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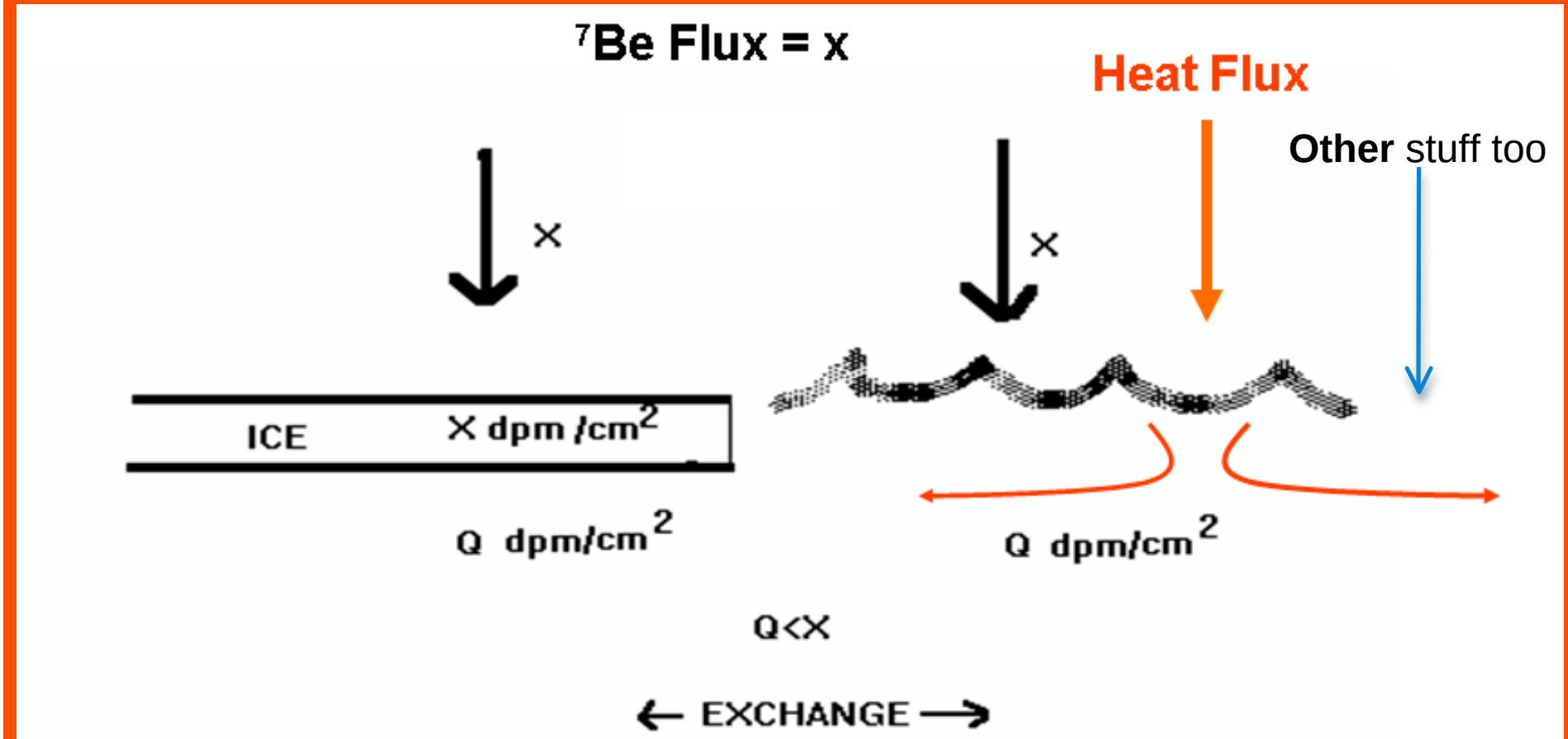
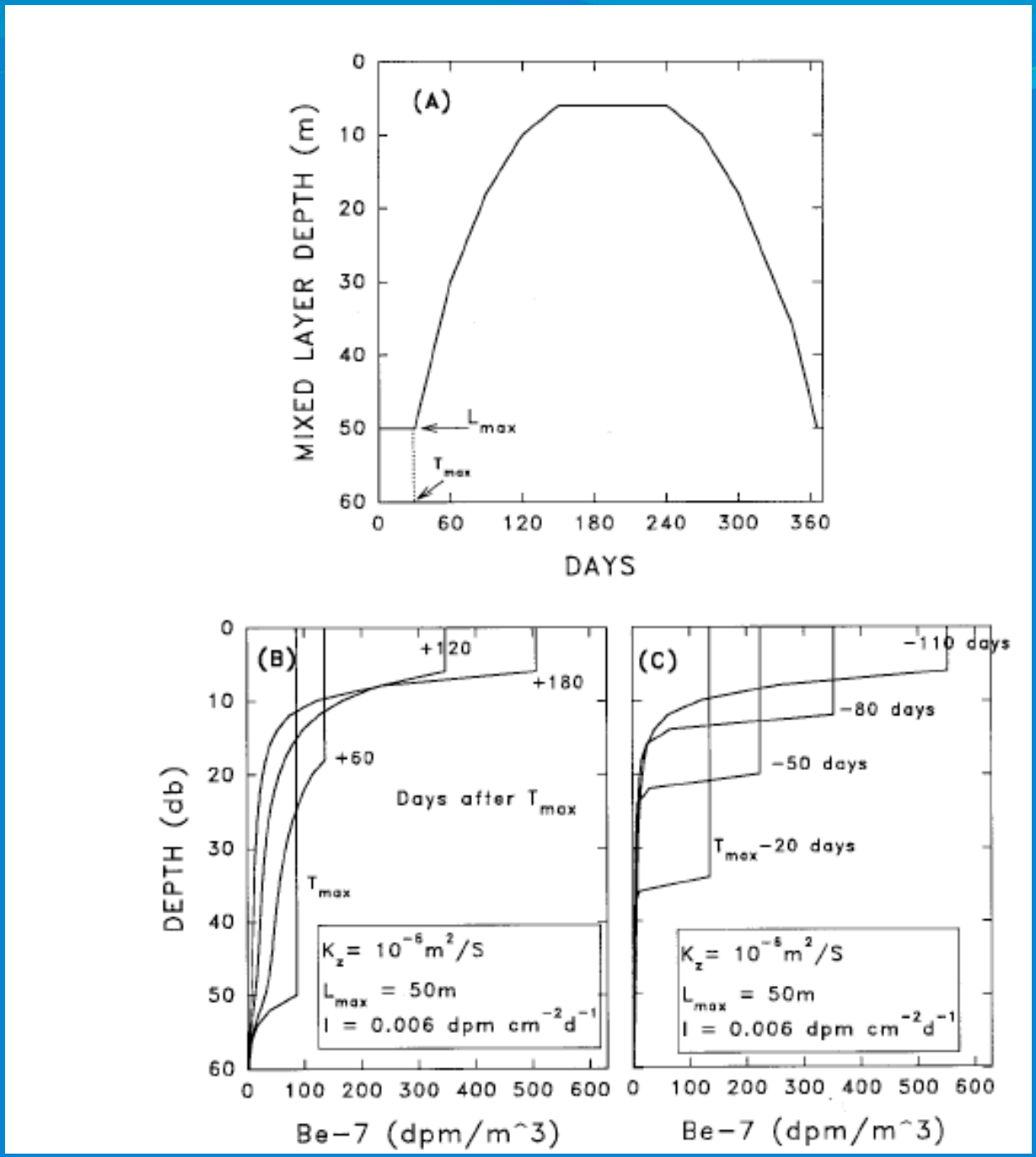
^{7}Be ($T_{1/2}$ = 53.3 d) seasonal timescale tracer

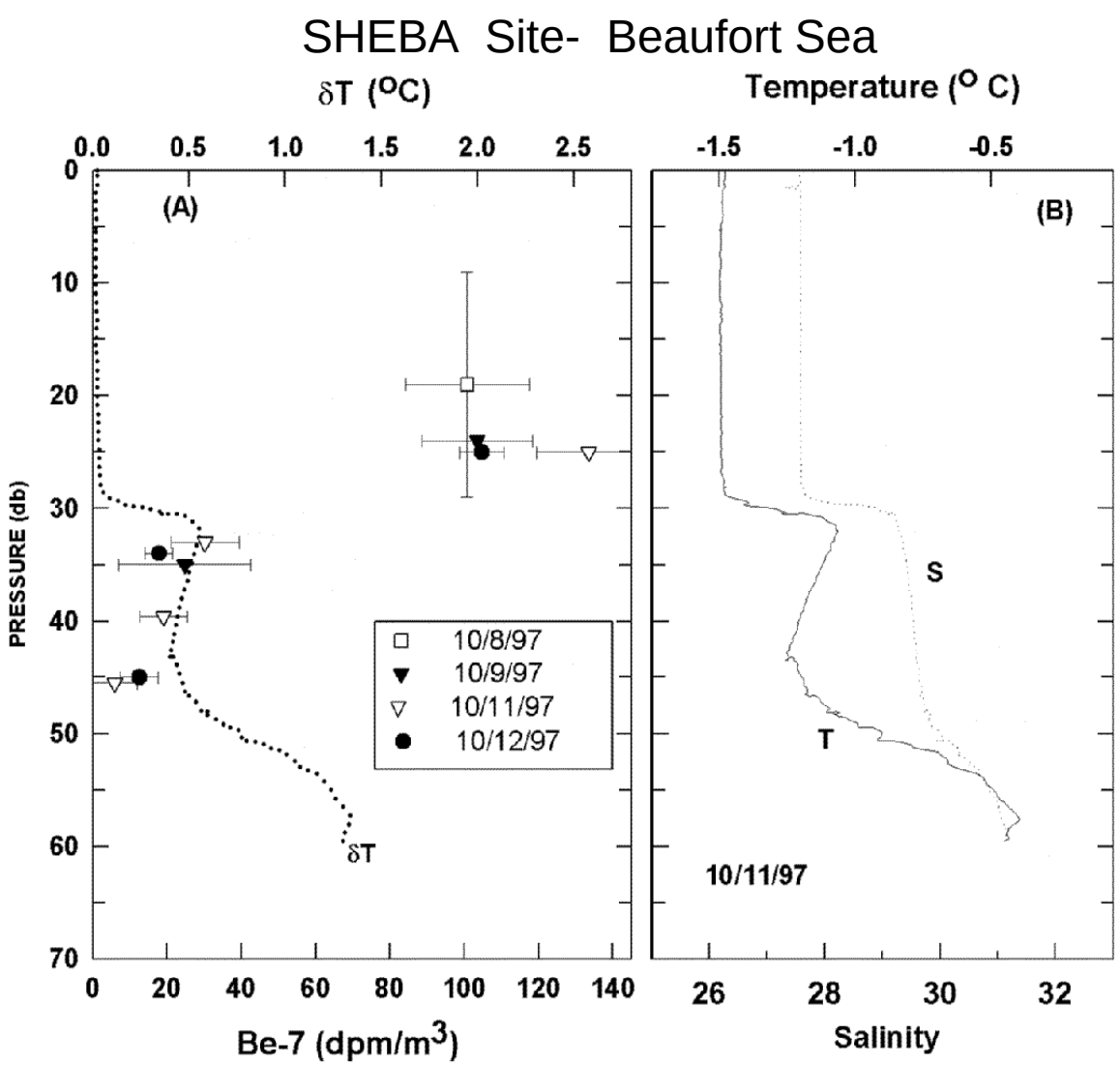
Evaluate:

- **seasonal evolution of the mixed layer**
- **oxygen utilization rates**
- **source and fate of heat input to the mixed layer**
  - **-important in the Arctic:**
    - **maintenance of ice cover**
    - **ice-albedo feedback**
- **atmospheric input of relevant species**



^{7}Be serves as a proxy for incoming solar radiation through leads over a seasonal timescale


(A)
MIXED LAYER DEPTH (m)
0
10
20
30
40
50
60
L_{max}
T_{max}
0
60
120
180
240
300
360
DAYS
(B)
+120
+180
+60
Days after T_{max}
T_{max}
$K_z = 10^{-6} m^2/S$
L_{max} = 50m
I = 0.006 dpm $cm^{-2} d^{-1}$
DEPTH (db)
0
10
20
30
40
50
60
0
100
200
300
400
500
600
Be-7 (dpm/m^3)
(C)
-110 days
-80 days
-50 days
T_{max}-20 days
$K_z = 10^{-6} m^2/S$
L_{max} = 50m
I = 0.006 dpm $cm^{-2} d^{-1}$
0
100
200
300
400
500
600
Be-7 (dpm/m^3)



Remnant ^{7}Be below the mixed layer marks the warm water as having been in contact with the sea surface within the previous ~77 d.

Thus the heated layer beneath the October mixed layer was remnant of an earlier, deeper mixed layer and was the result of very active heat input in the previous late spring-summer.

The heat and fresh water content of the SHEBA site was much greater than that measured during AIDJEX 20 years earlier. Likely caused by an 3-fold increase in open water.

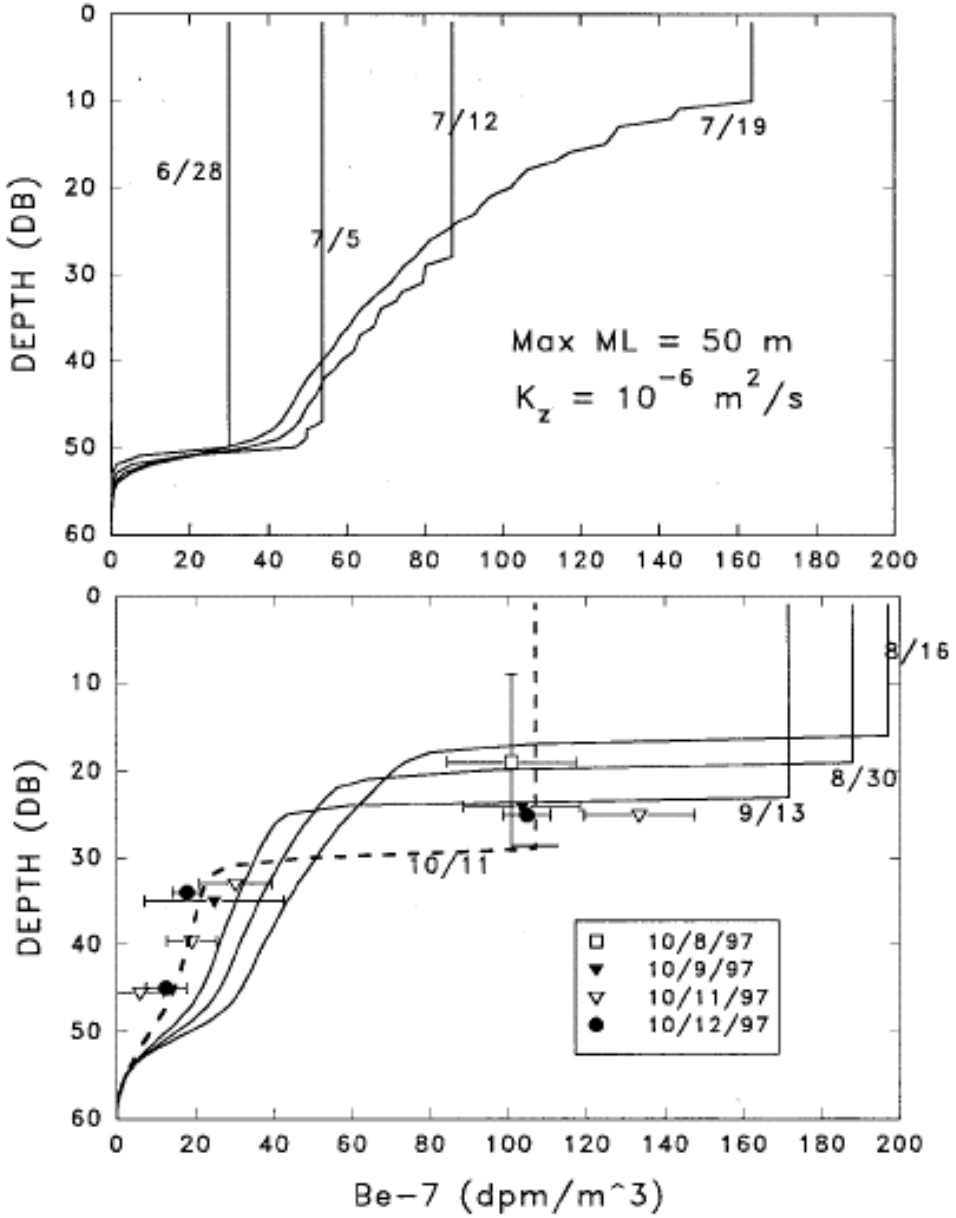


Figure 6. The model output showing the evolution of the ^{7}Be profile at SHEBA with time. Data from the period October 8–12 are superimposed upon the model profiles. The model profile for October 11 is shown as a dashed line.

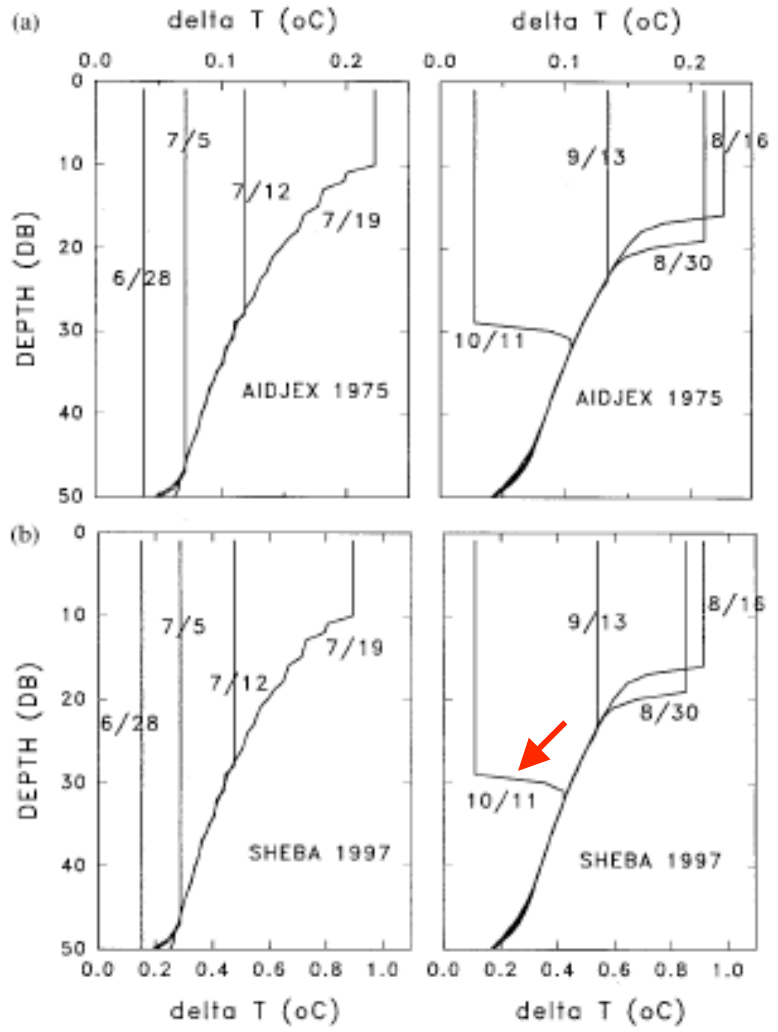
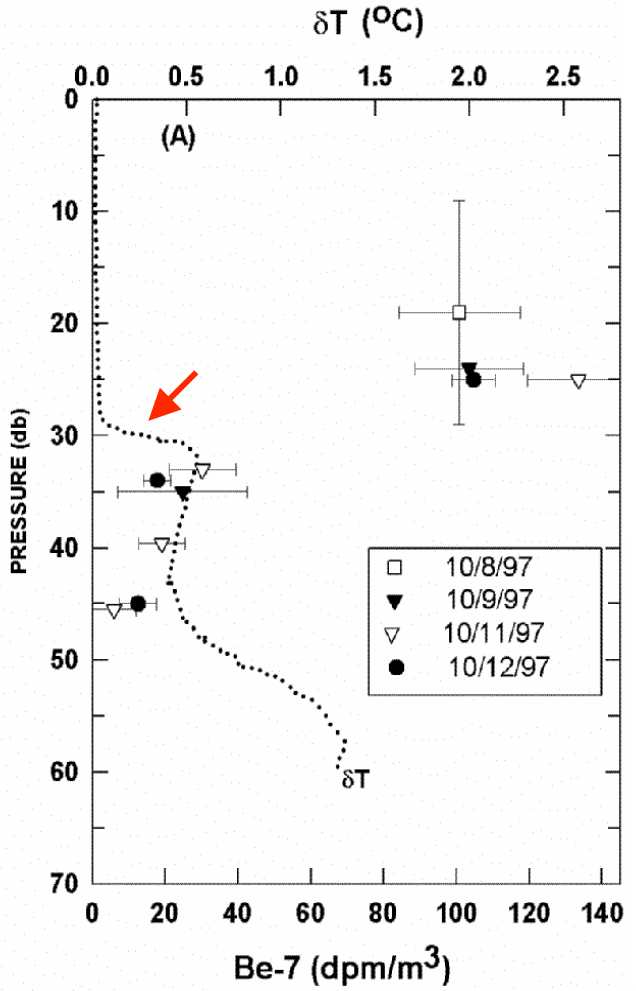


Figure 10. The model temperature output for (a) AIDJEX and (b) SHEBA. Note the change in temperature scale. It is seen that the δT maximum on October 11 corresponds to the temperature to which the mixed layer was heated by mid-July (as opposed to the solstice) and marks the depth of the mixed layer at that time.



Mixed layer history derived from ^{7}Be used to model the temperature profile.
As with ^{7}Be, the maximum in δT is a remnant feature of an early deep mixed layer.
At SHEBA in 1997, 1-D model can account for high heat content.

$AOU = [O_2^{sat}] - [O_2]$

$^{7}Be = 7Be_i$

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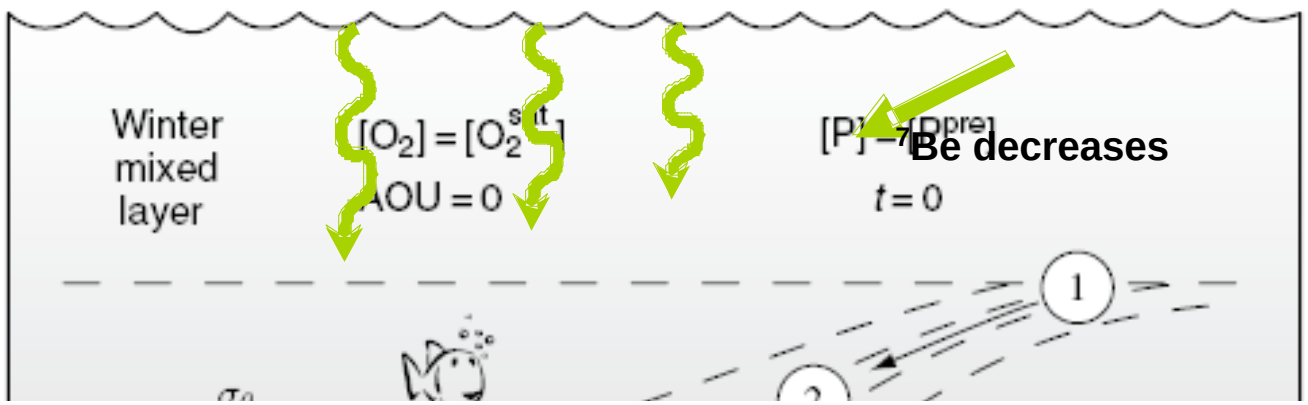
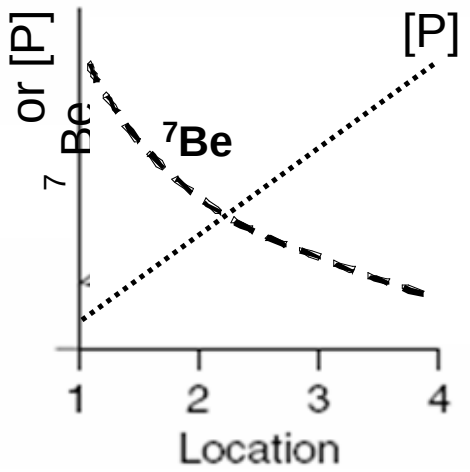
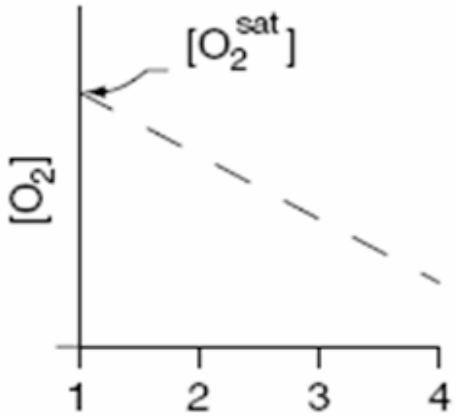
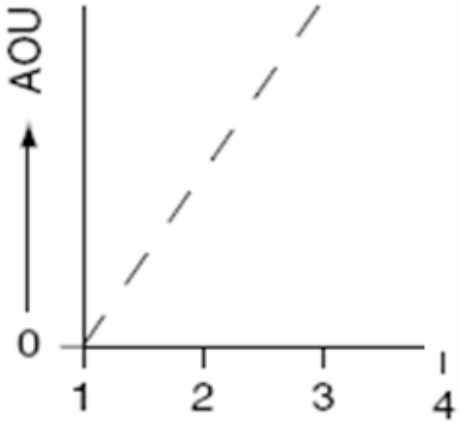


Properties on density surface σ_θ

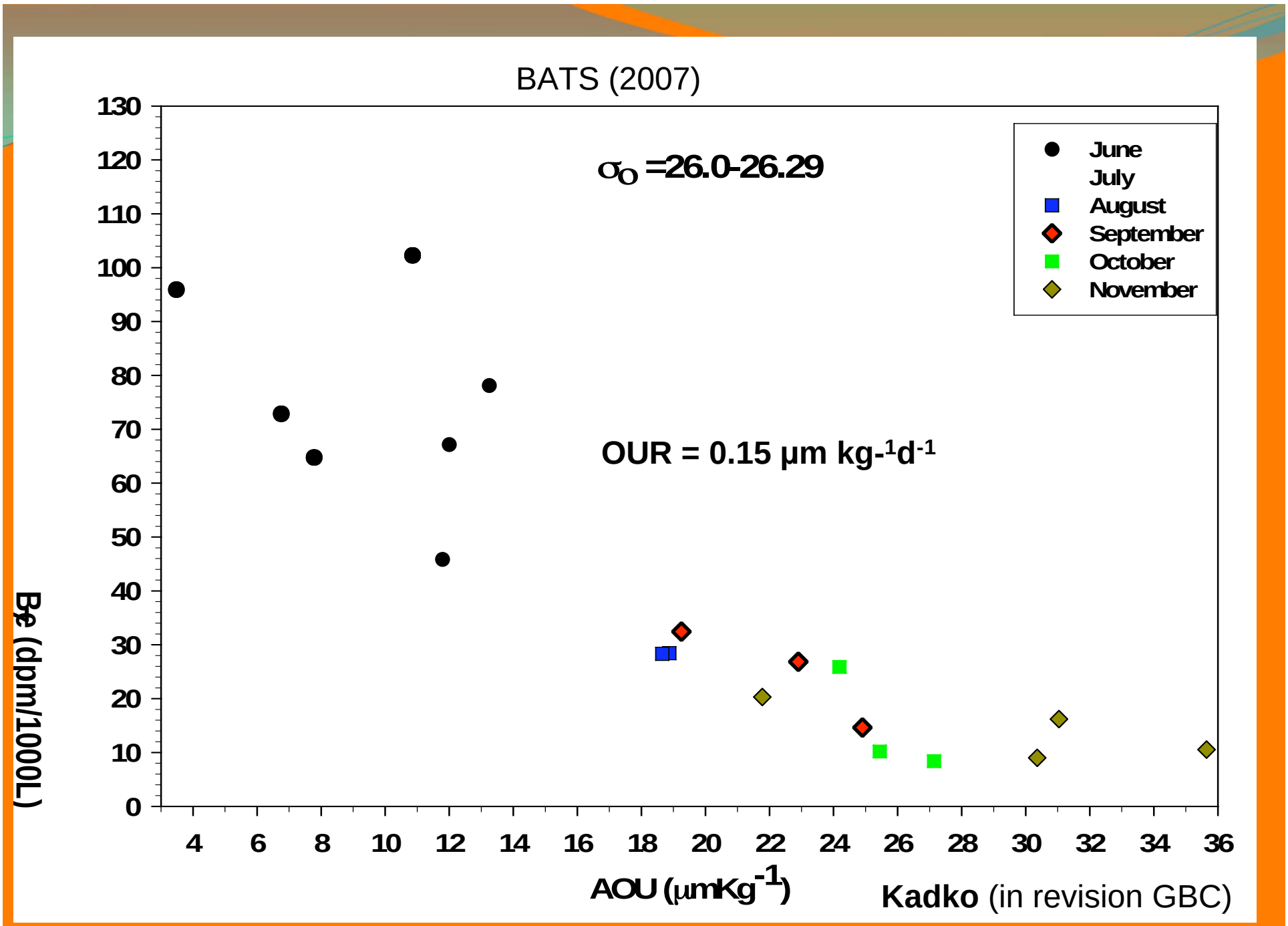




Apparent oxygen utilization



By comparing the decrease of oxygen to the decay of ^{7}Be it is possible to derive the rate of oxygen utilization beneath the mixed layer .


BATS (2007)
σ_O =26.0-26.29
OUR = 0.15 µm kg-1d-1
June
July
August
September
October
November
Be (dpm/100OL)
AOU (µmKg-1)
Kadko (in revision GBC)

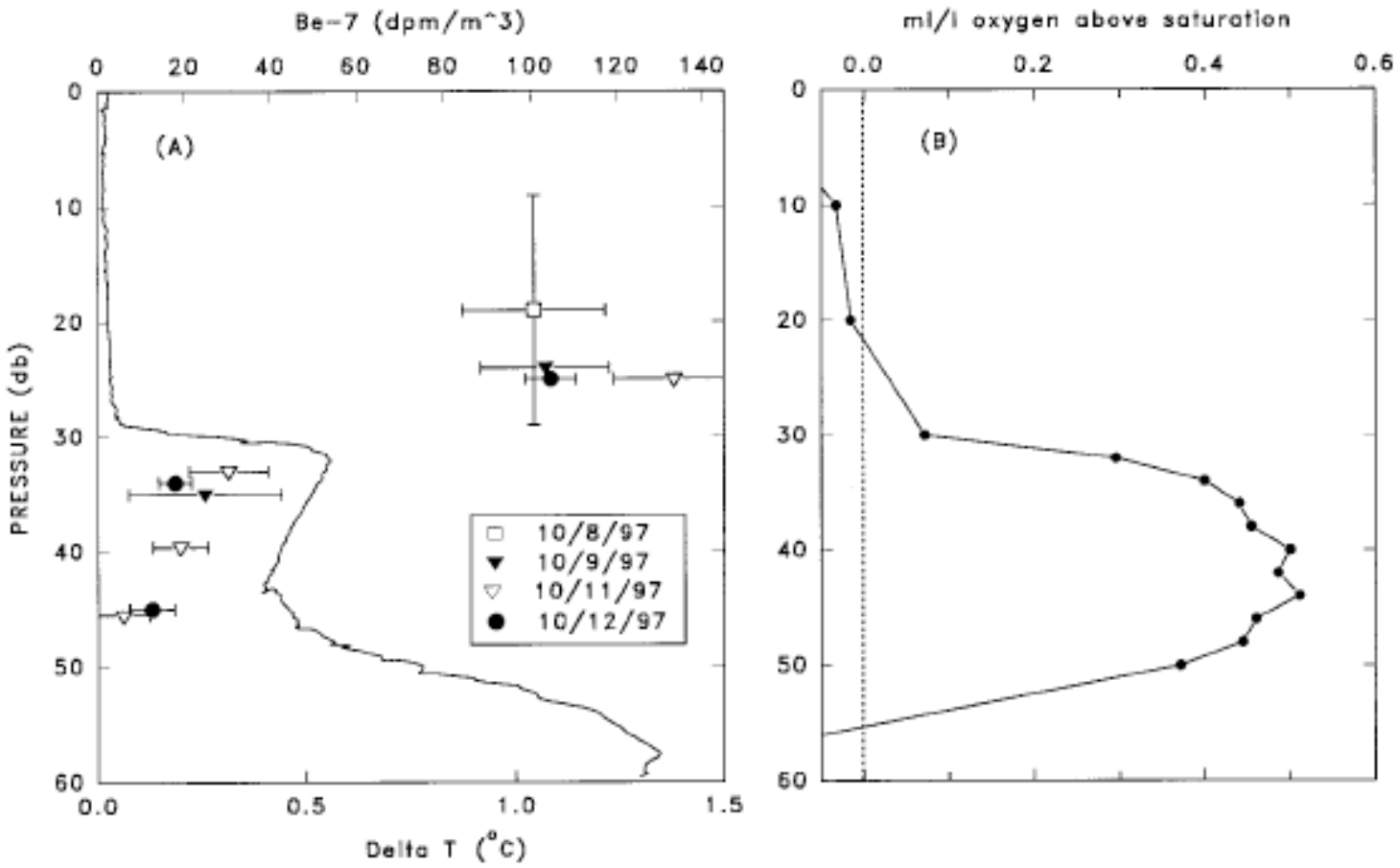


Figure 3. (a) The ^{7}Be measurements in October 1997 are displayed with the δT profile. The profile is similar to that expected from the model (Figure 4c). (b) The difference (O_2 concentration minus O_2 saturation) plotted versus depth for October 24, 1997 (data courtesy of E. Sherr, Oregon State University).

Suggests substantial primary production early in the melt season when the mixed layer was deeper. Persistence of the O_2 peak suggests low bacterial respiration rate. June-July primary production > 13 gCm^{-2}