavity into an ice block. Cavities had steep to vertical sides with a doming roof. Some of ice blocks used had trapped air bubbles. In these cases that melting of the ice could have led to trapping of air at the top of cavity, partially insulating the roof from hot water jet. The overall heat transfer rate in cavity formation varied with jet temperature from $<$100 kW m^{-2} to ˜900 kW m^{-2} while melting rates in the vertical direction yield heat transfer rates of 200-1200 kW m^{-2}. Experimental heat transfer rates can be compared to data on subglacial melting observed for ice cauldrons in Iceland. For lowest temperatures the numbers are comparable to those for geothermal water in cool, subglacial water bodies and above subglacial flowpaths of jökulhlaups. Highest experimental rates for 80-90C jets are 3-10 times less than inferred from observations of recent subglacial eruptions (2000-4000 kW m^{-2}). This can indicate that single phase liquid water convection alone may not be sufficient to explain the rates seen in recent subglacial eruptions, suggesting that forced 2 or 3 phase convection can be common.

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Date submitted: 18 Aug 2016 Electronic form version 1.4