AOGS 2005

Tracing Causes of Hypoxia in Riverine Ecosystems Using Isotope Techniques: A Case Study in the San Joaquin River, USA

CAROL KENDALL[1] and STEVEN R. SILVA[1]
[1]*United States Geological Survey, Menlo Park, California, USA*

Hypoxic conditions in rivers and coastal ecosystems can cause significant problems for fish migration, the local fishing industry, and for the usefulness of the water body for drinking water and recreational purposes. While it is usually obvious that the main cause of the low dissolved oxygen levels is excess nutrients, it is less obvious exactly what should be done to correct the problem. This is because there are many different land uses that contribute nitrate, ammonium, and organic matter to the river, and it is difficult to determine how much of the nutrients and organics in the river are derived from crop agriculture, dairies, feedlots, urban wastewater, etc. using standard chemical and hydrologic mass balance methods. Understanding the sources and sinks for organics and nitrate is critical for devising effective strategies for reducing their loads in the ecosystem and solving local problems with low dissolved oxygen levels and production of disinfection byproducts during water treatment.

In the last few decades, numerous studies have shown that stable isotopic techniques -- particularly multi-isotope approaches -- are a powerful tool for determining sources of nutrients and organic matter because materials derived from different sources and land uses often have distinctively different isotope compositions. Hence, isotopes can be used to test competing theories about sources and evaluate alternative remediation strategies. In this presentation we will use data from a pilot study [1] in the San Joaquin River (California, USA) as a case study to illustrate the usefulness of isotopic techniques for (1) determining sources of nutrients and organic matter in a river with episodic hypoxia problems in a dredged shipping channel, (2) showing the link between land use, nitrate, and the production of algae in this system, and (3) devising science-based remediation strategies.

The main conclusions from our preliminary investigations are: (1) particulate organic matter (POM) at main San Joaquin River sites is mainly algal in origin except during major storms, whereas POM from the creeks and drains contains appreciable terrestrial detritus, (2) most of the algae in the river appears to be produced in situ, (3) groundwater is a significant source of nitrate to the river, and (4) much of the nitrate in the river appears to be derived from animal waste, possibly from the many small dairies adjacent to the river. Hence, isotope data are a useful adjunct to traditional methods for assessing and monitoring sources of organics and nutrients.

References

[1] C.R. Kratzer, P.D. Dileanis, C. Zamora, S.R. Silva, C. Kendall, B.A. Bergamaschi,and R.A. Dahlgren, **USGS WRI 03-4127** (2004) http://water.usgs.gov/pubs/wri/wri034127/