

Problem Set 1 due Monday March 6

1. Given the mass balance equations:

$$M_o\delta_o + M_i\delta_i = \text{constant}$$

$$\Delta M_i / A_o = \Delta(\text{Sea level})$$

a particular $\delta^{18}\text{O}$ paleotemperature curve (Shackleton, 1974, linear curve fit to Uvigerina data):

$$T = 16.9 - 4.0(\delta_c - \delta_w)$$

assuming that:

the mean $\delta^{18}\text{O}$ of glacial ice was -30 to -40 ‰

and given that:

$$M_{o(\text{now})} = 1.4 \times 10^{21} \text{ kg @ an average density of } 1.03 \text{ g/cm}^3$$

$$A_o = 361 \times 10^6 \text{ km}^2$$

the mean salinity of the ocean today is 34.7 ‰

sea level was 120 m lower during the last glacial maximum

The isotopic composition of interglacial benthic carbonate is 3.5‰
(with respect to PDB).

The isotopic composition of glacial benthic carbonate is 5.1‰
(with respect to PDB).

(note: to convert SMOW to PDB scale, $\delta_w(\text{PDB}) = \delta_w(\text{SMOW}) - 0.2$)

Calculate:

- a. The salinity of the glacial ocean.
- b. The change in mean deep ocean temperature during the last glacial maximum, and how sensitive it is to your assumption about the isotopic composition of glacial ice.