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The ORE BIN
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GEOLOGY OF THE CAPE BLANCO AREA, SOUTHWEST OREGON

By R. H. Dott, Jr.*

Introduction

Cape Blanco, the most westerly headland in Oregon, encompasses some critical geological relationships important to the understanding of the western Klamath-Siskiyou region. The cape was named by 16th century Spanish sailors, as were many other Oregon headlands such as Cape Sebastian and Cape Ferrelo. Figure 1 shows the location of the Cape Blanco area, which includes also Blacklock Point, lying 3 miles to the northeast within the undeveloped Newburgh State Park.

Cape Blanco and Blacklock Point lie along the northwest landward end of a great sheared zone which is at least one mile wide. Though Cenozoic deposits mask most of the region to the east and south, the zone is considered co-extensive with the previously named Port Orford shear zone exposed 8 miles southeast of the cape (Koch and others, 1961). This is one of a series of such zones which lace the southwest Oregon coast just as they do in the northern California Coast Ranges (figure 1).

The bedrock types and ages exposed in the area are extremely varied, ranging from the Dothan? Formation of uncertain but presumably Jurassic age to extensive Cenozoic deposits. Particularly noteworthy is the recognition of Late Cretaceous strata north of Blacklock Point (Koch and others, 1961). These, together with the Dothan? Formation and rocks in Cape Blanco, were all mapped as the "Myrtle formation" by Diller (1903). Only those in Cape Blanco are here regarded as representing true equivalents of the Myrtle Group as defined by Imlay and others (1959). Of special interest in these latter strata is a spectacular unsorted pebbly mudstone zone exposed in the southwest face of Cape Blanco (plate 1). The writer discovered this curious deposit in 1955 and has since described it elsewhere (Dott, 1961; 1962). Because the Cenozoic deposits have been discussed previously (Diller, 1902; 1903; Bandy, 1944; Baldwin, 1945;

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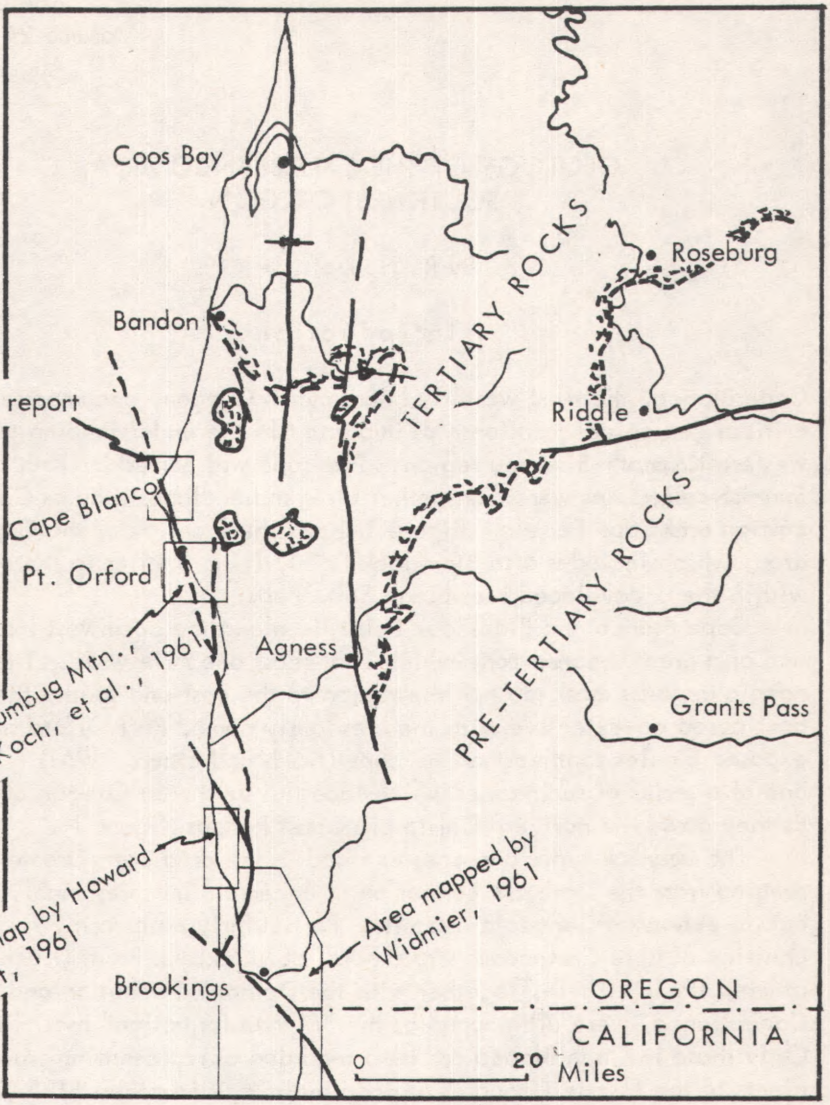


Figure 1. Index map showing major structural features and limits of Tertiary strata along the southwest Oregon coast. Areas of University of Wisconsin studies referred to in text are outlined.

Durham, 1953), only the Mesozoic rocks will be discussed in detail here.

Stratigraphy

Dothan? Formation

In 1959 the writer examined graywackes, bedded chert, greenstones, and glaucophane schist just south of Blacklock Point (plate 2), which had been mapped by Diller (1903) as the "Myrtle formation." Not until 1961, however, after further work to the south by the writer and co-workers, was it realized that this assemblage of rock types completely lacking fossils points to an older age. Nowhere do known "Myrtle rocks" (containing Buchia and other late Mesozoic fossils) include bedded chert, coarsely porphyritic, thick pillow lavas, and glaucophane schist like those at Blacklock Point. Only the Dothan Formation of the interior Siskiyou region is known to have all of these attributes. Moreover, petrology of the graywackes and associated conglomerates indicates closest affinity with lithologic equivalents of the Dothan Formation studied in detail by J.M. Widmier (1962) in the Brookings region (see figure 1). Figure 2 shows the most significant differences of sandstone composition in the chief formations of the northwest Klamath Province. Not shown here, however, are the varying percentages of potassium-bearing or K-feldspars in different formations. It has been found that Buchia-bearing ("Myrtle") strata contain a modest percentage of K-feldspar, whereas all older ones have essentially none (including the Dothan? Formation), but younger Late Cretaceous and Eocene ones contain large percentages. The graywackes south of Blacklock Point are barren of K-feldspar, thus strengthening the suggested correlation with the Dothan Formation. The nearest known similar assemblage of Dothan-like rocks is on Sixes River, approximately 15 miles east of Cape Blanco.

Of special interest is the discovery, just south of the mouth of Sixes River, of conglomerate with coarse, quartz-rich granitic cobbles essentially identical with those found in apparently equivalent conglomerates at Crescent City, California, by Widmier and Dott. Being in the Dothan? Formation, they indicate existence of important "pre-Nevadan" granitic plutons that have not hitherto been recognized in this region (Dott and others, 1962). These distinctive granites are coarser and more siliceous than the typical "Nevadan" and younger diorites. Small dioritic dikes and sills of the latter type, more or less brecciated, are also present south of Blacklock Point (SE$\frac{1}{4}$ sec. 24, T. 31 S., R. 16 W.), where they intrude graywacke, chert, and coarsely porphyritic pillow lavas. They are too

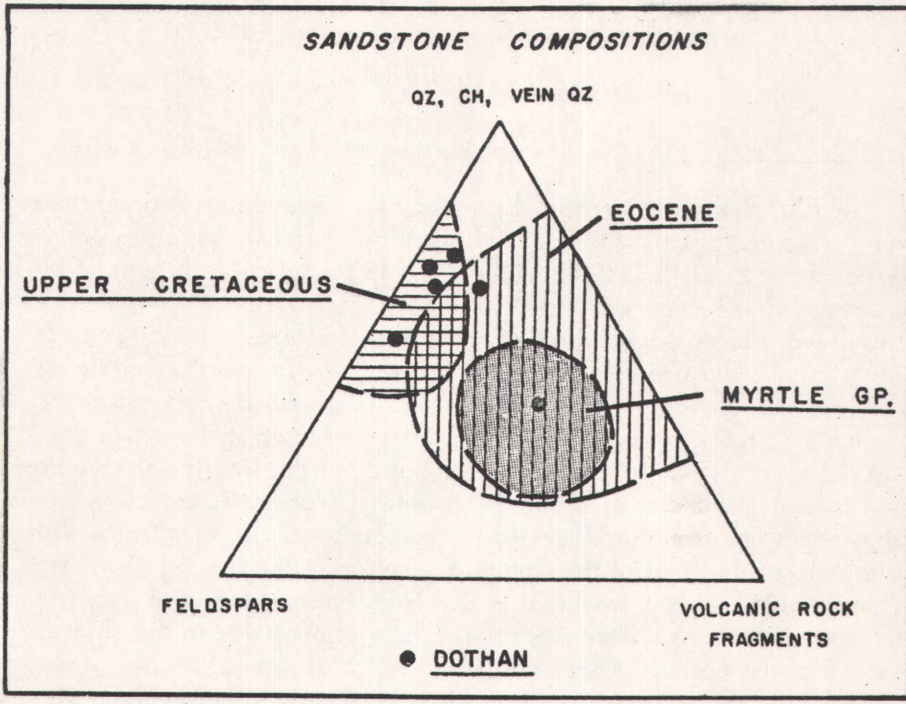


Figure 2. Comparison of modal analyses of Jurassic, Cretaceous, and Eocene sandstones of the northwest Klamath-Siskiyou Province. Relative abundance of volcanic rock fragments is the most diagnostic property shown here.

small to show on the map. The pillow lavas, which also crop out along the north bluff of Sixes River near its mouth, appear identical with distinctive ones in the Crook Point-Pistol River area farther south being studied by the writer and J. M. Widmier (figure 1).

Metamorphism has produced local schistose graywacke a short distance north of the mouth of Sixes River and bluish glaucophane schist southeast of Blacklock Point as well as just south of the mouth of Sixes River (plate 2). Similar very local glaucophane schist or amphibolite occurs in the Port Orford shear zone on the beach west of Battle Rock at Port Orford. Glaucophane schists are notably very localized and occur particularly in fractured and crushed zones (Williams and others, 1954, p. 225). In California they are known to have formed variously from diabase, basalt, sandstone, and chert. Those in the Cape Blanco area appear to have formed from either volcanic or sedimentary rocks of the Dothan? Formation.

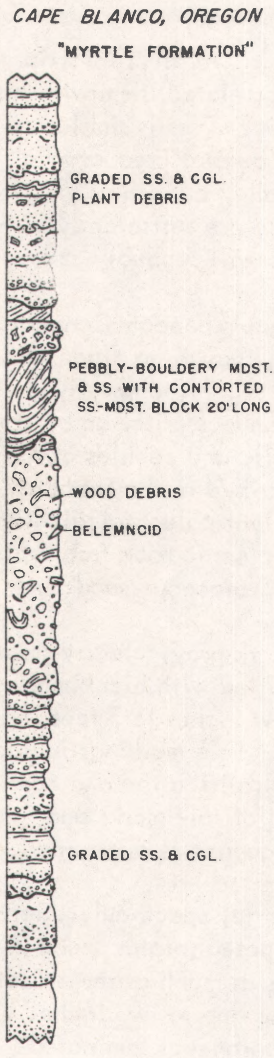
Latest Jurassic and Early Cretaceous strata

Diller (1903) applied the name "Myrtle formation" to all pre-Tertiary strata of the Cape Blanco-Port Orford region and correlated them with his original "Myrtle" of the inland Roseburg-Riddle area. Fossils similar to those of the type "Myrtle" have been found in the coastal area around Port Orford, Humbug Mountain, and Gold Beach (Imlay and others, 1959; Koch and others, 1961). However, the coastal strata are sufficiently distinctive lithologically that local formational names will probably prove preferable to "Myrtle."

At Cape Blanco the dark older rocks unconformable beneath Cenozoic deposits are considered a part of this same sequence, though no diagnostic index fossils have been found. This correlation is suggested chiefly by their petrology, lack of metamorphism (a perhaps tenuous criterion by itself), presence of belemnoids, abundant plant debris, and pebbles of diorite and porphyritic volcanic rocks like those described in the Dothan? Formation near Blacklock Point. Sandstones equivalent paleontologically to the Myrtle Group typically have more abundant volcanic rock fragments and a darker matrix than do the Dothan? or Late Cretaceous sandstones (figure 2).

The Cape Blanco strata are characterized by dark gray, clearly graded fine-granule conglomerate and sandstone interstratified with black mudstone. Graded sedimentation units range from a few inches to 7 feet in thickness with the average approximately one foot. Sole markings include load-flow, flute, and groove structures. Current stratification and convolute lamination are conspicuously rare. Reversal of sole marks and graded bedding clearly indicates that the entire sequence is overturned (plates 1 and 2).

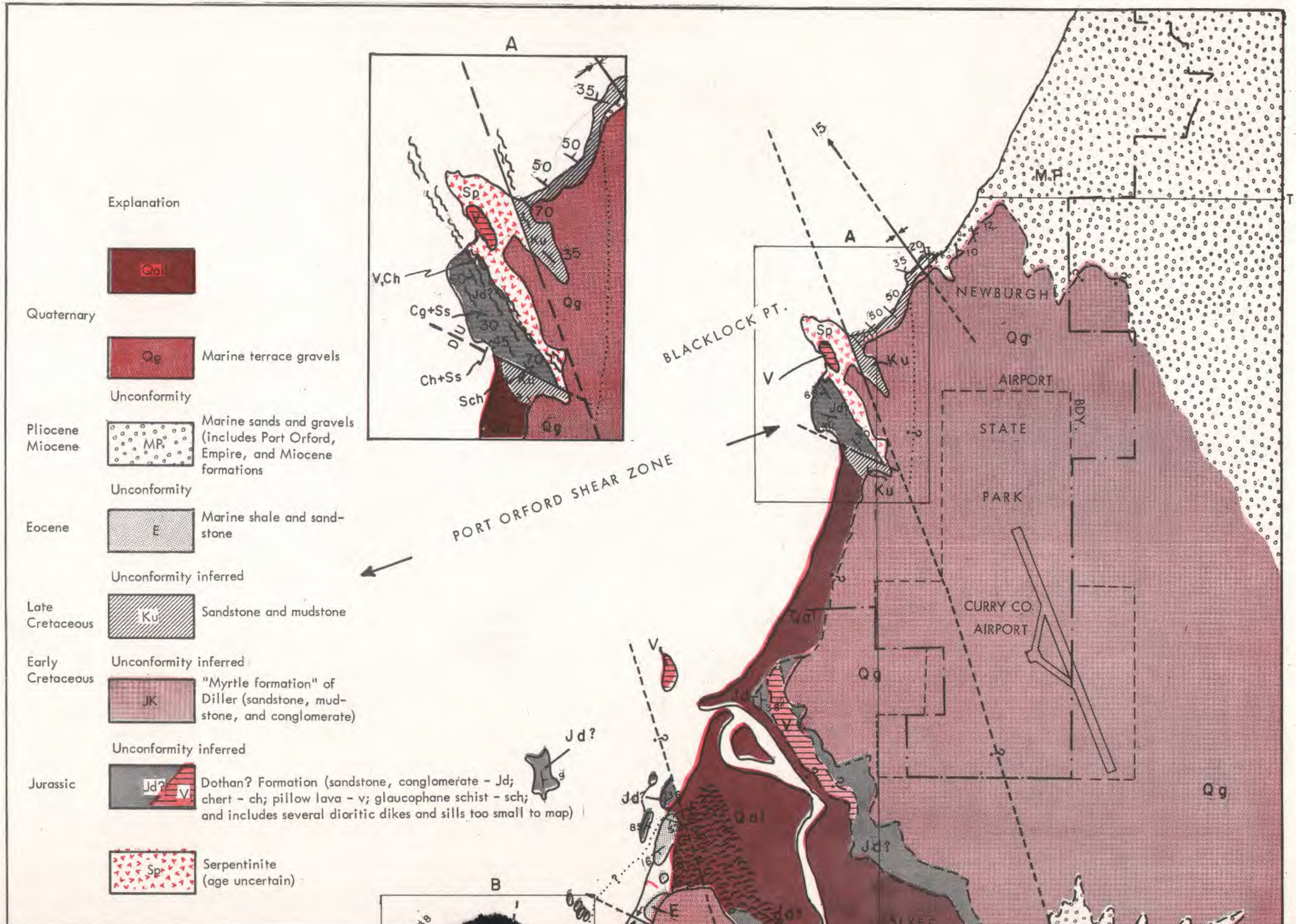
On the lower southwest face of the cape, a large, spectacular, lenticular unsorted pebbly mudstone mass is clearly exposed (plates 1 and 2). This deposit contains subrounded sandstone boulders as much as three feet in diameter, rounded pebbles and cobbles averaging one to two inches, and angular slabs and rolled masses of penecontemporaneous laminated mudstone and fine sandstone as much as 20 feet long. Angular chunks of wood (now charcoal) three feet long and several belemnoid tests also are present. Rounded cobbles include porphyritic volcanic rocks, sandstone, milky quartz, chert, and diorite. Photographs of this deposit are published elsewhere (Dott, 1961; 1962), but its general character is diagrammed in figure 3. The most impressive feature is a block of thinly stratified sandstone and mudstone about 20 feet long, which was folded upon itself plastically and now stands up-ended within the deposit.



Pebbly mudstone deposits like that at Cape Blanco were formed by subaqueous mass-gravity movements caused by failure of newly deposited sediments. The material flowed plastically, apparently just surpassing its liquid limit, to become a very viscous, churning, fluid mass -- a submarine mudflow. Then it suddenly regained cohesion, and was buried again by additional graded, stratified deposits. Occurrence of mass-gravity deposits such as this within graded sequences provides insight into one important mechanism for generation of turbidity currents. Normally, dilution and increased turbulence would convert the flowing, plastic mass to a turbulent suspension from which sediment could settle in graded fashion. Rarely, however, as at Cape Blanco, a very viscous plastic mass flow was arrested by sudden regain of cohesion, producing a heterogenous, unsorted and non-graded body. Thus these unusual subaqueous deposits were potential parents for turbidity currents; presumably many other such masses were completely converted to true turbid, fluid suspensions which ultimately deposited graded units. Typically pebbly mudstone deposits are lenticular; the Cape Blanco example is 60 feet thick at its center and thins to but a few feet in both directions along strike within a total outcrop distance of one-eighth mile (plate 1). This example is somewhat thicker than most others known to the writer. Because of its size, unusually clear exposure, and mixed marine and non-marine organisms, this deposit provides

Figure 3. Diagrammatic columnar section of the "Myrtle formation" exposed in the southwest face of Cape Blanco illustrating relationships of graded sedimentation units to the unsorted pebbly mudstone mass. Note that the entire section shown is overturned in the cape, but it has been restored to its normal situation for illustrative purposes. (Column also illustrated in Dott, 1961, fig. 4.)

Plate 1. Oblique air photo view of Cape Blanco from the west showing formations, faults, and the latest Jurassic or Early Cretaceous pebbly mudstone deposit. The various fault relationships and unconformities indicate clearly the long-continued, intermittent fault activity typical of the region. (Photo courtesy Oregon State Highway Department.)


Explanation
Quaternary
Qal
Qg
Marine terrace gravels
Unconformity
Pliocene
Miocene
MP
Marine sands and gravels (includes Port Orford, Empire, and Miocene formations
Unconformity
Eocene
E
Marine shale and sandstone
Unconformity inferred
Late Cretaceous
Ku
Sandstone and mudstone
Early Cretaceous
Unconformity inferred
JK
"Myrtle formation" of Diller (sandstone, mudstone, and conglomerate)
Unconformity inferred
Jurassic
Jd?
V
Dothan? Formation (sandstone, conglomerate - Jd; chert - ch; pillow lava - v; glaucophane schist - sch; and includes several dioritic dikes and sills too small to map)
Sp
Serpentinite (age uncertain)
A
V,Ch
Cg+Ss
Ch+Ss
Sch
BLACKLOCK PT.
PORT ORFORD SHEAR ZONE
NEWBURGH
AIRPORT
STATE
PARK
BDY.
CURRY CO.
AIRPORT
T. 31 S.
B
SIXES

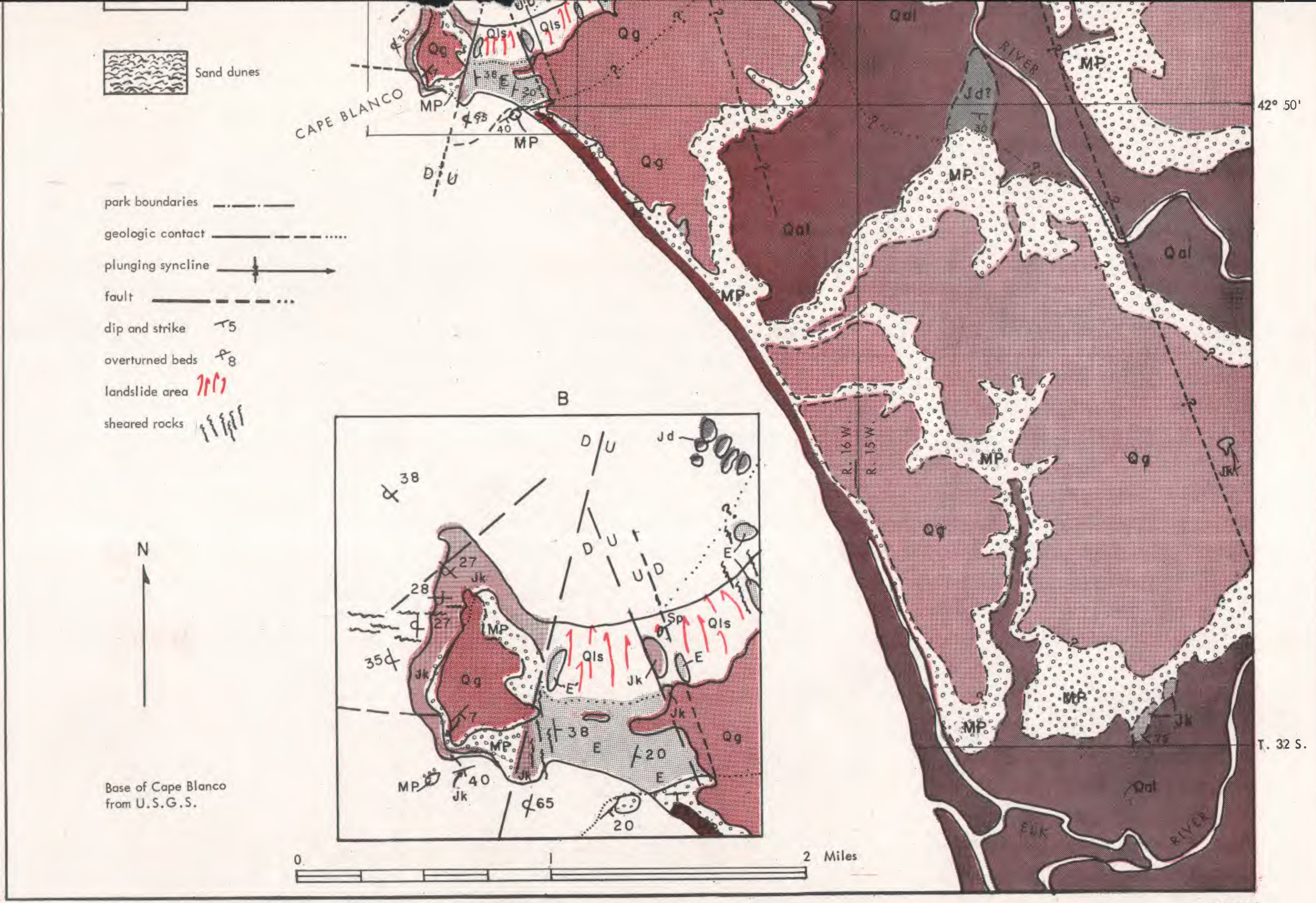


Plate 2. GEOLOGY OF THE CAPE BLANCO AREA

valuable insight into the general mechanisms of subaqueous gravity deposition.

Upper Cretaceous strata

More than 1,500 feet of interstratified light gray sandstone and dark olive-gray mudstone and shale occupy a broad, northwest-plunging syncline northeast of Blacklock Point, here named the Blacklock syncline (plate 2). These rocks were mapped as "Myrtle formation" by Diller (1903). However, they are lighter colored and are much less deformed than the known Myrtle Group equivalents and the Dothan? Formation. Moreover, their petrology suggests no affinity with the "Myrtle," for these sandstones are relatively deficient in volcanic rock fragments and possess a lighter matrix.

Two belemnoids have been found in these strata, the first in 1954 by D. L. Morgridge of Humble Oil & Refining Co. and another by the writer in 1959. In 1960, J. G. Koch of the University of Wisconsin collected several calcareous nodules which, through acid etching, yielded silicified and agglutinated Foraminifera. Koch has identified several forms similar to Upper Cretaceous ones of Texas, though the assemblage cannot be considered very diagnostic. Because of the lithology, microfauna, presence of belemnoids, only modest deformation, and generally close comparison with Late Cretaceous (Campanian) strata in the Cape Sebastian area, these rocks are considered of Late Cretaceous age also. They are most easily confused with Eocene rocks, but presence of belemnoids in shale rules out that age.

These deposits display dominant shale at the base, grading upward into evenly stratified sandstone and mudstone with a general upward increase in proportion and thickness of sandstone units. Intricate contorted and convolute stratification, fine cross stratification, some current-formed sole markings, and mudstone pebbles in sandstone are perfectly exposed by wave erosion. Graded bedding occurs sporadically. Although most sandstone units are not perceptibly graded, even microscopically, the sequence strongly resembles a turbidity current-deposited one. Grading may be obscured by the relatively fine grain size and moderate degree of sorting.

Cenozoic strata

Eocene gray shale and tan sandstone just east of Cape Blanco, also originally assigned to the "Myrtle formation" by Diller (1903), were dated as Eocene by Bandy (1944). These and older rocks are unconformably overlain by the Empire Formation of Diller (1903), presumably Pliocene (plates 1 and 2). Recently, however, Durham (1953) reported Miocene mollusks from the lower "Empire" southeast of Cape Blanco, and Warren Addicott of the U.S. Geological Survey (written communication, 1962) tentatively identified probable Miocene *Securella* cf. *S. ensifera* (Dall), *Securella* sp., and *Calyptraea* sp. collected by Koch from similar, poorly consolidated sandstones along the coast $1\frac{1}{2}$ miles southeast of Port Orford. Pliocene deposits are also present in the Cape Blanco area and they unconformably underlie the high marine terrace deposits (plate 2). Excellent exposures of Miocene and/or Pliocene cross-stratified sandstone and conglomerate lenses occur in a long sea cliff extending from half a mile north of Blacklock Point northward to Floras Lake (plate 2).

Pleistocene marine terrace sands and gravels as much as 150 feet thick mantle much of the region, which constitutes a broad, nearly flat surface (plates 1 and 2). The terrace has a general elevation of 200 feet above sea level, but it is somewhat warped (Baldwin, 1945; Dicken, 1961). Problems of the stratigraphy, dating, and correlation of these deposits and terrace surfaces are discussed by Baldwin (1945) and Addicott (in preparation).

Serpentinite

Serpentinite is present at Blacklock Point, where it has been intensely brecciated and sheared. A small mass of poorly exposed, sheared serpentinite also occurs half a mile northeast of Cape Blanco. At Blacklock Point, the ultramafic rock appears to have intruded the Dothan? sedimentary and volcanic rocks. Subsequently it was intensely brecciated along the northeast boundary of the Port Orford shear zone where it was faulted against Upper Cretaceous strata. Thus the age of its initial emplacement is quite dubious. It is probable that it was emplaced along the shear zone by profound faulting that penetrated deep into the earth's crust and that it has been remobilized, perhaps several times, by subsequent faulting. Similar sheared serpentinite has penetrated Lower Cretaceous sedimentary rocks in the same shear zone at Port Orford (Koch and others, 1961). Very probably the initial emplacement of such rocks occurred at different times in different sheared areas.

Structural Summary

The Port Orford shear zone appears to be one of the greatest structural features in southwest Oregon. It is believed to extend from Blacklock

Point southward through Port Orford, past the Humbug Mountain area and, according to the work of J. G. Koch, probably connects inland near Nesika Beach with a shear zone that extends at least to Rogue River a few miles above Gold Beach. It very likely continues still farther south (fig. 1).

In the Cape Blanco area, the Port Orford shear displays admirably all of the chief characteristics of these zones. Intense shearing, brecciation, overturning of strata, and great heterogeneity of contiguous rock types and ages are very typical. Presence of old rocks in a region of generally younger ones is common. Thus Dothan? rocks with local dioritic intrusives, volcanic rocks and chert, local glaucophane schist, and serpentinite are outstanding trademarks of this zone. Metamorphism as is displayed in foliated graywackes and glaucophane schist may be due to dynamic effects of the faulting. Extensive brecciation of the serpentinite and faulting of it against Upper Cretaceous shale is noteworthy as well. Less common, but of special interest, are the moderately large, gentle folds that are subparallel to the fault zones in young strata. Sub-parallel folds like that northeast of Blacklock Point and east of Cape Blanco are also prominent in the Upper Cretaceous of the Cape Sebastian region (Howard, 1961; Howard and Dott, 1961) and in California, particularly at Moss Beach in Tertiary rocks next to one of the major zones of the San Francisco Peninsula fault complex a few miles southwest of San Francisco. These folds were all produced as by-products of movement along slightly curving faults that presumably had important components of lateral movement (Howard and Dott, 1961). Around Cape Blanco, the great breadth, intensity of fracturing, steepness of dip of the major faults, and their apparent great depth constitute the only evidence for lateral displacement.

The coastal shear zones have had long histories of activity. The Port Orford shear cuts Dothan? rocks, and movement along it apparently caused overturning of the "Myrtle" graywackes on Cape Blanco. Movement related to the Port Orford zone clearly began before Early Cretaceous time near Humbug Mountain (Kaiser, 1962) and it probably dates from pre-latest Jurassic (Portlandian) time. Late Cretaceous marine deposits overlapped the shear zone as did Eocene ones. Both of these were subsequently caught up in intense faulting and final emplacement of serpentinites. Latest movements are recorded by subsidiary faulting in Cape Blanco that dropped the "Empire Formation" against Eocene and latest Jurassic or Early Cretaceous ("Myrtle") graywackes (plate 1). This and other faults were in turn overlapped by Pleistocene marine terrace deposits. Lastly, the whole region has been raised and warped gently. However, there is no reason to suppose that the Port Orford shear zone will not again become restless.

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NEW MINE SAFETY CODE ADOPTED

The State Industrial Accident Commission has adopted a new safety code covering mining, tunneling, and quarrying, following public hearings held May 16 and August 2. The effective date of the new code will depend upon the date it becomes available in printed form. This will probably not be before mid-December.

Safety regulations included in the code cover inspections, communications, fire protection and mine rescue, mapping of underground workings, hoisting equipment, access and egress, timbering, ventilation, operations underground, and pits and quarries.

Those who would like to receive a copy of the code should send their requests to the Accident Prevention Division, State Industrial Accident Commission, Salem, Oregon. Codes will be mailed as soon as they become available.

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WITHDRAWAL NOTICES AFFECT PUBLIC LAND STATUS

Notice has been received from the Bureau of Land Management that some of the proposed withdrawals in Malheur County (see The ORE BIN for October, 1961) have been terminated. Lands in Malheur County still subject to the original withdrawal application are the Nigger Rock area in Ts. 21 and 22 S., R. 43 E., and the Disaster Peak area in T. 40 S., R. 40 E.

Recent withdrawal applications involve two areas in national forests. They are 65 acres for campground in T. 32 S., R. 11 W., in the Siskiyou National Forest; and 279.96 acres for development of the Bull Prairie Recreation area in T. 7 S., R. 26 E. in the Umatilla National Forest.

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WILDERNESS BILL AMENDED BY HOUSE SUBCOMMITTEE

The House Interior Subcommittee on Public Lands reported to the full committee August 9 a substantially amended version of the Wilderness Bill (S. 174). The Subcommittee bill was reported as H.R. 776. The full Interior Committee has set August 28 as the date to consider the new version. Areas in Oregon affected by the amended bill total 662,847 acres and include the wilderness and wild regions in the national forests.

Although the mining industry considers H.R. 776 a great improvement over S. 174, it believes the provision limiting location of new mining claims until January 1, 1973 not in the national interest. Such a limitation, it was brought out in the hearings, would stop exploration in the wilderness areas, which coincide to a major extent with the areas in which geologic conditions are inherently favorable for the discovery of important new ore bodies. This would mean that a development of future supplies of minerals needed to replace those that will be exhausted 25 to 50 or more years from now would be drastically hampered. Miners are again urged to convey their feelings immediately to their Congressmen on this important piece of legislation.

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NEW DRILLING PERMIT ISSUED

The third permit of the year (Permit No. 48) was issued by the department to the Humble Oil & Refining Co. for a test hole to be drilled 6 miles north of Albany in the central Willamette Valley. Humble abandoned "Francis Wicks No. 1" in the Silverton hills area on August 1, 1962, and moved the Natl. 130 Montgomery Drilling Co. rig to the Howard Miller farm north of Albany. Drilling began on August 5, 1962. Location of the new well was given as 1,862 feet north and 4,156 feet east of the J. L. Miller donation land claim No. 61 in the SE$\frac{1}{4}$SE$\frac{1}{4}$ sec. 10, T. 10 S., R. 3 W., Linn County. Elevation of ground above sea level is 215 feet.

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WELL RECORDS RELEASED IN OPEN FILE

Records on the Linn County Oil Development Co. "Barr No. 1" drilled in sec. 32, T. 11 S., R. 1 W. were released by the Department in August. Information available includes history, cutting descriptions, electric log, gamma ray-neutron, gas analysis, and cuttings samples.

Although drilling on this hole was suspended in January 1959, abandonment plugging was not accomplished until August 1960. The Governing Board of the Department of Geology and Mineral Industries granted several extensions on the permit upon proof that arrangements were being made to continue drilling. The board refused further extension of the permit in August 1960 and ordered the hole to be plugged.

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AMERICAN MINING CONGRESS RELEASES PROGRAM

The 1962 American Mining Congress mining show will be held in the San Francisco Civic Auditorium and Brooks Hall September 24-27. The convention program includes discussions on national policies that affect the mining industry; technological advances in underground and open-pit mining, minerals beneficiation, exploration, health and safety; and management tools and techniques. At the Exposition, some 215 manufacturers of mining equipment will use five acres to exhibit all types of modern mining machinery.

Some of the scheduled events listed on the AMC advance program are as follows:

Monday morning, Sept. 24. Trade Expansion Act of 1962 and the European Common Market - their Impact on the Mining Industry. A panel discussion with Dr. James Boyd, Pres., Copper Range Co., as moderator. Panel members will include the Hon. Stewart L. Udall, Secretary of the Interior.

Tuesday afternoon, Sept. 25. Exploration and Geology Session, with Francis Cameron, Pres., St. Joseph Lead Co., as chairman. The session will include a paper on "Major new mineral discoveries in the past 10 years," by Charles F. Park, Jr., Stanford University.

Wednesday afternoon, Sept. 26. Taxation Panel, with Herbert C. Jackson, Exec. Vice Pres., Picklands Mather & Co., Cleveland, as chairman. Stockpiling discussion, with C. Jay Parkinson, Exec. Vice Pres., Anaconda Co., as chairman.

Thursday morning and afternoon, Sept. 27. State of the Mining Industries. Chairman of the session will be the Hon. Alan Bible, U.S. Senator from Nevada. On the same day there will be a Tax Forum with Lincoln Arnold, Attorney, Alvord & Alvord, Washington, D.C., presiding.

Friday, Sept. 28. Field trips to see: U.S. Army Engineers' hydraulic model of San Francisco Bay; IBM plant at San Jose and the Ideal Cement Co. and Leslie Salt Co. plants at Redwood City; and the Lawrence Radiation Laboratory at Berkeley.

On Sunday, Sept. 23, the California Division of Mines and Geology will hold open house at its new and enlarged quarters in the Ferry Building.

Members of the Western Governors of the AMC for Oregon are: Frank E. McCaslin, President, Oregon Portland Cement Co., Portland; Fay I. Bristol, President, Bristol Silica Co., Rogue River; and Hollis M. Dole, Director, State of Oregon Department of Geology and Mineral Industries.

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AVAILABLE PUBLICATIONS

(Please include remittance with order. Postage free. A complete list of publications will be mailed upon request.)

BULLETINS

8. Feasibility of steel plant in lower Columbia River area, rev., 1940: R.M.Miller 0..40
14. Oregon metal mines handbooks: by the staff
    C. Vol. II, Section 1, Josephine County, 1952 (2d ed.) 1.25
    D. Northwestern Oregon, 1951 . . . . 1.25
26. Soil: Its origin, destruction, preservation, 1944: W.H. Twenhofel 0.45
27. Geology and coal resources of Coos Bay quadrangle, 1944: Allen & Baldwin . . 1.00
33. Bibliography (1st supplement) of geology and mineral resources of Oregon, 1947: J. E. Allen 1.00
36. (1st vol.) Five papers on Western Oregon Tertiary foraminifera, 1947: Cushman, Stewart, and Stewart 1.00
    (2nd vol.) Two papers on Western Oregon and Washington Tertiary foraminifera, 1949: Cushman, Stewart, and Stewart; and one paper on mollusca and microfauna, Wildcat coast section, Humboldt County, Calif., 1949: Stewart and Stewart 1.25
37. Geology of the Albany quadrangle, Oregon, 1953: Ira S. Allison 0.75
40. Preliminary description, geology of the Kerby quadrangle, Oregon, 1949: Wells, Hotz, and Cater 0.85
41. Ground-water studies, Umatilla and Morrow Counties, 1949: Norman S.Wagner 1.25
44. Bibliography (2nd supplement) of geology and mineral resources of Oregon, 1953: M. L. Steere 1.00
45. Ninth biennial report of the Department, 1952-54 . . . . Free
46. Ferruginous bauxite deposits, Salem Hills, Marion County, Oregon, 1956: R. E. Corcoran and F. W. Libbey 1.25
49. Lode mines, central Granite Mining District, Grant County, Oregon, 1959: Geo. S. Koch, Jr. 1.00
51. Twelfth biennial report of the Department, 1958-60 . . . . Free
52. Chromite in southwestern Oregon, 1961: Len Ramp 3.50

GEOLOGIC MAPS

Prelim. geologic map of Sumpter quadrangle, 1941: J.T. Pardee and others . . . 0.40
Geologic map of the Portland area, 1942: Ray C. Treasher 0.25
Geologic map of the St.Helens quadrangle, 1945: Wilkinson, Lowry, & Baldwin . . 0.35
Geologic map of the Dallas quadrangle, Oregon, 1947: E. M. Baldwin 0.25
Geologic map of the Valsetz quadrangle, Oregon, 1947: E. M. Baldwin 0.25
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