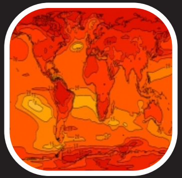
Thursday 16:30:

Is this a good time to be burning fossil fuels?

Andy Ridgwell



THE ROYAL SOCIETY
CELEBRATING 350 YEARS

University of BRISTOL

UK Ocean Acidification Research Programme

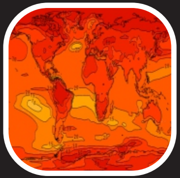
Thursday 16:30:

Is this a good time to be burning fossil fuels?

-------- Original Message --------
Subject: H&S concern in server room
Date: Fri, 23 Aug 2013 13:25:32 +0100

I understand that we have mixed phase power to at least one of the cabinets in this area. ... [we will] identify 'at risk' cabinets and mark them with 'No Access' tape and to provide an advisory notice on the door.

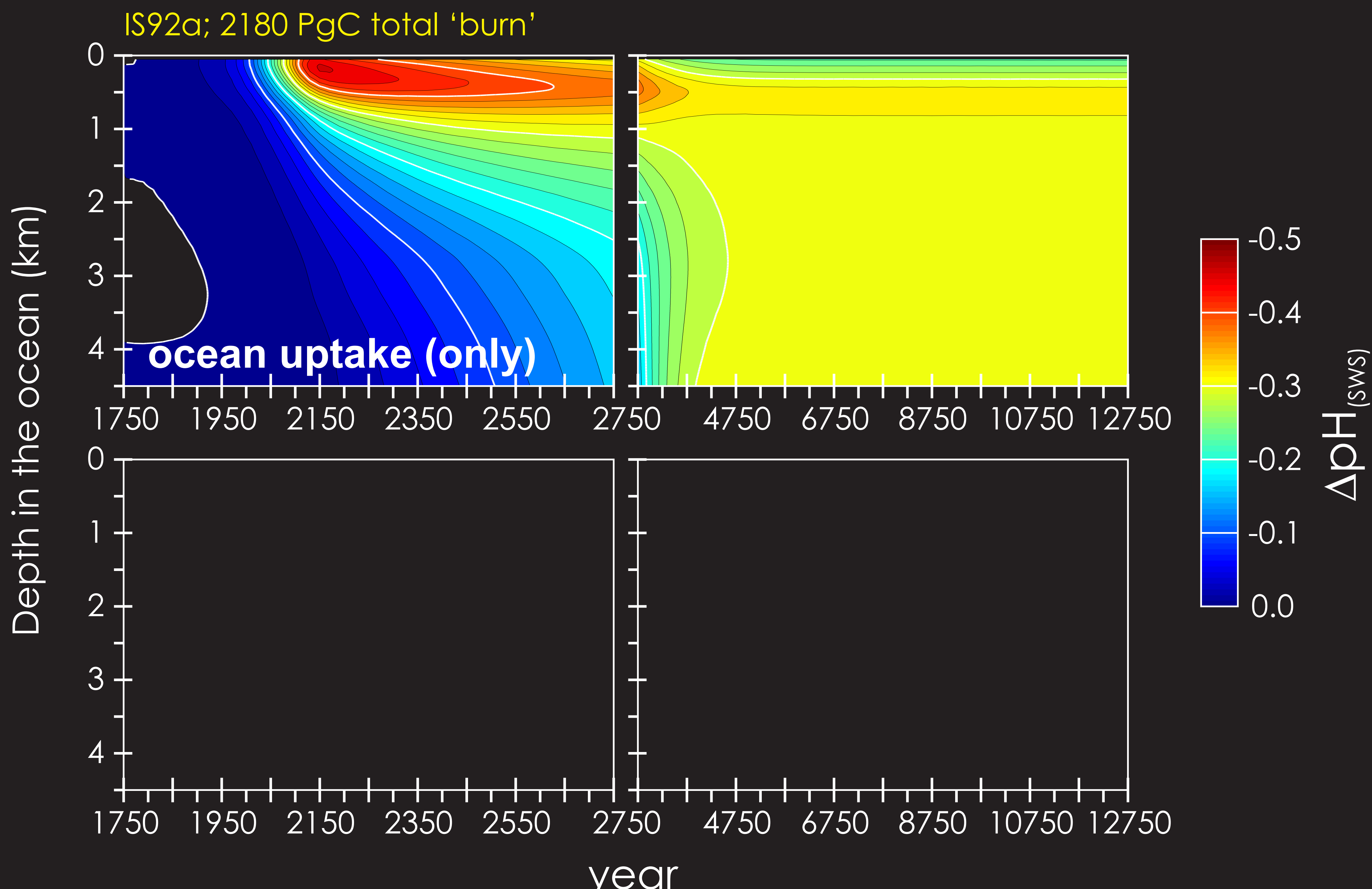
Once we understand the scale and implications of the issue we can take further steps - ... One likely outcome is that some **equipment will need to be shut down** to enable the power supply issue to be corrected.



How does the global carbon cycle response to past (geologic) CO_2 release differ (if at all) from now?

How can we quantitatively interpret past 'analogue' events for ocean acidification?

What is the fate of fossil fuel CO_2?



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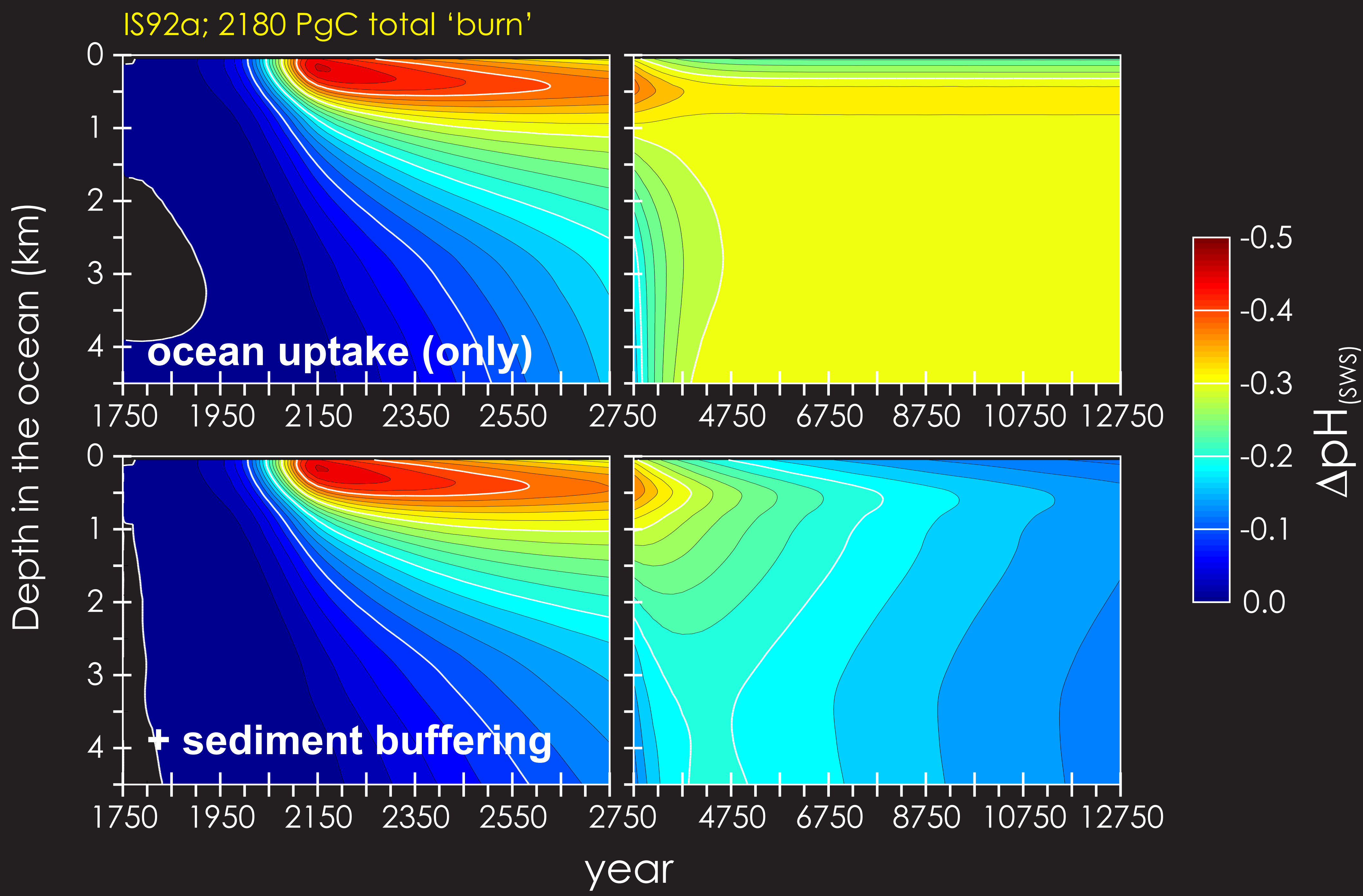
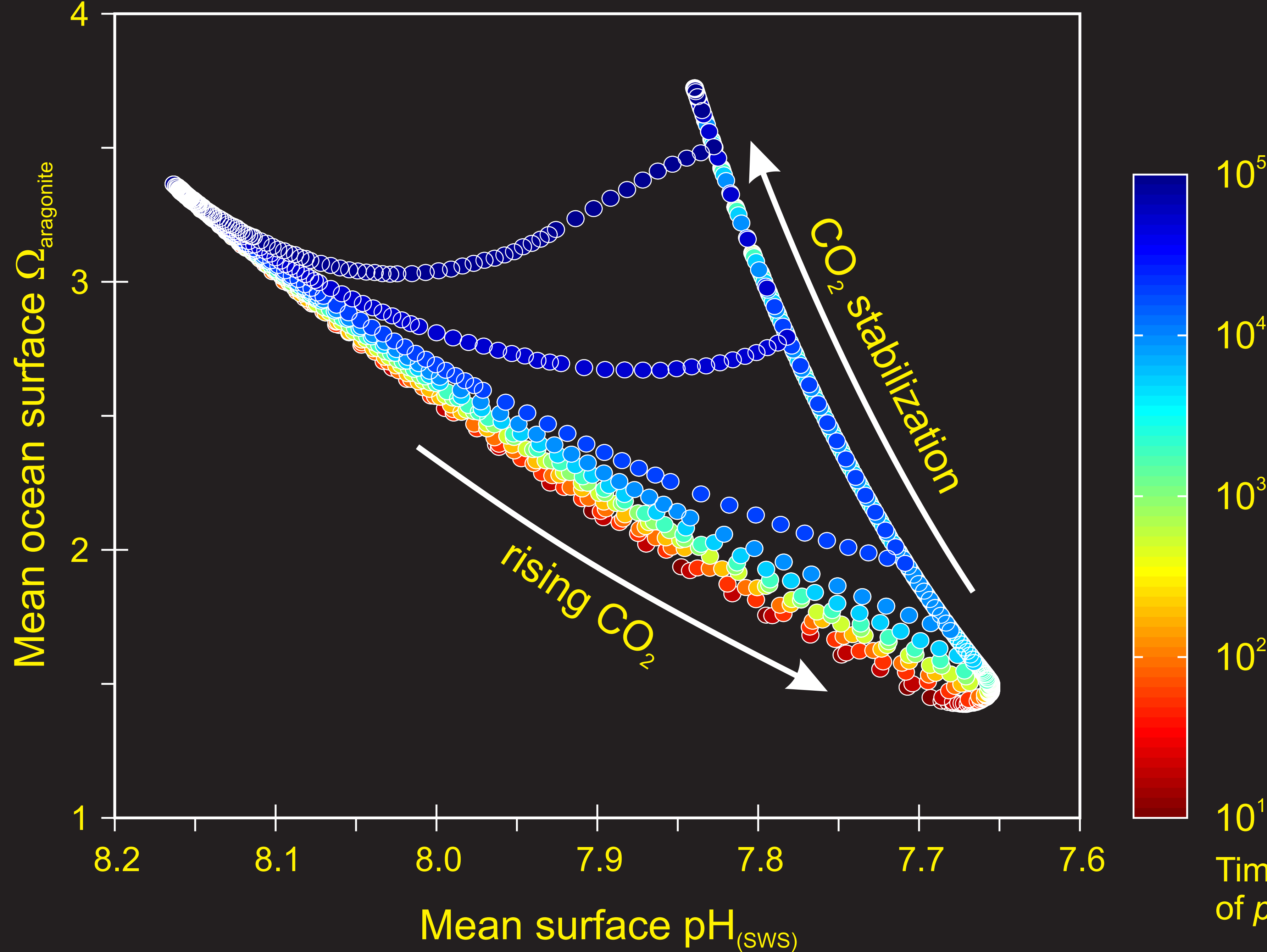
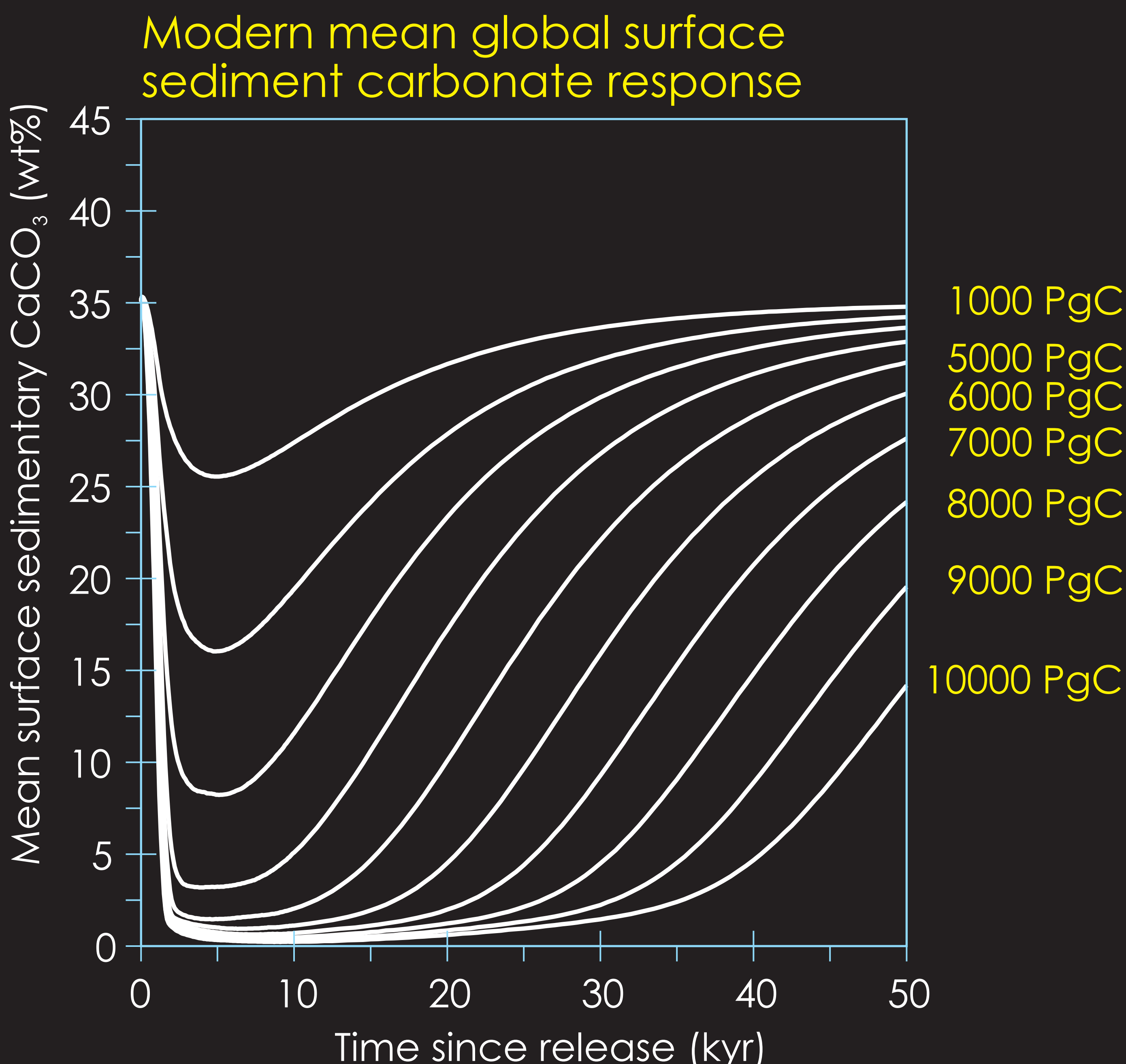


Time-scale dependence of the nature of ocean carbonate chemistry changes



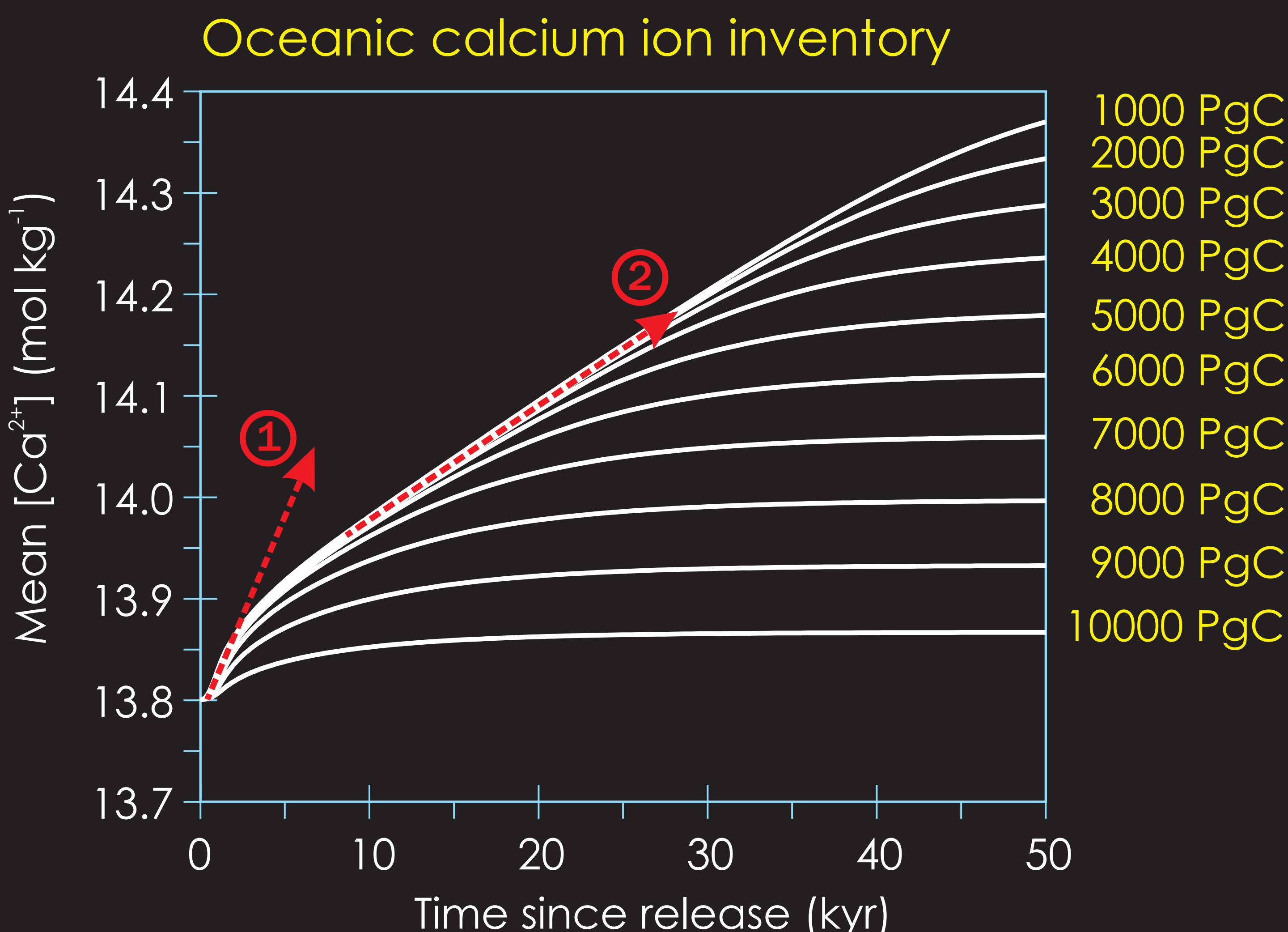
From: *Hönisch et al.* [2012]

Deep-sea sediments



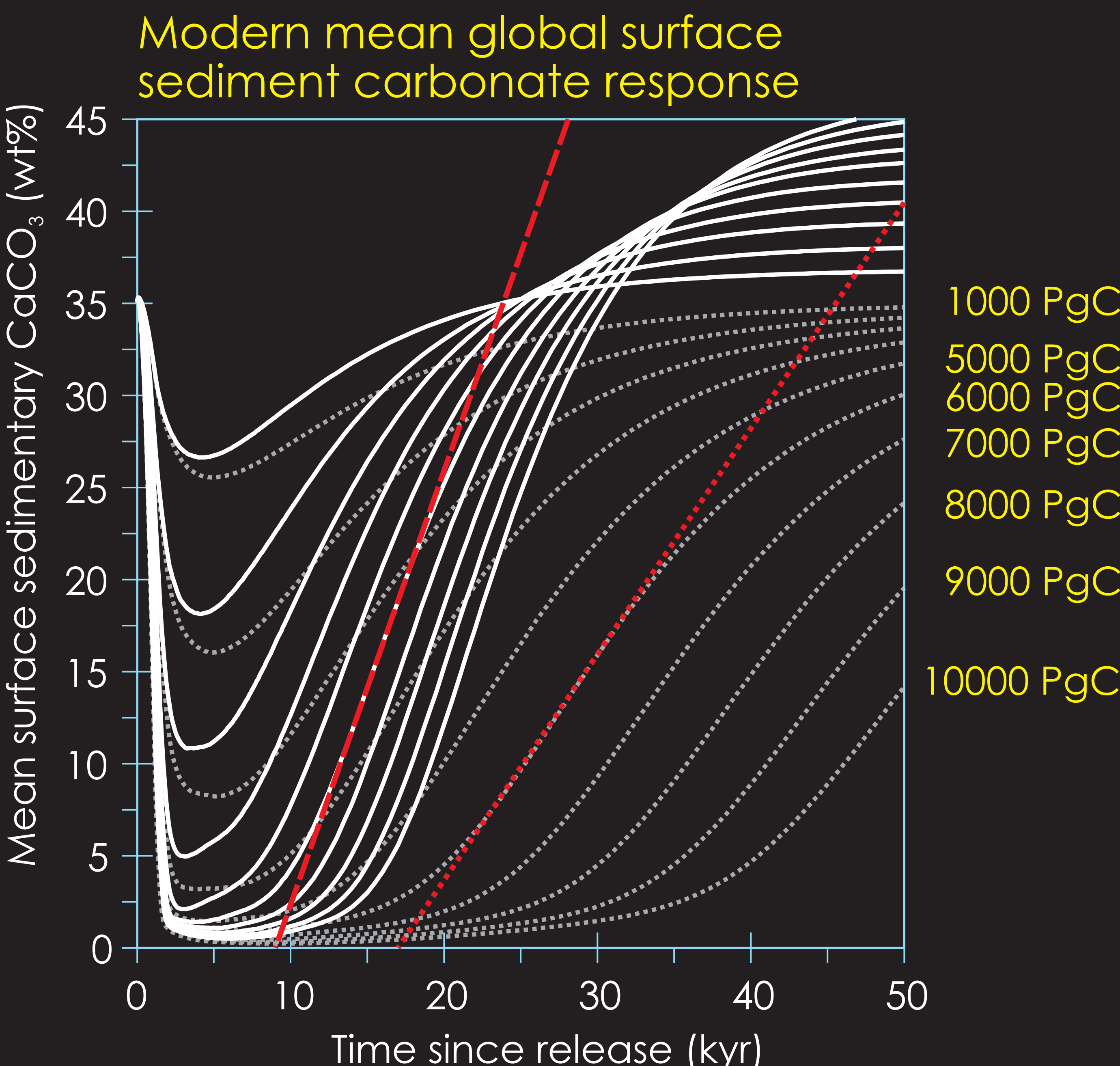
The strength of CO_2 neutralization by sea-floor carbonates is dependent on the total CO_2 release.
(Simply put: we run out of $CaCO_3$ to dissolve at some point ...)

Deep-sea sediments



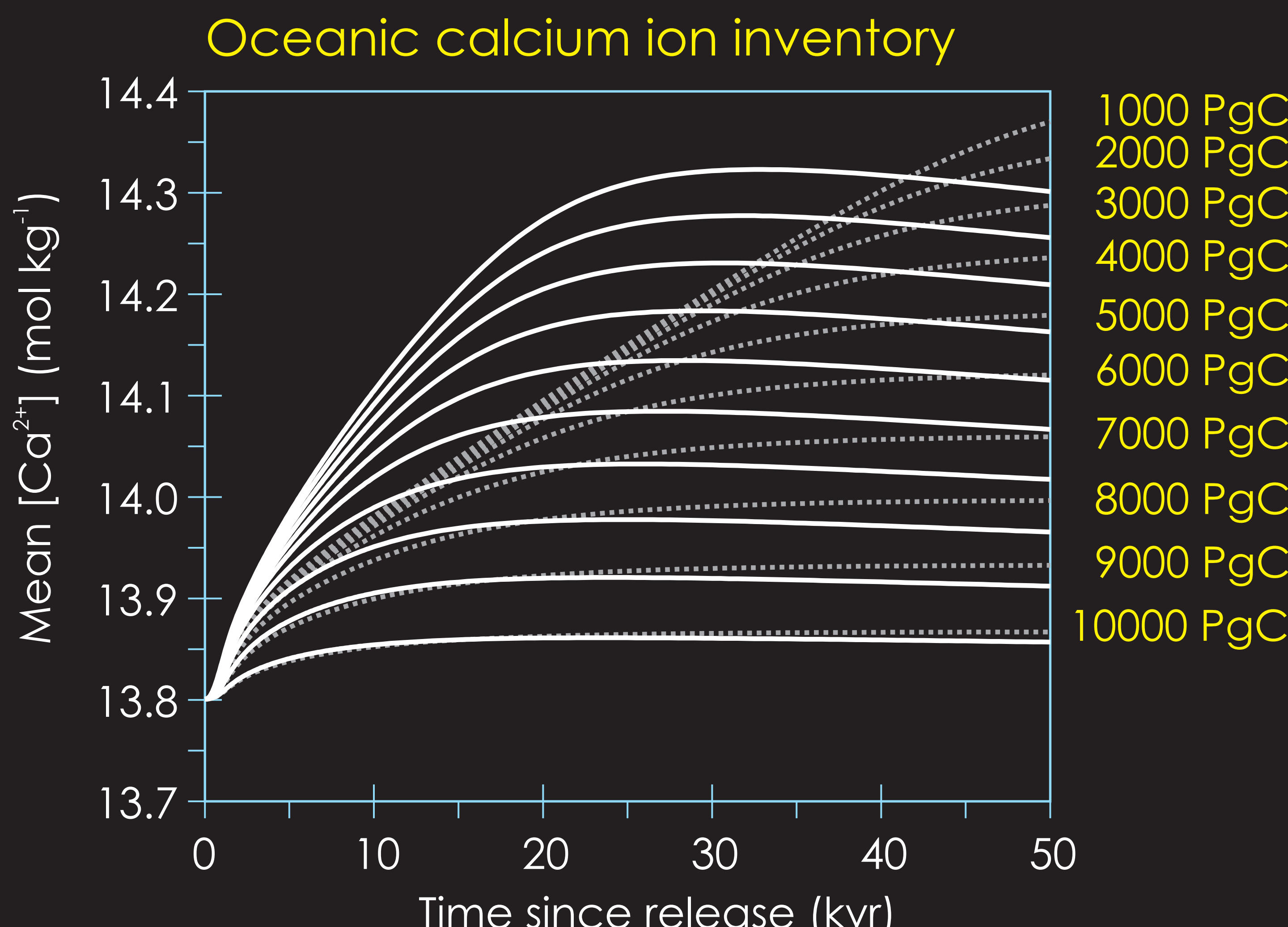
Without the silicate weathering feedback - two slopes, reflecting:
(1) Dissolution of $CaCO_3$ at the sea-floor.
(2) Imbalance between weathering and burial.

Deep-sea sediments & weathering feedback



Enhanced rates of silicate rock weathering drives an acceleration of the rate of recovery of sediment composition compared to in the absence of a change in weathering rates.
The reflects a larger imbalance between rates of (now enhanced) weathering and burial.

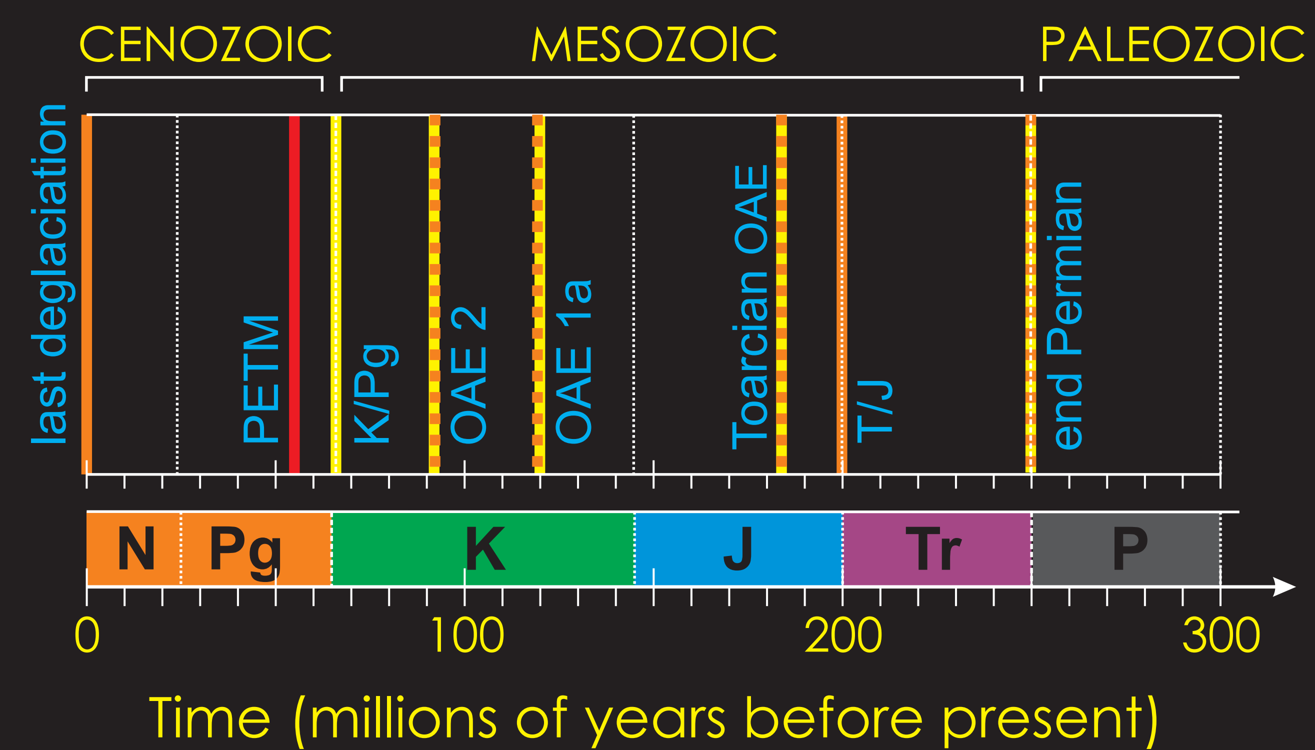
Deep-sea sediments & weathering feedback



With enhanced silicate weathering: calcium ion concentrations increase much more quickly than without the feedback.

The larger the CO_2 release, the greater global warming, and the greater the enhancement of weathering (and hence the steeper the increase in $[Ca^{2+}]$).

What constitutes an appropriate 'analogue' for the future consequences of massive CO_2 release and ocean acidification (in terms of marine carbonate and weathering dynamics)?



[*Hönisch et al.*, 2012]

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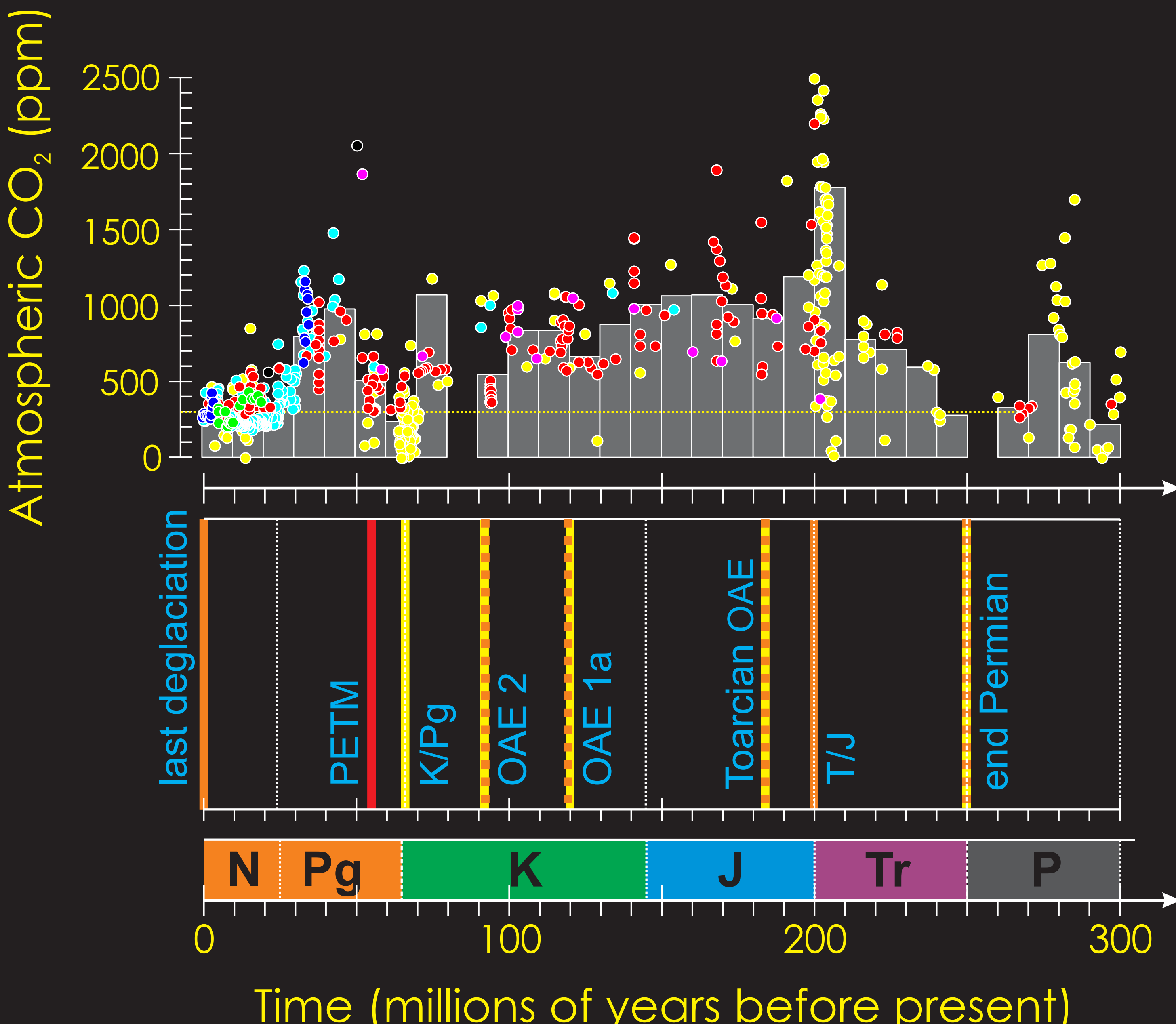

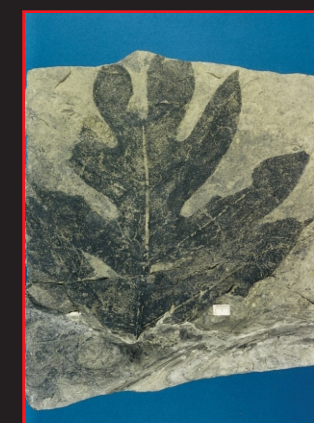

[Hönisch et al., 2012]

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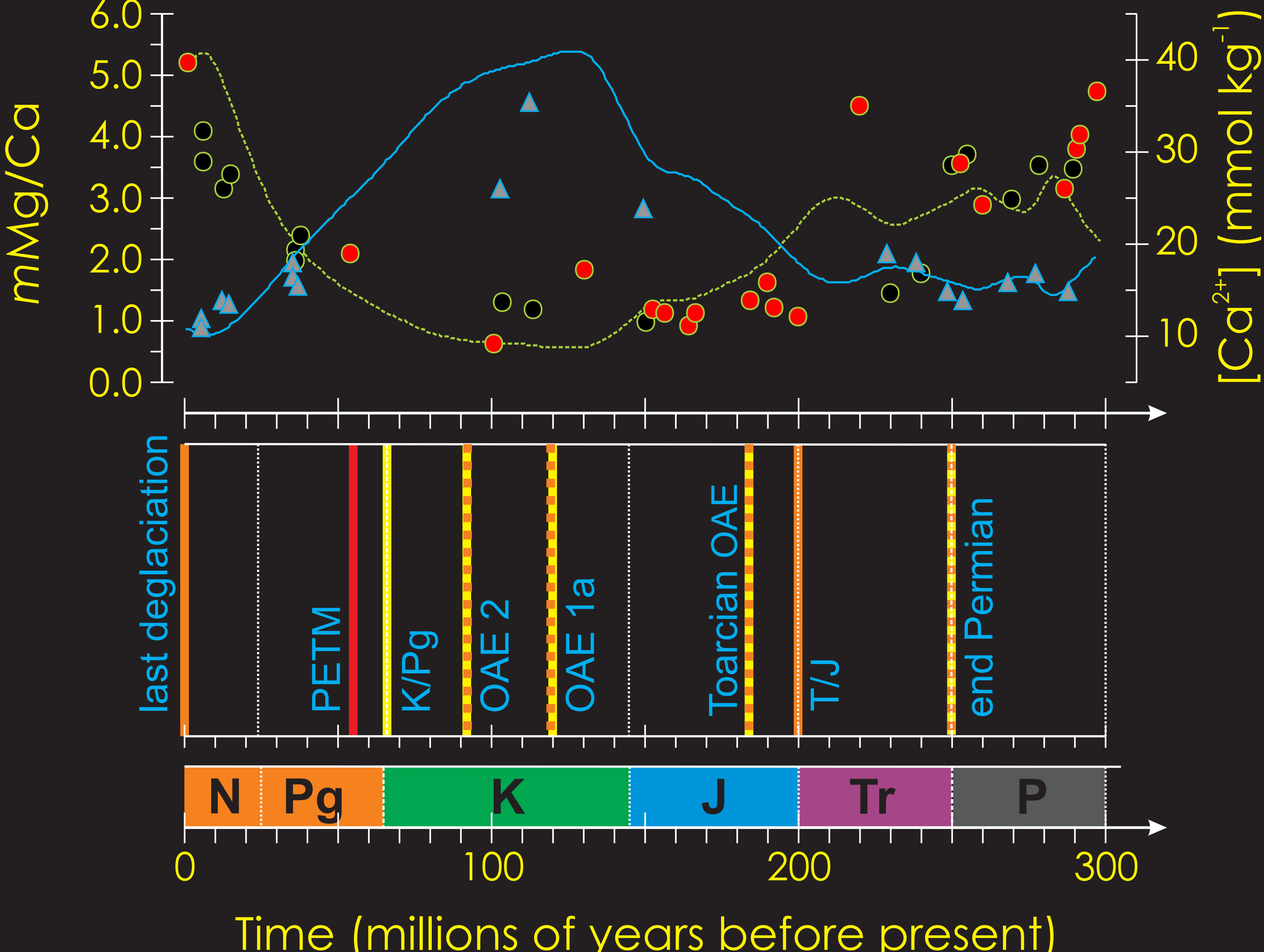

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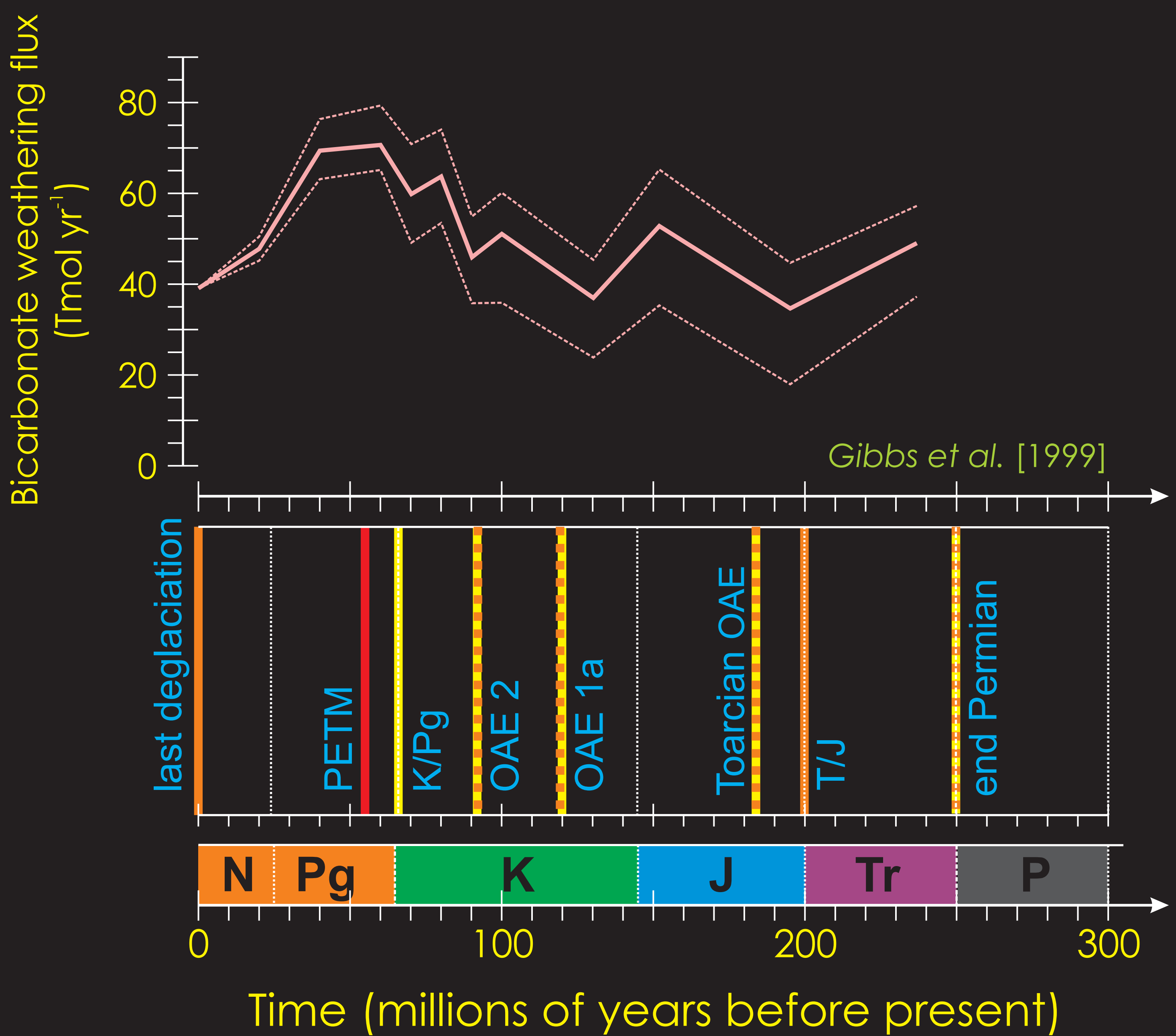

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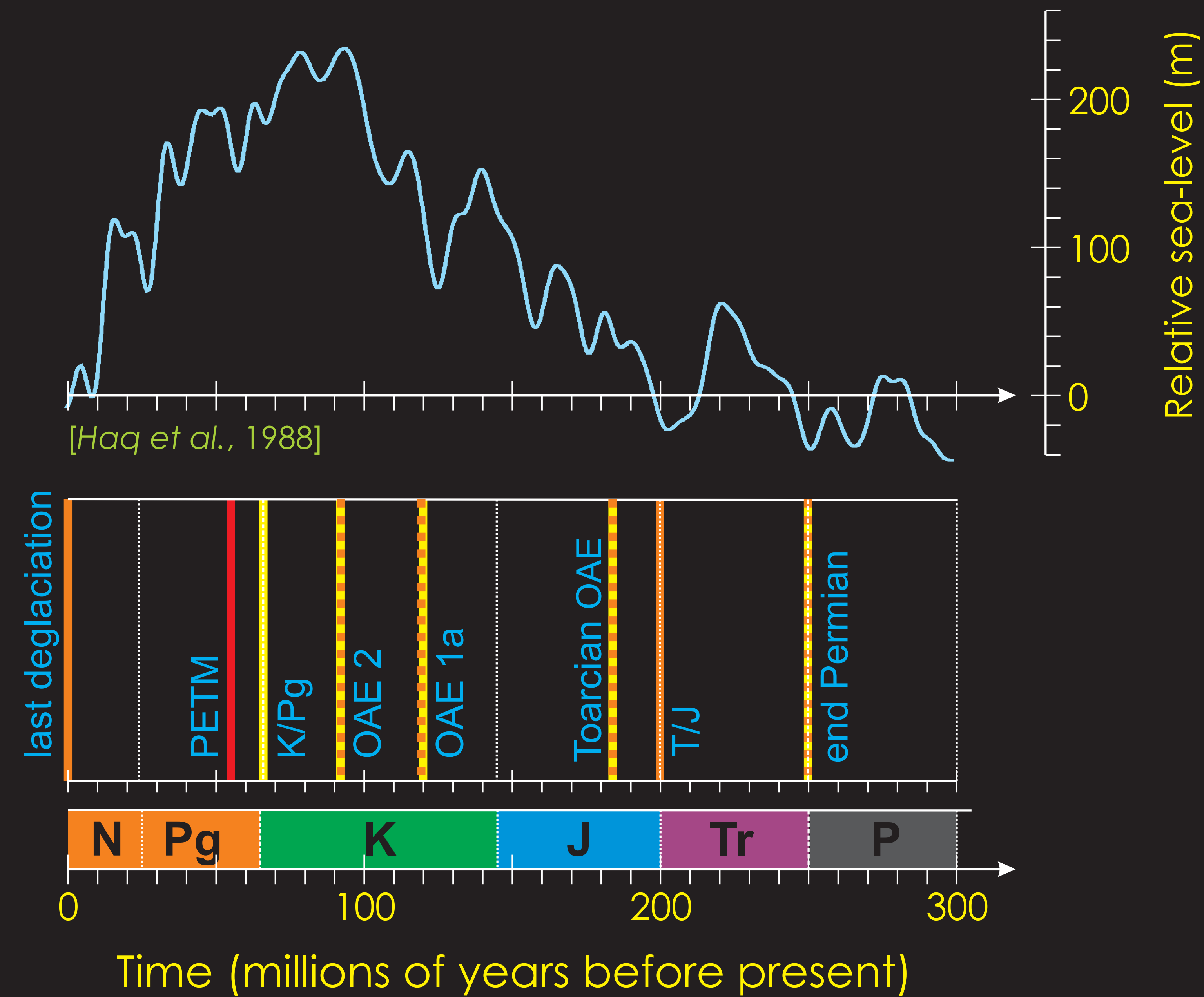

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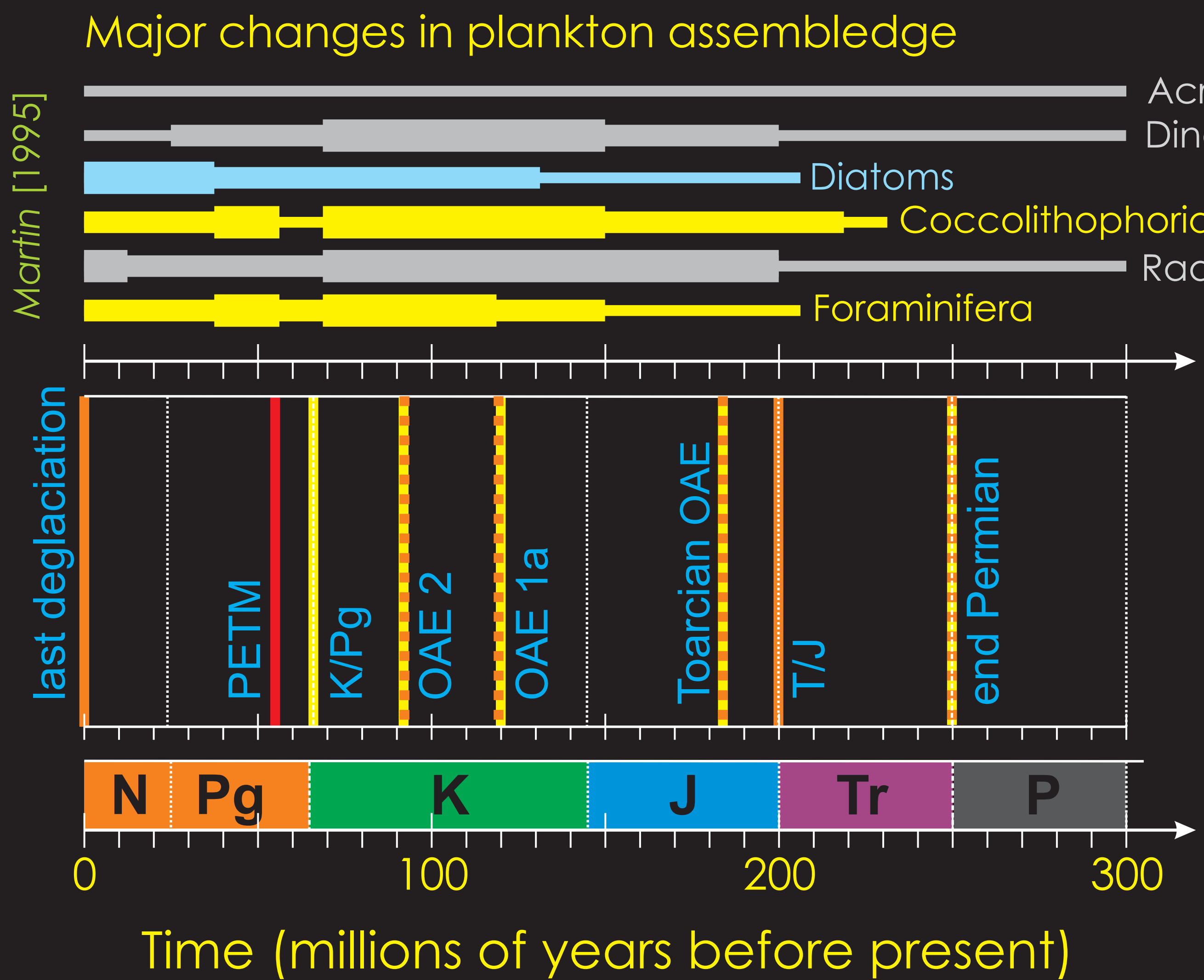

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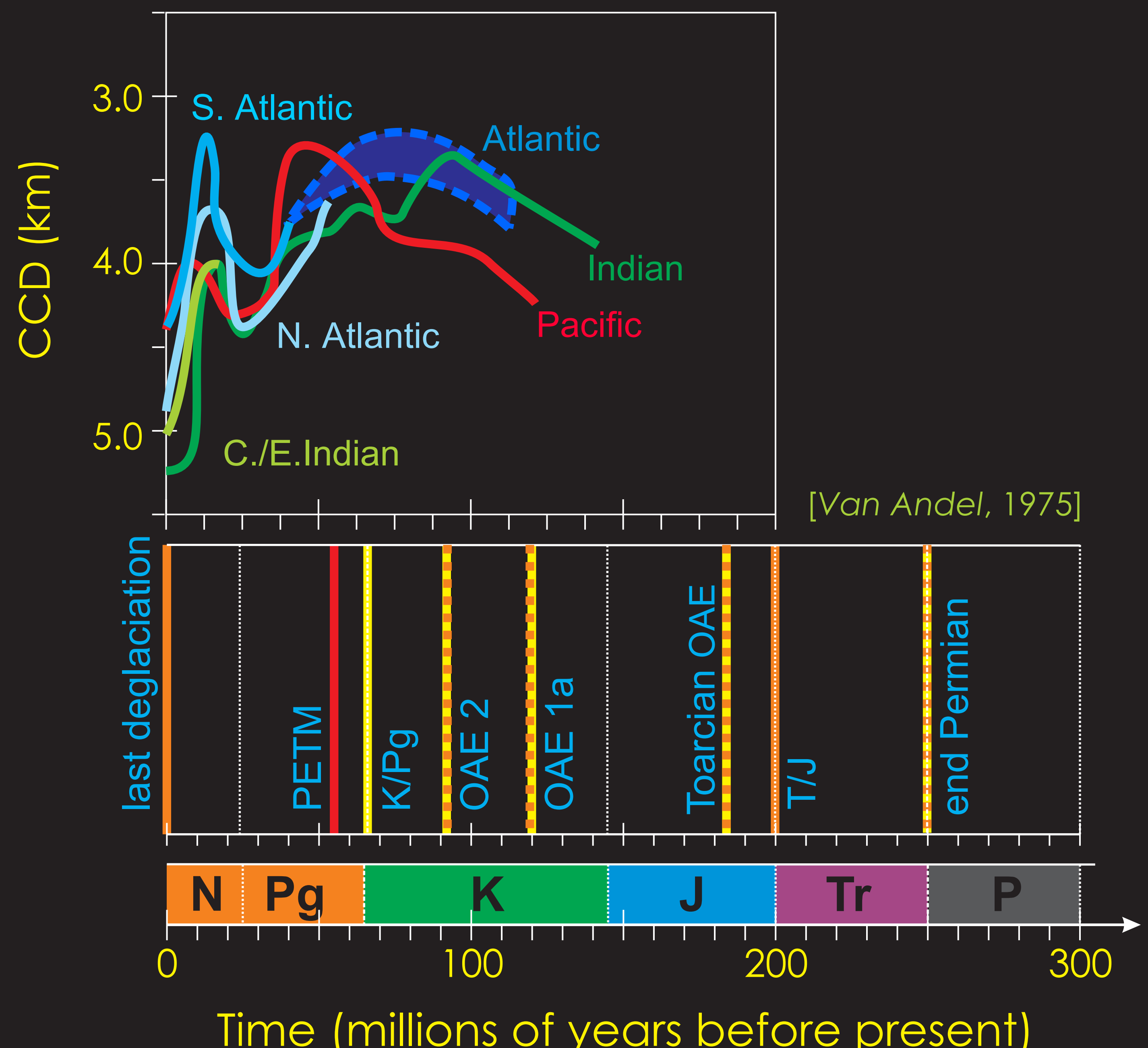
The 'CCD' and marine carbon dynamics



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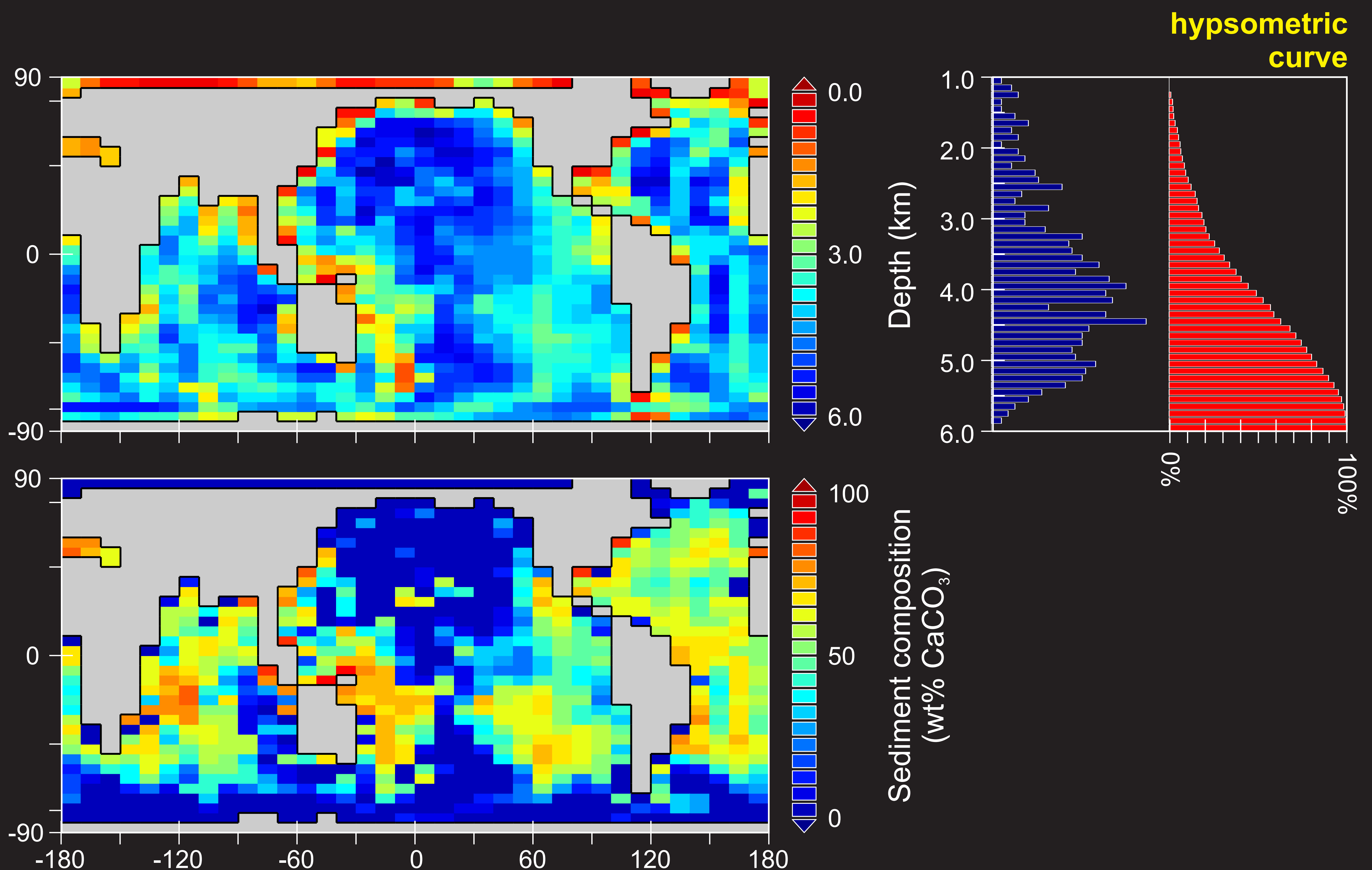

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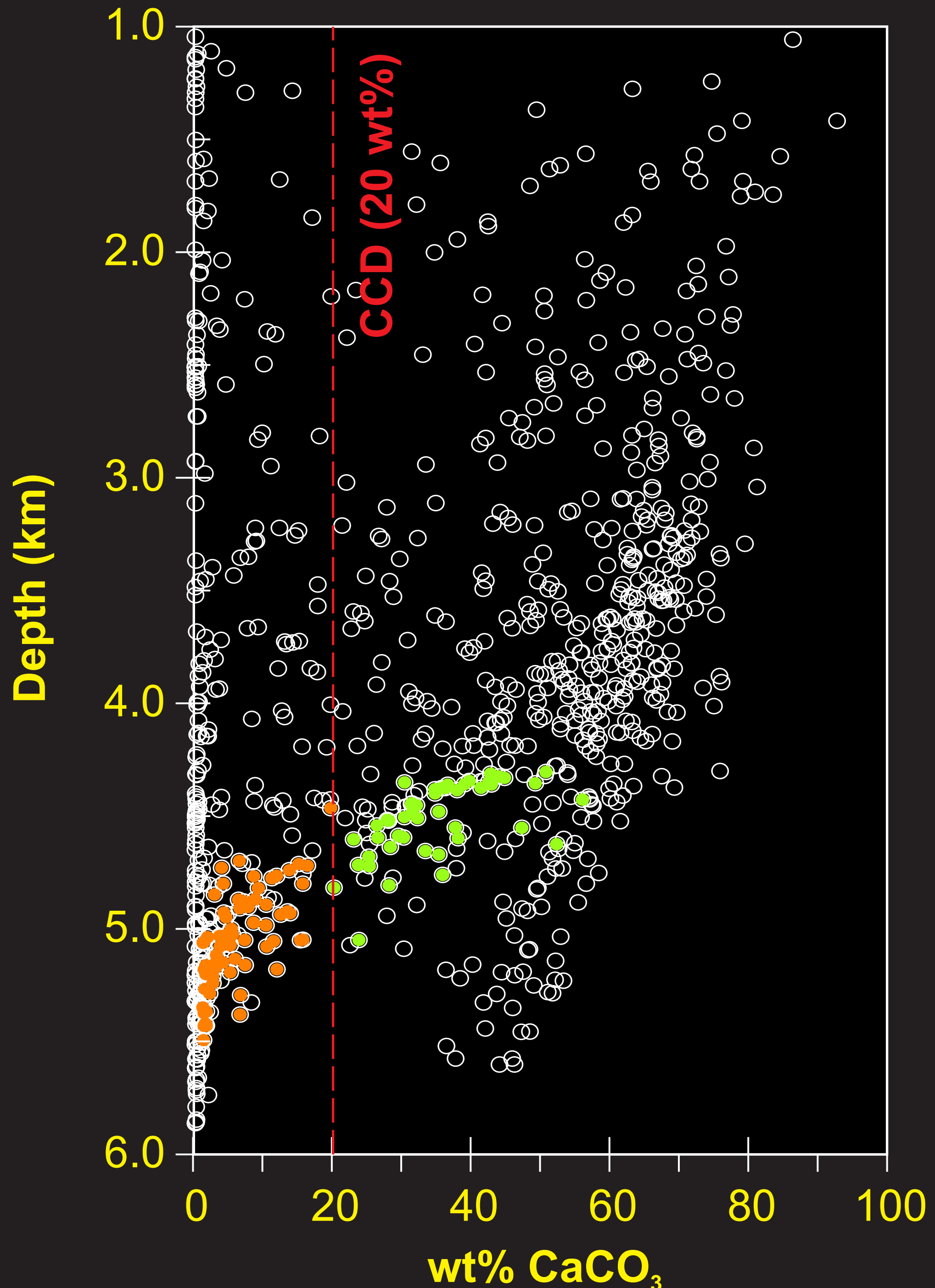

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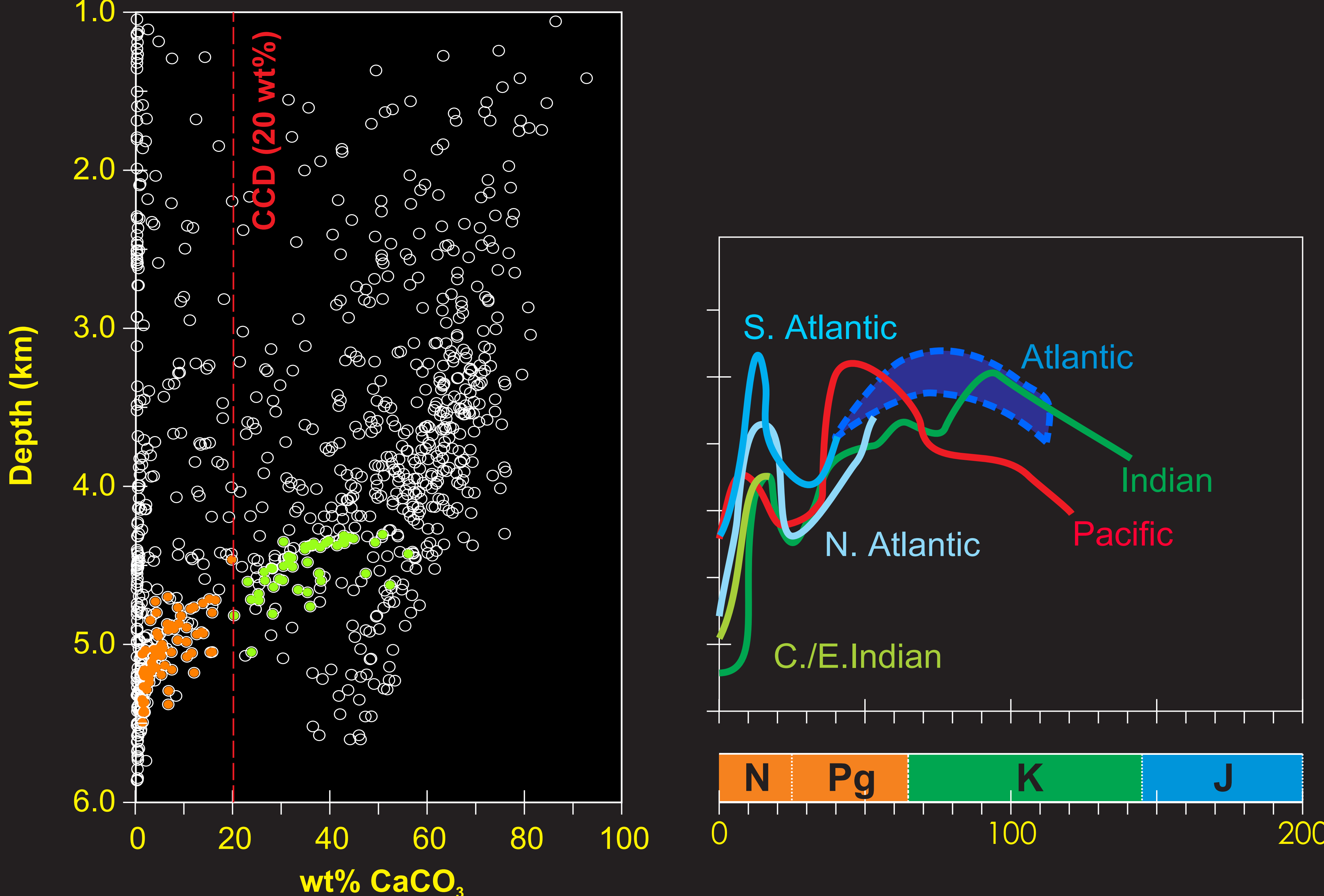
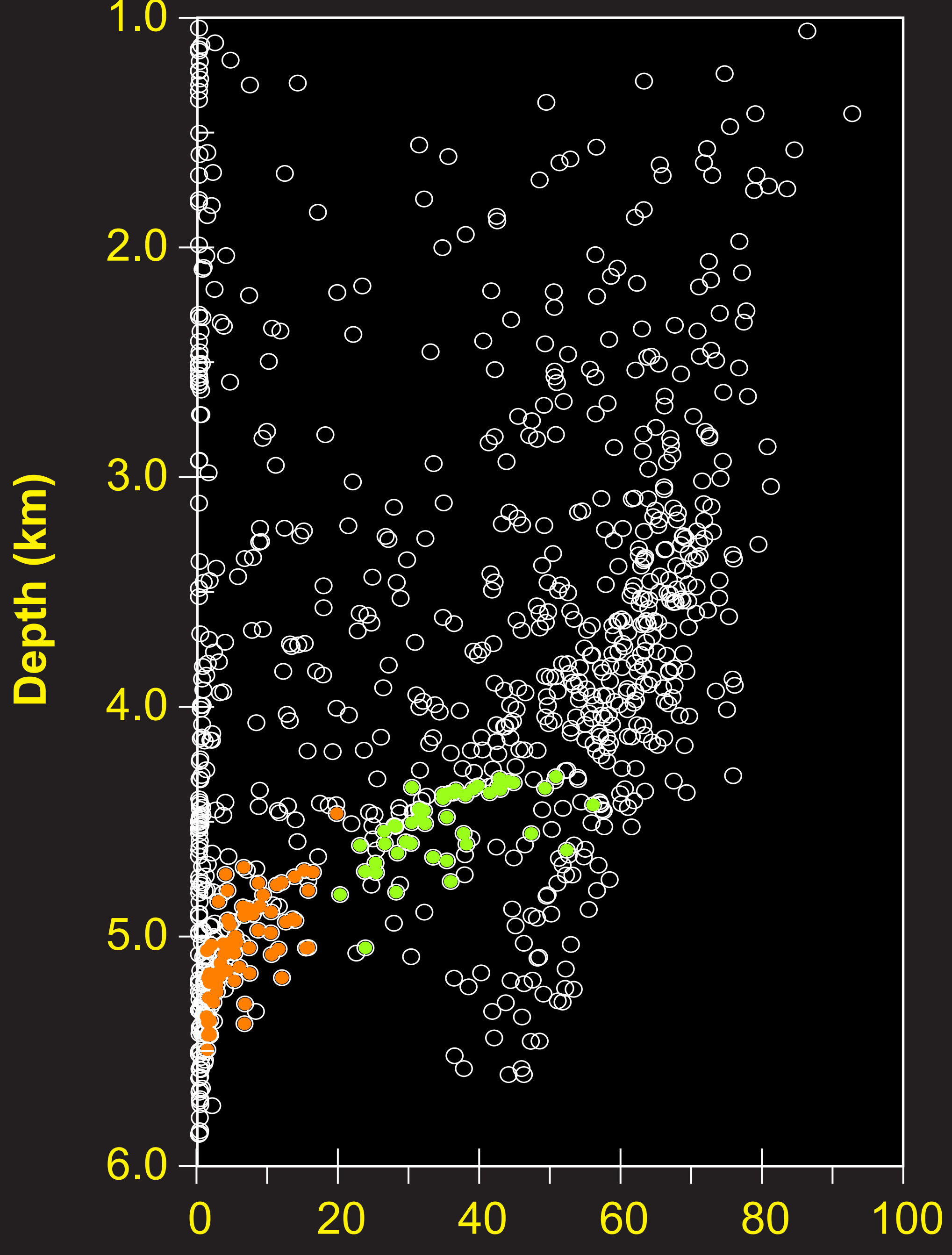


The 'lysocline'?



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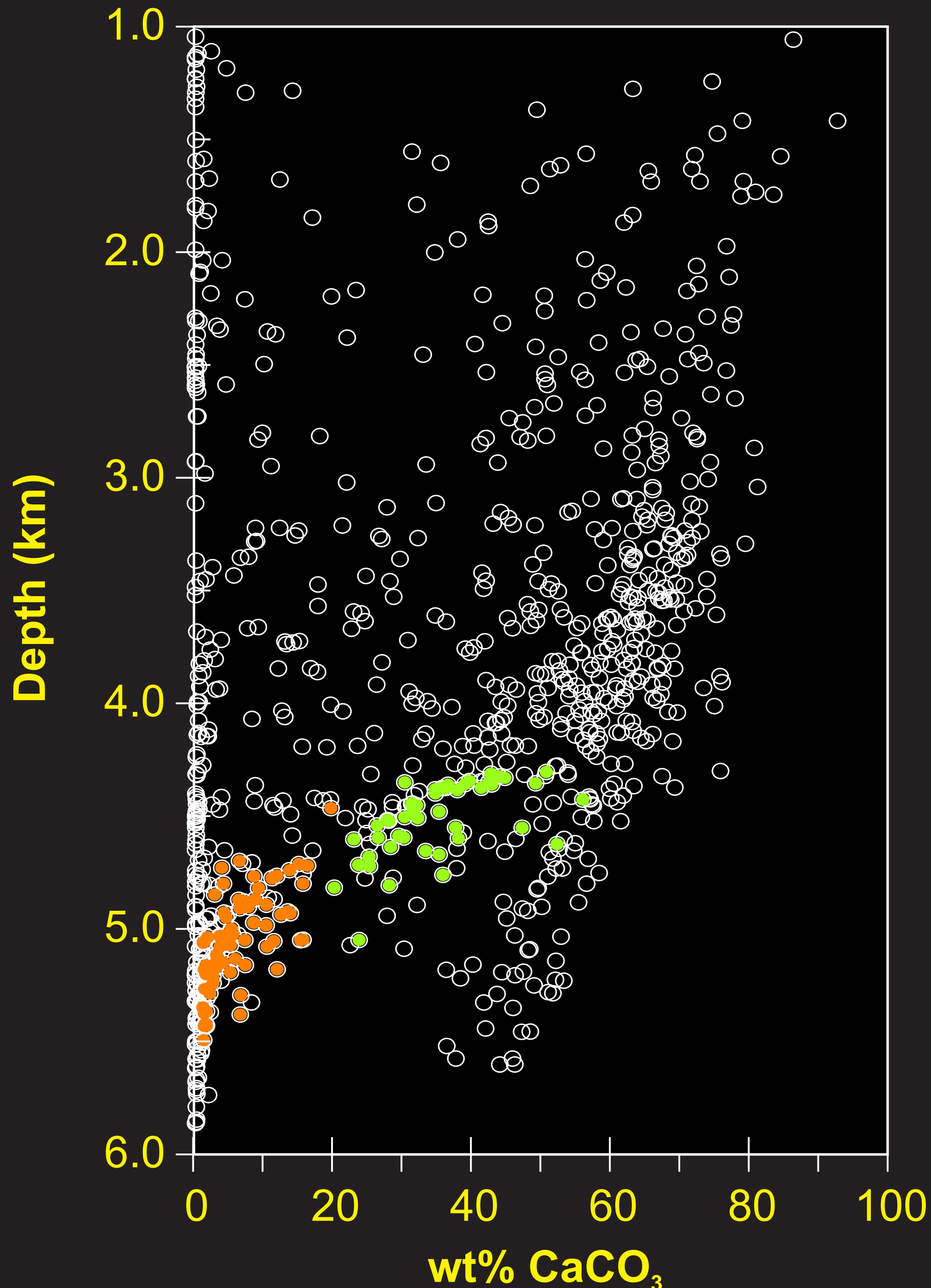
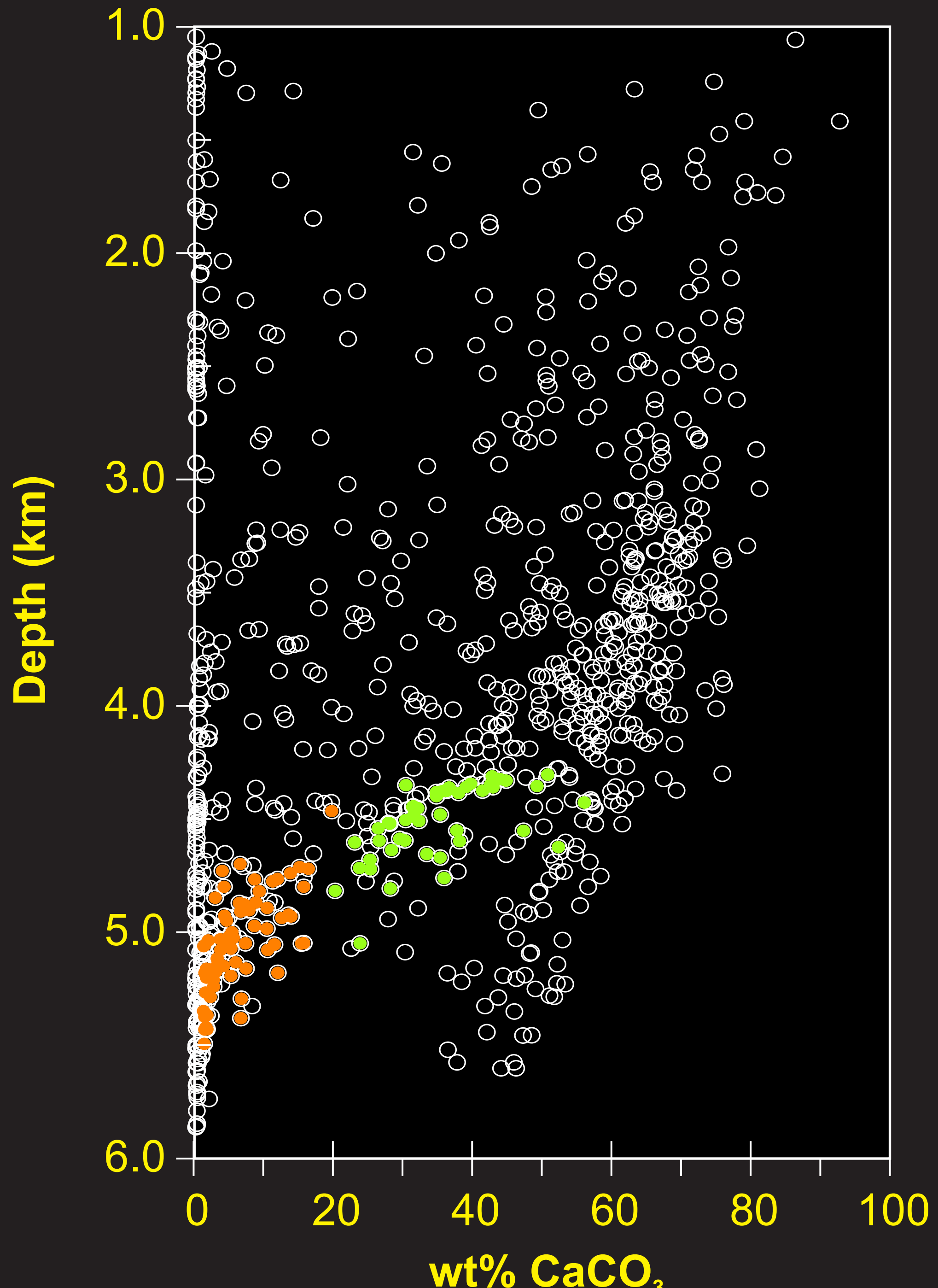


"The lysocline is the depth in the ocean below which the rate of dissolution of calcite increases dramatically."
[Wikipedia]

'a dissolving or loosening' of [carbonate content that] 'possesses or exhibits gradient'
[from the Greek: 'lyso' and 'cline']

The saturation horizon?



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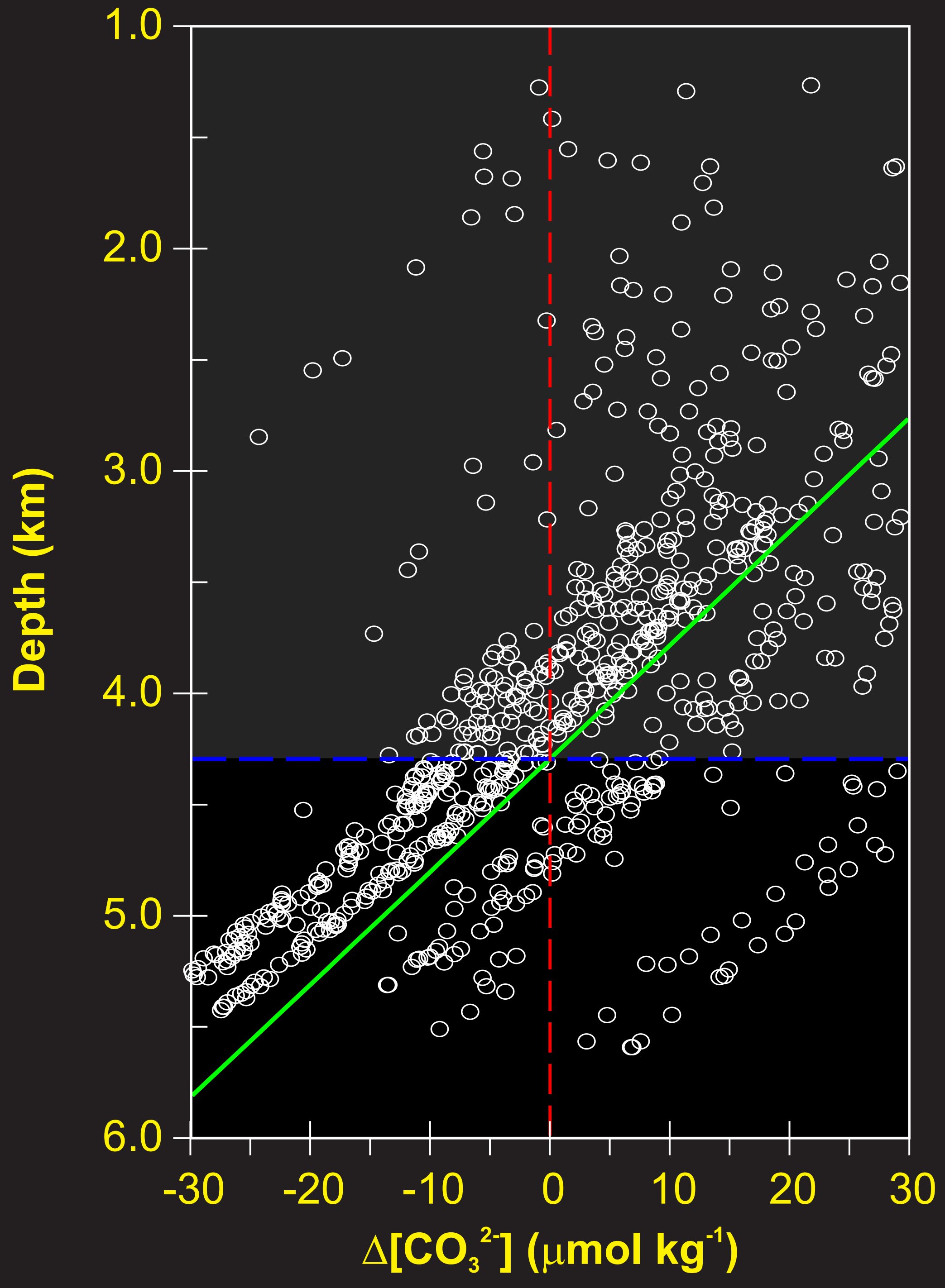
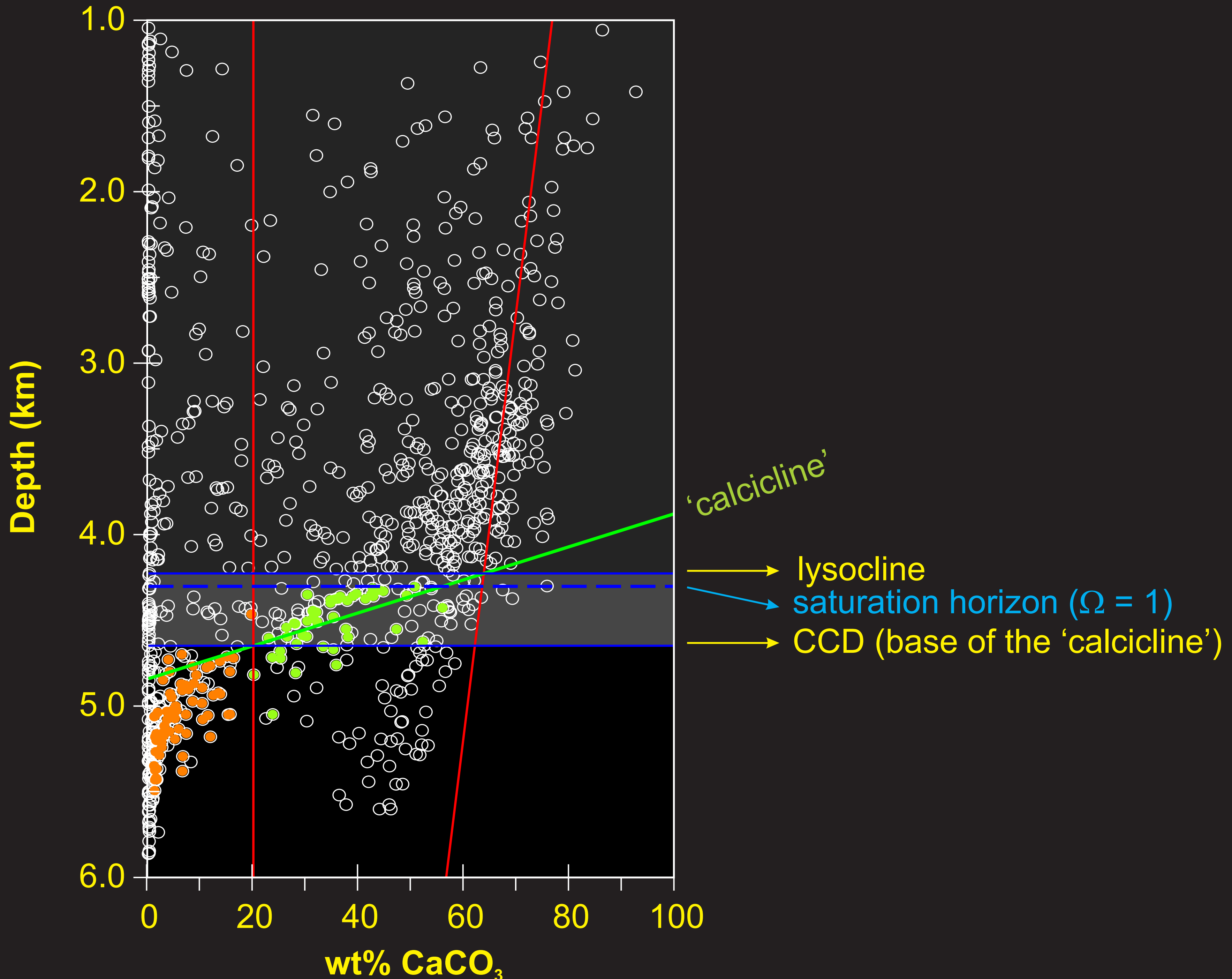


Characteristics of the marine (pelagic) carbonate sink



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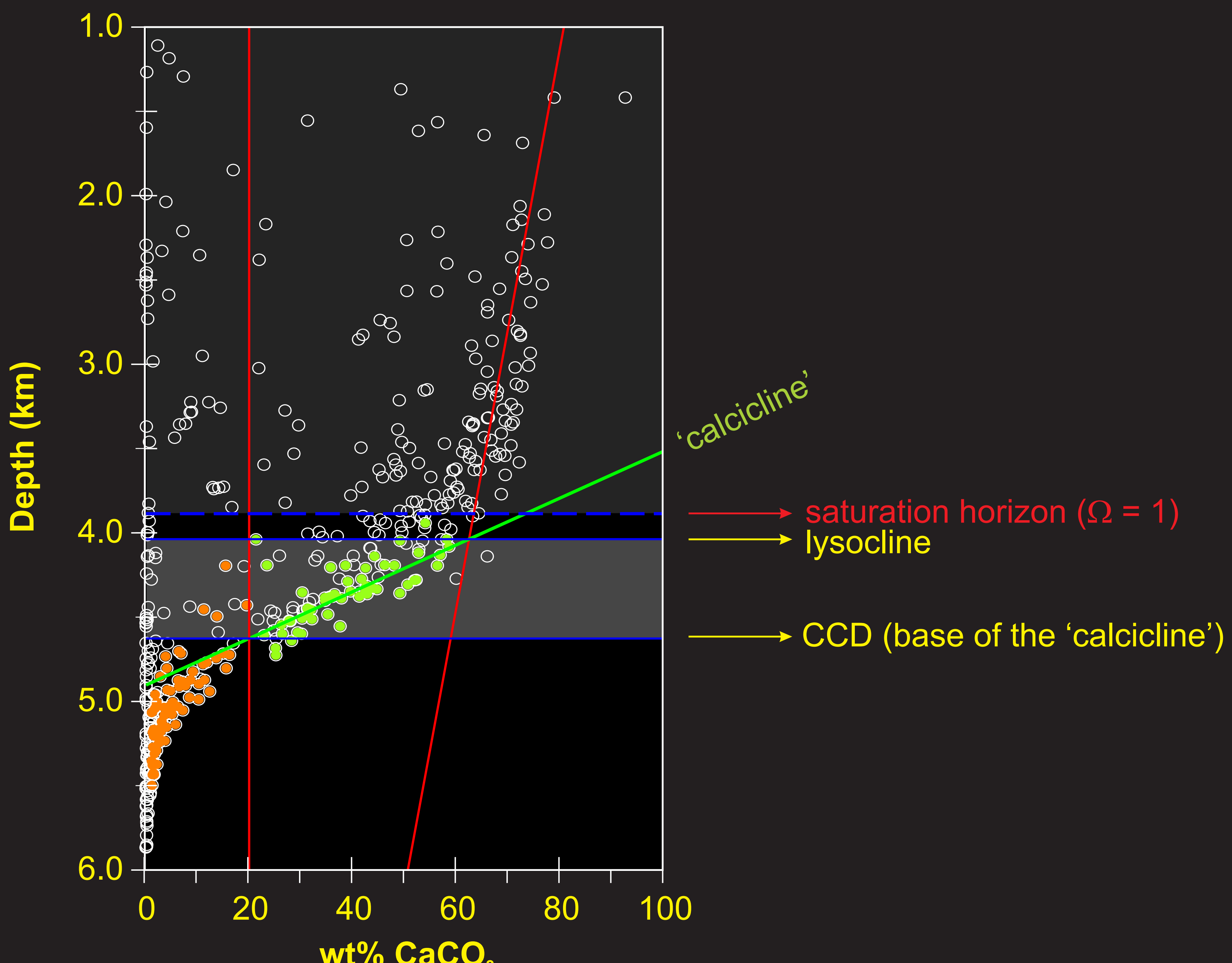

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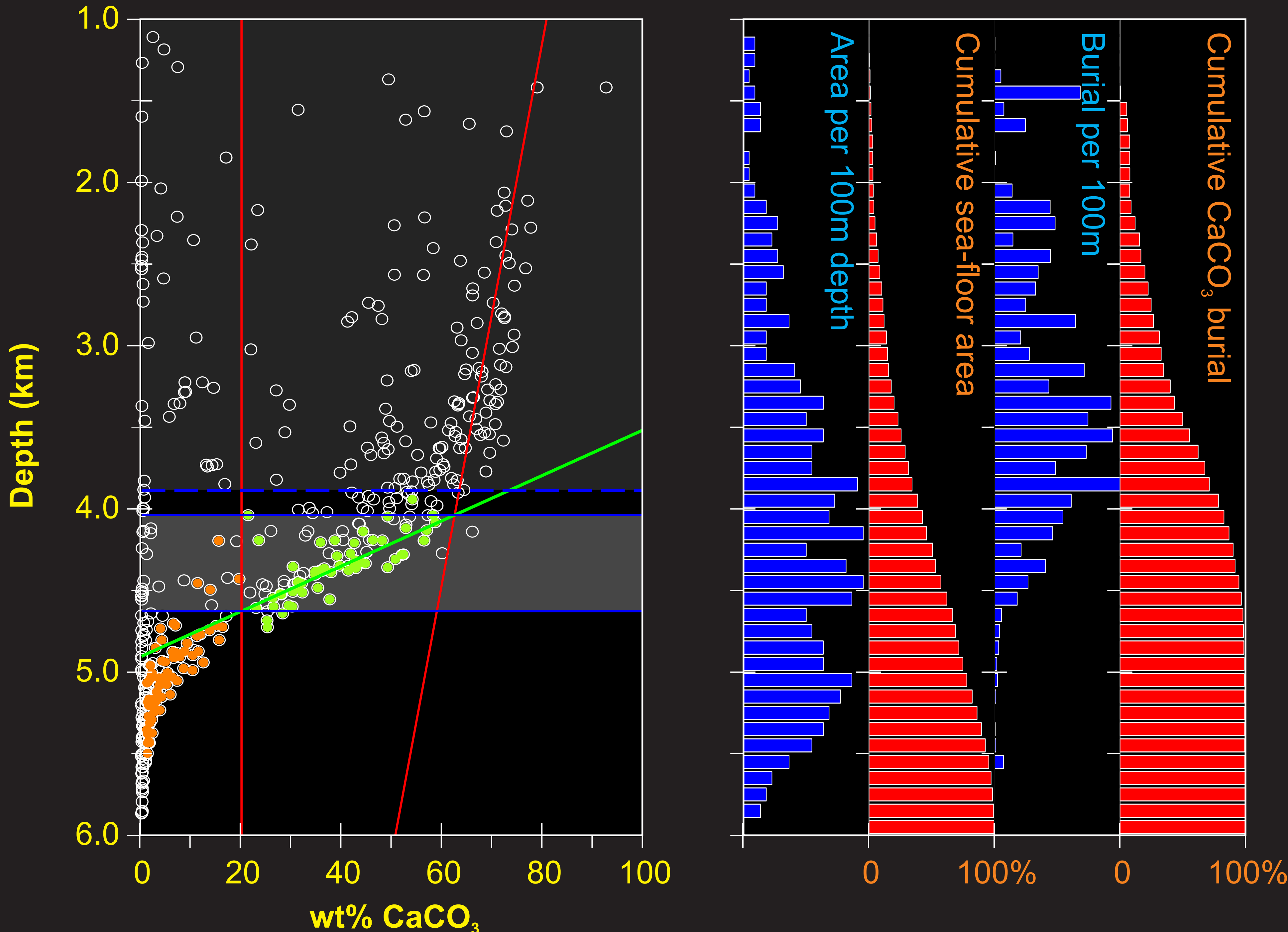
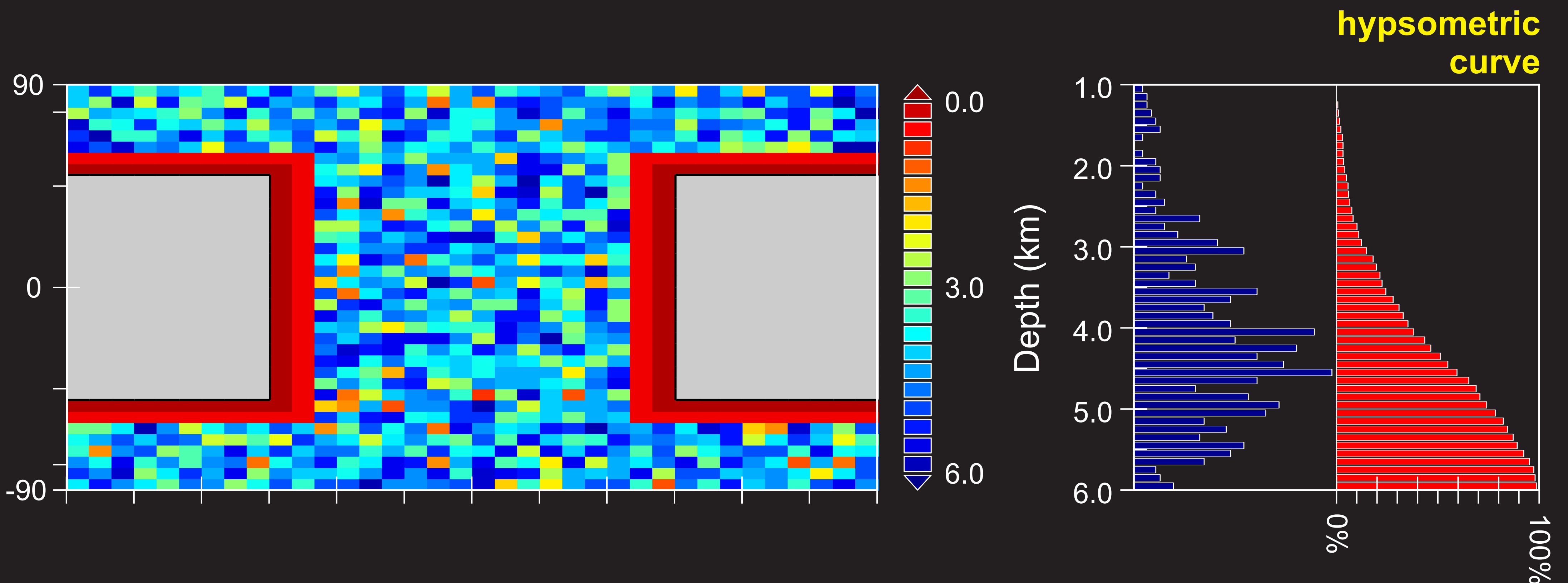


The marine carbonate sink [Earth 2.0]



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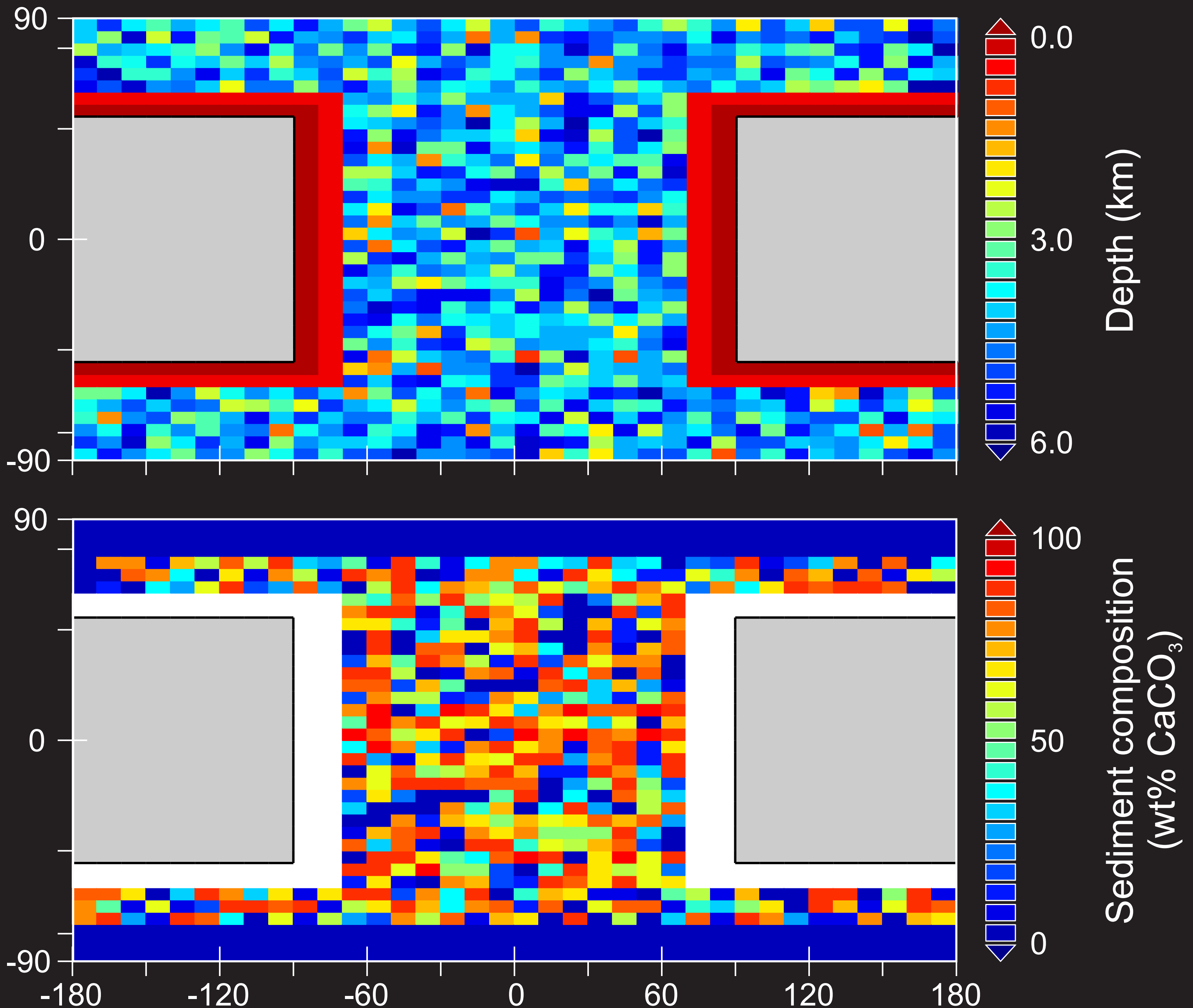

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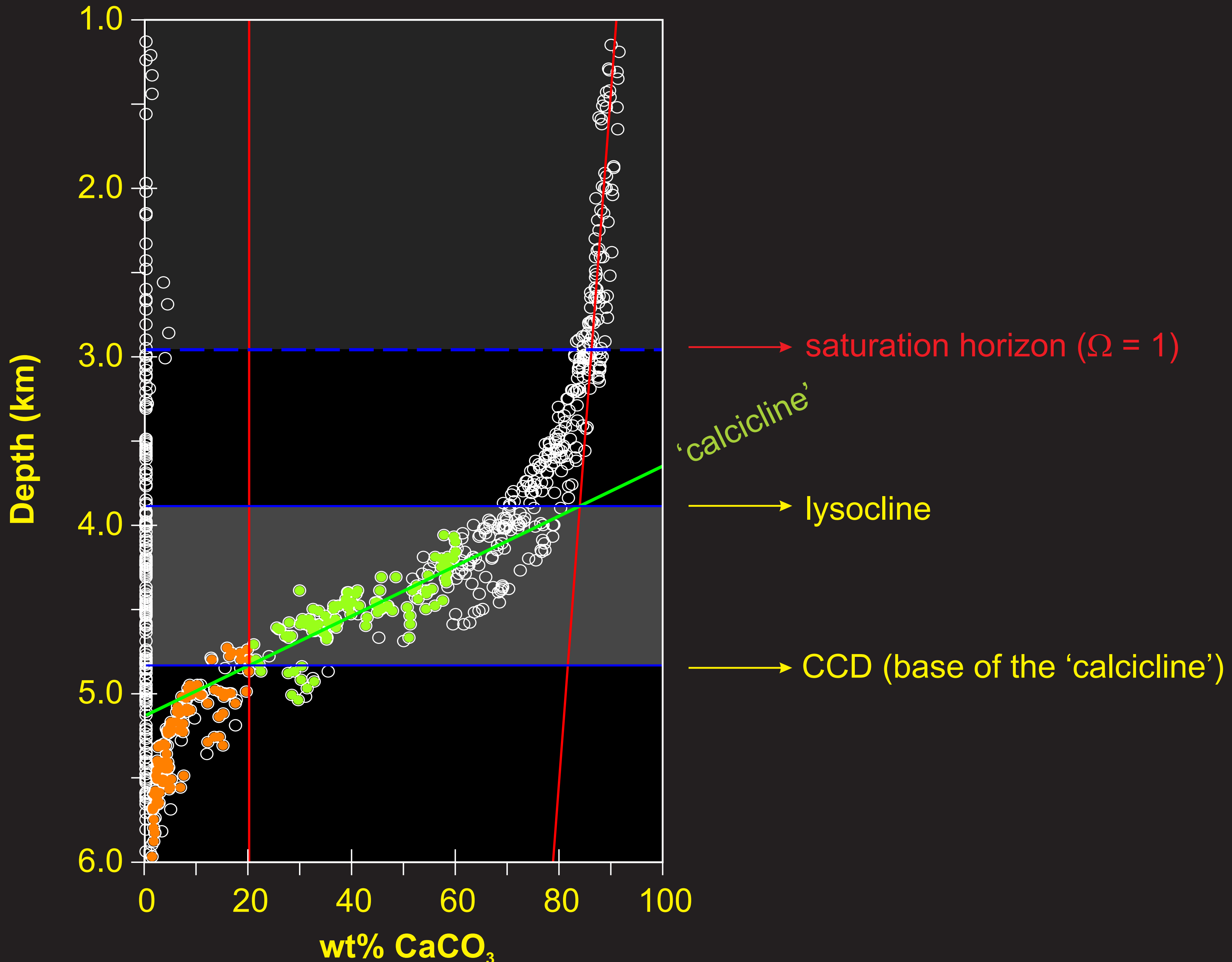

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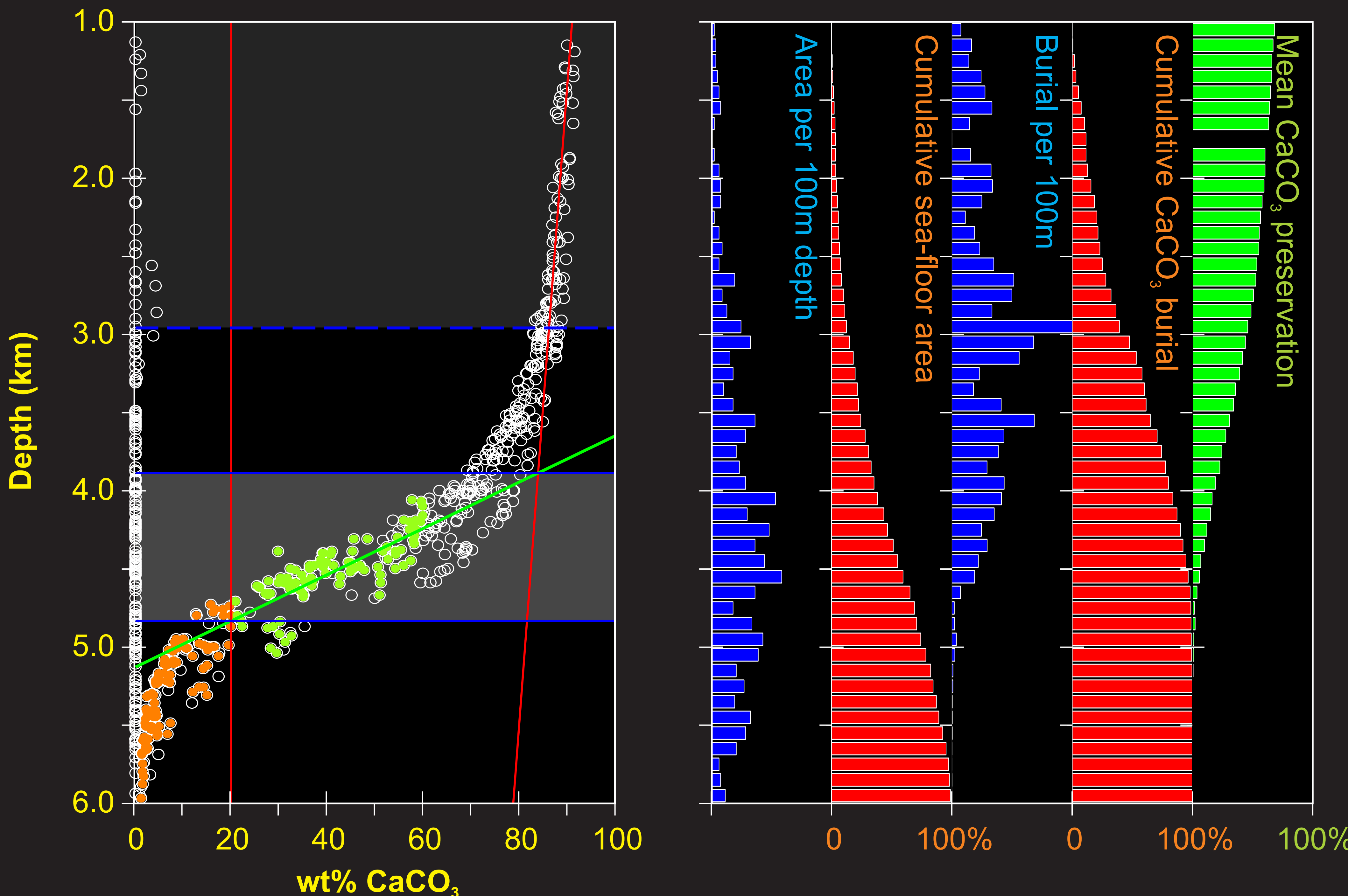

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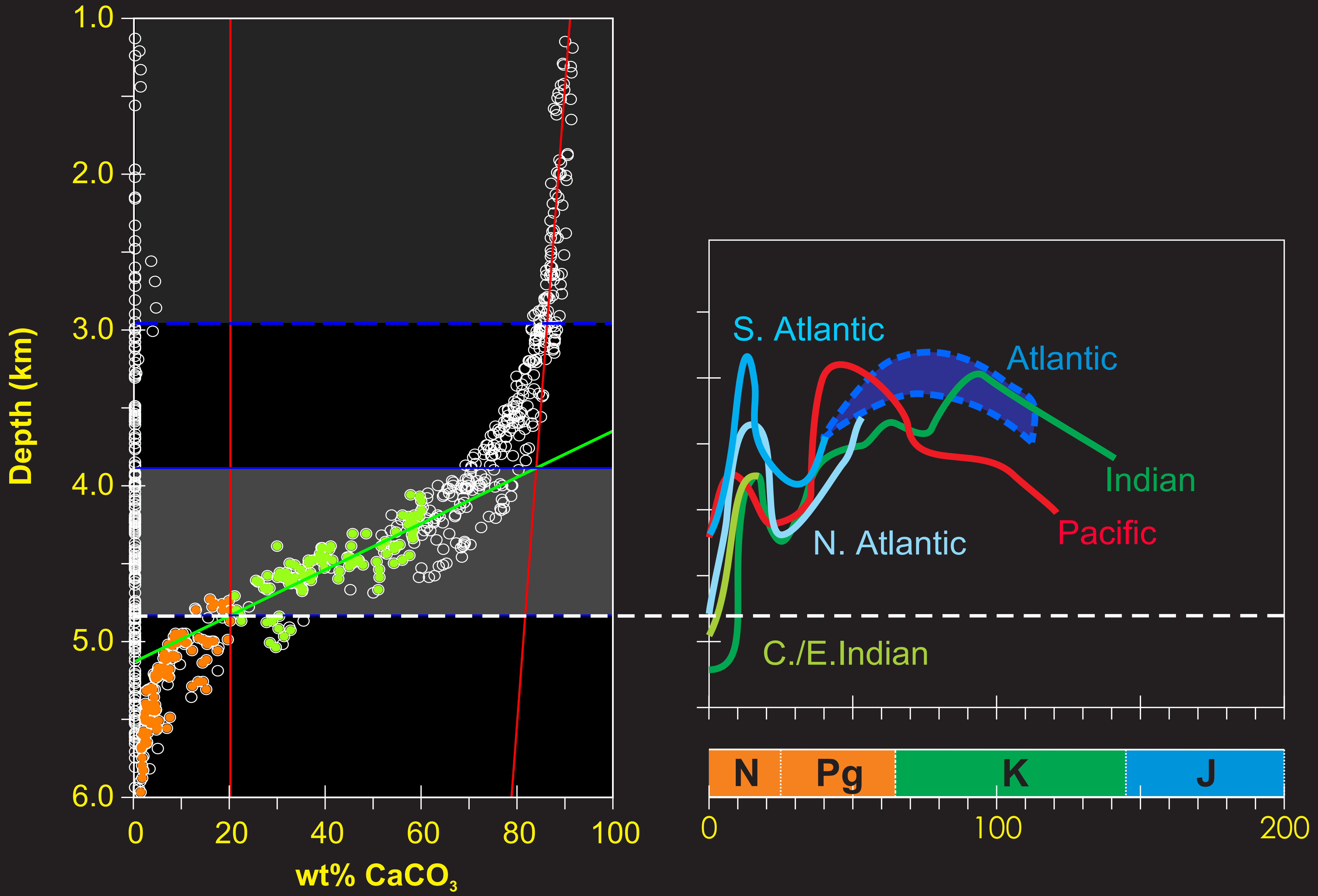
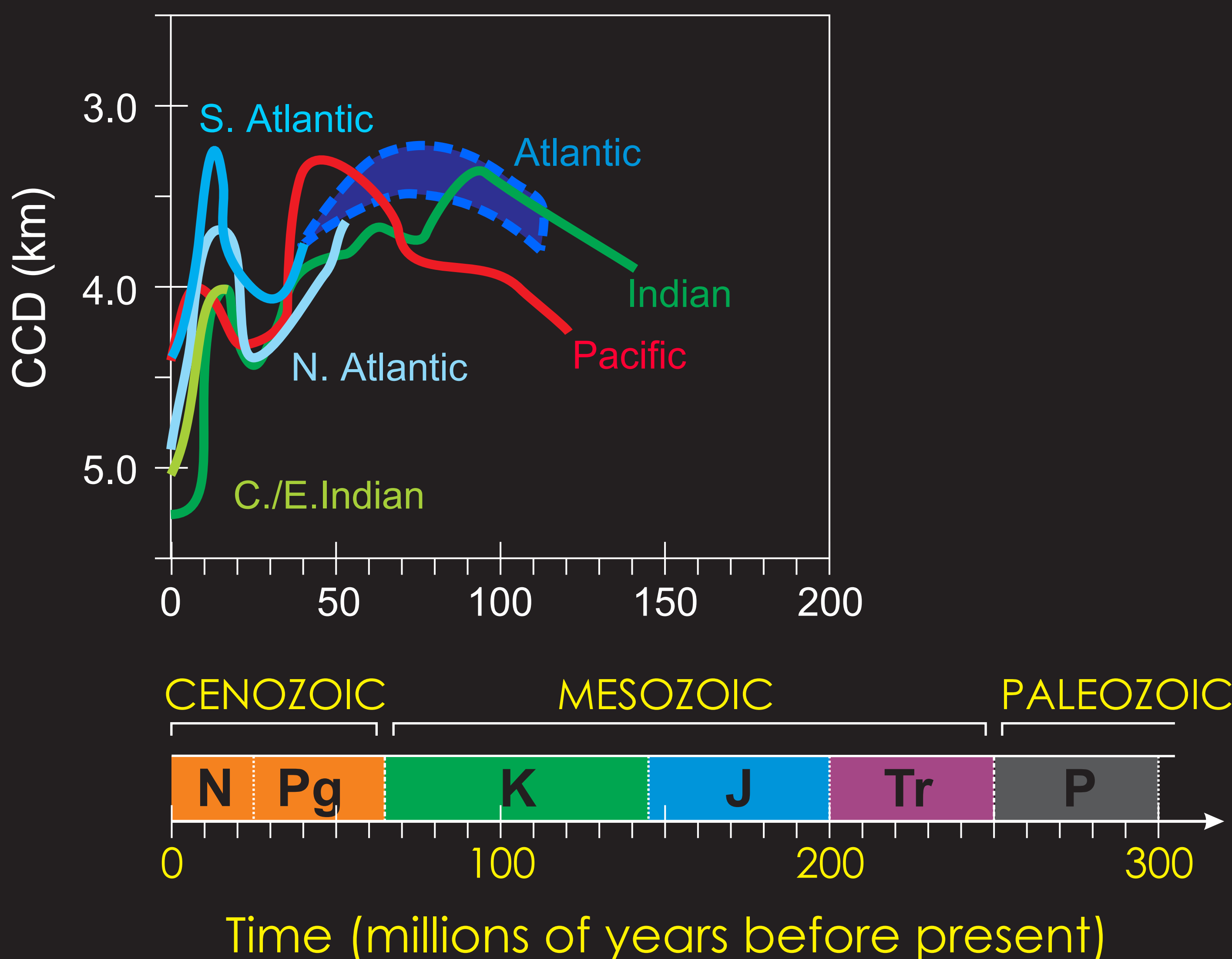


Evolution of the marine carbonate sink



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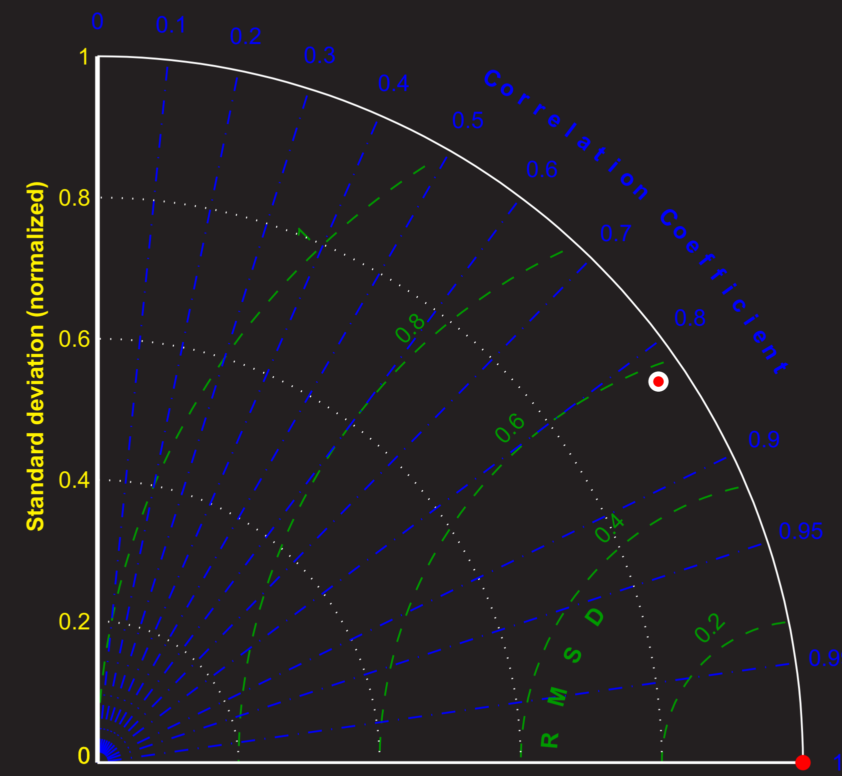
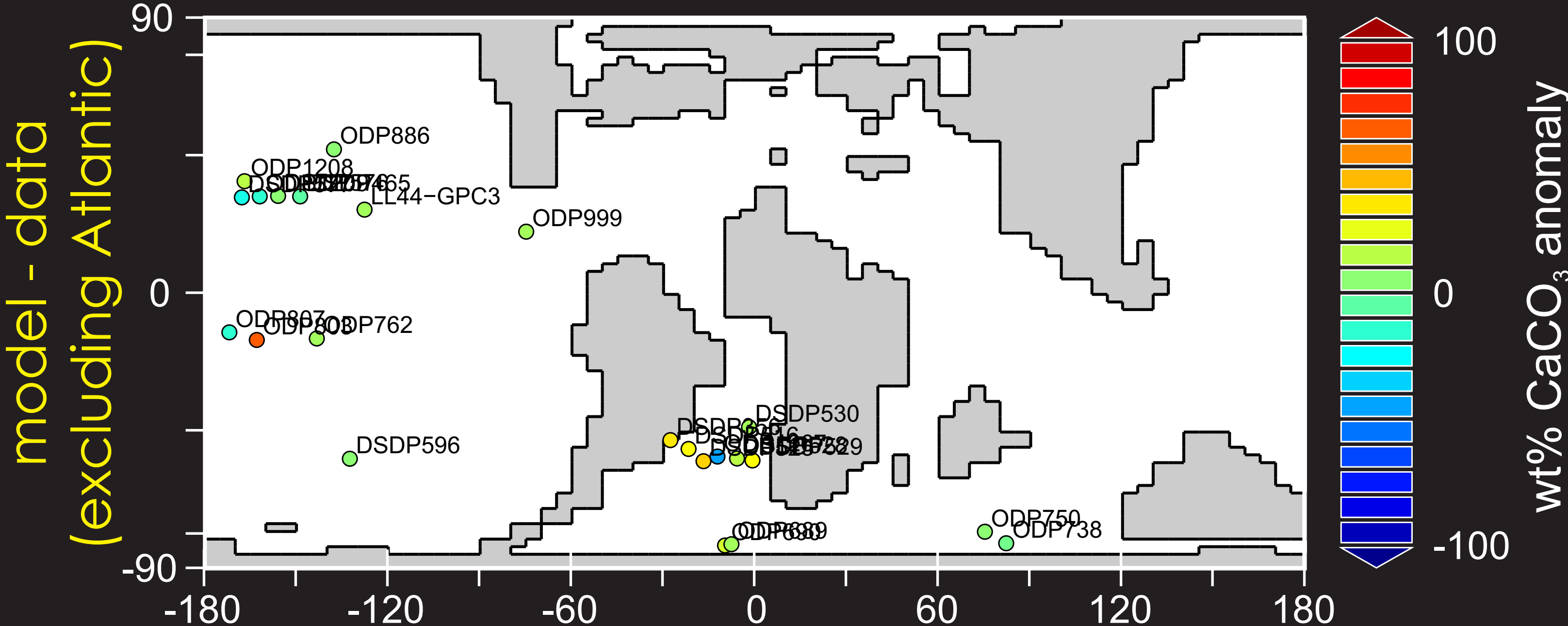
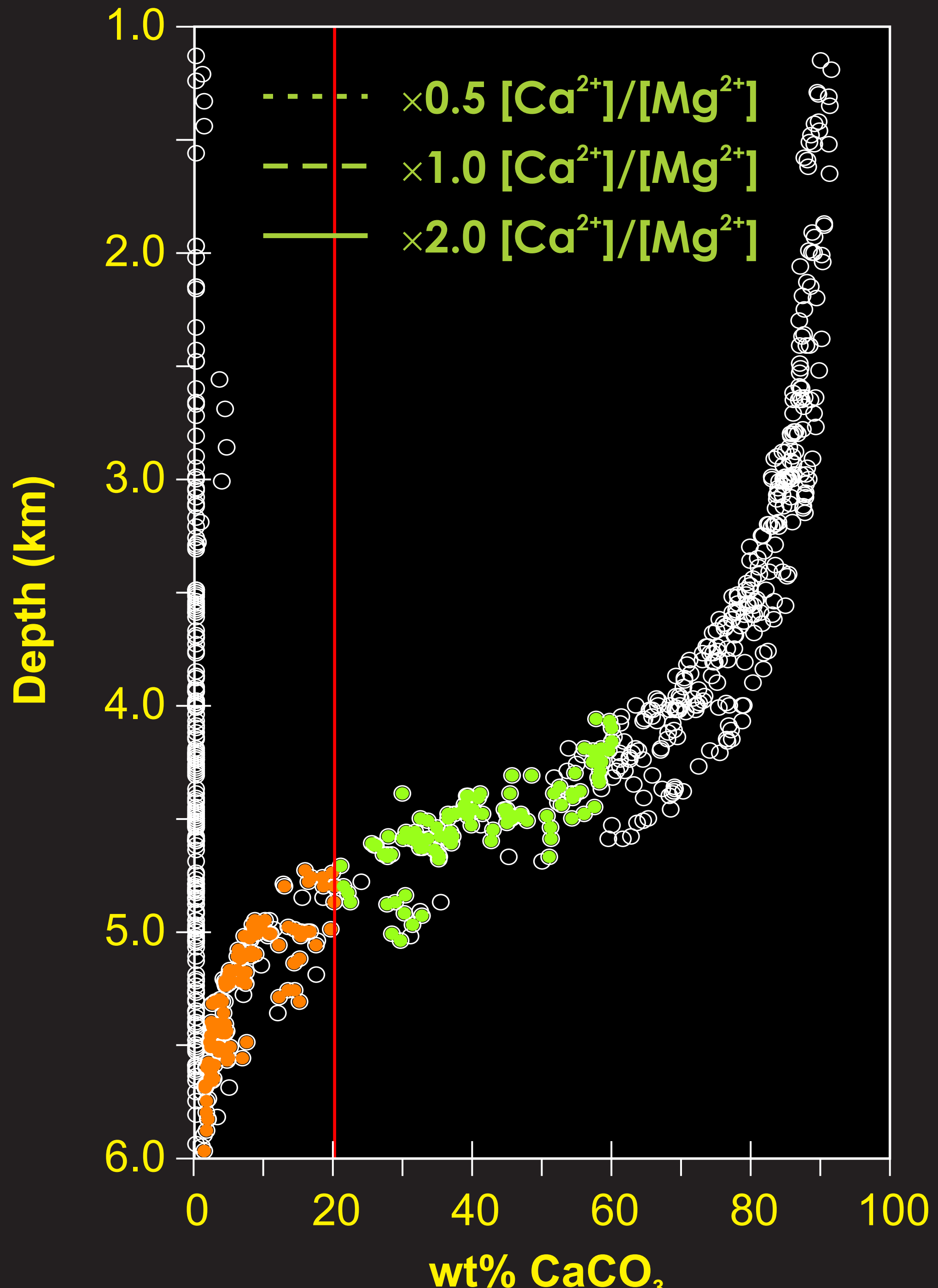
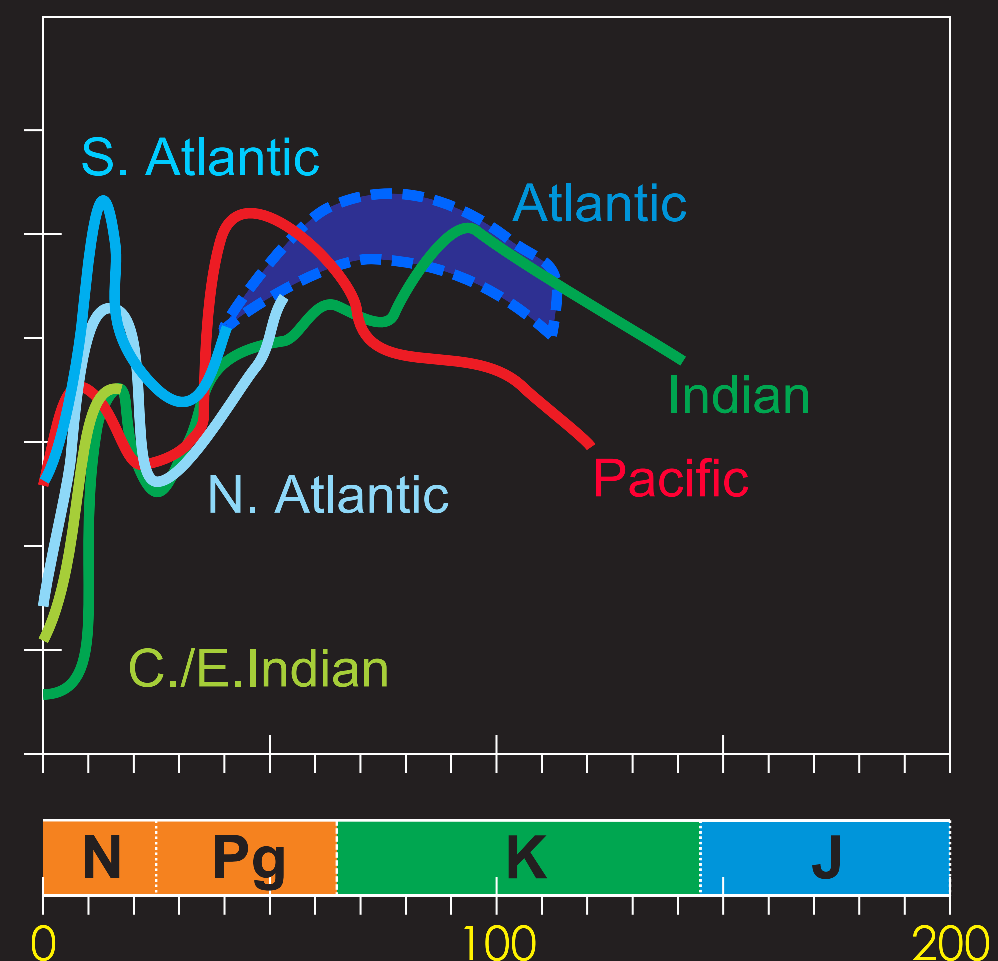




(1) Mg/Ca variability





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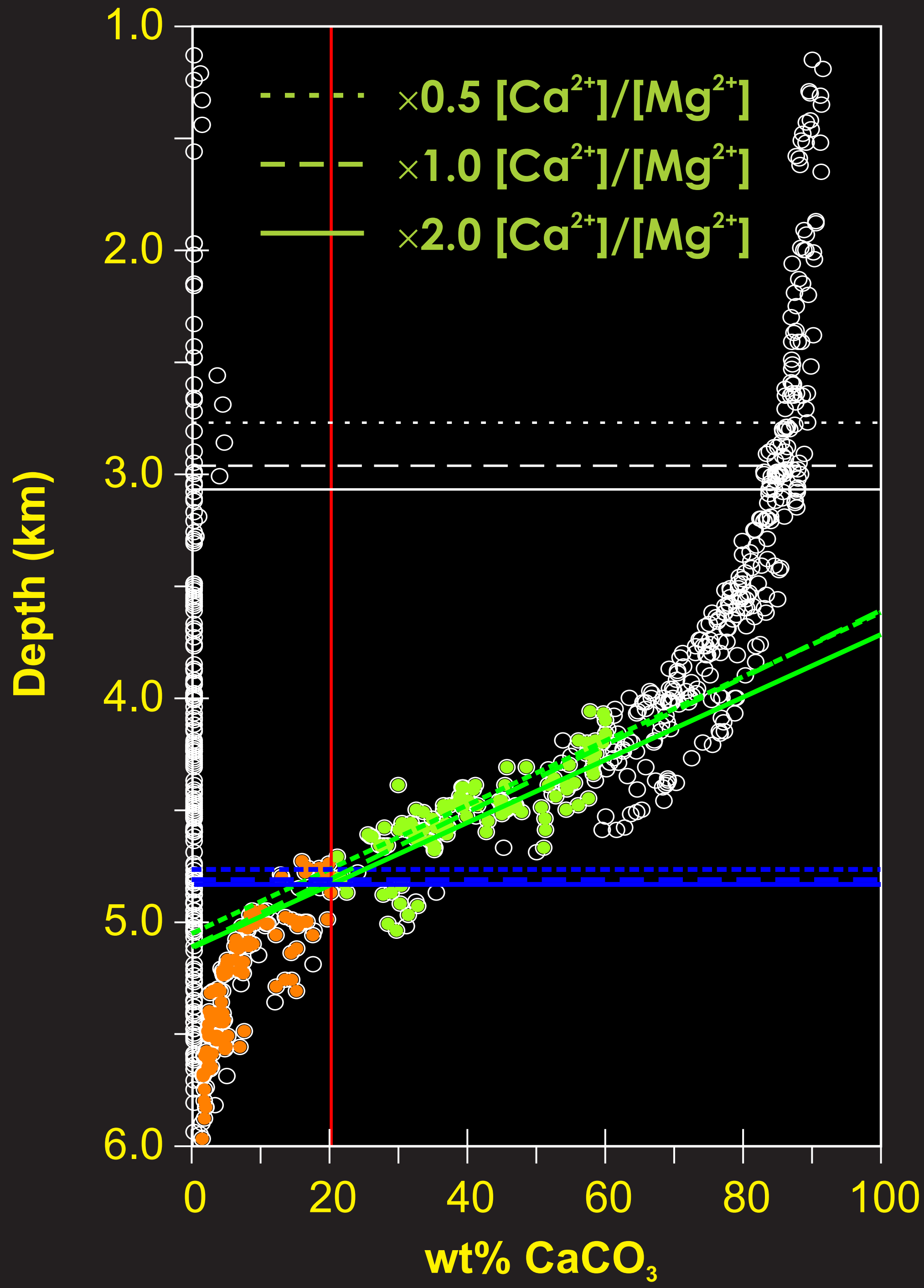
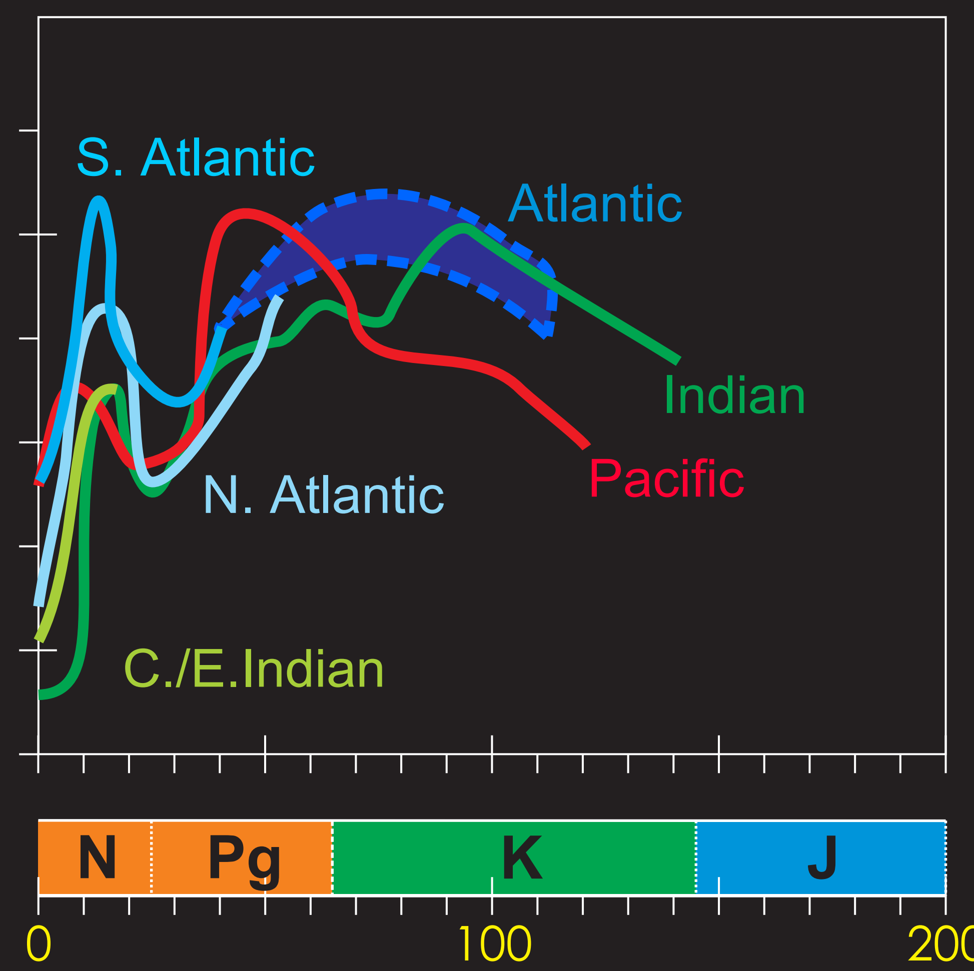
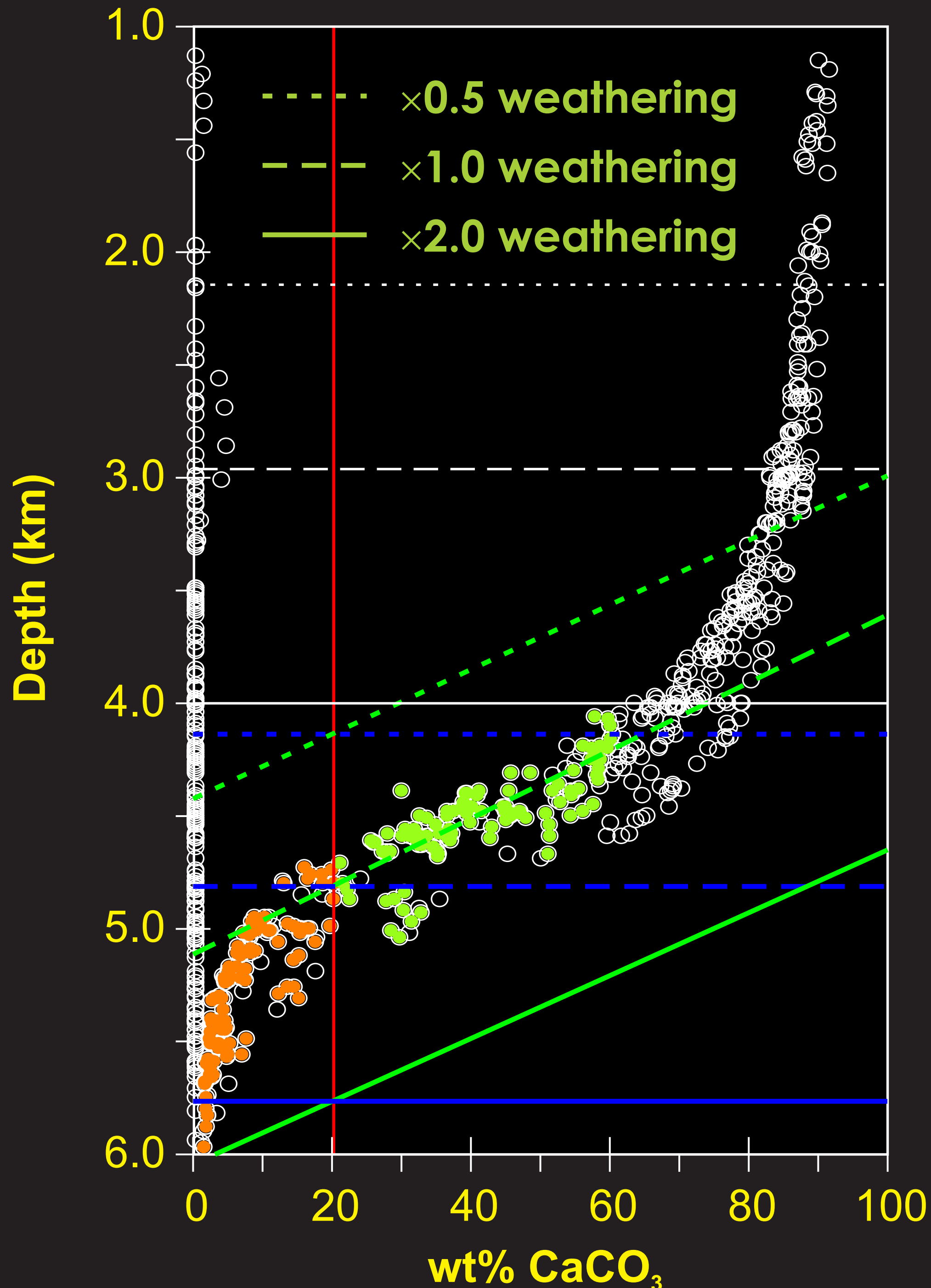
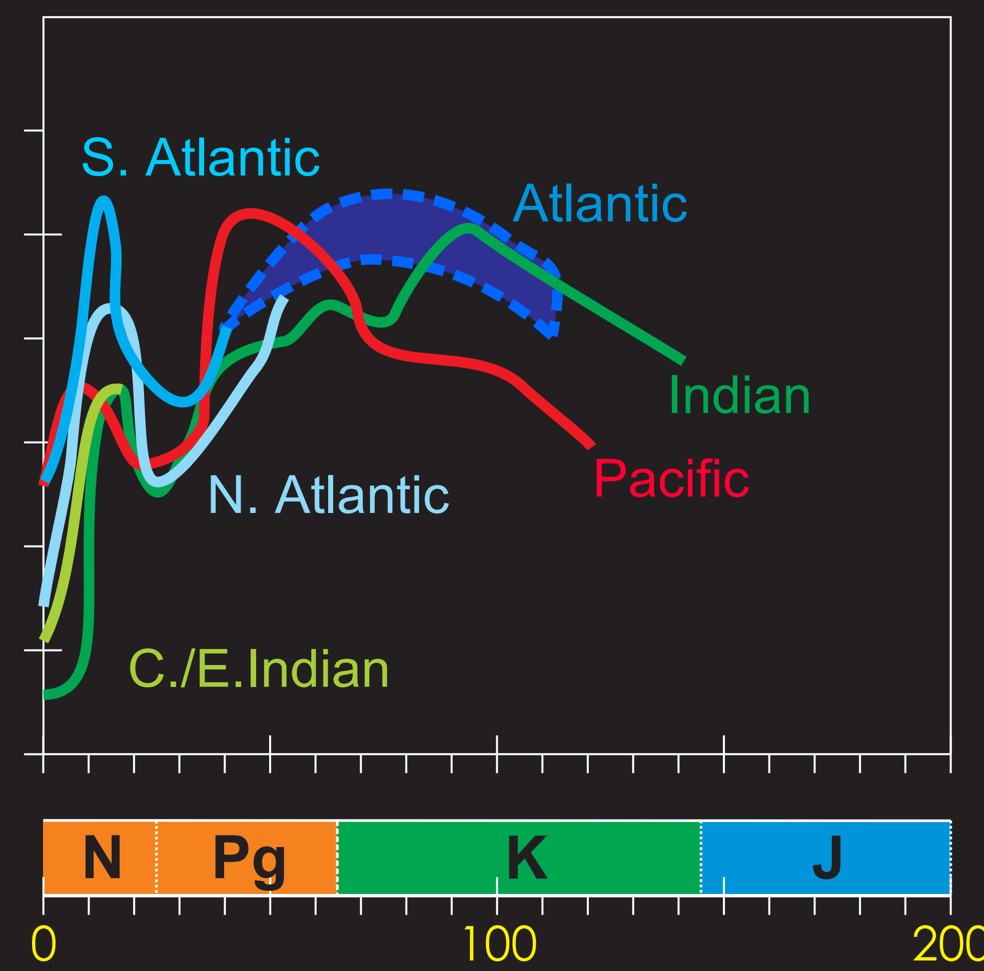


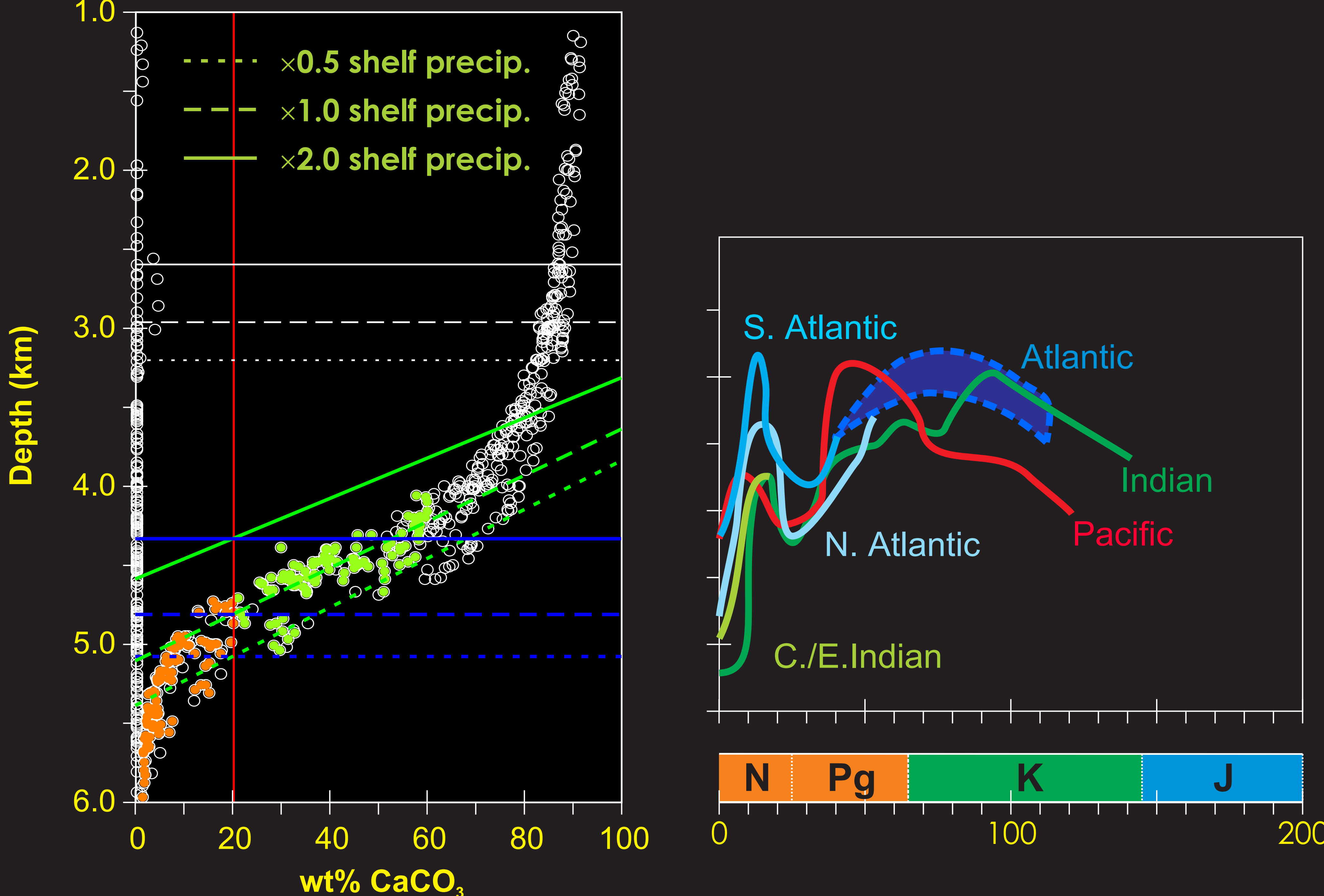


(2) weathering

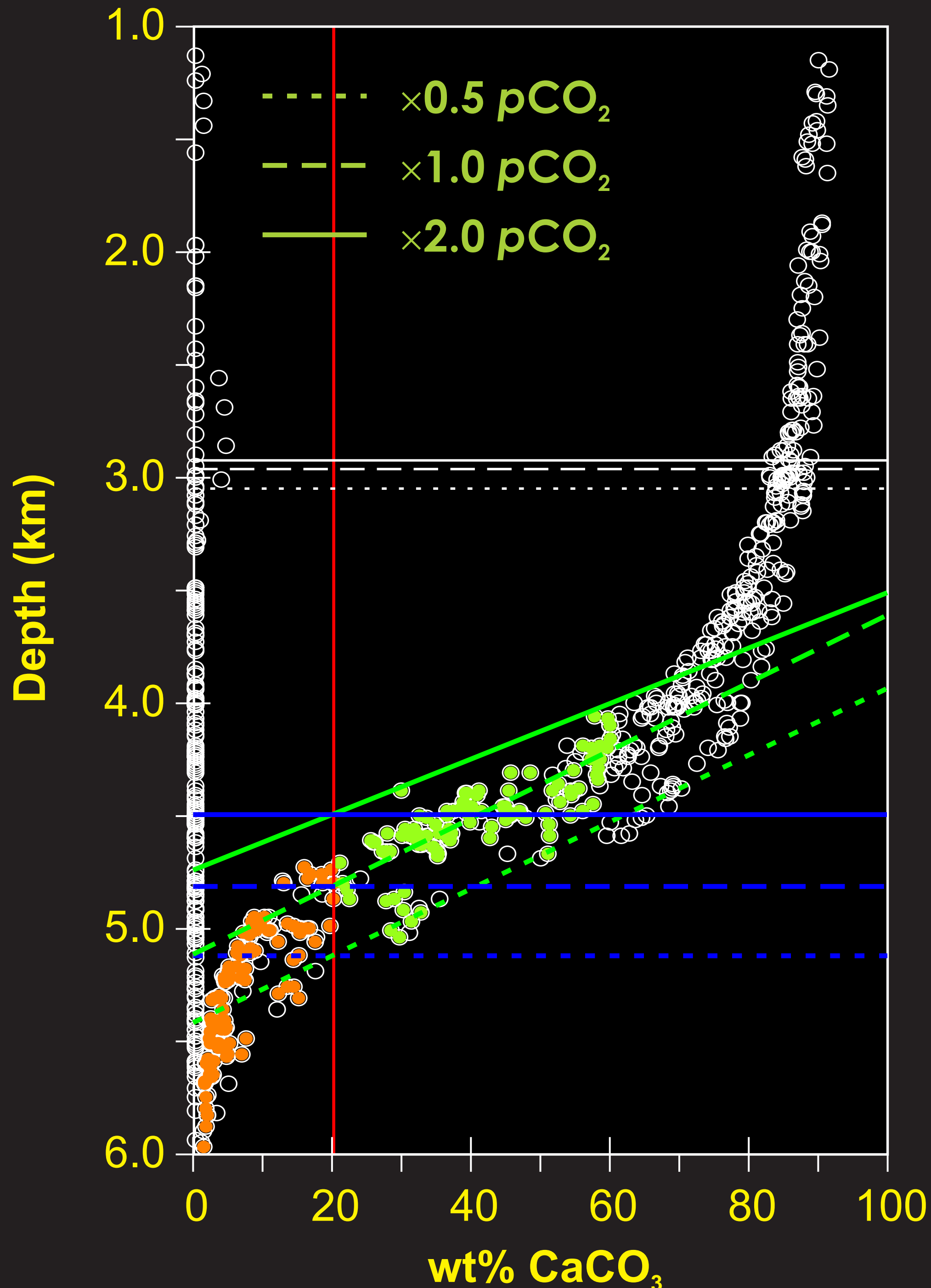


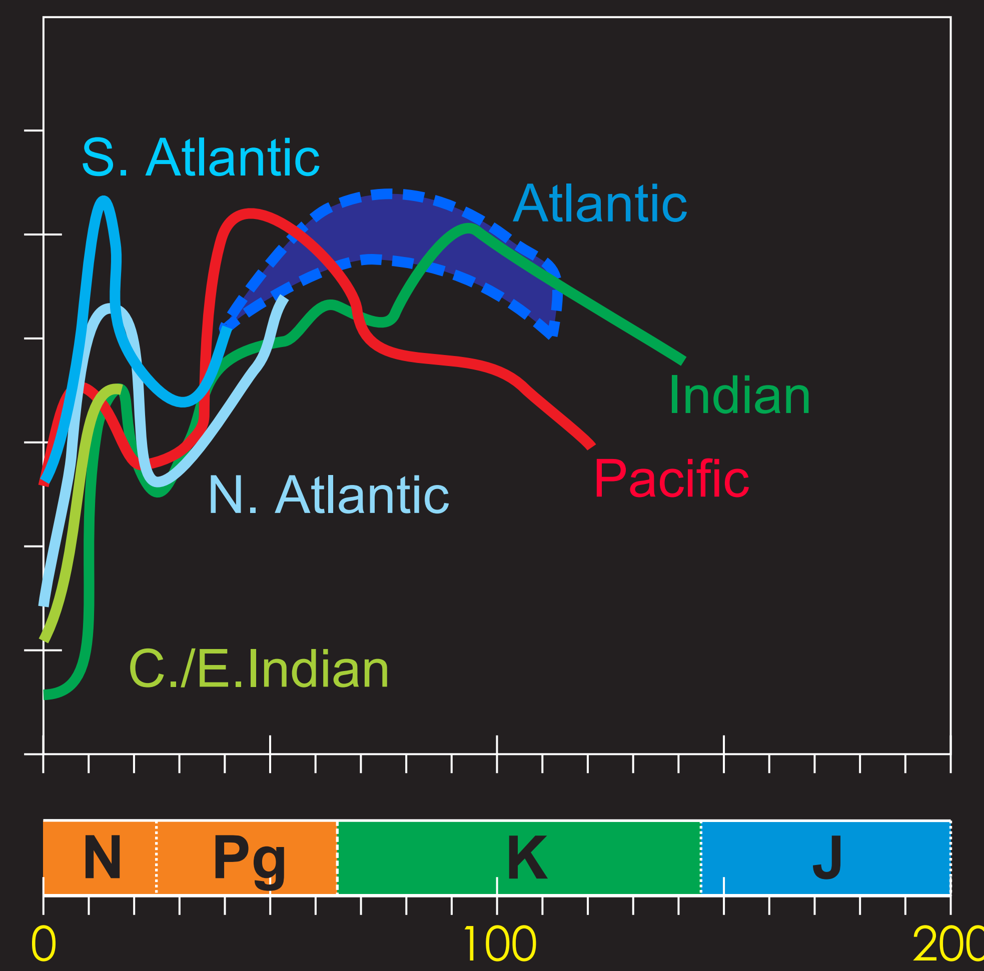


(3) basin-shelf $CaCO_3$ burial partitioning

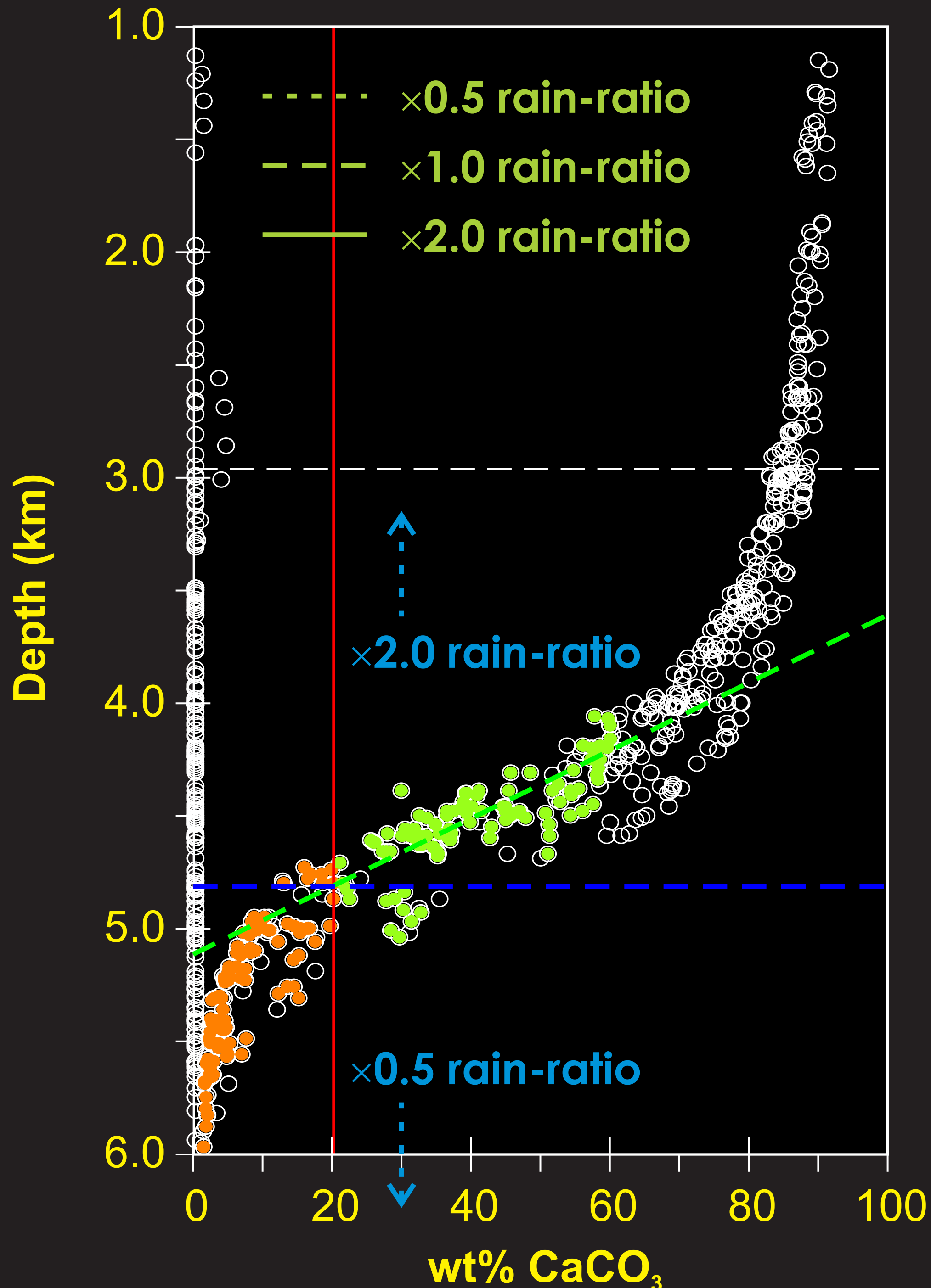


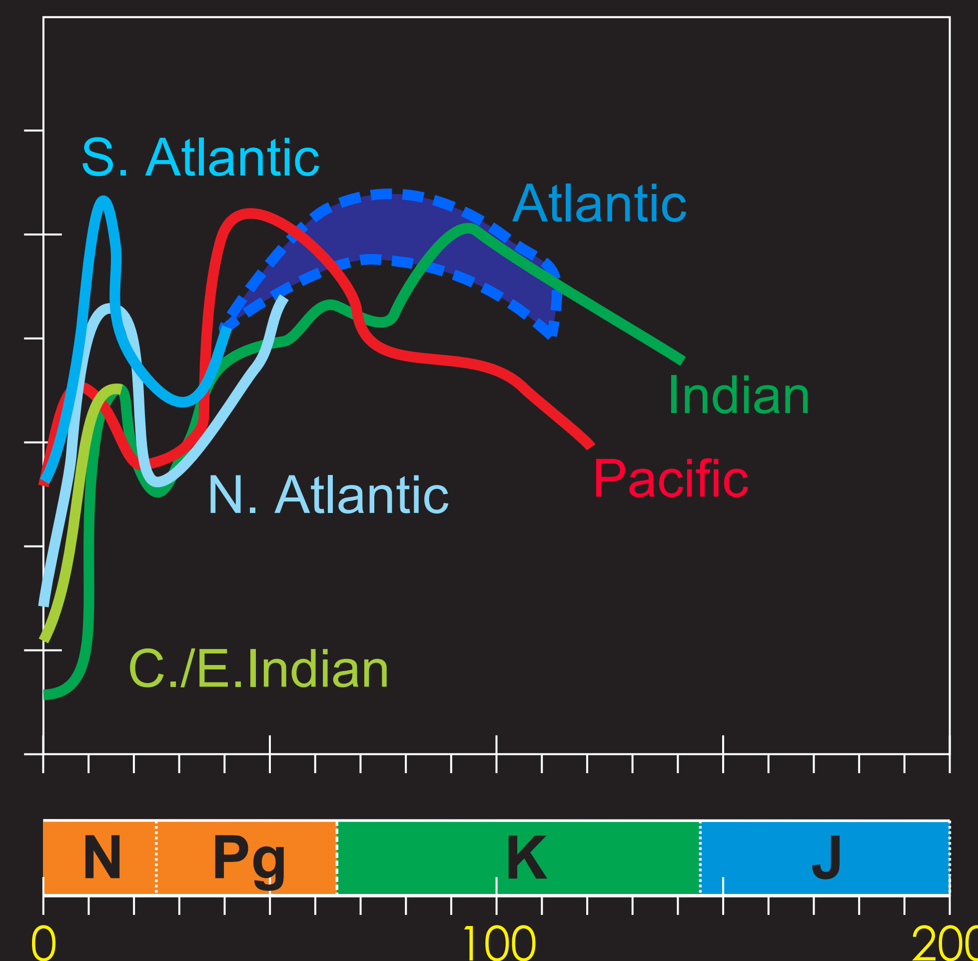
(4) pCO_2 variability



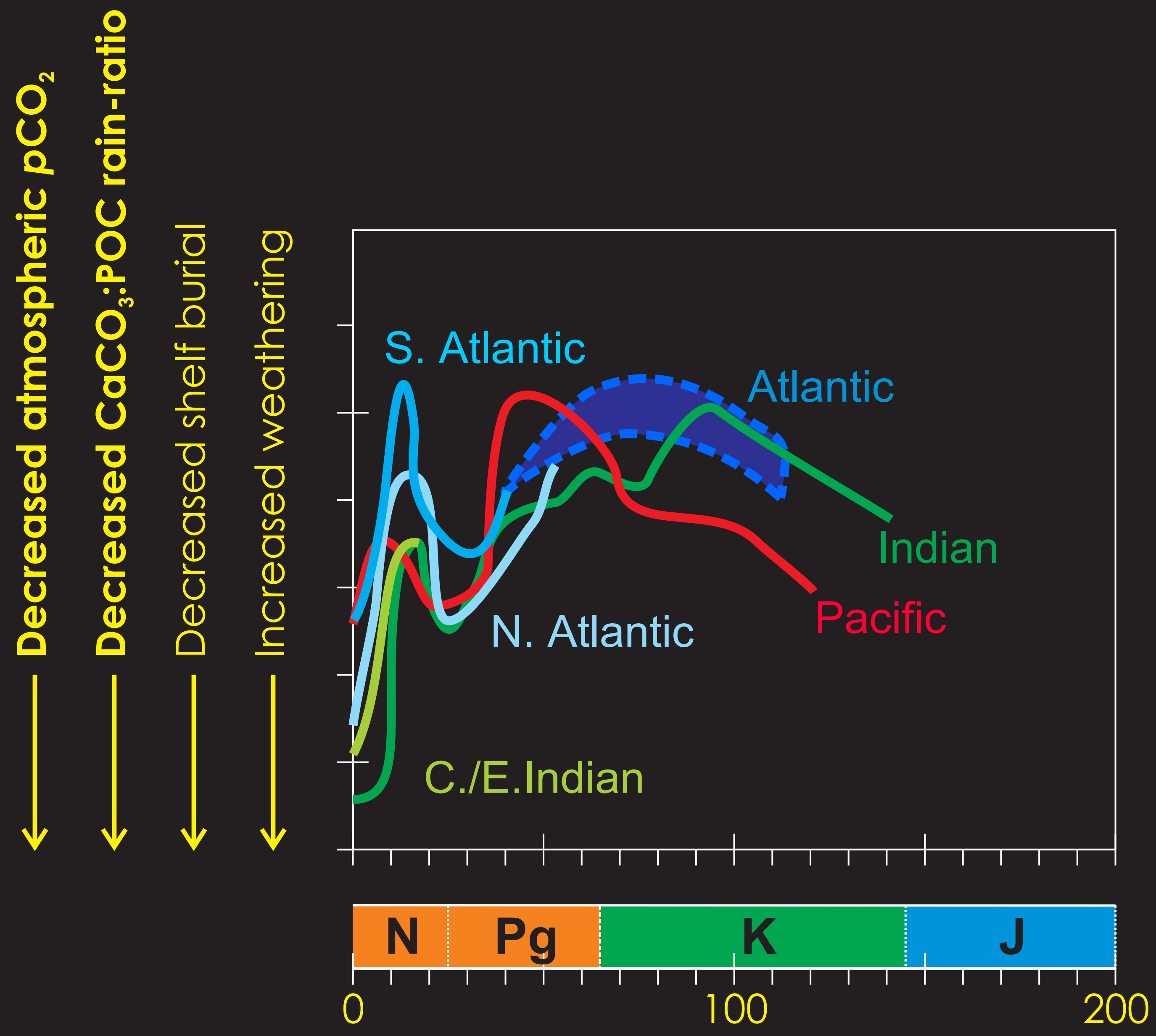


(5) $CaCO_3$:POC rain ratio



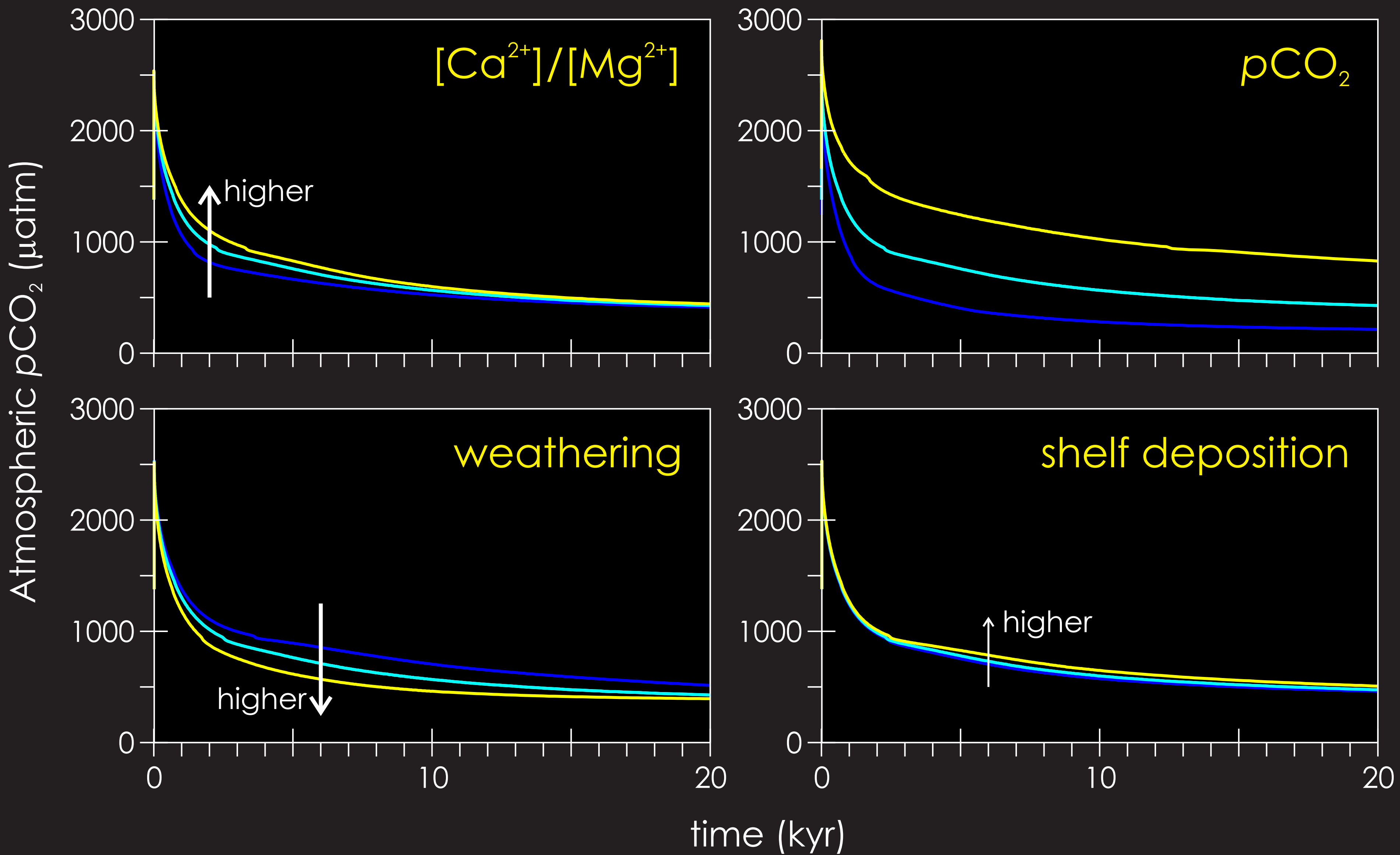


Summary


Decreased atmospheric pCO_2
Decreased $CaCO_3$:POC rain-ratio
Decreased shelf burial
Increased weathering
S. Atlantic
Atlantic
Indian
Pacific
N. Atlantic
C./E.Indian
N
Pg
K
J
0
100
200

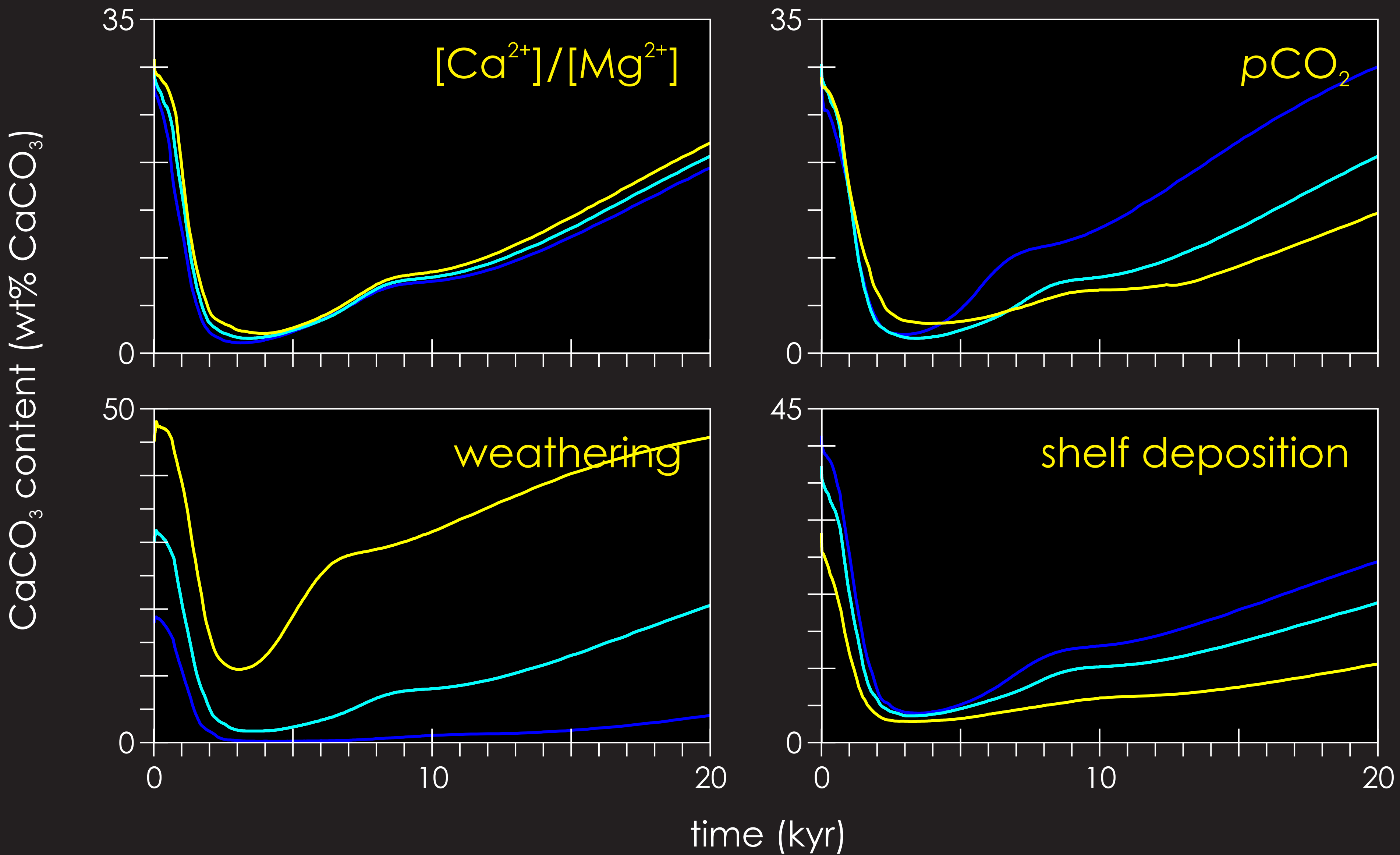
Sensitivity to perturbation: atmospheric pCO$_2$

[instantaneous emission of 5000 PgC]

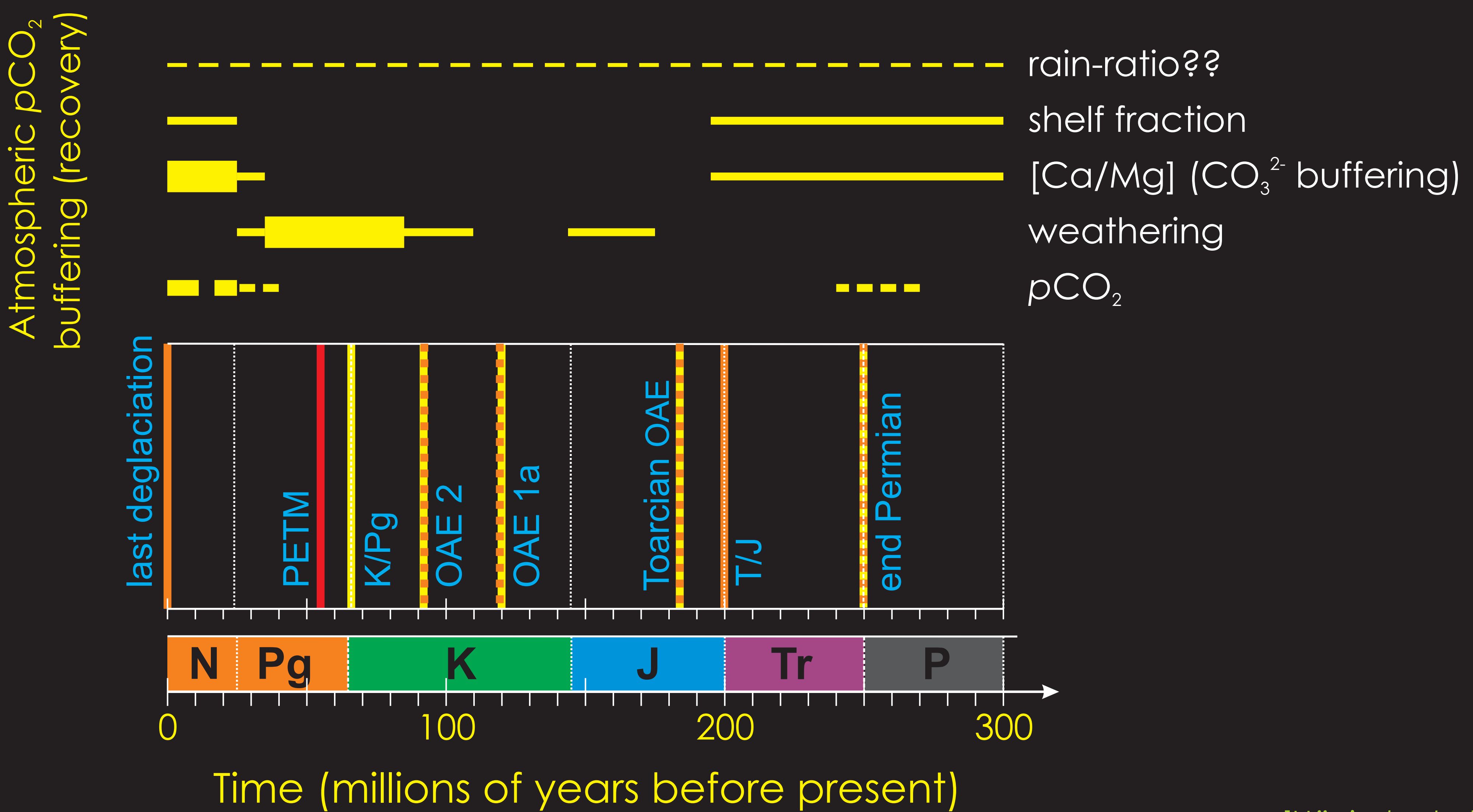


Sensitivity to perturbation: surface sediment composition

[instantaneous emission of 5000 PgC]



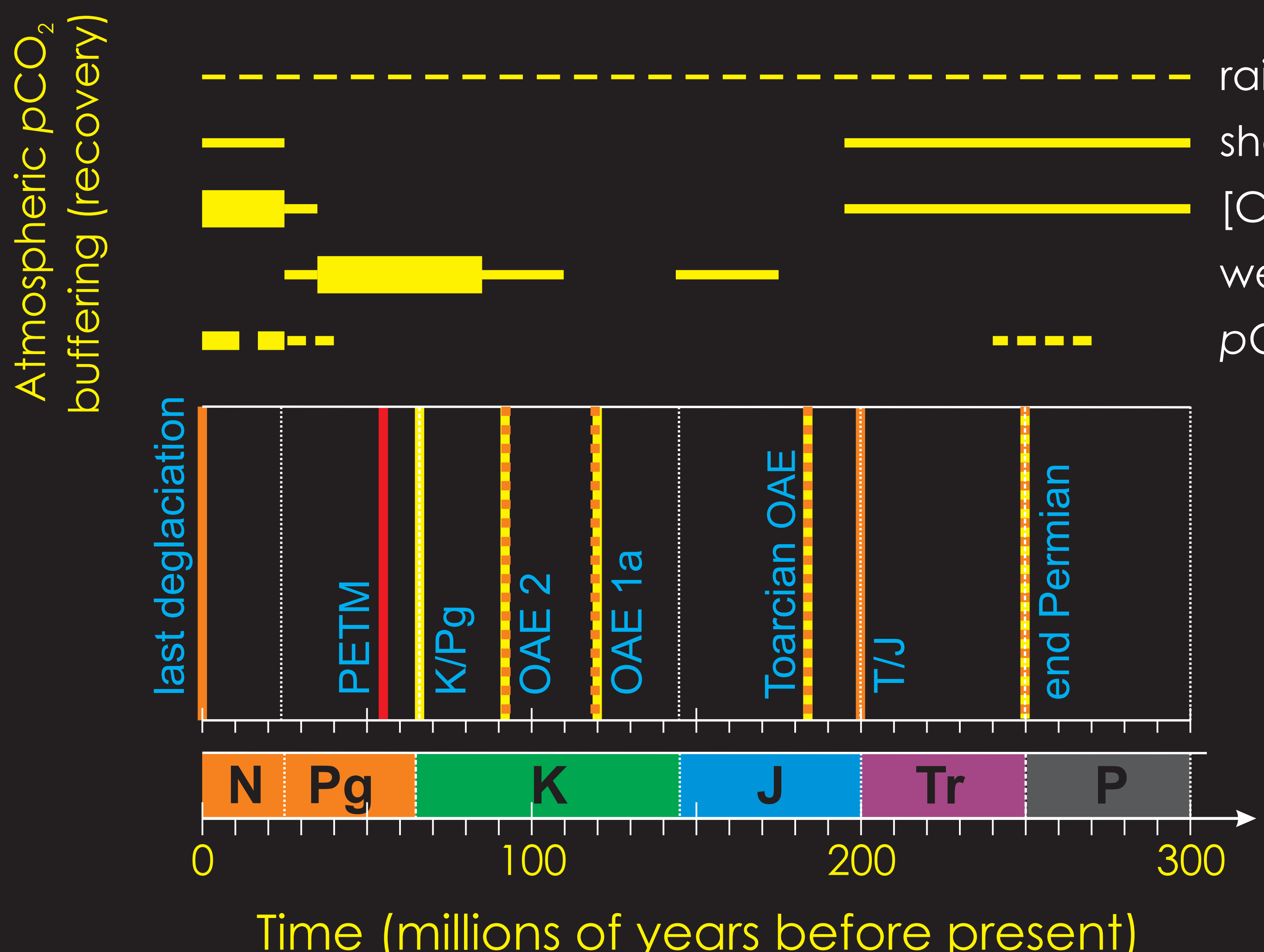
Is this a good time to be burning fossil fuels?



[Hönisch et al., 2012]

Is this a good time to be burning fossil fuels?

[somewhat]



[*Hönisch et al.*, 2012]