

COASTAL LANDFORMS BETWEEN YACHATS AND NEWPORT, OREGON

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The Oregon Coast between Yachats and Newport is a narrow, slightly elevated coastal plain. With the exceptions of basalt rock at Yachats and Seal Rock, the bedrock along this segment of the coast is sedimentary (see map, page 74). Several Pleistocene marine terrace levels are discernible at places along the plain, and sand dunes, both active and stabilized, impart a rolling topography to most of it. Numerous streams have incised small valleys and ravines into its surface; at Waldport the plain is interrupted by the estuary of the Alsea River and at Ona Beach State Park by the alluvial plain of Beaver Creek. Except in the two localities where basalt is exposed, the shore is marked by long stretches of sandy beaches bounded by low sea cliffs. Where the basalt is exposed, the shore has the rugged features that are characteristic of Oregon shores bounded by this type of rock.

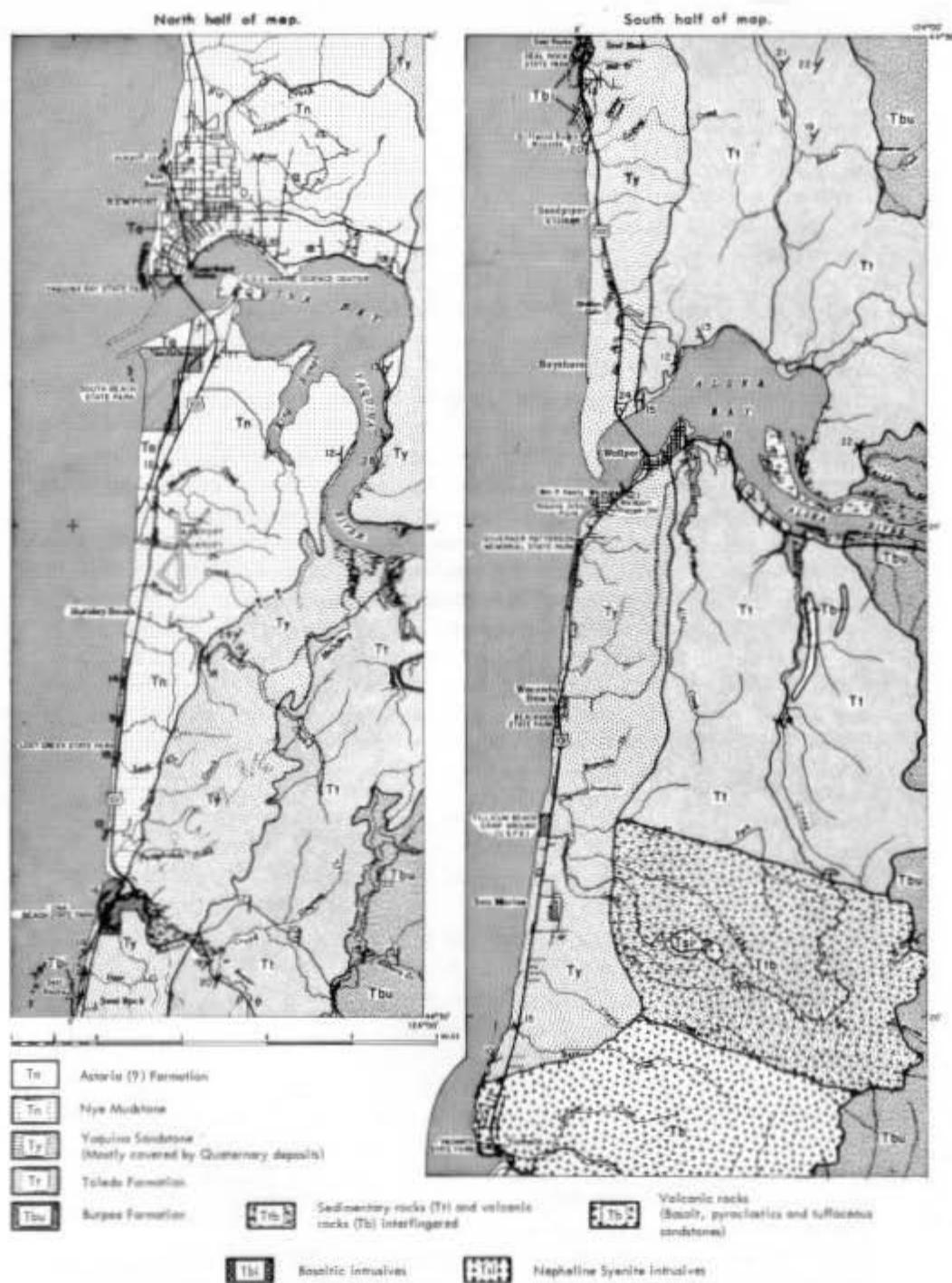
Tertiary Bedrock

Basalt

Two basalt formations are present in this segment of the coast: lava flows at Yachats and a sill at Seal Rock. (See Glossary, page 87.)

The basalt at Yachats is at the northern edge of a complex mass of lava flows and pyroclastic material that extends southward a short distance beyond Sea Lion Point. These rocks represent the remains of a huge center of volcanic activity in late Eocene time. At Yachats the basalt is mostly coarse flow-breccia. Its fragmentation is due in part to the breaking up of a solid crust of lava rafted along on the surface of a flow and in part to sudden chilling of the lava as it poured into the Eocene sea. Dense basalt is interlayered and otherwise intermixed with the breccia, and in places small dikes cut through the rock.

The basalt at Seal Rock is in the form of a sill intruded between beds of the Yaquina Formation. It is probably of late Miocene or younger age (Vokes, et al., 1949) and contemporary with the Columbia River Basalt. Its lower contact with the sedimentary strata is well displayed at the base of the large basalt rock mass known as Elephant Rock in Seal Rock State



INDEX AND GEOLOGIC MAP OF OREGON COAST, YACHATS TO NEWPORT
(modified from Vokes, Norbistrath, and Snively, 1949)
See road log (page 91) for mileage between points of interest



Figure 1. Elephant Rock, an elongate knob of columnar jointed basalt at Seal Rock State Park, is a remnant of a sill emplaced between layers of the Yaquina Formation.



Figure 2. Conglomerate consisting of large basalt boulders overlies basalt along the shore about 100 yards north of the Adobe Motel at Yachats. These boulders were eroded from the basalt and rounded into their present shape by wave action.



Figure 3. Excellent examples of spheroidal weathering are present in the upper part of a very coarse, local sand unit of the Yaquina Formation. Layers of the partly weathered rock separate from the non-weathered central core in a series of concentric shells.



Figure 4. Dark beds of the Yaquina Formation, exposed in sea cliff at Alsea Bay, have a gentle seaward inclination and are overlain by lighter colored, horizontal layers of terrace and dune sandstones.

Park (Figure 1). Sedimentary beds that once overlay it have long since been removed by erosion. The rock of this sill is fine grained and dense and has well-developed columnar jointing. It extends for a distance of about a mile and a half along the coast, and its position offshore is marked by numerous reefs and small sea stacks.

Sedimentary rocks

Yaquina Formation: About 100 yards north of the Adobe Motel at Yachats, the Eocene basalt is overlain by a conglomerate consisting of basalt particles that range in size from pebbles to boulders several feet across (Figure 2). The conglomerate extends northward along the shore for about 140 yards and gives way abruptly to a very coarse, pebbly sandstone made of basalt fragments. The age of the conglomerate is not definitely known, but it is considered a local aspect of the late Oligocene Yaquina Formation, which is younger than the basalt (Vokes, et al., 1949).

The coarse-grained sandstone is exposed along the shore in a bench that extends northward to the foot of Salmon Street, a distance of less than half a mile. Here it ends abruptly and gives way to a sand beach. At the northern end of the bench the sandstone is weathered, and the separation of concentric layers through spheroidal weathering is remarkably well displayed (Figure 3).

In a low cliff at the northern end of the bench one can see coarse sandstone overlying layers of finer textured sandstone, siltstone, and shale. The finer beds are exposed for a very short distance along the beach and disappear beneath Pleistocene terrace sediments. The coarse sandstone is assumed to be another local aspect of the Yaquina Formation, whereas the underlying siltstone, shale, and sandstone are more representative of the Yaquina Formation in the area covered by this study.

The Yaquina Formation borders the shore from its contact with the basalt at Yachats to a point about a mile north of Seal Rock, but it is exposed in only a few places over this distance. North of its exposure near Yachats it is next seen in a sea cliff on the south side of Alsea Bay just west of the city limits of Waldport (Figure 4), and from there it continues along the cliff that extends into the town. The formation is exposed along the shore at Seal Rock, where its beds are tilted seaward beneath the basalt sill at Elephant Rock. It forms low reefs that are exposed at low tide along the beach south of Elephant Rock (Figure 5). To the north it is exposed in places along the beach and at the base of the low sea cliff.

Nye Mudstone: The Nye Mudstone, which overlies the Yaquina Formation with a gradational contact, is exposed at numerous places on the beach and at the base of the sea cliff from a point about a mile north of Seal Rock almost to South Beach State Park south of Newport.



Figure 5. Beach at Seal Rock State Park. Outer reef is basalt; reef exposed on beach is a resistant layer of the Yaquina Formation dipping seaward beneath the basalt.

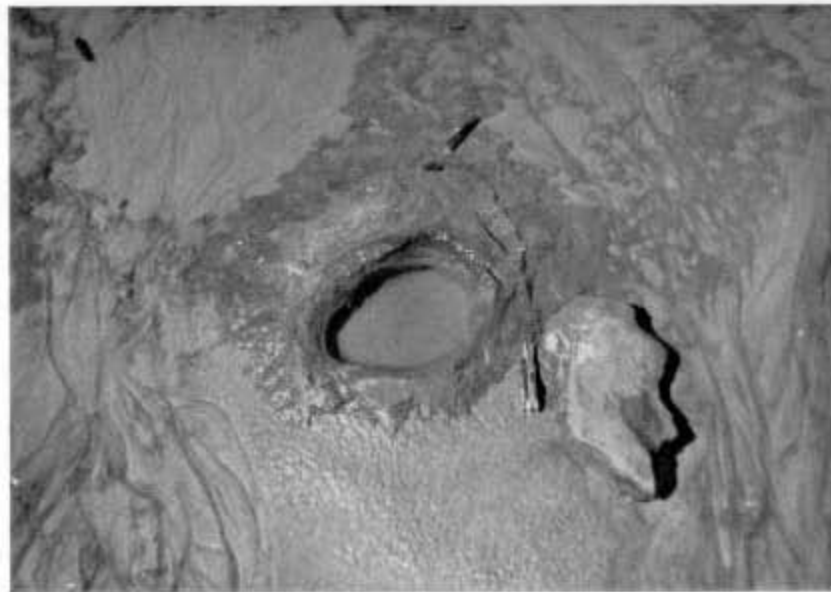


Figure 6. Hollow ironstone concretion, the upper part of which has been removed by erosion. These concretions are in the Nye Mudstone; some are exposed on the beach near the sea cliff about 200 yards south of Ona Beach State Park.

The formation is described as "... predominantly medium to dark olive-gray, massive, organic-rich mudstone and siltstone. Freshly broken samples have a strongly petroliferous odor. Calcareous and dolomite concretions as much as 4 feet across and lenticular beds 2 inches to more than 1 foot occur locally" (Snively, et al., 1969, p. 38). Some of the smaller concretions have been replaced by iron oxide and are hollow (Figure 6). These can be seen on the beach near the base of the sea cliff a short distance south of Ona Beach State Park. Molluscan fossils are reported to be sparse in the lower part of the formation but abundant in the upper part.

Quaternary Sediments

Marine terrace deposits

Beds of Pleistocene conglomerate and sandstone overlie the wave-cut surfaces that were formed on the several bedrock formations when sea level was higher during an interglacial stage (Figure 7). The base of the terrace deposits is usually a pebble conglomerate of varying thickness, and above this is sandstone, which makes up the greater part of the terrace sediments. The thickness of the terrace deposits ranges from a few feet to 20 feet or more. Sandstone up to 20 feet thick is exposed in the sea cliff at Yachats. In a few places the terrace sandstone overlies an older sediment that is finer textured and has logs and smaller pieces of wood in it. The older sediment is probably ancient stream channel filling.

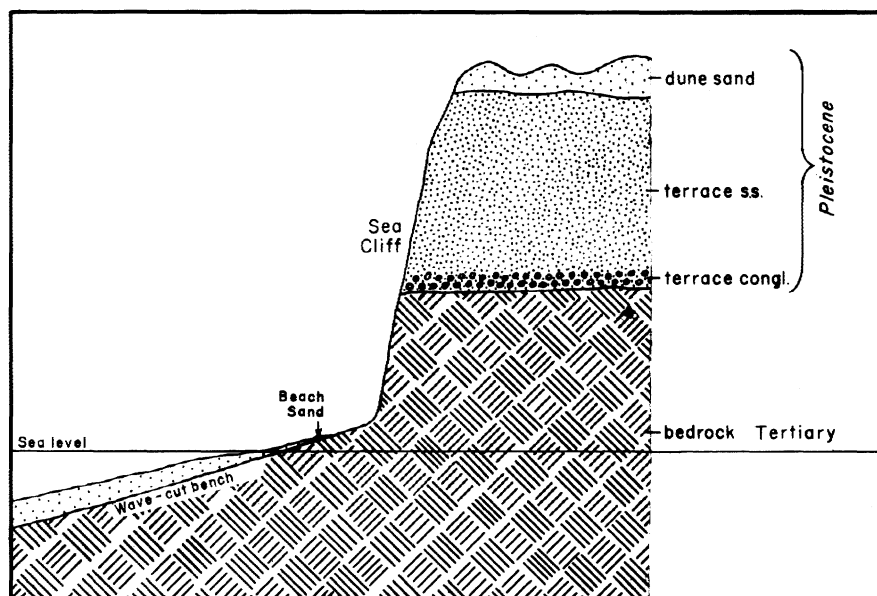


Figure 7. Generalized shore profile.



Figure 8. Beach and foredune at Ona Beach State Park. Dune is formed from sand swept off the dry beach and moved landward. It forms a barrier to Beaver Creek, which winds through an alluvial plain behind the dune before entering the ocean.



Figure 9. Present-day wave-eroded surface on the Nye Mudstone south of Ona Beach State Park. The bedrock extends seaward under a thin veneer of sand and continues landward in the sea cliff.

Dune deposits

Dune deposits can be divided into two groups according to age: old, stabilized wind-blown deposits that overlie the terrace sediments and the younger dunes that occupy the low areas around Yaquina and Alsea bays and at the mouth of Beaver Creek (Figure 8).

Landforms

Marine terrace

The marine terrace is the dominant landform between Yachats and Newport. It was formed at a time during the Pleistocene Ice Age when the sea level stood higher than it does at present and the waves cut a bench on the bedrock over which they moved. The present-day counterpart can be seen during low tide at many places along the shore where at high tide the waves are moving back and forth over bedrock. Where waves of Pleistocene seas were moving over sedimentary rock, the rate of erosion was greater than where they were working on basalt. Consequently the rate at which the sea encroached upon the land was greater in those areas underlain by sedimentary rock, and the coastal plain is much wider where the bedrock is sedimentary types than where it is basalt.

At Yachats and for a distance of about a mile north of the Yachats River, the terrace was formed on brecciated flow basalt, and at Seal Rock it is on a basalt sill for a short distance. With the exception of these two places, the terrace is on sedimentary formations of middle- to late-Tertiary age.

On the seaward side, the terrace ends abruptly at a sea cliff, the height of which ranges from a few feet to several tens of feet. Where the cliff is composed of bedrock, it is generally vertical or nearly so; terrace sediments and the older dune sands are also sufficiently cemented to maintain steep or vertical slopes (Figure 4). Younger dune sands, however, are not capable of supporting cliffs very long, and seaward-sloping surfaces develop on them along the terrace edge.

Wave-cut bench and beach

At the foot of the cliff is the wave-cut bench which forms the floor of the present-day beach. Most of the year, particularly during the summer, this bedrock surface is covered by sand, but during the winter months when the energy level of the storm waves is high, the sand may be swept off, exposing bedrock (Figure 9).

In the Nye Mudstone, layers high in calcium carbonate are harder than others, and because the formation has a gentle westerly tilt to it, these



Figure 10. Low spine of rock protruding through the sand south of Ona Beach State Park is a layer of calcareous sandstone in the less resistant Nye Mudstone.



Figure 11. Looking west across wide sand spit at Alsea Bay. A low dune ridge borders the ocean (left side of photo) and a grassy plain slopes gently toward the bay (right of photo). See Figure 18 for aerial view.

beds stand out in low reefs or broken ridges that are nearly parallel to or at a small angle to the shoreline. This type of rock forms small ridges on the wave-cut bench between Ona Beach and Seal Rock State Parks (Figure 10).

Sand dunes

Most of the terrace has areas of wind-blown sand, though dune forms are not prominent between Yachats and Waldport. Between Waldport and Newport, by contrast, the surface configuration is essentially one of dune forms. Low elongate ridges, low smoothly rounded hills, and small depressions occupied by lakes or marshy ground attest to the role of wind in shaping the surface. Dunes on the terrace are sufficiently old that a soil layer has developed on them, and they have been stabilized by a forest cover. Dune-type cross-bedding observed in many of the roadcuts gives further evidence of the wind's influence in shaping the surface on the terrace.

Young dunes north of Alsea Bay, at the mouth of Beaver Creek at Ona Beach State Park, and south of Yaquina Bay can be distinguished from the older ones by their lower position, scarcity of soil, and susceptibility to wind erosion, and are stabilized only in places by grass, bushes or scrubby trees.

The recent dunes north of Alsea Bay begin on the sandspit on the north side of the bay entrance and continue in a narrow strip northward a short distance past Driftwood Beach Wayside. On the sandspit a dune ridge lies near the beach, and this slopes off into a low sandy plain that borders Alsea Bay (Figure 11).

At Ona Beach State Park a small dune area that begins at the sea cliff on the south side of the park has formed a barrier to Beaver Creek that causes the creek to flow northward in a roundabout way before it enters the ocean. North of the creek a dune ridge lies between the highway and the beach for a distance of about half a mile (Figure 8).

Modern dunes cover an irregularly shaped area of several square miles south of Yaquina Bay. These dunes occupy, for the most part, an area that was once part of a more extensive bay at the mouth of the Yaquina River. Infilling of this part of the bay with sand and a lowering in sea level exposed a low surface to the wind, which was very effective in shaping a dune topography.

Bedrock bench at Yachats

The bedrock bench at Yachats is part of the Pleistocene marine terrace that extends from Yachats to Newport. For a distance of about a mile along the shore at Yachats the bedrock in the bench is basalt; northward for a distance of about half a mile it is composed of resistant conglomerate and coarse sandstone.

Wave erosion has stripped the terrace sediments off the surface of the bench and is chewing away at the hard bedrock. Where wave action has



Figure 12. Remnants of a Pleistocene wave-cut bench on basalt at Yachats State Park. This "exhumed" bench is slowly being removed by present wave action. Erosion is cutting trenches along fractures.



Figure 13. Short sandy beach at Yachats State Park where erosion along a fracture has removed the basalt. The people in the surf are netting smelt that come to spawn at these small beaches. (Oregon Highway Dept. photo)

not removed too much of this bedrock, the original terrace shape is still apparent (Figure 12). Differences in hardness of the rock and presence of fractures influence the rate of erosion and allow it to proceed faster in some places than in others, resulting in an interesting variety of landforms.

Where wave erosion is guided by fractures, narrow trenches (Figure 12) develop. In places where the trenches have been considerably widened and lengthened, the gaps in the bench are occupied by short, steeply sloping beaches of coarse sand (Figure 13).

Some small caves have been eroded along fracture zones, and where the cave roof has a hole in it, water is forced out during storms and high tides. These are the spouting horns which are so numerous along the Oregon Coast, especially where it is bounded by basalt. The widening of a cave may take place where a less resistant layer is overlain by a more resistant one, or it may go on simply by the abrasion caused by sand washing back and forth along the base of the cave wall. Undercutting at the base of a vertical surface by wave attack is evident in many places, especially around the small beaches (Figure 14).

Small arches (rock bridges) are seen in places where either a tunnel passes through a rock point (Figure 15) or a cave roof has collapsed (Figure 16). Adding to the ruggedness of this locality are the rough surfaces on the bench remnants and the numerous irregular rock masses of varying sizes and shapes that have been isolated from the bench.

Reefs and sea stacks at Seal Rock

One of the most spectacular parts of the coast between Yachats and Newport is at Seal Rock, where erosion of a basalt sill has formed sea stacks, reefs, and numerous rock knobs of varying sizes and shapes (Figures 5 and 17). The most prominent feature here is Elephant Rock, which looms up at the north end of the beach at Seal Rock State Park (Figure 1). This rock mass, now part of the mainland, was a sea stack at times of higher sea level during the Pleistocene Ice Age.

The basalt sill and the sedimentary rock layers between which it was emplaced have a seaward tilt of a few degrees at this locality. This tilt is apparent where the base of Elephant Rock is in contact with the underlying sedimentary rocks.

The sill was once continuous over the entire area where basalt is exposed along the shore and offshore, but wave erosion has removed a large part of it. The alignment of the remnant reefs and stacks nearly parallel to the shore here (best seen north of Elephant Rock) is related to the tilt in the rock layers. Sedimentary layers overlying the sill on its seaward side and sedimentary rock under it and on its landward side were removed by wave erosion, and the more resistant basalt projects above the general level of the sea floor in its variety of forms. This inclination of beds is also reflected in the small reef developed on a hard layer of sedimentary rock



Figure 14. The basalt bench has been eroded to these remnant knobs at Yachats State Park. Scouring by wave-carried sand cuts notches at base of knobs; overhanging rock collapses and is ground to smaller particles. A lower bench is being formed.



Figure 15. Small arch where erosion has penetrated through a point of basalt at Yachats State Park.

landward from the more prominent basalt reef at Seal Rock State Park (Figure 5).

Estuaries

The Alsea and Yaquina Rivers, and to a lesser extent the smaller Yachats River, are affected by tides for some distance upstream. The lower parts of these rivers, the bays, are said to be "drowned" and are referred to as estuaries (Figure 18). The development of these estuaries is closely tied to the sea level fluctuations during the Pleistocene Ice Age.

Four times during the Ice Age large amounts of the world's water were frozen in ice sheets that covered much of North America and northern Europe and Asia, as well as Antarctica and Greenland; sea level during those periods was several hundred feet lower than it is now. The mouths of the coastal streams of Oregon were then some considerable distance west of their present position. During the interglacial stages when most of the ice had melted and returned to the oceans, the sea stood at least 150 feet above its present level, and during these time of high sea levels the sea projected far inland along the larger river valleys. Wave erosion along the shore in the outer parts of these embayments enlarged them. With a lowering of sea level below its present position, the bays again came under the influence of the rivers.

In recent times the main effect of the rivers has been an infilling of sand and other sediment; the sizes and shapes of the bays vary according to the currents that are generated by the flow of the river together with the tidal rise and fall of sea level.

Sand spit

At the mouth of the Alsea River, ocean currents have constructed a southward-projecting sand spit that has blocked off most of the bay mouth and restricted the passage through which the Alsea River flows into the ocean. The size and configuration of the sand spit is in delicate balance with the forces that created it. That it has changed in its configuration since the Alsea Bay area was settled is shown in logs with sawed ends that were once covered by sand and that are now being uncovered by wind and wave erosion (Figure 19).

Glossary

Alluvial: Refers to sediment deposited by streams.

Basalt: Dark-colored, fine-grained rock of volcanic origin.

Bedrock: Solid rock beneath soil or sediment layer. May be exposed.

Breccia: Rock made up of large, angular fragments.



Figure 16. Two arches (bridges) where roof of small cave has collapsed.



Figure 17. Beach at Seal Rock State Park. Aligned small knobs in upper center of photograph are along a hard layer of the Yaquina Formation. The larger knobs are remnants of the basalt sill of Elephant Rock. (Oregon Highway Dept. photo)

Concretion: Structure (may be spherical or irregular in shape) in sedimentary rock; formed where mineral matter deposited around nucleus.

Conglomerate: Rock containing numerous rounded pebbles or large particles.

Dike: Tabular-shaped igneous rock body that cuts through another rock.

Estuary: Lower part of river affected by tides and mingling of salt water from ocean with fresh water from river.

Formation: 1. Land form. 2. Body of rock, the parts of which are related in space, time, and/or origin.

Gradational contact: Contact between two rock units that is transitional rather than abrupt.

Mudstone: Sedimentary rock composed essentially of solidified mud.

Pyroclastic: Volcanic rock made up of fragments erupted from a volcano.

Quaternary: The latest Period of geologic time; began about 2 million years ago. Includes Pleistocene (Ice Age) and Holocene (recent) Epochs.

Reef: Ridge in the sea floor partly or entirely covered by water.

Sandstone: Sedimentary rock made of sand that has been cemented together.

Sea stack: Small prominent island of bedrock near the shore.

Shale: Laminated sedimentary rock made of solidified mud.

Sill: Tabular-shaped body of igneous rock intruded into and lying parallel to sedimentary rock layers.

Siltstone: Sedimentary rock of particles finer than sand, coarser than clay.

Terrace: Bench-like landform cut into bedrock or built up by sedimentary deposition. Oregon shore terraces have aspects of both.

Tertiary: Period of geologic time between 65 million and 2 million years ago. Includes Eocene, Oligocene, Miocene, and Pliocene Epochs.

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Figure 18. Aerial view east across Alsea Bay, estuary of the Alsea River. U.S. 101 crosses the estuary at Waldport. Wide sand spit, bottom of photo, shelters bay from ocean and constricts river mouth to right of photo. (Oregon Highway Dept. photo)



Figure 19. Logs being uncovered by wave and wind erosion on the outer edge of sand spit at mouth of Alsea Bay. Sawed end on log in center indicates burial after Alsea Bay area was settled.

ROAD LOG BETWEEN YACHATS AND NEWPORT

<u>S-N</u>	<u>Mileage</u>	<u>N-S</u>	
<u>Mileage</u>	<u>Increment</u>	<u>Mileage</u>	
0.0		22.7	SOUTH
0.5	0.5	22.2	Yachats Post Office
0.8	0.3	21.9	Adobe Motel entrance
1.2	0.4	21.5	Yachats city limits
2.5	1.3	20.2	Salmon Street
3.6	1.1	19.1	Small interdune pond west of highway
3.8	0.2	18.9	Blodgett Road
4.1	0.3	18.6	Tillicum Beach Forest Camp
4.9	0.8	17.8	Big Creek; highway on low terrace
6.4	1.5	16.3	Beachside State Park
7.1	0.7	15.6	Viewpoint
7.5	0.4	15.2	Governor I. L. Patterson State Park
7.6	0.1	15.1	Waldport Ranger Station
7.8	0.2	14.9	Viewpoint at mouth of Alsea River
8.3	0.5	14.4	William P. Kealy Wayside
8.9	0.6	13.8	South end of Alsea bridge
9.4	0.5	13.3	North end of Alsea bridge and turnout
			Bayshore Drive; small interdune lake west
			of highway
9.9	0.5	12.8	Entrance to Sandpiper Village
10.1	0.2	12.6	Small lake west of highway (one of several
			along highway here)
11.0	0.9	11.7	Driftwood Beach Wayside
12.7	1.7	10.0	Viewpoint; quarry in basalt east of highway
13.2	0.5	9.5	Seal Rock State Park
13.5	0.3	9.2	Seal Rock Post Office
14.0	0.5	8.7	Turnout; beach viewpoint and access
15.1	1.1	7.6	Ona Beach State Park and Beaver Creek
15.5	0.4	7.2	Dune ridge west of highway
16.8	1.3	5.9	Lost Creek State Park
19.2	2.4	3.5	Entrance to Pacific Shores community
19.7	0.5	3.0	Airport junction; entrance to Surfland
			community
20.7	1.0	2.0	South Beach State Park
21.6	0.9	1.1	South Beach community
22.0	0.4	0.7	South end of Yaquina bridge; access to
			O.S.U. Marine Science Center
22.7	0.7	0.0	North end of Yaquina bridge; Yaquina Bay
			State Park

NORTH

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GEOLOGY OF MITCHELL QUADRANGLE PUBLISHED

Just off the press from the Oregon Department of Geology and Mineral Industries is Bulletin 72, "Bedrock Geology of the Mitchell Quadrangle, Wheeler County, Oregon." Authors are Dr. Keith F. Oles and Dr. Harold E. Enlows, Department of Geology, Oregon State University. The 62-page bulletin has a multicolored geologic map and is illustrated by numerous photographs with interpretive line drawings beneath them.

Bedrocks described range in age from Permian through Tertiary. They include Permian metasediments, Cretaceous marine beds (Hudspeth and Gable Creek Formations), lavas and tuffs of the Clarno and John Day Formations, Columbia River Basalt, Rattlesnake ignimbrite, and a variety of small intrusive bodies. A number of the rocks are analyzed petrographically and chemically. Special emphasis is given to the Clarno Formation, which the authors raised to group status on finding an upper and a lower phase separated by a marked unconformity. Keyes Mountain is shown to be the roots of a huge volcano that provided most of the material for the upper part of the Clarno rocks.

Bulletin 72 is for sale by the Department's Portland, Baker, and Grants Pass offices. The price is \$3.00.

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HOMESTAKE TO BUILD NEW GOLD PROCESSING PLANT

A year ago Homestake Mining Co. was having problems. Minute traces of mercury were getting into the Cheyenne River from its Lead, South Dakota gold mine. Homestake, the nation's largest producer of gold, mines the ores in workings as much as 6,000 feet underground, making mining and recovery costly endeavors.

Mercury played a vital role in the recovery of the gold. It was used as an amalgam to take the metal out of the ore during the milling process prior to cyanidation. But because of environmental concern, Homestake suspended the mercury circuit from its flow sheet, badly hampering production. Then while its own metallurgists sought new answers, the company asked the U.S. Bureau of Mines for help.

At the time of Homestake's request, the Bureau's Salt Lake Metallurgy Research Center was engaged in a study of ways to improve gold production in the United States. In a matter of six months Bureau researchers had devised a carbon-in-pulp method to capture the gold, completely eliminating the use of mercury from the process.

A pilot plant was built at Lead, and in March success of the research was confirmed. Homestake Mining Co. has announced it will build a full-scale plant with a capacity of 2500 tons a day. The new carbon-in-pulp plant will be completed in 15 months at a cost of \$850,000.

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