A systematic sounding of the seafloor

In March 1983, President Reagan added more than 3 million square miles to the United States' jurisdiction by declaring the waters 200 miles offshore as the nation's Exclusive Economic Zone (EEZ). Last year scientists on the British ship *Farnella* began a six-year mapping project of this region. The primary economic thrust of the project, called EEZ-SCAN, is to draw the road maps for finding future petroleum and mineral resources. But the *Farnella* — now charting the Gulf of Mexico with its unique side-scan sonar system GLORIA II — has already bestowed a wealth of scientific treasures on researchers, who have never had a comprehensive mapping of coastal regions on this great a scale.

"The difference between what we've been able to use in the past and using GLORIA is like the difference between exploring the Rocky Mountains in a jeep versus looking at them from the space shuttle and getting the overall view — where the major faults lie, how the geological features relate to one another," says Gary Hill, coordinator of the Marine Geology Program at the U.S. Geological Survey (USGS) in Reston, Va.

The wide view of EEZ-SCAN also enables scientists to see features that might have been overlooked by smaller-scale studies. Last summer, for example, on *Farnella*'s first main leg along the West Coast, researchers discovered dozens of new seamounts and a few new earthquake faults in the 250,000 square miles mapped.

The *Farnella* just finished the first of three excursions in the Gulf of Mexico, mapping 50,000 square miles on the western side. Most of the sonar data have yet to be processed, but USGS reports that hundreds of features — including salt domes, landslides and submarine channels — are visible. According to Hill, the images help to confirm an earlier theory that growing salt domes block old seafloor canyons, trapping organic sediments and creating basins that either generate or cap oil and gas reservoirs. They also found evidence suggesting that sediments are still actively squashing an underlying layer of salt, a somewhat unexpected result. In addition, *Farnella*'s crew discovered large sand dune fields in 3,000 meters of water — similar to dunes found in the Pacific last summer. "There's something going on in deep water that people just aren't aware of," says Hill.

The *Farnella* is currently mapping the eastern side of the Gulf of Mexico. Future legs are planned around Florida, Puerto Rico, Alaska, Hawaii and the Atlantic coast. Then the USGS will go back to these areas and sample the seafloor in order to help interpret the sonar images. As for the *Farnella* and GLORIA, Britain's Institute of Oceanographic Sciences, which designed and built the one-of-a-kind mapping system, is now discussing the possibility of using it to survey the EEZs of other countries.

Solar protons keep ozone models honest

Models of atmospheric chemistry are essential to understanding how chlorofluorocarbons from aerosols and other sources could threaten the layer of ozone that protects the earth from harmful ultraviolet rays (SN: 9/14/85, p. 165). One clear-cut check on these highly complex models is to look at solar proton events (SPEs), in which large numbers of high-energy protons, released by the sun at the peak of its sunspot cycle, are channeled by the earth's magnetic field into the polar region where they disrupt the chemical balance by ionizing molecules.

Five such SPEs during the last solar peak, around 1979 to 1982, were large enough to measure ozone changes with the NIMBUS 7 satellite, two atmospheric scientists report in two papers of the Aug. 20 JOURNAL OF GEOPHYSICAL RESEARCH.

Richard McPeters and Charles Jackman of the NASA Goddard Space Flight Center in Greenbelt, Md., found that ozone levels during the SPEs dropped at 50 kilometers altitude — confirming an earlier observation — but that this decrease was about two times greater than that predicted by their model. This means that the ozone-depleting chemistry of the hydrogen-oxygen compounds at higher altitudes is not as well understood as the chemistry of nitrogen-oxygen compounds at lower altitudes.

The researchers conclude that the ozone decrease at 50 km was due not to the effects of protons at that altitude but to the decrease of ozone at higher altitudes, which then let more ultraviolet light penetrate to 50 km. The ultraviolet light can increase or decrease ozone, they say, but at most times of the day the depletion mechanism wins out, as observed.

At sunset, however, past models have predicted that a decrease of ozone at one level can result in ozone increases at lower altitudes, an effect called self-healing. McPeters and Jackman think they also have the first evidence documenting self-healing, with ozone decreases at 55 km leading to enhanced ozone production at 45 km.

Tracking down ores with trees

There's gold in them thar trees — and arsenic, antimony and zinc. Prospectors have long taken clues from plants to hunt down precious ores. But while fortune hunters and scientists have understood that trees and other plants can take up many metals in the soil, until recently no one had done a controlled study in a natural environment of the relationship between soil minerals and the metal content of trees.

So several years ago three U.S. Geological Survey scientists took 57 pine, spruce and Douglas fir seedlings — each planted in a clay pot with soils containing different combinations of minerals — to a forest in the Rocky Mountains, where they buried the pots to their rims, and left. The minerals added to the soils were representative of four kinds of ore deposits. One group, for example, contained minerals deposited at high temperatures, such as bismuth and tin; another represented gold deposits.

Seven years later Harley King, Gary Curtin and Hansford Shacklette returned to analyze the chemicals in the trees, all of which had grown at expected rates. They found metals from soil minerals in the roots, stems and leaves of most of the trees. Even gold, which was thought to be very insoluble and resistant to chemical reactions, was taken up by some trees, they say.

The USGS researchers conclude that the three species studied showed no great differences in the uptake of metals, although they say in a recent USGS report that the Douglas fir "showed a remarkable ability to concentrate arsenic in leaves and stems, and lodgepole pine was found to be greatly limited in the absorption of barium."

NOAA plans wind profiler array

Wind patterns over the United States are currently measured twice a day by the release of helium-filled balloons at 70 sites. Now the National Oceanic and Atmospheric Administration (NOAA) is planning to install by 1989 a network of 30 very sensitive Doppler radar stations in the Midwest that will be able to monitor wind profiles as often as every half hour.

The ground-based wind profilers will measure wind speed and direction at altitudes up to 10 miles. NOAA hopes eventually to add microwave radiometers to the array to measure upper-air temperatures and humidity.

According to David Small, head of the Profiler Project Office at NOAA in Boulder, Colo., the Midwest was chosen because it has many severe storms, is the region in which the National Weather Service will be testing other advanced systems and has no mountains to complicate wind flow patterns. In addition to providing a data base for weather modelers, the profilers will help pilots choose routes to economize on fuel and will aid scientists studying chemical spills and acid rain, he says.