



# **Sediment Records of Biomass Burning and Global Change**

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# Sediment Records Of Biomab Burning And Global Change

**Nidhi Patel**



## **Sediment Records Of Biomab Burning And Global Change:**

*Reconstructing Late Holocene Fire, Agriculture, and Climate from Sediment Records in Costa Rica and the Dominican Republic* Erik Nicholas Johanson, 2016 We use multiple proxies from sediment cores to identify periods of climate stress during the late Holocene across the circum Caribbean region and to determine how fire activity and signals of Pre Columbian agriculture coincide with these arid periods We examine evidence of aridity from stable carbon isotope ratios and shifts in elemental composition along with pollen and microscopic charcoal at Bao Bog in the highlands of Hispaniola We infer two major periods of aridity 3600 2300 and 1040 850 cal yr BP with the later period associated with the late phase of the Terminal Classic Drought A third less marked interval of aridity corresponds to the Little Ice Age from 550 100 cal yr BP Southward shifts in the mean latitudinal position of the Intertropical Convergence Zone coincide with the arid periods in the Bao Bog record which we interpret as also coinciding with a lowering of the elevation of the Trade Wind Inversion We also produce three new records that show environmental change maize agriculture and fire history in southern Pacific Costa Our 4300 year record from Laguna Los Mangos shows the earliest evidence of Zea mays subs mays in the region at ca 3300 cal yr BP following a 1000 year period when the area around the lake was largely forested with slight or no agricultural activity The Laguna Los Mangos record contains evidence of the transition to maize agriculture and a later decline associated with the onset of the LIA and Spanish contact From Laguna Danta and Laguna Carse we developed high resolution records of fire history and maize agriculture spanning the Little Ice Age We found that fires occurred during the Little Ice Age and were influenced by human activity related to agriculture but that fires persisted following agricultural decline suggesting climate as a driver of fire in the lowlands The continuation of fire into the Little Ice Age contradicts a recent global synthesis of fire activity and suggests local variability in fire response to climate

*Holocene Climate and Carbon Sequestration Via Black Carbon Burial in Sediments* Nidhi Patel, 2011 Fire a global process that depends on climate volcanic activity vegetation and human practices is not constant through time and varies at decadal centennial and millennial time scales Wildfires that result in burning of large areas of land may increase in frequency in the future as a result of impending global warming Studies have shown a correlation between historically warmer climates and occurrences of wildfires The increased occurrence of these fires may add carbon dioxide CO<sub>2</sub> g to the atmosphere However such wildfires may also have led to CO<sub>2</sub> g sequestration by formation of pyrogenic black carbon BC followed by its subsequent burial In this manner climate driven wildfire occurrence and corresponding BC formation and burial is a negative feedback loop in the carbon cycle Carbon sequestration responding to climate fluctuations through fire occurrences may have implications for climate and carbon cycle models as well as future climate predictions It is hypothesized that an increased abundance in BC formation i e carbon sequestration will be correlated with a drier environment a drier climatic interval in the sedimentary record will correlate with a greater frequency of wildfires and pyrogenic BC abundance This hypothesis was tested in two areas coastal North

Carolina and Lake Bosumtwi Ghana Geochronological analysis conducted on a sediment core from coastal NC suggests that the core encompasses a time interval of 1081 Common Era CE to 1979 CE The abundance of BC in the core ranged from 4 % to 97 % and was related to established proxies of paleoclimate temperature and drought Furthermore stable isotopes of BC organic carbon OC and concentrations of polycyclic aromatic hydrocarbons PAHs were also used in an attempt to understand the type of biomass burned The type of biomass burned ranges from C4 plants 1081 until 860 CE to C3 plants 860 CE to present Also in the core from coastal NC cycles of BC excursions relate to climate proxies on decadal and centennial scales In a sediment core from Lake Bosumtwi Ghana the BC abundance relative to TOC is elevated 90 % of the TOC is BC throughout the core Stable isotopic signatures of BC and OC were also analyzed in the sediment core from Lake Bosumtwi These analyses suggested that a shift in vegetation change in environments occurred in western Africa a shift from a drier climate to a moist climate occurred at about 6 cm depth in the core There was not enough sediment to constrain geochronology in this core Both study sites are sensitive to the Atlantic Ocean and other ocean atmospheric teleconnections For example changes in the North Atlantic thermohaline circulation and the Intertropical Convergence Zone ITCZ could have a large influence on droughts and fires in coastal NC and western Africa If a relationship between carbon sequestration and paleoclimate can be identified a better understanding of how climate has affected global carbon cycle over geologic time can be established

**A Record of Holocene Climate Change from the Sunda Shelf, South China Sea** Anna Woodson, East Carolina University. Department of Geology, 2014 Variations in the East Asian Monsoon EAM control weather and regional climate conditions in the heavily populated agriculturally dependent regions of eastern and southeast Asia The South China Sea SCS especially the deep northern SCS has yielded many high resolution Quaternary records of the EAM due to its high sedimentation rates and central location within the EAM system The Sunda Shelf a low gradient shallow region in the southwestern semi enclosed SCS is characterized by thin 1 m Holocene deposits and thus has not been a target for paleoclimate reconstructions However flooded fluvial paleochannels on the Sunda Shelf contain thicker muddy Holocene sediments Herein we test the hypothesis that the sediment fill of fluvial paleochannels contains a record of Holocene paleoclimate Two piston cores were collected in fluvial paleochannels 80 km offshore of Bintulu Sarawak Malaysia Core D45 collected on the edge of a v shaped paleochannel exhibits 7200 years of sediment accumulation whereas core D42 retrieved in a shallower paleochannel to the west yielded a shorter 3 000 year but higher resolution record Mg Ca ratios of *Globigerinoides ruber* and *Globigerinoides sacculifer* in combination with the stable oxygen isotopic composition of *G. ruber* allow for the estimation of sea surface temperature SST the stable oxygen isotopic composition of seawater and salinity Furthermore the stable carbon isotopic composition of *G. ruber* illuminates trends in nutrient input and continental runoff Based on decreased salinity estimates a high sedimentation rate 0.064 cm yr and low stable carbon isotopic values core D45 records an interval of increased rainfall and continental runoff from 6.4 ka in keeping with nearby speleothem and

continental pollen records Additionally this core records coeval reduced SST values a trend not recognized in regional deep sea records suggesting a strong terrestrial runoff effect on the sedimentary record The Medieval Climate Anomaly and Little Ice Age are also tentatively recognized in SST data Core D42 shows similar trends in data for the late Holocene confirming that flooded fluvial paleovalleys can provide Holocene paleoclimatic records on continental shelves characterized by generally low sediment accumulation rates

**Deconvolving Climate and Biotic Signals from Taphonomic Overprints in Deep-sea Records of the Paleocene-eocene Thermal Maximum** Brittany Nicole Hupp, 2021 The Paleocene Eocene Thermal Maximum PETM an ancient global warming event that occurred 56 Ma was closely associated with a rapid perturbation to the global carbon cycle making the event an exceptionally relevant analog for evaluating the future consequences of modern climate change Here I examine deep sea planktic foraminifer records of the PETM from the Weddell Sea ODP Site 690 southern Indian Ocean ODP Site 1135 and equatorial Pacific Ocean ODP Site 865 This dissertation seeks to

- 1 better characterize geochemical and biotic changes at various latitudes in response to PETM conditions through application of novel techniques and
- 2 use the stratigraphic record of the PETM to assess how taphonomic processes such as sediment mixing and diagenesis have distorted deep sea records of abrupt climate change

In chapters 1 and 2 I use stable carbon  $^{13}\text{C}$  and oxygen  $^{18}\text{O}$  isotope records constructed with graduated series of size segregated planktic foraminifer shells to show how size dependent sediment mixing has distorted the stratigraphic structure of the Site 690 PETM reference section Chapter 3 demonstrates how the stable isotope signatures of individual foraminifer shells can be used to deconvolve the deleterious effects of sediment mixing on microfossil assemblages associated with abrupt biogeochemical perturbations Application of this isotopic filtering method on the Site 865 PETM record reveals a transient but significant decrease in the diversity of tropical planktic foraminifer communities at the onset of the event contrary to previous interpretations Application of the aforementioned isotopic filtering method to high latitude planktic foraminiferal assemblages of the PETM record of Site 1135 in chapter 4 revealed a similar short lived decrease in diversity previously undetectable in the unfiltered assemblages Lastly in chapter 5 I generate parallel  $^{13}\text{C}$  records of the carbon isotope excursion CIE marking the PETM in the Site 1135 section using traditional gas source mass spectrometry GSMS requiring analysis of whole foraminifer shells and secondary ion mass spectrometry SIMS where in situ  $^{13}\text{C}$  measurements are made on micrometer scale domains within individual foraminifer shells Comparison of these parallel  $^{13}\text{C}$  records shows how GSMS analyses fail to capture the full magnitude of the CIE due to incorporated measurement of diagenetic calcite

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