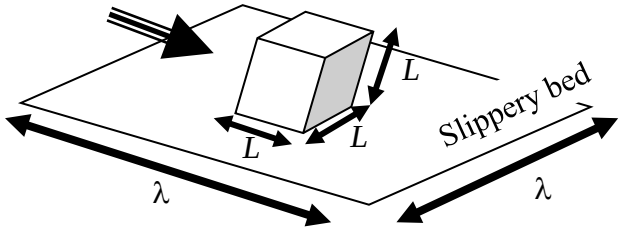
EARTH AND SPACE SCIENCE **Autumn 2017**
431 *PRINCIPLES OF GLACIOLOGY* 4 Credits, SLN 14841
505 *THE CRYOSPHERE* 4 Credits, SLN 14862

Lab Week 5 – Basal Sliding

Weertman's sliding law provides information about how the ice sheet responds to obstacles of different sizes at the ice sheet bed. Weertman showed conceptually that ice flows most easily past small obstacles by regelation, and flows more easily around large obstacles by enhanced creep. In class, we demonstrated regelation using copper wire, ice blocks, and weights.

Problem 1) What is the equation that describes ice flow speed by regelation derived in class, assuming a bed with some distribution of Weertman's tombstones (like those seen in the figure below)? Define each of the terms in the equation, and record their units.



Problem 2) Here you will be asked to compute the difference in time required for different gauged copper wires to pass through an ice block (like the experiment run in class). To facilitate calculation, we will simplify the physical setup according to the following assumptions:

> *Instead of a wire (which has complex bending forces), we will assume that this is a rigid metal rod, with a square cross section of side length L. L=0.0005m for the thin rod, and L = 0.0015m for the thick rod. The mass of the rod is evenly distributed, and is 10kg. The block of ice is a cube of side length 0.1m. The rod is oriented along the middle of the cube, running parallel to two of the cube edges.*

Part 1 – Draw the experimental setup, compute the contact area between the rod and the ice block. What is the applied pressure?

Part 2 – Using the physical constants supplied below, compute the amount of time required for each rod to pass through the block. ***Watch your units***.

Clapeyron Slope:	$-7 * 10^{-8}$ °C/Pa
Thermal Conductivity of the Rod:	400 W/m°C
Thermal Conductivity of Ice:	2 W/m°C
Acceleration due to Gravity:	9.8 m/s^2
Latent Heat of Fusion (ice):	330 J/g
Density of Ice:	912 kg/m^3

Problem 3) Solve for the critical obstacle size (L) at which flow switches from being dominated by regelation to dominated by enhanced creep.