Abrupt Climatic Change during the Latest Maastrichtian: Establishing Robust Temporal Links with the Onset of Deccan Volcanism and K/Pg Mass Extinction (PP23B-1301)

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1. Introduction

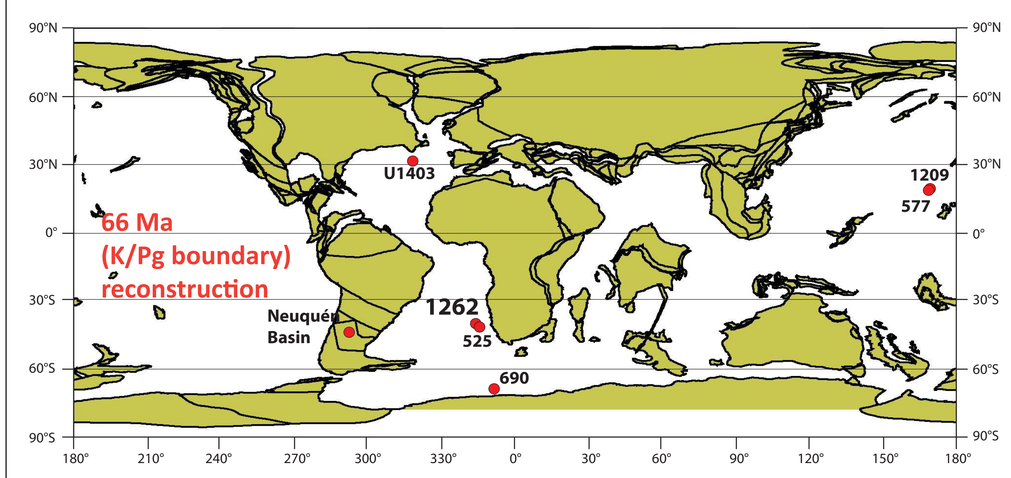
- Here we present the currently highest resolution (1.5-4 kyr) single-species (*Nuttallides truempyi*) benthic stable isotope record for the uppermost Maastrichtian up to the first 500 kyr of the Danian, from ODP Site 1262, South Atlantic

- This record is calibrated to an updated orbitally tuned age model, which along with recent advances in dating of the Deccan Traps, allows a correlation between pre-K/Pg climate change and Deccan volcanism to be made at unprecedented resolution

- A period of transient ~2.5-5°C global warming occurred ~200-300 kyr before the K/Pg mass extinction, herby termed the "**Late Maastrichtian warming event (LMWE)**"

- A compilation of previously published stable isotope, atmospheric pCO_2 and other geochemical data is also shown, which more precisely characterises the global nature of pre-K/Pg climate change

2. Location of sites



The new benthic isotope data generated during this project is from ODP Site 1262, the deepest of 6 sites drilled on the Walvis Ridge, South Atlantic, at a paleo-depth of ~3000m during the late Maastrichtian. Location of other sites from which previously published data on this event is used in this study are also shown.

Reconstruction from: http://www.odsn.de/odsn/services/paleomap/paleomap.html

3. Methods

- $\delta^{13}C_{Benthic}$ data generated using 40-70 µg of *N. truempyi* on an IsoPrime 100 Gas Source Isotope Ratio Mass Spectrometer at the NERC Isotope Geosciences Facility (British Geological Survey)

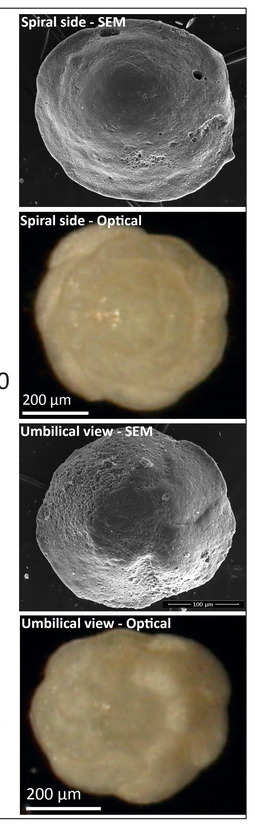
- Updated orbitally tuned age model for Site 1262 based on counting of the 405-kyr eccentricity cycle in our $\delta^{13}C_{Benthic}$ data set, correlated to the La2010b solution of Laskar et al. (2011) and anchored to a K/Pg boundary age of 66.02 Ma

- $\delta^{13}C_{Benthic}$ data was graphically detrended in KaleidaGraph, linear sampling and band pass filtering were conducted in AnalySeries 2.0

- All other published data has been migrated onto our age model by aligning at a K/Pg boundary age of 66.02 Ma and using the mean sedimentation rate at each site

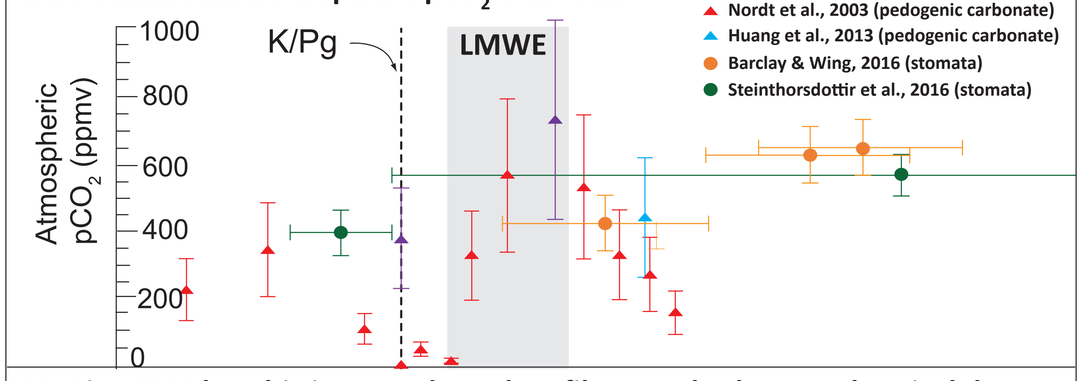
- Atmospheric pCO_2 estimates recalculated from the literature using a revised soil-respired CO_2 (Sz) concentration of 2500 ppm (Breecker et al., 2010)

- Deccan Trap formation volumes calculated assuming a constant base flow radius of 600 km (grey bars) and by varying the flow radius from 600 km (Poladpur & Wai formations) to 250 km for the other formations (red bars) (Jay & Widdowson, 2008)

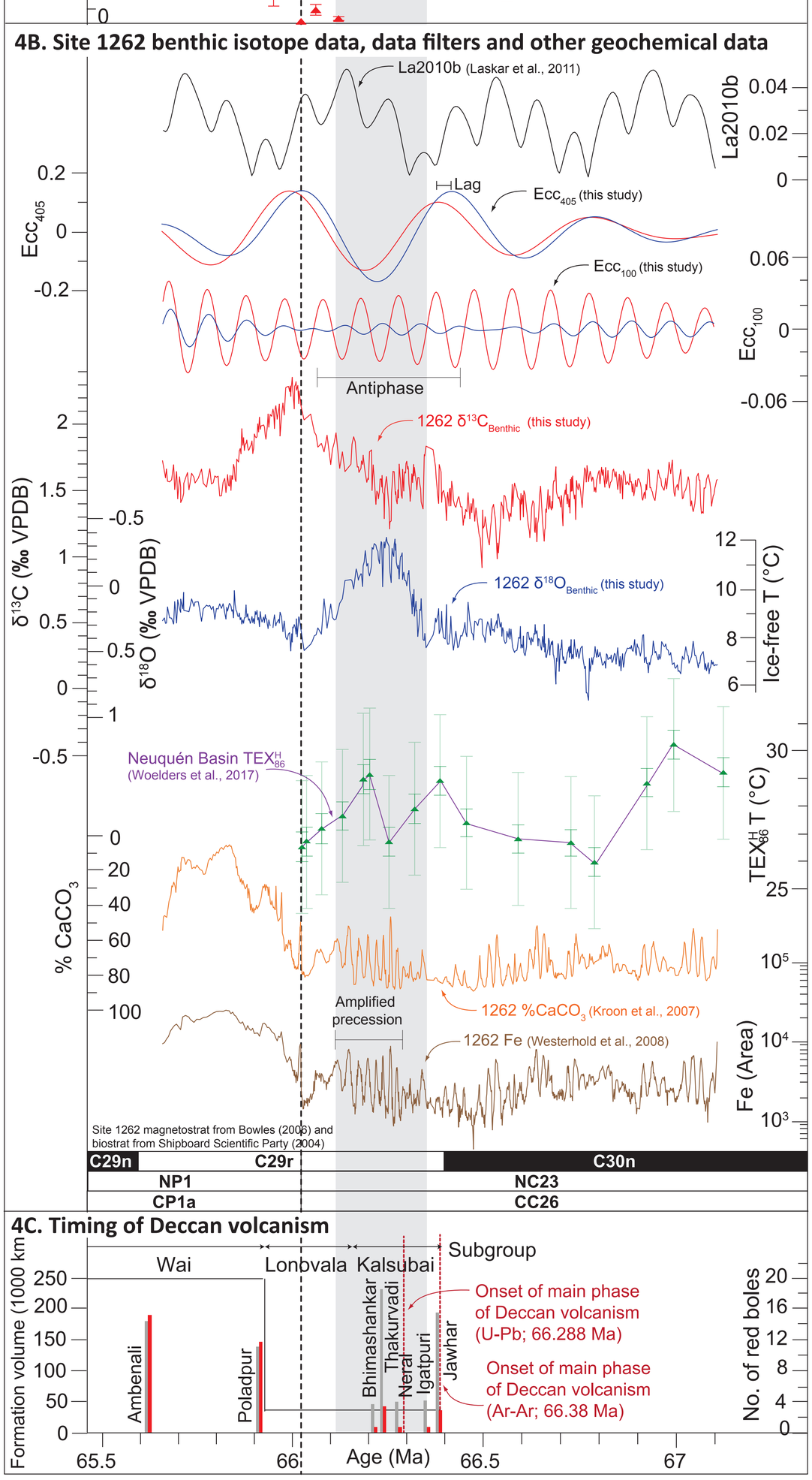


4. Correlation of environmental proxies to Deccan volcanism and the La2010b orbital solution

4A. Recalibrated atmospheric pCO_2 estimates



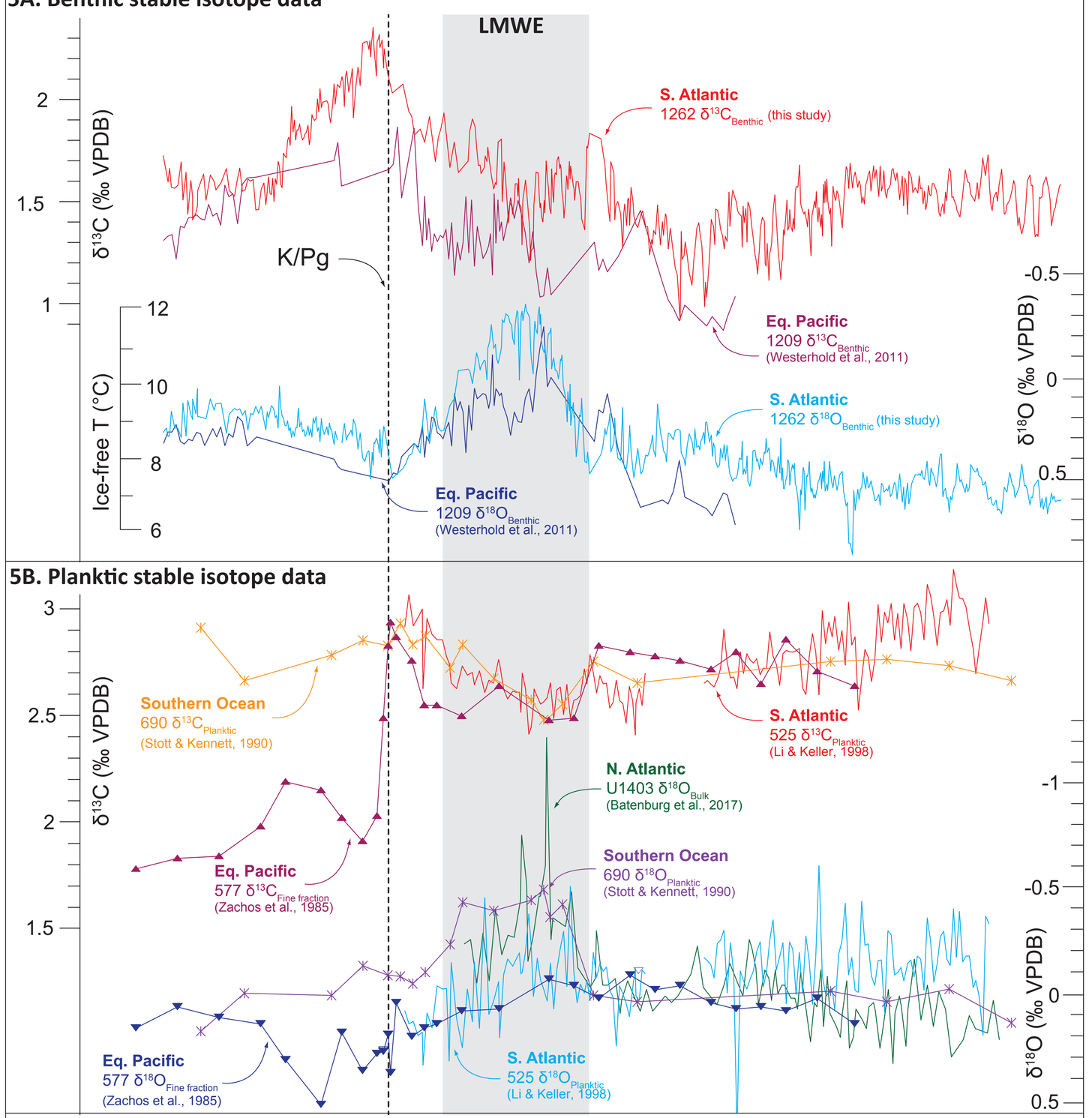
4B. Site 1262 benthic isotope data, data filters and other geochemical data



4C. Timing of Deccan volcanism

5. Comparison of stable isotope data across the Late Maastrichtian warming event

5A. Benthic stable isotope data



5B. Planktic stable isotope data

5C. Surface-to-deep marine $\delta^{13}C$ and temperature gradients at DSDP Site 525

6. Conclusions

- Late Maastrichtian warming event correlates with the onset of the main phase of Deccan volcanism, strongly suggesting a causal link
- Onset of the event occurs during a minimum in the 405-kyr eccentricity cycle, excluding a control by orbital forcing alone
- Evidence for amplified precession cyclicity within the carbon cycle and dissolution proxies during the event
- Despite evidence for elevated atmospheric pCO_2, the $\delta^{13}C$ response is muted due to heavier $\delta^{13}C$ signature (-7 ‰) of volcanogenic CO_2
- Pronounced bottom water warming within both the deep South Atlantic and Central Pacific suggest that the warming event is global
- Available published planktic records suggest potential polar amplification of the event, although more data is required to confirm this
- A more precise understanding of Deccan-induced climate change paves the way for future work focusing on the fundamental role of these precursor climate shifts in the K/Pg mass extinction