

Stable isotope tracing of nutrient and organic matter sources and cycling in the SJR, Delta, and North Bay

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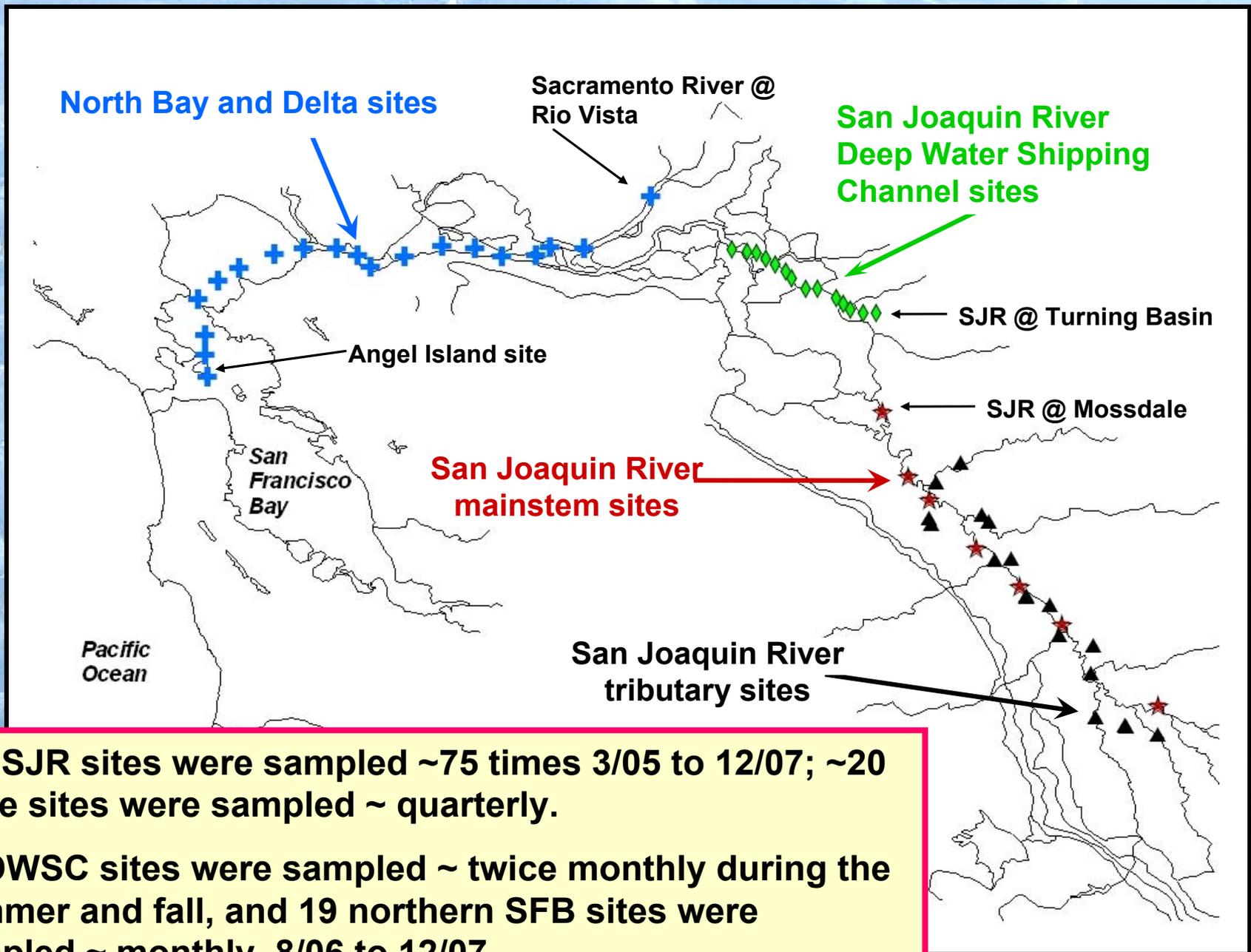
Boat access and chemical data provided by the USGS SFB group and the DWR DO Run group.

Project Purpose:

The approach of this project is to use both concentrations and isotopic composition of these water quality constituents in order to assess:

- (1) sources of nutrients,
- (2) sources of the organic matter, and
- (3) biogeochemical cycling of the nutrients and organic matter that lead to algal formation (that may affect aqueduct water quality and make the water difficult to treat) and oxygen demand.

Sampling Sites



~21 SJR sites were sampled ~75 times 3/05 to 12/07; ~20 more sites were sampled ~ quarterly.

14 DWSC sites were sampled ~ twice monthly during the summer and fall, and 19 northern SFB sites were sampled ~ monthly, 8/06 to 12/07.

Analyses

All samples were analyzed for:

- Water $\delta^{18}\text{O}$ and $\delta^2\text{H}$
- Nitrate $\delta^{15}\text{N}$ and $\delta^{18}\text{O}$
- POM $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, and C:N (at.)
- DOC $\delta^{13}\text{C}$
- Chemistry (extensive data for the SJR; very limited data for the Bay and Delta)

Subsets of samples analyzed for:

- DIC $\delta^{13}\text{C}$
- Sulfate $\delta^{34}\text{S}$ and $\delta^{18}\text{O}$
- Phosphate $\delta^{18}\text{O}$
- POM $\delta^{34}\text{S}$
- DO $\delta^{18}\text{O}$

Samples were archived for:

- Ammonium $\delta^{15}\text{N}$
- DOM $\delta^{15}\text{N}$ and $\delta^{34}\text{S}$
- Other chemical and isotopic analyses.

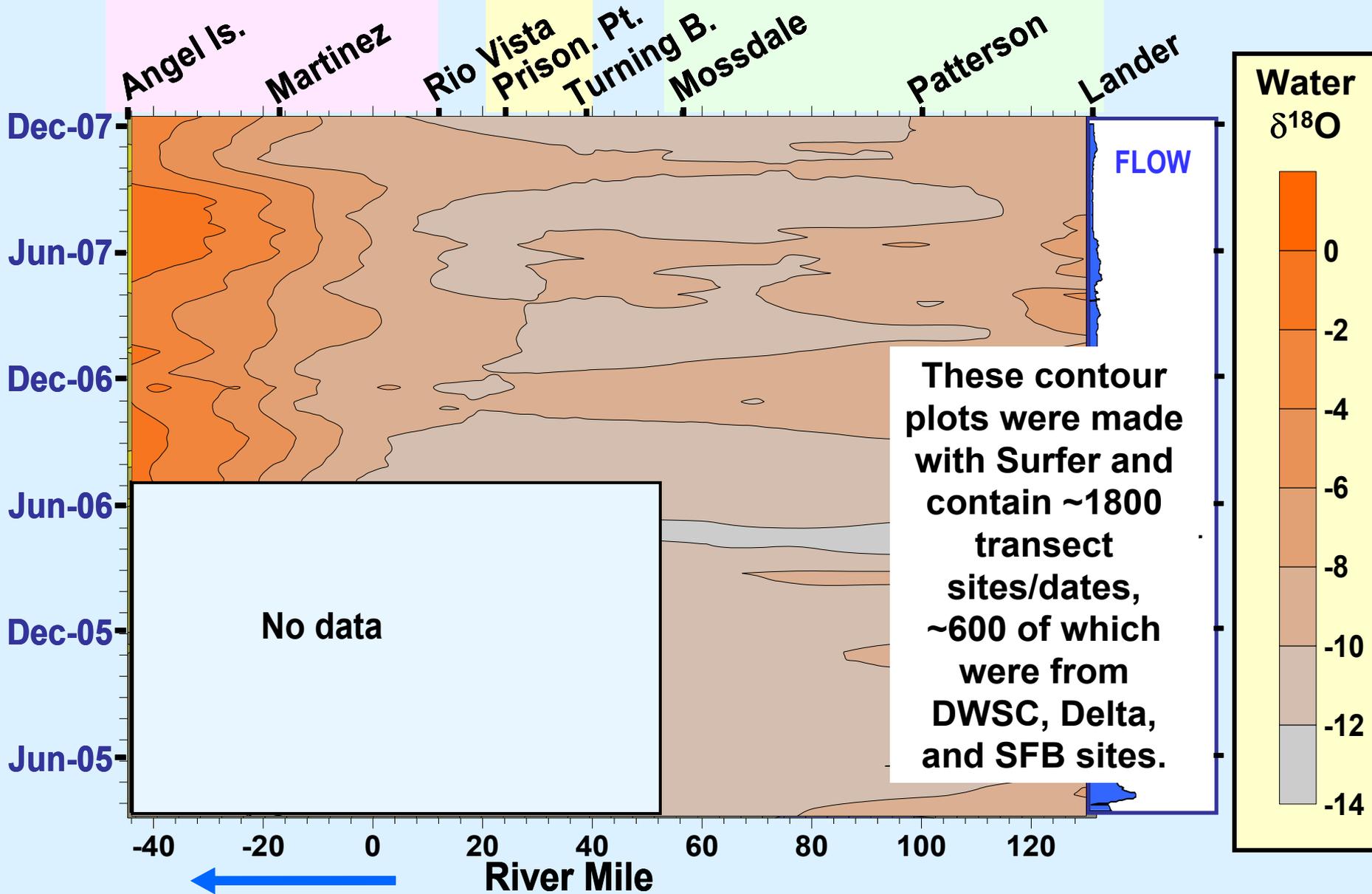
How do isotopes help trace sources of nutrients and organic matter ?

Sources and sinks can often be identified, traced, and semi-quantified because:

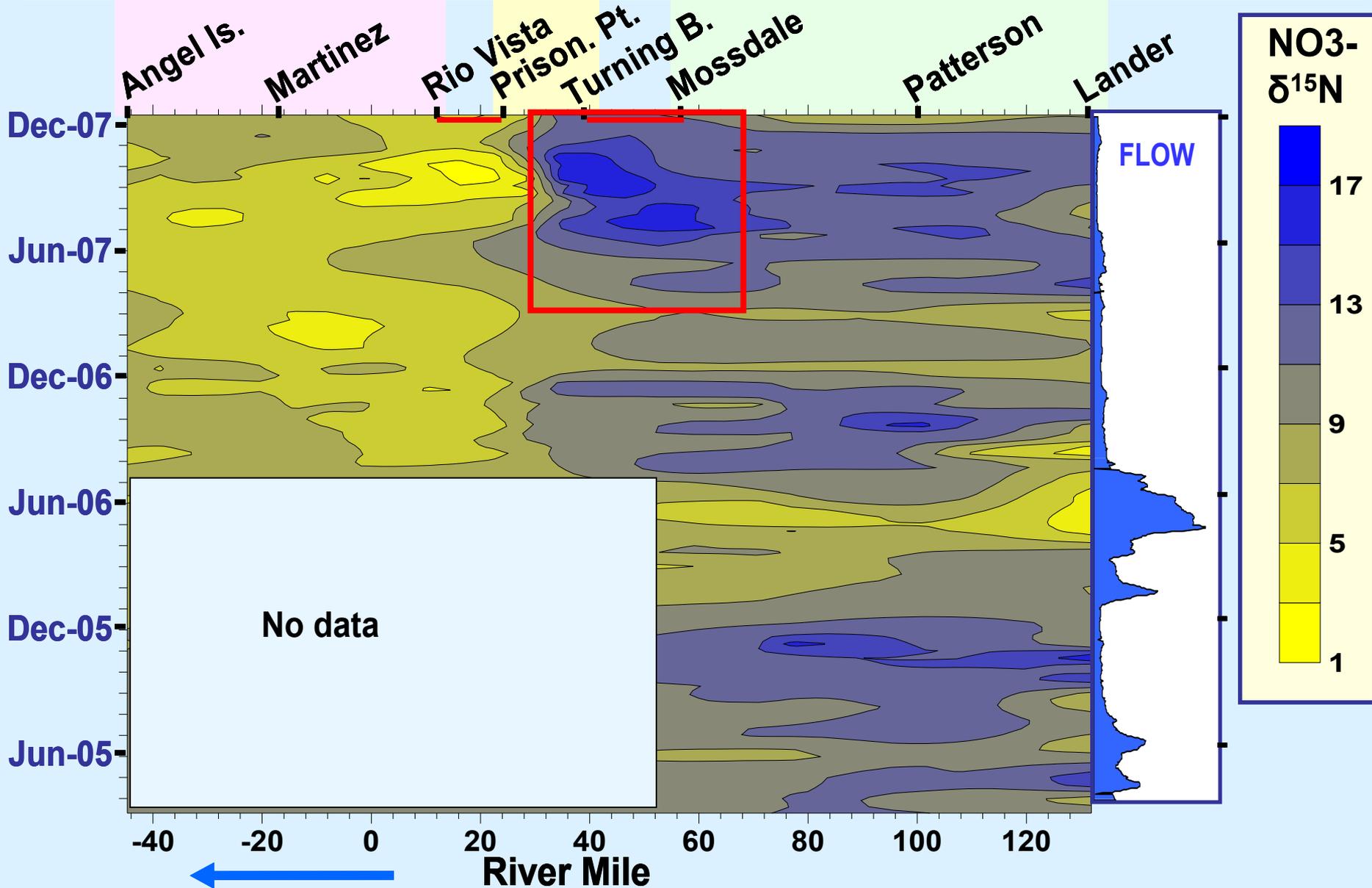
- ❖ nutrients and organic matter derived from different sources and land uses often have distinctively different isotope compositions, and
- ❖ different kinds of sinks can sometimes cause distinctive shifts in isotopic compositions.

In other words, different sources of nutrients and organic matter often have **distinctive isotope “fingerprints”** that can provide a better understanding of the system than just chemical data.

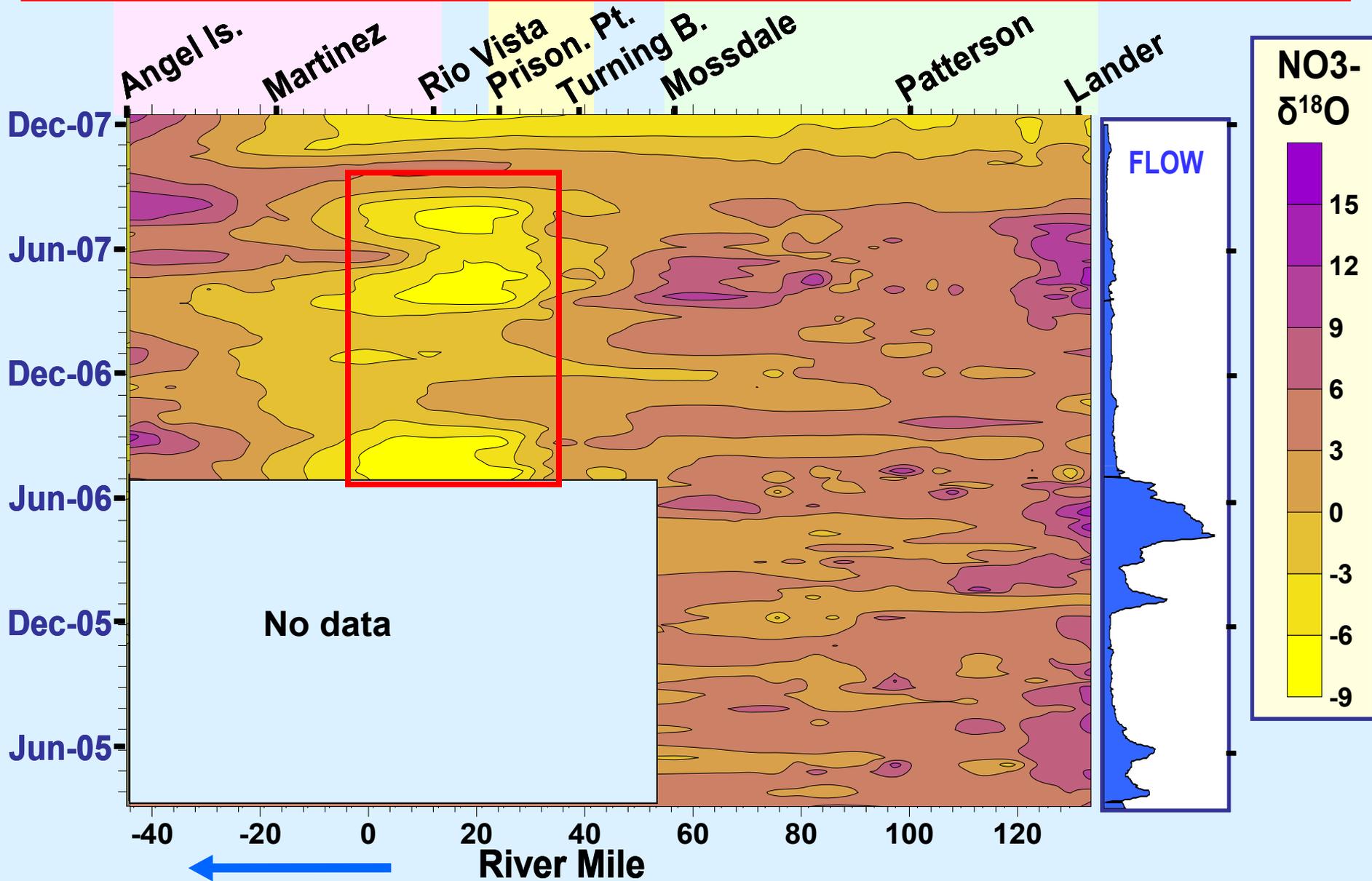
Temporal and spatial changes in H₂O- $\delta^{18}\text{O}$ over ~170 miles of the estuary



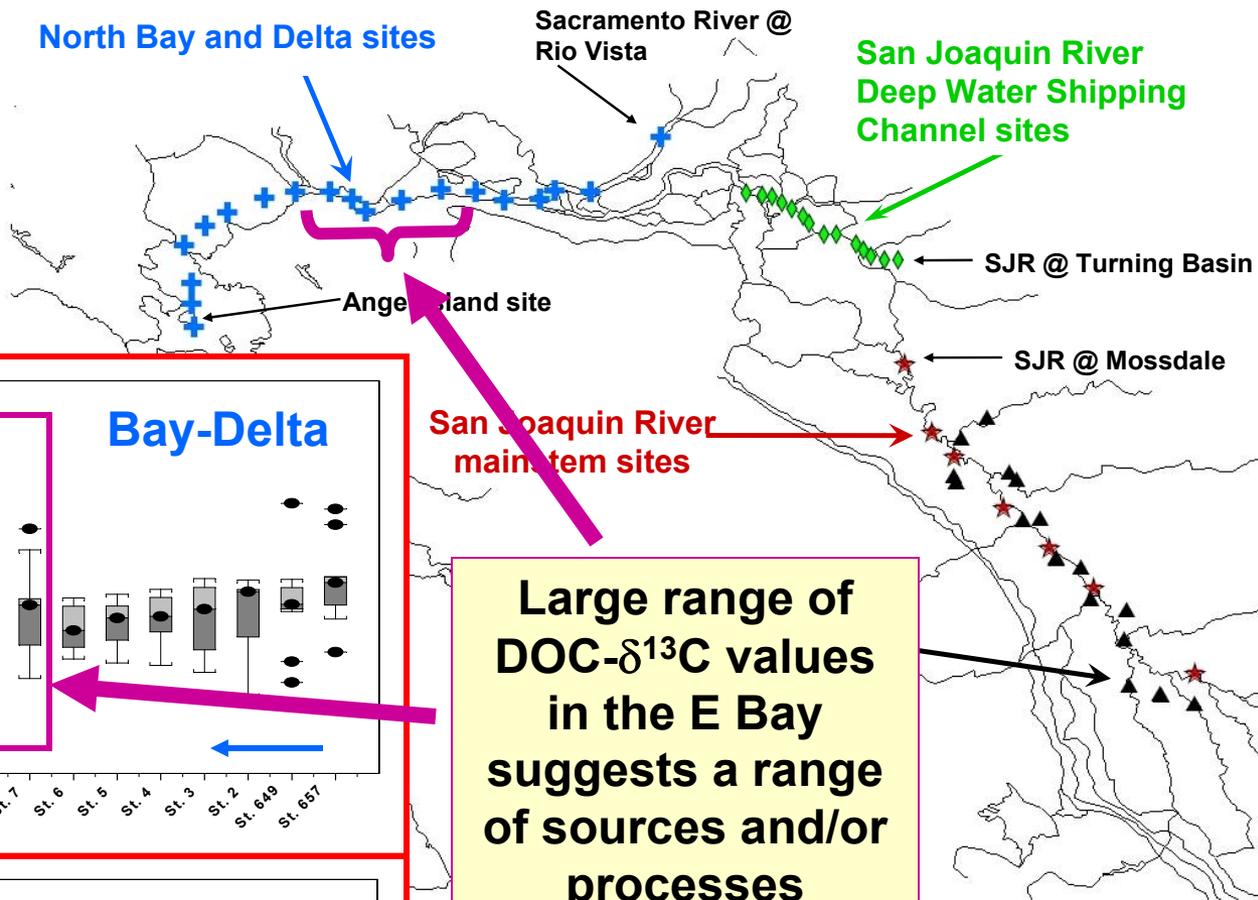
High $\delta^{15}\text{N}$ -NO₃ values are associated by intense algal blooms and/or waste sources



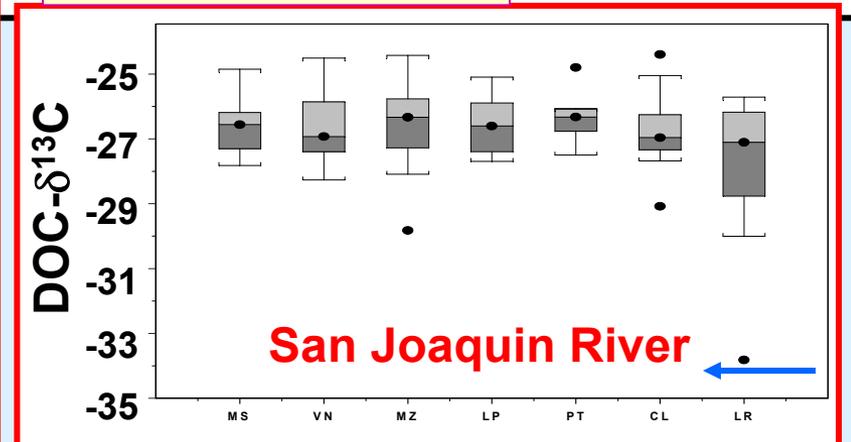
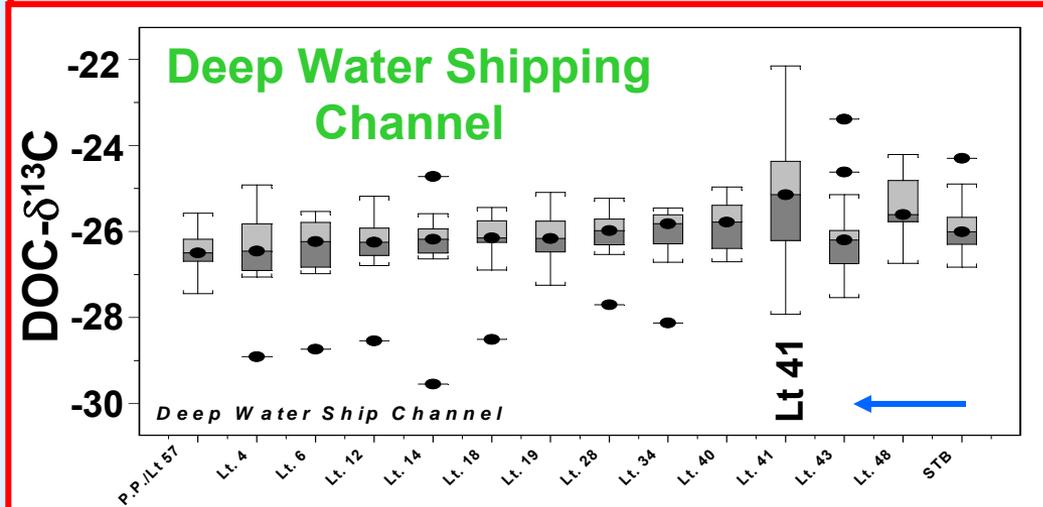
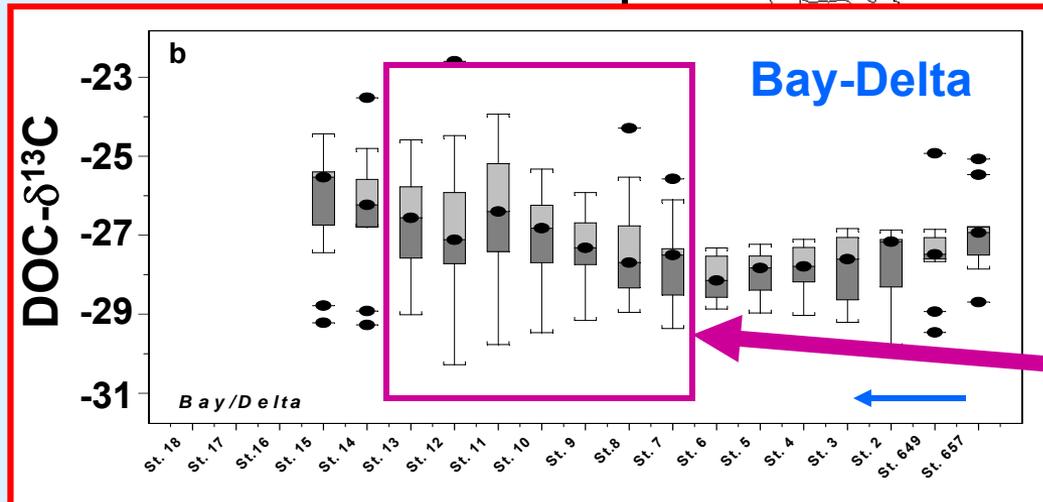
Low $\delta^{18}\text{O}$ -NO₃ values are associated with different sources of NO₃, perhaps due to nitrification of NH₄ in the Delta, derived from the Sacramento River or wetlands.



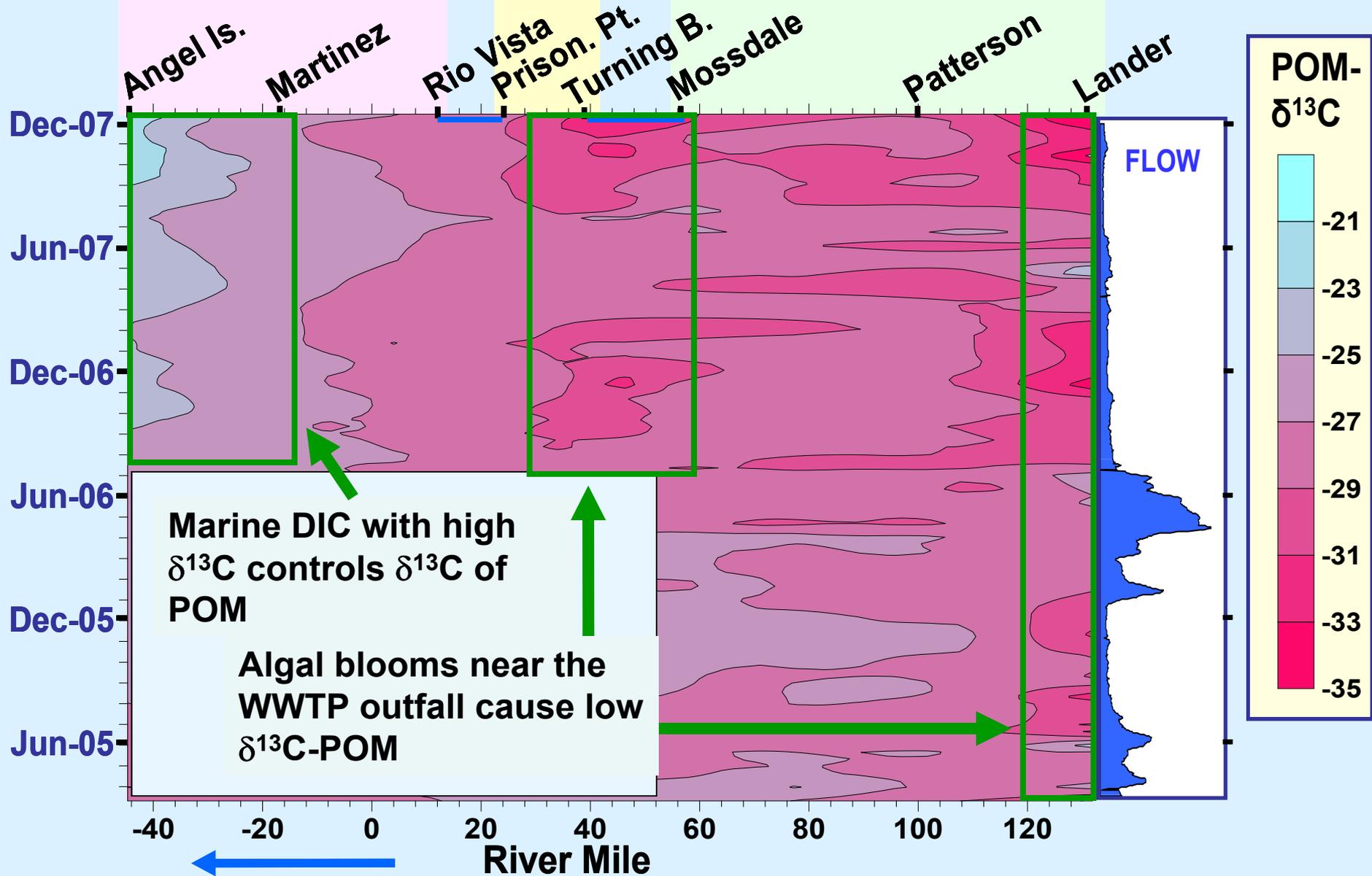
$\delta^{13}\text{C}$ of DOC usually shows small changes related to terrestrial vs algal sources of the DOC.



Large range of DOC- $\delta^{13}\text{C}$ values in the E Bay suggests a range of sources and/or processes

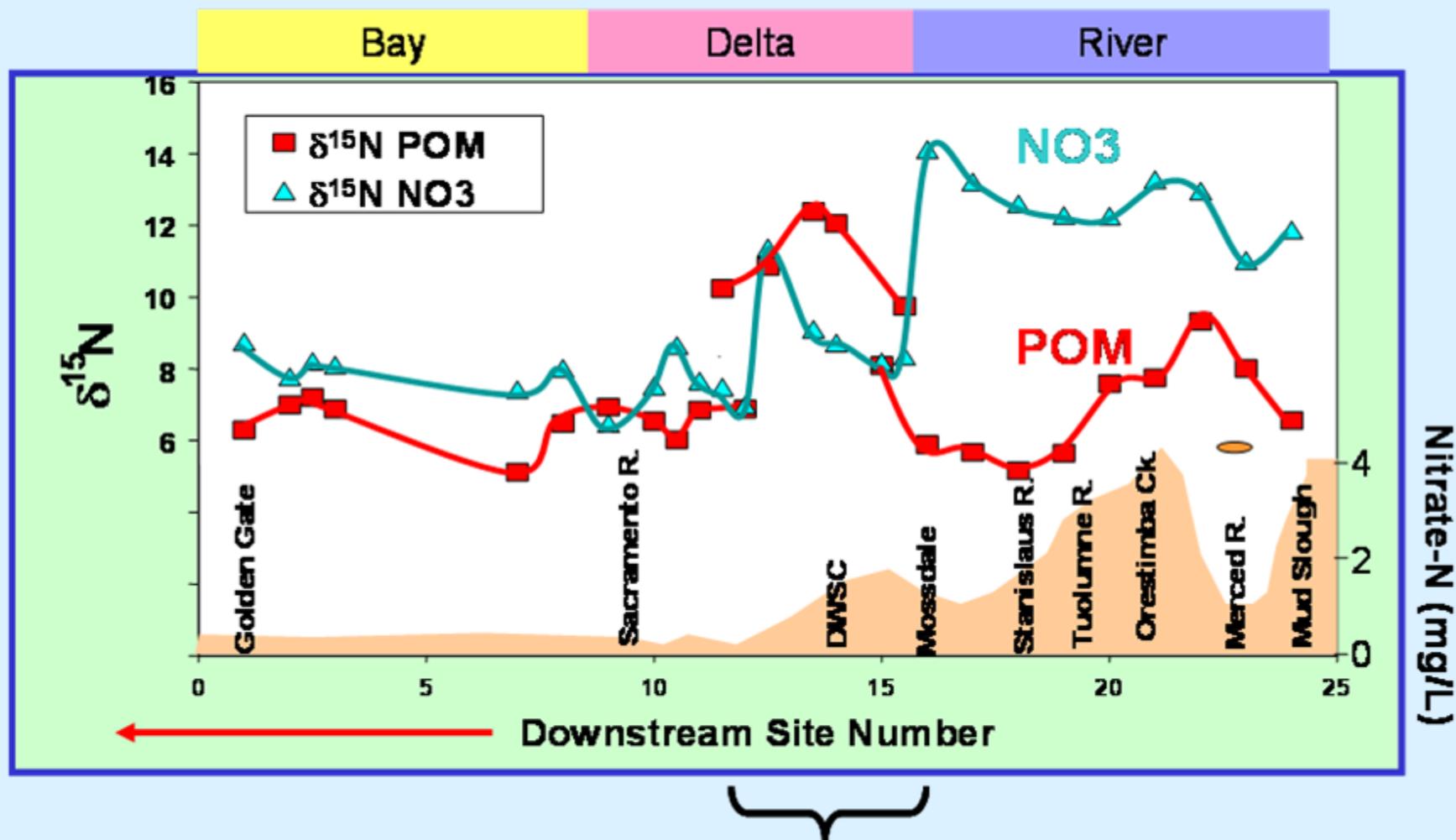


High $\delta^{13}\text{C}$ -POM values are caused by ocean DIC, low $\delta^{13}\text{C}$ values are caused by algal blooms



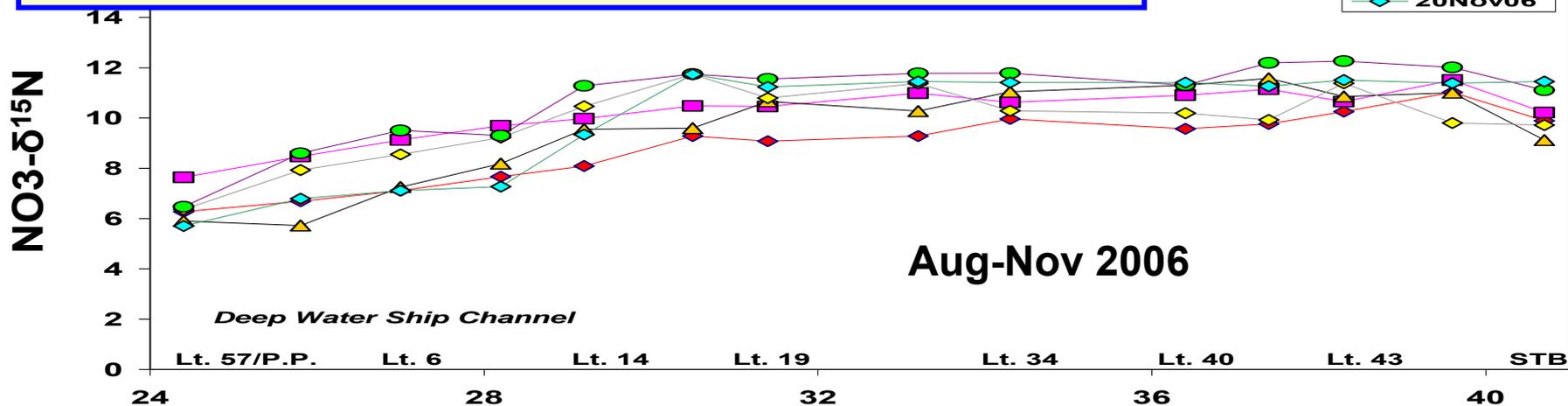
Transect showing changes in the $\delta^{15}\text{N}$ of NO_3 and POM in August 2004

The $\delta^{15}\text{N}$ of the river POM (mostly algal) tracks the $\delta^{15}\text{N}$ of nitrate.



Near the WWTP, $\delta^{15}\text{N}$ data indicate considerable nitrification of NH_4 , followed by uptake of the resulting ^{15}N -enriched NH_4 by algae.

These plots (and the subsequent paired plots) show how nitrate isotopes changed in the upper DWSC between 2006 and 2007.



The 6 transects in 2006 showed much less variability than the 12 transects in 2007.

