

Monsoon variability during Mid Pliocene Warm Periods: Evidence from Oceanic denitrification at Eastern Arabian Sea



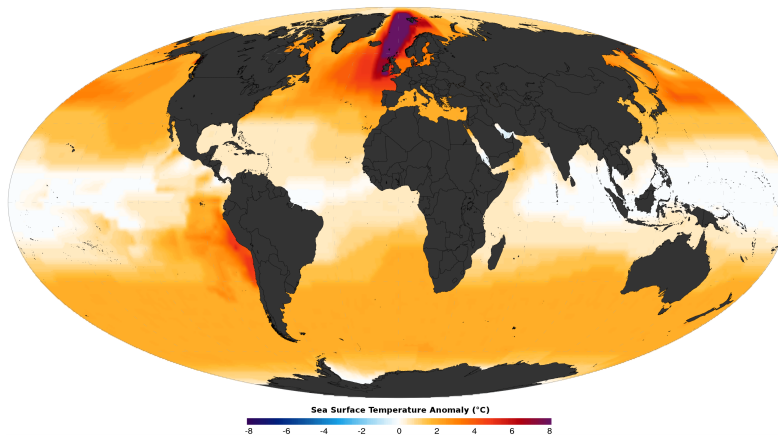
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Mid Pliocene Warm Period (MPWP)

CO₂ , ~ 400 ppmv, Sea level higher by ~20m than today

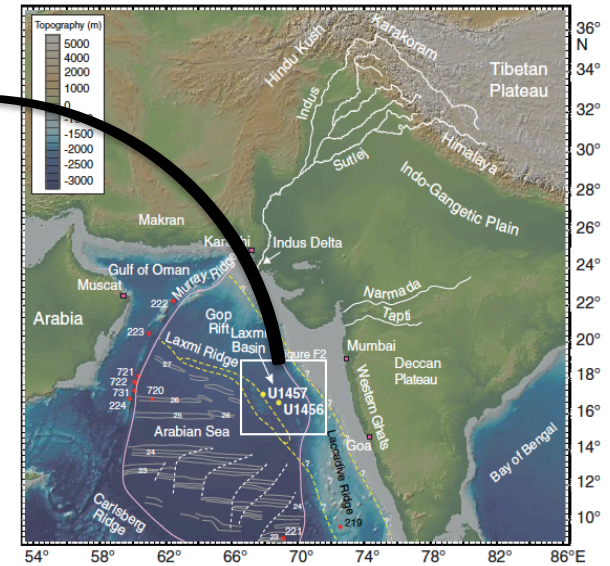
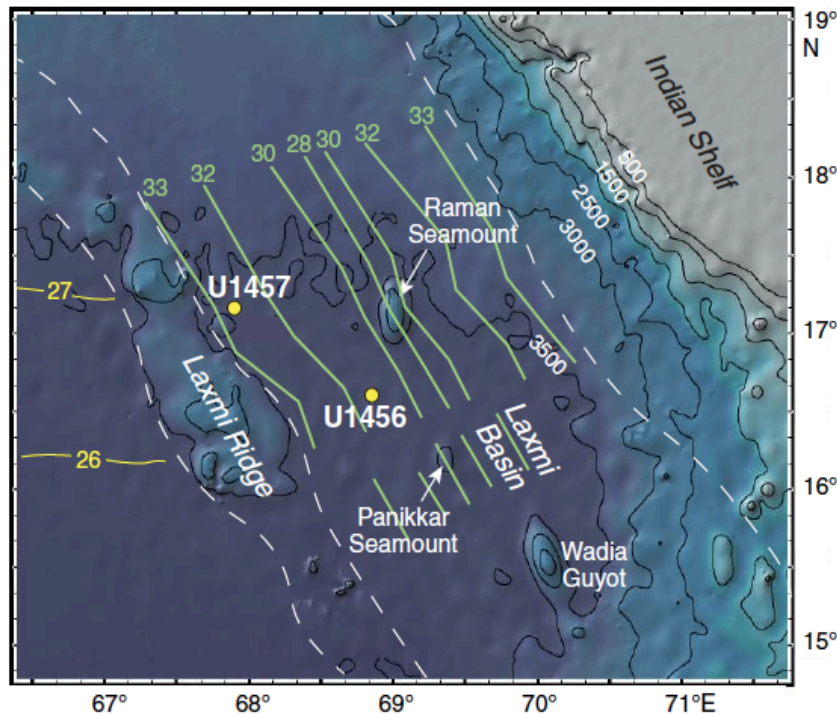
SST, higher by 2.7-4°C
Best analogue for present climate



Era	Period & Subperiod	Epoch & Subepoch	Age	Age (Ma)	GSSP
Cenozoic	Quaternary	Holocene			
		Pleistocene	L	'Tarantian'	0.012
			M	'Ionian'	0.126
				'Calabrian'	0.781
			Early	Gelasian	1.806
	Tertiary	Pliocene		Piacenzian	2.588
				Zanclean	3.600
		Miocene		Messinian	5.332
				Tortonian	7.246
				Serravalian	11.608
				Langhian	13.65
				Burdigalian	15.97
				Aquitania	20.43
					23.03
		Oligocene		Chatian	28.4
				Rupelian	33.9
		Eocene		Priabonian	37.2
				Bartonian	40.4
				Lutetian	48.6
				Ypresian	55.8
	Paleogene	Paleocene		Thanetian	58.7
				Selandian	61.7
				Danian	65.5

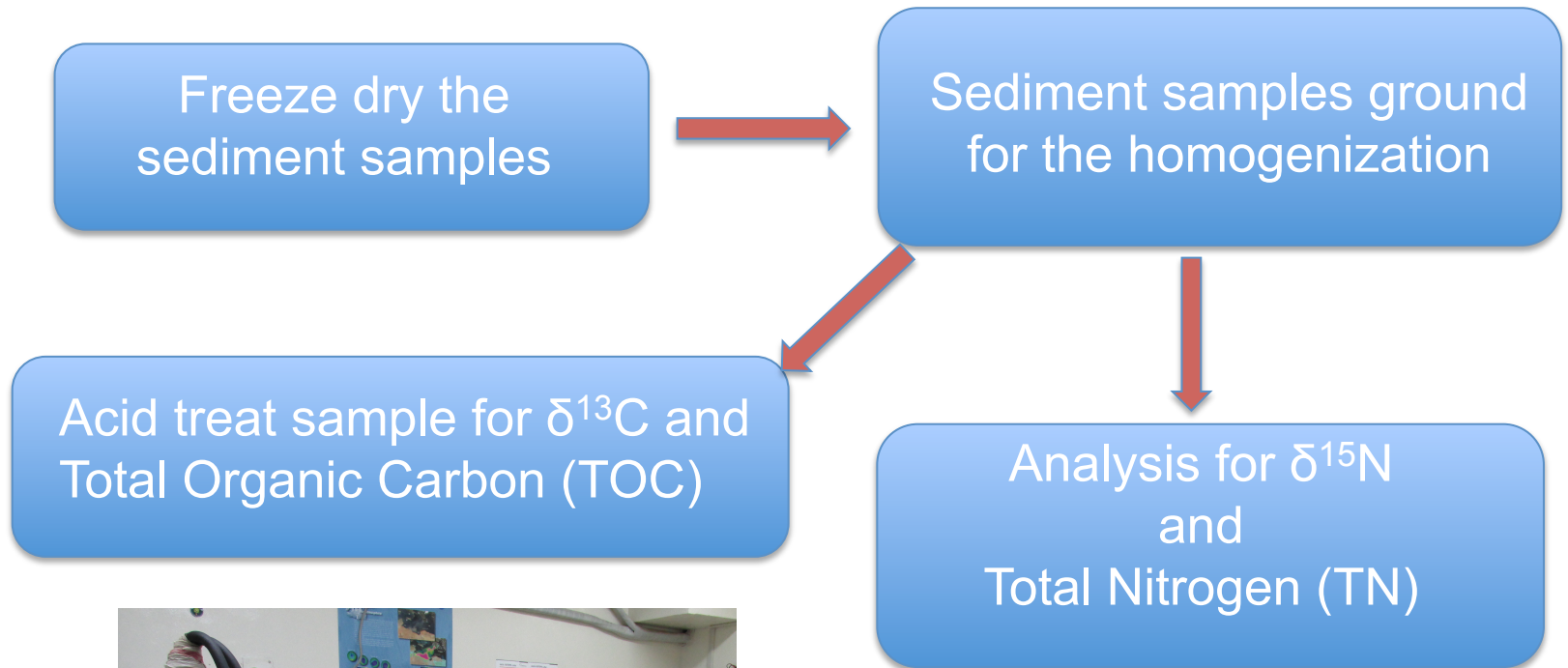
Study Area

IODP-355, Core site U1456 A,
water depth-3650m,
Lat: $68^{\circ}50.33'E$, Lon: $16^{\circ}37.28'N$



Study site is published in
IODP-355 chapter
(Pandey et al., 2016)

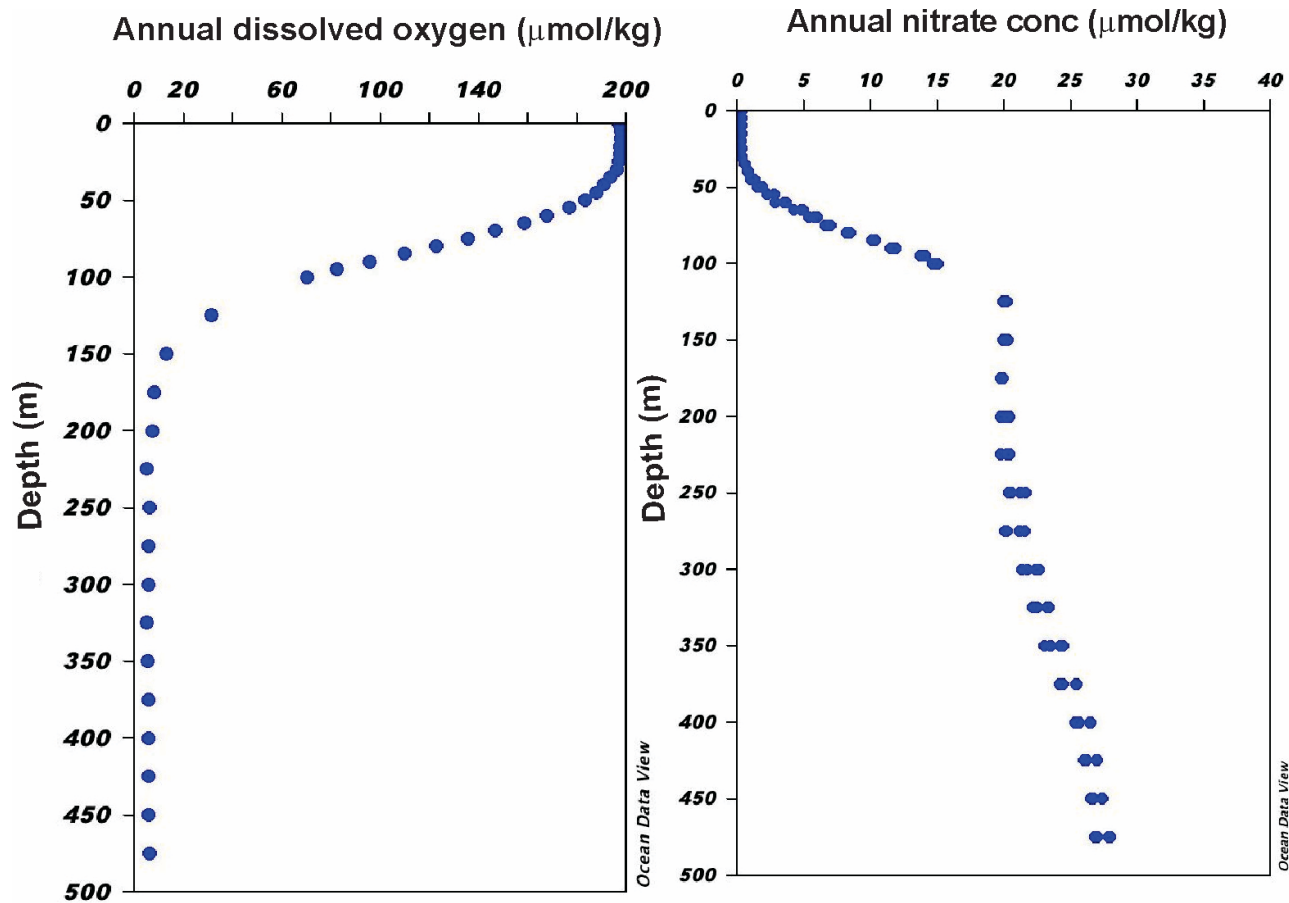
Methodology



EA-IRMS



OMZ and Denitrification

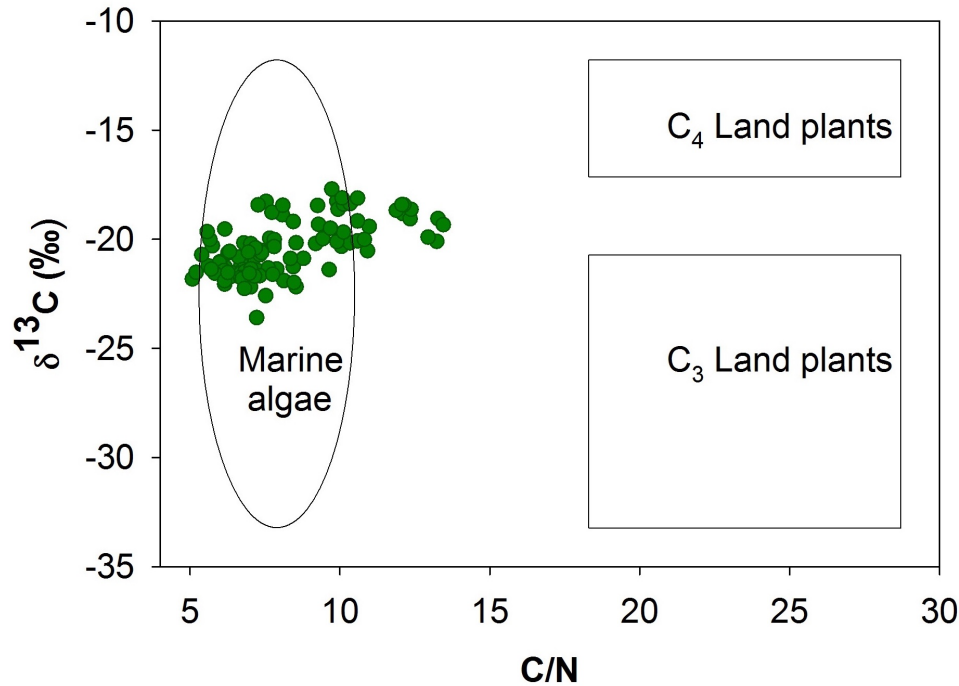


Profile of annual dissolved oxygen Plotted from Ocean Data View (ODV)

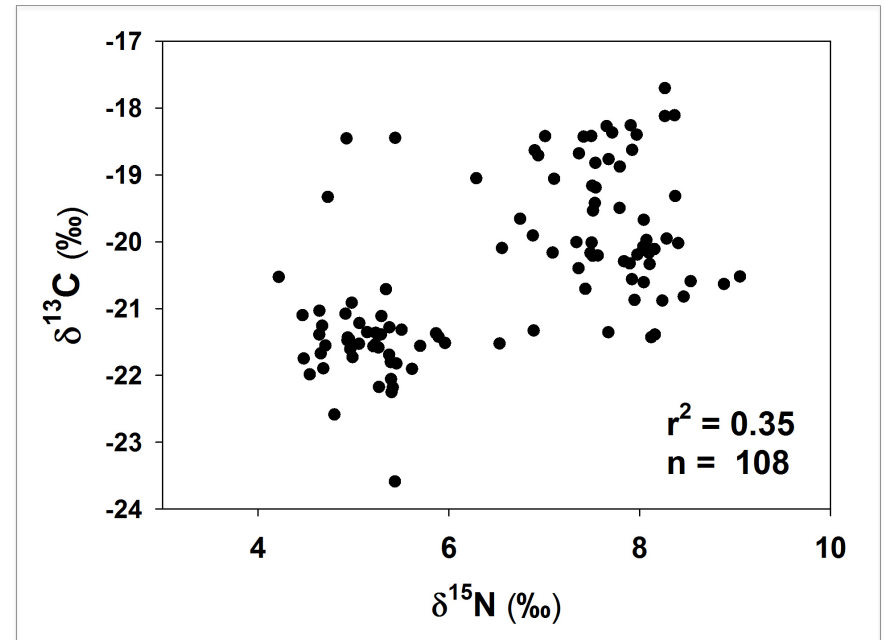
OMZ occurs at ~ 150m to 1200m depth, in this zone the nitrate (NO_3^-) is used as an oxidizing agent for the respiration of organic matter and the largest fractionation leads to high $\delta^{15}\text{N}$ values

Result

Provenance determination



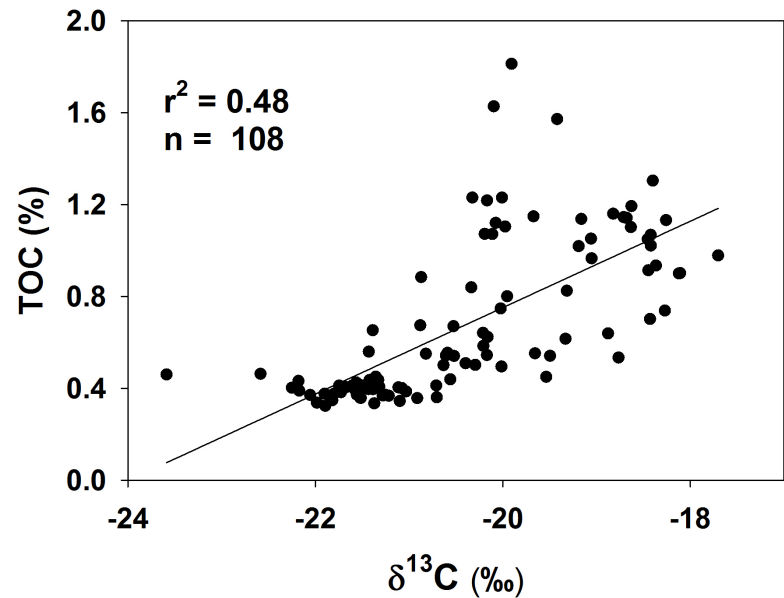
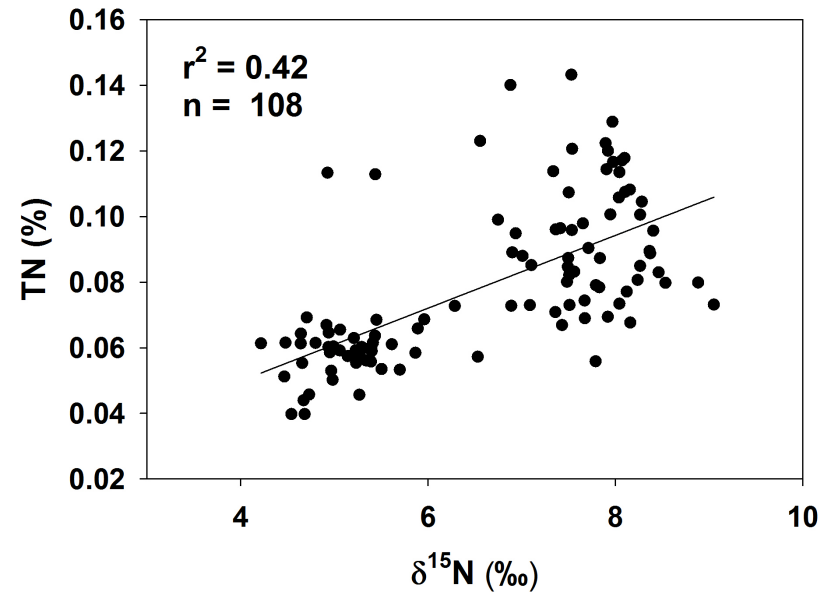
Core site has a mixture of both aquatic and terrestrial organic matter



Less effect of terrestrial input on nitrogen isotope

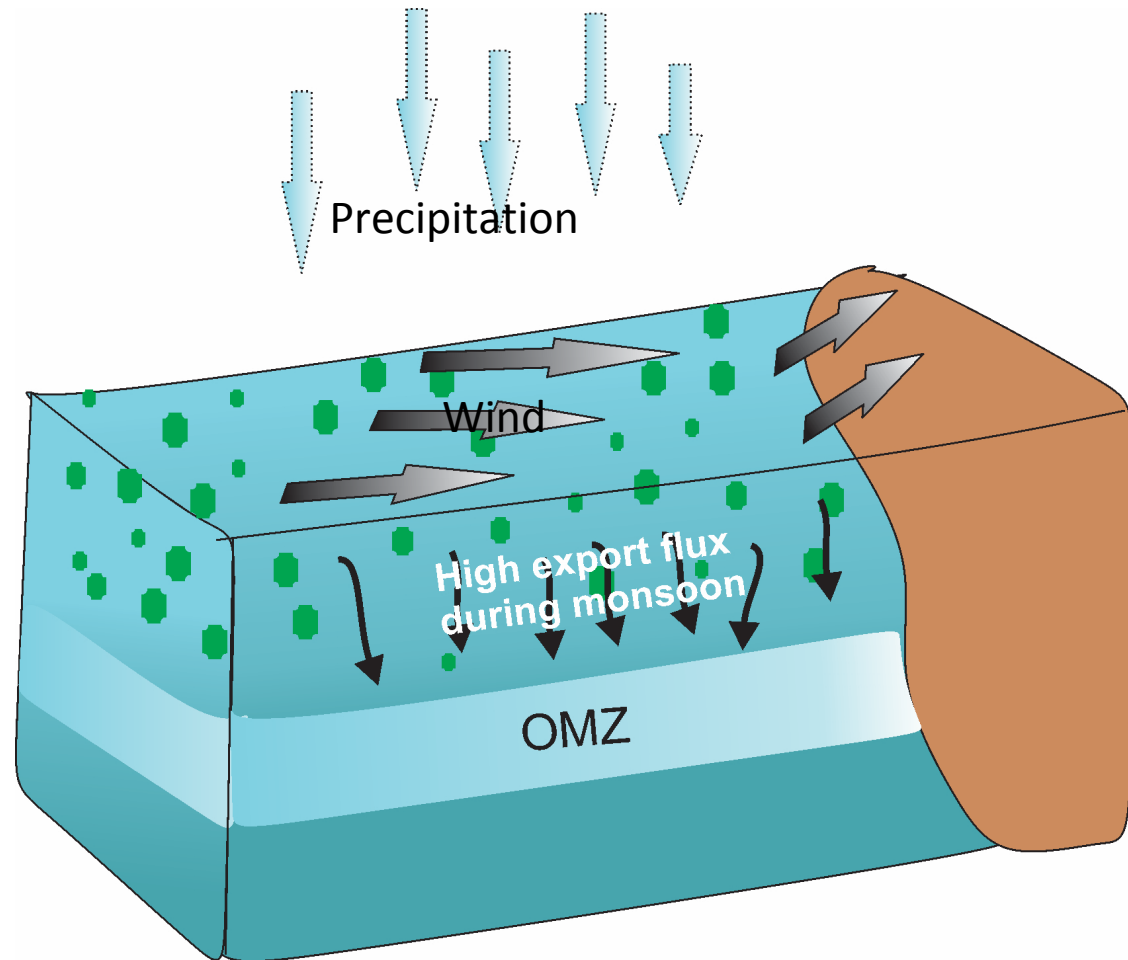
Result

- Early diagenesis affects both elemental concentration and isotopic composition of organic matter
- Isotopic value increases while elemental concentration decreases due to diagenesis
- The negative correlation between elemental concentration and their respective isotopic values indicates diagenesis effect on SOM
- Positive correlation indicates less impact of diagenesis at the core site



Conclusion

- High productivity during MPWP is indicated by high TOC and TN % representing the intensification of South Asian Monsoon
- High denitrification during MPWP shown by $\delta^{15}\text{N}$ values indicates low dissolved oxygen in water column due to the consumption of NO_3^- by monsoon induced productivity.



High productivity corresponds to strong denitrification (high $\delta^{15}\text{N}$), that indicates intensification of South Asian Monsoon during Mid- Pliocene warm period (3.26-3.02ma) and from 2.92- 2.75 ma.