VARIABILITY OF POC EXPORT FLUX FROM THE EUPHOTIC ZONE AT THE VECTOR TIME SERIE STATIONS

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WORKSHOP W10 Progetto VECTOR
(Rimini, 10-11 settembre 2007)

Objectives:

1. define variability of POC flux from the photic zone;
2. mechanisms controlling it

in two contrasting environments:

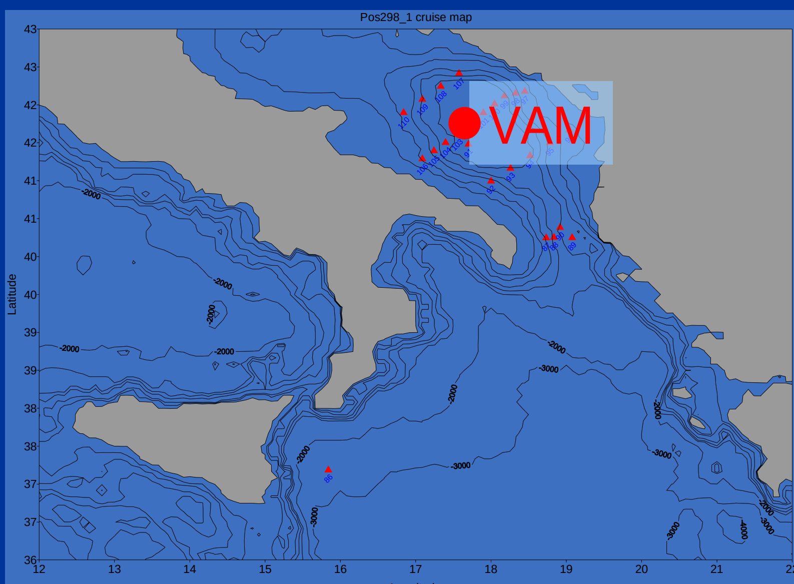
Southern Adriatic: open sea convection and spring bloom; most productive pelagic area of the Eastern Mediterranean.

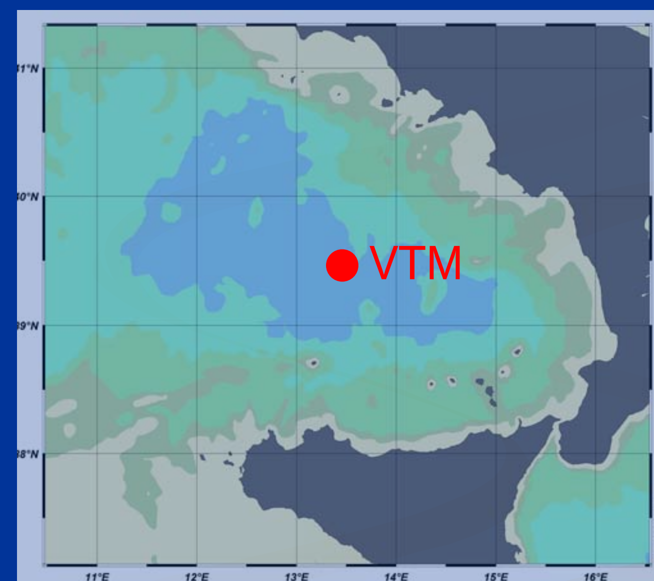
Southern Tyrrhenian: most oligotrophic area of the Western Mediterranean basin.

Methods:

1. $^{234}Th/^{238}U$ disequilibrium (Adriatic and Tyrrhenian)

2. Sediment traps (Tyrrhenian Sea)





Techniques for Estimating POC Flux

- Upper ocean sediment traps (free-floating, surface tethered)
  - Catch sinking particles
  - Hydrodynamic bias
  - Sample preservation issues, swimmers

- $^{234}Th/^{238}U$ disequilibrium
  - Surface water mapping from ships
  - Temporal integration

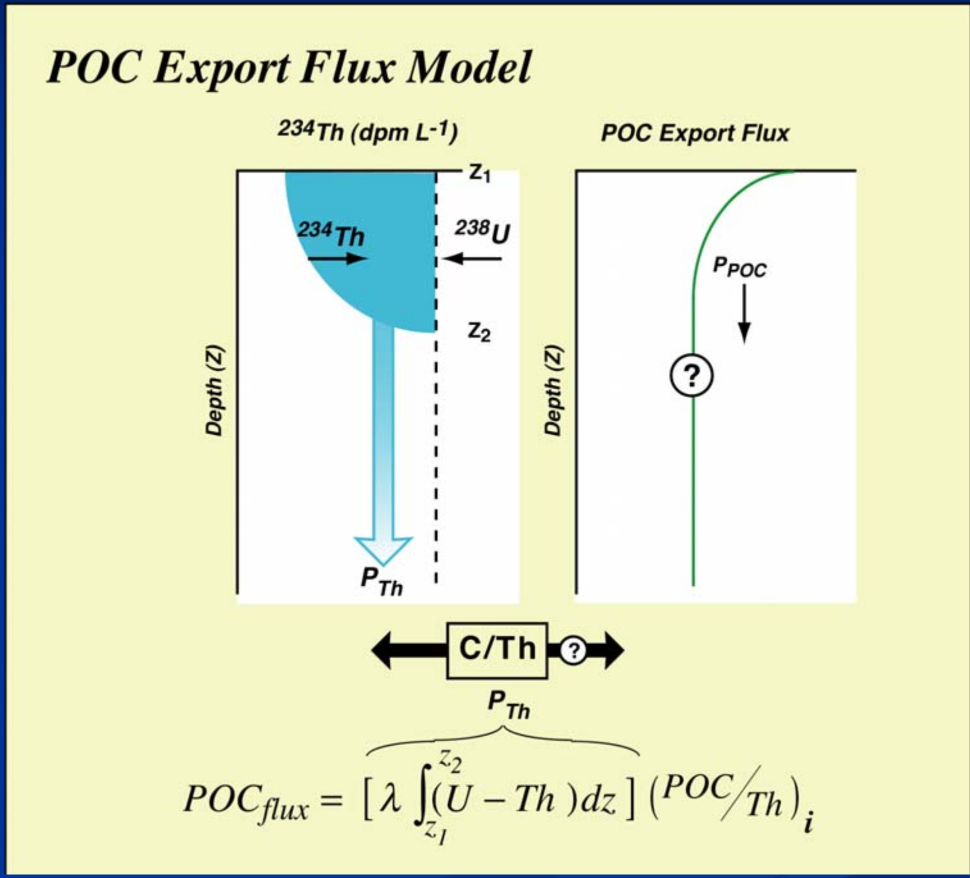
The $^{234}Th/^{238}U$ disequilibrium method

^{234}Th daughter of ^{238}U.
^{238}U half life (10^9 y) >> ^{234}Th half-life (24 days)
In absence of chemical/biological processes removing Th,
the two radionuclides are in *secular equilibrium* ,

i.e. $A_{Th} = A_U$

Th has high affinity for particles and in upper ocean is rapidly adsorbed onto particle surfaces and sinks with them.

In upper ocean $A_{Th} < A_U$



^{234}Th-derived POC Export Flux

$$\text{POC Export Flux} = \left(\frac{POC}{^{234}Th}\right) \times \lambda \int_0^z \left(A_U - A_{Th}\right) dz$$

Steady state, no duffusion/advection.

Uncertainty in POC Export Flux

- Analytical method
- ^{234}Th Export Flux (steady state assumption, integration interval)
- POC/^{234}Th Ratio

^{234}Th-derived POC Export Flux

Uncertainty in POC Export Flux

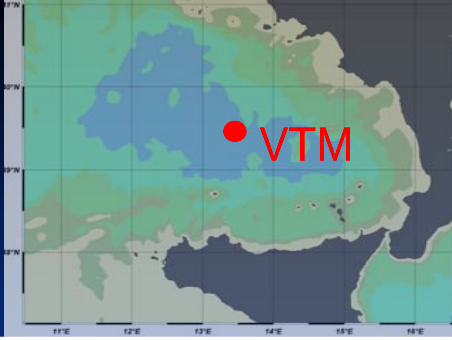
- Analytical method

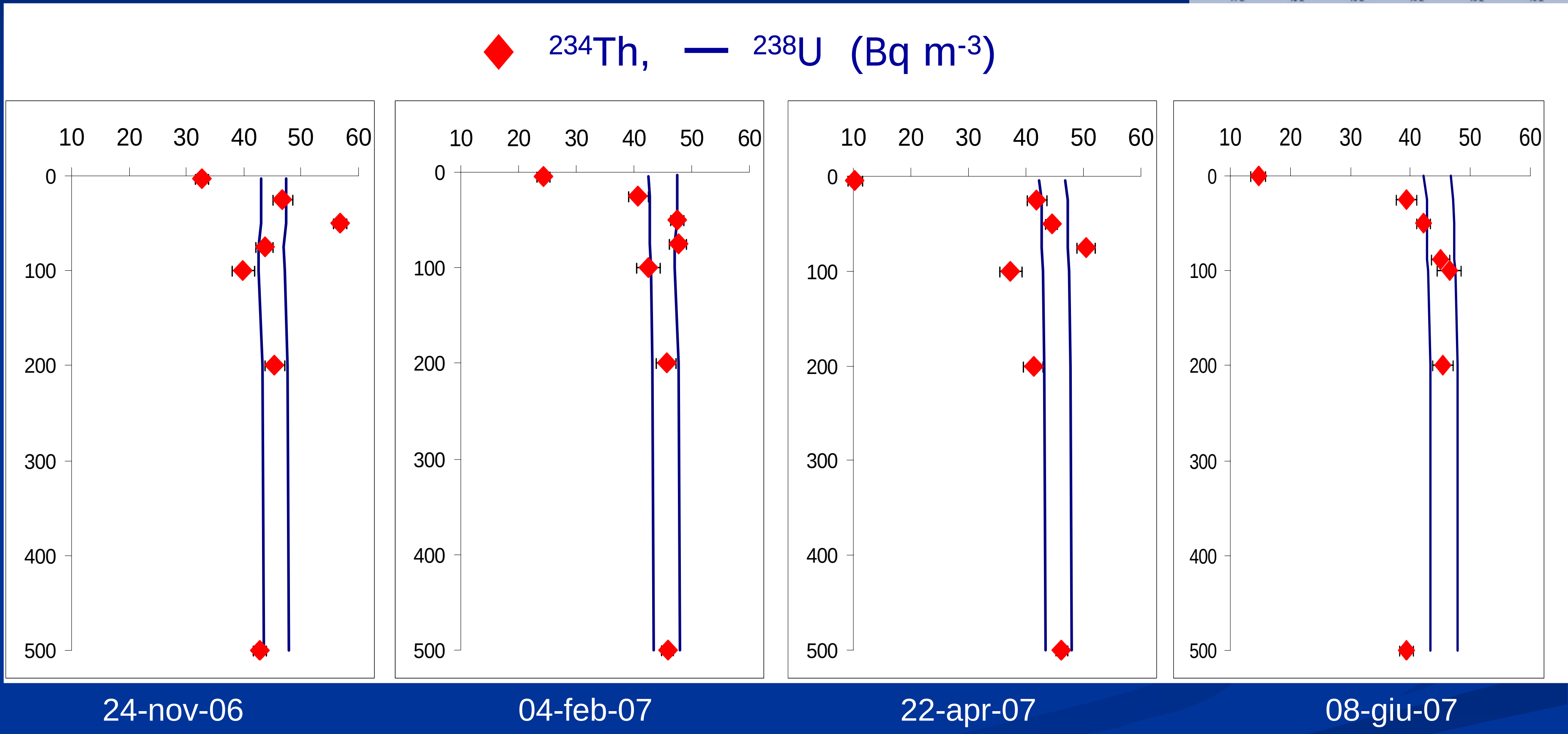
a. Standardization of chemical prcedure;

b. Accuracy control: analysis of deep water samples.

^{238}U:	45.4 ± 2.3
^{234}Th:	44.2 ± 2.4

Results – VECTOR TM





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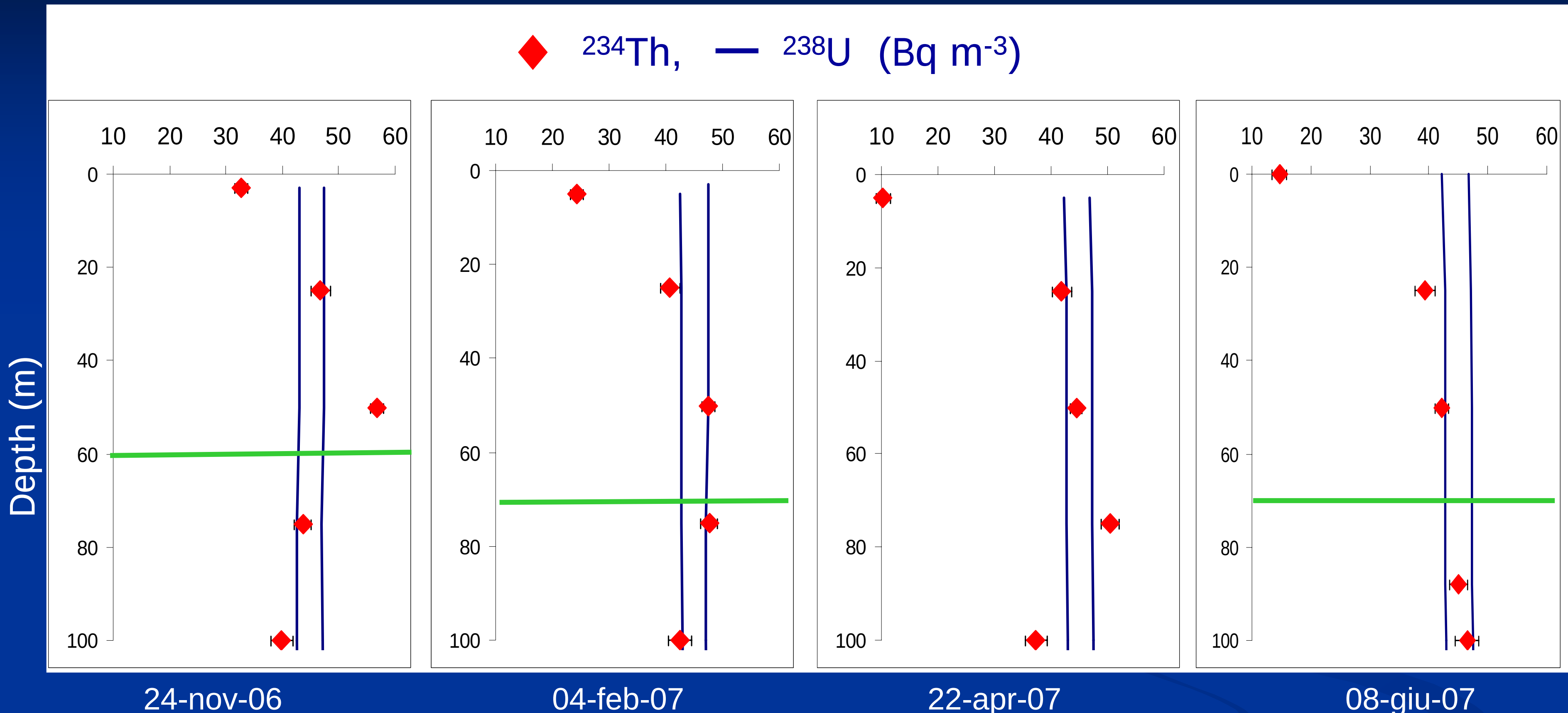
Results – VECTOR TM



1% PAR

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Results – VECTOR TM

Disequilibrium limited to the surface layer (max 25m)

More evident in April and June (higher PP?)

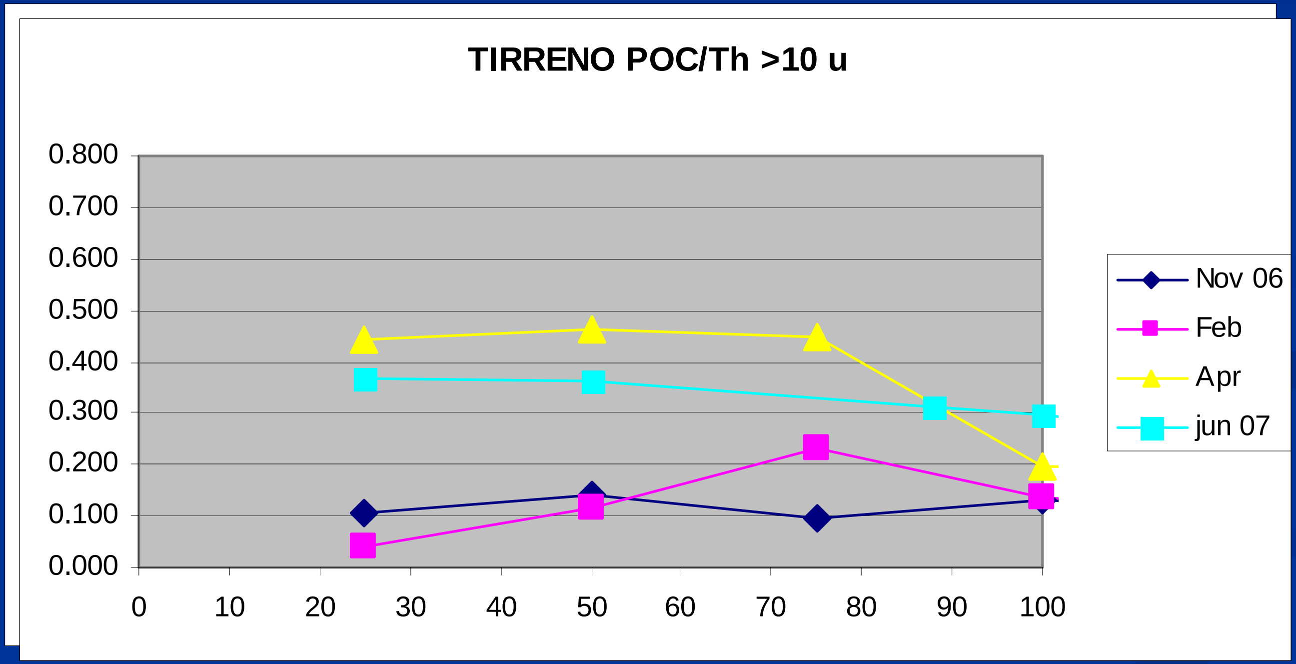
Integration within the euphotic zone

^{234}Th export flux:

Oct-Nov 2006	5 ± 5	Bq m^{-2} d^{-1}
Dec 2006 – Jan 2007	10 ± 3	
Mar-Apr 2007	15 ± 2	
Apr-May 2007	15 ± 4	

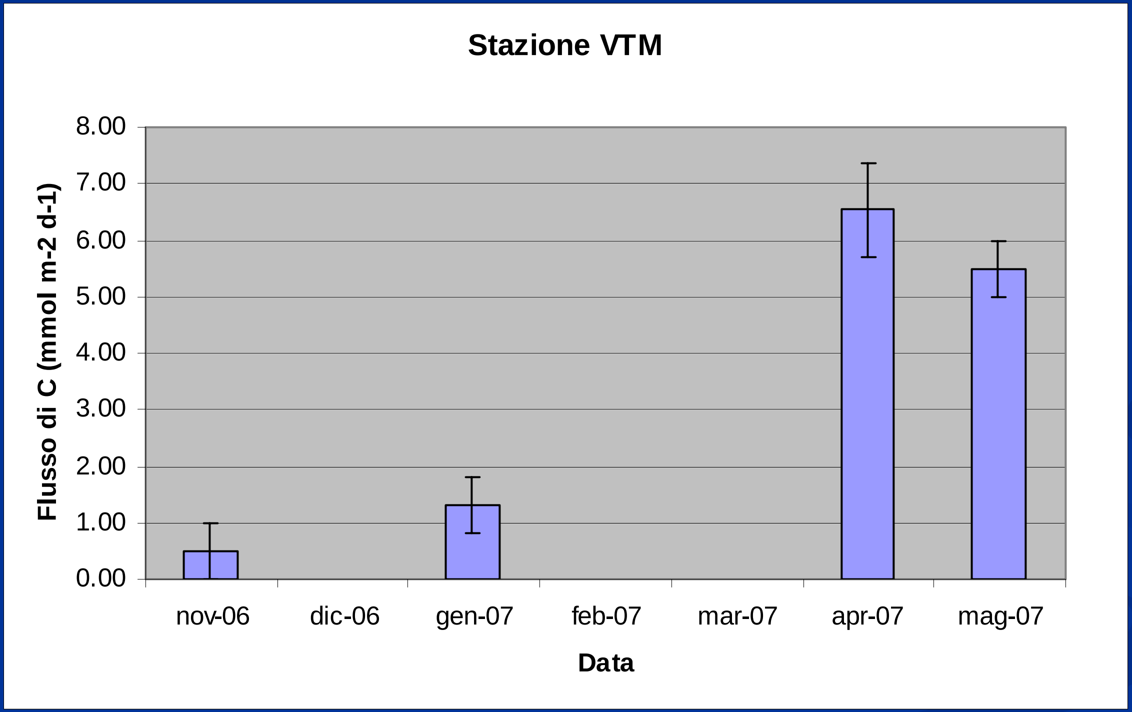
Results – VECTOR TM

POC/Th Ratio on sinking particles (ϕ > 10 μ)



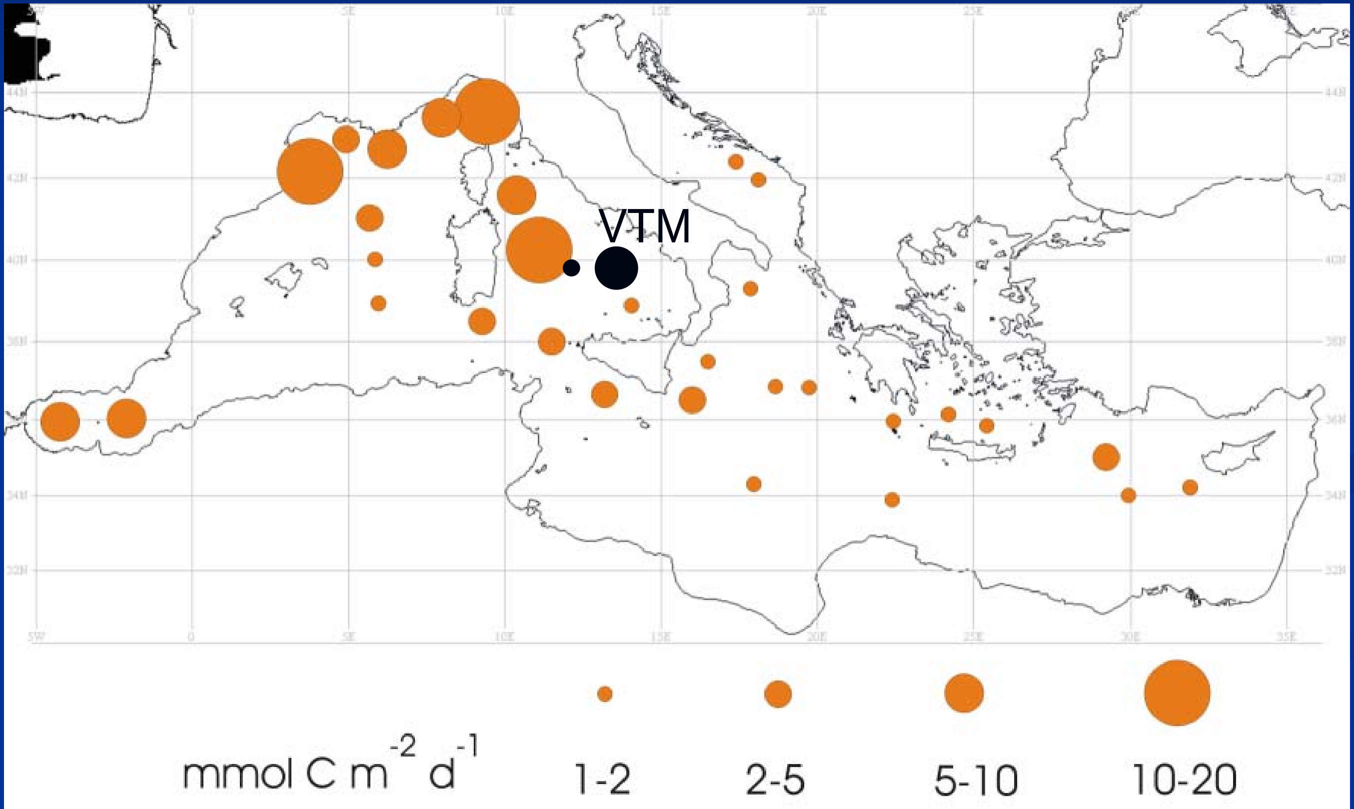
Results – VECTOR TM

POC flux from the euphotic zone



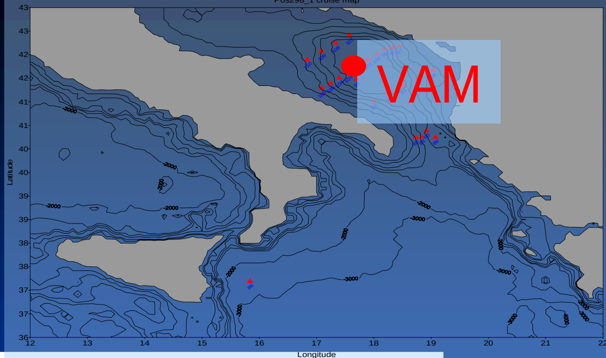
Results – VECTOR TM

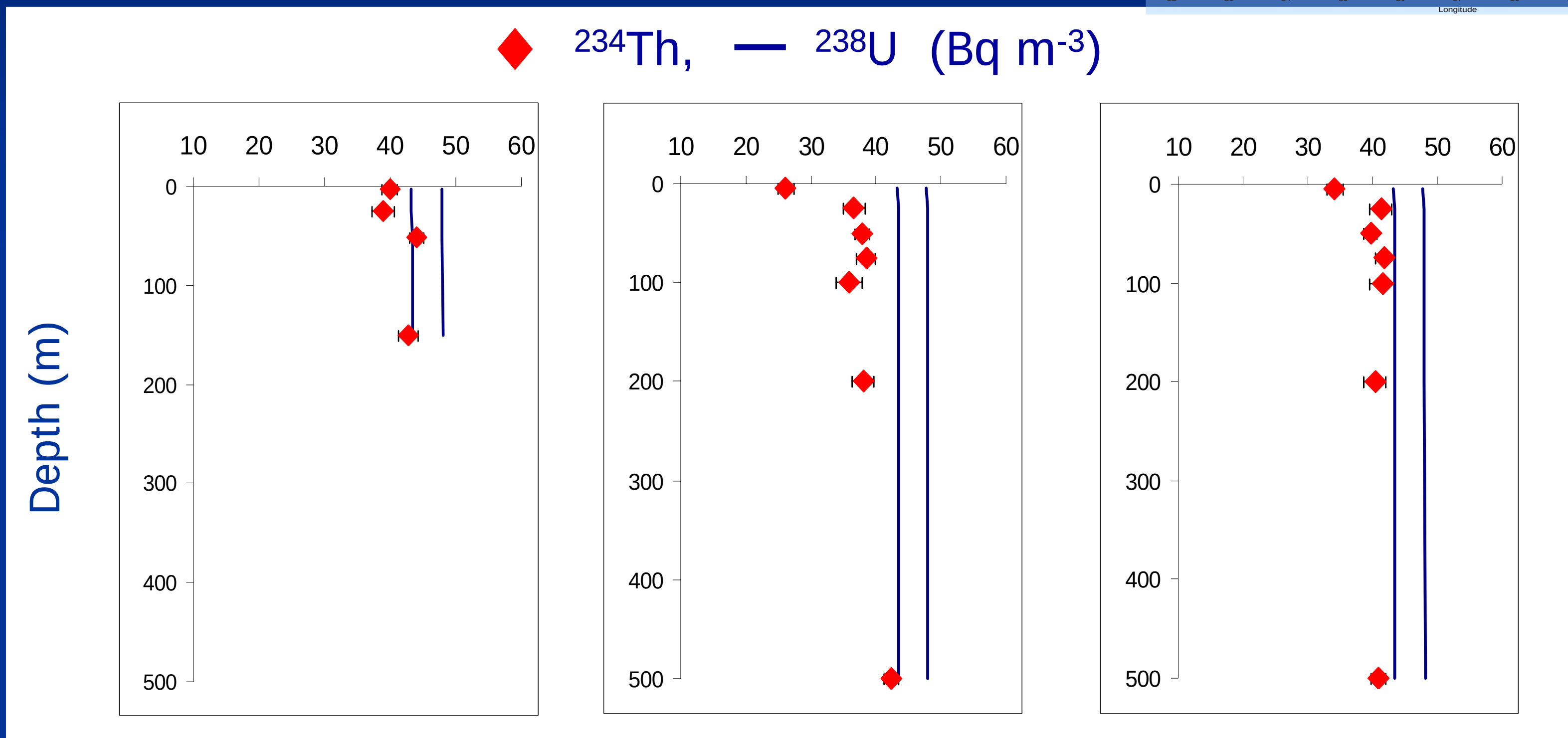
POC flux from the euphotic zone – published values



Speicher et al., 2006 - modified

Results – VECTOR AM





19-Nov-06 22-Feb-07 16-Apr-07

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Results – VECTOR AM

Disequilibrium limited to the upper 25 m only in November;

In February deficit down to at least 200 m.

↓

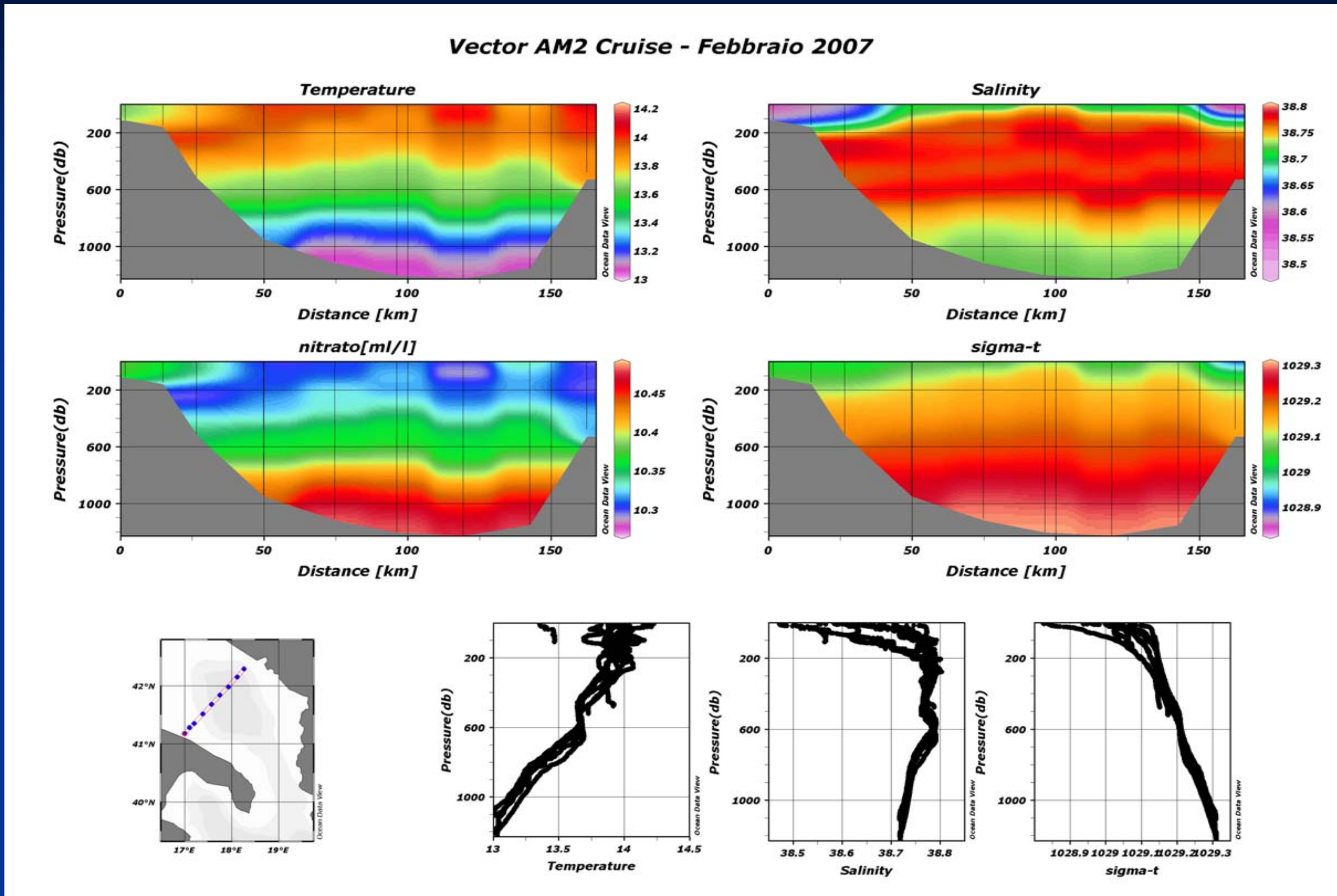
Export and subsequent mixing of the water column

In April, equilibrium in deep layer not established yet

↓

Significant export between the two samplings.

Results – VECTOR AM



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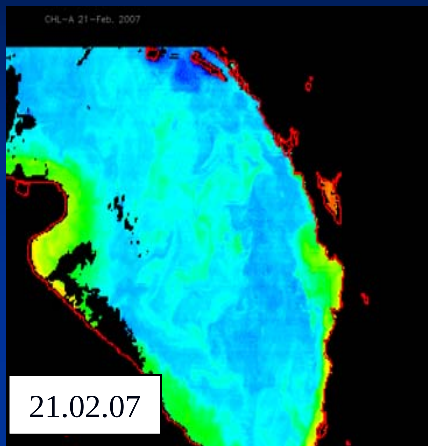
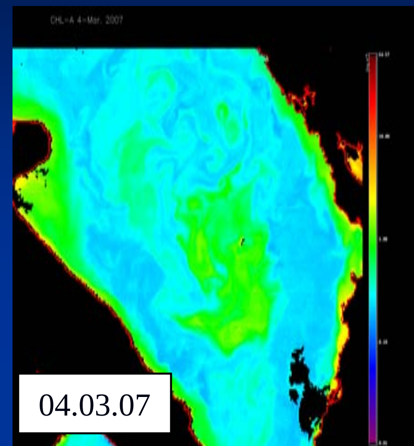
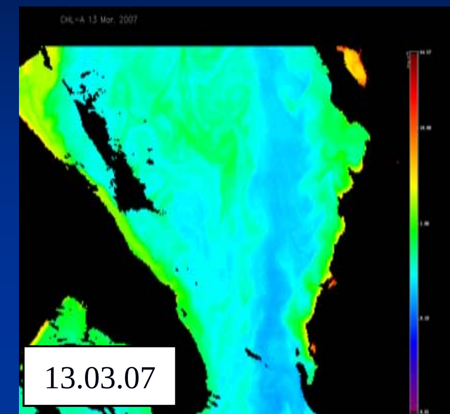
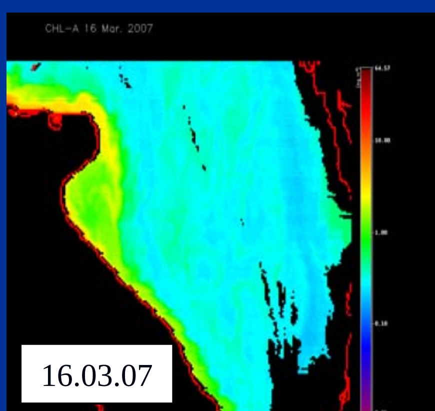
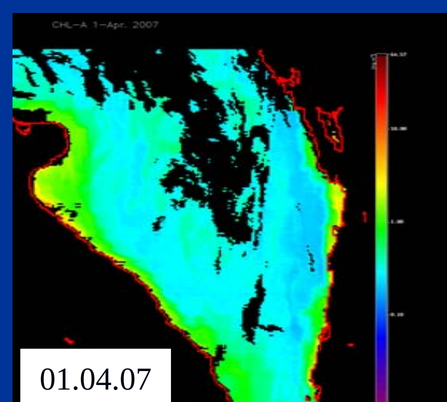
Results – VECTOR AM

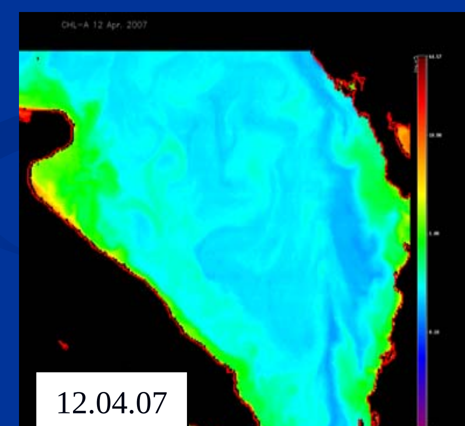




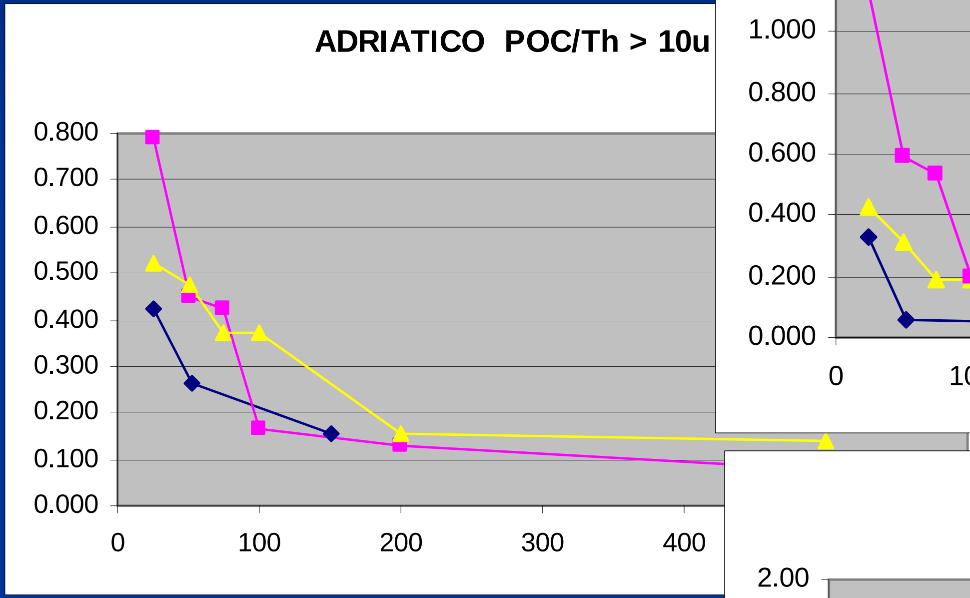


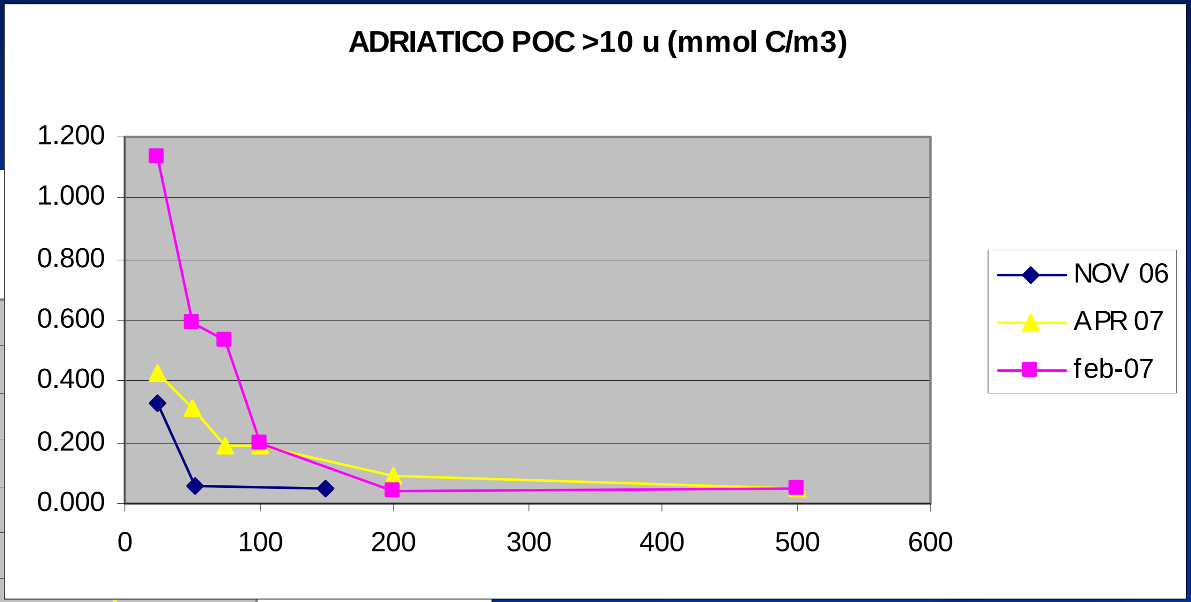


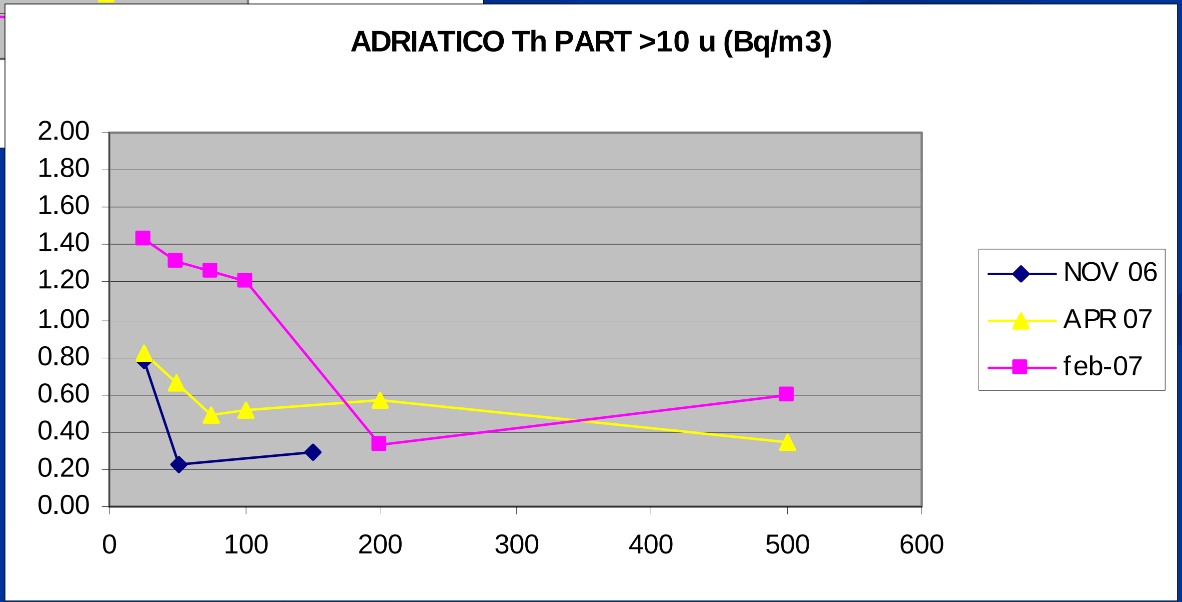




Results – VECTOR AM







Results – VECTOR AM

POC Flux from mixed layer
(Steady state, POC fraction > 10µ):

Oct-Nov 2006: 2 ± 1 mmol C m^{-2} d^{-1}
Jan-Feb 2007: 8 ± 2 mmol C m^{-2} d^{-1}
Mar-Apr 2007: 5 ± 2 mmol C m^{-2} d^{-1}

Summay

$^{238}U/^{234}Th$ method suitable for VTM;

C Flux: 1 – 5 mmol C m^{-2} d^{-1}

Steady state, sinking particles ϕ > 10 µ

POC/Th ratio at the base of the euphotic zone.

Indication from sediment trap data.

VAM: non steady state conditions in Feb. and April

C Flux from mixed layer: 2 – 8 mmol C m^{-2} d^{-1}

sinking particles ϕ > 10 µ

POC/Th ratio at the base of the mixed layer.

Summay

Other information from $^{238}U/^{234}Th$ method?

Calibration of sediment trap data

Disequilibrium – Primary production

Scavenging rates - Residence time of particles

POC/Th ratios – factors controlling them
indicators?