

CBEP 2017

Reconstructing the Paleocene-
Eocene by
Simultaneous
Inversions of a *Morozovella*
Subbotinae
Target

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University of California – Riverside
University of Bristol



vs.











Rice Village Sheriffs Department, TX

Re. Reponse to reported homicide,
15.24, Tuesday June 14th, 55.5 Ma



The deceased exhibited signs of blunt head trauma. From initial observations, the victim was assumed to have been attacked by a lump of methane hydrate.

The absence of any hydrates at the crime scene is consistent with it having melted before the arrival of Deputy Dickens.

Further, the responding officer found the presence of lead at the scene -- consistent with trace substitution in the hydrate lattice.

A warrent has been issued for the Paleogene Hydrate Capacitor.



FBI Crime Scene Report #12000-PgC

The x-file archives record only one previous incidence.

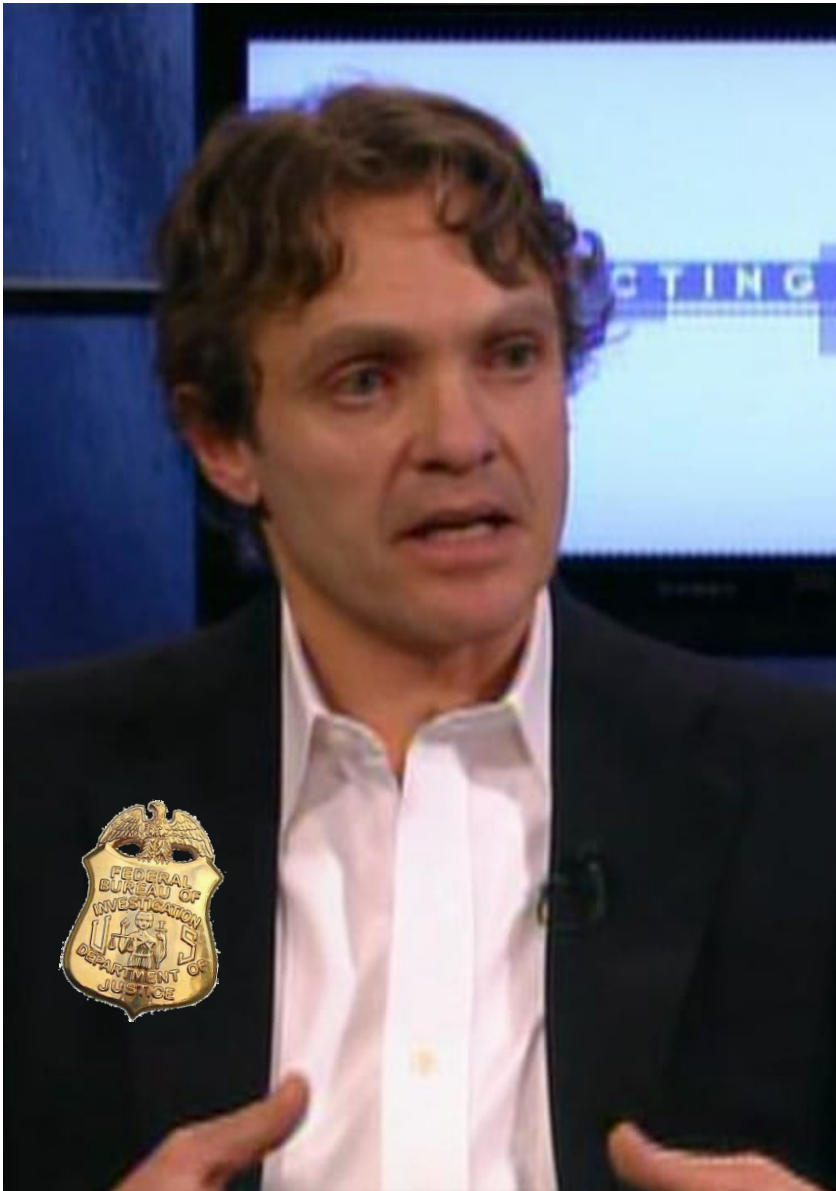
It occurred in a remote location of Utah near Cottonwood Canyon. Despite the heat, high up on the mountainside, permafrost formed.

What happened next is a subject of debate and no witnesses are alive today.

The case was closed and published in Nature.

The cherry pie was damn good.

Special Agent DeConto

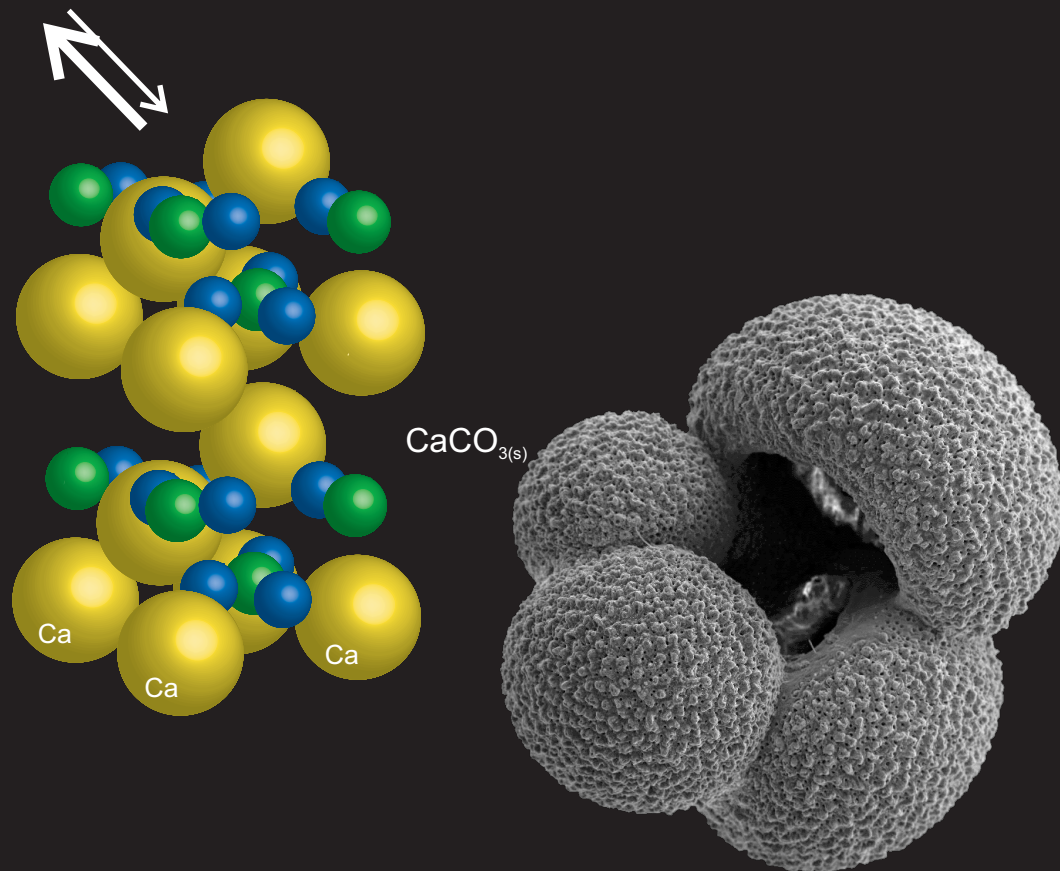
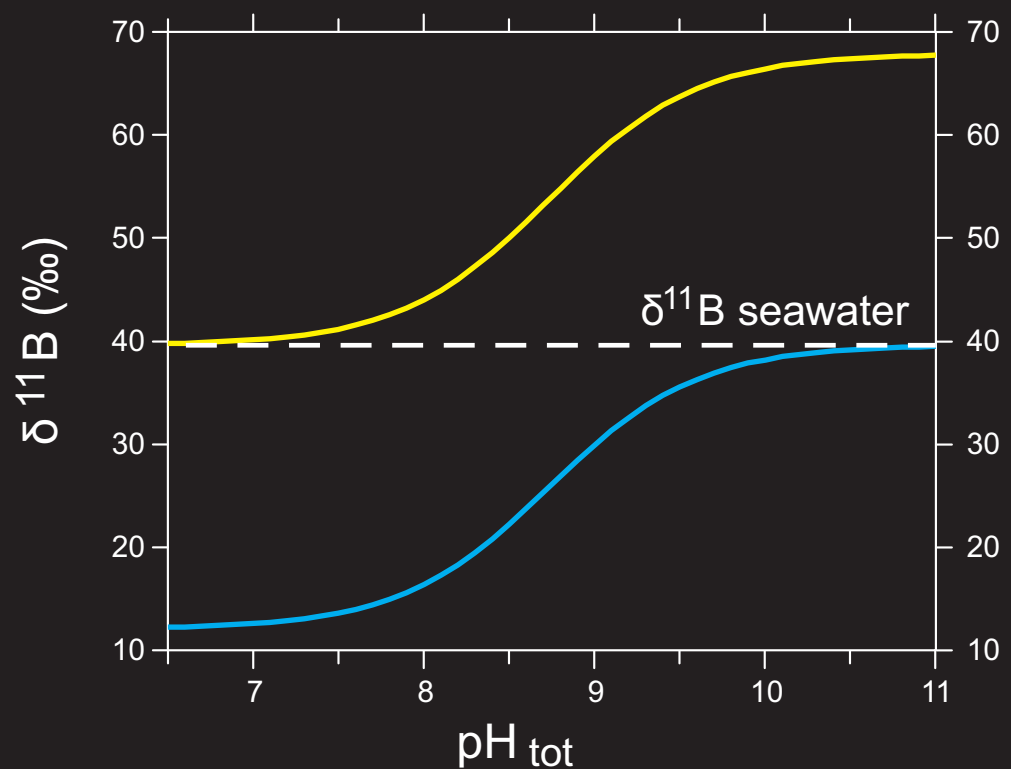
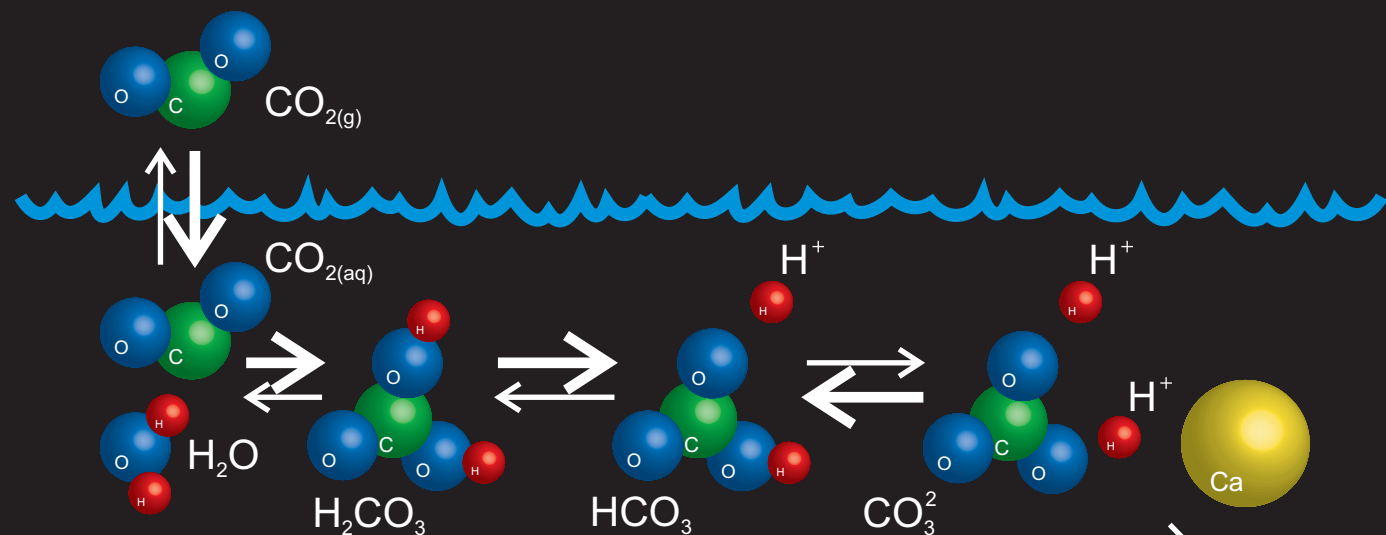


Paleogene Cluedo



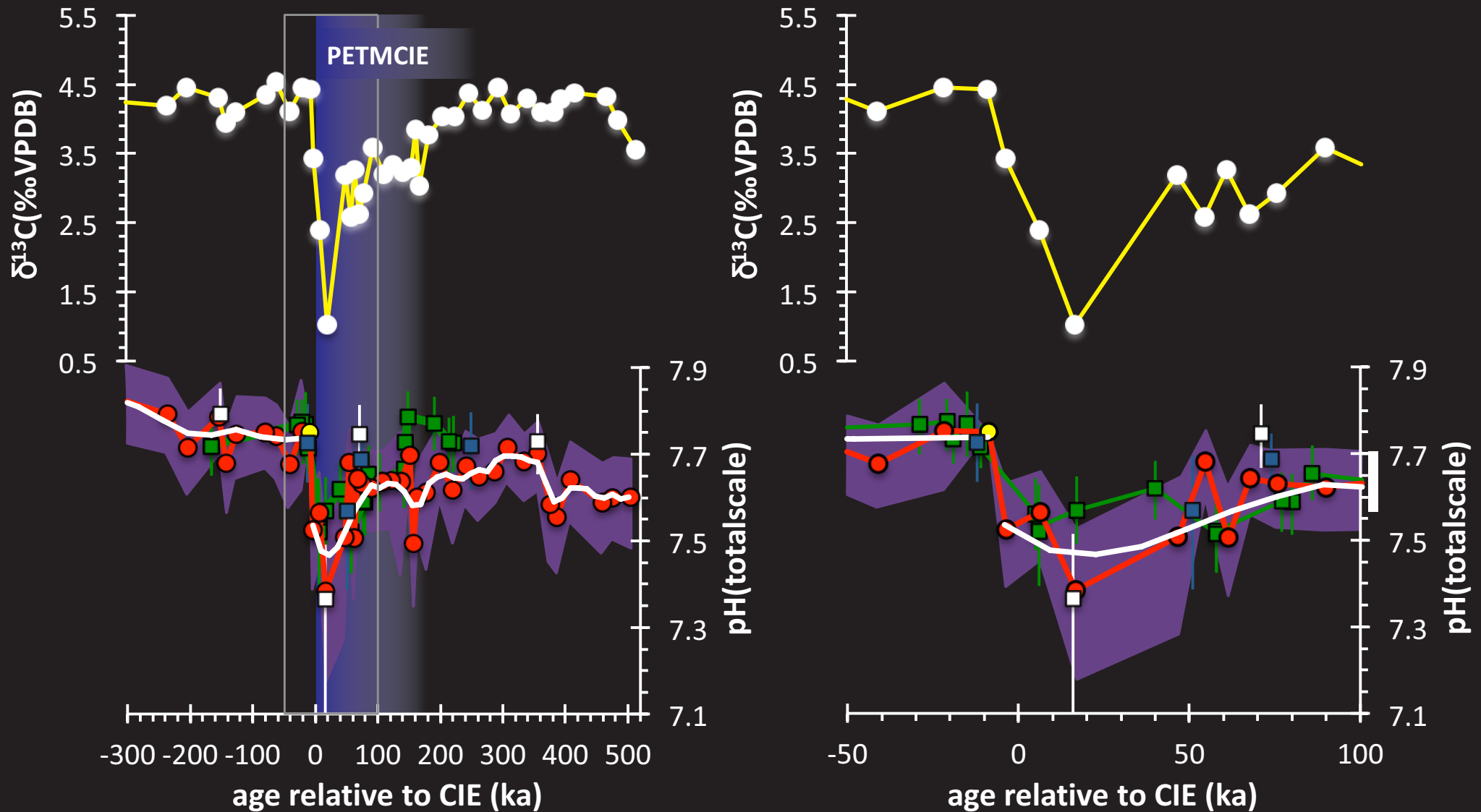
Credit: Michael Storey

Boron isotopes, paleo ocean pH, and carbon release





Gutjahr et al. [2017] (*Nature* **548**)



● Site 401 (NE Atlantic)

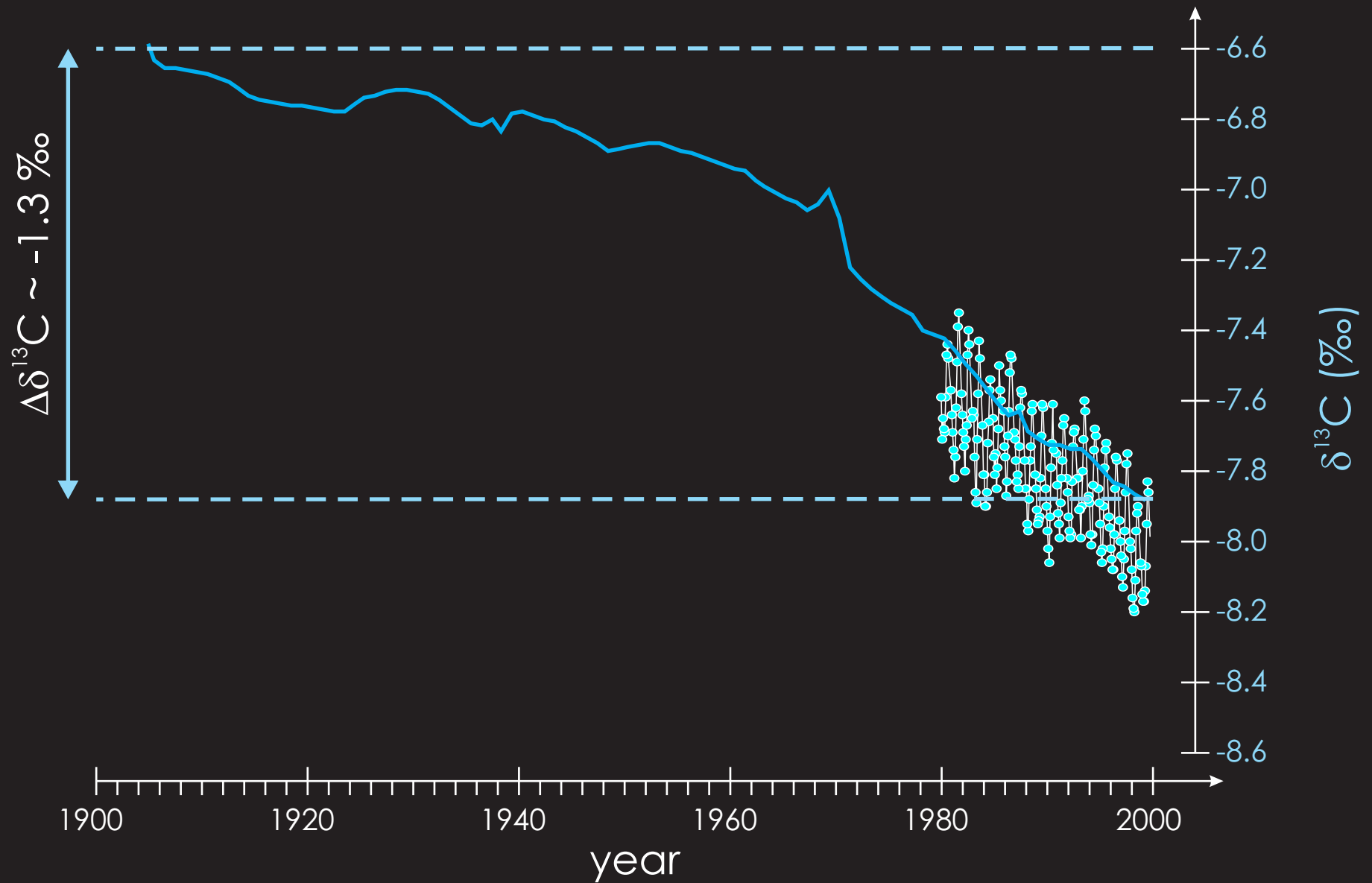
[unpublished]

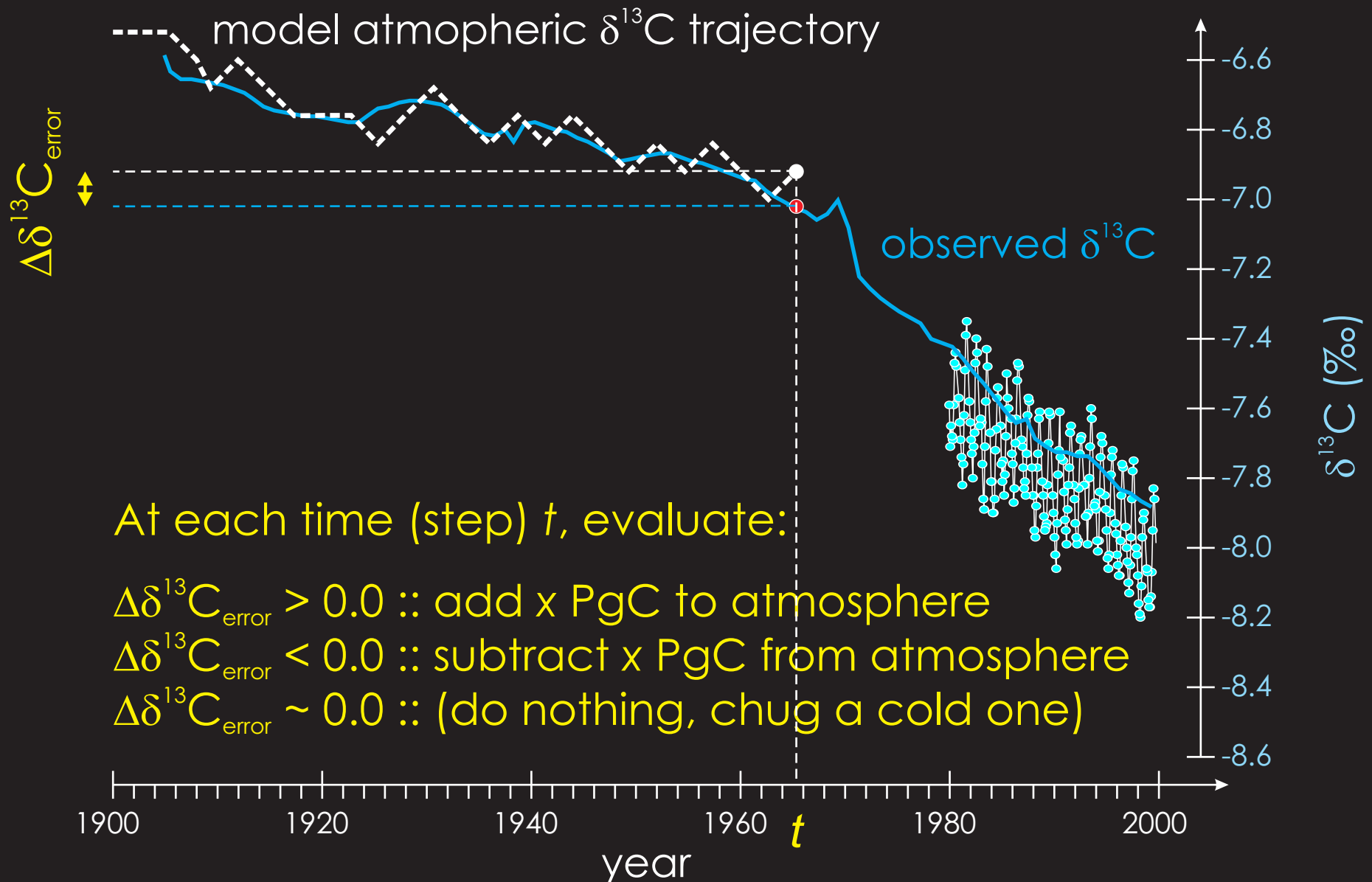
■ Site 865 (Eq. Pacific)

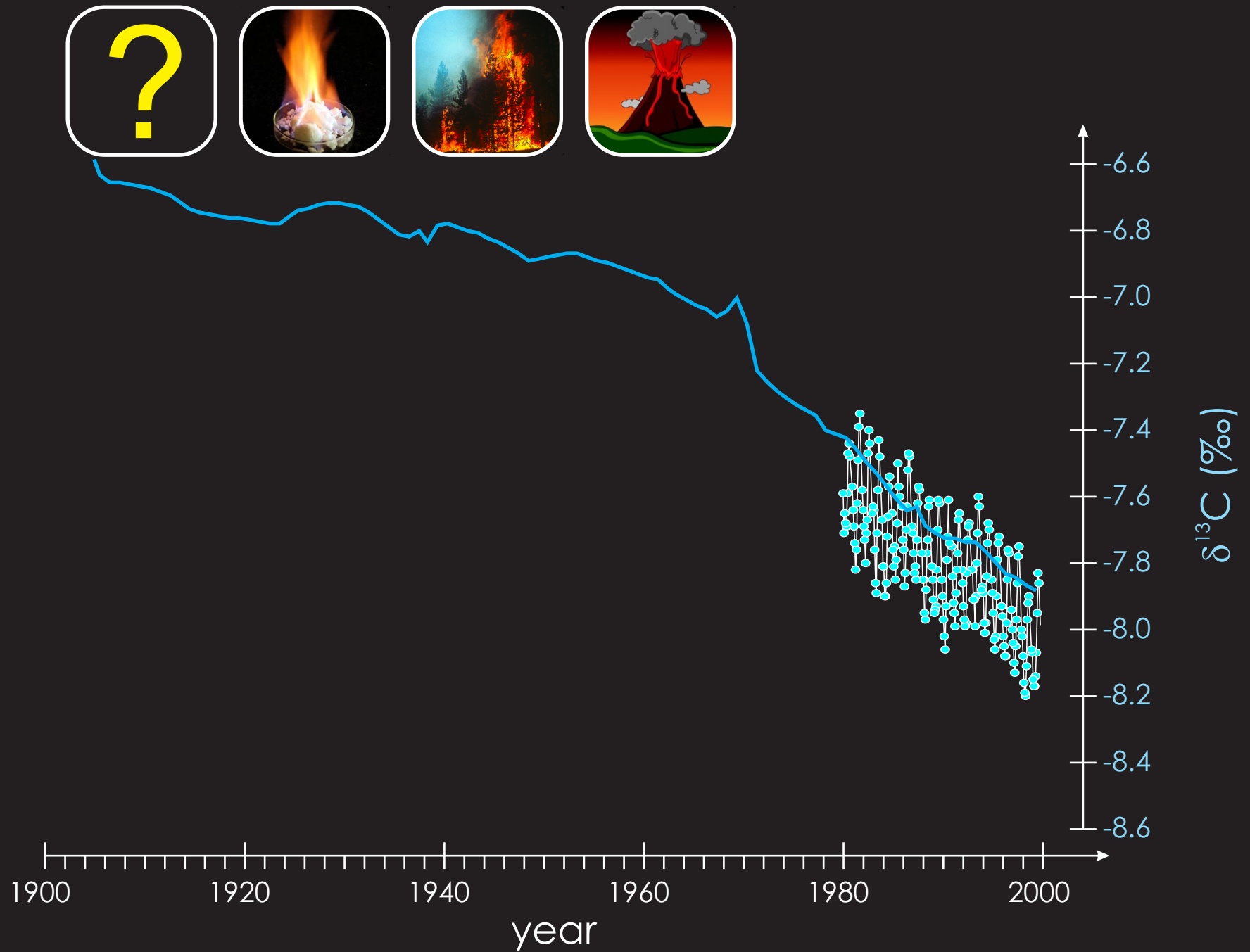
■ Site 1263 (ES Atlantic)

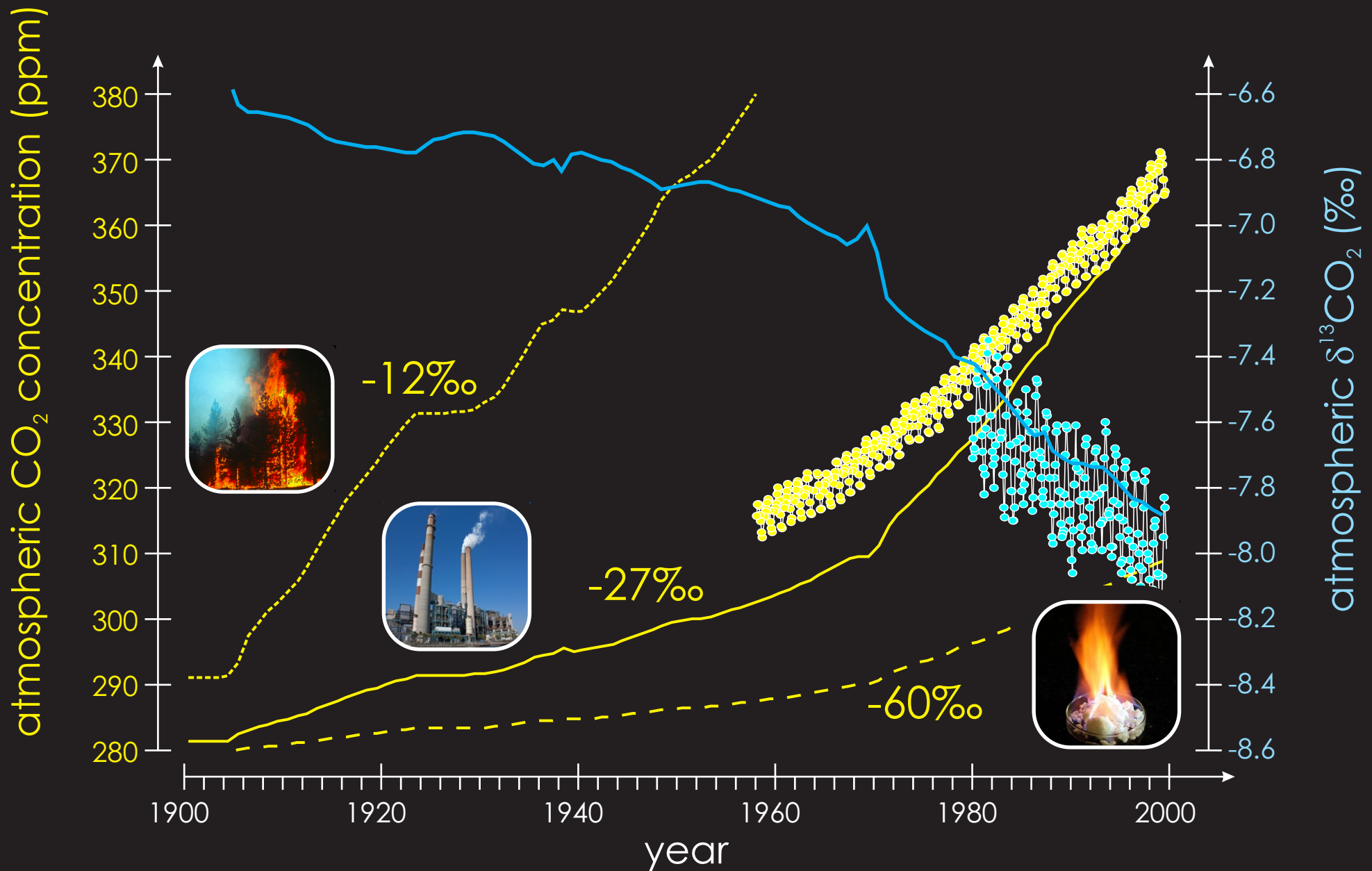
■ Site 1209 (N Pacific)

[Penman et al., 2014]

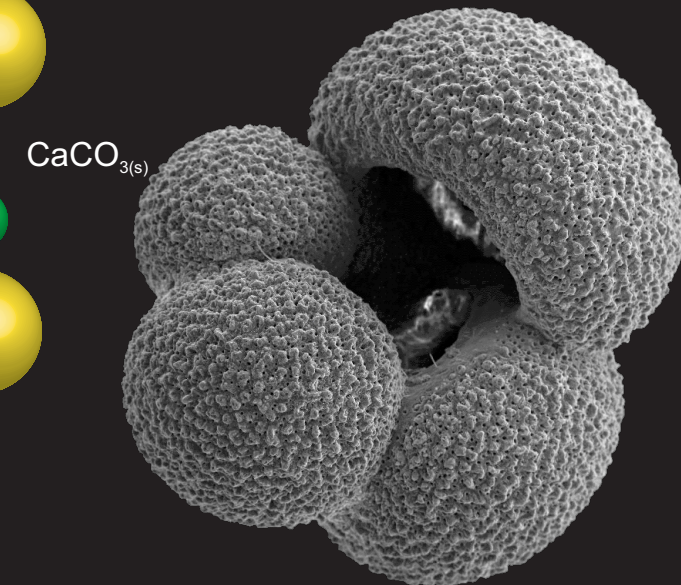
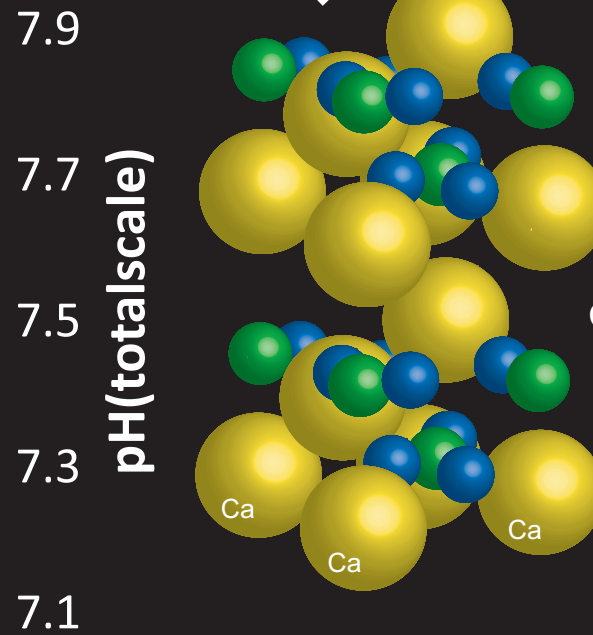
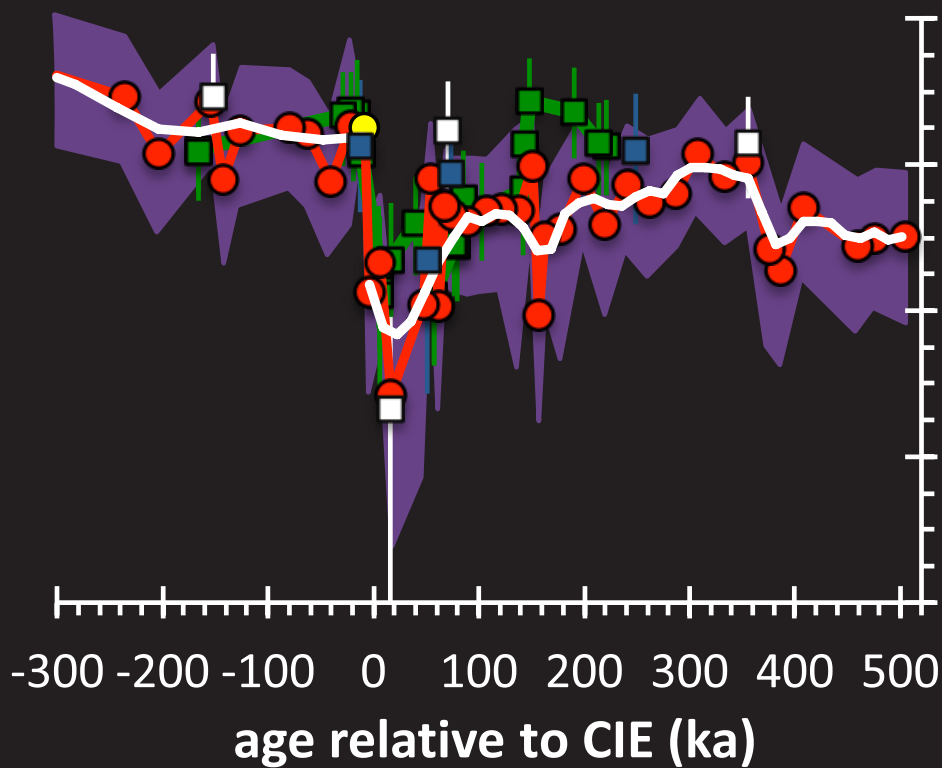
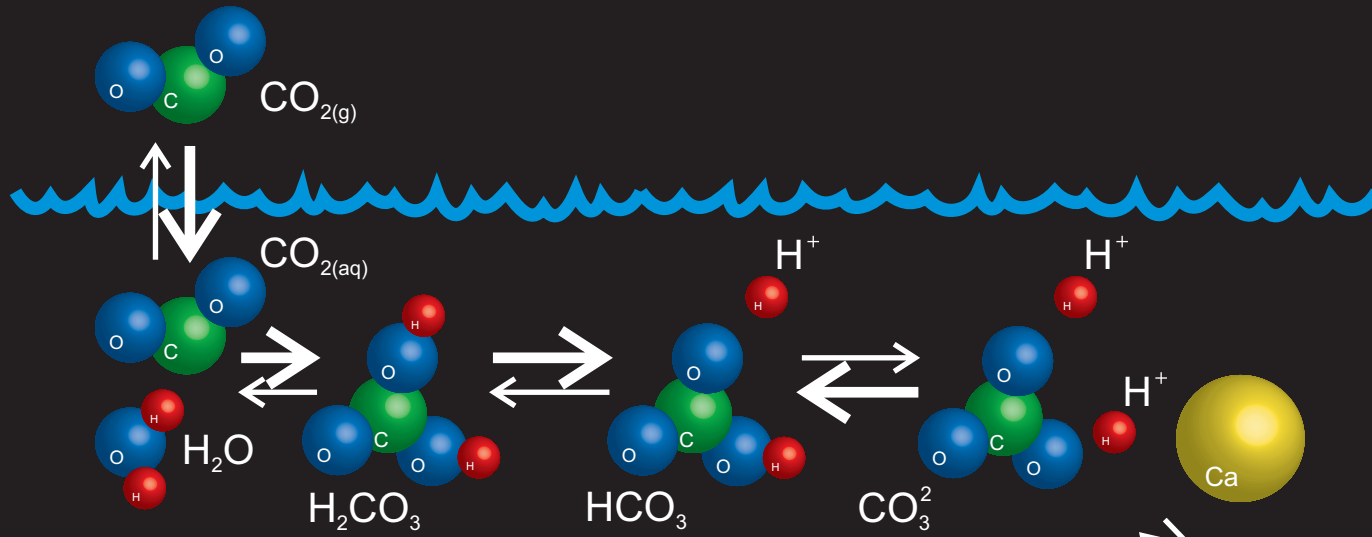




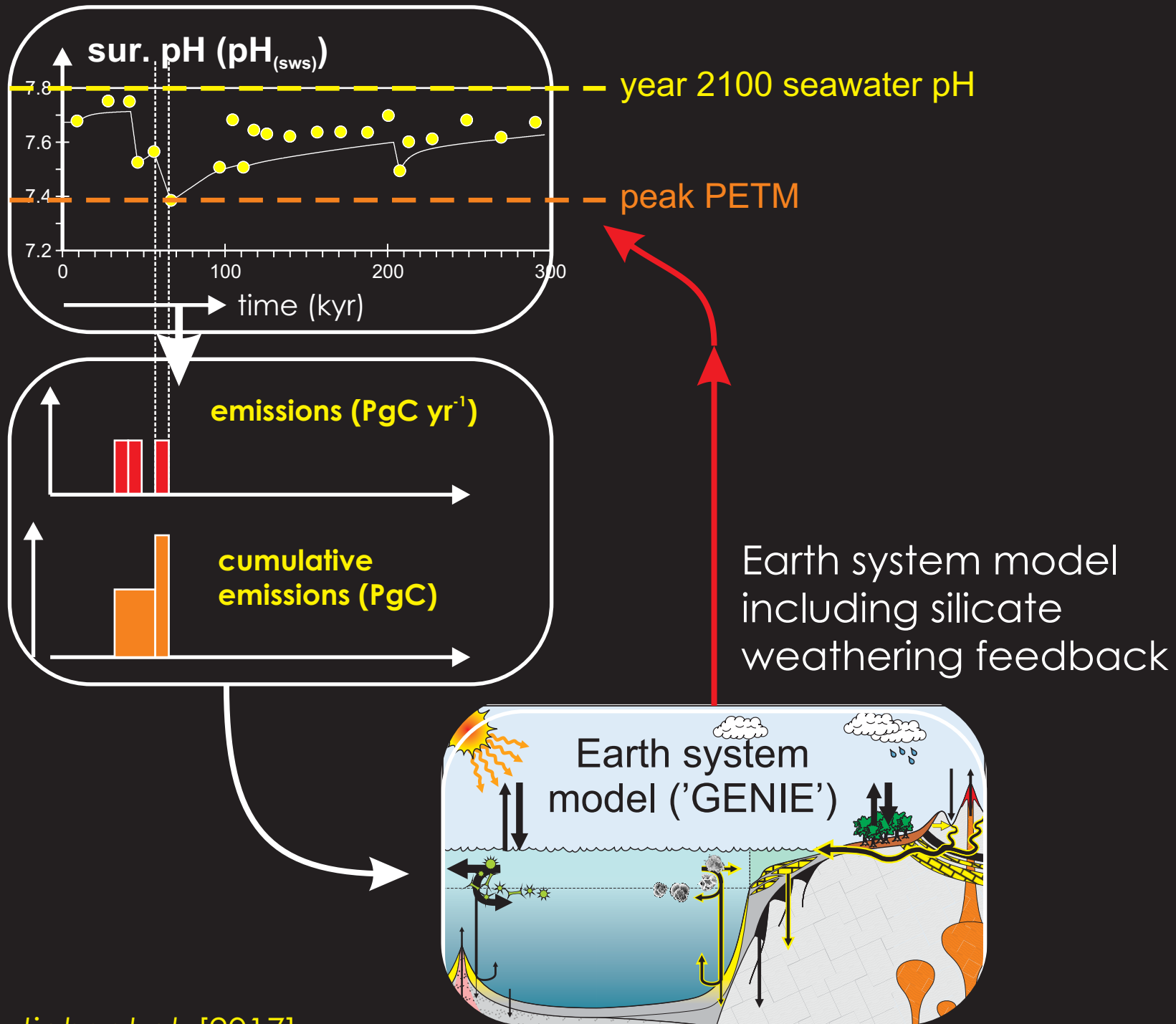




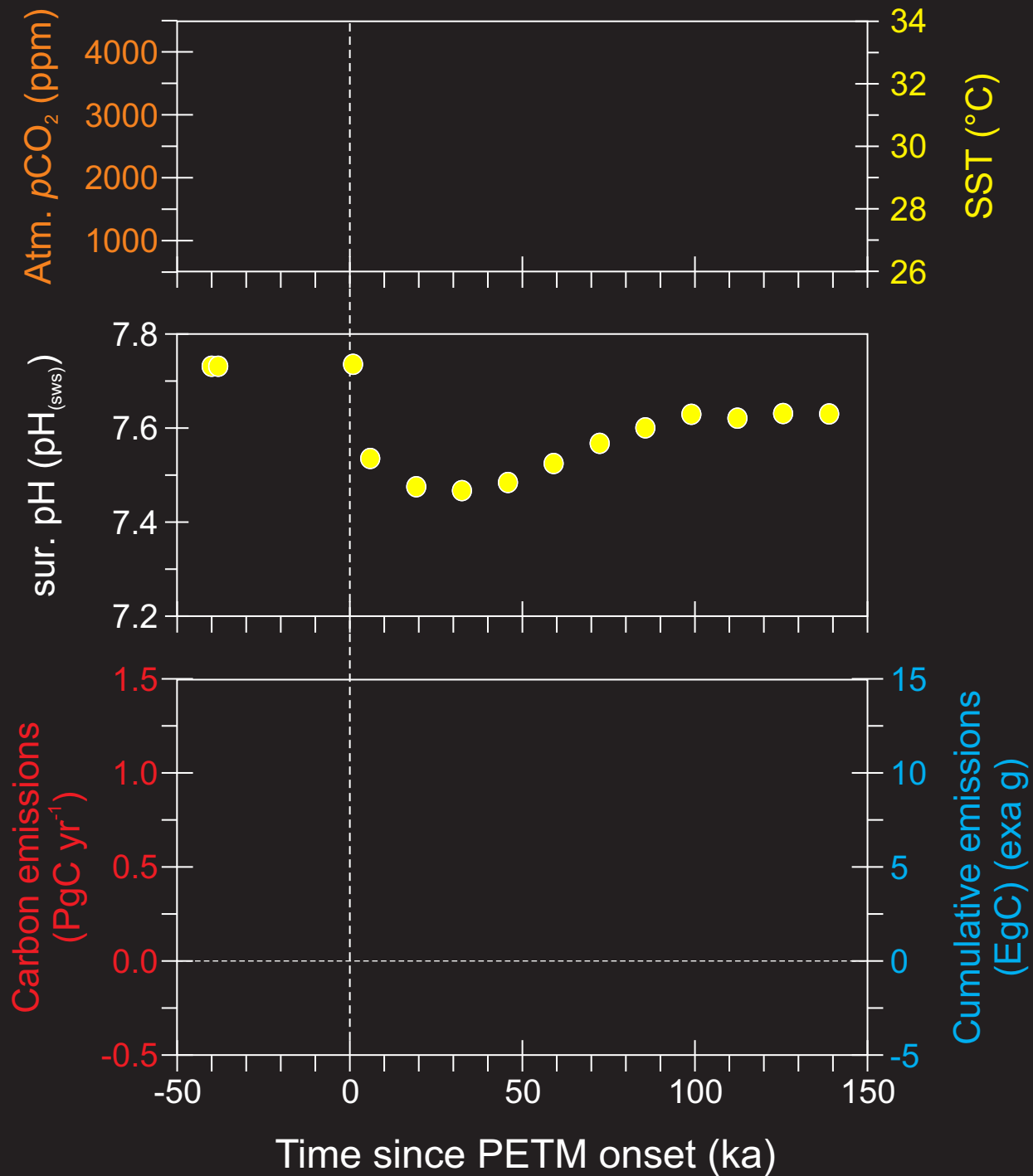
Boron isotopes, paleo ocean pH, and carbon release



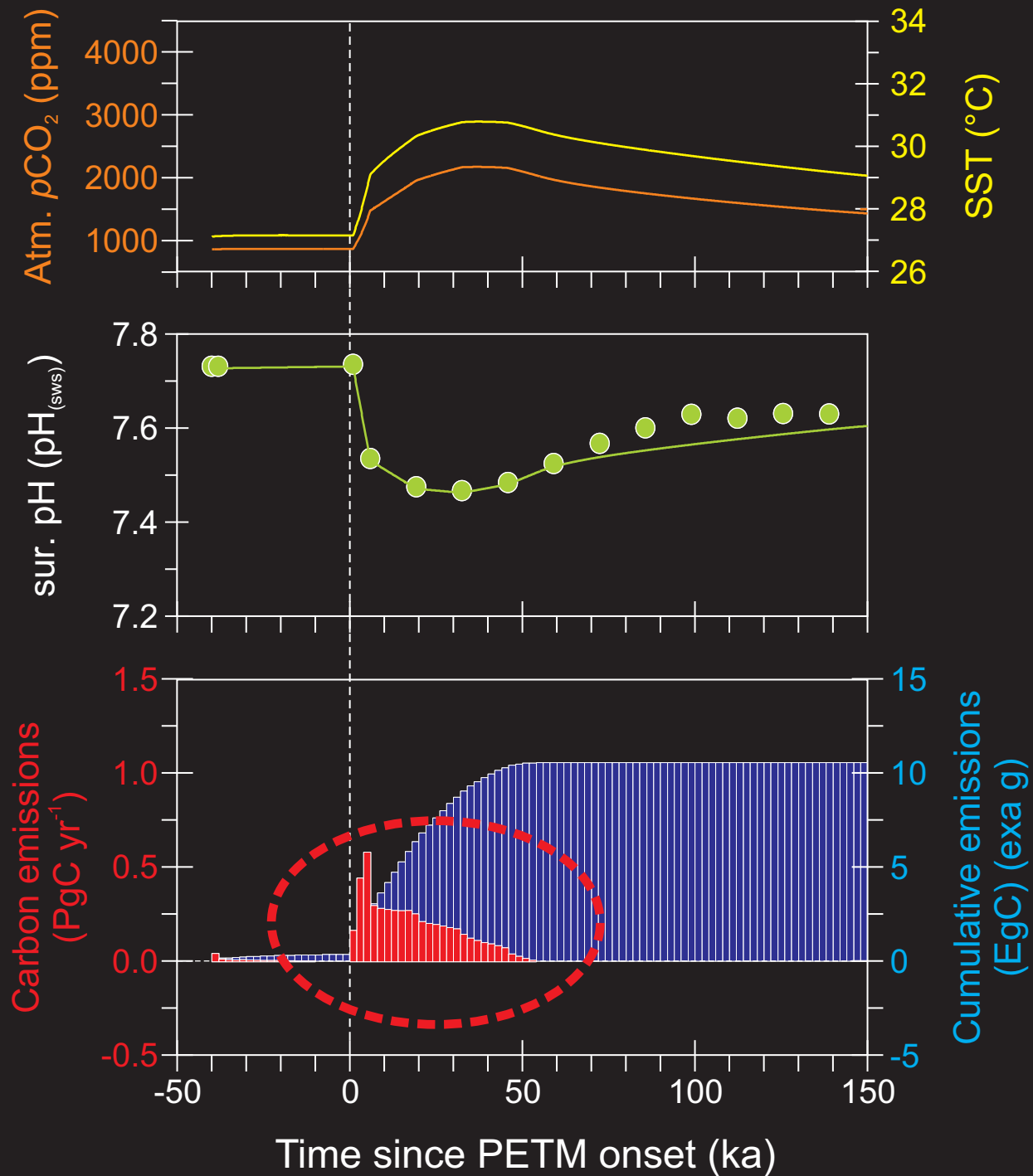
Assimilating surface ocean pH change (only)



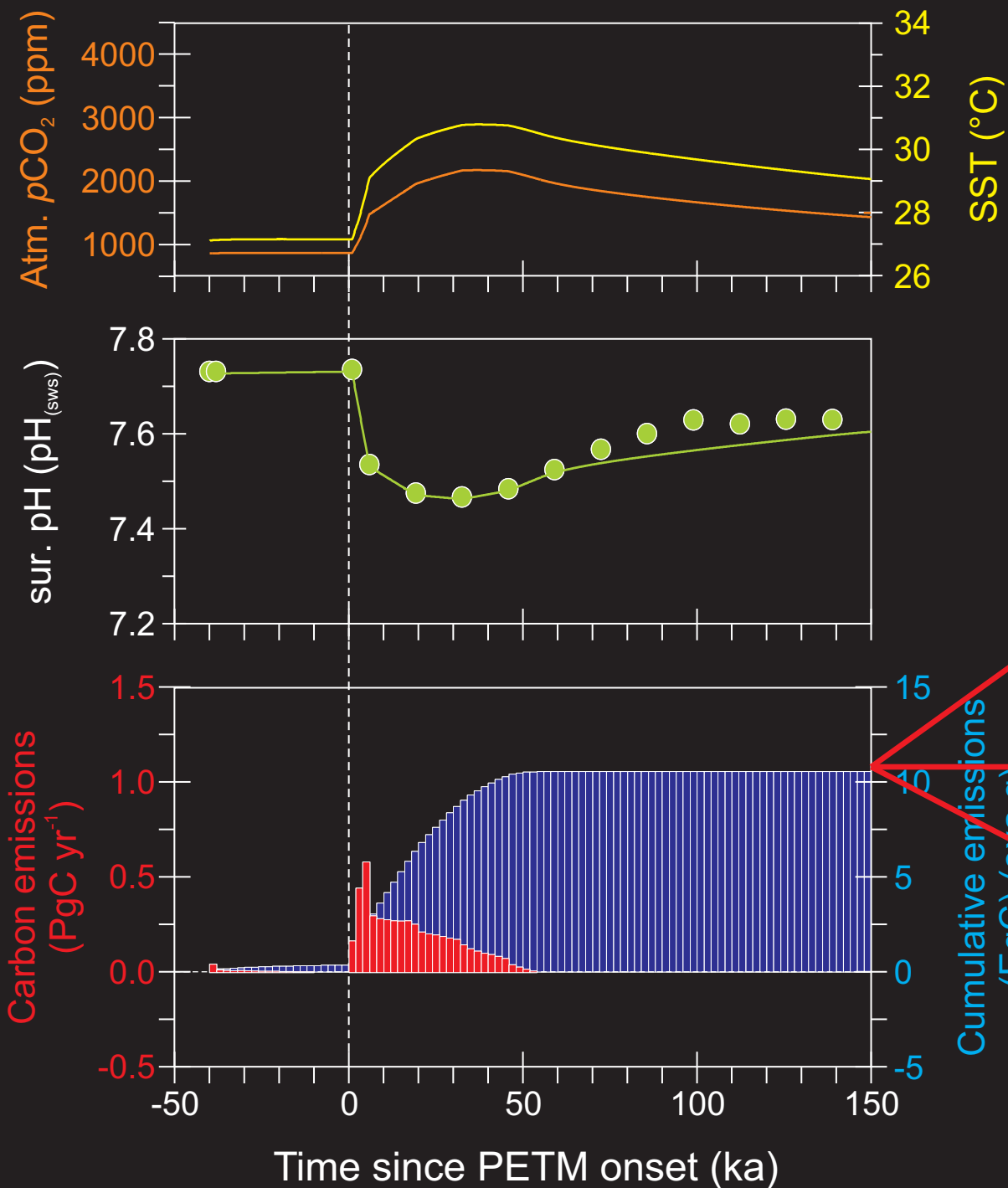
Assimilating surface ocean pH change (only)



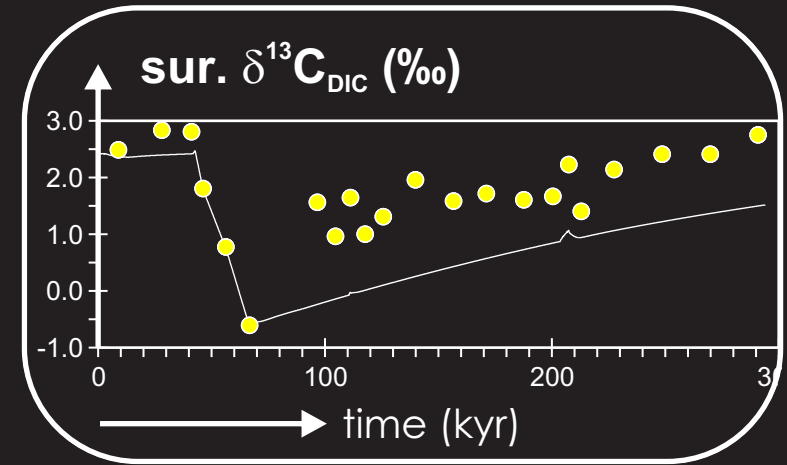
Assimilating surface ocean pH change (only)



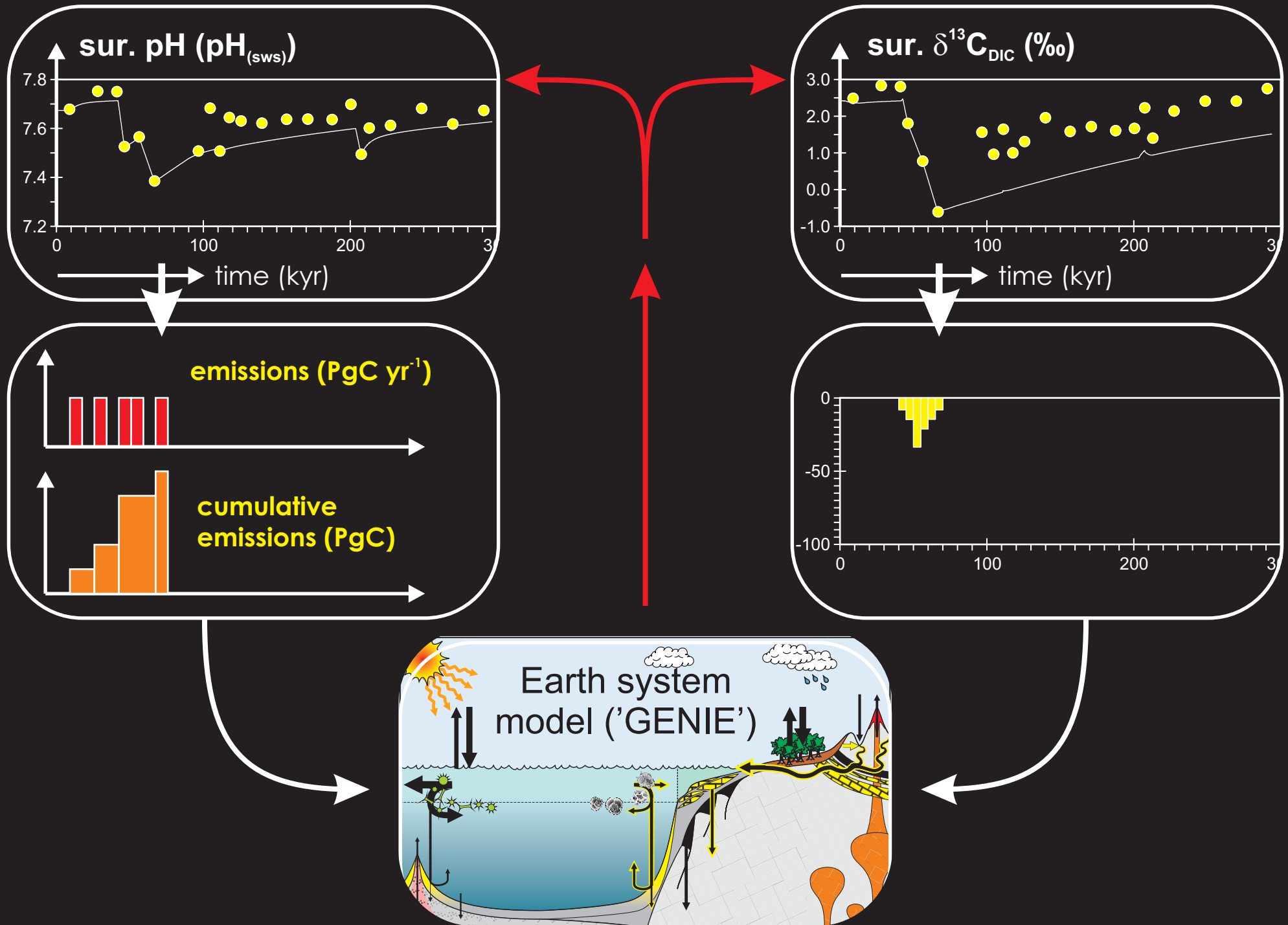
Assimilating surface ocean pH change (only)



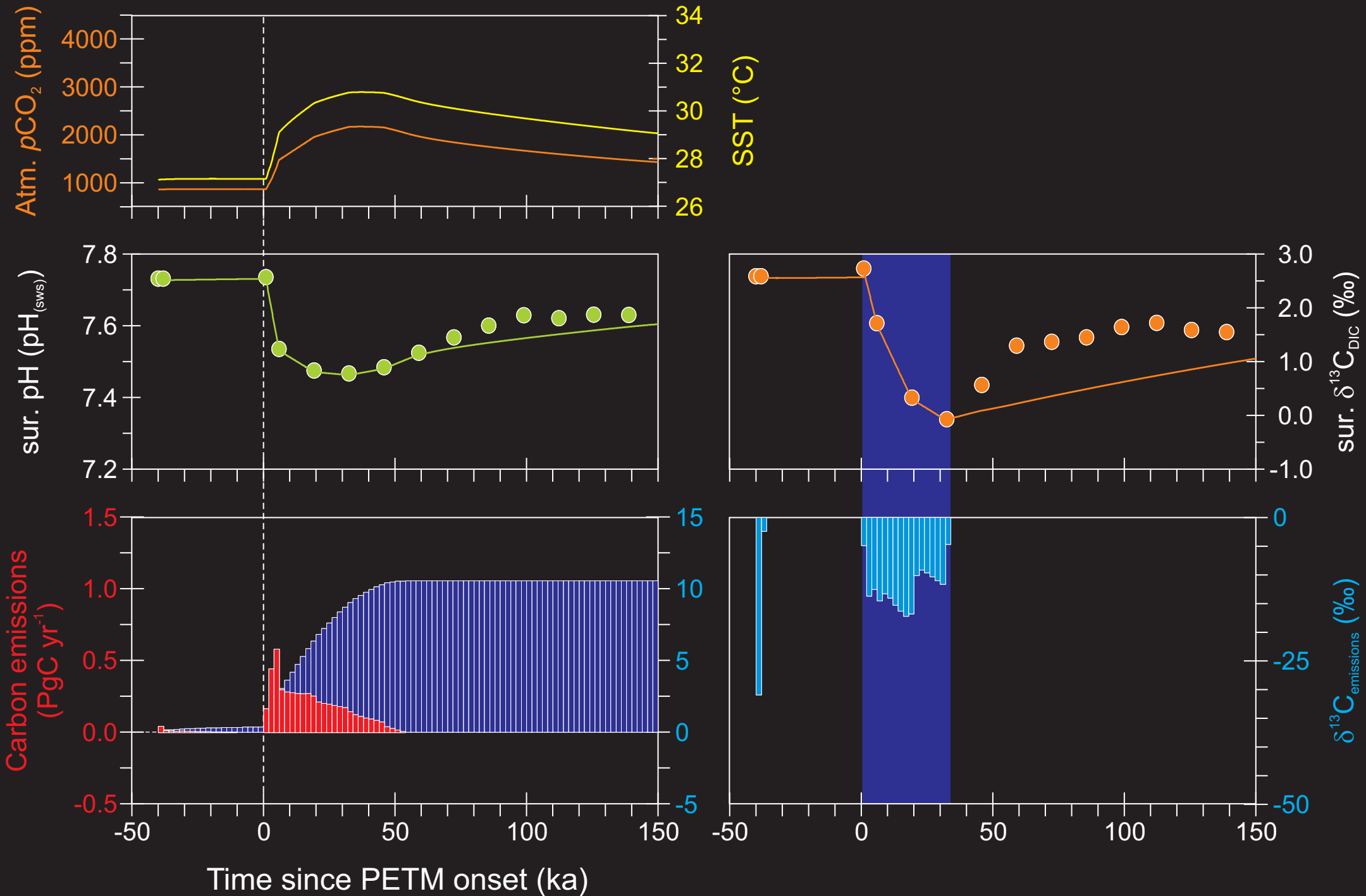
Assimilating surface ocean pH and $\delta^{13}\text{C}$



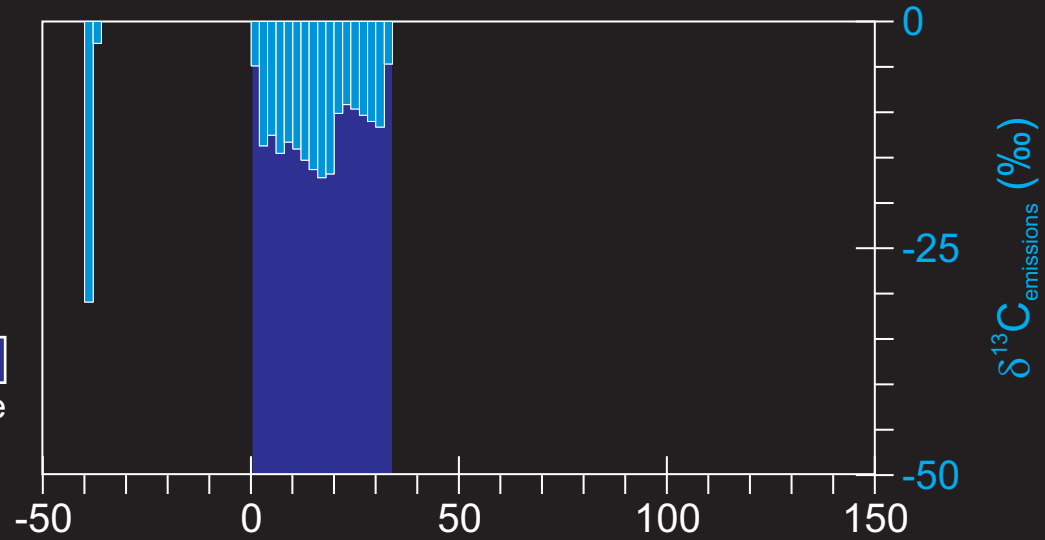
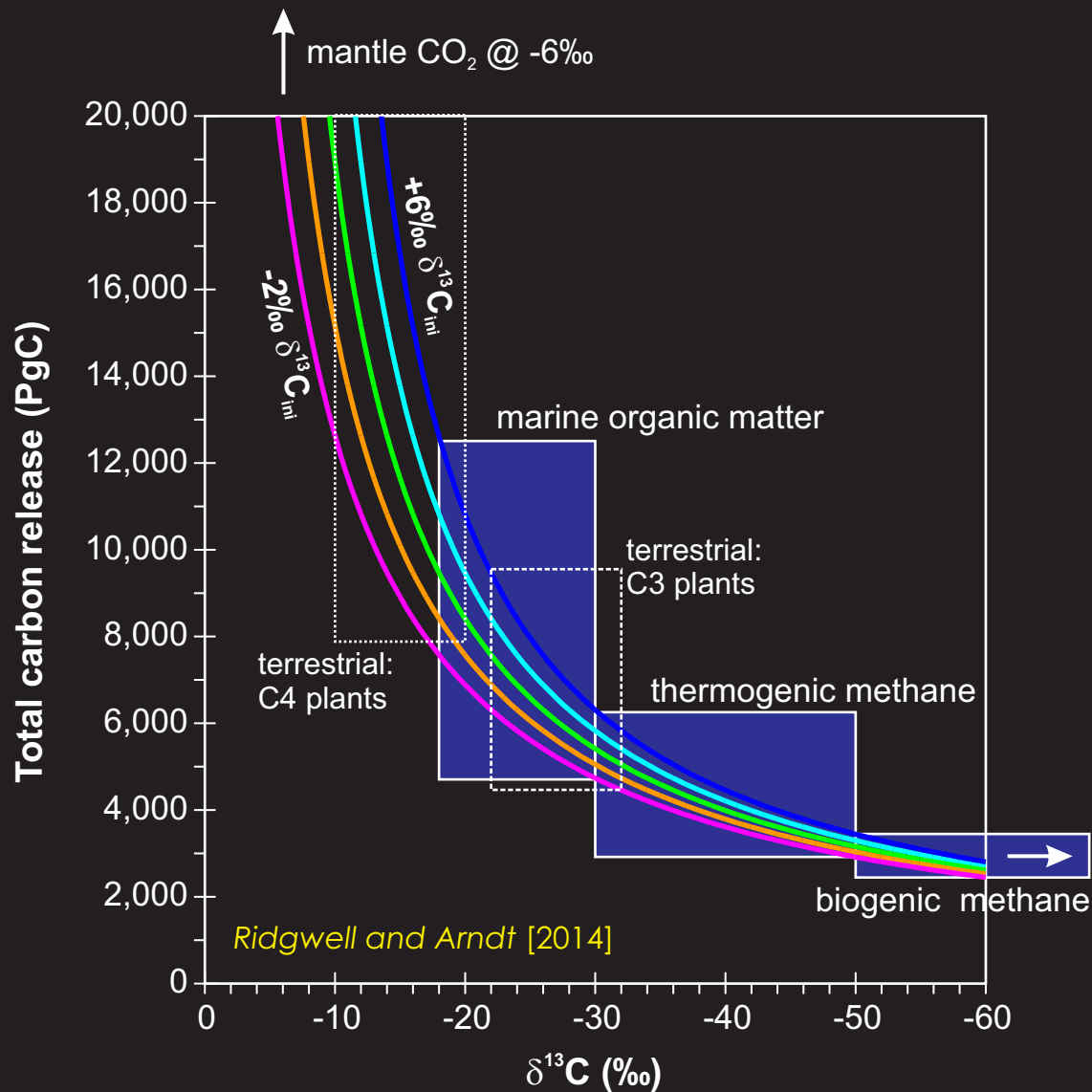
Assimilating surface ocean pH and $\delta^{13}\text{C}$



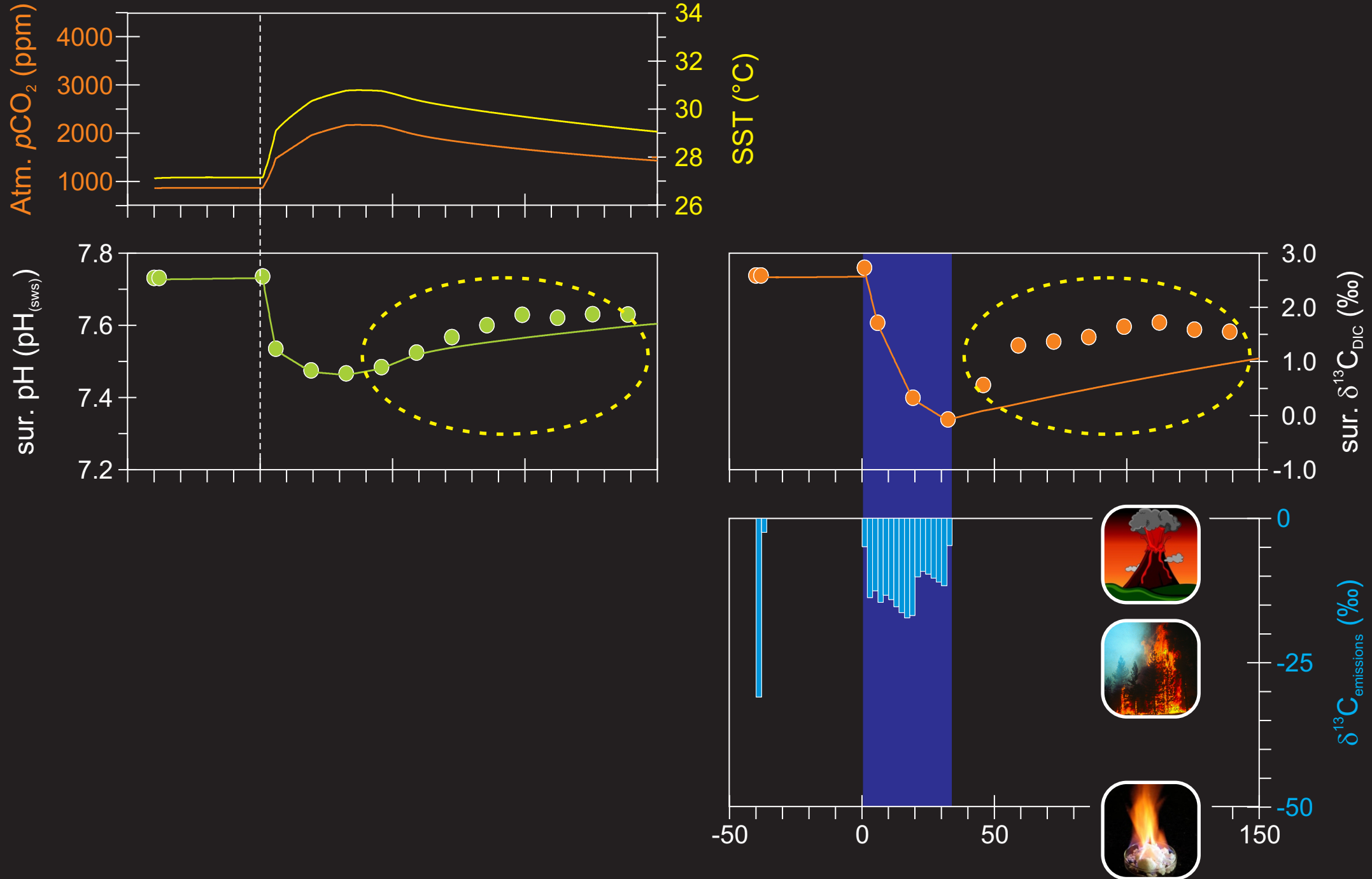
Assimilating surface ocean pH and $\delta^{13}\text{C}$



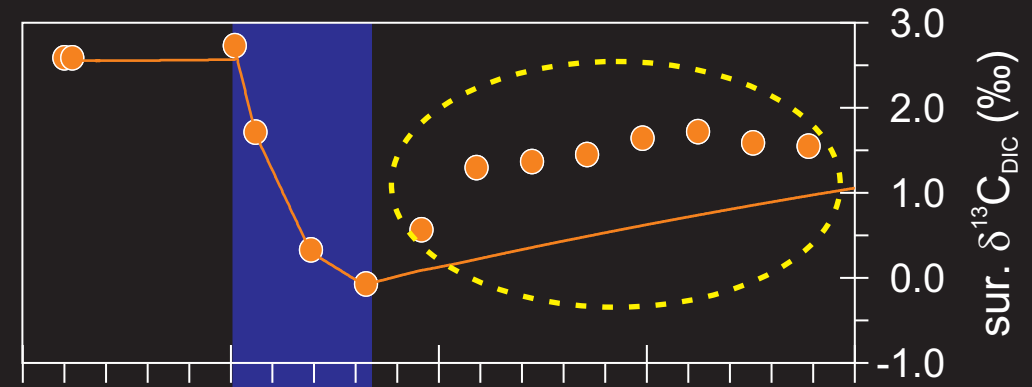
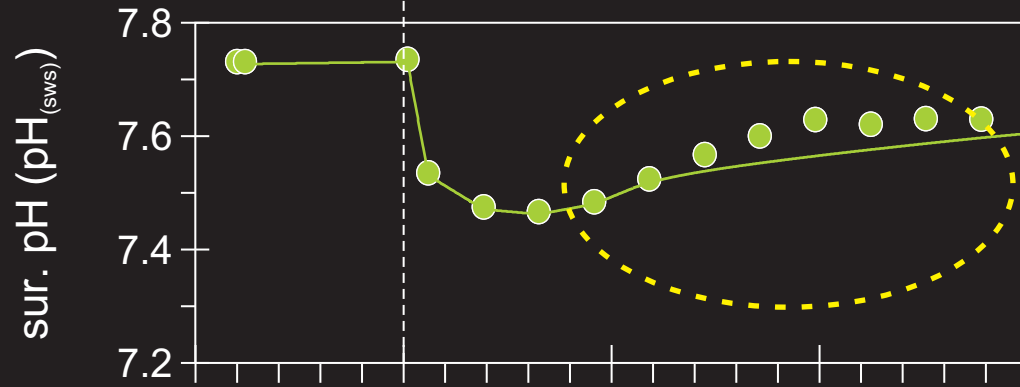
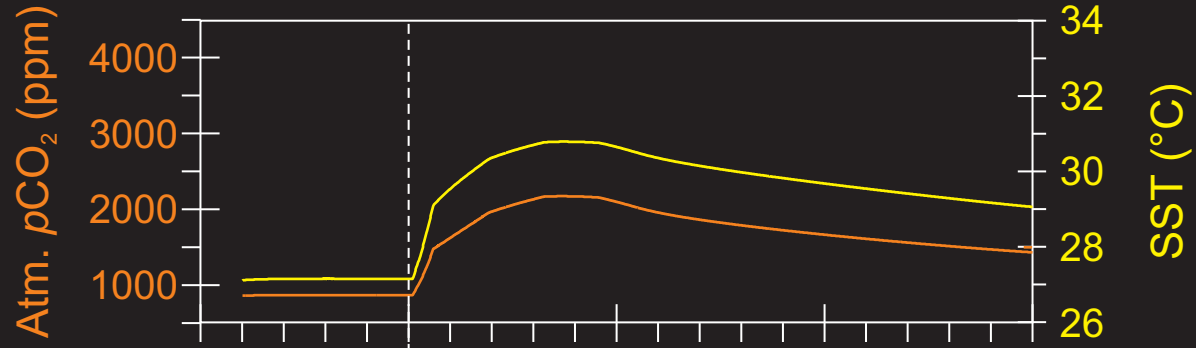
Assimilating surface ocean pH and $\delta^{13}\text{C}$



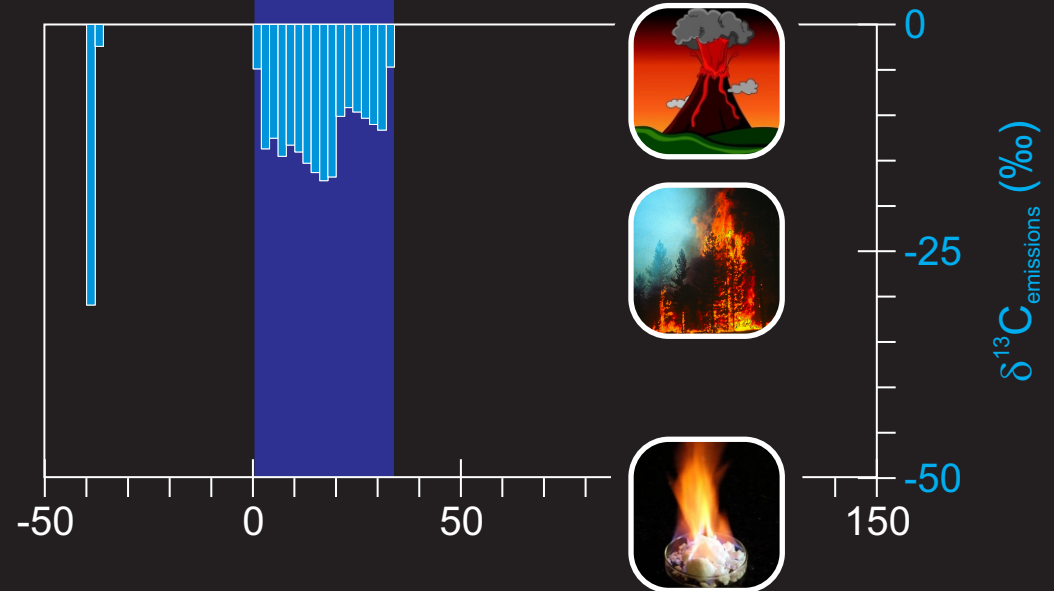
Assimilating surface ocean pH and $\delta^{13}\text{C}$



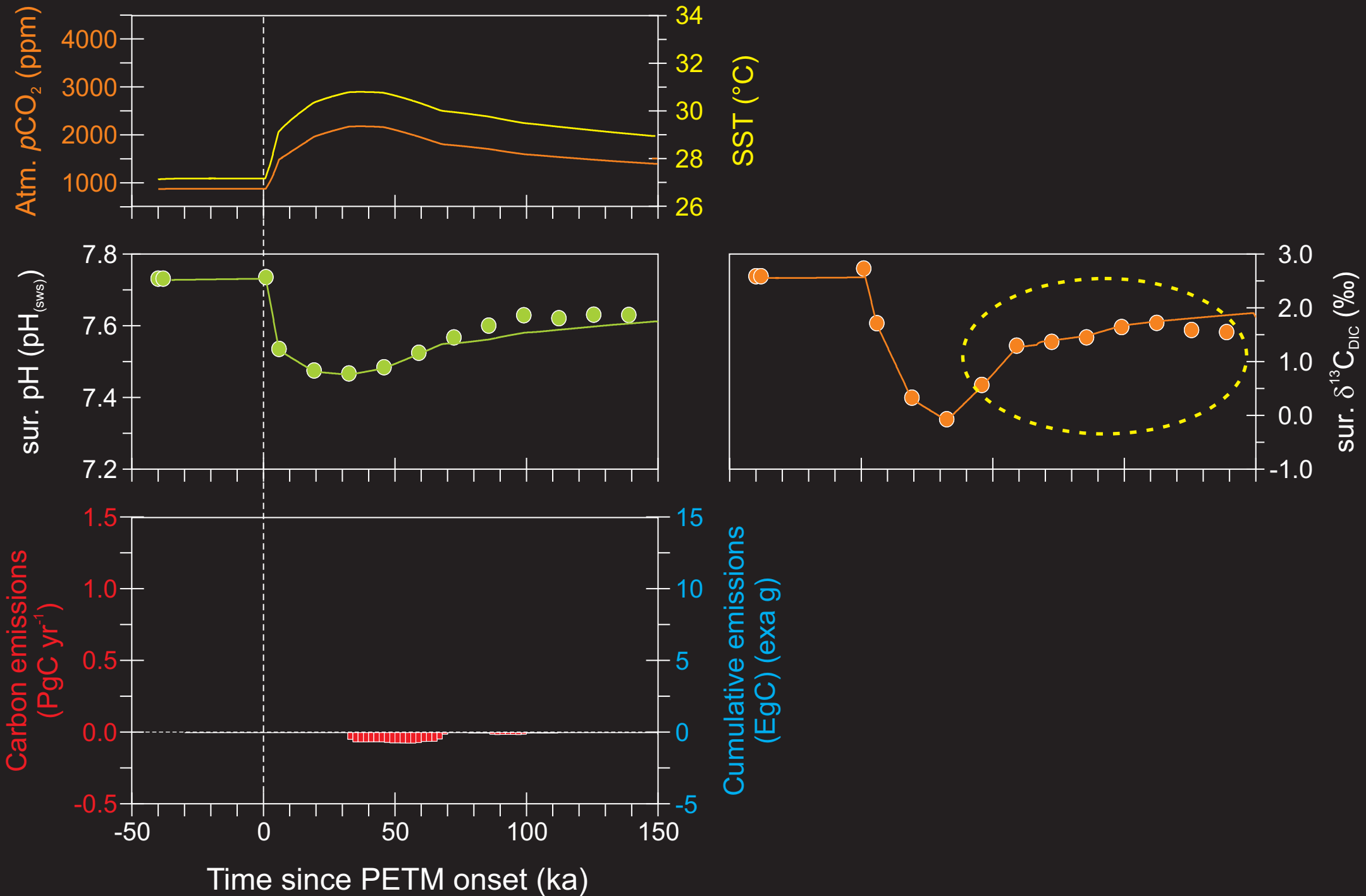
Assimilating surface ocean pH and $\delta^{13}\text{C}$



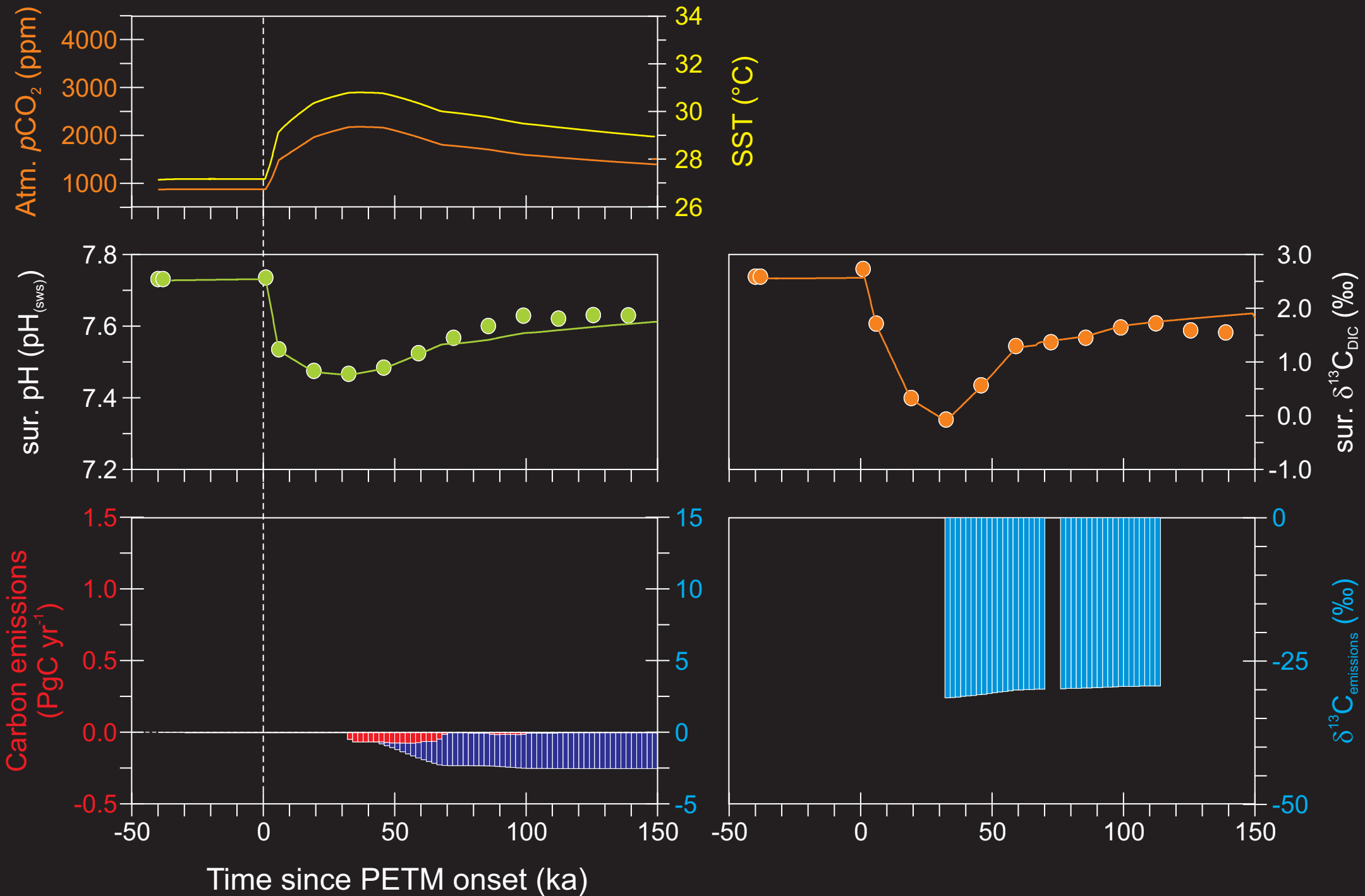
organic carbon
preservation



Assimilating surface ocean pH and $\delta^{13}\text{C}$



Assimilating surface ocean pH and $\delta^{13}\text{C}$





10,000–12,000 PgC was emitted over the PETM as a whole, with a mean isotopic signature of -11 to -17 per mil. This is largely independent of the assumed onset time-scale.

This can be explained entirely by volcanism + volcanic-related processes (e.g. thermogenic methane), or volcanism in combination with sufficient carbon cycle feedbacks.

A 'perfect' record could be assimilated in models to derive a time-resolved reconstruction of carbon emissions, and their specific sources.

The arrest warrant for the capacitor has been cancelled.



Thanks to:

Marcus Gutjahr [GEOMAR]

Gavin Foster [NOC]

Philip Sexton [The Open University]

Paul Pearson [Cardiff]

Sandy Kirtland Turner [UCR]

The European Research Council

Heising-Simons Foundation

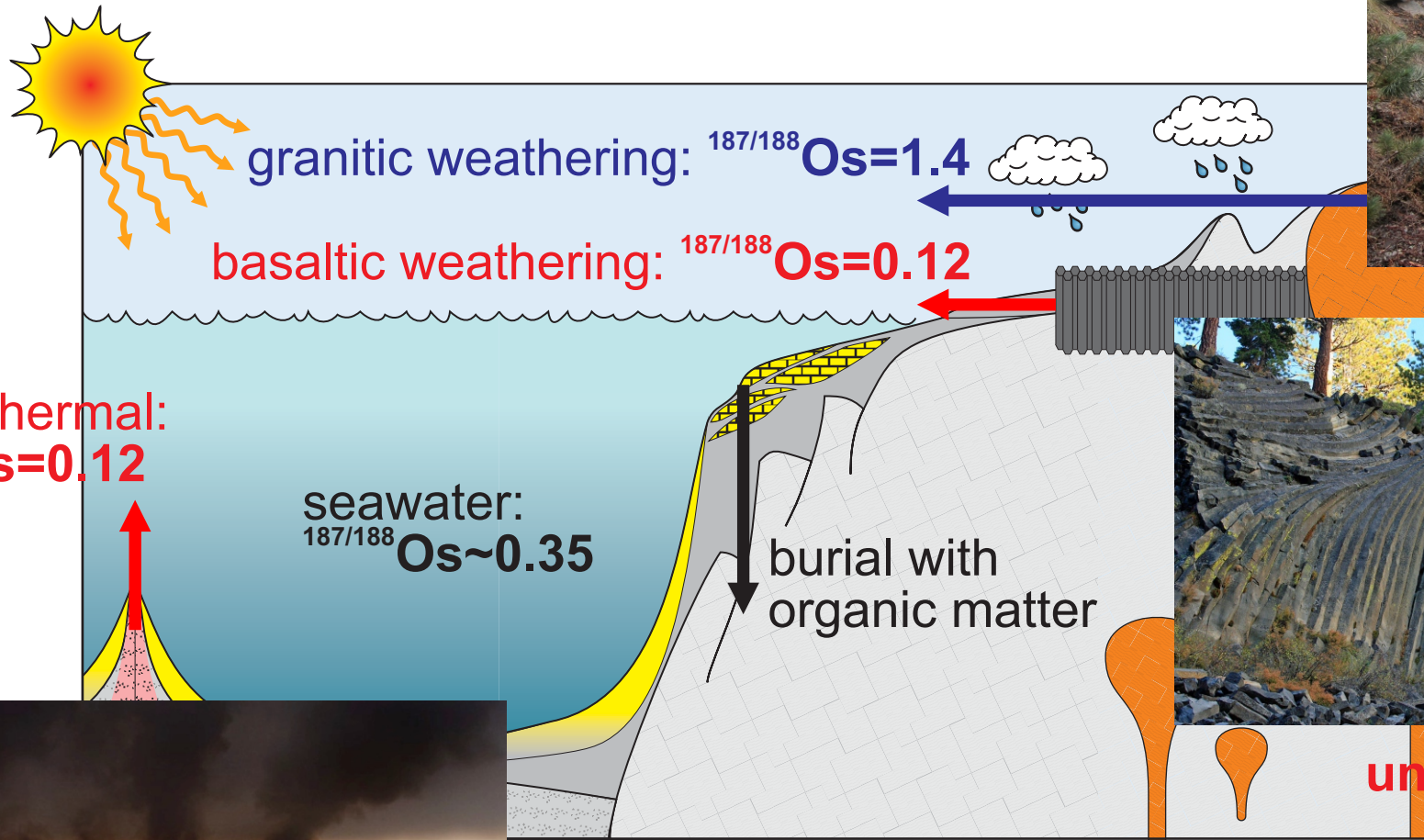
NERC



Osmium isotope records

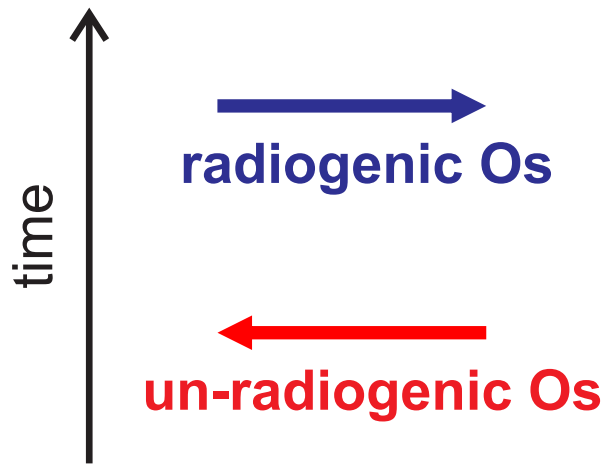
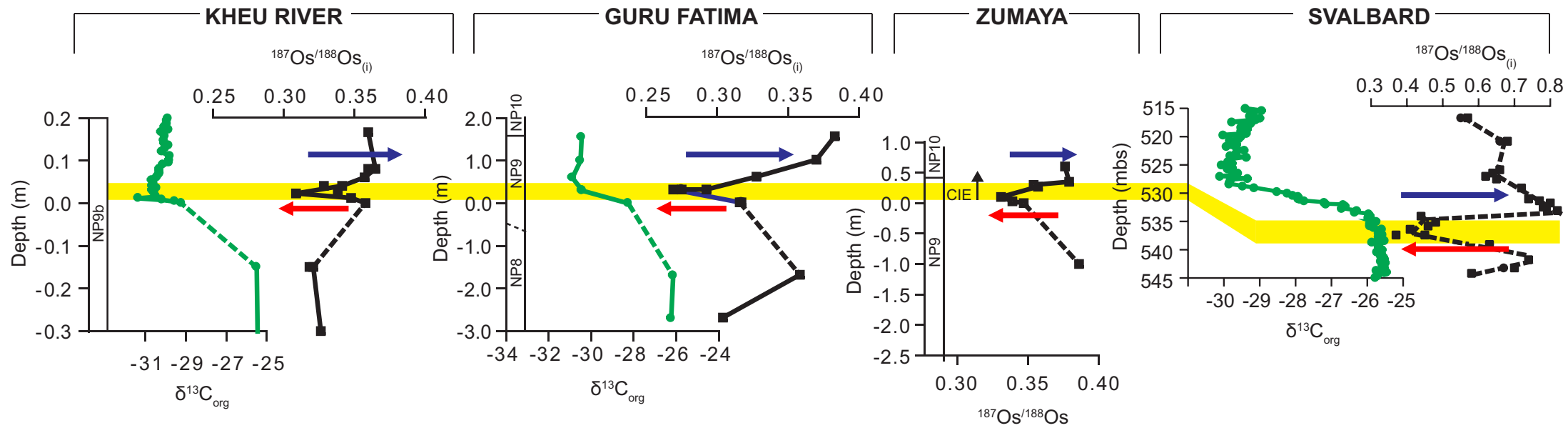


radiogenic Os



un-radiogenic Os

Osmium isotope records



PETM recovery characterized by long-lasting shift to radiogenic Os. Consistent with enhanced granitic weathering (silicate weathering feedback).

(Also, expulsion of fluids from organic rich sediments.)

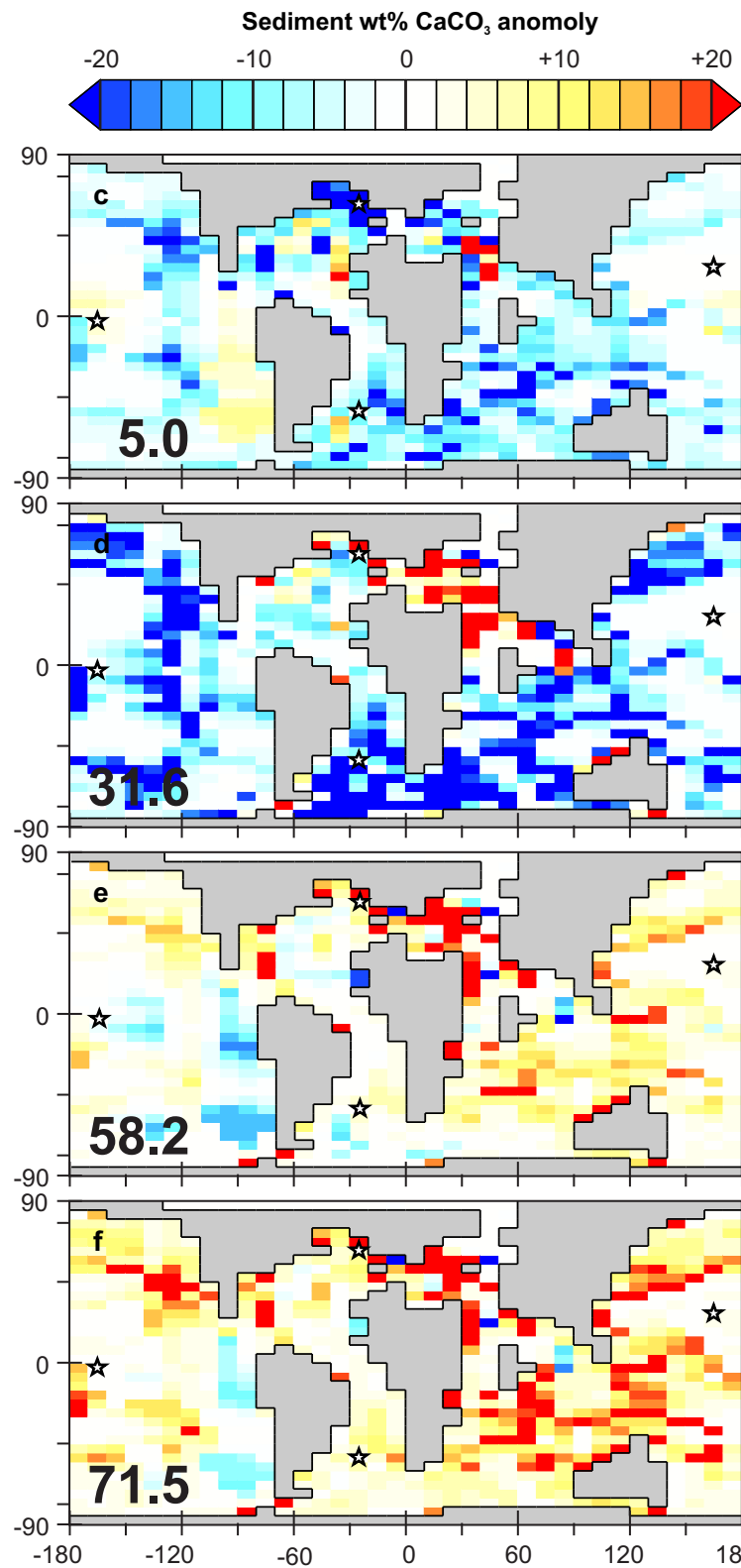
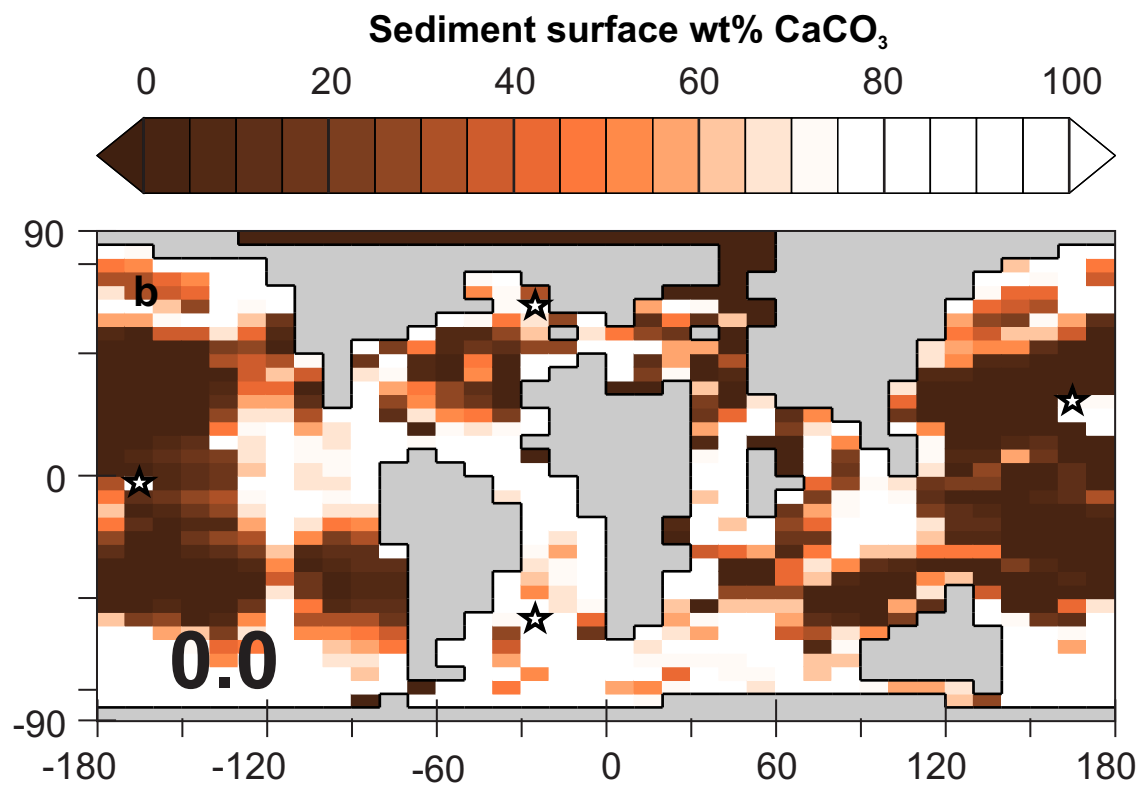
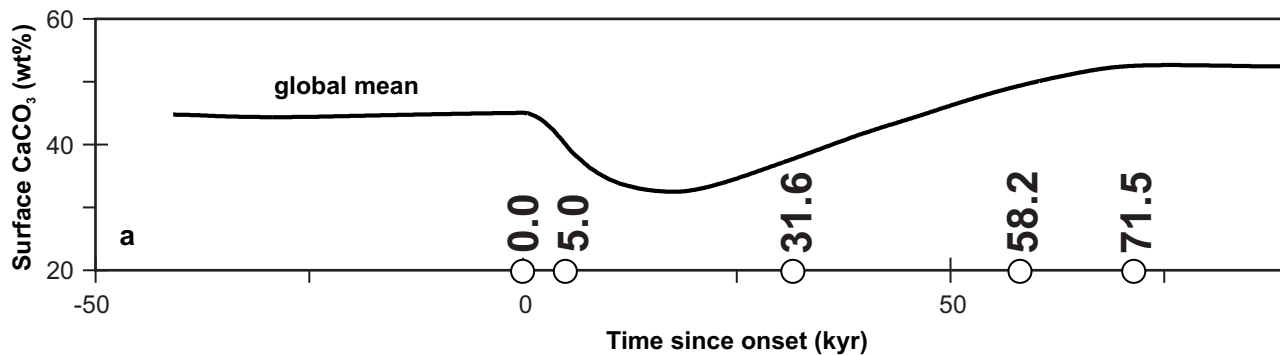
Strong transient decline in $^{187/188}\text{Os}$.

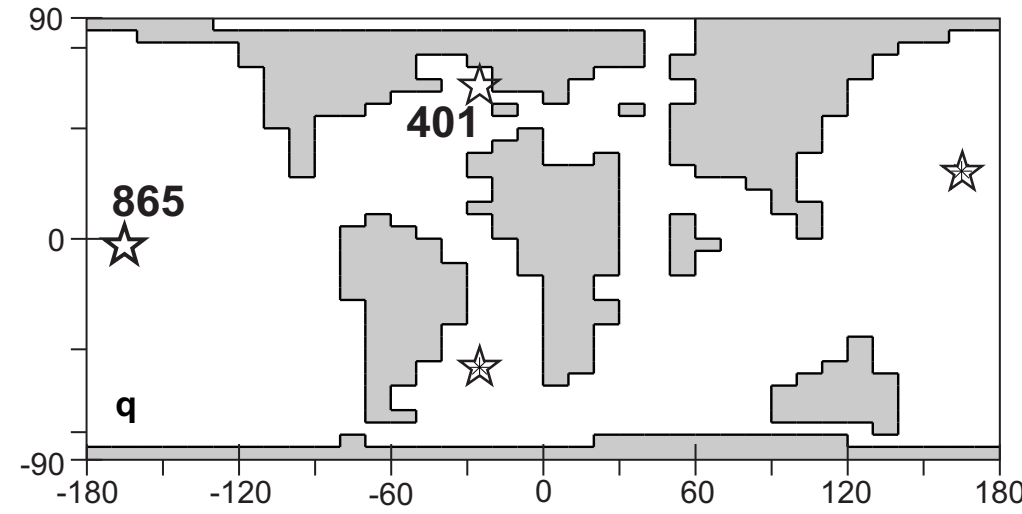
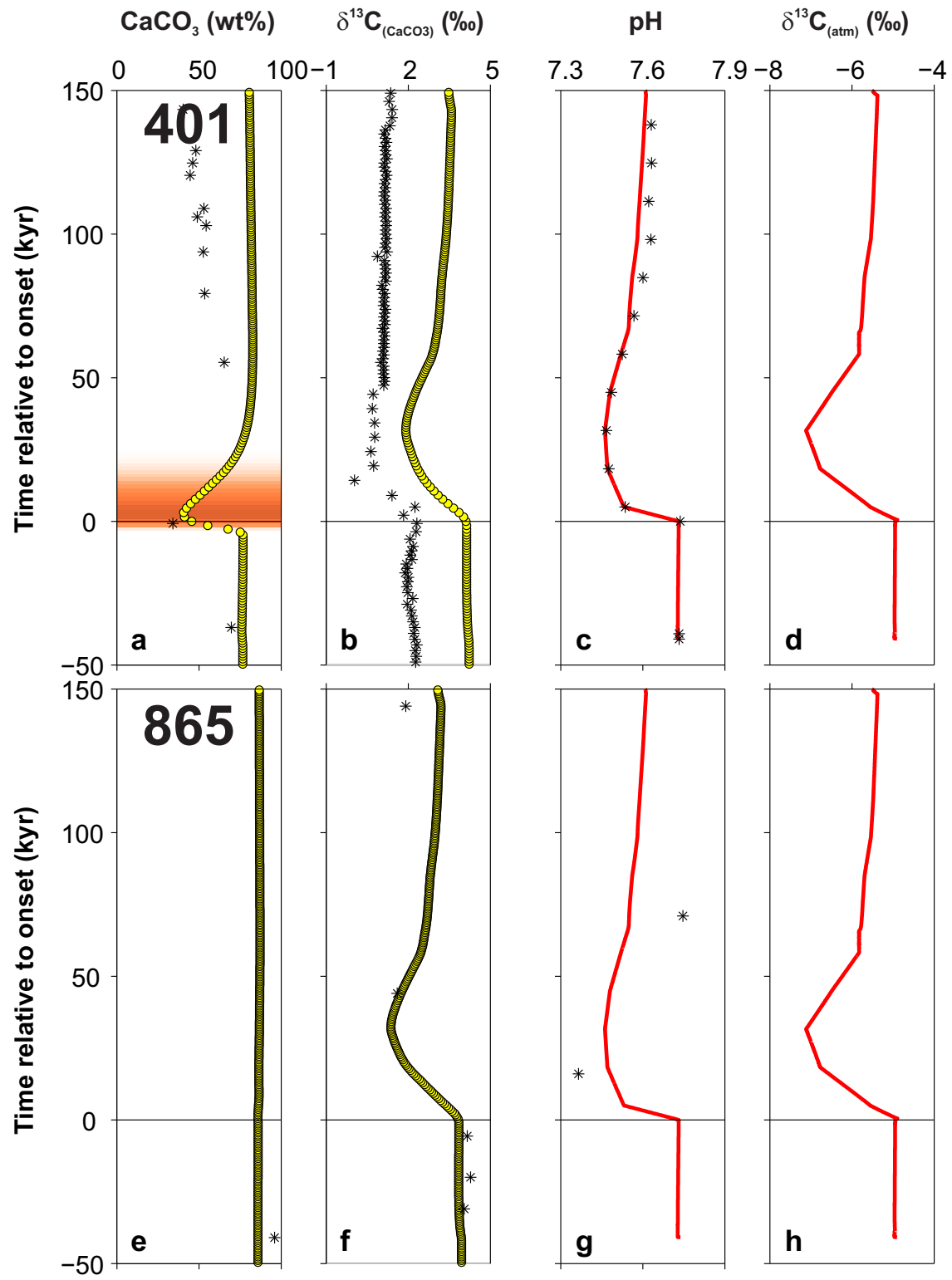
Enhanced unradiogenic input from volcanism. (Also, extraterrestrial ...)

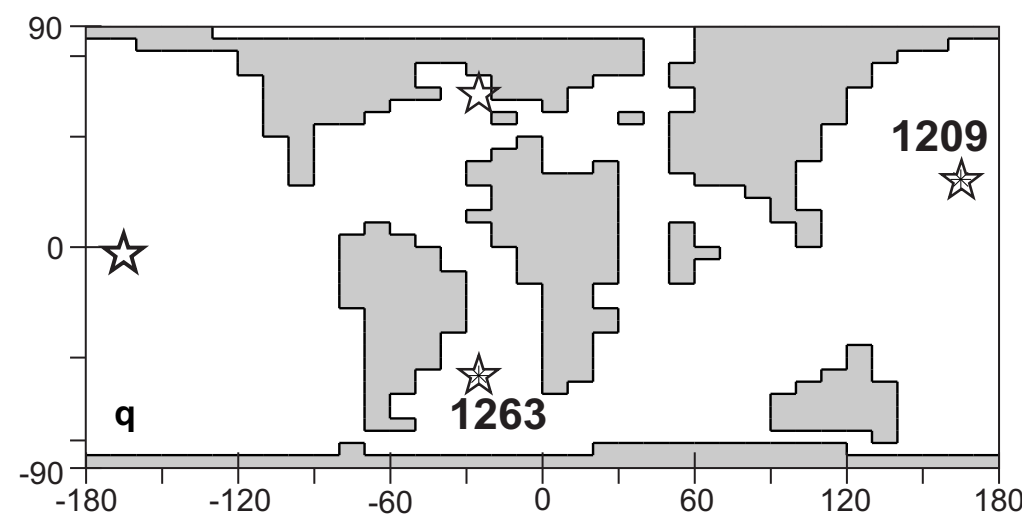
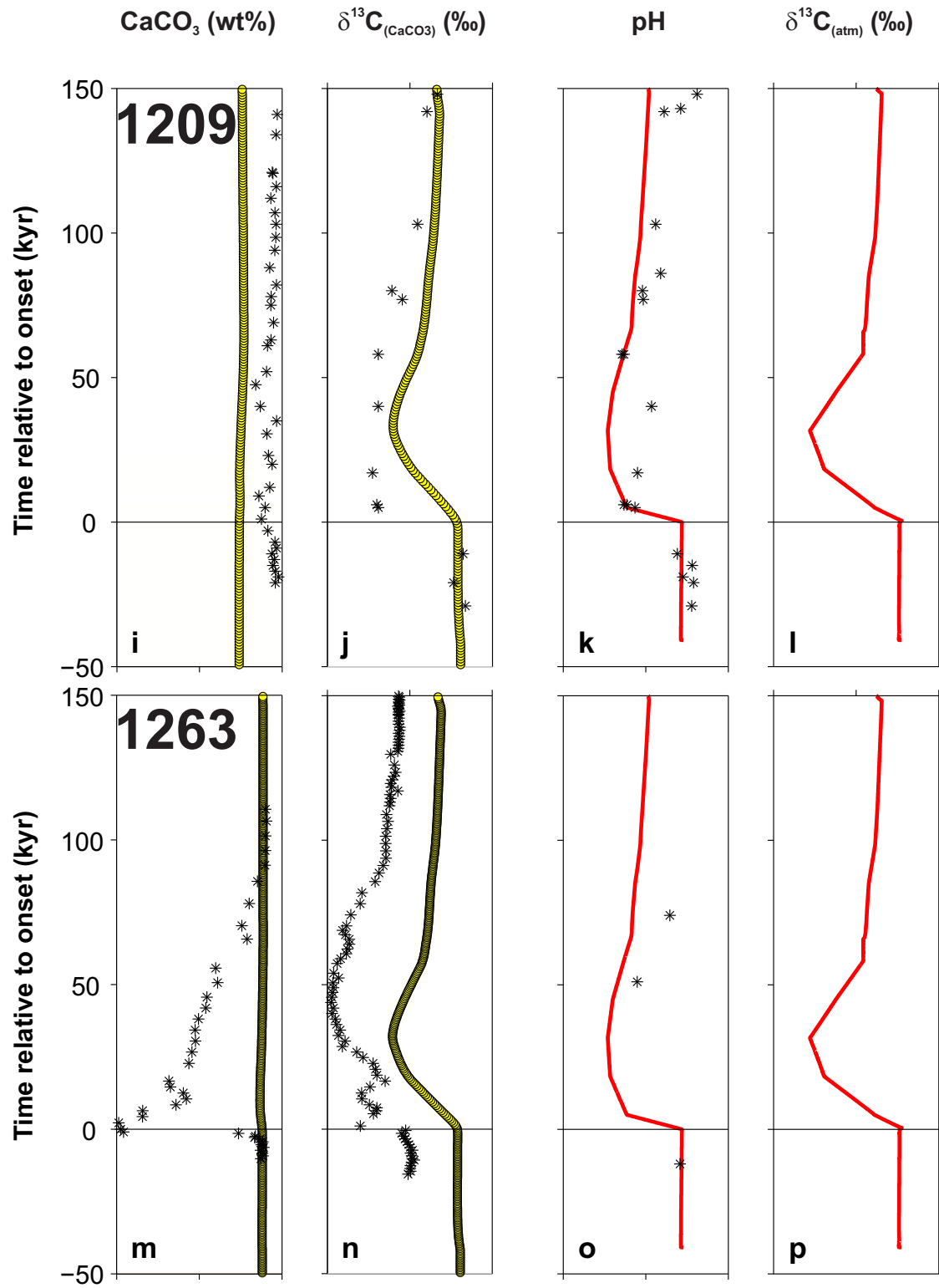
Dickson et al. [2015] (*Palaeogeography, Palaeoclimatology, Palaeoecology* **438**)

(also see: Wieczorek et al. [2013] (*GCA* **119**))

Deep-sea (modelled) carbonate response



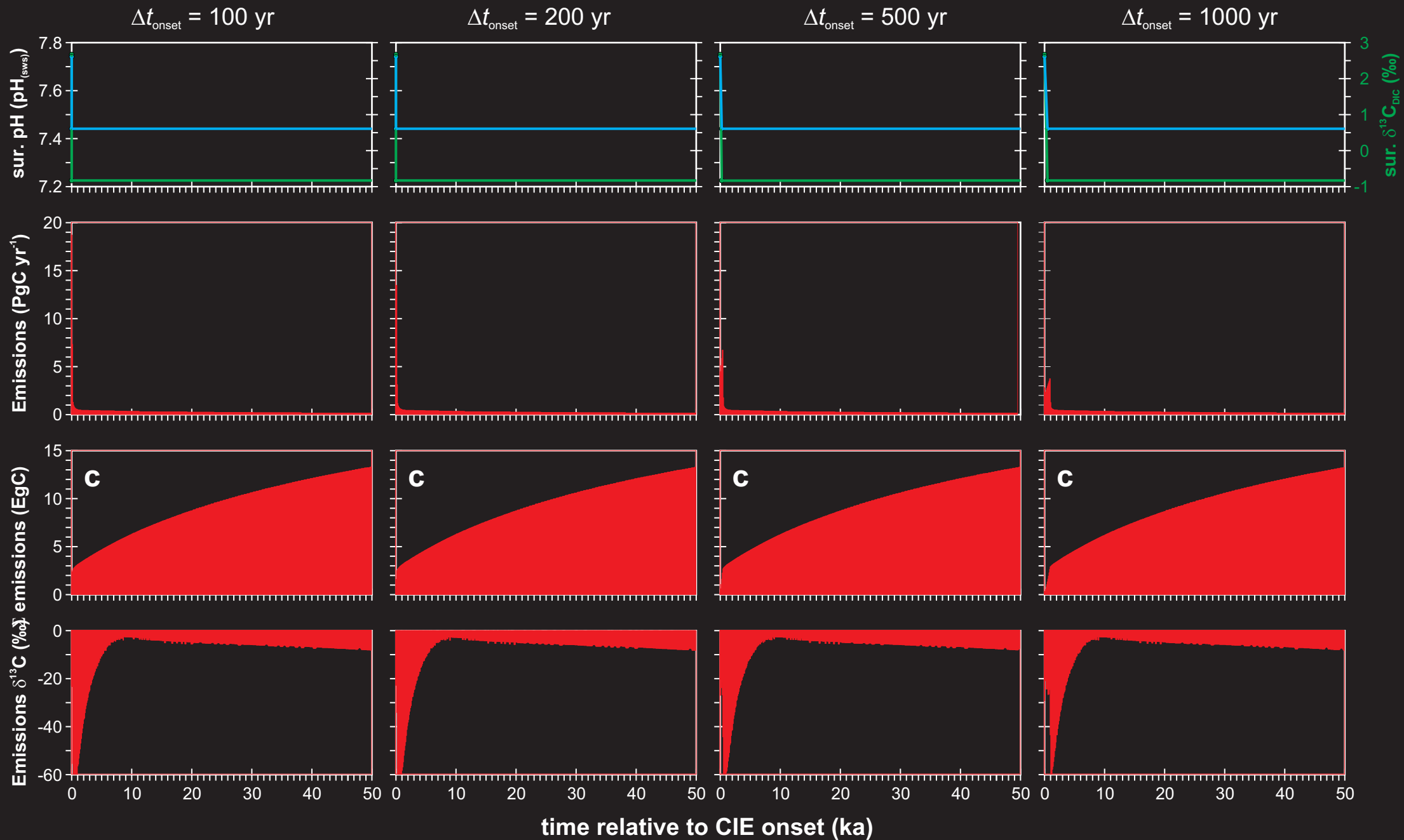




Sensitivity of total carbon release to onset time-scale



Assumed excursion on-set: 100 - 1,000 yr



Sensitivity of total carbon release to onset time-scale



Assumed excursion on-set: 2,000 - 20,000 yr

