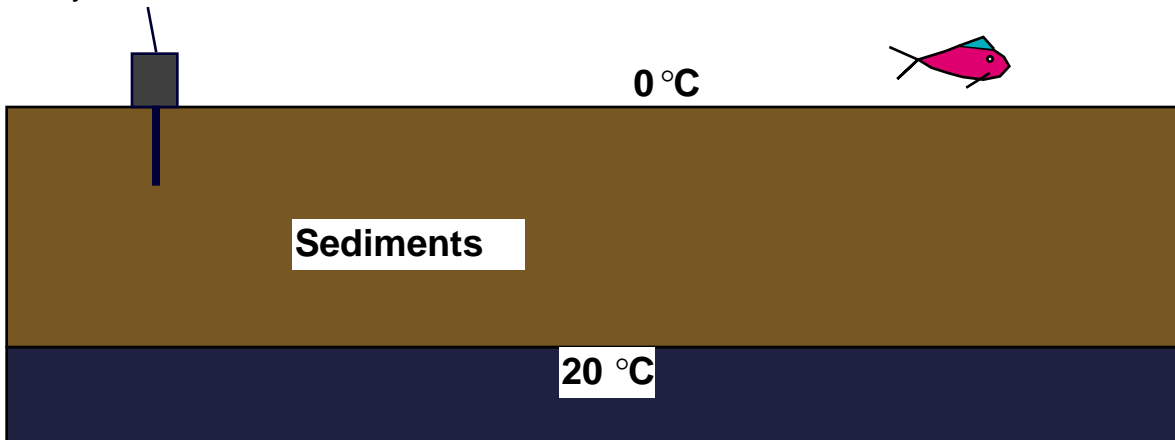


Geophysics 150: Home set due Oct. 11, 2000

1. We wish to measure conductive heat flow on old oceanic crust. The heat flow is measured in sediments with a conductivity of $0.8 \text{ W m}^{-1} \text{ K}^{-1}$. The volume specific heat of the sediments and the water within them is $4 \text{ MJ m}^{-3} \text{ K}^{-1}$. The sediments cover permeable rock (the upper part of layer 2A) where pore water is 20°C and circulates freely. The bottom water is 0°C .



a. The sediments are 250 m thick. Compute the thermal gradient and the heat flow assuming only conduction occurs.

b. Assume instead that the water upwelling velocity is 10^{-9} m s^{-1} at the base of and throughout the sediments. Compute the convective heat flow at the base of the sediments, the scale length, and sketch or plot the temperature as a function of depth within the region of the sediments.

c. What conductive heat flow would you measure with a very shallow probe into the sediment surface? Assume your actual probe is two meters long from the sediment-water surface. How accurately must temperature be measured to detect the convective heat flow?