SECRECY and the SEAFLOOR

The Navy and NOAA war over maps of the ocean bottom

By STEFI WEISBURD

. . . Kamarov was seated at the submarine's gravitometer board, a large rolled chart behind him. The young lieutenant was chain-smoking, and looked tense as he ticked off their position on the chart. . . . Installed in the Red October's *keel was a highly sensitive device called a gradiometer . . . [which] indicated variations in the local gravitational field. The navigator compared these highly precise local values to the values on his chart. With careful use of the gravitometers in the ship's inertial navigation system, he could plot the vessel's location to within a hundred meters, half the length of the ship.*

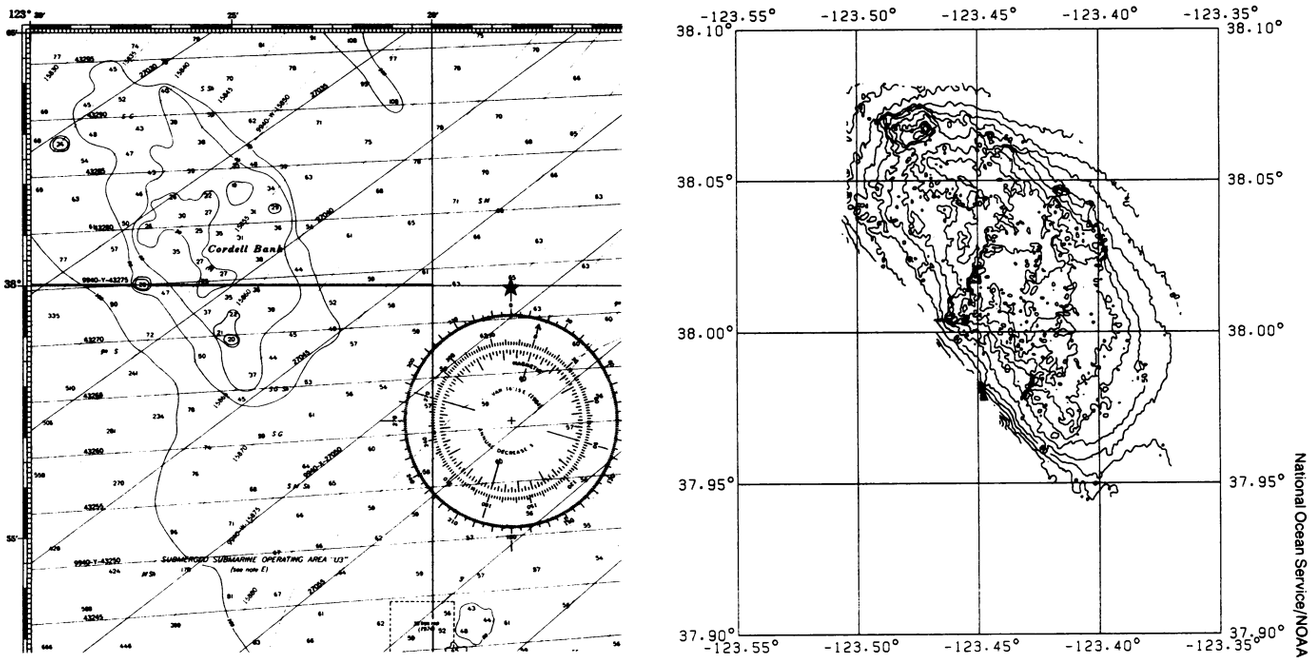
— from *The Hunt for Red October* by Tom Clancy (Berkley Books, N.Y., 1985)

For months now, *The Hunt for Red October*—a suspense novel, written by an insurance salesman in his free time, about a group of Soviet officers who defect to the United States with a state-of-the-art Soviet submarine — has been making waves in military and intelligence circles. What has so captivated these readers is the book's accurate technical portrayal of submarines playing hide-and-seek in the Atlantic Ocean — a sometimes deadly game whose object is to navigate without being detected.

While the fictional *Hunt for Red October* has been making a splash in the corridors of Washington, a sea of some very real troubles has been swelling in closed-door meetings. The debate concerns the collection of ocean-floor data that could have consequences spilling over into *Red October*'s realm of submarines and national security. At issue is the National Oceanic and Atmospheric Administration (NOAA) EEZ mapping program, a 10-year plan to chart the bathymetry, or sea-bottom topography, of the entire U.S. Exclusive Economic Zone, an area extending 200 miles off U.S. shores.

Much to the chagrin of NOAA officials, who expected their maps to be widely available to the public, the Navy and the Defense Mapping Agency have argued that NOAA's detailed EEZ bathymetry data should be classified secret. Just as *Red October's* navigator was able to guide his submarine with gravity charts, NOAA's extensive and detailed bathymetric maps, the Navy contends, would be extremely useful tools for an enemy submarine wanting to target missiles and to navigate without being detected.

Since the dispute began two years ago, the tide of events has generally favored the Navy. Both a National Academy of Sciences committee and the National Advisory Committee on Oceans and Atmosphere, for example, found the



With its multibeam mapping systems, NOAA will be able to produce contour maps of seafloor topography in considerably better detail than most existing charts. Here, for example, the Cordell Bank off the northern California coast has been mapped with conventional techniques (left) and by a multibeam mapping system (right). NOAA plans to produce bathymetry maps with depth contour intervals of about 20 meters at a scale of 1:100,000.

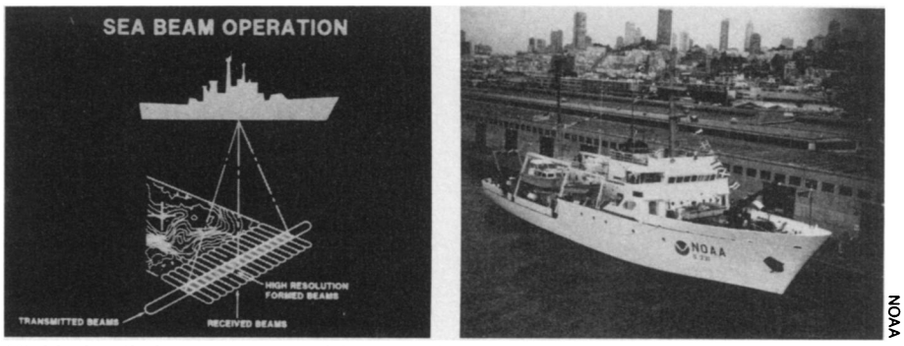
national security argument compelling enough to recommend that the dissemination of NOAA data be controlled in some way. And according to John F. Donnelly, who chairs the National Operations Security Advisory Committee – the subcommittee in the National Security Council set up to resolve this interagency conflict – NOAA Administrator Anthony J. Calio and Oceanographer of the Navy Rear Admiral John R. Seesholtz agreed several months ago that the raw data set would indeed be classified. So now the emphasis of meetings between the agencies involved is on ways for NOAA to produce unclassified versions of their EEZ maps for public consumption.

In February, Calio sent a letter to the Navy reportedly offering to abort NOAA's EEZ survey altogether if the issue cannot be resolved, and to return to an unsystematic mapping of small, unrelated areas of the ocean that participants in the issue call "postage stamps." But this offer may not be enough to calm the troubled waters. "If you do enough postage stamps," warns Donnelly, "you have [an EEZ-size] mosaic" that could threaten national security.

For the time being, NOAA is holding in limbo its maps of 12,000 square nautical miles surveyed in 1983 and 1984, preparing to treat them on a classified basis. The agency, which already handles a small amount of other kinds of classified data, is also expanding its secure facilities. But, says Paul Wolff, assistant administrator of NOAA and head of the National Ocean Service, "we're not prepared to handle large volumes of classified data."

While NOAA will say only that its current official position on classification is "evolving," individual NOAA officials such as Wolff are clearly unhappy with the situation. "Calio and I have compromised with the Navy to a much greater extent than as a good scientist I'm comfortable with," says Wolff. He also thinks that if the agency is required to treat its EEZ bathymetry data as classified, it would "be forced out of the mapping business." One observer who has worked with both the Navy and NOAA agrees: "It's difficult to justify [to Congress] doing that amount of work in theory for the public when it can't be released to the public."

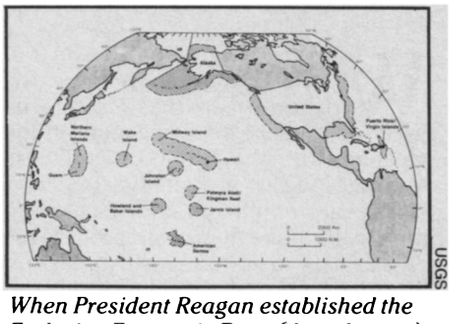
According to a Navy spokesperson, the Navy would like to see NOAA continue its EEZ program, provided that the detailed data set remains classified. "Everyone wants to make this a black or white issue," he told SCIENCE NEWS. ". . .We're working very hard with NOAA to try to find some gray area in the middle that satisfies both of our beliefs."



Highly detailed contour maps of the ocean bottom are produced by swath or multibeam mapping systems, which bounce sonar beams off the seafloor (left). In deep waters, the width of the seafloor covered (or the swath) is about 80 percent of the water depth. The resolution of the data along the seafloor is about 0.05 times the local water depth. With a satellite navigation system, NOAA crews will know their location to within about 50 meters. The Davidson (right) is one of NOAA's ships mapping the EEZ.

When President Reagan proclaimed the EEZ three years ago, he established U.S. jurisdiction and sovereign rights over the resources in an ocean region nearly twice the size of the total U.S. land area. Traditionally, the first step after a nation acquires a new territory is to survey it. So, drawing parallels to the Lewis and Clark Expedition, NOAA and the U.S. Geological Survey (USGS), which also has an EEZ survey program, have set out to explore this "new ocean frontier."

NOAA and USGS expect that the data collected in their surveys will be invaluable to a variety of ocean industries, ranging from oil and gas companies that drill and lay pipelines in deep water to fisherman who need to know where fish are likely to congregate on the seafloor and where it's safe to drag nets. The administration also hopes that NOAA and USGS explorations will eventually help companies locate and mine strategic minerals, thereby freeing the United States from dependency on politically unreliable sources. Capt. Christian Andreasen, head of NOAA's EEZ mapping program, argues that commerce is enhanced when the federal government does the mapping, because the government can absorb greater liabilities and because this arrangement circumvents the costs associated with many private-sector groups mapping the same areas.



When President Reagan established the Exclusive Economic Zone (dotted areas) in 1983, he added 3.9 billion acres to U.S. jurisdiction. Unlike the existing 2.3 billion acres of U.S. land, little of this new ocean territory has been mapped in detail. So far NOAA has surveyed less than 2 percent of the EEZ, but plans to map the whole region. The Navy, however, believes that by making the highly accurate and detailed contour maps available to the public, NOAA will jeopardize national security.

NOAA and USGS also emphasize that detailed and wide-ranging studies of the EEZ would be a boon to researchers interested in understanding the geologic processes that shape the seafloor – from the hydrothermal vents along the Gorda Ridge off the California coast to the sediment patterns and oil formation in the Mississippi River fan (SN: 1/4/86, p. 5). The mosaics produced by the USGS with its GLORIA sidescan sonar system (SN: 9/21/85, p. 191) – which produces a shadowy accoustic image of the seafloor and provides information on the ocean bottom composition and texture – are giving scientists their first reconnaissance view of the seafloor, helping them to see the connections between large-scale features in the ocean and leading to the discovery of new features like undersea volcanoes. And in order to quantify and better understand their GLORIA images, USGS researchers are looking forward to studying NOAA's EEZ bathymetry data.

The types of maps that NOAA and USGS hope to produce are also requisite for the planning and execution of other kinds of seafloor studies; for example, scientists would need to know the ocean-bottom terrain in detail before they could safely guide a submersible or dredging gear above the seafloor. Finally, says Wolff, "The things that we will find which we don't know are there are probably just as important the things that we know are there and want more information on."

The broad-brush images produced by USGS's GLORIA survey are, by themselves, of relatively little concern to the Navy. However, the high-resolution bathymetric data obtained with NOAA's primary survey tools – swath or multibeam sonar mapping systems – do trouble the Navy and the Defense Mapping Agency. Both organizations say the situation most injurious to national security would be the public release of

maps combining the GLORIA and bathymetry data.

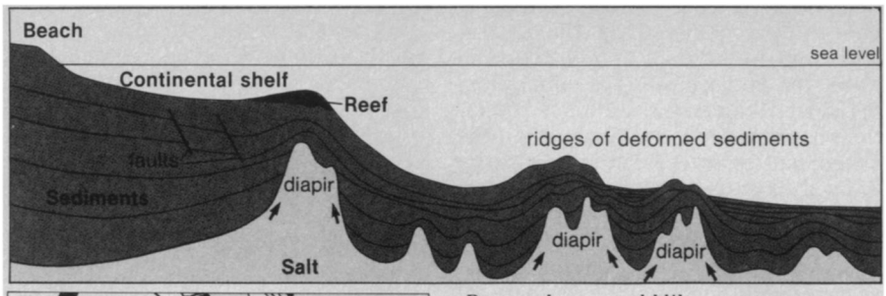
For many years NOAA used single sonar beams, which, when bounced off the seafloor, give scientists a measure of the distance beneath their ship to the sea bottom. Now, with the deep-water multibeam system called Seabeam, NOAA is able to enjoy the high resolution that comes with narrow sonar beams, but at the same time cover large areas relatively quickly because many beams are used side-by-side. Unlike ships in previous NOAA surveys, the EEZ vessels are also able to position themselves precisely as they conduct their surveys, because they can use a very accurate navigation satellite system called the Global Positioning System.

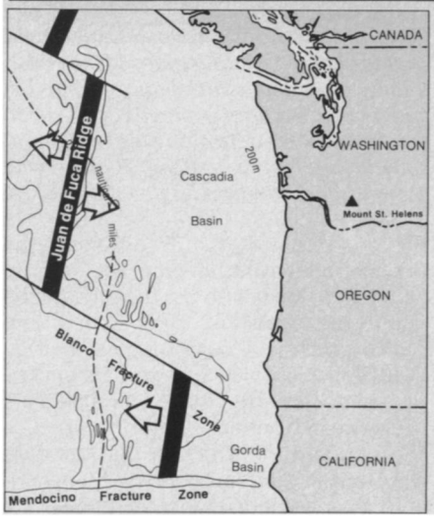
Almost everyone agrees that multibeam mapping of U.S. waters, especially those regions 30 miles offshore, will vastly improve the quality of NOAA maps. According to Andreasen, existing maps contain about 10,000 data points in a typical area, while the digitally made multibeam maps use 400,000 data points and those points account for only about 2 percent of all the observed data. Moreover, with complete coverage of the seafloor, scientists and others wouldn't have to guess what the ocean bottom looks like between the older, widely spaced NOAA survey tracks.

For researchers who have used multibeam systems in their studies, "the data have been like allowing us to remove several layers of opaque glass and get closer to an accurate definition of the seafloor," says Jeff Fox at the University of Rhode Island at Narragansett, who uses academic Seabeam systems in his research on the magmatic and tectonic processes at mid-oceanic ridges. Fox says he and his colleagues think of the swath systems as "the American Express card: You don't leave port without it."

But it's the same high resolution and precise positioning responsible for advancing scientific understanding of isolated spots of the seafloor that, when applied to an area as extensive as the EEZ, has the Navy worried. "This kind of data available with this kind of accuracy needs to be classified," says a Navy spokesperson. ". . . It is very useful to an adversary, particularly from a navigation standpoint."

According to one source, while the inertial navigation systems in submarines like the *Red October* help the vessels to find their way, these systems gradually drift off course so that the navigator periodically needs a fresh point of reference to recalibrate the navigation system. This is especially critical for submarine crews who are planning to launch missiles; they have to know exactly where their sub is in order to accurately direct the missile to its target. Currently, in order to get a new position reading, submarines must surface or float antennas so that they can communicate with a satellite or shore-based navigation system—a process that makes them vulnerable to detection and attack. With detailed bathymetry maps, however, a submarine would not have to surface; once its sonar picked up a seafloor feature that was distinctive enough to be correlated with a feature on a map, the crew would know exactly where they were. In addition, if external navigation systems such as satellites were destroyed during wartime, submarines would be able to get around quite easily without them. Putting this information in the public domain, easily accessible to the Soviets, is not a risk the Navy is willing to take.





USGS

Researchers would like as accurate a map of ocean topography as possible because the shape of the seafloor is crucial to understanding the tectonic, sedimentary and hydrothermal processes that create and sculpt the ocean bottom. Above, for example, ridges of deformed sediments in the Gulf of Mexico are caused by rising fingers of salt called diapirs, which may help to trap oil and gas. Detailed maps of the Juan de Fuca Ridge and other spreading centers off the coasts of Washington and Oregon (left) help scientists understand how new seafloor is created and how the tectonic plates move apart. Such maps also help in locating hydrothermal vents, which can support communities of exotic sea life and churn out minerals.

What the Navy *is* willing to do is to develop ways to process the data into maps that would not be useful for submarine navigation. In the meetings with NOAA, USGS, the Defense Mapping Agency and others, the Navy has been presenting a number of computer algorithms that would process the data to make them less sensitive. One approach on the table is to move seafloor features from their real locations. Another algorithm smooths out features that are topographically distinct. This last idea was endorsed by the National Academy of Sciences committee that considered the classification issue in March 1985. Assuming an algorithm is choosen, NOAA and the Navy will still have to decide how it will be applied—randomly throughout the EEZ, for example, or on a case-by-case basis.

A Navy spokesperson and Donnelly both contend that even with such "massaged" data, NOAA will be producing public maps that are much better and more complete than what is currently available. And, as Andreasen notes, maps that have been altered in some way would probably still be quite useful to fishermen, who don't navigate very precisely. But at the other end of the spectrum are researchers, who say they would not touch altered maps.

James V. Gardner and Steve Eittreim at the USGS in Menlo Park, Calif., were among the scientists asked to assess the scientific usefulness of some maps that had at the time been up for consideration by the Navy and NOAA. Eittreim was most disturbed by the algorithms that displace seafloor features, because as a geophysicist he studies how the seafloor morphology reflects tectonic processes. For example, if computer processing rotated a transform fault, which slices through an ocean ridge, he might wrongly conclude that the plate motion from the ridge had changed direction. Gardner, a sedimentologist, says he wouldn't want to work with a map altered by either kind of algorithm because they both could change the shape of valleys, canyons and other features subject to erosional and depositional processes. For example, a V-shaped channel, formed by active erosion, might be changed by an algorithm into a U-shaped channel that is accumulating a lot of sediments. "Science requires the highest resolution it can get," says Gardner. "To give us something less than the best is simply telling science it doesn't deserve it."

Chances are that researchers needing reliable EEZ bathymetry data from

NOAA will have to work under classified conditions. A number of officials from the various agencies involved say that the data set appears to be so good in terms of submarine navigation that it will probably all be classified secret. Classification means that scientists would need security clearances to work with the data, which could be examined only in secure facilities, and that NOAA would have to take special care in the collection and transport of the data from ships.

Classification would make research more difficult, but if that's the only way researchers can see NOAA data "we certainly might profit by changing our habits to work with it," says Gardner. What most concerns Gardner and other government researchers is that they would not be allowed to publish data in support of their conclusions and that their papers would be subject to Department of Defense review.

Noticeably silent during this debate have been university researchers, in part because they have their own Seabeam systems to do surveys at specific sites. "I expected that there would be considerable scientific outcry of support here," says NOAA's Wolff, "but it hasn't come about because the oceans don't have much of a constituency in this town [Washington] and because a lot of scientists interested in oceanography are dependent on the Navy for their livelihood, so they don't dare say anything." But, comments Gary Hill of USGS in Reston, Va., "if the military decides it is necessary to classify NOAA's Seabeam activities, the logical next question is, what about the data being collected by academics?"

A Navy spokesperson says the Navy is not unconcerned with university data, but he doubts that it's a significant problem, because academic Seabeam vessels are not surveying large areas and the data collected are not published in their entirety. "The science does not dictate going over the whole EEZ," he adds.

Still, with existing academic and industry surveys covering more than 15 percent the U.S. EEZ, according to Andreasen, and with more than 17 Seabeam systems in the world, owned by countries such as France, Japan and West Germany, Hill and others wonder whether the Navy is "trying to close the barn door after the horse has gone." Multibeam technology – originally developed by the Navy and released for commercial use in the late 1970s – has "advanced to a point where many of these things they're trying to protect are fast becoming part of the public domain," says Hill. "And even if they're successful in stopping agencies such as ours from doing this type of work, the EEZ is internationally open to research." Wolff adds that he feels "that the Navy is singling out NOAA for special prohibitions in this case which don't apply to universities and foreign countries."

A number of researchers also worry that classifying NOAA's EEZ data will make it awkward for U.S. scientists to conduct surveys in other countries' EEZs. Donnelly notes that the administration is considering placing access to the U.S. EEZ on a reciprocity basis, so that if U.S. researchers are allowed to study the EEZ of another nation, scientists from that nation will be given free access to the U.S. EEZ. This issue has captured the attention of the State Department, which has sent representatives to some of the Navy-NOAA meetings.

In spite of the amount of time NOAA and the Navy have spent on this problem, it is clear that the agencies are far from seeing eye to eye. In the opinion of a Navy spokesperson, "No one has ever explained to the Navy what NOAA needs data of that quality and resolution for." And Andreasen of NOAA says, "We don't really understand the *why* of classification." This polarization, observes one participant, is like a presidential election with 52 percent voting one way and 48 percent the other: "Like it or not, 48 percent of the people go away unhappy."

Whatever the eventual outcome of this particular conflict, it is unlikely that military and civilian agencies have seen the last of the classification question. NOAA and the Navy, for example, could potentially be at odds in the future over other kinds of seafloor data, such as magnetic and gravitational field variations. As technological advances such as satellite instruments expand the scope and accuracy of earth-science data collection in general, those interested in surveying and studying the earth may find that dealing with security issues in one form or another is becoming a way of life. □

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should care what the numbers are!

James D. Morefield
Flagstaff, Ariz.

"The aim of natural selection is survival," say Skinner's opponents. Natural selection does not have aims – only consequences. Furthermore, behavior that results in relative reproductive success, not merely survival, is selected for. Many behavioral scientists still accord (Spencerian) design to a process that has no purpose, just results. NeoDarwinians reject teleology; in this sense we agree with Skinner.

On the other hand, Skinner wants to argue the relative merits of heredity and environment, a debate that has absolutely no significance to an evolutionist. Behavior is selected for in a specific environment; if the environment changes, different behavioral predispositions are selected for.

Ray H. Bixler
Louisville, Ky.

I believe that neither Skinner nor his many opponents are right. While both factions indicate that culture is an important ingredient in determining behavior, neither is, in my opinion, specific.

To me, the economic, political and social system establishes the cultural norms: Its ethics, its morality, its economic practices and its class system are, for the vast majority, subtly or otherwise taught and accepted as worth pursuing and continuing. Thus war, fierce commercial competition, the exploitation of other nations and their peoples, and poverty alongside excessive wealth are regarded as legitimate; behavior is based on such broad acceptance.

Can war, which kills off the flower of our youth, be a reinforced, survival adaptation? Are the super-rich necessarily the ones whose genes will help us survive? I seriously doubt it.

Leonard T. Boyer
Flushing, N.Y.

This was no boxing match between Skinner and his opponents. Not a single solid punch was landed in six rounds. The facts fit better with a scuffle in a fruit market in which one side throws apples and the other oranges. Only by standing back from the action and not taking sides does it become clear that the fruit throwers' inability to deal with their own behavior in a reasonable way casts considerable doubt on their ability to understand what is going on in the minds of all us bystanders.

Galen Rowell
Albany, Calif.