Twilight zone particulate Ba in the North Pacific:

• What does it tell about organic carbon mineralization in at ALOHA and K2 ?

• How well does it compare with other carbon flux measurements, especially BCD and NBST ∆POC flux ?

• Have we come closer toward a 'generic' proxy for twilight zone organic carbon mineralization ?

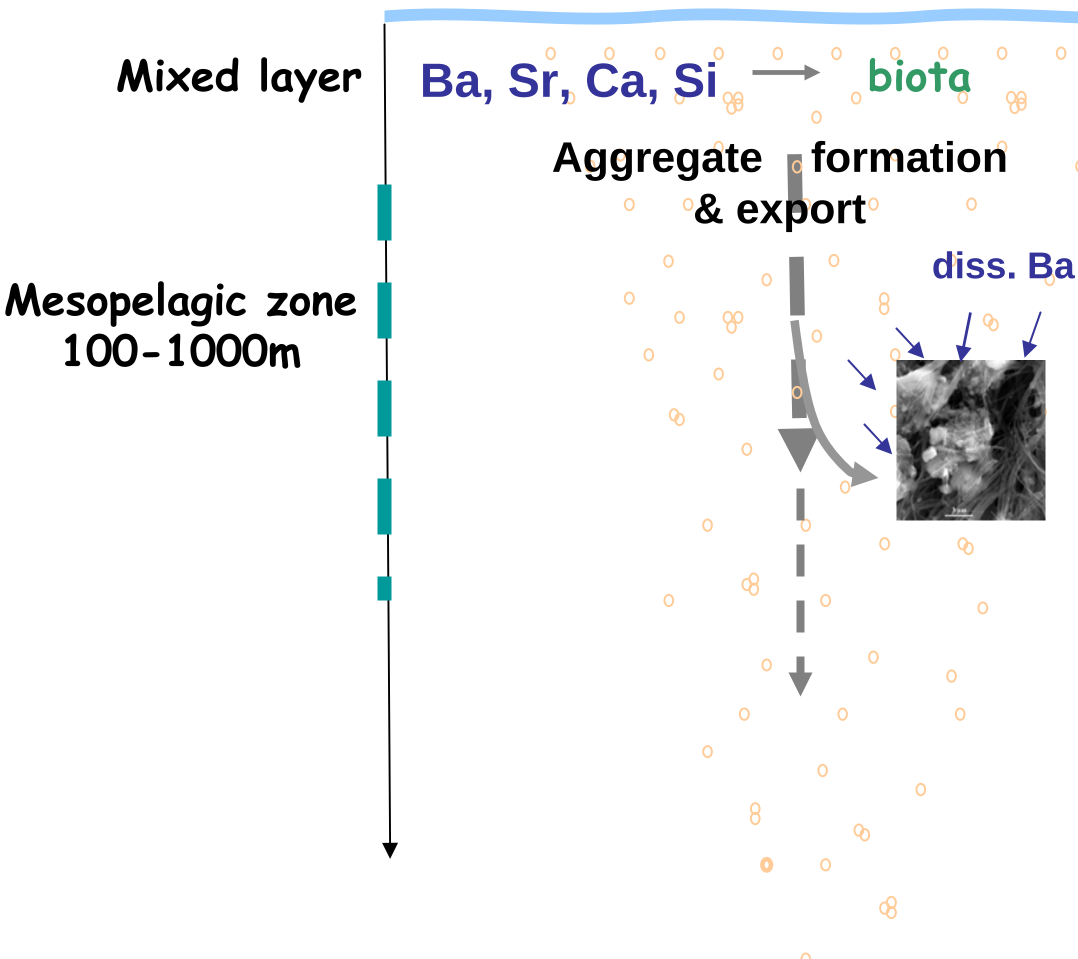
State of the art:

The non-lithogenic fraction of Ba in suspended matter is present mainly as micro-crystalline barite

This barite appears to be formed in degrading biogenic material (aggregates, fecal pellets) settling through the water column

Profiles of suspended Ba usually show increased concentrations at mesopelagic depths, which are related to export and mineralization of organic matter

Probable scenario for barite formation:



1/ Barite ($BaSO_4$) formation inside μ-environments

2/ Release of μ-crystals during aggregate break-down and OM mineralization

Mesopelagic Ba and POC mineralization:

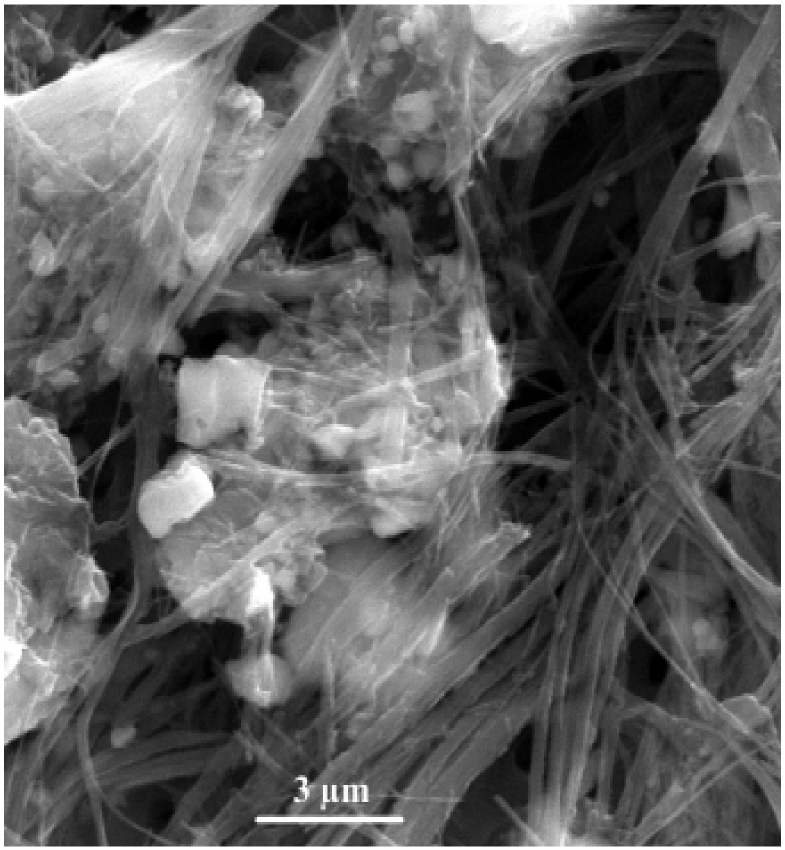
Earlier Southern Ocean results revealed the following empirical relationship:

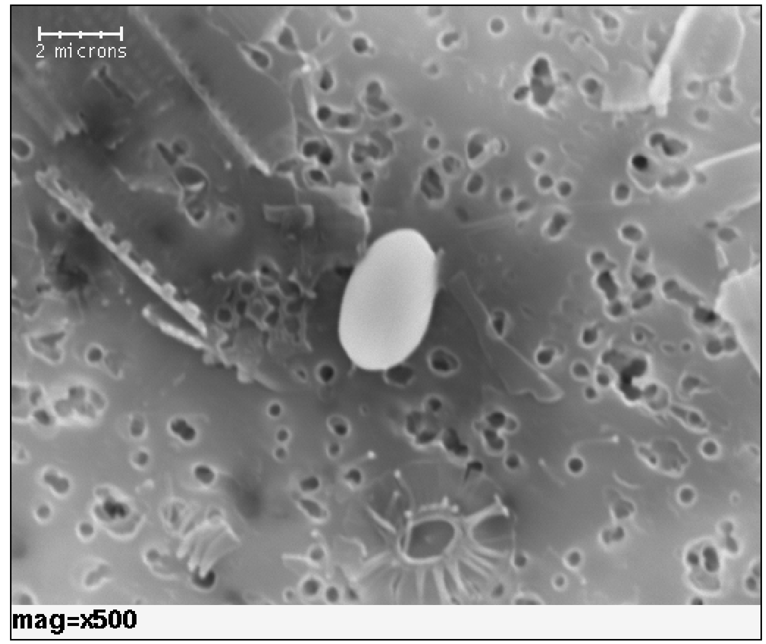
$$JO_2 = \{[Ba_{xs}]_{meso} - [Ba_{residual}]\} / 17200$$

a given respiration rate yields a specific mesopelagic Ba_{xs} conc..

In terms of POC mineralized and integrated between 150 and 500m (depth range of the sediment traps):

$$JPOC = JO_2 * (0.71) * 350$$


3 µm


2 microns
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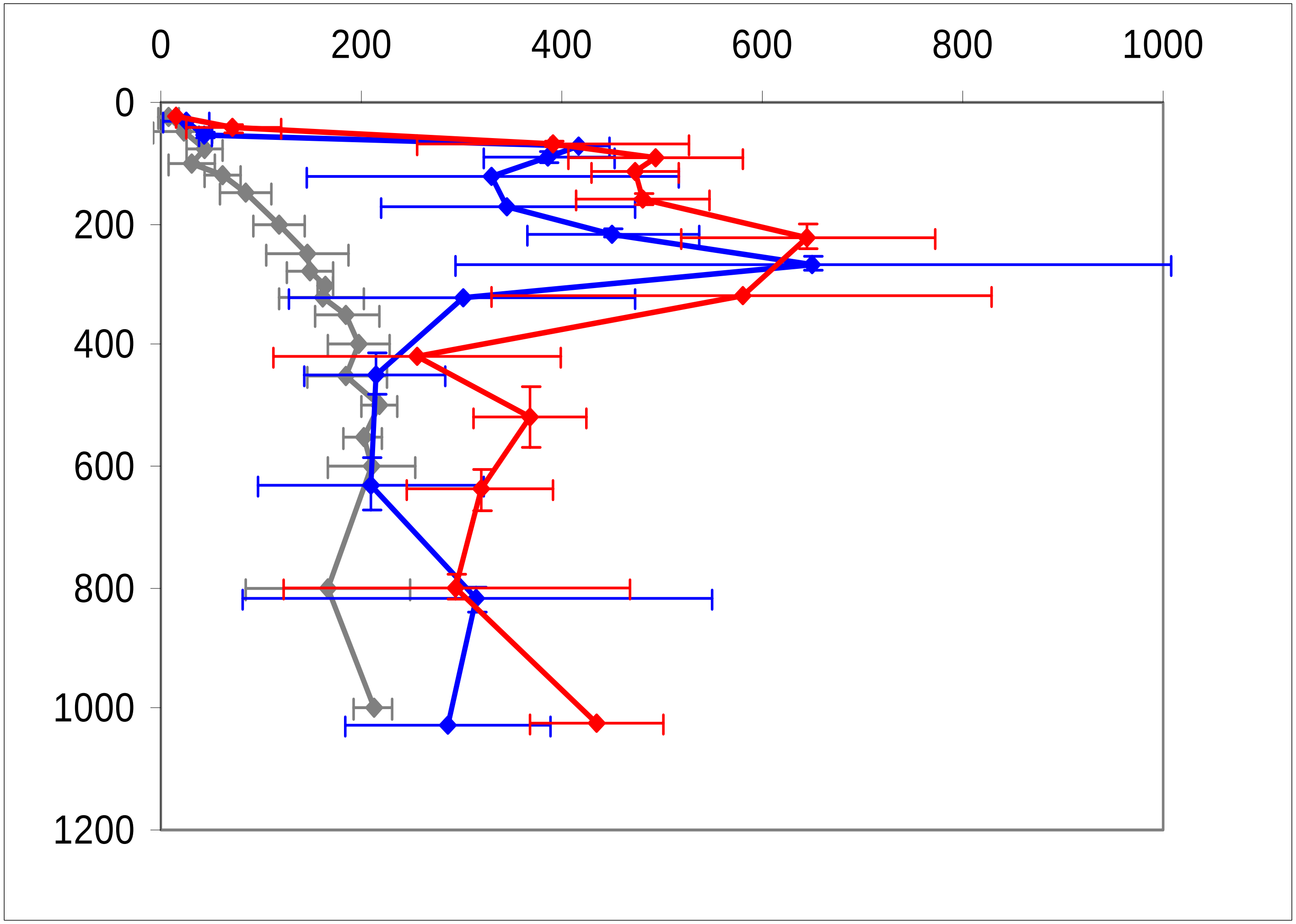
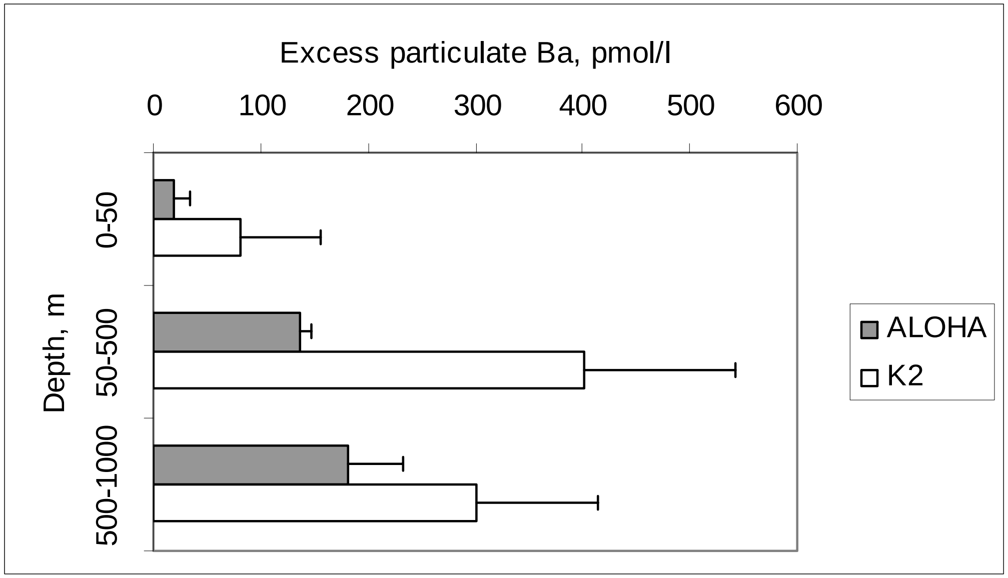


ALOHA: 7 casts (CTD & MULVFS)

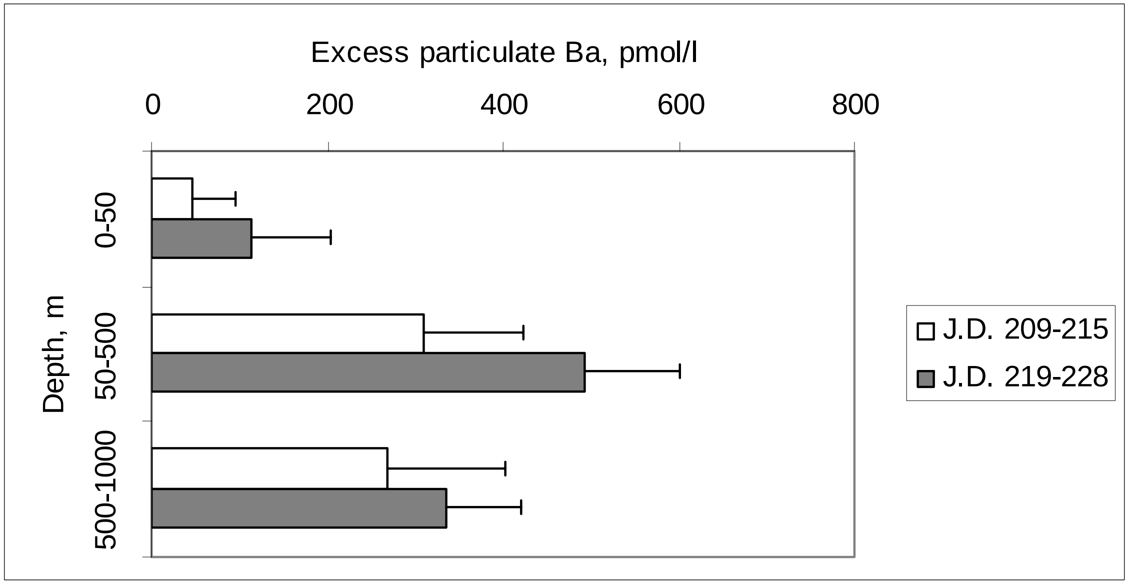
K2 J.D. 209-215: 5 casts (CTD & MULVFS)

K2 J.D. 219-228: 5 casts (CTD & MULVFS)

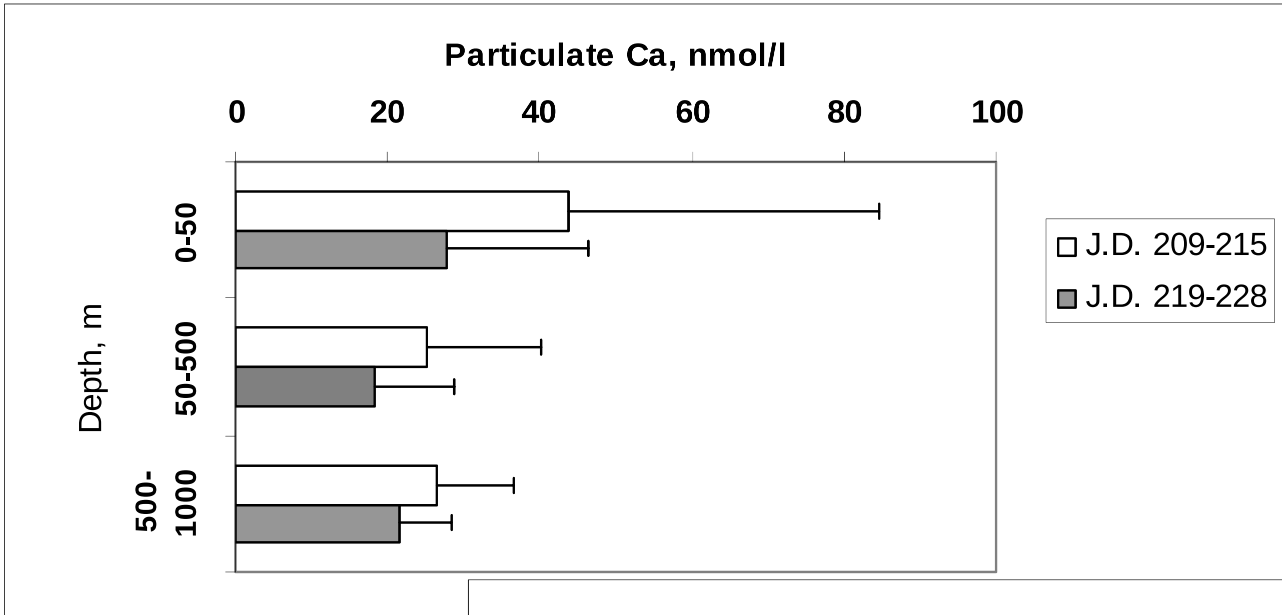


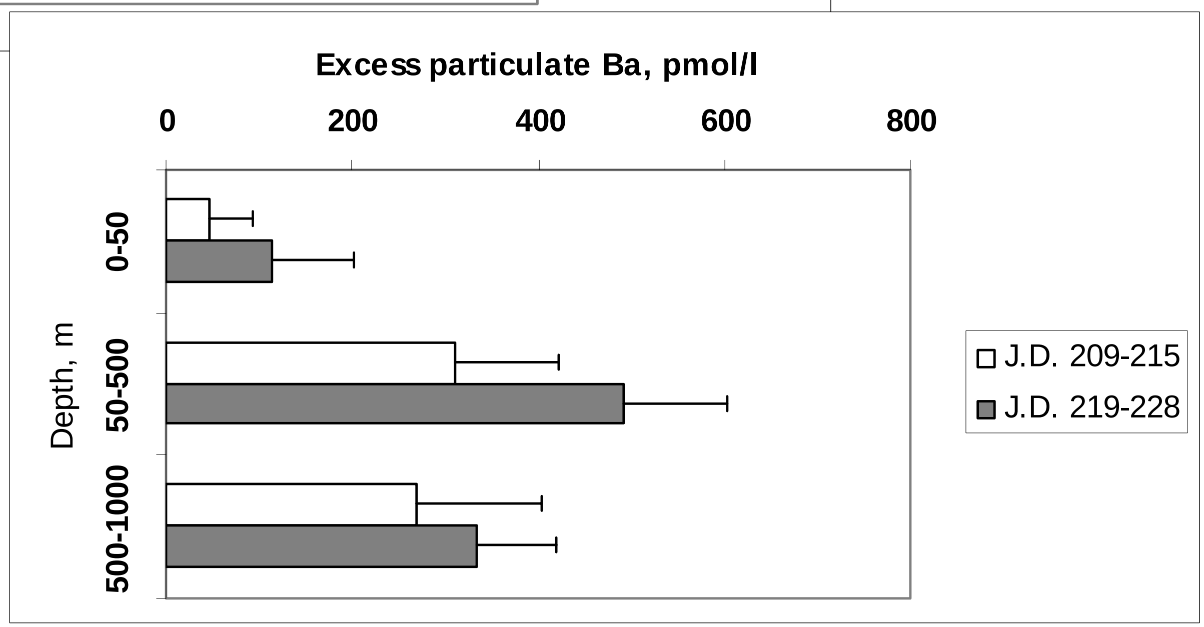
Clearly more Ba_{xs} at K2 than at ALOHA

At K2 Ba tends to increase over the study period, generally contrasting with other observations



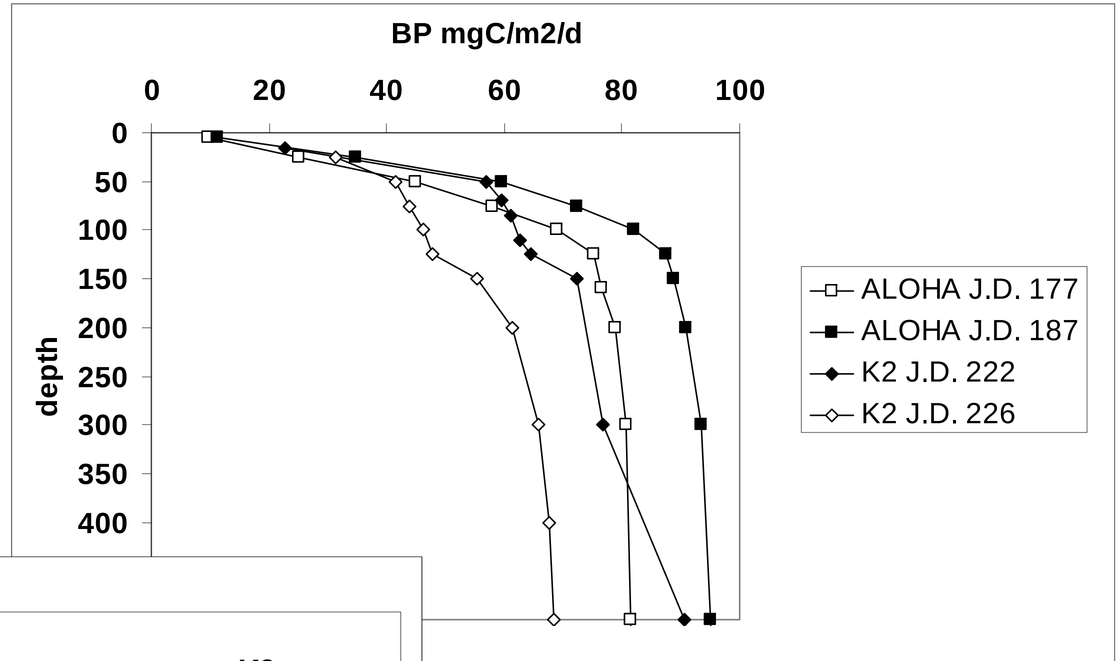
At K2 Ca decreases over time..as does PP, NBST fluxes

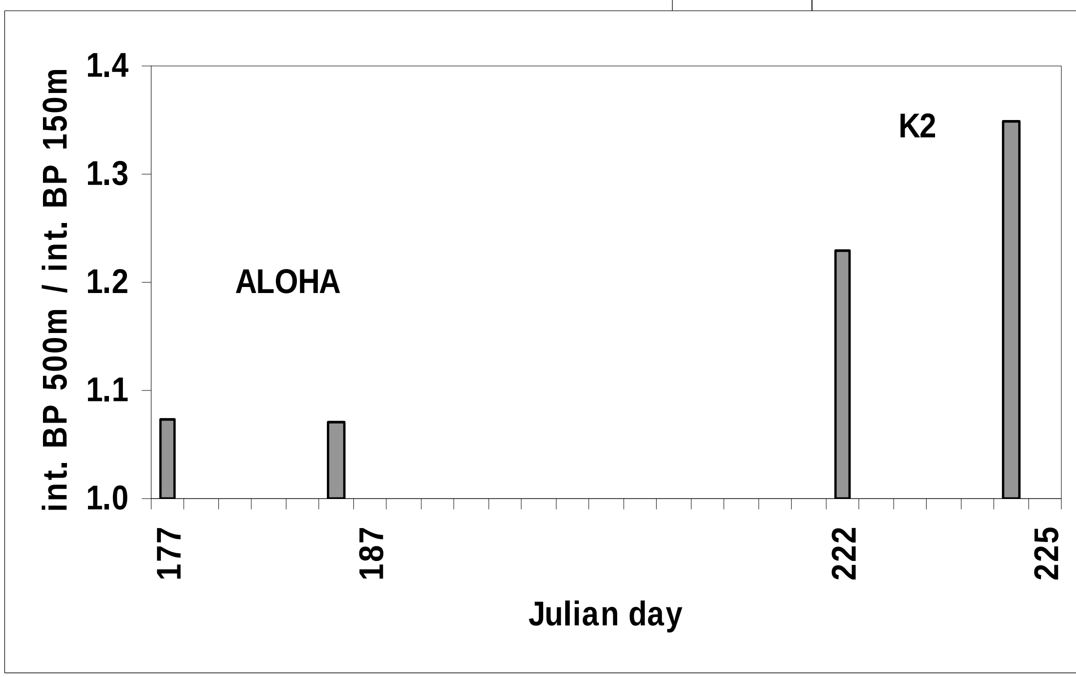




Ben's bacterial production data:

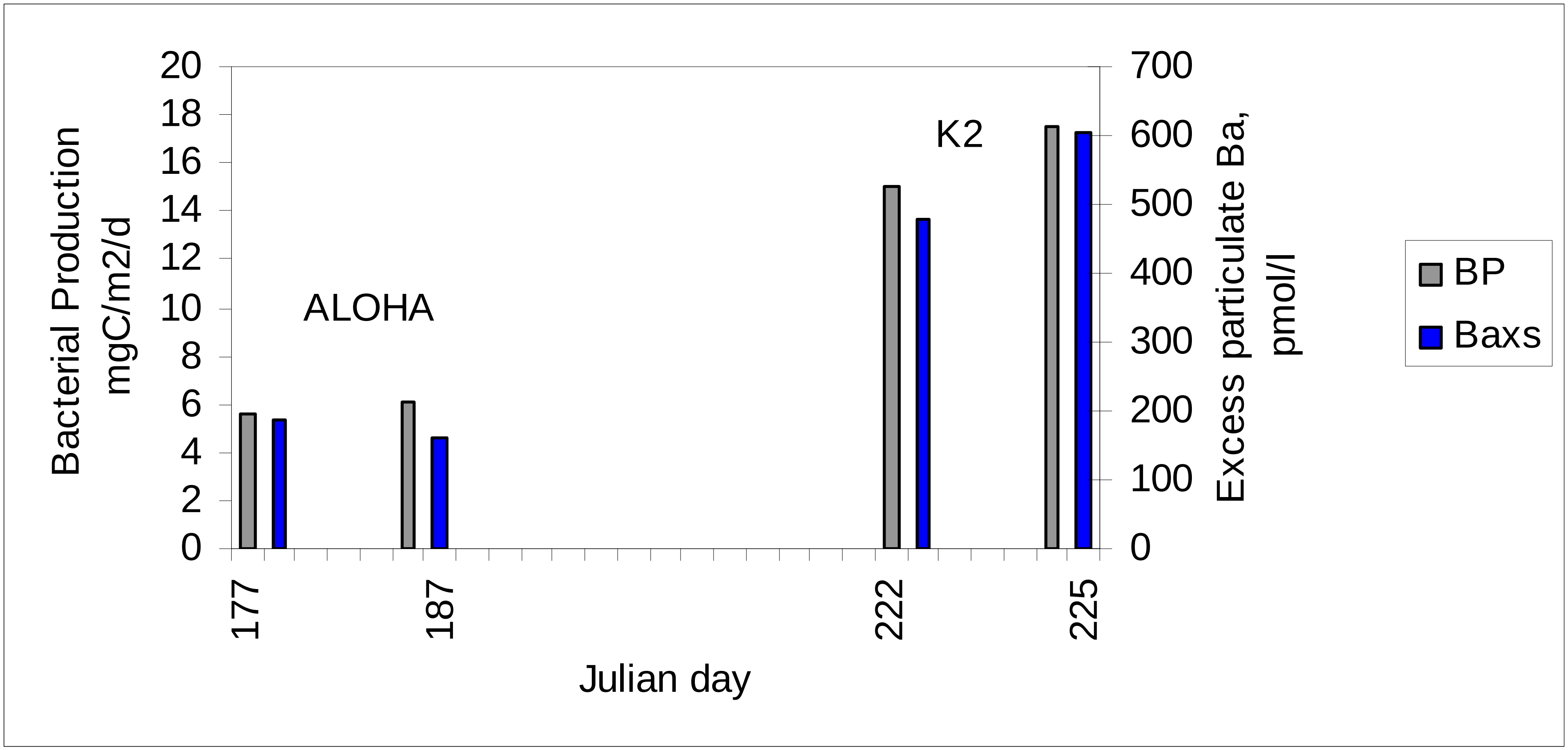
Integrated BP →





← 500m/150m int. BP

Twilight zone (150-500m): integrated BP and depth weighted av. Ba_{xs}



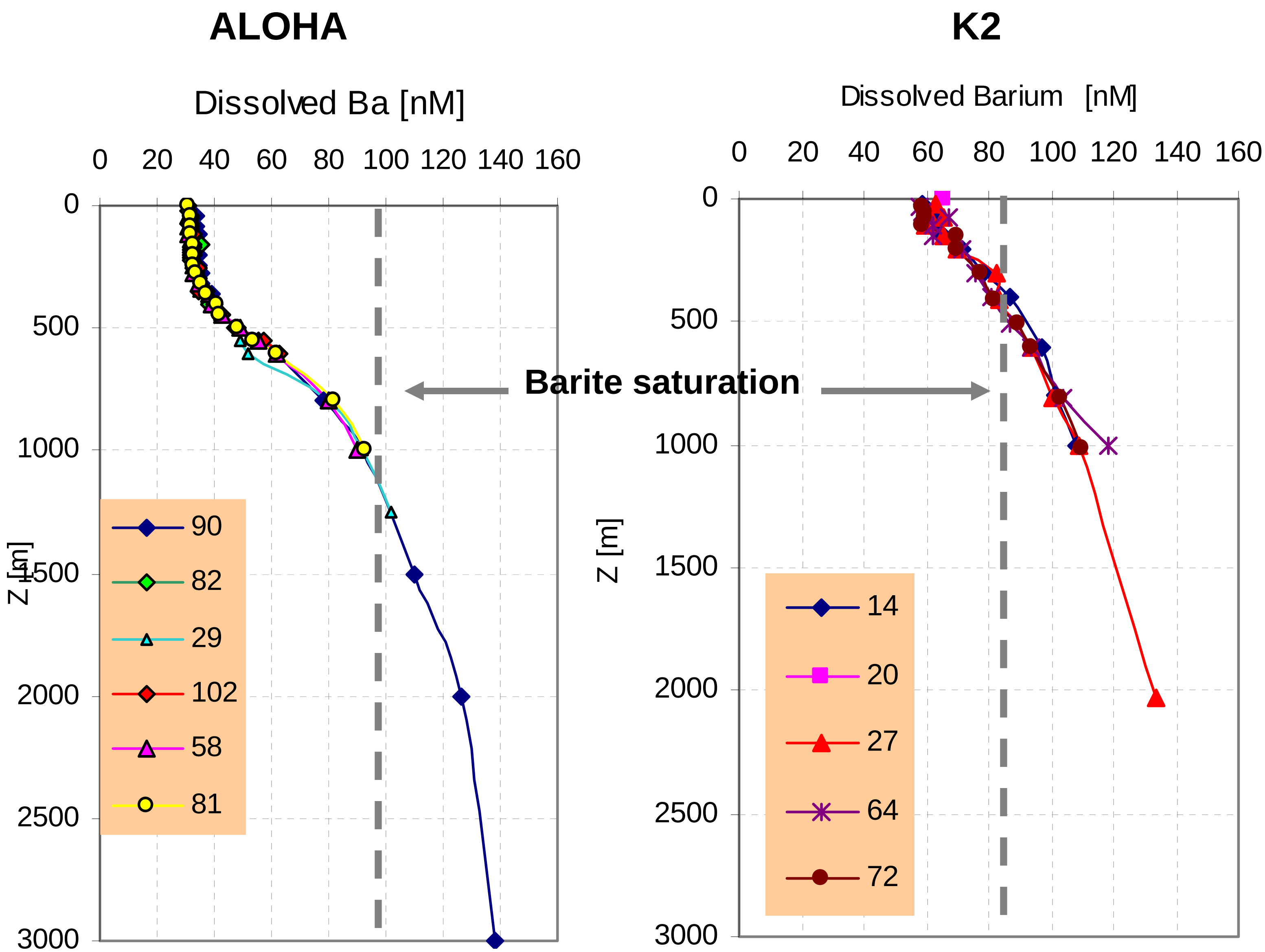
Twilight zone carbon utilization:

	Bacterial C demand[1] (150-500m) mgC/m²/d	**C demand based on Ba_{xs} (150-500m) mgC/m²/d**
ALOHA J.D. 177	19 – 56	22 – 31 *
ALOHA J.D. 187	20 – 61	19 – 28 *
K2 J.D. 223	50 – 151	58 – 67 **
K2 J.D. 226	58 – 175	81 – 89 **

[1] min. : cells/mole TdR = $1*10^{18}$ and BP/0.15; max. : cells/mole TdR = $2*10^{18}$ and BP/0.10

*** residual Ba_{xs} taken as 50 and 0 pM, resp.**

**** residual Ba_{xs} taken as 150 and 100 pM, resp.**



ALOHA
K2
Dissolved Ba [nM]
Dissolved Barium [nM]
0 20 40 60 80 100 120 140 160
0 500 1000 1500 2000 2500 3000
Z [m]
90
82
29
102
58
81
14
20
27
64
72
Barite saturation

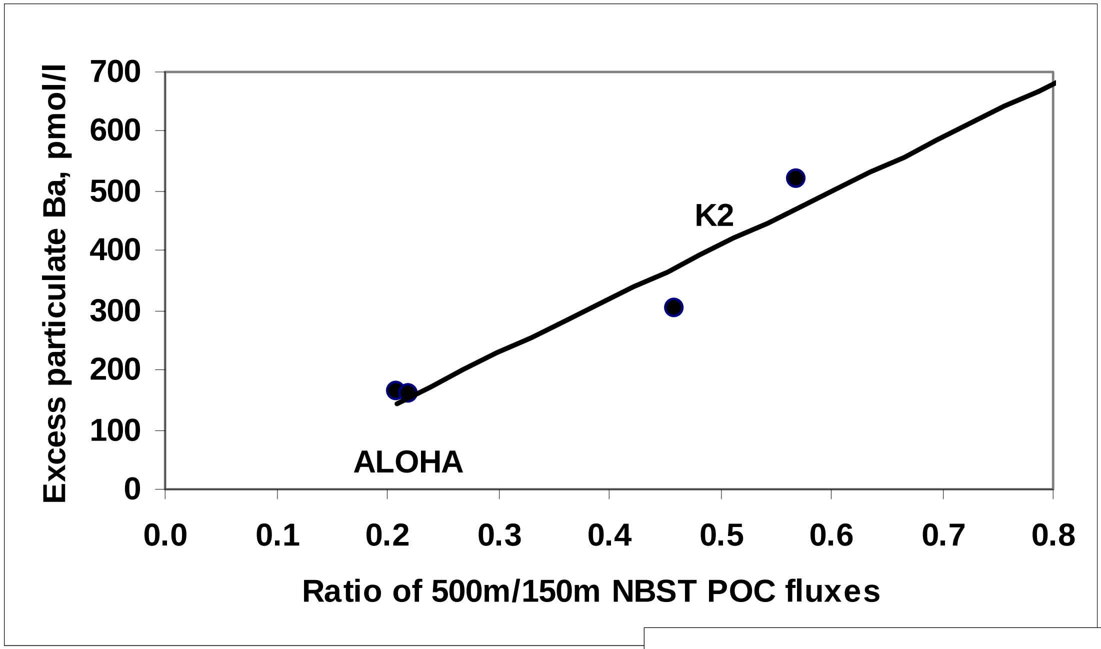
	NBST ΔPOC flux (150-500m) $mgC/m^2/d$	**C demand based on Ba_{xs} (150-500m) $mgC/m^2/d$**
ALOHA #1 J.D. 178 - 182	14.4	20 – 29 ± 4* (3)
ALOHA #2 J.D. 186 - 191	14.4	19 – 28 ± 1* (4)
K2 # 1 J.D. 209 - 215	33	27 – 36 ± 22** (5)
K2 # 2 J.D. 219 - 225	10	64 – 73 ± 18** (5)

*** residual Ba_{xs} taken as 50 and 0 pM, resp.**

**** residual Ba_{xs} taken as 150 and 100 pM, resp.**

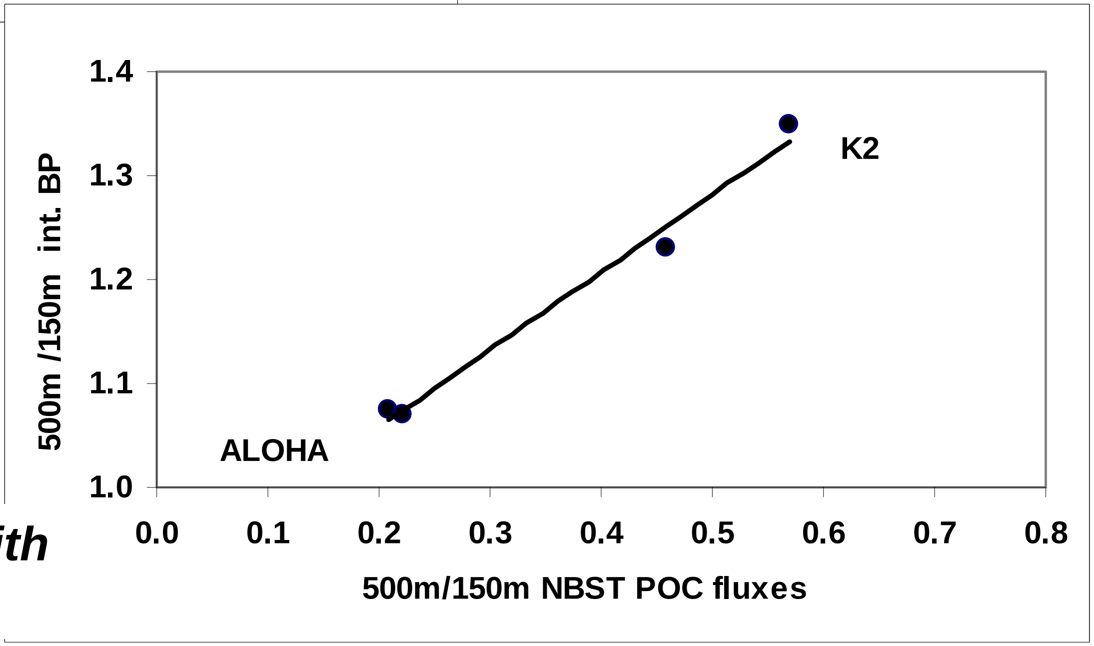
(n) = number of casts

Twilight zone 150-500m



Meso Ba vs NBST POC flux ratio

BP ratio vs NBST POC flux ratio



lesser attenuation goes with BP extending deeper ...