Fractional melting

$$\frac{C_s}{C_{s_0}} = (1-F)^{\frac{1}{D}-1}$$

or

$$\frac{C_m}{C_{s_0}} = \frac{1}{D}(1-F)^{\frac{1}{D}-1}$$

} instantaneous melt

$F = \frac{M_m}{M_{s_0}}$ ← all melt extracted

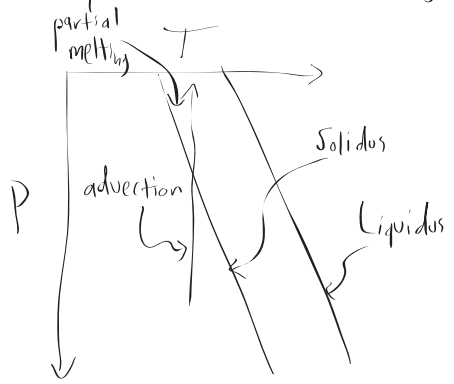
What if we want the C_m of all melt over an interval of melting?

average $\frac{\bar{C}_m}{C_{s_0}} = \frac{1}{F}\int_0^F \frac{1}{D}(1-F)^{\frac{1}{D}-1}\,dF$

$dF = -d(1-F)$

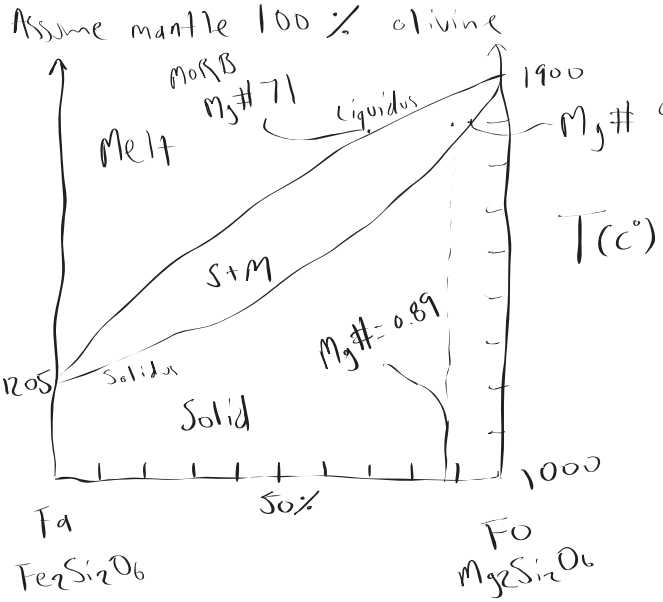
$$\frac{\bar{C}_m}{C_{s_0}} = \frac{1-(1-F)^{1/D}}{F}$$

Example: mid ocean ridge melting



How could we estimate F?

→ use compositions of primitive mid ocean ridge basalts and major elements in peridotite



"lever rule"

71 a 89 b 91

$a+b = 20$

$\frac{M_m}{m_0} = \frac{b}{a+b} = F = 0.1$

With partial melting of $F = 0.1$, can we reconstruct depleted mantle trace elements?

Rb D in bulk peridotite ~ 0.5, C_{Rb} in MORB ~ 1.1 relative to PM

depleted mantle

$$\frac{1.1}{x} = \frac{1-(1-0.1)^{\frac{1}{0.5}}}{0.1}$$

$x = 0.57$ mantle has lost almost half of its original Rb