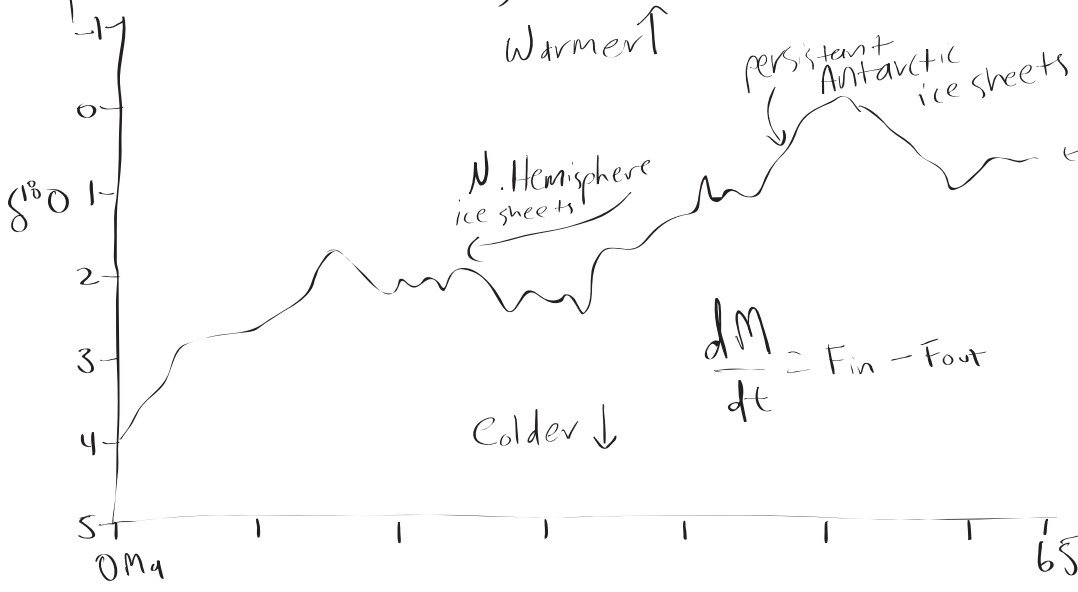


# Example: Cenozoic Cooling

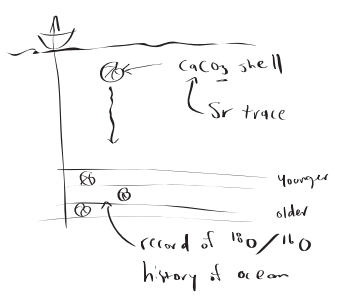
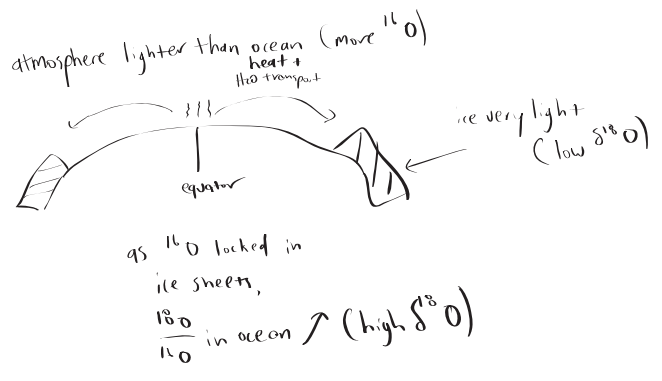


① Changing  $F_{in}$ ?  
 • look at age of sea floor  
 • look at Robley 2002 Fig 1  
 ↳ no apparent change

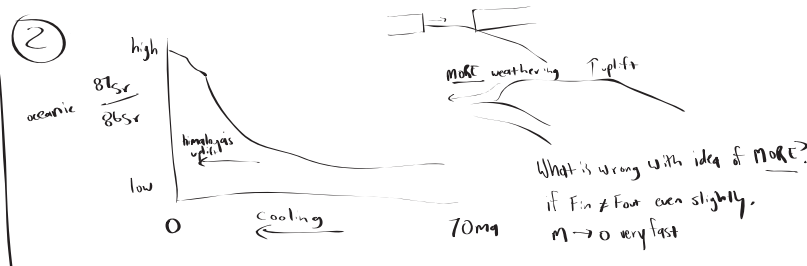
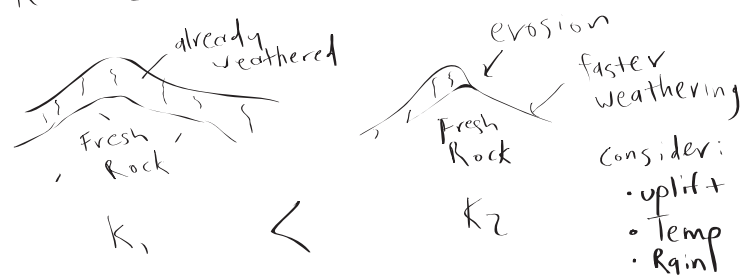
② Changing  $F_{out}$ ?  
 $^{87}\text{Rb} \rightarrow ^{87}\text{Sr}$   $\lambda_{1/2} = 49.2 \text{ Ga}$   
 • Rb is highly incompatible and stored in continental crust  
 • CC rocks (granites) have high  $^{87}\text{Sr}/^{86}\text{Sr}$   
 • MORB (melts of depleted mantle) have low  $^{87}\text{Sr}/^{86}\text{Sr}$

$$\frac{dM}{dt} = F_{in} - F_{out}$$

$\delta^{18}\text{O} \sim \text{ratio of } ^{18}\text{O} \text{ to } ^{16}\text{O}$



$K \sim f(\text{tectonics, climate})$



Instead of  $^{87}\text{Sr}/^{86}\text{Sr}$  indicating  $M$   
 $\delta_{\text{Sr}} = ^{87}\text{Sr}/^{86}\text{Sr}$   
 $S_{\text{Sr}} \approx S_{\text{Sr}}^{\text{crust}}$  (steady state)  
 $\frac{d(^{87}\text{Sr}/^{86}\text{Sr})}{dt} = \delta_{\text{Sr}}^{\text{MORB}} \cdot F_{\text{in}}^{\text{MORB}} + \delta_{\text{Sr}}^{\text{cc}} \cdot F_{\text{in}}^{\text{cc}} - \delta_{\text{Sr}}^{\text{cc}} \cdot (F_{\text{out}}^{\text{cc}} + F_{\text{out}}^{\text{cc}})$   
 $^{87}\text{Sr}/^{86}\text{Sr}$  reflects source of weathering products

③  $F_{out} = KM$

$$\frac{dM}{dt} = F_{in} - KM$$

same amount

$$0 = F_{in} - KM$$

(steady state)

$$M = \frac{F_{in}}{K}$$

lower  $M \text{ CO}_2 \rightarrow$  higher  $K$

"strength of the weathering feedback" or weatherability

has increased over Cenozoic

Also, source balance has shifted to higher  $^{87}\text{Sr}/^{86}\text{Sr}$  rocks