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GEOLOGY OF HUG POINT STATE PARK
NORTHERN OREGON COAST

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Hug Point State Park is a strikingly scenic beach and recreational area between Cannon Beach and Arch Cape on the northern coast of Oregon (Figure 1). The park is situated just off U.S. Highway 101, 4 miles south of Cannon Beach (Figure 2). It can be reached from Portland via the Sunset Highway (U.S. 26) west toward Seaside, then south on U.S. 101 at Cannon Beach Junction. The day-use park includes a parking area, picnic, water, and restroom facilities, scenic beaches, and coastal cliffs. No overnight

Figure 1. Sea cliffs and sea caves in Hug Point State Park. Hug Point is the headland farthest to the left.

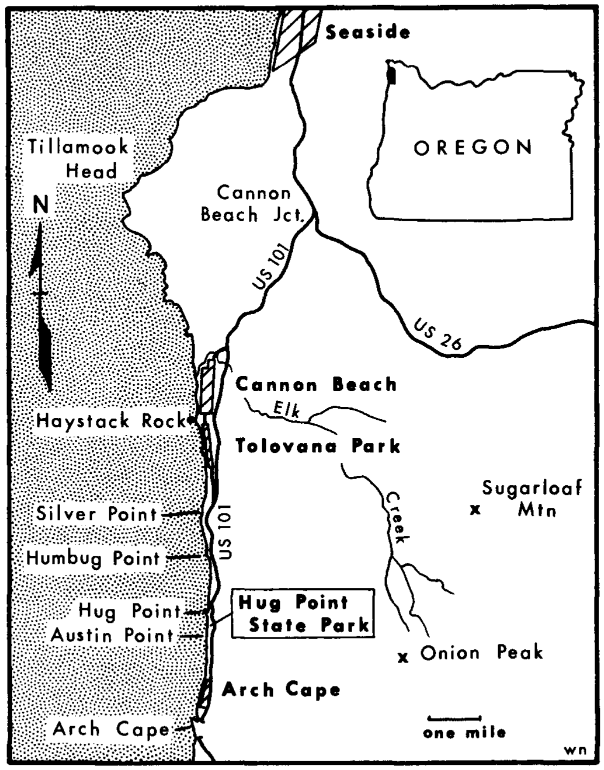

Figure 2. Index map of Hug Point-Cannon Beach area.

camping is available. A 1-mile hiking geologic field trip along the beach and a road log for a 4-mile drive on U.S. 101 in the Hug Point vicinity are described in this report. Points of geologic interest are shown on the maps (Figures 4 and 5).

Hug Point acquired this name because it was necessary to hug the rocks to get around the point without getting wet (McArthur, 1974). In the late 1800's, a stagecoach road was blasted out of the sea cliff to make passage along the beach possible during high tide (Figure 3). Early settlers used the beach for a highway when they traveled between Astoria and Tillamook (Dicken, 1971).

Physiographic Features

The Hug Point-Cannon Beach area is a part of the Coast Range physiographic province, which extends from the Coquille River and the Klamath Mountains on the south to the Columbia River on the north and is bordered

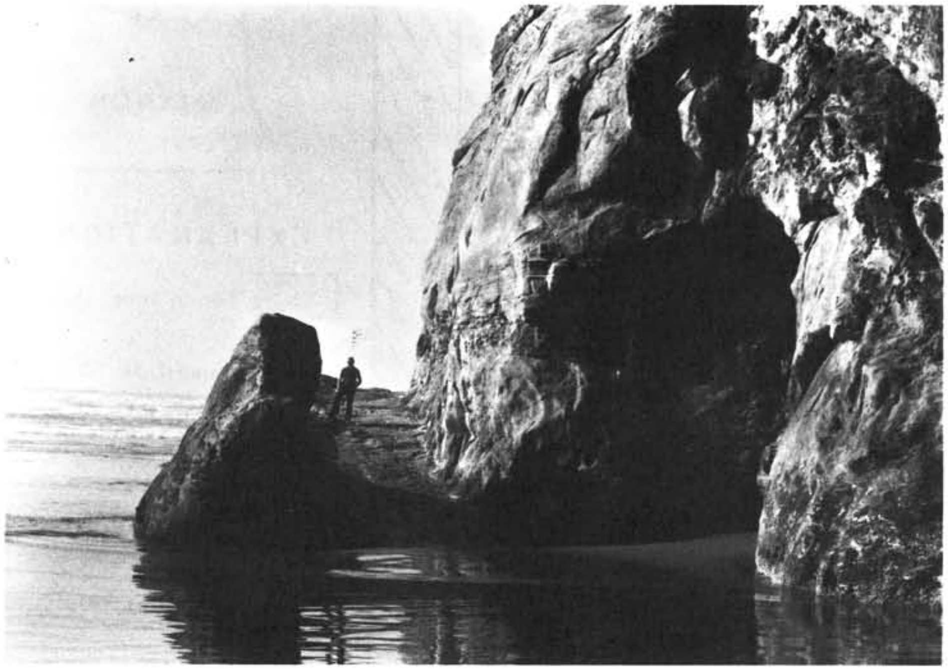

Figure 3. Coastal stagecoach road blasted into the sea cliff at Hug Point.

by the Willamette Valley on the east and by the Pacific Ocean on the west (Baldwin, 1964). Average elevation of the Coast Range is about 1,500 feet. The 3,000-foot peaks adjacent to the Park, Sugarloaf Mountain and Onion Peak, are among the highest in the northern Oregon Coast Range (Figure 2).

The coastline is characterized by steep headlands, sea stacks (small offshore islands), and long narrow beaches. The precipitous headlands, such as Tillamook Head to the north and Arch Cape to the south of Hug Point State Park (Figure 2), are resistant basalt. Hug Point and Austin Point in the Park (Figure 4) consist of well-cemented sandstone and are separated by coves which have been eroded in softer sandstone by the pounding waves of countless winter storms. The sea stacks are eroded remnants of resistant basalt sills and dikes.

The inland area just east of the Park is a region of forested hummocky lowlands and intervening stream valleys carved into sedimentary rocks. Farther east are prominent steep ridges and rugged mountains composed of basalt.

Bedrock Geology

Hug Point State Park and the surrounding area is underlain by the middle Miocene Astoria Formation and by Miocene Depoe Bay Basalt and Cape Foulweather Basalt (Figures 4 and 5).

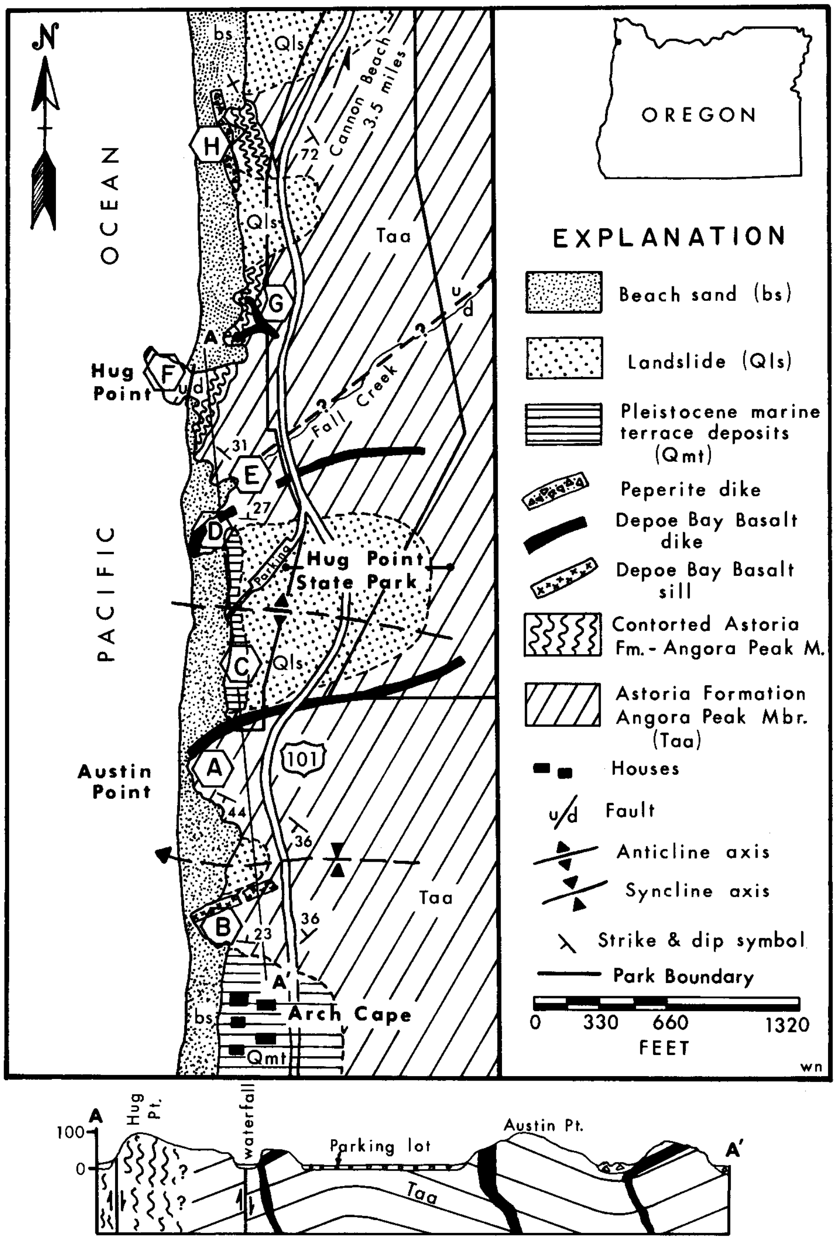

Figure 4. Geologic map and cross section of Hug Point State Park (after Smith, 1975). Letters A through H refer to points of interest on hiking field trip described in text.

Astoria Formation

The Astoria Formation in this area is composed of two informal units, the 1,100-foot thick Angora Peak sandstone member named for outcrops in Angora Peak about 1 mile south of the map area, and the overlying 650-foot thick Silver Point mudstone member named for outcrops at Silver Point.

Angora Peak member: The Angora Peak sandstone member consists of thick layers of laminated and cross-bedded, feldspathic and lithic sandstones interbedded with minor layers of well-laminated, dark-gray, carbonaceous and micaceous siltstones, and channel pebble conglomerates (Smith, 1975). Local coal beds occur near Angora Peak (Cressy, 1974). The well-indurated sandstones are carbonate cemented, typically orange yellow and iron stained, and at Hug Point State Park form sea cliffs 50 to 100 feet high (Figures 1 and 4). The sandstones are medium to very coarse grained, locally pebbly, and moderately to poorly sorted. They are composed of predominantly subangular and subrounded quartz, plagioclase, potash feldspar, and volcanic rock fragments. Fine-grained fossiliferous shallow-marine sandstones and siltstones in the upper part of the unit are well laminated, highly carbonaceous, and micaceous. The channel conglomerates and fluvial cross-bedded sandstones (Figure 6) contain abundant subrounded, poorly sorted pebbles of quartz, pumice, basalt and andesite, chert, quartzite, and tuff.

Silver Point member: The Silver Point mudstone member, which overlies and may interfinger with the upper part of the Angora Peak sandstones, is composed predominantly of dark, laminated, silty mudstones and very thin-bedded, light-gray, tuffaceous siltstones. The lower part of the Silver Point member is characterized by rhythmically interbedded dark-gray mudstones and light-gray, fine- to medium-grained, laminated, feldspathic sandstones (Figure 7). Rare channel graded pebble conglomerates also occur. The laminations are produced by a concentration of muscovite, biotite, and dark carbonaceous plant fragments. Sandstones and conglomerates have sharp bottom contacts and gradational upper contacts, are graded (Figure 8), and locally contain contorted laminations, load casts, flute and groove marks, and mudstone rip-ups. The lower part of the Silver Point member is well exposed in the sea cliff at Silver Point adjacent to U.S. 101 2 miles north of Hug Point (Figures 2 and 7).

Deep-marine microfossils occur in the Silver Point mudstone in Ecola State Park (Niem and Van Atta, 1973; Neel, 1975). The mudstones contain abundant montmorillonite clay and form extremely unstable hummocky slopes. There have been destructive landslides along the Coast where winter wave erosion has undercut the support of cliffs composed of this mudstone. At Silver Point, several scarps and landslide terraces contain asphalt slabs of old U.S. Highway 101. Just south of Silver Point, a 1,200-foot-wide landslide in these mudstones occurred in February 1974 (Figure 9).

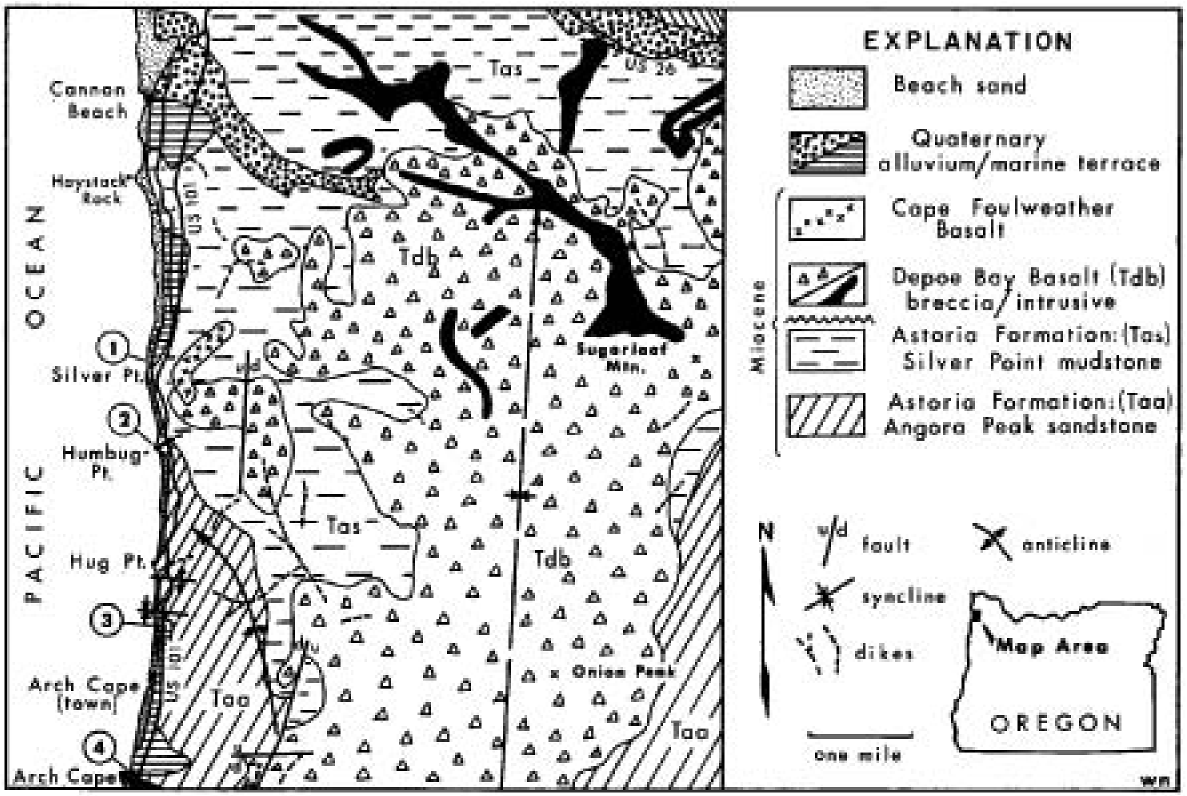

Figure 5. Geologic map of the Arch Cape-Cannon Beach area (after Smith, 1975 and Neel, 1975). Numbers 1 through 4 refer to stops on highway field trip described in text.

Figure 6. Coarse-grained, cross-bedded Angora Peak sandstone beds in Hug Point State Park (Point B on Figure 4).

Figure 7. Interbedded mudstones and sandstones of the Silver Point member in sea cliff below viewpoint at Silver Point on U.S. 101. Note thick lens-shaped sandstone bed in middle of sequence.

Depoe Bay Basalt

The Depoe Bay Basalt, named for exposures at Depoe Bay, Oregon (Snavely and others, 1973), is a hard, dark-gray, finely crystalline basalt. In the northern Coast Range, it lies with angular unconformity on the underlying Silver Point and Angora Peak members of the Astoria Formation. At nearby Sugarloaf Mountain and Onion Peak, it forms more than 2,000 feet of resistant basalt breccias and rarer isolated pillow lavas and pillow breccias. The breccias consist of poorly sorted, angular fragments of dark aphanitic basalt and basaltic glass in a matrix of dark-yellow-brown palagonite and basaltic glass (sideromelane and tachylyte). The brecciated lavas were extruded on the ocean floor and formed by fragmentation of hot molten lava flows coming in contact with the cold sea water.

Numerous Depoe Bay Basalt sills, dikes, and irregular intrusions associated with the extrusive Depoe Bay breccias penetrate the underlying Astoria Formation. Some sills are thick (up to 600 feet) and form wave-resistant headlands, such as Tillamook Head near Seaside (Figures 2 and 10) and Neahkahnie Mountain, 4 miles south of Arch Cape. These large sills generally dip gently to the southeast and are commonly in fault contact with the surrounding Astoria Formation. The sills range from finely crystalline basalt to diabase and are characterized by well-developed, nearly vertical columnar jointing. The dikes are finely crystalline to aphanitic basalt and are also columnar jointed. They are generally thinner than the sills and irregular in shape. Small sills and dikes are abundant in Hug Point State Park (Figure 11). Thin, reddish baked zones occur where the hot lava came in contact with the surrounding host rock.

Cape Foulweather Basalt

The Cape Foulweather Basalt was named for exposures at Cape Foulweather north of Newport, Oregon (Snavely and others, 1973). The unit overlies the Depoe Bay Basalt and the Astoria Formation in the Oregon Coast Range. It is characterized by large, scattered, yellow phenocrysts of plagioclase (labradorite) in a groundmass of aphanitic to finely crystalline, dark-gray basalt. Cape Foulweather submarine breccias overlying Silver Point mudstones form Haystack Rock near Cannon Beach (Figure 10). A Cape Foulweather Basalt sill is exposed near Silver Point (Figure 5). The Depoe Bay and Cape Foulweather Basalts are middle Miocene in age (14 to 16 million years old based on potassium-argon dating [Snavely and others, 1973; Niem and Cressy, 1973]).

Unconsolidated Deposits

Marine terrace deposits occur in small coves between headlands. They are 25 to 40 feet thick and are composed of thin layers of well-sorted,

Figure 8. Graded pebbly sandstone beds in Silver Point mudstone.

Figure 9. Landslide in Silver Point mudstones south of Silver Point, February 1974. (Photo courtesy of Seaside Photo)

reddish, iron-stained beach sands, lenses of rounded basalt gravels, layers of peat and carbonized tree limbs, irregular gray, thin ancient soil horizons, and thin ash beds. The deposits are soft and unconsolidated and can be excavated easily. The anatomy of a marine terrace deposit (30 feet thick) is well exposed along the beach near the parking lot at Hug Point State Park (Figure 4).

Beach sands are laminated, well sorted, and fine grained. Subangular to subrounded quartz and feldspar are the dominant mineral constituents. In the winter, several feet of the beach sands are removed by strong storm waves to form offshore bars, thus exposing the underlying well-rounded basalt gravels on the upper parts of the beach zone.

Landslides are common along the coastal sea cliffs, particularly in the Silver Point mudstones and Angora Peak sandstones (Figure 5) and in marine terrace deposits between Hug Point and Arch Cape (Figure 4). Landslide terrane is hummocky and poorly drained. Cliff exposures of landslides along the beach consist of chaotic mixtures of gray, sticky, plastic muds, with tree limbs and blocks of basalt, and sandstone. Recent movement on landslides is recognizable by cracks in the pavement of the highway and by trees tilted in many directions.

Geologic History

The rocks in the Hug Point-Cannon Beach area were deposited during the Miocene Epoch (approximately 13 to 35 million years ago). During and since the Pliocene Epoch (3 to 13 million years ago), the rocks of the Coast Range have been gently uplifted, faulted, folded, and eroded (Baldwin, 1964). The strata are unconformably overlain, in places, by a thin veneer of Pleistocene marine terrace deposits, Holocene dune and beach sands, and stream alluvium (gravel, silt, and sand).

Miocene Epoch

During the middle Miocene, much of western Oregon was uplifted above sea level (Snavely and Wagner, 1963). Along the western margin of the uplifted area, however, local subsidence produced a shallow marine embayment from the Hug Point-Cannon Beach area to Astoria. Other embayments were centered in the Newport and Tillamook areas. Great quantities of sand, mud, and gravel were transported westward from the early Cascade Mountains and eastern Oregon, Washington, and Idaho via an "ancestral Columbia River" (Cressy, 1974). These sediments were deposited in the Hug Point-Cannon Beach area in the form of a large delta (Niem and Van Atta, 1973; Smith, 1975), much like the Mississippi or Niger delta today. The delta contained a distributary river system and intervening coal-forming marshes and swamps. Along the delta front, strong wave-energy reworked the sands in the form of shallow-marine bars, beaches, and spits and into a

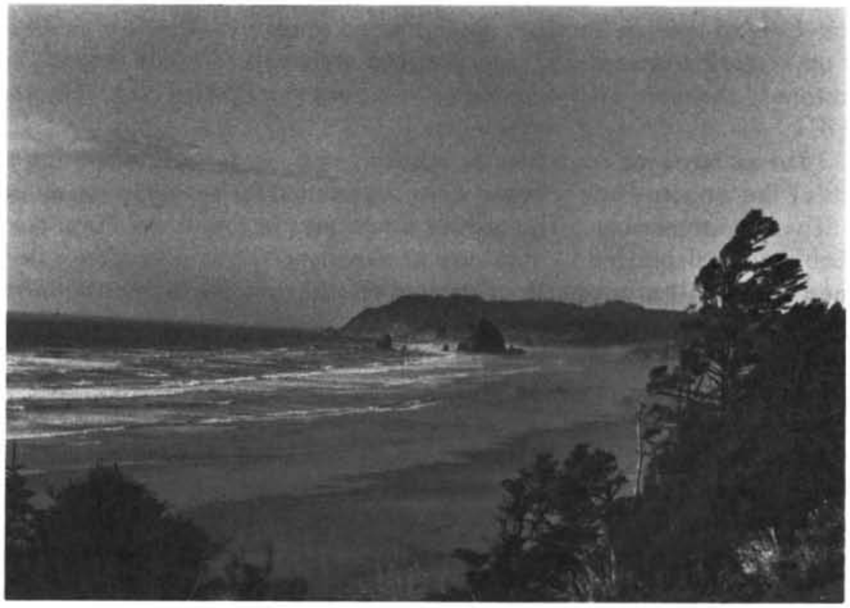

Figure 10. View from Silver Point. Headland in distance is Tillamook Head. Haystack Rock is the largest sea stack in foreground.

Figure 11. Sea-cave with dark basalt dike on left and light-colored Angora Peak sandstone on right. A thin basalt dike also cuts diagonally through the sandstone on right (Point D on Figure 4).

broad sheet of shallow-marine, fine-grained sands with shells of mollusks and other marine animals. These lithified sediments form the Angora Peak sandstones, the main cliff-forming unit in Hug Point State Park (Figures 1 and 4).

The embayment continued to subside, and, in time, the shallow-marine sands of the Angora Peak member were superseded by deep-marine muds of the Silver Point member. The graded sandstones in the Silver Point member probably were deposited by turbidity or density currents of muddy water which formed as a result of submarine slumping or sliding of muds and sands from the delta front into a deeper basin. The graded bedding formed where the coarser and heavier grains suspended in the current settled out first and were followed by the finer grains (Figure 8). The mudstones and thin siltstones represent the clays and silts that settled very slowly by pelagic sedimentation on the submarine part of the delta (prodelta). Uplift and erosion produced an unconformable surface on the Astoria Formation. This was followed by further subsidence and inundation by the sea.

During the later part of the middle Miocene, great volumes of basalt breccias (the Depoe Bay Basalt) were erupted on the deep-sea floor from a north-south trending series of submarine volcanic centers. Eroded remnants of the volcanic rocks now form the two highest peaks in the Hug Point-Cannon Beach area -- Sugarloaf Mountain and Onion Peak. This submarine volcanism was contemporaneous with eruption on land of the Columbia River Basalt of eastern Oregon and Washington (Snavely and others, 1973).

The submarine lava flows along the Coast were fed by many basalt dikes. Some dikes and sills intruded and locally deformed thick piles of semi-consolidated Astoria Formation strata (Figures 11 and 12). In certain places, forceful intrusion of hot magma into these water-saturated sediments formed dikes of peperite composed of angular blocks of altered basalt, sandstone, and mudstone (Figure 13). Great volumes of steam were generated as a result of this interaction and may have helped displace and deform the semi-cohesive sediments (Figure 12; contorted zone on Figure 4). Steam blasting incorporated angular pieces of the host sedimentary rock into the dike. A north-trending peperite dike occurs approximately 600 feet north of Hug Point (Figure 4, point H).

Pliocene Epoch (3 to 13 million years ago)

During the Pliocene, the Coast Range was uplifted (Baldwin, 1964). No marine Pliocene strata are recognized in the Hug Point-Cannon Beach area, but thick strata occur in the nearby offshore area (Kulm and Fowler, 1974). During this time of mountain building, a large north-south syncline with its axis trending across Onion Peak and Sugarloaf Mountain and a smaller adjacent anticline were formed (Figure 5). The sedimentary strata and breccia were also displaced several hundred feet by high-angle faults, one set trending east-west and the other north-south (Figure 5). Some smaller faults are visible in the sea cliffs at Hug Point State Park where adjacent layers of Angora Peak sandstone have been broken and displaced. An anticline and an adjacent syncline in Angora Peak sandstones with east-west trending axes are readily observable in Hug Point State Park (Figure 4, cross section). These small folds may have formed during the Pliocene, or earlier at the time of the middle Miocene intrusions. The syncline near Austin Point has a width at beach level of about 600 feet and the anticline has a width of 1,000 feet. The strata were tilted from 23° to 44° to form these folds.

Pleistocene (11,000 to 3 million years ago) and Holocene Epochs

Erosion became the dominant geologic process after the main uplift and deformation of the Coast Range in the Pliocene Epoch. Stream and sheet erosion excavated valleys in the softer Angora Peak sandstones and Silver Point mudstones, leaving the harder, resistant Depoe Bay Basalt sills and dikes as elongate narrow ridges and the volcanic breccias as high, rugged mountains.

Sea level fluctuated several times during the Pleistocene owing to development of continental glaciers and their subsequent melting. In addition, continued uplift of the Coast Range may have influenced the relative sea level. As a result, wave-cut benches representing former stands of the sea lie 40 to 100 feet above present sea level along this part of the Oregon Coast. In Hug Point State Park, wave erosion planed off the flat surfaces that now form the tops of the sea cliffs. Beach sands and gravels were deposited locally between headlands to form flat marine terraces.

Since the Pleistocene, waves have been carving a new wave-cut bench below the surface of the water and have been eroding away parts of the less resistant rocks to form stacks, caves, notches, cliffs, and narrow sand beaches, leaving the more resistant headlands, such as Hug Point.

Hiking Field Trip Along the Beach

A short, interesting hike may be taken along the beach and sea cliffs beginning at the parking lot. Points of interest along this hike are shown on the enlarged geologic map of the Hug Point area (Figure 4).

⟨A⟩ Austin Point. Small headland approximately 600 feet south of parking lot. A thick, dark dike of Depoe Bay Basalt intrudes yellow, cross-bedded, coarse-grained, Angora Peak sandstones. The sandstones dip 40° southwest and form Austin Point (passable at low and slack tides).

⟨B⟩ Small headland approximately 780 feet south of Austin Point. A sill of Depoe Bay Basalt 10 feet thick in Angora Peak sandstones. The sill has well-developed, columnar joints that formed perpendicular to the cooling surface. The baked zone is only a few inches thick. Between Austin Point and this headland is the axis of a westward-plunging syncline. At this location, one limb of the syncline is dipping northward and the other limb can be seen in the southward-dipping beds of Austin Point (Figure 4, cross section).

On the south side of the small headland is a good example of cross-bedding involving pebbly sandstone with very thin mudstone interbeds (Figure 6). Grading along the cross-beds probably represents deposition in large submarine sand waves at the mouth of an ancient river channel. The orientations of the cross-beds indicate that the river currents flowed from east to west. Abundant pebbles of quartz, quartzite, pumice, and chert, basalt, and andesite suggest that the material was eroded from the ancient Cascade Mountains and rocks of eastern Oregon and Idaho and brought here possibly via an "ancestral Columbia River." Some fragmented fossil plant debris, including carbonized logs up to 8 inches long, can be found in these channel deposits. The summer homes south along the beach are built on a flat Pleistocene marine terrace.

⟨C⟩ Eroded cliff of Pleistocene marine terrace deposits approximately 200 feet south of Hug Point parking lot. The deposits are composed of soft, iron-stained, friable beach sands, carbonized tree limbs, and thin, reddish, clayey ancient soil horizons. This terrace deposit fills an old cove cut into the Angora Peak sandstones. Winter storm waves now undercut the soft terrace deposits, resulting in many landslides. Several live trees are tilted in a variety of directions where landsliding has been recently active. In winter the beach consists of basalt gravels and piles of logs.

⟨D⟩ Small sandstone headland approximately 400 feet north of parking lot (passable during low or slack tide). Laminated, coarse-grained Angora Peak sandstones, cut by a thick Depoe Bay Basalt dike with well-developed columnar jointing, are partly contorted, but the overall dip is to the north, representing the limb of the anticline whose axis passes approximately through the parking lot (Figure 4). The sandstone contains many small calcareous and pyrite-filled nodules. The southwest side of the headland has been infilled with blocks of alluvium. The abrasional action of beach sand and the hydraulic compressive force of waves have created a deep, narrow sea cave in a crack between the basalt dike and the sandstone (Figure 11).

⟨E⟩ Waterfall and sea caves 550 feet north of parking lot. Waterfall is in northward dipping Angora Peak sandstone (Figure 14). Ocean waves have undercut the sandstone faster than the downcutting of Fall Creek, resulting in a waterfall here. The pinnacle of Angora Peak sandstone is a resistant erosional remnant. A fault between the pinnacle and Fall Creek is a possible reason for the location of Fall Creek (Figure 4).

⟨F⟩ Hug Point. Large, deep sea caves and sea notches carved into Angora Peak sandstones by storm waves. South of the Point (Figure 3), blocks and

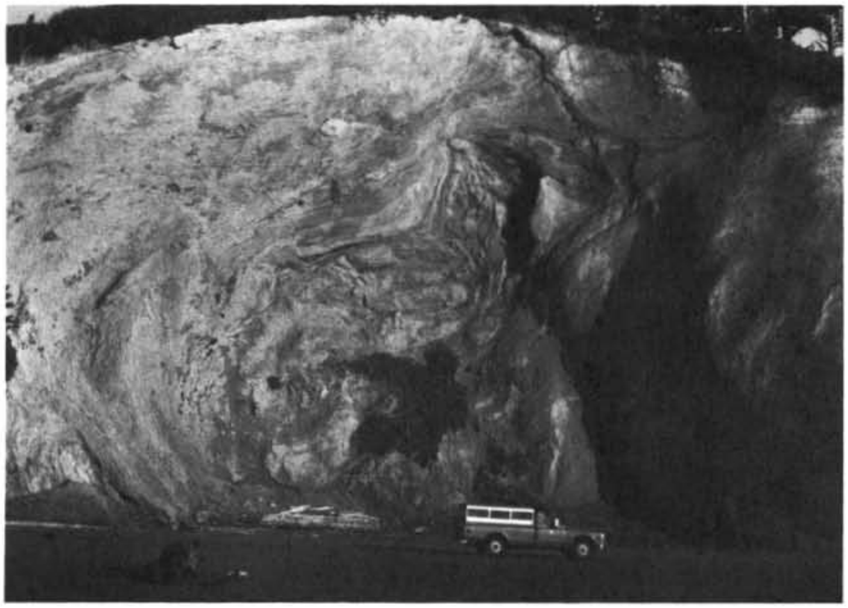

Figure 12. Sea-cliff exposure of vertically deformed sedimentary strata north of Hug Point. Note thin basalt dike cutting across strata in right half of photo (Point G on Figure 4).

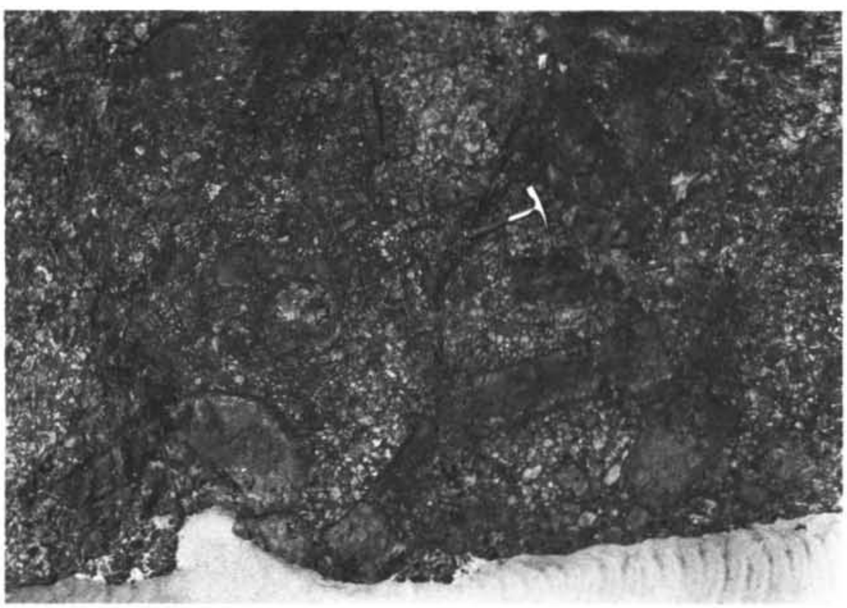

Figure 13. Peperite dike composed of numerous angular blocks of altered basalt, mudstone, and sandstone. Exposed in beach north of Hug Point (Point H on Figure 4).

layers of the sandstones are vertical or overturned. Note the abrupt vertical break between the contorted strata and the layers of cross-bedded sandstone 20 feet east of where the old stagecoach road rises above the beach. This break is a high-angle, north-south trending fault (Figure 4); the layers on the west have been moved upward relative to the contorted layers on the east. A narrow sea cave has formed along this fault where the strata were broken and fragmented and thus were easier for waves to excavate.

Follow the old stagecoach road around Hug Point (passable during low and slack tides; Figure 3). Note that the pebbly cross-bedded Angora Peak sandstones that form Hug Point dip 15° northeastward. The wear of many wagon wheels cut deep ruts in the old roadbed.

⟨G⟩ A sea cliff 70 feet high approximately 200 feet northeast of Hug Point. Vertical standing beds of Angora Peak sandstones in a contorted zone 50 to 100 feet wide (Figures 4 and 12). Differential erosion has cut a bowl-shaped depression into many of the vertical layers. The sandstones are mostly fine grained but contain some local conglomerate channels and pebbly zones. Two thin basalt dikes cut through the deformed sandstones.

⟨H⟩ Sea cliff 1,000 feet north of Hug Point. Peperite dike at the base of the cliff consists of angular blocks of fine-grained laminated Angora Peak sandstones and altered greenish to dark-gray basalt in a sand matrix (Figure 13). The dike trends north-south, is approximately 15 feet wide, and is partly covered by beach sand. Associated with the dike are vertical beds of very fine-grained, Angora Peak sandstones which are a continuation of the contorted zone from Point G. The peperite dike probably formed as a result of steam blasting and quenching of hot molten basalt magma in contact with water-saturated, semi-consolidated Angora Peak sands soon after their deposition. The forceful intrusion of the magma displaced and folded the strata into a vertical position. Microfaults that formed in the mobilized semi-consolidated sands can be seen in the sea cliff.

Note the hummocky landslide area to the north of this sea cliff. The ocean is undercutting the toe of the slide, setting the scene for continuous landslide movement in this area.

Road Log from Silver Point to Arch Cape on U.S. 101

The stops in this 4-mile road log are shown on the geologic map of the Arch Cape-Cannon Beach area (Figure 5) and include two short hikes to the beach.

STOP 1. Follow U.S. 101 north from the Hug Point parking lot for 2 miles to Silver Point. Pull off the road at southernmost viewpoint.

Sea stacks at Silver Point, west of the first parking lot, are wave-eroded remnants of a once more-extensive basalt sill. To the north

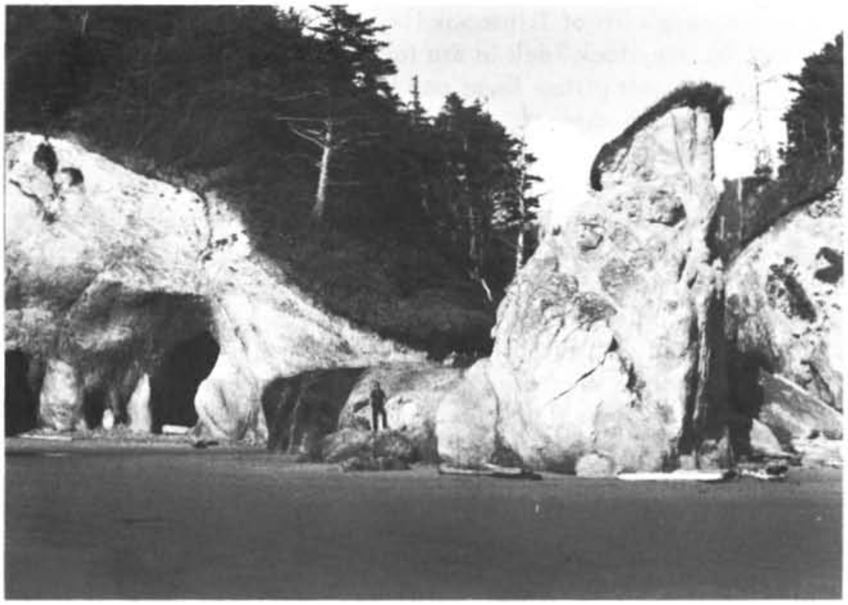

Figure 14. At its mouth, Fall Creek plunges over a waterfall onto the beach between sea caves on left and the pinnacle with a thin vegetative cap.

Figure 15. Dark basalt dike intruded into light-colored Angora Peak sandstones, Humbug Point (Stop 2 on Figure 5).

is the steep cliff of Tillamook Head, a 600-foot thick basalt sill (Figure 10). Haystack Rock in the foreground is composed of Cape Foulweather Basalt pillow lavas and breccias unconformably overlying Silver Point mudstones. Hug Point can be seen to the south. The large roadcut on the east side of U.S. 101 exposes the Silver Point mudstone member of the Astoria Formation. Approximately 200 feet above this exposure are the overlying Depoe Bay submarine basalt breccias that form the high hills above the roadcut. Recent landslide debris in the center of the roadcut illustrates a common engineering geology problem in these mudstones.

The sea cliff directly below the viewpoint parking lot is a large landslide block composed of interbedded fine-grained graded sandstones and silty mudstones typical of the Silver Point member (Figure 7). A trail over the slumped pavement of old U.S. Highway 101 provides access to the beach.

Proceed south 0.1 mile on U.S. 101.

0.1 In the spring of 1972, a section of U.S. 101 two-tenths of a mile in length dropped 3 to 6 inches as the result of a landslide in the Silver Point mudstones. In February 1974 after heavy rains had saturated the mudstones and winter storm waves had undercut support of the toe of the slide, there was extensive renewed movement. U.S. 101 dropped 25 to 35 feet vertically and moved 100 feet toward the sea (Figure 9). The slide covered an area of 1.25 square miles and destroyed this section of U.S. 101 and several summer homes. The headscarp of the slide is a quarter of a mile above the road. In order to stabilize the landslide, highway engineers terraced the slope near the top of the slide to remove excess weight, developed a drainage system to remove surface and ground water, and re-aligned the highway (the road now curves around the slide).

0.5 In roadcuts on both sides of U.S. 101, a basalt dike is exposed which intruded and deformed blocks of Angora Peak sandstones.

0.7 STOP 2. Humbug Point. Pull off on dirt road at day-use area. Follow small trail to beach. The small headland 100 feet to the north (Humbug Point) is held up by a 20- to 30-foot thick basalt dike surrounded by a chaotic mass of sedimentary blocks of fine-grained, well-laminated Angora Peak sandstone in a pebble sandstone matrix (Figures 15 and 16). The force of the intrusion probably deformed and broke these semicohesive strata because this sedimentary breccia zone parallels the trend of the dike. Some small pyrite nodules and crystals can be found between the sedimentary breccia fragments.

2.0 Intersection with Hug Point State Park road; continue south on U.S. 101.

Figure 16. Chaotic mixture of blocks of laminated Angora Peak sandstone at Humbug Point.

2.3 North limb of syncline of Angora Peak sandstones in deep roadcut on both sides of the road; beds dip 45° to the south.

2.5 South limb of syncline of Angora Peak sandstones dipping 35° northward. A thin basalt sill parallels the bedding.

2.7 STOP 3. Pull off on the left. Cannon Beach historical marker tells about shipwreck of U.S. Naval schooner in 1846 from which jettisoned cannons washed ashore.

3.5 Entering Arch Cape, which is built on flat Quaternary marine terrace gravels and sands.

3.6 STOP 4. Town of Arch Cape, take paved road on right to beach (0.1 mile). Walk south about 800 feet to headland that forms Arch Cape (cross small stream). Arch Cape is a large intrusion of Miocene Depoe Bay Basalt that forms a southeast-trending ridge 1 mile long and 400 feet high. Very well-developed fan-like columnar jointing and huge incorporated blocks of Angora Peak sandstone occur on the seaward face of Arch Cape (passable only at low tide). The highway tunnel just south of the town of Arch Cape is bored through this basalt mass.

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GOLD TO FEATURE IN PORTLAND METALS CONFERENCE

GOLD will be a popular topic at the forthcoming Pacific Northwest Metals and Minerals Conference to be held at the Sheraton Motor Inn in Portland April 6-9, 1975. The gold meetings will include the Fifth Gold and Money Session, which will be concerned with international economic outlook, and the Technical Session on Gold, which will offer a wide range of topics on geology, exploration, and operations. The schedule for the Fifth Gold and Money Session is given below and is followed by general information on the technical sessions and the rest of the Conference program.

Fifth Gold and Money Session
Tuesday, April 8, 1975

Morning Session - 9:00 a.m.

Presiding chairman: Henry L. Day, Day Mines, Inc., Wallace, Idaho

"Twentieth Century Inflation" - John E. Holloway, Consultant, Marshalltown, South Africa

"Gold and the Economy: A Study in Contrasts" - Peter L. Bernstein, Consulting Economist, New York, N.Y.

"Real Money and Counterfeit Money: Their Effect on World Conditions" Eugene Guccione, Senior Technical Editor, Mining Engineering, Salt Lake City, Utah

Luncheon - 12 noon

Presiding Chairman: Donald H. McLaughlin, Homestake Mining Co., San Francisco, California

Speaker: C. Austin Barker, Vice President-Consulting Economist, Hornblower & Weeks-Hemphill, Noyes, New York, N.Y. "International Monetary Outlook and Gold Related Assets"

Afternoon Session - 1:45 p.m.

Panel discussion by luncheon and morning speakers

Moderator: Donald H. McLaughlin

For further information on the Gold and Money Session, contact:
Raymond E. Corcoran, Chairman, Gold and Money Session,
1069 State Office Bldg., Portland, Oregon 97201 (503) 229-5580

Technical Session on Gold

The Technical Session on Gold will be held on Monday and Wednesday, preceding and following the Gold and Money Session. Specialists from gold-mining districts in Canada, Australia, Mexico, and the United States will be presenting papers on gold deposits and operations in their areas. One of the 12 scheduled speakers will be Department geologist Len Ramp, who will talk on "Oregon's Gold Potential."

Other Sessions and Programs

The Conference will include three days of technical sessions on metallurgy, welding, aluminum technology, and refractory metals. Three field trips have been arranged for Conference participants to visit Precision Castparts Corp. in Portland, the Centralia strip coal mine and power plant in southwestern Washington; and the titanium and refractory metals plants in Albany, Oregon. In addition, there will be a program of activities for the ladies, and on Tuesday evening a Conference banquet. An Industrial Trade Exposition put on by various suppliers and service organizations will be on display.

To obtain complete Conference program, write to:
AIME Conference Headquarters, 2014 N.E. Sandy Blvd.,
Portland, Oregon 97232

Registration: Attendance for one day, $7.00, for entire conference, $17.00; Gold and Money Luncheon, $6.00.

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METCALF INTRODUCES HARDROCK MINERAL ACT

Sen. Lee Metcalf (MT) has introduced S. 282, the "Hardrock Mineral Development Act of 1975," which would repeal the 1872 mining law and establish a leasing system for hardrock minerals. It is identical to S. 3085 (93rd Congress), which was considered during three days of hearings early last year by the Senate Interior Subcommittee on Minerals, Materials, and Fuels.

In introducing the measure, Metcalf stated that the Mining Law of 1872 contains no general requirement for consideration of other resource values of the land. A critical weakness of the 1872 law, he said, is that it puts the land use decision entirely in the hands of the miner; he added that the basic principle of the mining law that mineral development is always the highest use of the land must be modified.

Metcalf stated that he intends to schedule hearings on the measure at an early date. However, the hearings are likely to be delayed for some time since these other items on the subcommittee's agenda currently have higher priority: (1) surface mining, (2) revision of Federal coal leasing procedures, and (3) outer continental shelf oil and gas leasing.

(Amer. Mining Cong. News Bull., no. 75-3, 1975)

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PRESIDENT VETOES SURFACE MINING BILL

On Dec. 30, the last day on which he could have approved S. 425, an act to regulate surface mining, President Ford announced he would not do so. Although a formal veto message was not prepared, a "Memorandum of Disapproval" was issued, setting forth the President's reasons for the veto.

In a press statement issued at Vail, Colorado, President Ford listed several principal aspects of the bill which led to its veto, including the following: The excise tax on coal production; excessive direct Federal involvement in reclamation and enforcement programs; coal production losses in 1975 of 2% to 8%, with losses by 1977 of 18% or 141 million tons, according to FEA estimates; surface owner protection provisions that would have limited access to Federal coal lands, produced windfall profits to surface owners, and reduce Federal revenue from leases; and complex procedural requirements and standards which would have involved extensive litigation and potential production impact.

Among the procedural deficiencies listed were a very broad citizens suit provision, a near prohibition on mining that disturbs alluvial valley floors or water supplies in the West, requirements that could have delayed permits for new mining operations or imposed a temporary moratorium on mining permits for Federal lands, requirements to prevent any increase in siltation above premining conditions and designation of areas not suitable for surface mining.

The President also stated that S. 425 provides for excessive Federal expenditures and would have an inflationary impact on the economy. He said the Administration's goal in the new year would be to strive diligently to ensure that laws and regulations are in effect which establish environmental protection and reclamation requirements appropriately balanced against the nation's need for increased coal production.

(Amer. Mining Cong. News Bull., no. 75-1, 1975)

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SUMMER FIELD COURSE IN MINING OFFERED

The Colorado School of Mines and the Colorado Mining Association are jointly sponsoring a summer field course in the "Total Concept of the Mining Industry," a 6-hour credit course designed for teachers.

The course will be held at the Colorado School of Mines, Golden, Colorado, June 9 to July 18, 1975. Scholarships are available. For further information write to: Col. W. E. Leckie, Director of Continuing Education, Colorado School of Mines, Golden, Colorado 80401.

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GEOLOGIC MAP OF THE UNITED STATES PUBLISHED

A new geologic map of the United States (exclusive of Alaska and Hawaii) compiled by Philip B. King and Helen M. Beikman, has been issued by the U.S. Geological Survey. The new map, which replaces the Survey's 1932 map, is in a set of three sheets on a scale of 1:2,500,000. The compilers have prepared a 40-page illustrated explanatory text which supplements the map and describes the historical development of geologic mapping extending back more than two centuries.

"Geologic Map of the United States - 1974" is for sale by the U.S. Geological Survey, Reston, VA 22092. Price for three sheets is $5.00.

"Explanatory Text to Accompany the Geologic Map of the United States" (U.S.G.S. Professional Paper 901) is for sale by the Superintendent of Documents, U.S. Govt. Printing Office, Washington, D.C. 20402. The price is $1.25 (stock no. 2401-02573).

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EARL NIXON

Earl K. Nixon, the first Director of the State of Oregon Department of Geology and Mineral Industries, died December 8. He was 79. Mr. Nixon was appointed to the directorship (a position later changed to State Geologist) in 1937 and resigned in 1944 to become manager of Western Exploration for the Freeport Sulphur Company.

Nixon organized the Department, selected its personnel, and planned its projects. He could foresee the need for strategic mineral development and, in addition to many other mineral studies, had surveys made of the State's resources of quicksilver, chromite, and manganese; reports of these important war minerals were then available when World War II came. Largely by his efforts, three Metals Reserve Company purchasing depots were established in the State. He became consultant for the War Production Board and the Metals Reserve Company and was appointed State Emergency Coordinator of Mines.

Nixon's tremendous drive and enthusiasm are best illustustrated by the fact that during his seven years as Director of the Department, a total of 28 bulletins and many minor publications were issued.

His later years were spent in a wide variety of activities including iron-ore exploration in Venezuela for U.S. Steel, promotion of Kansas minerals for the Kansas Geological Survey, and teaching at the Kansas University Department of Mining and Metallurgy.

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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
52.	Chromite in southwestern Oregon, 1961: Ramp	3.50
57.	Lunar Geological Field Conf. guidebook, 1965: Peterson and Groh, editors	3.50
60.	Engineering geology of Tualatin Valley region, 1967: Schlicker and Deacon	5.00
61.	Gold and silver in Oregon, 1968: Brooks and Ramp	5.00
62.	Andesite Conference Guidebook, 1968: Dole	3.50
64.	Geology, mineral, and water resources of Oregon, 1969	1.50
65.	Proceedings of the Andesite Conference, 1969: McBirney, editor (photocopy)	10.00
67.	Bibliography (4th suppl.) geology and mineral industries, 1970: Roberts	2.00
68.	The Seventeenth Biennial Report of the State Geologist, 1968-1970	1.00
69.	Geology of the Southwestern Oregon Coast, 1971: Dott	3.75
70.	Geologic formations of Western Oregon, 1971: Beaulieu	2.00
71.	Geology of selected lava tubes in the Bend area, 1971: Greeley	2.50
72.	Geology of Mitchell Quadrangle, Wheeler County, 1972: Oles and Enlows	3.00
73.	Geologic formations of Eastern Oregon, 1972: Beaulieu	2.00
75.	Geology, mineral resources of Douglas County, 1972: Ramp	3.00
76.	Eighteenth Biennial Report of the Department, 1970-1972	1.00
77.	Geologic field trips in northern Oregon and southern Washington, 1973	5.00
78.	Bibliography (5th suppl.) geology and mineral industries, 1973: Roberts and others	3.00
79.	Environmental geology inland Tillamook Clatsop Counties, 1973: Beaulieu	6.00
80.	Geology and mineral resources of Coos County, 1973: Baldwin and others	5.00
81.	Environmental geology of Lincoln County, 1973: Schlicker and others	7.50
82.	Geol. hazards of Bull Run Watershed, Mult. Clackamas Cos., 1974: Beaulieu	5.00
83.	Eocene stratigraphy of southwestern Oregon, 1974: Baldwin	3.50
84.	Environmental geology of western Linn Co., 1974: Beaulieu and others	8.00
85.	Environmental geology of coastal Lane Co., 1974: Schlicker and others	7.50
86.	Nineteenth Biennial Report of the Department, 1972-1974	1.00

GEOLOGIC MAPS

Geologic map of Oregon west of 121st meridian, 1961: Wells and Peck	2.15
Geologic map of Oregon (12" x 9"), 1969: Walker and King	0.25
Geologic map of Albany quadrangle, Oregon, 1953: Allison (also in Bulletin 37)	0.50
Geologic map of Galice quadrangle, Oregon, 1953: Wells and Walker	1.00
Geologic map of Lebanon quadrangle, Oregon, 1956: Allison and Felts	0.75
Geologic map of Bend quadrangle, and portion of High Cascade Mtns., 1957: Williams	1.00
GMS-1: Geologic map of the Sparta quadrangle, Oregon, 1962: Prostka	1.50
GMS-2: Geologic map, Mitchell Butte quad., Oregon: 1962, Corcoran and others	1.50
GMS-3: Preliminary geologic map, Durkee quadrangle, Oregon, 1967: Prostka	1.50
GMS-4: Gravity maps of Oregon, onshore & offshore, 1967: Berg and others [sold only in set] flat $2.00; folded in envelope	2.25
GMS-5: Geology of the Powers quadrangle, 1971: Baldwin and Hess	1.50
GMS-6: Prelim. report, geology of part of Snake River Canyon, 1974: Vallier	5.00

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21. Lightweight aggregate industry in Oregon, 1951: Mason	0.25
24. The Almeda mine, Josephine County, Oregon, 1967: Libbey	2.00

MISCELLANEOUS PAPERS

1. Description of some Oregon rocks and minerals, 1950: Dole	0.40
2. Oregon mineral deposits map (22 x 34 inches) and key (reprinted 1973): Mason	0.75
4. Rules and regulations for conservation of oil and natural gas (rev. 1962)	1.00
5. Oregon's gold placers (reprints), 1954	0.25
6. Oil and gas exploration in Oregon, rev. 1965: Stewart and Newton	1.50
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7. (Supplement) Bibliography of theses, 1959 to Dec. 31, 1965: Roberts	0.50
8. Available well records of oil and gas exploration in Oregon, rev. 1963: Newton	0.50
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OIL AND GAS INVESTIGATIONS SERIES

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3. Prelim. identifications of foraminifera, General Petroleum Long Bell no. 1 well	1.00
4. Prelim. identifications of foraminifera, E. M. Warren Coos Co. 1-7 well: Rau	1.00

MISCELLANEOUS PUBLICATIONS

Landforms of Oregon: a physiographic sketch (17" x 22"), 1941	0.25
Geologic time chart for Oregon, 1961	free
Postcard - geology of Oregon, in color . . . 10¢ each; 3 - 25¢; 7 - 50¢; 15 -	1.00
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