**DISSOLVED OXYGEN**
- High at surface (ventilated from atmosphere)
- Low = OLD water (long time since at surface) or
  = Evidence of high biological activity

**THUS – Pacific Water has LOW Dissolved Oxygen**

Falkner et al, 2005 DSR
SILICATE, NITRATE, PHOSPHATE
- High from source in Pacific
  BUT – not conservative

\[(\text{CH}_2\text{O})_{106}(\text{NH})_{16}(\text{H}_3\text{PO}_4) + 138 \text{ O}_2 = 106 \text{ CO}_2 + 122 \text{ H}_2\text{O} + 16 \text{ HNO}_3 + \text{ H}_3\text{PO}_4\]

**Biogenic matter + oxygen = Carbon Dioxide + Water + NUTRIENTS**

Fixing of nutrients and Carbon to make biogenic matter

Decay of biogenic matter using up Oxygen, forming nutrients

Try to create a “tracer” that is conservative “Quasi-conservative Tracer”

“NO” and “PO” – Broecker, 1974
- cope with growth and decay
  \[\text{NO} = 9 \text{ NO}_3 + \text{ O}_2\]
  \[\text{PO} = 135 \text{ PO}_4 + \text{ O}_2\]

N:P ratios
NO:PO ratios

\[N^* (N \text{ star}) – \text{Gruber and Sarmiento, 1997}\]
- indicates nitrogen fixation and denitrification
  \[N^* = 0.87 [N – 16 P + 2.9 \mu\text{mol kg}^{-1}]\]
NITRATE: PHOSPHATE RELATIONSHIP
different in AW and PW

= For a Nitrate value, PW have more Phosphate
= Slope set by Redfield
= Exact lines may change
NO₃(pw) = 14.828 x PO₄(pw) – 12.16   (Falck, 2001)

BUT work out % influence of PW and AW
( ..but certainly no better than 10%
.... assumes ice melt, P and runoff same as AW
....  denitrification .. and other such processes)

% PW in upper 30m

Figure 2. Nitrate vs. phosphate from AOS94 Stations 4 to 12 (triangles) and St. Anna Trough, ARKTIS XII Stations 3 to 19 (circles). Freshwater is represented by a cross.

Jones, Anderson and Swift, GRL, 1998
Distribution of Atlantic and Pacific waters in the upper Arctic Ocean: Implications for circulation
**Upper Arctic Ocean Circulation and Ventilation**

**HALOCLINE BASICS**
- Formation possibilities
- Western versus Eastern Arctic
- Different branches of PW

**CIRCULATION CHANGES**
- Shift in rivers outflow
- Retreat and recovery of CHL
- Shift of Pacific/Atlantic Front

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**MECHANISMS OF SHELF-BASIN EXCHANGE**
- Wind-driven upwelling and mixing of AW with PW
- Potential vorticity conservation, following topography
- Dense water outflow from polynyas
- Eddies (AC, ~ scale of Rossby radius)
- Wind-driven undercurrents (Yoshida jet)
- Tides and inertial oscillations

**TRACING PW versus AW HALOCLINE**
- PW lower salinity, smoother TS
- PW lower dissolved oxygen
- PW higher nutrients (esp Silicate)
- AW/PW NO3:PO4 ratio

*Rudels et al, 1996*