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COASTAL LANDFORMS
BETWEEN FLORENCE AND YACHATS, OREGON

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The 26-mile stretch of shore extending from Florence to Yachats (Fig. 1) is one of the most rugged and scenic parts of the Oregon Coast. Along most of this part of the coast the shore is bounded by basalt bedrock of varied types. Through differential erosion of the basalt, the many landforms, such as headlands, rocky shores, reefs, and sea stacks, that impart the rugged character to the coast have been and are still in the process of being developed. In places where the basalt bedrock is least resistant to erosion, small embayments with bay-head beaches have been formed, and areas where the bedrock is sedimentary are characterized by coastal plains as much as 4 miles wide. The larger areas of coastal plain are also areas of sand dunes; here the surface configuration is attributed to dune development that has gone on from late Pleistocene to the present.

Bedrock

Basalt

The basalts between Florence and Yachats were extruded in the form of lava flows and pyroclastic fragments from numerous centers during late Eocene time. The textures and structures of the basalt are varied, depending on the mode of eruption and on whether the eruption was subaerial or submarine. In places, the lava flows are dense, hard, and uniform in texture. Elsewhere they are very much fragmented to yield breccias in which the particles commonly exceed a foot in their maximum dimension (Fig.2). The large number of flows in sequence and their nearly horizontal position in places, as at Cape Perpetua, suggest that the flows accumulated as broad volcanic structures such as shield volcanoes.

The fragmental basalt makes up a large part of the total and is of several origins. Some of it is breccia that formed at the tops of lava flows, where a solidified crust formed on the surface of a still mobile lava and then broke into fragments as the underlying lava continued to flow. Where the lava erupted beneath the sea or where it poured into the sea, the sudden chilling of the solidified part caused fragmentation. In places these fragmental lavas have associated spheroidal masses, the pillow structure, which indicates a submarine origin. A third mode of origin of fragmental basalt was pyroclastic eruption, in which the particles were exploded from a volcano either in the solid state or as liquid particles that solidified while still airborne.

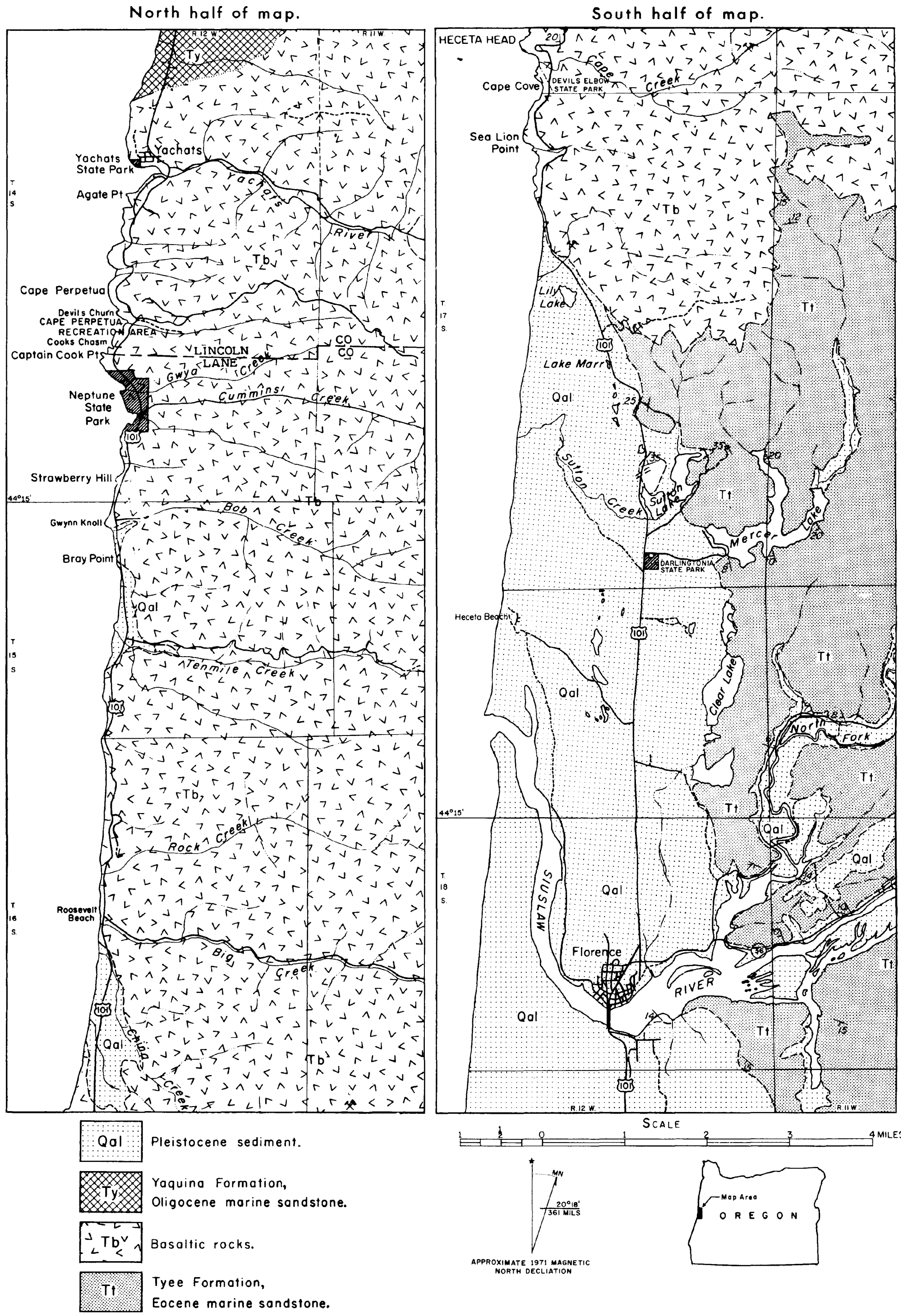

Figure 1. Index and geologic map of Oregon coast between Yachats and Florence.

Figure 2. Volcanic breccia in sea cliff at Devil's Elbow State Park.

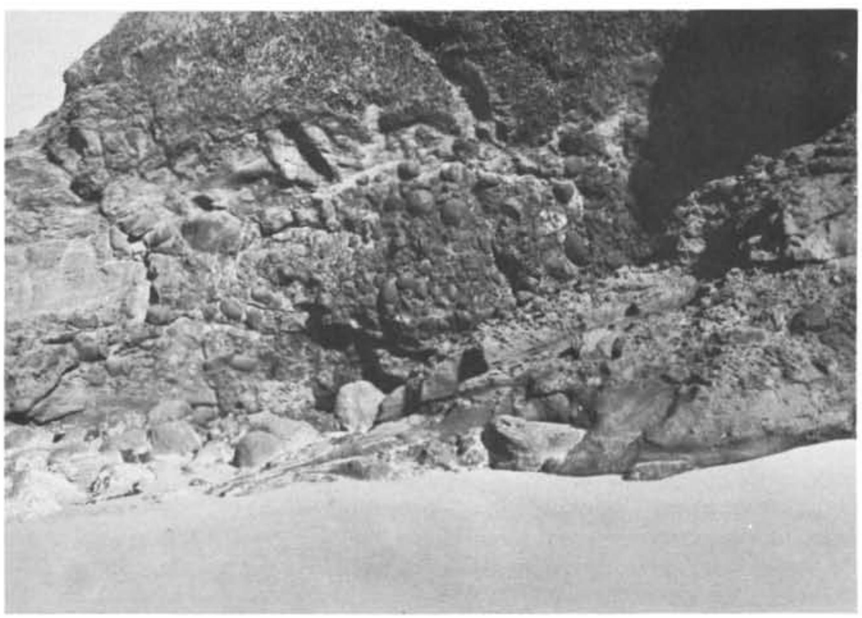

Figure 3. Sorted and stratified volcanic material and rounded boulders in sea cliff at Devil's Elbow State Park.

Where fragmental rock was directly formed beneath the ocean or where the particles entered the ocean subsequent to solidification some size-sorting, rounding and stratifying of particles by wave action (Fig. 3,4) has occurred. In places the water-reworked volcanic materials are intermixed with sediment of other origins, including shell fragments of marine organisms. Several of the volcanic units in the sequence at Heceta Head are of stratified and sorted volcanic material, some of which contains shell fragments.

Numerous small dikes ranging from a few inches to several feet in width cut through the extrusive basalts and are particularly abundant in the fragmental varieties (Fig. 5). These dikes were probably formed where rifts developed on the flanks of volcanic cones. Lava welled up through the rifts and extruded out over the surface, and in the final stages the lava remaining in the rifts solidified to form the dikes.

Sedimentary rocks

South of Sea Lion Point and the associated headlands the bedrock belongs to the Tyee Formation, an Eocene sandstone older than the basalts. This sedimentary rock underlies the dune sand in the lowland of the "Florence embayment" (Fig. 6) and crops out along the margins of the dune belt where the dunes join the hilly terrain of the Coast Range. Along Oregon Highway 126 the North Fork of the Siuslaw River marks the boundary between the Eocene sandstone and the Pleistocene dune sand.

North and east of Heceta Head is a small area (not shown on map) where the bedrock is an unnamed series of interbedded sandstones, siltstones, and shales. These beds are believed to be of Eocene age, but their affinities are not well known. They crop out along Cape Creek and extend northward, underlying Pleistocene sediments in an "embayment" along China Creek north of Heceta Head.

Basalt extends for about a mile north of Yachats(Fig. 7), and beyond that is the Yaquina Formation, a sandstone of Oligocene age. Along the coast, erosion during the Pleistocene reduced the surface on the Yaquina Formation to a platform, over which were deposited terrace sediments; the area underlain by the formation is now a coastal plain.

Pleistocene Sediments

Bay filling

The "embayment" north of Heceta Head is an area of low elevation covered by sand dunes. During the Pleistocene it was a small bay of the ocean that received sand and silt from the streams flowing into it. These sediments are exposed along the shore at the southern end of Roosevelt Beach north of Heceta Head. For about a mile north of Heceta Head they form a low sea cliff (Fig. 8). Their upper surface is marked by tree stumps, logs, and other pieces of wood and organic matter. They are somewhat more compacted and consolidated than the overlying dune sand and are capable of maintaining vertical cliffs, whereas the dune sand is a slope former. The bay sediment is less permeable than the dune sand, and water that filters down through the dune sand moves laterally along its contact with the bay sediments and emerges along the sea cliff as springs and seeps at the contact and in the upper layers of the bay sediment.

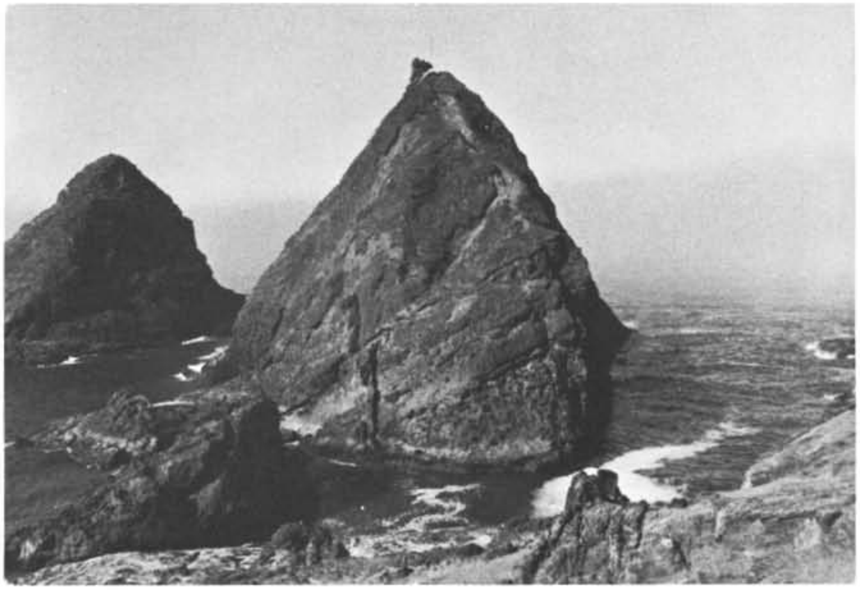

Figure 4. Stratified and sorted volcanic material in sea stack at Devil's Elbow State Park.

Figure 5. Surface of Pleistocene wave-cut bench from which the overlying terrace sediments have been removed. A small dike extends from the lower left to the center of the photograph.

Figure 6. Air view of Heceta Beach from near Sea Lion Point. Summer dunes are present on the dry-sand part of the beach. Several active dune areas are shown in the upper part of the photograph, and near the center are some stabilized dunes. (Oregon State Highway Department photograph)

Figure 7. View to the north from Cape Perpetua. Yachats, in the upper right, is built mostly on a marine terrace. The basalt bench on which the terrace was formed is exposed along the edge of the shore. (Oregon State Highway Department photograph)

Terrace deposits

Numerous preserved segments of a marine terrace that was once extensive along the Oregon Coast are present in the more protected parts of the coastal area described in this article. The terrace was formed during late Pleistocene time when sea level was higher than it is at present. During this time a wave-cut bench was formed at an elevation higher than the bedrock surface presently under wave attack, and as sea level receded, a layer of sediment was left over the wave-cut surface (Fig. 5).

The terrace sediments range in thickness from a few feet to several tens of feet and have been weakly consolidated into sandstone and conglomerate capable of maintaining a vertical cliff on the seaward side(Fig. 9). The surface of the terrace, where not modified by dune development or stream erosion, is generally level or has a slight seaward slope. The terrace segments are desirable building sites along the coast, and most of the town of Yachats is on one of the larger segments. The conglomerate is the major source of agates found along the beaches.

Dune deposits

Sand dunes, the ages of which range from the Pleistocene to the present, extend from the headlands south of Sea Lion Point (Fig. 6.) southward to Coos Bay in a continuous belt that is as much as 4 miles wide in places. In the Florence vicinity the dune sand is believed to cover a wave-cut platform that was developed on the Tyee Formation during the Pleistocene, when sea level stood higher and the shore line was along the foothills of the Coast Range.

North of Heceta Head is a dune area, mentioned above, that extends to China Creek, a distance of about 2 miles, and attains a maximum width of about three-quarters of a mile (Fig. 10). Dune sand entends southward to the saddle on the back side of Heceta Head, where it is exposed in a roadcut; it overlies the bay sediments along the shore and perhaps older sedimentary rock along China Creek. Where dune sand comes to the edge of the beach, the sea cliff is poorly developed or absent.

In the vicinity of Neptune Beach and just south of Cape Perpetua (Fig. 11) are small dune areas where the dune sand rests on terrace deposits. The Cape Perpetua Visitor Center is built on dune sand, and dune sand forms a prominent knob at the north parking area of Neptune State Park. Numerous shell fragments at the top of this knob are from a kitchen midden, the "garbage dump" of the Indians that used the area.

Major Landforms

In an explanation of the origin of the landforms along the coast, consideration must be given to the characteristics of the bedrock along the shore and to the geologic history of the area through the Pleistocene to the present.

Coastal plains and dunes

The sedimentary rocks are generally less resistant to erosion than the basalts, and, as stated above, where the bedrock is one of the sandstone formations erosion has created a lowland area of coastal plain. The development of the plain was

Figure 8. Sea cliff developed on bay sediments along Roosevelt Beach near Washburne Park. Dune sand overlies the bay sediments. Note log near the contact.

Figure 9. Sea cliff against terrace conglomerate and sandstone at Neptune State Park.

at a time or times when sea level stood higher than it does now, for during the Pleistocene interglacial stages there was less ice on the land and a correspondingly greater amount of water in the sea. When sea level rose, the shore line shifted landward at a greater rate where the bedrock is sandstone than where it is basalt. A wave-cut platform was formed over the sedimentary rock, and a layer of sediment of mostly sand and gravel was deposited on the platform. As the sea receded with the onset of another period of glaciation, the layer of sediment was left behind, covering the wave-cut surface.

Once above sea level, the plain came under the influence of wind and sand dunes were formed over its surface. Most of the dunes have been stabilized with vegetation but many are still active. The surface of dune areas is characterized by ridges, knobs, and depressions. Many of the depressions are deep enough that they intersect the ground-water level, and these are the sites of interdune lakes, of which there are many in the major dune areas.

Headlands and rockbound shore

Within the basalts there is a wide variation in the resistance to erosion, the greatest resistance being offered by the dense flows and the least by some of the fragmental varieties. A further factor in the erosion of the basalts is the extent to which the rock has been broken along fractures. Fracture zones are places of weakness and erosion proceeds at a greater rate there than where the rock is intact.

Where the shore is bounded by basalt, two major types of terrain have developed. One is the promontory or headland (Figs. 12,13) developed where the rock offers the greatest resistance to erosion and where in certain places, as at Cape Perpetua and Sea Lion Point, the basalt flows accumulated to great thickness. The other type of terrain is the low, rockbound shore (Figs. 7,11), where a wave-cut bench, formed at a time of higher sea level and covered by Pleistocene terrace deposits, is now being uncovered and reshaped by wave action. Flows of dense, hard basalt and interbedded fragmental rocks are characteristic of the promontories, whereas the lower areas are characterized mainly by fragmental types and associated dikes. A narrow ledge (Fig. 12) present in many places near the base of the promontories in the Heceta Head-Sea Lion Point vicinity corresponds to the wave-cut bench developed on the less resistant fragmental basalt. At Cape Perpetua the bench is continuous along the shore around the headland.

Minor Landforms

In the two major types of terrain developed on the basaltic rock are numerous landforms of lower order of magnitude. The shaping of these landforms is governed mainly by differences in resistance to erosion, and this in turn is related to differences in hardness of the rock from place to place and the extent to which the rock has been weakened through fracturing.

Sea stacks

Sea stacks are prominent erosional remnants that have become isolated from the mainland and stand as small, steep-sided islands (Figs. 4,14). In some places the rock in the stack is harder than the rock around it and, therefore, becomes isolated when the less resistant surrounding rock erodes. In other places fractures

Figure 10. Beach along Ponsler Wayside (lower left and Washburne State Park (upper left). Beach terminates against Heceta Head. Stabilized dunes are visible between the wayside and the park. (Oregon State Highway Department photograph)

Figure 11. View south of Cape Perpetua. The Pleistocene basalt bench with its many erosional landforms is well displayed here. Cook's Chasm is at the bridge near the center of the photograph. The roadcut near the left side is in dune sand. (Oregon State Highway Department photograph)

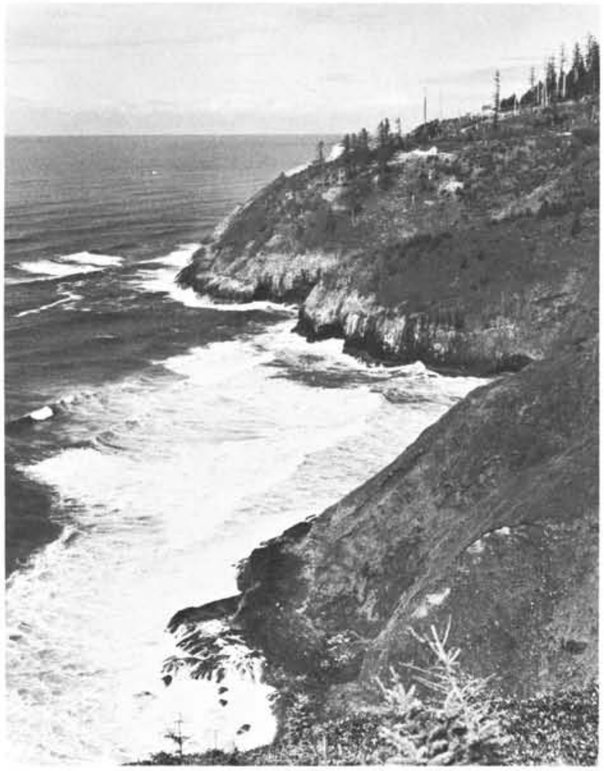

Figure 12. Sea Lion Point and caves. Cave farthest to the left is the south entrance to the Sea Lion Cave. A small segment of the Pleistocene bench is shown at the bottom of the photograph. (Oregon State Highway Department photograph)

localize the erosion that ultimately separates the rock of the stack from the mainland.

Stacks in the area described here are associated mainly with the headlands and are best developed in the vicinity of Heceta Head, where fractures in the rock have guided erosion in such a way that several large rock masses stand isolated near the shore. Near Cook's Chasm, south of Cape Perpetua, a rock mass rises above the general level of the Pleistocene bench (Fig. 15). This was a sea stack during the Pleistocene.

Sea caves, trenches, and chasms

Sea caves, trenches, and chasms have formed in places where the bedrock has been weakened by fractures, and in many places the fractures are distributed over a zone from a few feet to many feet wide. Broken rock along the fracture zone is quarried by the forces of water under pressure and compressed air and either a cave or an open trench or chasm is formed. Trenches and chasms are essentially the same type of landform, and the only distinction made here is one of size. Trenches are only a few feet across (Fig. 16), and chasms are from a few feet to several tens of feet across (Figs. 17,18).

Some of the chasms and trenches may have been sea caves originally, but were "deroofed." Many have sea caves at their landward ends. The Devil's Churn, an excellent example of this landform, terminates in a sea cave suggesting

Figure 13. Heceta Head and the tunnel promontory. Cape Cove is in the foreground. (Oregon State Highway Department photograph)

Figure 14. Devil's Elbow State Park. Beach sand and gravel forms a thin veneer over the present-day wave-cut bench, visible to the right of the center of the photograph. (Oregon State Highway Department photograph)

that "deroofing" of a cave contributed in part to its origin. Trenches and chasms are numerous along the coast from Yachats southward to Neptune Beach where the Pleistocene bench is most prominently displayed.

Numerous small caves are present in the basalt on which the Pleistocene bench was cut, but the largest ones are at Sea Lion Point (Fig. 12), and the most magnificent of all is the Sea Lion Cave (Fig. 22). This cave was localized by intersecting fracture zones, one trending about north-south and the other in a nearly east-west direction. The largest opening is along the east-west fracture and is the one used by the animals as they move in and out of the cave. A tunnel that passes through the headland was developed along the north-south fracture zone, and the floor of the southern part is below sea level. The northern part is the site of the viewpoints for the cave and the shore to the north. The position of this segment of the tunnel above sea level indicates that it was formed during a time of higher sea level. The fractures along which the tunnel was formed are visible in the ceiling. Lateral erosion within the cave and dislodging of rock from the ceiling have shaped it into a large, high-vaulted, amphitheater-like cavern.

Another form related to the north-south fracture zone in the cave is a cleft that separates a small stack from a promontory south of Sea Lion Point. As with other stacks in the Heceta Head-Sea Lion Point locality, the separation of the stack from the mainland was by erosion localized along the fracture zone.

Spouting horns and hissing fissures

Some of the small caves in the Pleistocene bench have small openings along them, mainly at their landward ends, and when waves are driven with sufficient force into these caves, water erupts through the openings. These are called spouting horns (Fig. 19). A few of the caves have fissures in their ceilings that extend to the surface, and air expelled from the cave by an incoming wave makes a loud hissing sound. When the water recedes, the cave "breathes" in a fresh supply of air. If the water level in the cave is high enough, water is expelled along the fissure in a sputtering fashion.

Arches

The large arches along the Oregon Coast are sea stacks penetrated by tunnels that usually have a high arch. Smaller versions of the arch are common along the Pleistocene bench, most of them being remnants of what was once a sea cave or tunnel through a rock mass. There is a small one near the sea cliff just south of the sand-dune knob at the north parking area of Neptune State Park (Fig. 20).

Tidal Pools

Many tidal pools occupy irregular depressions over the Pleistocene bench, and these are the sites of a varied assemblage of marine animals and plants. Some have a change of water with each high tide and offer a favorable habitat for living things. Others receive a change of water only during storms and have a limited flora and fauna. During the summer months, when there is little or no change of water in these pools and the evaporation rate is high, salt may precipitate, and in some of the small ones a thin salt layer that looks like ice forms over the surface.

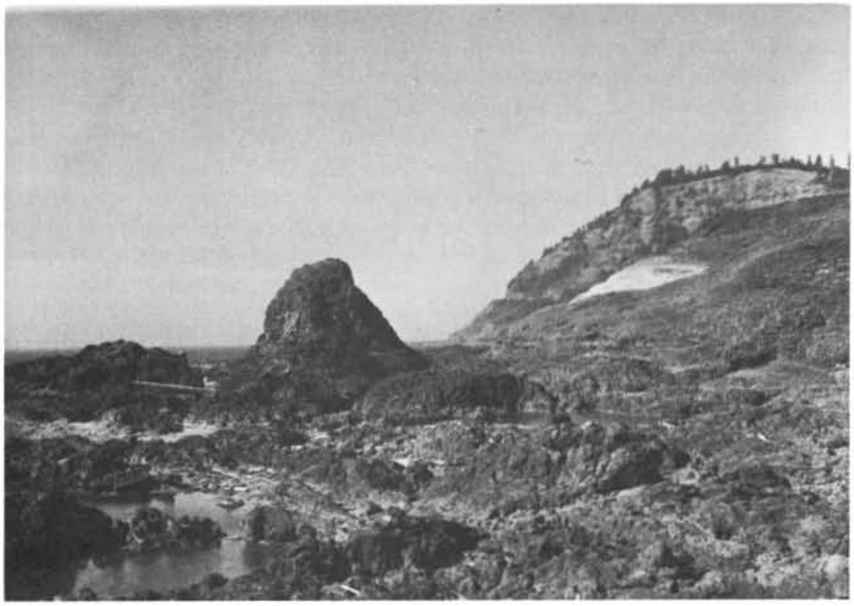

Figure 15. Irregular surface on the Pleistocene bench south of Cape Perpetua. Knob in the center of the photograph was a sea stack during the Pleistocene.

Figure 16. Trench formed along a fracture in the basalt at Neptune State Park.

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ROAD LOG BETWEEN FLORENCE AND YACHATS

The following road log was prepared with the starting point at Florence, but north-to-south mileages are given so the southbound traveller can use the log by starting at the end and working towards the beginning. Certain difficulties are inherent in this arrangement because a road log is prepared from a shifting point of view, and the direction of motion is a factor, but an attempt has been made to minimize these difficulties.

The log not only lists landmarks along the route but also includes descriptions of select segments of the shore. Most of the landforms remain the same throughout the year, but others, where the substance of the form is mobile, change seasonally. A beach that is predominantly sand during the summer may be mostly cobbles and boulders after winter storms have swept the sand away. Summer dunes on the dry sand part of the beach are destroyed by winter storm waves sweeping across the full width of the beach. Spouting horns that are dormant during the summer come to life during winter. The patterns in the sand are more striking in the winter than in the summer because the colored grains become concentrated by selective removal of the lighter quartz sand. These colored components - the pink garnet, green olivine, epidote, pyroxene, amphibole, and black magnetite and ilmenite - are selectively transported and redeposited.

Appealing as the scenes along the coast may be, much of the charm of the shore comes from the sounds made by the waves as they break over the beach, plunge against a sea cliff or rush along a trench or chasm. One can hear the steady roar of the waves from a distance, but only at close range can the variety of sounds be totally appreciated. The rattle of rocks rolling back and forth can be heard only at the site, and the hissing of air through a fissure is audible only near the vent. Sounds, like some of the landforms, vary from season to season. Those made by the waves are subdued in summer but are increased in volume many times over by the violence of a winter storm. The roar of the surf in summer becomes thunderous in winter, and the feeble sputtering of a spouting horn changes to a forceful eruption. Those who are privileged to visit the coast after a winter storm, when the air is clear and calm and when the waves are still running high, will find the visit a rewarding experience.

Figure 17. Cook's Chasm near Cape Perpetua Visitor Center.

Figure 18. Devil's Churn on the south side of Cape Perpetua is a chasm that terminates in a sea cave.

Mileage S-N	Mileage increment	Mileage N-S	
0.0		25.6	Junction of Oregon Highway 126 and U. S. 101. The city of Florence is built on dune sand at a place where the dune belt is 3 miles wide. For a distance of 7½ miles north of Florence, Highway 101 passes along a dune belt with gently rolling terrain marked by low dune ridges and knobs and intervening flat areas and depressions. In many of the low areas the land surface intersects the ground-water level, and these places are sites of lakes, marshes, and bogs. Most of the dunes are stabilized by a cover of trees and underbrush, but in places they are active.
3.0	3.0	22.6	Heceta Beach junction.
3.3	0.3	22.3	Active dunes west of highway.
5.0	1.7	20.6	Mercer Lake junction. Darlingtonia Botanical Wayside: a small bog with pitcher plants is the main feature.
5.4	0.4	20.2	Sutton Creek and Sutton Lake. Sutton Lake lies mostly within the dune belt and was formed by the impounding of Sutton Creek with dune sand. Mercer Lake, which lies east of Sutton Lake, is of similar origin, but it lies mostly in the lower parts of two small intersecting stream valleys cut into the Eocene sandstone.
5.8	0.4	19.8	Active dunes west of highway.
6.3	0.5	19.3	Buck Lake west of highway.
6.5	0.2	19.1	Alder Dune turnoff. Dune crossbedding in roadcut on east side of highway.
7.4	0.9	18.2	Lake Marr west of highway.
7.6	0.2	18.0	North edge of dune belt along highway. Dunes extend farther to the north along the shore.
8.4	0.8	17.2	Lily Lake west of highway (Fig. 6).
9.9	1.5	15.7	Viewpoint with excellent view of Sea Lion Point and caves (Fig. 12). Headlands and small beaches characterize the shore between Heceta Beach and Roosevelt Beach. The headlands, the most prominent of which are Heceta Head and Sea Lion Point, consist of basalt flows and interlayered pyroclastic material. Numerous caves in the headlands were formed along fracture zones in the basalt. Narrow ledges around the base are segments of a wave-cut bench formed during a time of higher sea level.

10.9	1.0	14.7	Sea Lion Caves (Fig. 22).
11.1	0.2	14.5	Viewpoint with excellent view of Heceta Head and lighthouse (Fig. 13).
11.5	0.4	14.1	South end of tunnel.
11.7	0.2	13.9	North end of tunnel.
12.0	0.3	13.6	Entrance to Devil's Elbow State Park. Devil's Elbow Park (Fig. 14) is in a small cove between Heceta Head and the tunnel promontory. The parking and picnic area is on a

low terrace, the surface of which is continuous with the narrow alluvial plain along Cape Creek. The beach is typical of small beaches that lie between or are adjacent to headlands. The upper part is a zone of boulders and cobbles and driftwood, and seaward from that a layer of sand covers a wave-cut bench of basalt bedrock. The bench is exposed north of the sand beach during the lower stages of the tide.

The basalt in the cliffs and the sea stacks north of the park is mostly the fragmental variety (Fig. 2) cut by numerous small dikes. Stratification, sorting and rounding of boulders indicate that the fragments either were erupted into the sea or entered it shortly after eruption and were reworked by waves (Fig. 3). The inclination of the rock layers suggests that they were deposited on the western flank of a volcano (Fig. 4).

Several shallow caves were formed in the sea cliff along fracture zones; the fractures are visible in the rock above the caves. One of the most striking features formed along a fracture zone is a deep, narrow chasm at the base of Heceta Head. Another fracture zone intersects this one and passes behind the large sea stack nearest the shore. A chasm along this fracture separates the stack from the mainland. A tunnel passes through the projection of rock that separates the two chasms but is not accessible.

The residence building formerly used by the lighthouse keeper is on a terrace segment. A layer of terrace conglomerate overlies the wave-cut bench on the basalt and is well exposed in the sea cliff along the edge of the terrace. Above the conglomerate the terrace sediment is sandstone. Shells in the sand just below the surface indicate that this site was used by Indians.

12.5	0.5	13.1	Dune sand in roadcut.
14.0	1.5	11.6	Entrance to Carl G. Washburne Memorial State Park. Washburne Memorial Park (Fig. 10) is in a stabilized sand dune area

that was a small embayment during a higher stand of sea level in Pleistocene time. The dune sand overlies sediments deposited in the embayment; these older loosely consolidated sediments are exposed along the southern end of Roosevelt Beach, where they support a low sea cliff (Fig. 8). The upper surface of the bay sediments is marked by logs, stumps, and smaller pieces of wood, and because the bay sediment is less permeable than the dune sand, springs and seeps occur along or just below the contact between the two.

Figure 19. Spouting Horn near Cook's Chasm. Water erupts from an opening in the ceiling of a small sea cave.

14.4	0.4	11.2	China Creek and boundary between dune sand and terrace.
14.7	0.3	10.9	Entrance to Muriel O. Ponsler Memorial Wayside. Ponsler Wayside (Fig. 10) is on a marine terrace that extends to Rock Creek.

A low sea cliff exposing terrace conglomerate at the base and sandstone above borders the beach. Basalt crops out at numerous places along the beach between the Wayside and Rock Creek. Just north of Big Creek weathered basalt bearing white agate amygdules is exposed in the sea cliff. The amygdaloidal basalt overlies a clay bed at this locality; it is also exposed at the base of the cliff just south of Rock Creek and near the base of the small headland north of Rock Creek.

15.0	0.3	10.6	Big Creek.
15.2	0.2	10.4	Roadcut in basalt.
15.5	0.3	10.1	Roadcut in basalt.
15 6	0.1	10.0	Rock Creek and north end of terrace.

Figure 20. Small arch at Neptune State Park.

Figure 21. Rock knobs along the beach at Neptune State Park are remnants of the Pleistocene bench.

15.7	0.1	9.9	Roadcut in basalt behind small headland.
16.1	0.4	9.5	Entrance to Ocean Beach picnic area. The Ocean Beach picnic area is on a small segment of terrace, and terrace conglomerate is exposed at the base of the sea cliff

between the small headland to the south and a point a short distance north of the trail to the beach. Northward for a distance of about 2 miles the cliff is on basalt overlain by soil and rock particles that have moved down from adjacent slopes. The sand beach is about half a mile long, and north of it basalt crops out along the shore for about $1\frac{1}{2}$ miles.

17.1	1.0	8.5	Viewpoint
17.2	0.1	8.4	Viewpoint
17.9	0.7	7.7	South edge of terrace. Terrace conglomerate and sandstone are in the sea cliff here, and basalt is exposed at the beach level northward to Rockwood Beach.
18.5	0.6	7.1	Tenmile Creek and Rockwood Beach (Fig.23). Rockwood Beach is at a place where Tenmile Creek has breached the terrace. The terrace

deposits have been eroded away over a short distance, and instead of a sea cliff, a steeply sloping, rocky beach marks the shore line. The terrace resumes north of Tenmile Creek and continues to Bray Point. Basalt is exposed along the beach at numerous places between Tenmile Creek and Bray Point. Rough rock masses around Bray Point are remnants of the Pleistocene bench.

19.3	0.8	6.3	North edge of terrace.
19.6	0.3	6.0	Bray Point and viewpoint.
20.0	0.4	5.6	Bob Creek; small segment of terrace.
20.2	0.2	5.4	Dune sand in roadcut.
20.4	0.2	5.2	Terrace.
20.6	0.2	5.0	Strawberry Hill; viewpoint. The Pleistocene bench is well displayed at Strawberry Hill and continues northward to a point beyond Yachats, interrupted here and there where it is crossed by streams or where it has been removed by wave erosion.
21.0	0.4	4.6	Dune sand in roadcut.
21.2	0.2	4.4	Roadcut in basalt.

Figure 22. Interior of Sea Lion Cave. (Oregon State Highway photograph)

Figure 23. Tenmile Creek crosses a segment of marine terrace. Rockwood Bench is in the foreground. A low sea cliff is developed on the terrace sediments north of the creek, and basalt is exposed along the beach that ends at Bray Point in the upper left corner of the photograph. (Oregon State Highway photograph)

21.3	0.1	4.3	Entrance to Neptune State Park camping area.
21.4	0.1	4.2	Entrance to south picnic area of Neptune Park.
21.5	0.1	4.1	Cummins Creek.
21.6	0.1	4.0	Dune sand in roadcut.
21.8	0.2	3.8	Entrance to north picnic area of Neptune State Park. Most of Neptune State Park is on a terrace segment; the two picnic areas

are on flat parts of the terrace, and between them the terrace deposits are covered by dune sand. The sea cliff between and adjacent to the picnic areas is against terrace sediments, with the usual sequence of conglomerate at the base and sandstone above (Fig. 9). The cliff gives way to a steep slope on the dune sand above the terrace sediments. The conglomerate rests on the surface of the Pleistocene bench, which here is as much as 15 feet above the surface that is presently being eroded on the basalt. The Pleistocene bench is in various stages of erosion. Where it has been recently exposed through the removal of the terrace deposits, it is fairly level (Fig. 5). Where it has been subjected to erosion for a long time, it has been sculptured into the fascinating landforms that give this segment of the coast between Strawberry Hill and Yachats its distinctive charm. The numerous isolated rock masses (Fig. 21) between the picnic areas are erosional remnants of the bench, and the more nearly intact part of the bench adjacent to the sea cliff is penetrated by numerous trenches formed along fractures.

At the north picnic area the bench projects seaward and is bounded on the north by a chasm through which Gwynn Creek enters the sea. The projection of the basalt bench is cut by numerous trenches (Fig. 16) trending in various directions, and small caves penetrate it at several places. Openings in ceilings of caves are the sites of spouting horns and hissing fissures. Numerous tidal pools supporting many forms of marine life occupy depressions on the bench, and at its southern edge is a small arch. The knob at the west edge of the north parking area is a sand dune.

22.2	0.4	3.4	Viewpoint on Captain Cook Point at north edge of Neptune State Park.
22.3	0.1	3.3	Lane-Lincoln County boundary.
22.4	0.1	3.2	Cook's Chasm and viewpoint. Some of the best examples of trenches, caves, arches, spouting horns (Fig. 19), and other forms developed on the Pleistocene bench are in the

vicinity of Cook's Chasm. A knob (Fig. 15) projecting above the general level of the bench south of the Chasm was a sea stack during the Pleistocene. A tunnel penetrates the rock on its north side.

22.6	0.2	3.0	Cape Perpetua Visitor Center entrance. Displays, slides, and a movie tell the story of this locality. Forest Service personnel are available for further information. Easy trails lead to selected areas of biologic and geologic interest. A 22-mile self-conducted auto tour through the forest begins just north of the Center and ends at Yachats.
22.7	0.1	2.9	Dune sand in roadcut below Visitor Center.
22.9	0.2	2.7	Side road to Cape Perpetua viewpoint and beginning of self-conducted auto tour.
23.0	0.1	2.6	Devil's Churn parking lot. The Devil's Churn (Fig. 18) is an outstanding example of a chasm and, like other chasms and trenches along this part of the coast, was formed along a fracture in the basalt. It terminates in a cave, which suggests that it owes its origin, at least in part, to the "deroofing" of a sea cave.
23.4	0.4	2.2	Viewpoint on face of Cape Perpetua with excellent view of the shore to the north and Yachats (Fig. 7).
24.3	0.9	1.3	Yachats city limits; highway on terrace.
24.5	0.2	1.1	Yachats Beach access road.
25.2	0.7	0.4	Yachats River and Yachats Beach access road. The road is a scenic drive along the south edge of the river and the seashore.
25.6	0.4	0.0	Yachats Post Office. Yachats, like many towns along the Oregon Coast, is built on a marine terrace. The basalt beneath the veneer of sedimentary rock underlying the terrace is exposed along the shore and imparts to it the ruggedness that characterizes this part of the coast.

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NOTICE: IMPORTANT MINERALS ACT PASSED

An Act to establish a national mining and minerals policy was passed by the House and Senate and signed by the President on December 31, 1970. It is titled "Mining and Minerals Policy Act of 1970." For the purpose of the Act, "minerals" includes all minerals and mineral fuels. More information about this important legislative matter will be presented in the March 1971 ORE BIN.

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