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The ORE BIN
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LANDFORMS ALONG THE COAST OF SOUTHERN COOS COUNTY, OREGON

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A marine terrace (Figure 1) borders the shore of Coos County for much of the distance between the entrance to Coos Bay and the Curry County line, and erosion along this terrace has produced a shore with varied and magnificent scenery. Different degrees of resistance to erosion have allowed the waves to sculpture the terrace into sharp points of land, reefs, islands, secluded coves, and a myriad of smaller forms. Rocks on which the terrace was formed differ along the shore, and this is reflected in a variation in shore features from one segment of the Coos County coast to another.

Figure 1. Rugged coastline and marine terrace at Shore Acres State Park. (Oregon State Highway Division photo)

Figure 2. Shore between Cape Arago and Coos Bay. Middle Cove is in foreground. (Oregon State Highway Division photo)

Between the Coos Bay entrance and Cape Arago, the terrace is on a sequence of Tertiary sedimentary rocks that are inclined steeply towards the east and cut by numerous fractures. The edges of these beds are exposed to wave attack along a southwest trending coast. Erosion, directed along soft sedimentary layers and fractures, has shaped a shore that is distinctly different from that of any other part of the Oregon coast (Figure 2). South of Cape Arago, where the trend of the coast is more nearly parallel to the trend of the Tertiary sedimentary strata, the shoreline is much more regular. The terrace is missing for about 2 miles and the shoreline is at the base of a high cliff along a stretch of rugged terrain (Figure 3). Except for the small projection and sea stacks at Fivemile Point, the shore along the terrace between Sacchi Beach and the Coquille River is regular and with wide beaches (Figure 4 and 21).

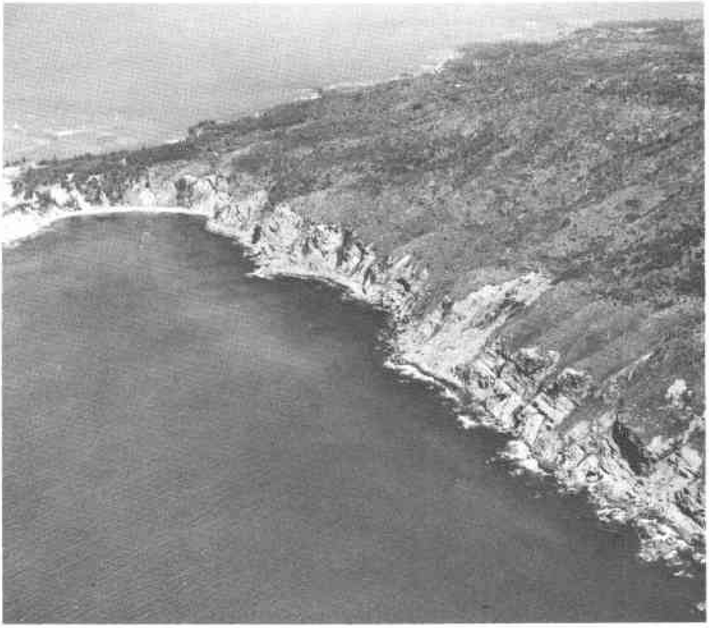


Figure 3. Shore along Seven Devils south of Cape Arago. (Oregon State Highway Div. photo)

Figure 4. Sacchi Beach. (Oregon State Highway Division photo)

Figure 5. Shore south of Bandon. Coquille Point is in upper left and Grave Point in foreground. (Oregon State Highway Division photo)

Along the shore from the Coquille River southward for about 3 miles, the terrace is on Jurassic rocks of varied composition and hardness. The shore along this stretch is irregular and rugged but in a different way from that north of Cape Arago (Figure 5). Along the remaining 9 miles, from about Crooked Creek to the county line, the shore is bordered by a low, wide coastal plain with sand dunes along the outer edge (Figure 6).

Geologic investigations of this part of the state go back to about the turn of the century when Diller (1901) mapped and described the geology of the Coos Bay quadrangle. Coal in the Tertiary sedimentary rocks around Coos Bay and other minerals of potential economic importance in this region have stimulated much of the investigation. An article of popular interest with emphasis on the state parks at Cape Arago was prepared by Ehlen (1967). A recent work by Baldwin and others (1973) is a comprehensive study of the geology and mineral resources of Coos County and contains an extensive bibliography of earlier geologic works dealing with this part of the state.

The writer wishes to express his appreciation to Dr. Ewart M. Baldwin, professor of geology at the University of Oregon, for his critical reading of the manuscript and helpful suggestions and to Ward Robertson of Coos Bay for air photographs used in this article.

Figure 6. Shore at Bandon State Park and southward. Bradley Lake in upper left. (Oregon State Highway Division photo)

Bedrock

Pre-Tertiary rocks

Pre-Tertiary rocks along the Coos County coast are sedimentary and metamorphic types of Jurassic age. Rocks of Late Jurassic age are assigned to the Otter Point Formation and are a complex mixture of types that include graywacke sandstone, greenstone, and chert. Isolated bodies of blueschist embodied within the formation became incorporated in it from an outside source during a time of intense deformation. The rock that was quarried from what was known as Tupper Rock for use in construction of the jetty at Bandon is blueschist. Jurassic rocks are exposed in the sea cliffs and in the knobs, sea stacks, and larger islands along the shore south of the Coquille River.

Tertiary rocks

Roseburg Formation: Rhythmically bedded turbidites, which are alternating thin beds of sandstone and shale thought to have been deposited under conditions of turbidity on the sea floor, are exposed at Fivemile Point.

Elkton Siltstone: Beds of mica-bearing siltstone and thin-bedded sandstone that crop out at Sacchi Beach are assigned to the Elkton Formation of Eocene Age.

Coaledo Formation: The Coaledo Formation is exposed along the shore from the north end of Sacchi Beach to the south end of Bastendorff Beach. This Eocene Formation consists of approximately 6,000 feet of sandstone, siltstone, and shale. It has been subdivided into three members, principally on the basis of the amount of silt and clay in the strata. The middle member has more of these finer sediments than the upper and lower members, which are mostly sandstone and are coal-bearing. The middle member has no coal. The contacts between members are gradational, and their boundaries are arbitrarily defined.

Thickness of beds in the Coaledo Formation ranges from a fraction of an inch in the thin shale laminae to tens of feet in the massive sandstone beds. The massive sandstone offers the greatest resistance to wave erosion and the shale and siltstone layers the least, a condition that is one of the main reasons for the great irregularity along the shore between Bastendorff Beach and the tip of Cape Arago.

A striking feature of the Coaledo Formation is the abundance of large concretions, some having a diameter of more than 2 feet. These structures were formed in the sandstone by a cementing process after the sand was deposited. Initially a small particle of shell or other substance in the sand acted as a nucleus around which calcium carbonate (calcite) precipitated from water percolating through the porous sand. As precipitation continued, the concretion grew, incorporating the surrounding sand into a calcite-cemented sandstone body of more or less spheroidal shape. Because the sandstone in the concretions is harder than that surrounding them, they stand out in positive relief on an eroded surface (Figure 7).

Bastendorff Formation: The Bastendorff Formation lies behind the beach between Yoakam Point, known locally as Mussel Reef, and Tunnel Point. This formation, of upper Eocene and lower Oligocene age, consists of about 2,900 feet of shale that overlies the Coaledo Formation. The shale of the Bastendorff Formation is easily eroded; consequently, where it occurs along the shore, there is an indentation in the coastline.

Tunnel Point Formation: The Tunnel Point Formation is exposed in a point of land that projects onto the beach about half a mile south of the south jetty at the Coos Bay entrance. This formation of Oligocene age consists of 800 feet of fine-grained, massive sandstone that overlies the Bastendorff Formation. It is similar to sandstone beds of the Coaledo Formation and erodes in a similar way.

Figure 7. Concretions in lower member of Coaledo Formation (diameter about 2 feet).

Figure 8. South Slough and Coos Bay entrance. Bastendorff Beach left of jetty and tip of Coos Bay sandspit in upper right. (Photo by Ward Robertson)

Empire Formation: The Empire Formation of Pliocene age extends from its contact with the Tunnel Point Formation eastward and is the bedrock on both sides of the South Slough. Baldwin (1966) reports an outcrop at the mouth of China Creek 3 miles south of Bandon.

Pleistocene sediments

Coquille Formation: The Coquille Formation, described and named by Baldwin (1945), is composed of bay sediments deposited during late Pleistocene at the mouth of the Coquille River when its channel was north of its present position. These sediments consist of loosely consolidated conglomerate, sandstone, and mudstone containing stumps, logs, and smaller pieces of wood. The beds are exposed in the sea cliff between Whisky Run Creek and Cut Creek and are the source of the petrified wood and varieties of quartz found on the beach between these creeks.

Terrace sediments: Terrace sediments were formed at different times during the Pleistocene and are at different altitudes. The youngest and lowest was named the Whisky Run terrace by Griggs (1945). Because of warping in the earth's crust, its height above sea level is different at different places. Baldwin (1945) reports an altitude of 125 feet at Cape Arago and a decrease to about 25 feet at Fossil Point on the east side of the bay just north of the mouth of South Slough. The highest terrace in the Cape Arago vicinity is at about 600 feet and tilts in the direction of South Slough.

The 125-foot altitude of the Whisky Run terrace is within the range of sea level fluctuation during the Pleistocene Ice Age and was formed during an interglacial stage when sea level stood higher than it does now. The altitudes of the older terraces, however, are far greater than the highest level of sea during the interglacial stages, and their positions are attributed to upward movement in the earth's crust.

Terrace sediments consist principally of weakly consolidated sand. In places the sand overlies conglomerate that rests on the bedrock, but conglomerate is usually absent where the bedrock is sandstone or less durable rock.

Dune sand: Wherever the shore is bordered by a coastal plain, wind has blown sand off the beach to form a belt or area of sand dunes. The most extensive of these is along the southern part of the Coos County coast. Dunes are also a prominent feature on the plain at the mouth of the Coquille River (Figure 21).

Structure

The sedimentary formations in the area around South Slough have been bent downward into a trough-like structure referred to as the South Slough syncline. A low in the topography, a former stream valley, coincides with the low part of the syncline and is occupied by South Slough (Figure 8). The sedimentary formations on either side are inclined towards the slough,

Figure 9. Tilted beds of Coaledo Formation overlain by horizontal terrace sand at Shore Acres State Park.

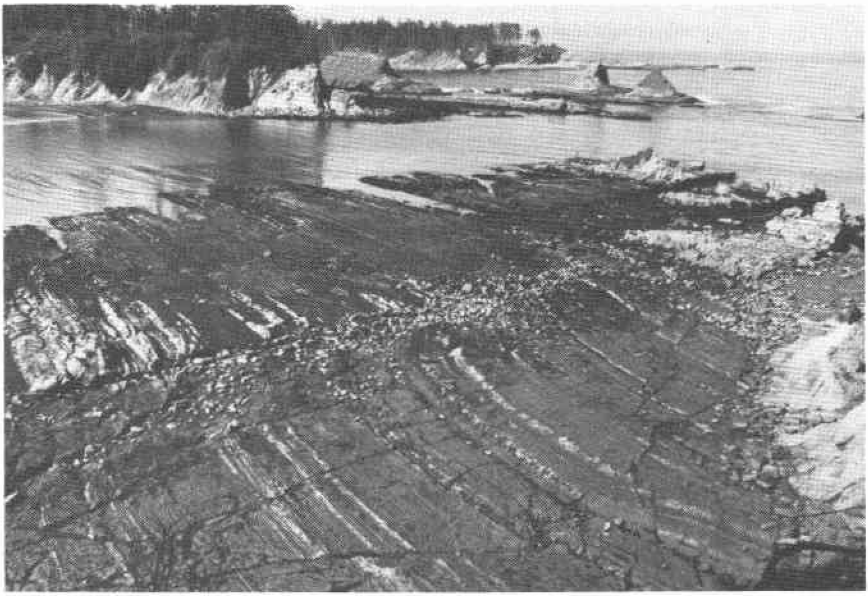


Figure 10. Fault cutting rock in the wave-cut bench in Sunset Bay.

and so all the strata between it and Cape Arago tilt downward towards the east. This is remarkably well displayed along the shore where the edges of the beds are exposed in the sea cliffs (Figure 9).

The stresses in the earth's crust that formed the syncline also fractured the rock in numerous places. Movement along many of the fractures caused faults along which strata were displaced (Figure 10). Displacement is only inches along some faults but many tens of feet along others. In some the displacement was along a single surface, and in others it was distributed along zones of varying width. Rock in the fault zones is badly shattered and therefore very susceptible to erosion.

Landforms

Along most of the shore between Coos Bay and the Curry County line, a beach of sand or mixed rock and sand forms a thin veneer over a wave-eroded surface. In places the beach lies at the foot of a sea cliff composed of terrace sediments, bedrock, or, most commonly, bedrock overlain by terrace sediments. Where there is no sea cliff and the terrain is low, a foredune ridge lies behind the beach.

Where waves are working against terrace deposits or other Pleistocene sediments only, the shore has little irregularity. Where they are eroding bedrock, the shore varies from regular to extremely irregular depending upon structural characteristics and hardness of the rocks under attack.

Between the Coos Bay entrance and Sunset Bay, the shore has a general southwest trend that is diagonal to the trend of the South Slough syncline (map). With strata exposed along the shore in cross section, wave erosion can take maximum advantage of differences in rock hardness. Between Sunset Bay and the end of Cape Arago, the shore is more nearly parallel to the trend of the sedimentary beds, but the rock is cut by numerous faults. Erosion is directed along soft strata and fault zones where the rock has been weakened by shattering. The Coos County coast has its greatest irregularity between Coos Bay and Cape Arago (Figure 2).

Bays, coves, and indentations

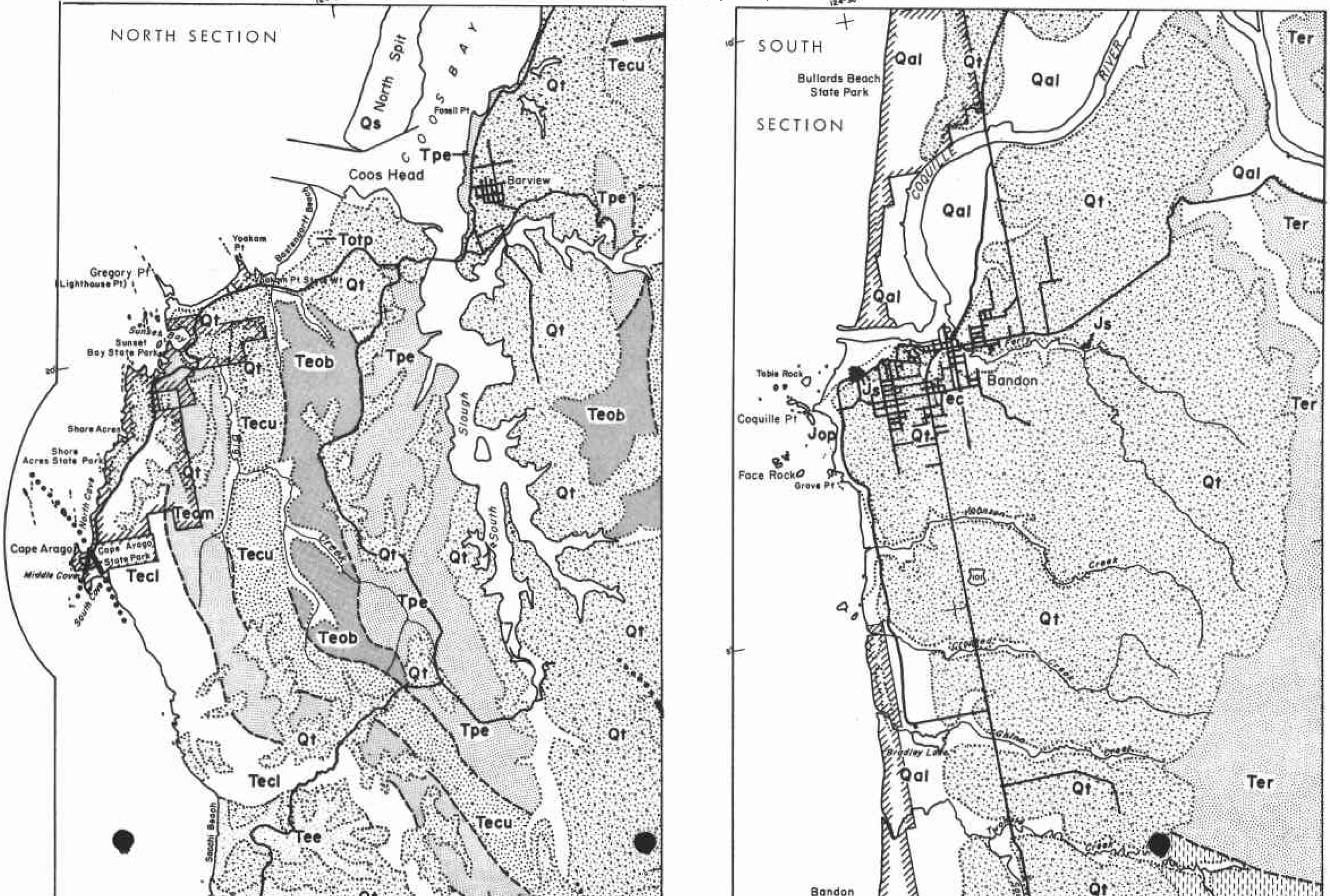
Bays, coves, and indentations are variations of the same general shore form, differences being mainly in size and shape. Bays and coastal re-entrants that are related to rivers do not belong in this category.

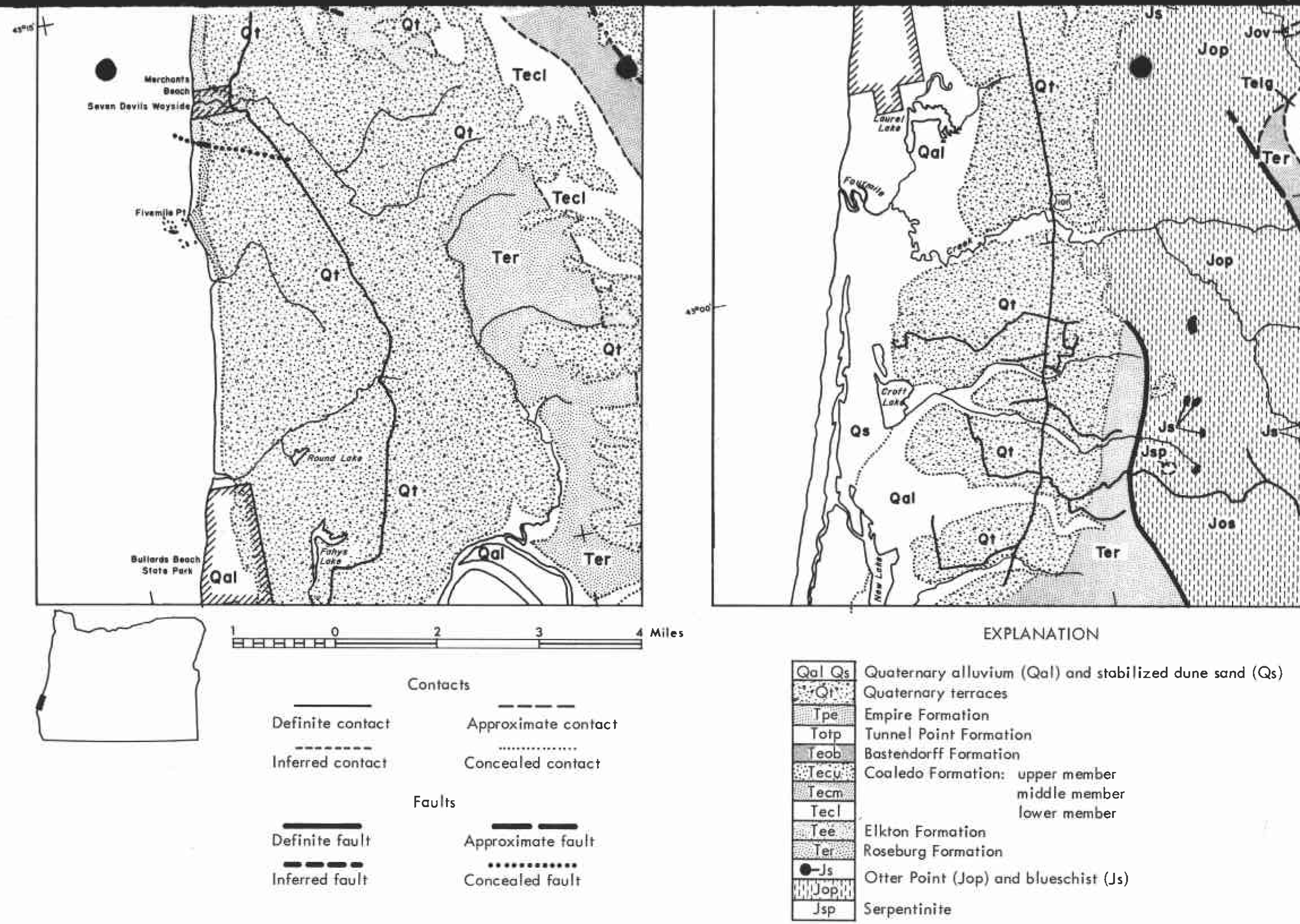
Two broad indentations, one between Tunnel Point and Yoakam Point and the other between Yoakam Point and Lighthouse Point (shown on the map as Gregory Point), are at places where there is a thick sequence of weak beds. Between Tunnel Point and Yoakam Point, the rock is shale of the Bastendorff Formation. Prior to the construction of the south jetty, Bastendorff Beach was limited by these two points. After the jetty was built, sand filled in, causing the shore to shift seaward and extending Bastendorff Beach

Figure 11. Lighthouse Beach with points of land on hard units of middle member of Coaledo Formation. (Photo by Ward Robertson)

Figure 12. Sunset Bay, Lighthouse Point, Squaw Island, and reefs. (Oregon State Highway Division photo)

GEOLOGIC MAP OF THE COAST OF SOUTHERN COOS COUNTY, OREGON
(from Baldwin, 1973)




Merchants Beach
Seven Devils Wayside
Fivemile Pt
Bullards Beach State Park
Round Lake
Fahys Lake
Laurel Lake
Fourmile
Creek
Croft Lake
New Lake
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43°00'
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Contacts
Definite contact
Approximate contact
Inferred contact
Concealed contact
Faults
Definite fault
Approximate fault
Inferred fault
Concealed fault
EXPLANATION
Qal Qs Quaternary alluvium (Qal) and stabilized dune sand (Qs)
Qt Quaternary terraces
Tpe Empire Formation
Totp Tunnel Point Formation
Teob Bastendorff Formation
Tecu Coaledo Formation: upper member
Tecm middle member
Tecl lower member
Tee Elkton Formation
Ter Roseburg Formation
Js Jop Otter Point (Jop) and blueschist (Js)
Jsp Serpentinite

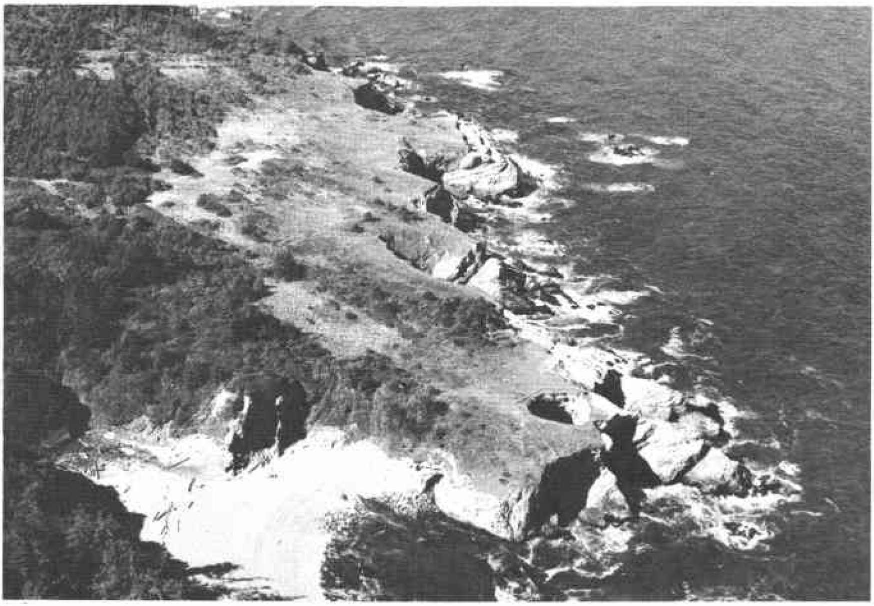

Figure 13. Round hole in terrace at Shore Acres State Park is a collapse in the roof of a sea cave.

Figure 14. Chasm at Yoakam Point (Mussel Reef).

to the jetty (Figure 8). This extension of the beach has somewhat obscured the natural boundaries of the indentation.

The concavity between Yoakam Point and Lighthouse Point is against the middle member of the Coaledo Formation. Although this member has a greater amount of shale and siltstone components than the lower and upper members, it has some massive sandstone beds. These units form points that project onto Lighthouse Beach, and small indentations lie between them (Figure 11).

Between Sunset Bay and the tip of the cape, the shore is against the lower member of the Coaledo, and the trend of the shore is nearly parallel to the trend of the strata. Most of the irregularities in this stretch are related to faults, though differences in rock hardness play an important role in shaping the coves.

Sunset Bay (Figure 12), largest of the coves, lies partly in the lower member and partly in the soft middle member of the Coaledo. At this locality, numerous faults cut through the rock nearly at right angles to the shore. The forming of the bay occurred when erosion, guided by these faults, breached the lower member and scoured out the softer rock behind the constricted entrance. The lobe at the southern end of the bay is an extension along the valley of Big Creek.

The cove south of the view house at Shore Acres State Park (Figure 13) and numerous smaller ones along this part of the shore are somewhat similar to Sunset Bay in origin, though their enlargement was in softer strata of the lower member and not in the middle member of the Coaledo.

North, Middle, and South Coves (Figures 2 and 3) at the outer lobe of Cape Arago are in the lower Coaledo and owe their origin in part to difference in rock hardness and in part to structure. The Cape Arago fault crosses the "neck" of the lobe in an approximate north-south direction. A local wrinkle in the strata called the Cape Arago anticline is associated with the fault and also has a north-south trend. It is likely that the coves formed where fracturing of the rock along these structures created zones of weak rock.

Points, reefs, and islands

As the weaker rock is worn away by waves, various forms emerge where the rock is more resistant to erosion. The sandstones and metamorphic rocks of the pre-Tertiary formations and the massive sandstones of the Tertiary formations are the most durable types and the ones that make up the points, reefs, islands, and miscellaneous smaller rock masses that lie along the shore.

Coos Head is supported by the Empire Formation, Tunnel Point by the Tunnel Point Formation, Yoakam Point and Lighthouse Point by massive sandstone units of the upper and lower Coaledo respectively, and Cape Arago by lower Coaledo sandstone. Numerous sandstone units in the middle Coaledo support smaller, unnamed promontories (Figure 11). Shale and siltstone in

Figure 15. Yoakam Point between Bastendorff Beach on upper right and Lighthouse Beach on lower left. (Oregon State Highway Division photo)

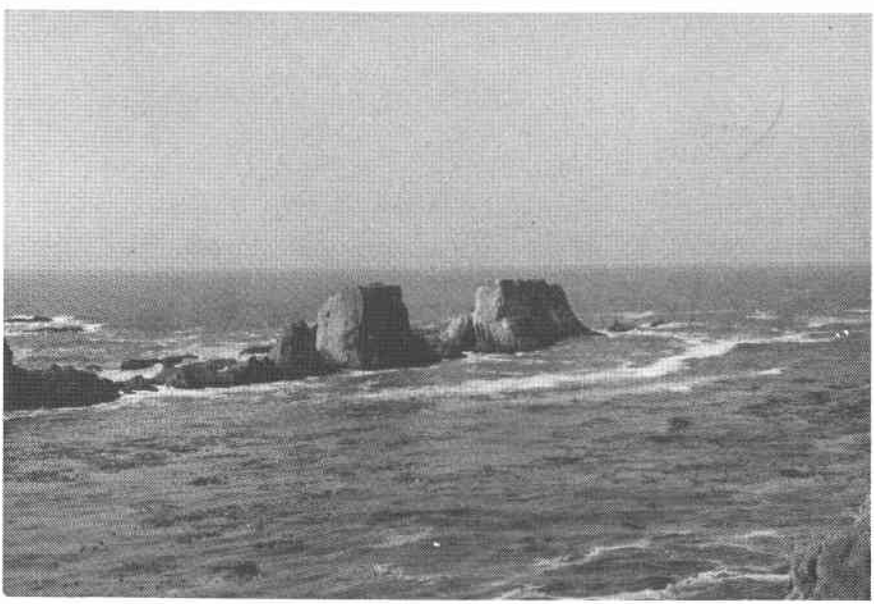

Figure 16. Sea stacks along a reef west of Lighthouse Point.

the upper and lower Coaledo permit deep penetration of erosion with the development of second order points on these members. Yoakam Point and the point of land at Lighthouse Point are forked where chasms have been eroded in weak rock between resistant sandstone units (Figure 14).

Fivemile Point (Figure 4), south of Cape Arago, is a well-indurated mass of interlayered sandstone and shale of early Eocene age. Coquille Point (Figure 21) and the point at Bandon Beach Wayside (Figure 5) south of Bandon are of lightly metamorphosed graywacke sandstone of Jurassic age.

Reefs at Yoakam Point (Figure 15) and aligned rock masses off the tip of Lighthouse Point are erosional remnants of points of land. Several groups of aligned rock masses that lie west of Lighthouse Point (Figures 12 and 16) are reefs and are probably remnants of a much larger promontory that included Lighthouse Point ages ago.

Simpson's Reef is on massive sandstone units of the lower Coaledo. The outer reef (Figure 17) is mostly a continuous spine developed on a single rock unit, and the inner reef is a cluster of rocks in parallel groups aligned along several sandstone units. That the reefs are remnants of the mainland that extended farther to the north and west in the distant past is a plausible assumption. It is likely that all or part of the inner reef was once a point of land that projected northward from the outermost part of the Cape.

Along the shore at Shore Acres State Park, a sloping wall of rock is separated from the terrace by a trench cut along a weak layer (Figure 9). With continued widening of the trench, the wall will become more distinctly a reef. This mode of origin offers a possible explanation for the origin of the outer reef north of the Cape.

The numerous islands, stacks, and associated smaller rock knobs along the shore near Cape Arago and south of Bandon are terrace remnants; where erosion has not removed it, terrace sediment caps a body of bedrock. Where the terrace sediment is still intact, the top of the stack or island is at the same level as the terrace on the nearby mainland (Figure 18).

Squaw Island, just off the entrance to Sunset Bay, is only a "part-time" island, for at low stages of the tide it can be reached by a bedrock connection with the mainland. This natural causeway is improved by a tombolo, a deposit of sand that links an island to the mainland or another island. Bedrock also extends to the reef just west of the island (Figure 12). These connections joining the reef, the island, and the mainland owe their origin to local wave refraction. Part of a wave moving towards the entrance of Sunset Bay may be refracted in such a way that it moves northward towards the island. Part of a wave moving towards Lighthouse Point may be refracted southward towards the island. When the water level is high enough that the island is completely surrounded, waves from the north and waves from the south neutralize each other. Consequently, erosion at this place is considerably diminished, and at times sand is deposited. When the island is not continually surrounded by water, waves wash up onto the tombolo, bringing sand from both directions (Figure 19). At times during winter storms, large

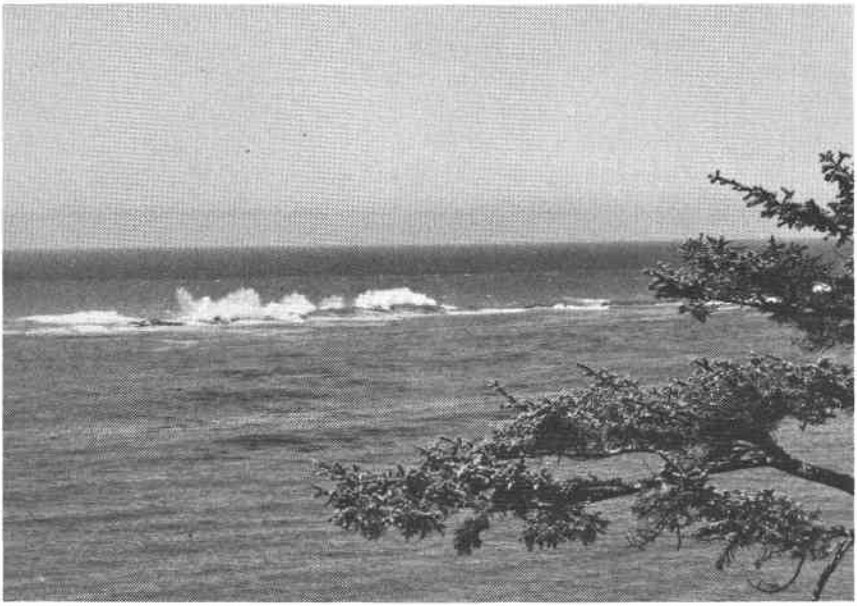

Figure 17. Outer reef of Simpson's Reef. (Oregon State Highway Division photo)

Figure 18. Stacks and islands off Coquille Point. (Oregon State Highway Division photo)

waves rush through the gap between the island and the mainland, sweeping the bedrock clear of sand.

The part of Lighthouse Point on which the lighthouse sits is separated from the mainland by a chasm that was formed by erosion along a fault. This part of the point is technically an island, and it is the largest in the Cape Arago locality.

The largest islands and the greatest number of islands and stacks are south of Bandon along a stretch of the shore that extends from Coquille Point southward to Bandon State Park, a distance of about 3 miles. The largest are off Coquille Point (Figure 18). The large number of stacks and islands and their size can be attributed to the durability of units in the Jurassic rock along this part of the coast.

Trenches, chasms, and tunnels

Trenches and chasms are considered here to be the same type of feature, differing only in size. Some are formed along weak rock layers and others along fractures in the rock. There are many of the former between Yoakam Point and Shore Acres, and remarkable examples can be seen at Yoakam Point (Figure 14) and Lighthouse Point. Trenches and chasms related to faults are common between Sunset Bay and the tip of Cape Arago. A good example of this variety shows up on the wave-cut bench in Sunset Bay at low tide (Figure 10). Several trenches related to fractures cut across the rock apron that fringes the northern part of the lobe at the tip of Cape Arago.

Some trenches and chasms end in caves (Figure 20). At Cape Arago at least two of the trenches terminate in caves that penetrate into the sea cliff several tens of feet.

At Shore Acres State Park, caves have formed in weak rock layers, and towards the rear of one of them the roof has collapsed, leaving a natural bridge (Figure 13). This feature is much like the famous Devil's Punch Bowl at Otter Rock in Lincoln County, Oregon.

Tunnel Point gets its name from a tunnel that passes through it near the tip. Prior to the building of the south jetty, the tunnel was awash during high tide, but the sand deposition that followed jetty construction moved the beach line away from the point, and the tunnel has been partly filled.

Sandspits

At the mouths of Coos River (Figure 8) and Coquille River (Figure 21), sandspits have grown from the north and have pushed the rivers against bedrock along their south banks. During the summer, northwest winds form longshore currents that flow southward, and during the winter southwest winds form northward flowing currents. Cape Arago to the south of Coos River and Coquille Point to the south of Coquille River cut off most of the supply of sand from the south so at both of these rivers the longshore currents from the north are more influential in building the sandspits.

Figure 19. Squaw Island and tombolo connecting it to the mainland.

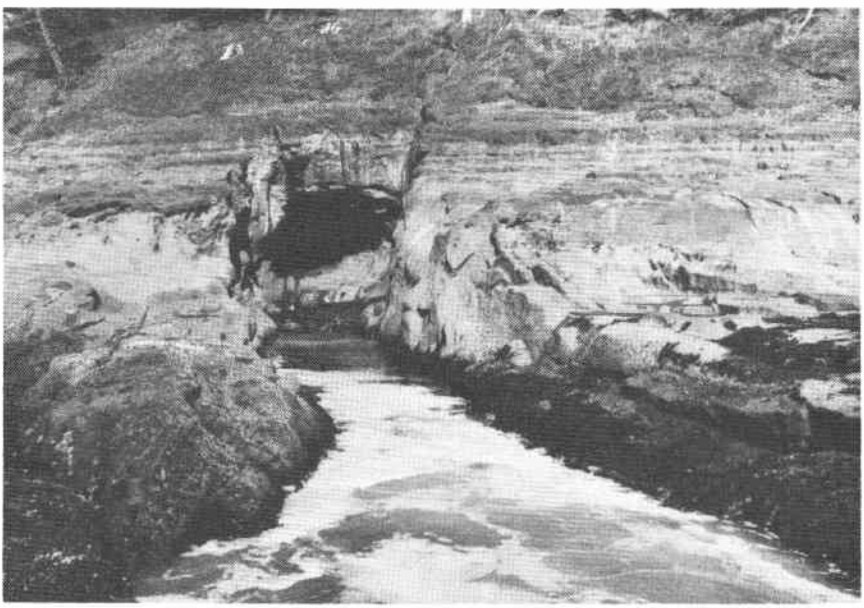

Figure 20. Trench and cave along a fault at Cape Arago.

Figure 21. Sandspit at the mouth of Coquille River. (Oregon State Highway Division photo)

Dunes and lakes

A low, narrow strip of dunes lies behind Bastendorff Beach and is the only one between the jetty and the end of the Cape. The dunes have been stabilized by dune grass, allowing little shifting of sand by wind.

Dunes border most of the shore from Whisky Run Creek southward into Curry County. Between Whisky Run and Cut Creeks they rest on the Whisky Run terrace, which in turn rests on the Coquille Formation. A sea cliff along the shore between these two creeks prevents any new sand from moving into the dunes, and they are stabilized by a forest cover. From Cut Creek southward to the Coquille River is a strip of active dunes behind the shore, and inland from it is a half-mile-wide strip of stabilized dunes. A foredune ridge along the shore is stabilized with beach grass, and very little new sand is reaching the active strip behind it. These dunes are on a low area where the Coquille River removed a segment of the terrace.

From Bandon south to Crooked Creek stabilized dunes occupy a position at the edge of the terrace. Because of the sea cliff, no sand is being added from the beach. South of Crooked Creek a low area between the beach and the terrace is receptive to wind-blown sand, and a strip containing active dunes extends southward into Curry County; this strip widens to the south. A stabilized foredune ridge is almost continuous along the shore, and little new sand is moving over it. Consequently, as in other dune belts along the Oregon coast, the area covered by active dunes is decreasing and the area of vegetated dunes increasing.

Where dunes increase in size until they block a creek's drainage to the ocean, a lake may be formed. Round Lake and Fahys Lake, north of the Coquille River, lie behind an older stabilized dune ridge. Bradley Lake (Figure 6), Laurel Lake, Croft Lake, and New Lake, south of the Coquille River, are behind the active dune belt.

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TEXACO RECORDS RELEASED

Well records on Texaco "Federal No. 1" well were released from the Department's confidential file on Nov. 22, 1973, 2 years after date of abandonment. The 8,000-foot test hole was drilled in sec. 31, T. 17S., R. 23 E., in Crook County. No oil shows were found, but noncommercial gas shows were encountered between depths of 1,700 and 3,500 feet. The well is believed to have bottomed in Jurassic volcaniclastic rocks.

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ERTS MAP OF OREGON PUBLISHED

The ERTS (Earth Resources Technology Satellite) map of Oregon is now in print. The map is reproduced in shades of green at a scale of approximately 1:1,000,000 with names of the main geographic features overprinted in red. Both map and text were prepared by the Environmental Remote Sensing Applications Laboratory at Oregon State University. The publication, Miscellaneous Paper 16, is published by the Oregon Department of Geology and Mineral Industries and is for sale at its Portland, Baker, and Grants Pass offices. The price is $2.00.

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AVAILABLE PUBLICATIONS

(Please include remittance with order; postage free. All sales are final - no returns. Upon request, a complete list of Department publications, including out-of-print, will be mailed)

BULLETINS

8. Feasibility of steel plant in lower Columbia River area, rev. 1940: Miller . . . $0.40
26. Soil: Its origin, destruction, preservation, 1944: Twenhofel 0.45
33. Bibliography (1st suppl.) geology and mineral resources of Oregon, 1947: Allen . . 1.00
35. Geology of Dallas and Valsetz quadrangles, Oregon, rev. 1963: Baldwin 3.00
36. Papers on Tertiary foraminifera: Cushman, Stewart & Stewart. vol. 1 $1.00; vol. 2 1.25
39. Geology and mineralization of Morning mine region, 1948: Allen and Thayer . . 1.00
46. Ferruginous bauxite deposits, Salem Hills, 1956: Corcoran and Libbey 1.25
49. Lode mines, Granite mining district, Grant County, Oregon, 1959: Koch . . . 1.00
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69. Geology of the Southwestern Oregon Coast, 1971: Dott 3.75
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