MISSISSIPPI AND ATCHAFALAYA RIVER INFLUENCE ON SEDIMENT POREWATER CHEMISTRY

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INTRODUCTION

- The Mississippi & Atchafalaya Rivers drain ~⅔ of the United States
- Delivers ~380 km^3 / yr of freshwater to the Louisiana Continental Shelf (LCS)
- The LCS is seasonally hypoxic
- Terrestrially derived organic matter (OM) is deposited in highest concentrations nearshore tapering off with distance and depth
- Bacteria use oxygen to hydrolyze complex OM into additional byproducts
- Reduced end products contribute to sediment oxygen demand (e.g., NH_4^+, FeII, & HS^-)
- Re-oxidation consumes most of the oxygen in coastal sediments with <25% consumption from aerobic respiration (Middelburg and Levin, 2009)
- Hetland & DiMarco (2008) propose water column respiration as the predominant cause of hypoxia on the eastern LCS with benthic respiration having a stronger influence on the western LCS
- Most sediment biogeochemistry studies have been focused east of Terrebone Bay
- Information from a shelf wide study indicated differences in sediment parameters between near shore and offshore stations and also between eastern and western shelf stations

MATERIALS AND METHODS

- 12 stations, 4 transects across LCS, 3 stations / transect
- No hypoxia
- Triplicate 10 cm diameter cores
- Processed under N_2
- 1 cm fractions - top 4 cm, 2 cm afterwards
- Porewater and sediment solid phase

Porewater analyses: DIC and NH_4^+ were analyzed by flow injection analysis (Hall & Aller), Fe^{2+} using ferrozine (Stookey), Mn quantified by ICP-MS, and NO_X, Si, & oP were determined using standard methods on a discrete analyzer.

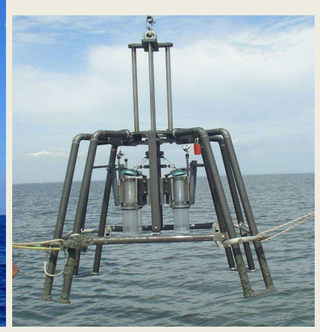
Solid Phase analyses: FeII and FeT (total) were determined on oxalate extracts (Thamdrup & Canfield), FeIII by subtraction (FeT - FeII), SRR was determined following distillation (Fossing & Jørgensen), and OC determined from HCl fumed sediments by combustion analysis.

Concentrations were averaged across the triplicate samples at each depth interval. The concentrations were integrated to 8 cm (porewater) and 10 cm (solid phase), accounting for porosity and particle density in the case of solid phase measurements (Burdige), and are presented on a m^{-2} of basis.

AVERAGE ANNUAL LOADING

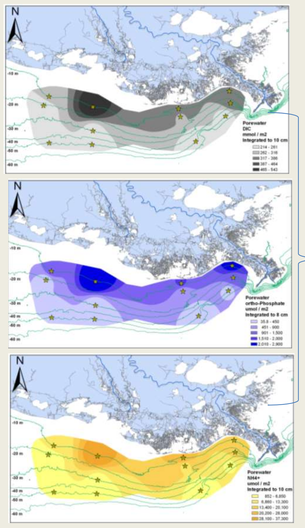
	Flow	OC	oP	NH_4^+	NO_X	SiO_2	Fe	Mn
MS R	441	233	1.3	2.5	42.7	95.9	46.7	1.73
Atch R	193	118	0.6	1.5	14.1	42.6	15.6	0.68

*Data set obtained from USGS. 1/1/1950-12/31/2009. Averaged and scaled to 1 year.
Flow = km^3 / yr Analyte units = Gmol Analyte / yr
MS R = Tarbert Landing, MS Atch R = Simmesport, LA

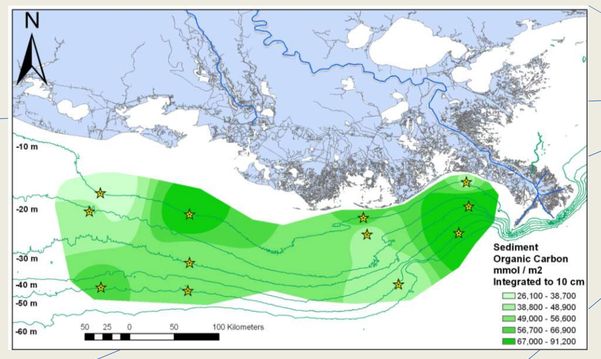


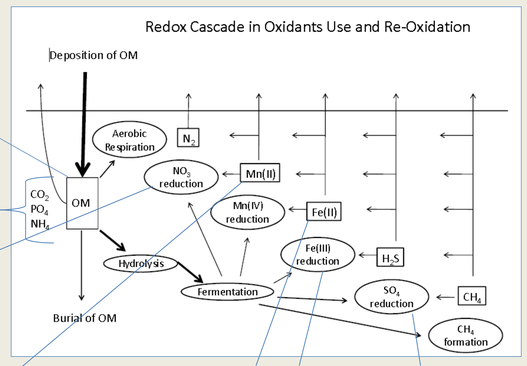
ORGANIC MATTER (OM) DISTRIBUTION

Decomposition of OM results in production of DIC, oP, and NH_4^+. Spatial patterns in the concentrations of these are similar to the pattern seen with OM.

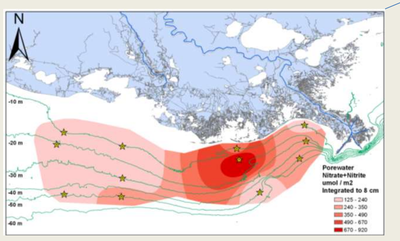


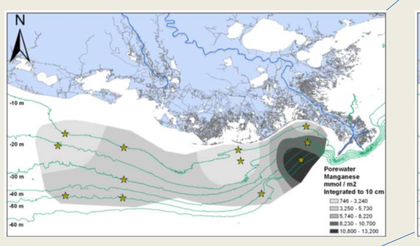
OM concentrations are highest near the outfalls of the Mississippi & Atchafalaya Rivers.

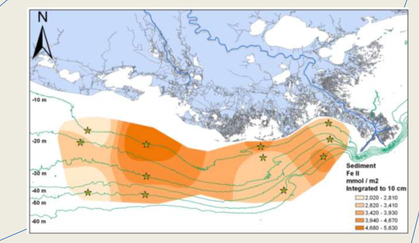




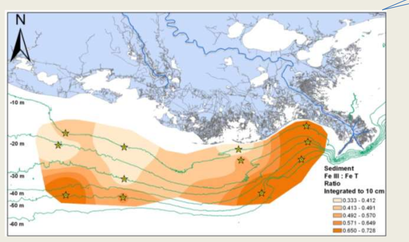
OM degradation and re-oxidation pathways in marine sediments. Oxidants are utilized sequentially (O_2, NO_3, metal oxides, and SO_4). Middleburg & Levin, 2009

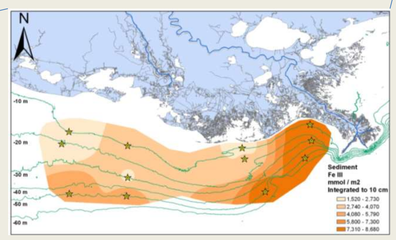




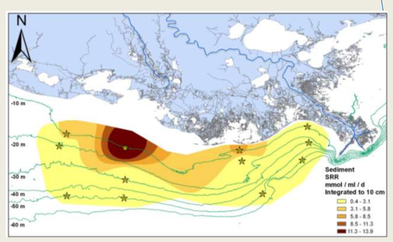


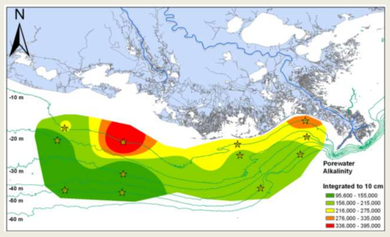
Higher ratios of oxidized : total iron were found near the Mississippi Delta and also in the deeper, off-shore stations.



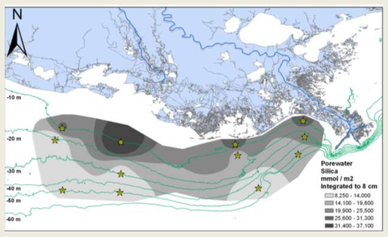


High Mn concentrations were observed close the Mississippi Delta and are lower outside of the Atchafalaya where SRR measurements were high.





Fe reduction associated with higher alkalinity, while Fe oxidation reduces alkalinity. Krumins et al. 2012



Riverine input is the dominate source of Si. High concentrations nearshore reflect this delivery source. Tréguer et al. 1995

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SUMMARY

- Areas identified as having higher concentrations of Organic Carbon were observed adjacent to the major sources of freshwater input.
- In addition to the high Organic Carbon observed in the Atchafalaya outfall, high concentrations of DIC, oP, NH_4^+, SRR, and Si were also observed.
- Lower SRR rates near the Mississippi River Delta correspond to higher concentrations of reduced porewater Mn^{2+} (opposite of the Atchafalaya).
- Oxidized vs. reduced iron patterns.
- Alkalinity patterns and parallels.
- Indications of differing sediment zonation.

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