HW-4: Sedimentation

In the Ursa Basin, the sedimentation rate over the last 50,000 yrs is 12mm/yr (0.012m/yr). The coefficient of consolidation (*cv*) for mudstone is 2x10-8 m2/s (0.63 m2/yr). In contrast the coefficient of consolidation for siltstone is 2x10-7 m2/s (6.3 m2/yr).

The coefficient of consolidation is:

$c\_{v}=\frac{k}{μm\_{v}}$, Eq. 1

Where *k* is permeability, ** is viscosity, and *mv* is compressibility.

The Time Factor, *T* is:

$T=\frac{m^{2}t}{c\_{v}}$ Eq. 2

1. How severe is the overpressure for these two lithologies at a depth of 200 meters and 500 meters? Please plot predicted pressure on Figure 2. Please estimate the predicted pressure and $ λ^{\*}$ value ($λ^{\*}=\frac{u^{\*}}{σ\_{v}-u\_{h}})$ at 200 and 500 meters after 50,000 years.



Figure 1: Right: A plot of Gibson’s Time Factor (#s in boxes). Relative Pressure (hydrostatic to lithostatic) is on the horizontal axis. Relative depth is on the vertical axis.



Figure 2: Pressure vs. depth (left) and Overpressure vs. Depth (right). Please plot pressure for both the mudstone and siltstone.



Figure 3: Observed pressures in the Ursa Basin.

1. *cv* at Eugene Island at the depths you are looking at is very similar, but the permeability is much lower. Can you propose a reason why?
2. A way to estimate the time scale of pressure dissipation is to look at the scaling of the coefficient of consolidation.



$C\_{v}=\frac{k}{u m\_{v}}$ Eq. 3

$T\_{v}=\frac{C\_{v}t}{d^{2}}$ Eq. 4

Please rearrange Eq. 4 to solve for ‘*t*’ given *Tv* = 0.7 to estimate the time it will take to dissipate the majority of the pressure at 0.01m, 100m, and 1000m thickness of Ursa mudstone.