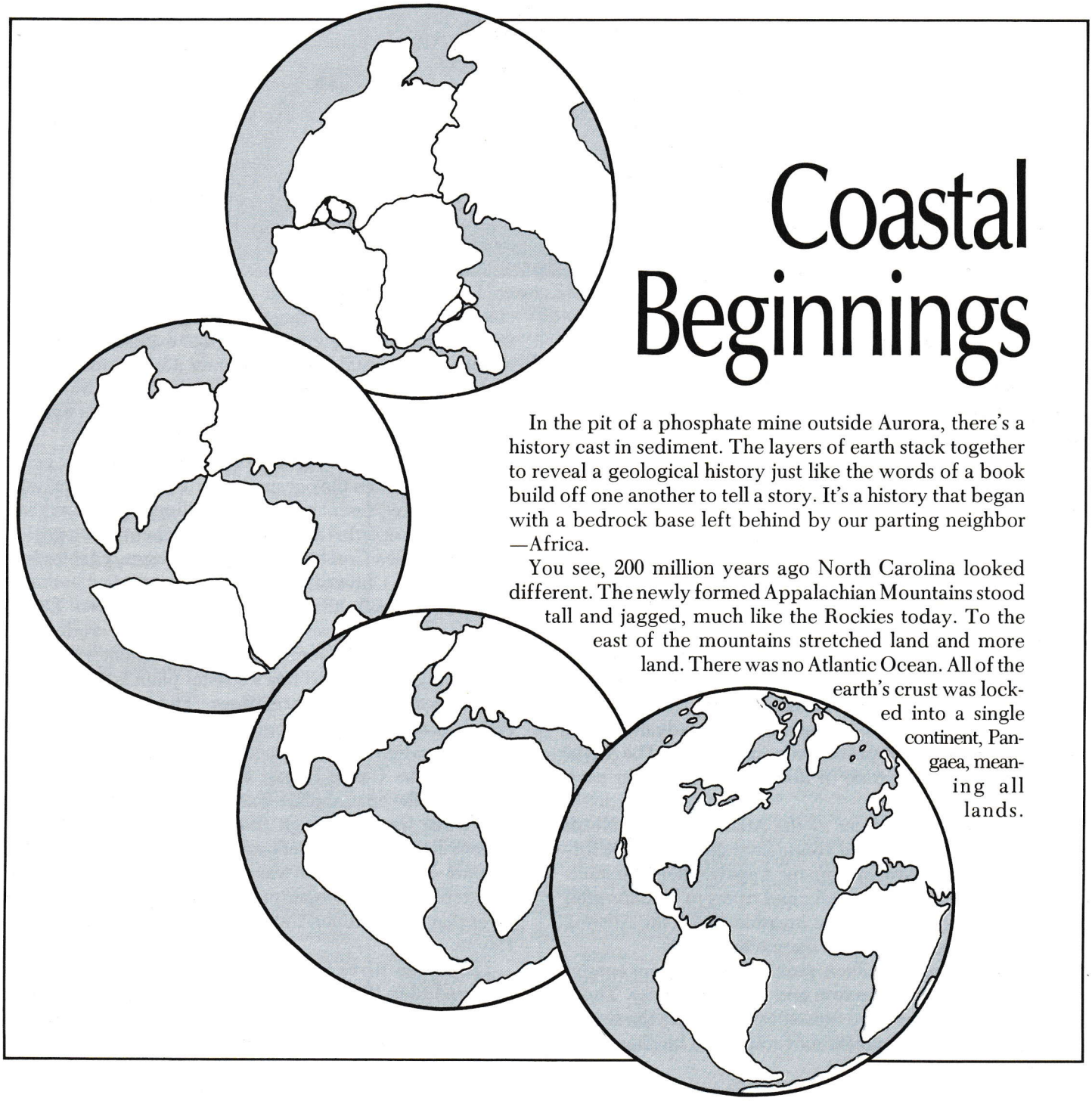
UNC Sea Grant

January, 1986

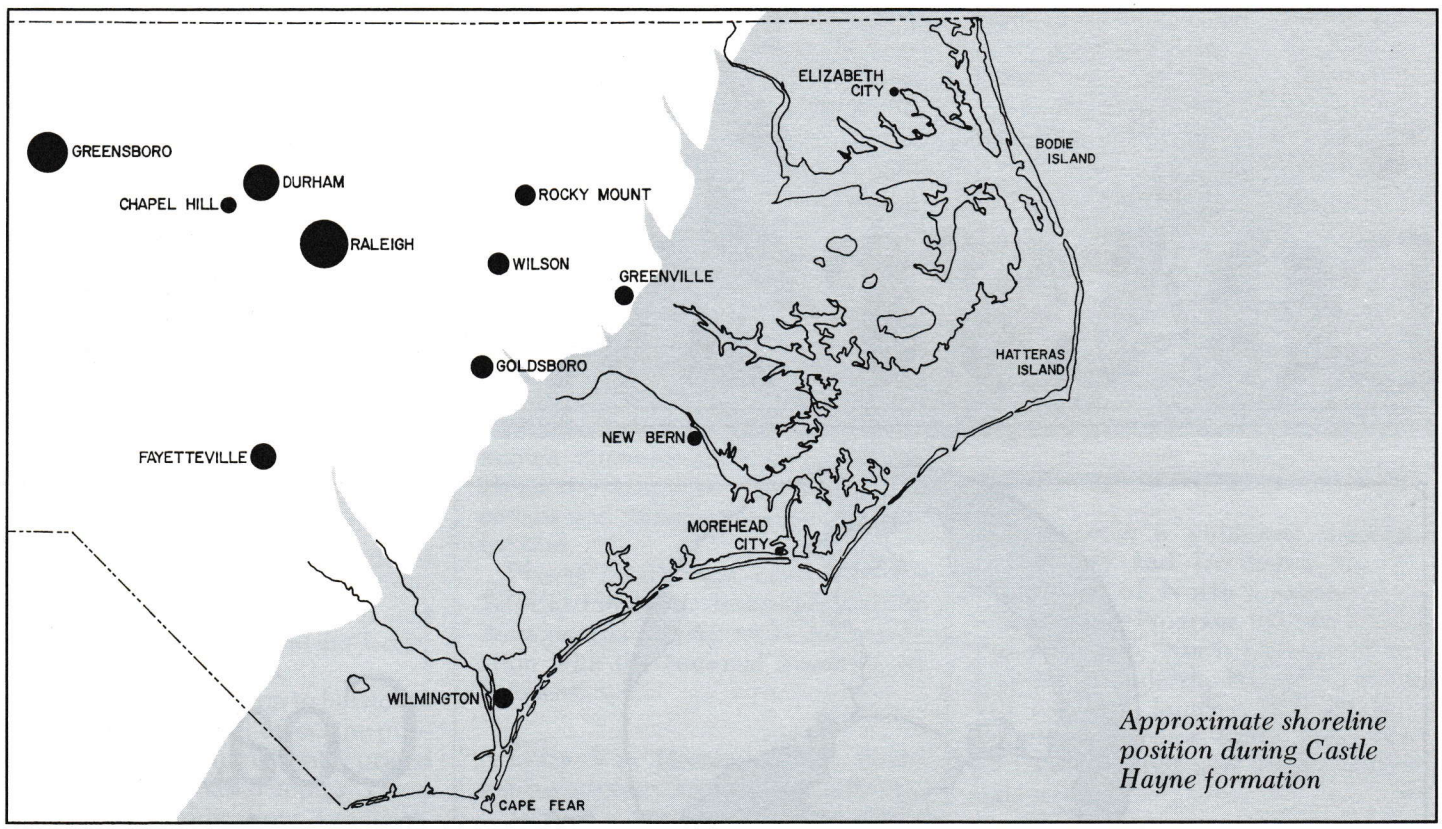
COASTWATCH



Coastal Beginnings

In the pit of a phosphate mine outside Aurora, there's a history cast in sediment. The layers of earth stack together to reveal a geological history just like the words of a book build off one another to tell a story. It's a history that began with a bedrock base left behind by our parting neighbor —Africa.

You see, 200 million years ago North Carolina looked different. The newly formed Appalachian Mountains stood tall and jagged, much like the Rockies today. To the east of the mountains stretched land and more land. There was no Atlantic Ocean. All of the earth's crust was locked into a single continent, Pangaea, meaning all lands.



A lot of geologic history has occurred since then—history that left North Carolina with rounded mountain tops, an ocean to its east, a gentle sloping coastal plain and a string of sandy barrier islands. It's a history marked by major movements in the continents, the formation of an ocean, and large fluctuations in sea level. It's a history that began when Pangaea started to break up.

The earth's crust is divided into sections, or plates, that float on top of the mantle. The mantle is made of pliable rock. Thermal forces within the Earth cause the mantle to move, which, in turn, causes the continental plates to shift. About 160 to 180 million years ago, these thermal forces caused Eurasia and Africa to pull away from North and South America.

As the continents pulled apart, new material was generated inside the Earth and pushed to the surface at the rift. This material was dragged along with the parting continents, creating an ever widening basin that gradually began to fill with water. (This process continues today. The Atlantic Ocean grows at a rate of about one centimeter each year.)

During the development of the Atlantic Ocean, North Carolina's coastal plain and continental shelf began its formation. Eroded sediment from the Appalachian Mountains washed downstream via creeks and rivers to be deposited in coastal areas. And periodic invasions from the Atlantic Ocean deposited a variety of marine sediments.

Throughout the 160 million-year formation of our coastal plain, the Atlantic Ocean rose and fell many times. These sea level fluctuations were caused by changes in the size of the ocean basins due to plate movement and by changes in climatic conditions. During one ice age, global ice volume was so great that sea level dropped to expose all of what is now the continental shelf. In warmer periods, the polar ice caps melted and the oceans swelled. During one warm period 5 million years ago, the Atlantic Ocean reached slightly west of Wilson.

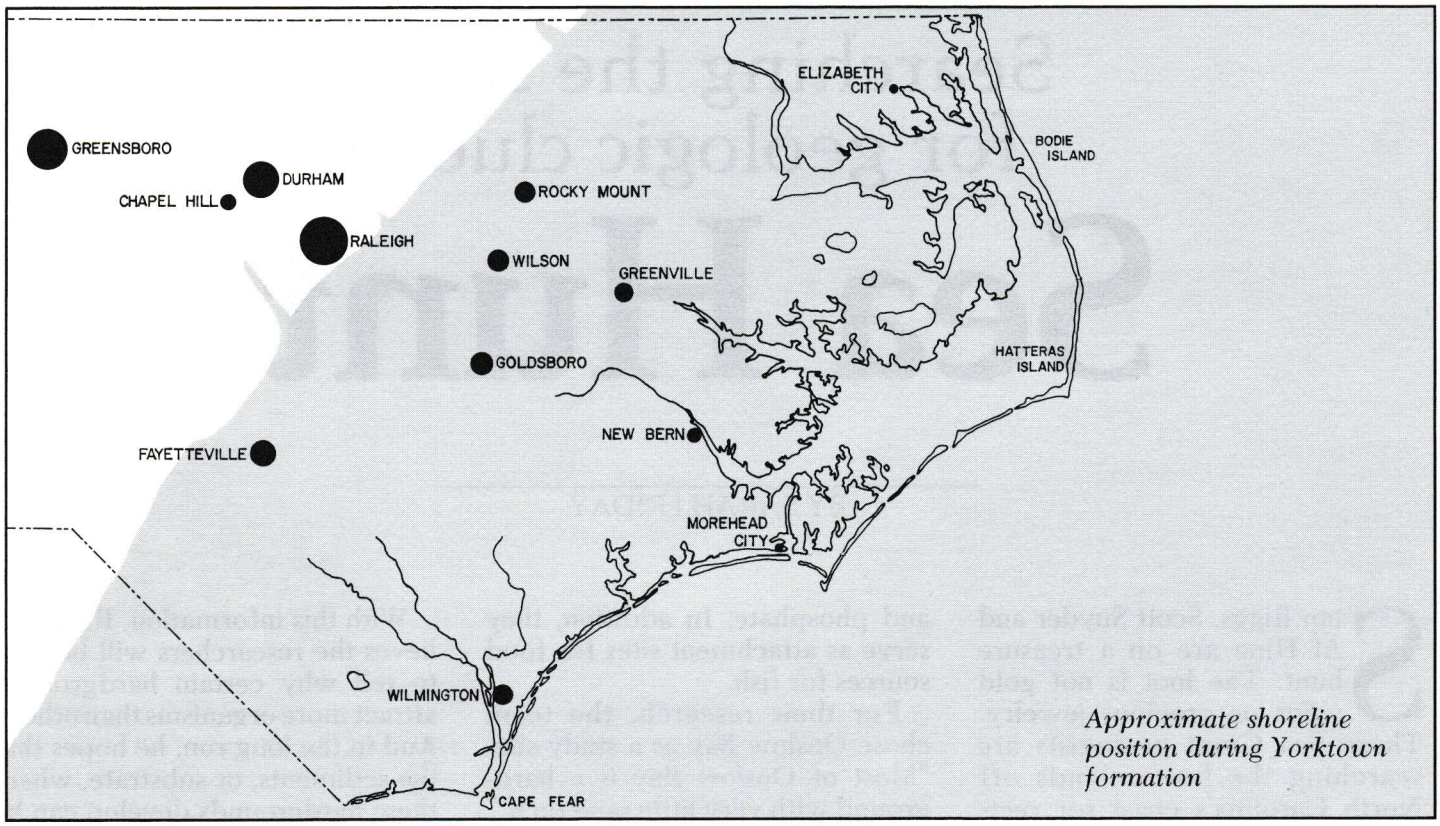
By digging into the sediments of our coastal plain, geologists can tell when the oceans were rising and falling, what minerals were present and what the climate was like. "Sediments are a recorded message of what's happening geologically," says Sea Grant researcher Stan Riggs, a geologist at East Carolina University.

But occasionally that message was interrupted. During periods of low sea level, sediment was often eroded, and during high sea level, sometimes little sediment was added.

Basically, North Carolina's coastal plain is divided into four major sediment formations. They are: the Castle Hayne formation, the Pungo River formation, the Yorktown formation and the Croatan formation.

During the Castle Hayne formation, about 45 million years ago, the coastal plain was coated with layers of limestone. Sea level was high (the ocean reached almost to Greenville), and the waters were warm. This limestone, or calcium carbonate layer was made up of the skeletons of invertebrate living organisms. The best exposure of this layer that can be found today is near Wilmington at Castle Hayne.

The Pungo River formation, the next major formation, occurred 13 to 19 million years ago. Sea level was generally high (the shoreline reached Washington) and fluctuated often. The ocean was colder, and large quantities of phos-



phate were deposited across the continental shelf.

Although some geologists debate the source of the phosphate, Riggs advocates a theory based on ocean upwellings. A buildup of phosphorus had occurred in the depths of the ocean. But during this formation, the phosphorus was transported from the ocean floor to the continental shelf.

Riggs says this transportation occurred because of the location of the Gulf Stream. If sea level rises, the Gulf Stream moves inland. During the phosphate formation, the Gulf Stream was moving landward when it bumped into protrusions of the continental shelf. This deflected the warm surface current offshore and allowed the ocean water beneath to rise and spread over the continental shelf, according to Sea Grant oceanographer Len Pietrafesa. This cold nutrient-rich ocean is associated with phosphate formation.

Riggs says eventually the Gulf Stream moved onto the shelf, cutting off the phosphorus supply and creating conditions that favored carbonate deposition. Because sea level fluctuated during this period, geogolists find alternating layers of phosphate and carbonate in this formation.

The Pungo River formation is a valuable one for North Carolina. Phosphate is mined by Texasgulf Chemicals Co. near Aurora on the Pamlico River and processed into fertilizer.

Some phosphate and carbonate were deposited in the lower layers of the Yorktown formation, which was formed between 3 1/2 and 5 million years ago. But this formation is made up largely of quartz. Continental margin temperatures alternated between warm and cold, and the shoreline stood west of present-day Wilson.

The youngest geological formation, the Croatan, flooded less of the coastal plain (shoreline in the vicinity of Aurora). Warm seas during this era left behind dense layers of carbonate shell hash.

But sediment formation isn't the only North Carolina geologic feature to interest scientists. The ever mobile barrier islands are another feature of study.

Riggs says the present barrier islands formed about 18,000 years ago after a glacial era. Global warming caused sea level to rise. In North Carolina, the ocean flooded low-lying areas, but left behind strips of high-standing beach that had formed from ocean and river deposits.

North Carolina may have seen many such sets of barrier lands during its formation. Multiple barrier formations can be traced across the coastal plain. Greenville lies on one such ridge, Tarboro on another.

Today's barrier islands are a geologic feature in motion. They are a product of the wave energy that builds, molds and maintains them, Riggs says. In response to the continued rise in sea level (the world is still recovering from its last glacier period, and sea level rises in North Carolina at a rate of about one-half foot per century), the barrier islands are moving inland via washover and inlet migration. And as the islands move, the estuaries behind them also push westward.

Barrier island movement, rising sea level, the ever-widening Atlantic basin and the continued deposit of sediments add up to a coastal plain still in creation. As geologists delve in its sediments to reveal its past, they also use their findings to predict its future.

—Kathy Hart

Searching the shelf for geologic clues

Sea Hunt

BY SARAH FRIDAY

Stan Riggs, Scott Snyder and Al Hine are on a treasure hunt. The loot is not gold coins or precious jewelry. These Sea Grant geologists are searching the bottomlands off North Carolina's coast for reef-type structures that hold a wealth of natural resources.

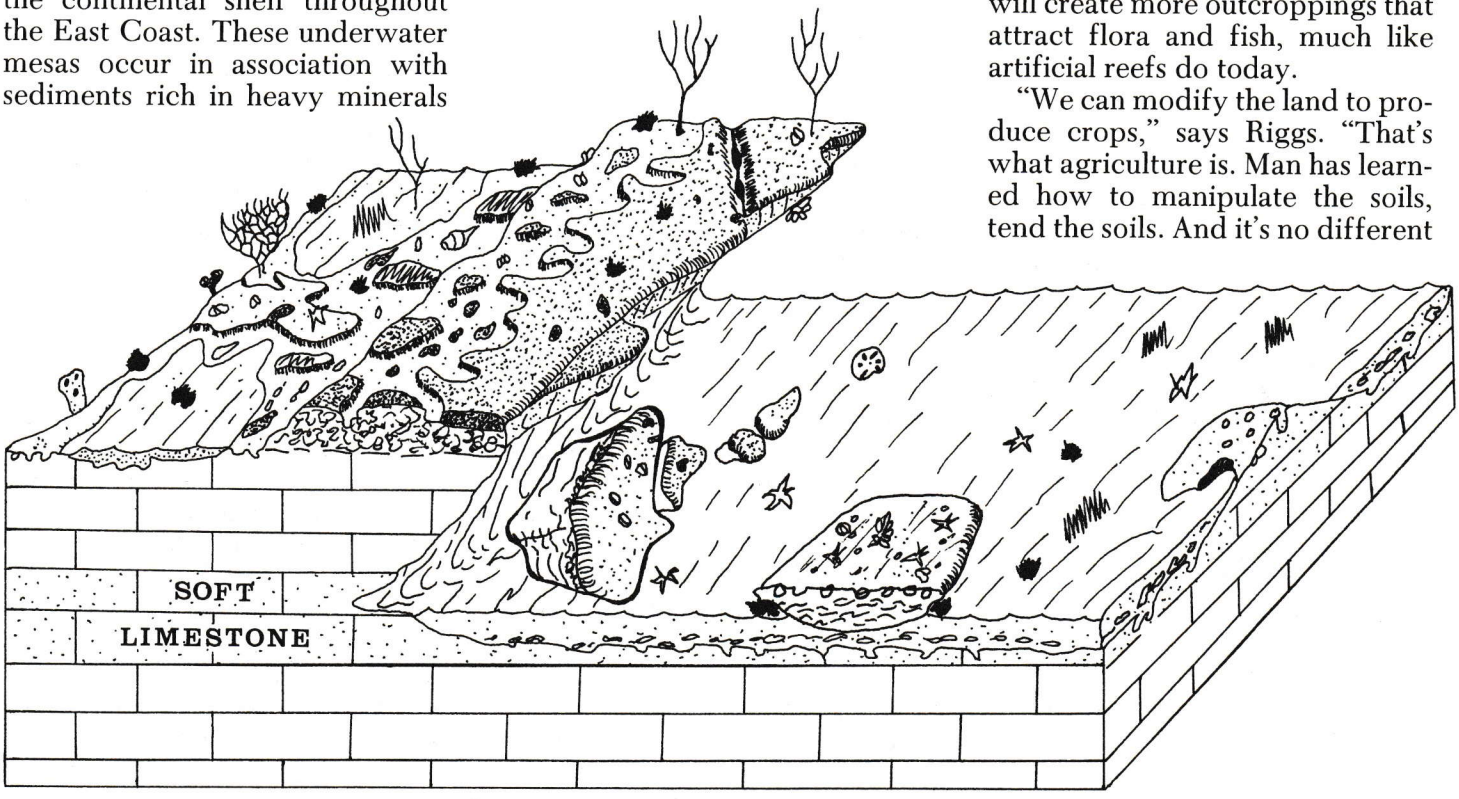
The structures, called "hardgrounds," lie anywhere from just beyond the shoreline to the edge of the continental shelf throughout the East Coast. These underwater mesas occur in association with sediments rich in heavy minerals and phosphate. In addition, they serve as attachment sites for food sources for fish.

For their research, the team chose Onslow Bay as a study site. "Most of Onslow Bay is a hardground with very little sand on it," says Riggs. "What we're trying to do is understand what are the different kinds of hardgrounds? Where do they occur? What is their geologic nature?"

With this information, Riggs believes the researchers will be able to tell why certain hardgrounds attract more organisms than others. And in the long run, he hopes that the sediments, or substrate, where these hardgrounds develop can be made more productive.

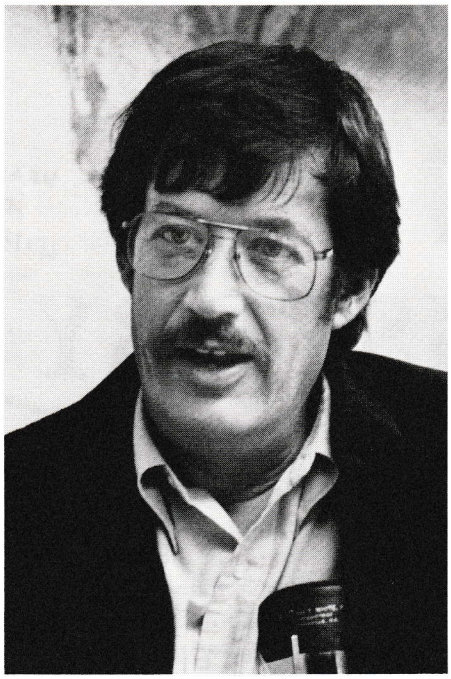
Riggs believes that someday it may be possible to "plow" the shelf floor to build ridges of rock above the abrasive flat sands. These ridges will create more outcroppings that attract flora and fish, much like artificial reefs do today.

"We can modify the land to produce crops," says Riggs. "That's what agriculture is. Man has learned how to manipulate the soils, tend the soils. And it's no different



Scarps like this on the underwater mesas of Onslow Bay collect a variety of corals, other organisms and, eventually, fish

Photo by Kathy Hart



Stan Riggs

because there's a little layer of water on top of this. It's just like a soil there. And if we understand the physical, biological and chemical processes of that system, then we ought to be able to manage that system in the same way we manage an agricultural field. And we ought to be able to increase the productivity out there.

"There's a lot that has to be done before that resource is potentially developed," says Riggs. "We must first understand it."

So far, what the researchers have learned is that hardgrounds differ greatly. Variables in their composition and shape affect the types of communities of organisms they attract.

The first question Riggs asks is what kind of substrate lies in certain areas of the shelf floor. The type of rock will determine the amount of organisms that will grow there. The floor can be barren or can have whole reef developments on it with corals, algae, fish and other marine life.

Some sections of Onslow Bay are made up of a fine mud or coarse, mobile sand, says Snyder, a geologist at East Carolina University. In these areas, sand moves around and keeps boring organisms like clams and worms from attaching. "The sediment waves come over and bury them and kill them," says Riggs. "The only kind of organisms that can live on it are those that can withstand the movement."

Prolific development occurs on the outcroppings that jut above the loose sediments, says Snyder. Without the moving sands, larvae have the chance to become established.

Using side-scan sonar, seismic data and bottom television, the researchers and graduate student Dave Mearns of the University of South Florida located many kinds of hardgrounds in Onslow Bay. One group, which dates more than 10 million years, is small and moundlike. They measure from a few inches to a few feet above the bottom and consist of solidified muds cemented together with calcium carbonate, or limestone. These hardgrounds attract only a few types of organisms.

Younger hardgrounds—1 or 2 million years old—offer the richest substrate. Composed mostly of limestone, these outcroppings rise up to 10 meters above the shelf floor and dot the bay. Many of these mesas formed when rivers cut across an exposed continental shelf and created huge valleys. The ledges, or scarps, produce big, nice reefs, says Riggs. "These are the ones fishermen are interested in; the ones divers want to dive on." And they're the main type he, Snyder and Hine, a geologist at the University of South Florida, want to locate, study and map.

One reason is that these hardgrounds occur near sediments that contain potential mineral resources such as shell and quartz gravels, gold and uranium. They also serve as future sources of phosphate and of sands for beach replenishment.

These younger outcroppings win their all-around popularity, however, for serving as attachment sites for organisms that attract fish. The two major kinds of organisms that secure themselves to the hardgrounds have names like warriors from the latest sci-fi flick—the borers and the encrusters.

Encrusters such as corals, sea whips and barnacles tend to make their home on the top of the hardground's scarp. Generous amounts of nutrients and sunlight invite them to settle there.

"The encrusters get the best real estate," says Snyder. "The borers would be there if the encrusters weren't."

Instead, the borers move in on the lower, vertical surfaces of the scarp. Here, certain species of clams, sponges and mechanical borers continuously chip away at the limestone ledge, creating erosion. This, combined with wave action, shapes new surfaces where other organisms can take hold. The more marine life on a hardground, the more fish it will attract.

Although the maps that the researchers will produce from these studies aren't likely to excite those looking for ready-made treasure, they will pinpoint prime fishing areas for anglers, and potential sources for tomorrow's minerals.

Photo by Kathy Hart

Scott Snyder

COLLECTING HISTORY

Peter Harmatuk of Bridgeton scooped up a handful of dirt, sifted it through his fingers and picked out a pointy gray shark's tooth. "This is from a sand shark. It's about 10 million years old," he says, examining it with the casual eye of an expert who'd seen others like it a thousand times.

For nearly 28 years, Harmatuk has been digging up history in North Carolina, helping to piece together the puzzles of its past. His findings, and those of other fossil hunters, provide important clues to the weather conditions, rock formations and animals that existed in the area over a 20 million-year period that spanned four geologic formations (Pungo River, Yorktown, Croatan and Post Croatan).

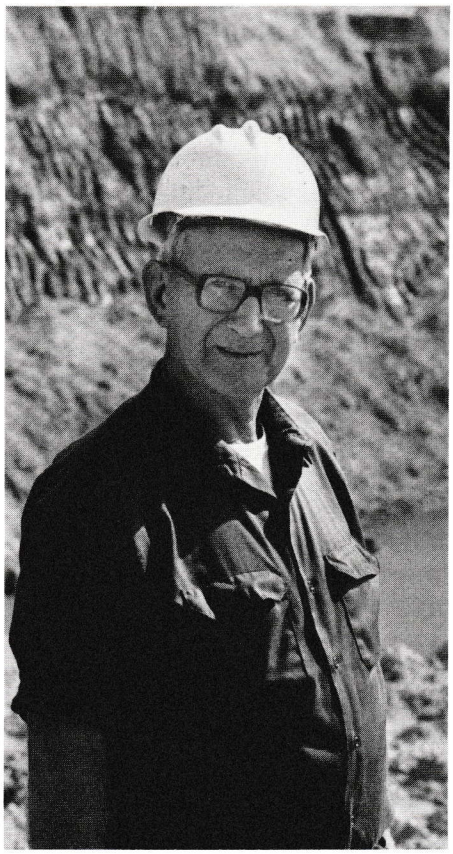
Harmatuk spends most of his time sifting through the rubble at the Texasgulf Chemicals Co. in Aurora. In this canyon-sized pit in eastern North Carolina, the petrified remains of hundreds of species of fish, shellfish, plants and animals lay scattered across the dirt like toys in a game room.

The mine, in a way, is a collector's playground. Harmatuk says 85 million sharks' teeth are dug out of the dirt in a 24-hour period. And since the mine opened in the early 1960s, 70 different kinds of fish, 24 kinds of porpoises and 24 species of birds have been uncovered.

"We keep finding new stuff all the time," says Harmatuk. Just recently, collectors found new whale and porpoise species.

Of the 2,300 feet of sedimentary layers in Aurora, only the first 100 feet are exposed in the pit. Most of the fossils uncovered are from the Pungo River formation and later, says Rusty Walker, former manager of public affairs for the N.C. Phosphate Corporation in Aurora.

Photo by Sarah Friday



Peter Harmatuk

In the Pungo River formation, most evidence reveals bottom dwellers like worms, clams, brachiopods and shrimp-like animals, says Walker.

What collectors have found are many prototypes of animals we know today. Fossils of primitive whales and dolphins with their neck vertebrae not fused are typical of the Pungo River formation.

In terms of variety, the Yorktown layer is the richest, says Harmatuk. When the ocean covered eastern North Carolina 5 million years ago, conditions were hearty for all kinds of life. As a consequence, many of the fossils found in the 50-foot Yorktown layer represent land and water animals that still exist. Very few plants survived because they were so fragile.

"I found a giant tortoise (fossil) a few months ago," says Harmatuk. "It weighed about 700 pounds." He's also discovered remnants of sharks, whales, porpoises, fish, walruses, elephants, horses, camels and birds—rare birds, he says, awks mostly and some buzzards. "I found a bird that was essentially complete, and it had its last meal in its stomach—fish bones."

After all these years, Harmatuk still frequently finds a surprise buried beneath the soils. He's dusted off the fossilized remains of tapirs (hoglike mammals), manatees and crocodiles. And even the Smithsonian Institution doesn't believe he found pieces of volcanic rock. "They say it shouldn't be here, but it is," he says. One possible explanation is that it floated across the Atlantic Ocean.

Many of Harmatuk's treasures are on display at the Aurora Fossil Museum, which opened in 1978. The museum shares the secrets of fossils once locked in the earth's crust. When revealed, their messages are clear.

"They let us know how the earth was formed," says Walker. "If we look at fossils, we can see what conditions were here. And the same geologic forces are at work today."

—Sarah Friday

THE BACK PAGE

"The Back Page" is an update on Sea Grant activities — on research, marine education and advisory services. It's also a good place to find out about meetings, workshops and new publications. For more information on any of the projects described, contact the Sea Grant offices in Raleigh (919/737-2454). For copies of publications, write UNC Sea Grant, NCSU, Box 8605, Raleigh, N.C. 27695-8605.

An accidental plunge into cold winter waters can be life-threatening, no matter how well you swim. The loss of body heat is probably the greatest hazard because water cools the body 25 times faster than cold air. Within 10 to 15 minutes, the temperature in your body's core—the brain, heart, lungs and other vital organs—begins to cool, producing a condition known as hypothermia.

Signs of pain, tiredness, poor coordination, numbness, poor speech and mental confusion appear. When the body's core temperature falls below 90°F, the victim becomes unconscious. At 85°F, heart failure occurs.

How fast does all this occur? The answer depends on several factors including water temperature, body size, body fat and activity in the water. Whatever the factors, there are some steps you can take to improve your chances of survival until you're rescued.

Don't swim. A person cools 35 percent faster by swimming. Instead, move just enough to keep your head and neck above water. If you're wearing a life vest, assume the fetal position, or if there is another person in the water, huddle together. And, keep a positive attitude about your rescue. A will-to-live can make a difference.

To treat a hypothermia victim, rewarm him carefully. Do not massage his arms or legs since cold blood could flow to the core, further lowering the body temperature. Apply warm, wet towels to the head, neck, groin, chest and abdomen. Even if a victim appears drowned, administer heart massage and mouth-to-mouth resuscitation. Transport the victim as soon as possible to a hospital.

The idea of air freighting seafood is taking off in North Carolina. With new markets opening across the country and overseas, shipping by air ensures the product will reach its destination fast and fresh—and still net the dealer a profit.

A new Sea Grant *Blueprint*, "Air Freighting Seafood from Coastal North Carolina," gives detailed suggestions for packaging and shipping fresh fish and shellfish. Written by Gary Van Housen, Sea Grant's seafood marketing specialist, the *Blueprint* includes information on shipping containers, packaging materials, airline regulations and costs. It also lists cities having airports with refrigeration facilities and companies distributing packaging materials.

For a free copy of Van Housen's *Blueprint*, write UNC Sea Grant, Box 8605, N.C. State University, Raleigh, N.C. 27695-8605. Ask for UNC-SG-BP-85-4.

UNC Sea Grant has been awarded $1,250,000 in federal funds for 1986 by the National Sea Grant College Program, which is part of the National Oceanic and Atmospheric Administration. The funds will support the second year of UNC Sea Grant's three-year approved grant cycle.

Why do sport fishermen prefer to catch a grouper rather than a triggerfish, a snapper rather than a jack crevalle? It's all in how they perceive the fish, say Jeff Johnson and David Griffith, Sea Grant researchers at the Institute for Coastal and Marine Resources at East Carolina University.

In a new Sea Grant publication, *Perceptions and Preferences for Marine Fish: A Study of Recreational Fishermen in the Southeast*, Johnson and Griffith describe the results of a study that was designed to find out why fishermen favored some species of fish over others.

The results are already being used to change recreational fishermen's minds about some misunderstood species—bonito, shark, jack crevalle, triggerfish and more.

For a copy of this publication, write UNC Sea Grant. Ask for UNC-SG-85-01. The cost is $3.75.

For every snapper, grouper and king mackerel a recreational fisherman has pulled in, you can bet he's probably cast aside an amberjack, triggerfish or shark. Why? Well, it's not because these fish aren't just as good to eat. More than likely, the fisherman just doesn't realize that amberjack can be just as tasty as king mackerel.

To help some of these fish shake their poor image and to ease the pressure on more popular species, Sea Grant Marine Advisory Service Director Jim Murray and East Carolina University anthropologists Jeff Johnson and David Griffith have developed a series of 10 colorful brochures. Each contains information on catching, cleaning and preparing an underutilized species. Amberjack, triggerfish, skates and rays, sharks, sea robin, sheepshead, bonito, panfish, jack crevalle and croaker are featured. And, several recipes are included for each species.

The brochures were designed to complement a National Marine Fisheries Service study in which the researchers examined why anglers prefer some species of fish over others. They found that recreational fishermen reject fish they perceive as ugly, difficult to clean, dangerous to handle and poisonous. Often, this rejection is based on hearsay and rumor, rather than actual experience.

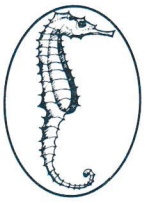
For a free copy of the brochures, write Sea Grant. Please specify which

Continued on next page

brochures you want: amberjack, UNC-SG-85-09; sea robin, UNC-SG-85-10; skates and rays, UNC-SG-85-11; triggerfish, UNC-SG-85-12; panfish, UNC-SG-85-13; jack crevalle, UNC-SG-85-14; sharks, UNC-SG-85-15; sheepshead, UNC-SG-85-16; bonito, UNC-SG-85-17; and croaker, UNC-SG-85-18. Retailers who would like multiple copies of the brochures can contact the Sea Grant office for more information.

UNC Sea Grant has just published a new listing of all of its popular booklets, brochures and pamphlets. Although the titles (*How to Build a Crab Pot* or *Building and Stabilizing Coastal Dunes with Vegetation*) have yet to appear on the *New York Times* Best-seller List, they are publications that can help you work, play and live better in coastal North Carolina.

From seafood selection to hurricane preparation, Sea Grant offers the public a variety of free or modestly priced publications on coastal topics. For a copy of this publications brochure, write UNC Sea Grant.



A new Public Broadcasting Service television series will explore the history of our 4½ billion-year-old planet Earth. The seven-part series, Planet Earth, will premiere Jan. 22, at 9 p.m. EST. Visit an erupting volcano, dive to the bottom of the Atlantic aboard a submersible craft, hop aboard the space shuttle, and take a voyage to other planets.

The one-hour programs reveal scientific insights and discoveries of the past two decades. Internationally known scientists share their theories about the formation of the earth, its oceans and climate, and the universe beyond.

Planet Earth was produced by WQED/Pittsburg, renowned for its *National Geographic* series, in cooperation with the National Academy of Sciences.

Gary Van Housen, a Sea Grant marine advisory agent at Bogue Banks, is leading a series of seminars across the state for seafood retailers. Upcoming sessions will be held in the Greensboro/Winston-Salem area and in the Charlotte area.

Van Housen says the seminars have something for everyone from seafood counter clerks to meat department personnel who handle seafood. He and a panel of instructors will cover topics such as advertising and promotion, quality in seafood, nutritional value of seafood, purchasing guidelines, demographics, and management of a retail market. For more information, contact Van Housen at 919/247-4007.

Coastwatch is published monthly except July and December by the University of North Carolina Sea Grant College Program, 105 1911 Building, Box 8605, North Carolina State University, Raleigh, NC 27695-8605. Vol. 13, No. 1, January, 1986. Dr. B.J. Copeland, director. Kathy Hart, editor. Nancy Davis and Sarah Friday, staff writers.

COASTWATCH

105 1911 Building
Box 8605
North Carolina State University
Raleigh, NC 27695-8605