

Geophysics 150: Home set due Oct. 16, 2002

3. Use parameters from problems 1 and 2. Obtain the depth that 5°C water exists on Mars.

a. Assume that the conduit water is cooled to just 0°C so that no freezing occurs when it reaches the surface. Compute the heat loss from the conduit to its sides over its full length. You can use average from question 2 or integrate over the depth of the conduit. How fast must the water flow (in $\text{m}^3 \text{s}^{-1}$) to balance this heat loss?

b. Instead assume that 10% ice in the water can stay in suspension. What is the needed flow rate then. Use heat flow from part a for simplicity. In actual arctic springs freezing occurs in the rock if pores exist and this self-seals the conduit. Note that small freezing self-seals the spring from leaks.

c. The flow is tapped from a kilometer radius to feed the spring. What is the vertical down flow flow rate averaged over that region need to supply the water in part b?