

Continental shelf sediments off Oregon

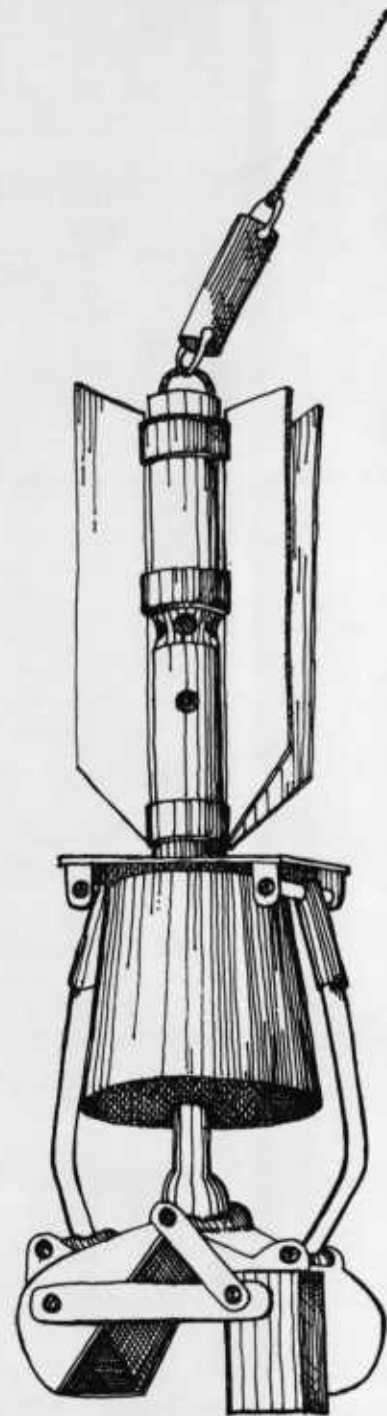
by **John V. Byrne**, Professor of Oceanography, Oregon State University
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The economic potential of the continental shelf lies in the exploitation of its fisheries and of its mineral wealth. The purpose of this publication is to provide information concerning the surface of the continental shelf—its shape and what the bottom is made of. The information provided here is a result of the efforts of a number of the staff and students of the School of Oceanography at Oregon State University. The original scientific research was carried out under contract with the Office of Naval Research.

The continental shelf is the shallow platform or terrace which surrounds the continent. It extends from the low line to a position offshore where the slope of the bottom increases markedly downward. The position at which the bottom slope changes is commonly called the shelf edge or the shelf break. Off Oregon, the continental shelf varies in width from approximately 9 to 40 miles, and the shelf edge lies in water 70 to 100 fathoms deep. It is a smooth surface interrupted in only a few places by small hills. The contour chart reveals that the shelf is extremely irregular in outline. It is narrowest off Cape Blanco and widest off the central coast in the vicinity of Florence. The average slope of the continental shelf varies from about 10 feet per mile to about 55 feet per mile. In general, the slope of the shelf is steepest at the inner and outer edges and flattest in the central portions. Except for the hilly areas, the bottom is covered by sand, muddy sand, or mud. In the hilly areas, rock is commonly present.

The map of bottom sediments is based on more than 800 samples collected from the continental shelf at three-mile intervals north of Coos Bay and at two mile intervals south of Coos Bay. The boundary lines between sediment types should be considered approximate, as samples on either side of the boundary are two or three miles apart. It should also be kept in mind that bottom currents may shift the sediments from time to time.

The types of sediments indicated on the chart are based on the size of the sedimentary particles. The diameter of the particles making up the sediment was measured by passing the sediment through a sieve having standard size openings. The map shows the type of sediment exposed at the bottom. Samples were col-



The clamshell grab is one device used to obtain samples of lake and nearshore ocean sediments.



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lected by means of a clamshell type device which grabs approximately one-half pint of sample from the surface of the sediment. Rocky areas are indicated where rocks were collected and little or no sediment was recovered.

BOTTOM SEDIMENTS

The sediments outlined on the map are sand, mud, and muddy sand. Sand is defined as consisting of particles which have diameters larger than 0.0625 millimeters (about 1/400th of an inch). Sediments which consist of more than 75% particles of this size are termed sand. Where less than 50% of the sediment by weight consists of sand-sized particles, the sediment is termed mud. For those sediments that are 50 to 75% sand, the term muddy sand is used. Most of the sand which occurs on the continental shelf off Oregon is similar to the sand on the beach. It is usually relatively fine in texture, although it feels gritty when rubbed between the fingers. The color varies from a light yellow to dark gray, but in general most of the sand is medium to light gray. Mud is slick or slimy to the feel, and ordinarily is a greenish or olive-gray color. The characteristics of muddy sand fall between those of sand and mud. Muddy sand feels slick, although the grittiness of the contained sand is apparent. The color varies from gray to olive-green.

Sand

Sand occurs in two major areas on the continental shelf: close to shore and at the shelf edge. The near-shore sand is usually gray. It extends from the shoreline out to a depth of about 50 fathoms off the northern and central coast. In the vicinity of the Umpqua River, sand is limited to shallower water, generally 30 fathoms or less, and forms a narrow belt along the coast at least as far south as the Rogue River. Sand which occurs as patches near the edge of the shelf is more variable in its characteristics than the nearshore sand. Shelf-edge sand may be somewhat coarser than the nearshore sand, and may vary in color from yellow or brown to dark green. In many areas, it contains appreciable amounts of broken shells.

Wherever sand occurs, it is likely that current activity on the bottom is regular and fairly strong (not as strong as in rocky areas, however). The bottom will generally be smooth and relatively hard. Where current or wave activity is persistent, it is not uncommon for ridges or ripples of sand to be produced.

The organisms common in the sandy inner shelf sediments include rapidly moving animals such as the commercially important Dungeness crab and English sole, slow creeping animals such as the Nassarius snail, and stationary buried organisms such as clams. Sand dollars (flat sea urchins) are found close to the coast. These animals generally feed on minute plant material in the water or on other animals or sometimes on decayed plant and animal remains.

Muddy sand

Gray to olive-gray muddy sand generally grades into the sandy areas. It occurs seaward of 50 fathoms in the northern portion of the shelf and seaward of about 30 fathoms in the southern portion. It is also common on the upper continental slope beyond the shelf edge. In areas where this sediment is present, the bottom is usually smooth but somewhat softer than the sandy bottom. There is less current activity at the bottom, but it is possible that in some places a rippled surface will have developed. It is not uncommon to find Rex and Petrale sole living on this type of sediment. Sea cucumbers, sea urchins, starfish, snails, and other invertebrates are also commonly associated with these sediments.

Mud

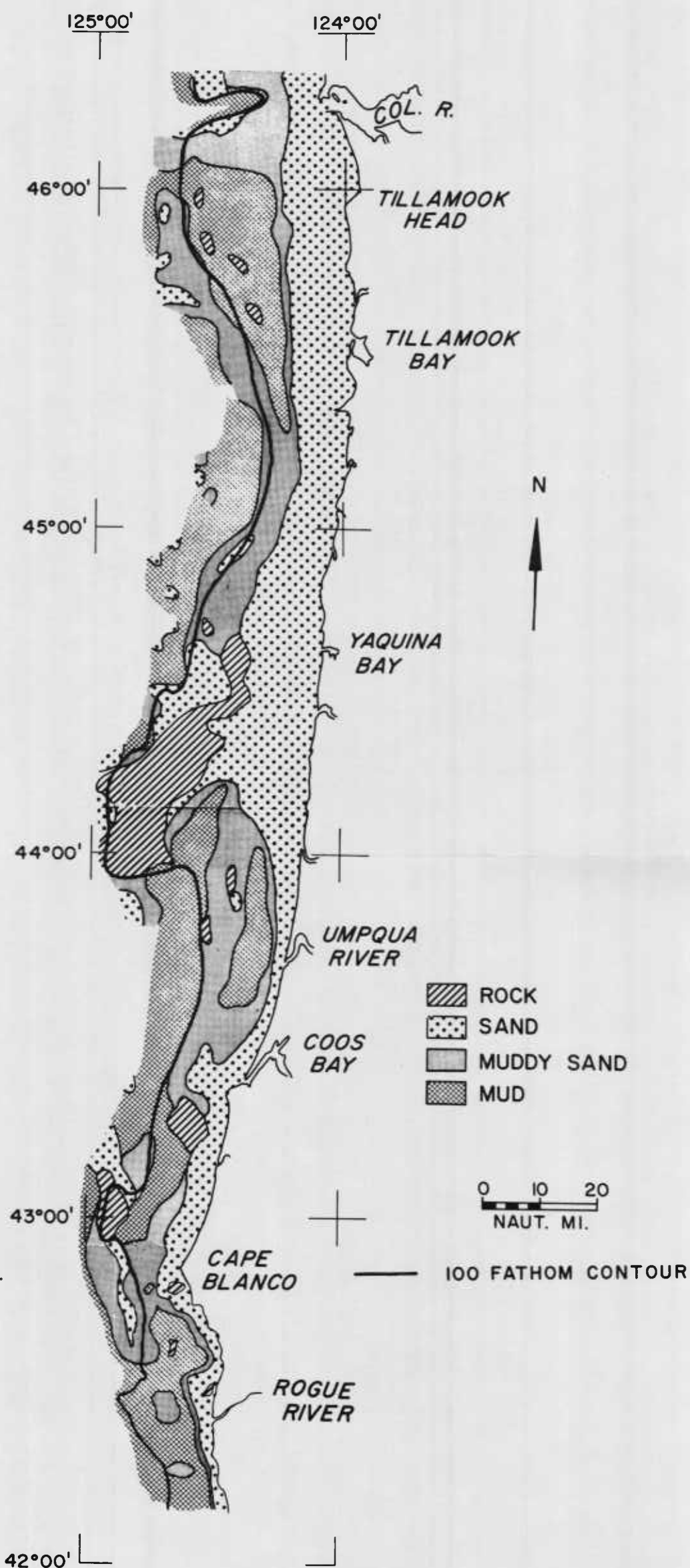
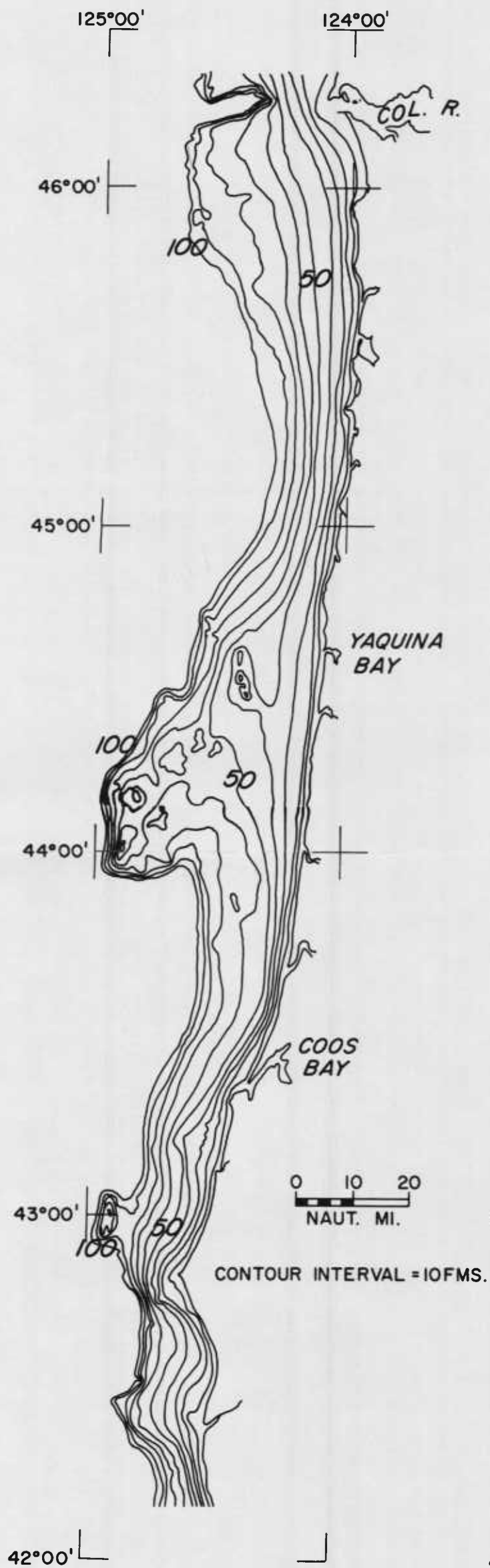
Muddy bottom is most common at or beyond the shelf edge. Mud is a finer grained sediment usually found in quiet water. It grades into muddy sand; the boundary between the two sediment types may be indistinguishable. Mud also occurs on the continental shelf southwest of the mouth of the Columbia River and off the Umpqua River. The muddy bottom is generally smooth and very soft. There is little or no current activity at the bottom, and burrowing organisms such as polychaete worms are very abundant. In addition, numerous sea urchins, sea cucumbers, starfish, and brittle stars are found on the sediment. Dover sole and pandalid shrimp are among the commercially important animals common to this type of bottom.

Rock

Rock is most common along the coastline and in banks some distance offshore. Rock is also exposed in patches at the shelf edge. Rocky areas are generally higher than the rest of the shelf and are extremely rough and irregular. They are areas of strong current activity and are commonly inhabited by attached animals such as sponges, sea fans, sea anemones, corals, tube worms, and hydroids. Starfish and brittle stars are also present. Halibut is one fish generally living around rocky banks.

Subsurface sediments

Operations such as dredging may disturb the surface sediment enough to encounter different sediments beneath the surface. Recent studies have indicated that sand probably underlies mud and muddy sand in most areas. It is conceivable that dredging or coring operations near the boundaries of the mud and muddy sand areas will penetrate the softer, finer grained sediments and will reach the sand a short distance beneath the surface. It is also possible that dredging or coring operations in the vicinity of the rocky areas will penetrate the thin sediment cover and encounter rocks beneath the surface of the sediment.



SHELF SEDIMENT TYPES

Below are underwater photos of three major sediment types. Not pictured is a sample of muddy bottom, which is similar in appearance to muddy sand. Muddy bottom is most common at or beyond the shelf edge and grades into muddy sand (Figure 2), and the boundary between the two sediment types may be indistinguishable.

The inside foldout chart shows a continental shelf off Oregon that is irregular in outline. The sediment chart shows approximate boundary lines of sediment types.

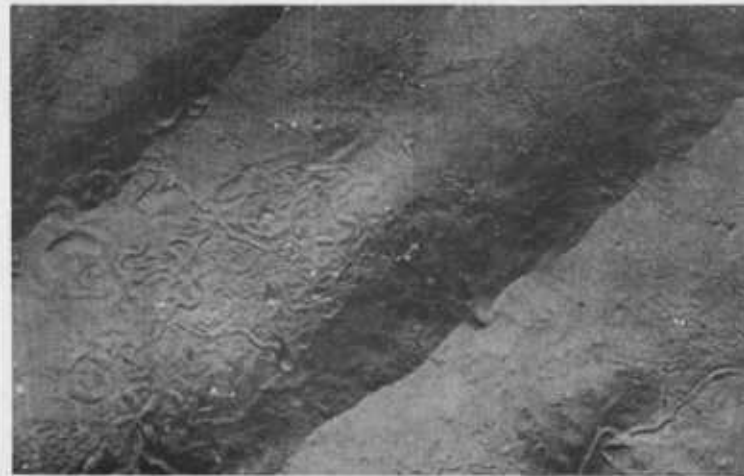


Figure 1: SAND. Taken northwest of Yaquina Bay at a latitude of 44°39.9' by longitude 124°05.4'. The sandy bottom at a depth of 20 meters clearly shows current ripples. Trails have been left by rapidly moving animals such as the Dungeness crab and English sole, and slow creeping animals such as the nassarius snail.



Figure 2: MUDDY SAND. Taken west of Cascade Head at a latitude of 45°01.6' by longitude 124°15.2'. At a depth of 160 meters the bottom is smoother and shows less current activity. Note the pandalid shrimp and sole common to these sediment areas.



Figure 3: ROCK. Taken at the south end of Heceta Bank at a latitude of 43°59.9' by longitude 124°53.5'. This photo, taken at a depth of 76 meters, is typical of the rough and irregular nature of these areas. Rocky areas are generally higher than the rest of the shelf and experience strong current activity. Note the attached organisms such as the basket star, crinoid, and various encrusting fauna common to these areas. The device in the upper part of the photo is a combination compass and current vane.

BATHYMETRIC CHARTS

Detailed water-depth information can be extremely valuable. Standard nautical charts present a considerable amount of information on bathymetry (water depths). However, other charts are available that present even more complete bathymetric data. There are advantages and disadvantages to each of the charts.

All of the bathymetric information used for any of these charts is based on government hydrographic surveys. The last full survey of the continental shelf off Oregon was made in 1928-1929. Some bays and smaller areas have been surveyed more recently. All charts, regardless of their type, use this same basic information.

The first kind is the *standard nautical chart* (figure 4). These charts show about 20 percent of the soundings that have been collected. They show depths in feet or fathoms and have Loran lines and other helpful navigational information. These charts sell for \$3.25 and are available through chart dealers or by mail order.

The second kind of chart is the *bathymetric map*, a chart specifically intended for presentation of depth information. Through more complete use of contours, these charts show about 98 percent of the bathymetric information that has been collected. Bathymetric maps show depths in meters and do not have Loran lines.

The bathymetric maps for Oregon are: 1308N-17, *Umpqua River to Cape Ferrelo*, and 1308N-22, *Tillamook Head to Heceta Head*. No bathymetric maps providing coverage further north than 46°N latitude (approximately Seaside) have been published.

Bathymetric maps cost \$5.00. Most chart dealers do not carry them; order them from Distribution Division C44, National Ocean Survey, Riverdale, MD 20840.

The third kind of chart is the *original hydrographic survey* itself. Each chart of this kind shows every depth sounding taken on that survey. It shows depth in feet or fathoms and is extremely basic: black printing on a white background, no navigational information other than locations of survey reference points. The original surveys are work sheets covering irregular areas rather than complete charts.

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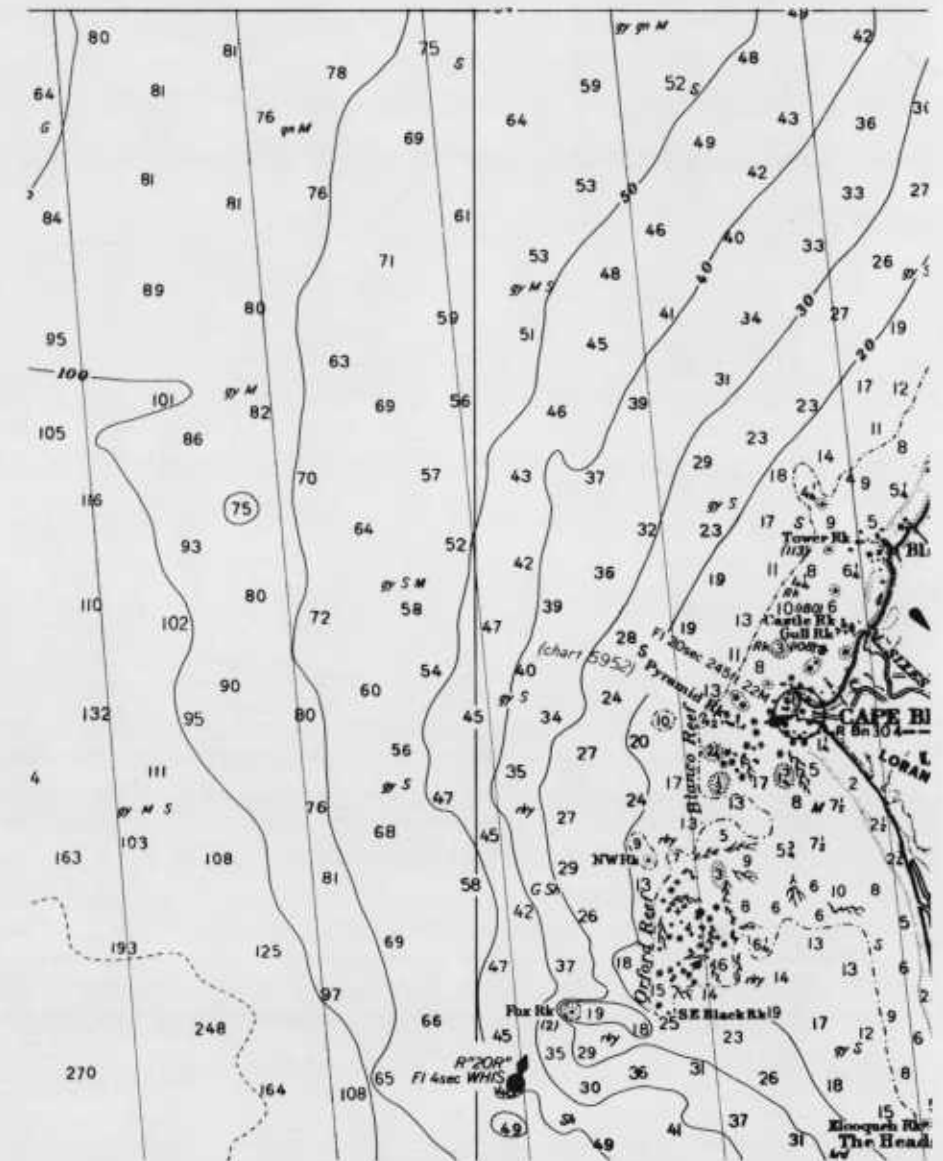


Figure 4: a portion of standard nautical chart 18580 (old 5802), off Cape Blanco. Note the indicators for sediment types: rky, rocky; gy S, gray sand; and gn M, green mud.

sion oceanographer Daniel A. Panshin have catalogs of the original surveys off Oregon. A copy of any survey may be purchased for \$16.00; order it from:

Director, National Ocean Survey (Attn. Hydrographic Data Section C353), National Oceanic and Atmospheric Administration, Rockville, MD 20852.

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