SUMMARY AND CONCLUSIONS

A two year study of sediment cores collected from the Pamlico and Neuse River estuaries has been completed. The purpose of this paleoecological study was to begin to re-create the history of water quality in these estuaries by dating sediment core samples and analyzing indicators of water quality, nutrient and trace metal flux, and diatom assemblages through time. We also analyzed the stratigraphic record of pollen found in the sediments for dating purposes. The results indicate that this type of study is not only feasible in these estuarine systems but also very useful. Sediment chronologies have been developed for the sediment cores collected, and the resolution of each 2-cm increment of each core varies from less than 1 year in recent sediments to 36 years in older sediments. Average sedimentation rate in the past 50 years is 0.65 cm yr^{-1}. Sedimentation rates have generally increased three to 10-fold in the past 50 years over previous sedimentation rates based on the data and the models used.

Results show that nutrient, metal and sulfur flux to the sediments has increased over the past 50 years. Trace element analyses show that surface sediments often contain heavy metal concentrations that exceed "Threshold Effects Levels" (TEL) as reported by the U. S. Environmental Protection Agency. Cadmium shows highest levels in the Pamlico estuary at the core collection site nearest the phosphate mining operations. Most other metals show higher concentrations in the Neuse River estuary.

Diatom valves and pollen grains are well preserved in the sediments of the Neuse and Pamlico. For example, samples analyzed to date from the Pamlico River estuary contain diatom valves in abundances of about 1 to 5 million valves per cubic cm of wet sediment, and pollen grains are present in abundances of about 50,000 to 500,000 per cubic cm of wet sediment. Over 430 diatom species have been identified from subsampled intervals of the Pamlico and Neuse sediment cores to date.

Diatom and pollen assemblages have changed through time. The most dramatic assemblage changes in the diatoms appear to have occurred in the past 30-50 years in the Pamlico and Neuse estuaries, possibly associated with industrial activity, increasing population, and land-use changes. Recent assemblages are composed of higher abundances of small planktonic taxa that are often found in large blooms in higher nutrient waters. These samples exhibit relatively low species richness and diversity compared to older (pre-1950) samples. Older diatom assemblages are composed of more benthic and epiphytic taxa. Changes likely reflect eutrophication, increased turbidity and sedimentation, and increased freshwater flow to the estuaries, as well as an increase in industrial activities. They may also reflect declines in submerged aquatic vegetation in these estuaries. Overall trends are similar to those found in the Chesapeake Bay, although the time frame of major changes is different. Similar changes began to occur much earlier in the Chesapeake. Pollen assemblage changes include an increase in ragweed pollen over the past several hundred years signifying increased land disturbance by humans. Pollen count results also show an increase in nut tree pollen (walnut and pecan) over the last several hundred years and an increase in sweetgum tree pollen in the past 50 years.

The biogenic silica (BSi) results and the determination of diatom valve flux to the sediments both show that more diatom frustules are being deposited to the sediments in recent years. BSi is primarily a measure of diatom frustules, which are composed of biologically deposited silica. These results indicate higher diatom production, most likely due to increased nutrient inputs to the estuaries. As production increases, dissolved silica in the waters may become limiting, especially if diatoms frustules are preserved in the sediments and not recycled. As silica becomes limiting in the water column, diatoms may be out-competed by other algal species, including dinoflagellates. Diatoms are generally better food sources in the estuarine food web than other algal species, so this change could potentially cause problems in higher trophic levels.

Understanding the historical processes of water quality problems is important for managing the continuing impacts of growing populations in North Carolina. These data are useful for providing information on historical changes in estuarine water quality and realistic goals for management.

RECOMMENDATIONS

- Human impacts on estuarine water quality are evident, especially over the past 30-50 years, and should continue to be addressed.

- Sedimentation rates and nutrient and trace metal flux to both the Pamlico and Neuse estuaries appear to have increased in the past 30-50 years. Trace metal levels in surface sediments exceed "Threshold Effects Levels" as reported by EPA at several sites. Efforts should continue to be made to reduce sediment, nutrient and metal inputs to the estuaries.

- Industrial sources are apparently responsible for some of the increase in nutrient and trace metal accumulations in estuarine sediments. This influence appears to be substantial, and should continue to be monitored.

- Population trends and land clearance also appear to have influenced sedimentation and water quality in the estuaries and appear to be more significant for the Neuse. Careful planning and management of development should be a priority for local and state government.

- Preliminary results indicate that hypoxic and anoxic bottom waters can most likely be reduced in the Pamlico with proper management of nutrients and sedimentation.

- Diatom assemblages have changed significantly in the past 10-50 years. These changes may be related to eutrophication, increased turbidity, loss of submerged aquatic vegetation, and increased freshwater flow to the estuaries. Continued monitoring of water quality and algal species would increase our understanding of linkages and aid in management.

- The time frame of water quality changes seen in the Pamlico and Neuse estuaries occurs more recently than similar changes in the Chesapeake Bay. These differences may be due to several factors, including slower population growth, different land use near the estuaries, and the geomorphology of the estuaries. This may indicate that proper management could reverse trends in water quality changes more quickly for these estuaries than for the Chesapeake Bay.