GEOLOGIC MAP GM-4

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GEOLOGY OF THE GRAYS RIVER QUADRANGLE, WAHKIAKUM AND PACIFIC COUNTIES, WASHINGTON

By

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U. S. GEOLOGICAL SURVEY

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DIVISION OF MINES AND GEOLOGY

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INTRODUCTION

The Grays River quadrangle is in southwestern Washington on the north side of the Columbia River approximately 20 miles upstream from the river mouth. Mild climate and heavy rainfall (approximately 115 inches per year just west of the map area at Naselle) produce lush vegetation and deep and intensive weathering.

Previously published geologic work in the Grays River quadrangle is limited to the pioneering studies of C. E. Weaver. His monograph on the Tertiary stratigraphy and paleontology of western Washington and northwestern Oregon (1937) includes a generalized geologic map of the Grays River area. More recent detailed geologic studies of nearby areas in southwestern Washington (Henriksen, 1956; Pease and Hoover, 1957; Rau, 1958; Snavely and others, 1958; Gower and Pease, 1965; Livingston, 1966; H. C. Wagner, in press) do not include the area of the Grays River quadrangle, but they deal with stratigraphic sequences closely related to the succession in this quadrangle.

Geologic mapping was carried out by E. W. Wolfe and E. H. McKee, of the U. S. Geological Survey, in the summers of 1963 to 1966 as part of a cooperative program with the State of Washington Division of Mines and Geology. Weldon W. Rau, of the Division, made all foraminiferal determinations and correlations; all molluscan identifications and correlations were made by Warren O. Addicott, of the U. S. Geological Survey. Assistance in the field by A. R. Brown in 1963, M. D. Himes in 1964, W. G. Gilbert in 1965, and N. S. MacLeod for part of the 1966 field season is gratefully acknowledged.

STRATIGRAPHY

Crescent Formation

The oldest rock unit exposed in the Grays River quadrangle is a sequence of basaltic rocks called the Crescent Formation in accordance with the usage established by Gower (1960). The sequence crops out in the relatively rugged highland areas in the northwestern and northeastern parts of the quadrangle and is probably more than 5,000 feet thick.

The Crescent Formation is predominantly aphanitic to fine-grained pillow basalt, although massive and columnar-jointed basalt as well as aquagene tuff and siltstone occur locally. The pillows are well defined, range from about 1 to 3 feet in diameter, and are characterized in cross section by well-developed radial jointing. In fresh exposures the pillow basalt looks greasy, possibly because of abundant altered glass. Locally the basalt is amygdaloidal.

Foraminifera from siltstone interbeds in the Crescent Formation of the Grays River quadrangle indicate a middle Eocene (Ulatisian age of Mallory, 1959) or possibly earliest late Eocene (early Narizian age of Mallory, 1959) age. The Crescent Formation is lithologically correlative with the lower part of the early to middle Eocene Siletz River Volcanic Series of the Oregon Coast Range (Snavely and Baldwin, 1948).

Unit A

Overlying and perhaps intertonguing locally with the upper part of the Crescent Formation is a unit, informally designated unit A, of siltstone and interbedded sandstone that may be as much as 2,000 feet thick. The unit is exposed in the northwestern and northeastern parts of the quadrangle.

Siltstone in unit A is well indurated, thin bedded, and dark gray where freshly exposed. It consists of angular silt-sized quartz, feldspar, and lithic grains, as well as minute mica flakes in a chloritic or vermiculitic matrix.

Sandstone forms beds ranging in thickness from less than a foot to more than 10 feet. In fresh exposures the sandstone is greenish gray, but in most outcrops it is weathered to yellow or brown. The sandstone is very fine to medium grained and has abundant interstitial clay and randomly scattered mica flakes. Locally the sandstone contains coarser sand and granules. The sandstone beds typically have no visible internal structure. Graded bedding can be seen in some outcrops, but usually it is difficult to recognize because of the absence of coarse detritus. Small-scale crossbedding occurs locally. The basal contacts of the sandstone beds are always sharp; sole marks are rarely found.

North of Sweigiler Creek, in the eastern part of the quadrangle, interbedded siltstone and sandstone have been mapped with unit A. The sandstones in this area are volcanic sandstones containing grains of plagioclase and basalt. They occur as individual beds ranging from a few inches to about 2 feet in thickness, and some are graded.

Foraminifera from unit A in the north-central part of the quadrangle indicate an age of late middle Eocene (late Ulatisian age of Mallory, 1959) or possibly earliest late Eocene (early Narizian age of Mallory, 1959).

Unit B

The next younger rock unit, informally designated unit B, consists of several thousand feet of sedimentary and volcanic rocks. The absence of distinctive marker beds and lack of knowledge of the structural details precludes a precise determination of the thickness, but a thickness of more than 5,000 feet seems likely. The contact with the older rocks, where exposed, is a fault.

The most widespread rock type in unit B is marine tuffaceous siltstone, which is well indurated, well stratified, and is generally gray or greenish gray. Calcareous concretions are common and range from spheres about an inch in diameter to elongate lenticular masses as much as 1 foot thick and many feet long. Megafossils are rare, but Foraminifera are abundant and are commonly visible in hand specimens.

The volcanic rocks of unit B consist predominantly of massive basalt flows of probable subaerial origin in the Grays River valley and of aquagene tuff and flow breccia of marine origin in the Naselle River valley. The massive flows of the Grays River valley consist of relatively fresh porphyritic basalt, and some tuff and basaltic breccia. Their thickness is unknown, but it is probably at least 2,000 feet. Bright-red zones of oxidized tuff or altered basalt occur locally. At the base of the sequence the massive flows grade downward into volcanic breccia, tuff, and volcanic sandstone that are interbedded with marine siltstone of unit B.

Basaltic rocks of submarine origin interfinger with marine tuffaceous siltstone in the Naselle River valley. They also crop out in the North Nemah River valley in the northwest part of the quadrangle and near the headwaters of Hull Creek in the east-central part of the quadrangle. These marine volcanic rocks consist predominantly of structureless to distinctly bedded aquagene tuff or, in places, of extremely amygdaloidal basalt, basaltic sandstone, or siltstone rich in coarse volcanic debris. Nonamygdaloidal basalt, lithologically similar to the massive flows of unit B in the Grays River valley, is present locally in unit B in the Naselle River valley area. It occurs most commonly as flow breccia, but in places it is pillowed or massive. Small masses of volcanic rock mapped in unit B between Hull Creek and the Naselle River include massive basalt as well as breccia and aquagene tuff; some may be intrusive.

Sandstone constitutes a minor part of unit B. A massive, fine- to medium-grained, friable arenite approximately 200 feet thick resting on the upper Eocene volcanic rocks is mapped in the eastern part of the quadrangle. It grades upward into marine tuffaceous siltstone in the upper part of unit B. Similar sandstone, as well as basaltic sandstone, occurs in scattered outcrops elsewhere. In a few localities, particularly in the north-central part of the quadrangle and in the Naselle River channel near the west edge of the quadrangle (sec. 12, T. 10 N., R. 9 W.), very fine-grained sandstone is interlaminated with siltstone. Parallel lamination that has concentrations of mica and carbonaceous detritus on the bedding surfaces is characteristic. Small-scale crossbedding occurs locally.

Foraminifera represent the *Bulimina* cf. *B. jacksonensis*, *Uvigerina* cf. *U. yazooensis*, and *Plectofrondicularia* cf. *P. jenkinsi-Bulimina schencki* Zones of Rau (1958), of middle and late Eocene age (Ulatisian and Narizian Stages of Mallory, 1959), and possibly the *Sigmomorphina schencki* Zone (Snavely and others, 1958). Rau (written communication, 1967) refers the latter zone to the lower part of the Refugian Stage of Schenck and Kleinpell (1936) and now tentatively regards it as late Eocene in age. The McIntosh, Northcraft, and Skookumchuck Formations of the Centralia-Chehalis district (Snavely and others, 1958), considered as a group, are correlative with unit B.

Lincoln Creek Formation

The most complete section of the Lincoln Creek Formation (Beikman and others, 1967) is exposed in the southeastern part of the Grays River quadrangle. No obvious angular discordance is recognized between the Lincoln Creek Formation and the older rocks in the central part of the quadrangle, but relations east of the Grays River valley suggest that the basal contact is unconformable. Incompleteness of structural data due to poor exposures precludes a precise determination of the thickness, which undoubtedly varies because of overlap of the Lincoln Creek by the Astoria(?) Formation. However, a lower limit for the thickness is obtained from the Richfield-Weyerhaeuser No. 1 well (located near the mouth of Deep River), which penetrated approximately 3,500 feet of strata that are correlated with the Lincoln Creek on the basis of Foraminifera. In the west-central part of the quadrangle, the Lincoln Creek Formation was not recognized. However, unit B may include some strata equivalent to the Lincoln Creek mapped in the eastern part of the area.

The Lincoln Creek Formation consists predominantly of massive to indistinctly bedded tuffaceous siltstone and contains a basal zone in which basaltic sandstone and glauconitic sandstone occur. Bedding is less well developed in Lincoln Creek siltstones than in the underlying siltstones of unit B, although well-developed bedding occurs locally in the Lincoln Creek Formation. The siltstone is well indurated in the lower part of the formation but becomes less indurated upward.

Basaltic sandstone occurs in the lower part of the formation; the basal contact is drawn at the base of this sandstone. The maximum development of this sandstone occurs in the east-central part of the quadrangle, in the vicinity of Fossil and Klints Creeks. There the basaltic sandstone, which contains interbedded siltstone, is about 800 feet thick. The sandstone is medium light gray to olive gray or dark greenish gray, massive, very fine to fine grained, and in the easternmost outcrops, where large clasts are coarsest and most abundant, it contains rounded grains of basalt and glauconite up to half a centimeter in diameter. Carbonized wood fragments occur locally. Molluscan fossils are abundant, and subspherical, baseball-sized concretions commonly contain crab remains. Thickness of the sandstone unit, the proportion of sandstone to siltstone, and the maximum grain size greatly diminish west of the Grays River valley.

Tuffaceous siltstone, in part interlaminated with relatively well sorted very fine-grained sandstone, is exposed in the headwaters of Klints Creek; in highway cuts at the east edge of the quadrangle; and in the valley of Eggman Creek, just east of the quadrangle. Parallel lamination that has subordinate small-scale crossbedding and an abundance of mica and carbonaceous debris on the bedding surfaces characterizes the sandstone units. These strata are believed to be a local facies of the lower part of the Lincoln Creek Formation.

In the upper part of the formation, glauconitic, basaltic, and tuffaceous sandstone is abundant, although subordinate in quantity to siltstone. Light-colored tuff beds occur locally. Glauconitic beds, some of which are more than 10 feet thick and which in many places are more than half glauconite, are common. A discontinuous line drawn on the map indicates the lowest known occurrence of glauconite or sandstone in the upper part of the formation.

Foraminifera from the Lincoln Creek Formation represent the *Sigmomorphina schencki* (Snavely and others, 1958), *Cassidulina galvinensis* (Rau, 1966), and *Pseudoglandulina* aff. *P. inflata* (Rau, 1958) Zones and indicate an Oligocene and possibly latest Eocene age (Refugian Stage of Schenck and Kleinpell, 1936, and Zemorrian Stage of Kleinpell, 1938) in the Grays River quadrangle.

Mollusks from the lower sandstones are referable to the Oligocene "Lincoln Stage" of Weaver and others (1944). Faunal groups corresponding to the *Molopophorus gabbi* and *Turritella porterensis* Zones of Durham (1944) are recognized. Some of these strata also contain *Sigmomorphina schencki* Zone Foraminifera, which Rau (written communication, 1967) tentatively regards as late Eocene.

Megafossils from the upper part of the formation are referable to the *Echinophoria rex* and *Echinophoria apta* Zones (Durham, 1944) of the "Blakely Stage" of Oligocene and Miocene ages (Weaver and others, 1944).

Astoria(?) Formation

Siltstone and sandstone unconformably overlying the Lincoln Creek Formation are referred to the Astoria(?) Formation. The name "Astoria shales" was originally applied by Condon (Cope, 1880) to fossiliferous sedimentary rocks that were exposed in the vicinity of Astoria, Oregon, but that have since been concealed by urban development. Other geologists working in southwestern Washington (e.g., Pease and Hoover, 1957; Snavely and others, 1958) have used the name Astoria(?) Formation for lower or middle Miocene strata underlying or interfingering with basalt of Miocene age. The name is used in a similar sense here, except that the Astoria(?) Formation is not known to interfinger with basalt in the Grays River area. The Astoria(?) of the Grays River quadrangle may include strata correlative with both the Nye Mudstone and the Astoria Formation of west-central Oregon (Snavely and others, 1964).

The predominant lithologic type, seen in outcrops in the valleys of Grays and Deep Rivers, is massive dark-gray argillaceous siltstone to very fine-grained sandstone. An abundance of mica and very finely comminuted carbonaceous debris distinguishes the formation. Glauconite occurs commonly as scattered grains or, rarely, concentrated in beds. Typical outcrops show no bedding, and excavation of relatively unweathered outcrops reveals that nearly all depositional structure has been destroyed, presumably by burrowing organisms. Locally a few short wisps of the original bedding have been preserved. Calcareous concretions occur in places.

Massive tuffaceous siltstone, similar to Lincoln Creek siltstones, crops out in a few places. Molluscan and foraminiferal assemblages, as well as stratigraphic association with typical Astoria(?) carbonaceous and micaceous siltstone or sandstone, indicate that the tuffaceous siltstone is part of the Astoria(?) Formation.

Relatively clean sandstone in beds as thick as 160 feet is interbedded with typical argillaceous Astoria(?) strata on the ridge north of the Columbia River in the eastern half of the quadrangle. The sandstone is best exposed in outcrops north of Brookfield and on the ridge above Fink Creek. It is very fine to fine grained and contains sweeping crossbeds up to 6 feet long. Similar sandstone between Altoona and Dahlia, along the bank of the Columbia River, is mapped as Astoria(?) Formation, but it may be a younger unit reworked from the underlying Astoria(?) strata.

A different and distinctive lithologic assemblage is mapped in the upper part of the Astoria(?) Formation west of Deep River. It occurs along the Columbia River bank and on the ridge between Sisson and Salmon Creeks in the southwestern part of the quadrangle. The unit consists of more than 1,000 feet of bedded siltstone containing interbeds of very fine- to very coarse-grained friable sandstone ranging in thickness from half an inch to 40 feet or more. The sandstone forms beds and abundant clastic dikes that intrude the surrounding sedimentary rocks. Light-colored tuffaceous beds ranging in thickness from about a sixteenth of an inch to 1 foot occur locally. The unit as a whole is characterized by sparse crossbedding and extensive development of parallel lamination. The lamination results from alternation of tuff and siltstone, alternation of sandstone and siltstone, or concentration of carbonaceous detritus in layers in otherwise massive sandstone. Locally, the sandstone also contains beds of tabular pebbles and cobbles derived from the associated siltstone.

On the ridge south of Salmon Creek just west of the quadrangle boundary, a conglomerate composed of pebbles and cobbles of basalt is exposed in a single outcrop. Sedimentary rocks above and below the conglomerate are similar to each other, except that the overlying siltstone may be more tuffaceous and contains abundant pumiceous granules and pebbles as well as oxidized leaf fragments.

The maximum thickness of the Astoria(?) Formation is unknown. The Richfield-Weyerhaeuser No. 1 well, located near the mouth of Deep River, penetrated about 2,600 feet of strata considered to be Astoria(?) Formation on the basis of Foraminifera. This thickness plus the thickness exposed southwest of the well suggest a total of about 3,500 feet in the southwest part of the quadrangle. In the central part of the map area the available data suggest that the Astoria(?) Formation is anomalously thick, but the probability of structural repetition precludes determination of the actual thickness. In the southeastern part of the quadrangle the thickness ranges from less than 500 feet near the eastern edge of the map area to approximately 2,000 feet in the exposures north of Dahlia. The eastward thinning in this area may result from unconformable relations at the contacts.

Mollusks, common in the Astoria(?) Formation except in the interbedded sandstone and siltstone mapped west of Deep River, indicate an early to middle Miocene age. Foraminifera are ubiquitous in the fine-grained rocks and are referred to the *Epistominella parva* Zone (Rau, 1958) of early to middle Miocene age (Saucesian and in part Relizian Stages of Kleinpell, 1938).

Basalt Flows and Intrusive Rocks

Basalt flows, approximately 500 feet thick, rest with probable unconformity on the Astoria(?) Formation in the southern part of the quadrangle. The flows are divided into two units on the basis of lithology, chemistry, and fabric.

Basalt exposed along the Columbia River in the southeastern part of the quadrangle at Three Tree Point and eastward consists largely of massive basalt but also contains some flow breccia and pillow lava. Some intrusive rock may be included with the unit in its westernmost exposures. The basalt is black and aphanitic; it is chemically similar to the lower unit of Miocene volcanic rocks of the central Oregon Coast Range (Snavely and others, 1965, p. 107) and to the Yakima Basalt of the Columbia Plateau (Waters, 1961, p. 593).

Along the Columbia River between Altoona and Jim Crow Point the basalt consists predominantly of flow breccia; only small amounts of pillow lava and massive basalt are present. The basalt is fresh and black and contains scattered plagioclase phenocrysts as large as half an inch in diameter in an aphanitic groundmass. It is chemically similar to the upper unit of Miocene volcanic rocks of the central Oregon Coast Range (Snavely and others, 1965, p. 107) and to the late Yakima type of the Columbia River Group of the Columbia Plateau (Waters, 1961, p. 594). Some of the basaltic breccia mapped with the unit may be shallow intrusive rock closely associated with the flows.

All intrusive rocks in the southern two-thirds of the quadrangle and the intrusive in secs. 14 and 23, T. 11 N., R. 9 W., at the western edge of the quadrangle, are lithologically like the flows exposed along the bank of the Columbia River. The two distinctive chemical types recognized in the extrusive rocks are also found among the intrusives. The intrusive rocks chemically similar to the basalt of Altoona contain similar and distinctive scattered large plagioclase phenocrysts. The rest of the intrusives are aphanitic to very fine grained. A third chemical type is represented by the sill between Salmon and Sisson Creeks in the southwestern part of the quadrangle and by the intrusive in secs. 14 and 23, T. 11 N., R. 9 W., approximately 6 miles to the north, which is part of a thick sill exposed west of the map area.

The basalts of Three Tree Point and Altoona rest on the Astoria(?) Formation of early to middle Miocene age (Saucesian to Relizian Stages of Kleinpell, 1938). In the central part of the Oregon Coast Range the two volcanic units, chemically similar to the two units of the Grays River area, are regarded as middle Miocene in age (Snavely and others, 1965, p. 111, 112). An age of middle Miocene or younger is inferred for the basalts of Three Tree Point and Altoona and for the associated basaltic intrusive rocks.

Older Alluvium

Deposits of sand, silt, and gravel derived from the local sedimentary and volcanic rocks rest unconformably on Tertiary rocks along the edges of the Grays River valley. The maximum thickness is about 100 feet. The broad flat upper surfaces of these deposits of older alluvium form terraces that are easily recognizable on aerial photographs.

Alluvium

Recent alluvial deposits consisting of sand, silt, and gravel derived from local sources fill the major stream valleys. In the valleys of Salmon Creek and the Naselle River some alluvium, possibly as old as Pleistocene, and deposits produced by mass movement on valley walls are mapped with the alluvium.

Landslide Debris

Mass movement, ranging from surface creep to landslides covering areas as wide as half a mile, is ubiquitous. Only the largest landslides, easily recognizable on aerial photographs, are shown on the map.

Intrusive Rocks

Intrusive rocks ranging from basalt dikes a few feet wide to large gabbroic intrusives are abundant in the northern third of the quadrangle.

Many of the smaller intrusives in this part of the area consist of porphyritic basalt that is similar in petrography to the porphyritic basalt flows of unit B. The larger intrusive bodies are medium grained; augite and plagioclase crystals are nearly half a centimeter, and locally as large as a centimeter, in diameter. A late Eocene age is inferred from the petrographic similarity of the smaller intrusives to flows of unit B, from their close association in space, and from the absence of these distinctive lithologic types in rocks intruding strata known to be younger than the volcanic rocks of unit B.

STRUCTURAL GEOLOGY

Details of the geologic structure are difficult to ascertain because of poor exposures, the limited variety of rock types, the massive character of much of the rock sequence, and the scarcity of distinctive marker beds. Anomalous attitudes, which are not uncommon, may well be the result of landslides or slumping rather than of tectonic deformation.

Generally, the rocks decrease in age southward along the southern flank of a large northwest-trending anticline that has its crest in the higher country near the north edge of the quadrangle. The complementary synclinal trough underlies the Columbia River south of the mapped area. A series of lesser folds and faults is superimposed on this broad structure.

A structurally complex syncline strikes northwest in the west-central part of the map area and is part of a group of northwest-striking folds and faults that are strongly defined west of the map area. In the southeast quarter of the quadrangle, upper Eocene and Oligocene rocks form a broad, nearly homoclinal belt of northwest-striking strata unconformably overlapped on the south by the east-west-trending rocks of the Astoria(?) Formation. The northwest structural trend is emphasized by high-angle faults that form the western boundaries of the two large blocks composed of the Crescent Formation and unit A in the northeastern and northwestern parts of the quadrangle. The northeastern block is bounded on its southwest side by a pronounced scarp that reflects one of these faults. North- to northwest-trending dikes in the southeastern part of the quadrangle may lie along a southern extension of this fault, or a southern extension may exist unrecognized in the volcanic rocks of unit B in the east-central part of the quadrangle.

Northeast structural trends are less pronounced. The more important of these trends are defined by the southern boundaries of the two large masses of Crescent Formation and unit A, by northeast-striking rocks of unit B in the north-central part of the quadrangle, and by the strike of the Astoria(?) Formation in the Grays River valley. The faults bounding the Astoria(?) Formation are conjectural, and were drawn to account for the thick northeast-striking mass of the Astoria(?), which truncates the northwest-striking Lincoln Creek Formation in the south-central part of the quadrangle, and to account for the absence of the Lincoln Creek Formation between the Astoria(?) and unit B in the west-central part of the quadrangle. An additional fault within the Astoria(?) west of Deep River accounts for opposing northeast and northwest structural trends within the formation.

ECONOMIC GEOLOGY

Ferruginous Bauxite

Ferruginous bauxite, a potential ore of aluminum, develops as a weathering product of some basaltic rocks. However, no ferruginous bauxite is known to exist in the Grays River quadrangle, although intrusive basalt about half a mile west of the crest of Jim Crow Hill shows unusually deep weathering. The rock is altered almost completely to a soft reddish-brown powdery deposit, in which, according to an X-ray diffractogram, gibbsite is probably the major crystalline constituent. The following chemical analyses indicate that some decrease in silica content and accompanying increases in alumina, iron oxide, and titania have occurred.

	Fresh basalt① (percent)	Weathered basalt② (percent)
SiO_2	55.2	39.6
Al_2O_3	14.4	17.6
Fe_2O_3	1.1	13.3
FeO	9.9	3.6
MgO	3.7	2.5
CaO	6.9	3.5
Na_2O	3.2	.90
K_2O	1.3	.27
H_2O-	.34	7.3
H_2O+	1.0	6.3
TiO_2	1.8	3.6
P_2O_5	.35	.66
MnO	.20	.23
CO_2	.52	.06
	99.91	99.42

① SE¼SE¼ sec. 7, T. 9 N., R. 7 W.

② SE¼NW¼ sec. 17, T. 9 N., R. 7 W.

Rapid rock analyses by P. Elmore, S. Botts, L. Artis, and H. Smith (U.S. Geological Survey).

An average of analyses of ferruginous bauxite from Cowlitz County, Wash. (Livingston, 1966, p. 88, Table 13), shows Al_2O_3, 38 percent; Fe_2O_3, 27 percent; TiO_2, 4 percent; and SiO_2, 6 percent. These analyses indicate that typical western Washington ferruginous bauxite deposits are higher in Al_2O_3, Fe_2O_3, and TiO_2 and much lower in SiO_2 than the weathered basalt from the Grays River quadrangle.

Road Metal

Basalt from the volcanic and intrusive rocks is quarried from numerous small pits for use as road metal in the extensive network of logging roads.

Sand

Medium- to coarse-grained sand that could be used in construction has been dredged from the bed of the Columbia River near its north bank at Dahlia and Brookfield, in the south-central part of the quadrangle. Except for scattered pumice pebbles, the sand is well sorted.

Oil and Gas

Sedimentary rocks of the Grays River quadrangle contain organic material and could be source beds for oil or gas. The stratigraphic succession consists predominantly of volcanic rocks and extremely fine grained sedimentary rocks that are too impermeable to be suitable reservoir rocks for oil or gas. Middle Eocene sandstones contain a large amount of clay matrix and can be expected to have low porosity. Unit B and Astoria(?) strata, however, include some relatively clean sandstones that may be potential petroleum reservoirs.

An exploratory well, the Richfield-Weyerhaeuser No. 1, was drilled near the mouth of Deep River in the southwestern part of the quadrangle. It was started in the Astoria(?) Formation below the upper unit mapped west of Deep River and bottomed in volcanic rocks of unit B at a total depth of 9,110 feet. The well did not intersect any oil-producing strata.

Except for the single thick sandstone mapped in unit B in the Grays River valley, sandstones of unit B are too thin and sporadically distributed to form sizable reservoirs. Northeast of the map area, thick upper Eocene sandstones of the Skookumchuck Formation (Pease and Hoover, 1957; Snavely and others, 1958) are a near-shore facies of the deeper marine strata of unit B in the Grays River quadrangle. Areas to the east offer more likely possibilities for the occurrence of structural or stratigraphic traps in upper Eocene strata than does the Grays River quadrangle.

The better sorted sandstones of the Astoria(?) Formation seem especially favorable as potential petroleum reservoirs, because they are interbedded with fine-grained strata that are rich in organic material and can serve both as source rocks and as barriers to oil or gas migration. The clean crossbedded sandstones of the Astoria(?) in the southeastern part of the quadrangle are probably a shallow-water facies of limited areal extent. Their distribution to the east is unknown; they probably do not occur farther west, where the basin presumably was deeper.

The Astoria(?) sandstones in the separately mapped unit west of Deep River are interbedded with siltstones that, at least in part, contain Foraminifera indicative of bathyal deposition (W. W. Rau, written communication, 1966). The only mollusks known in the sequence are mud pectens, which, occurring alone, also suggest deposition at bathyal depths (W. O. Addicott, oral communication, 1966). The possibility exists that these are deep-water sandstones, perhaps deposited by turbidity currents. If so, they may occur in the present offshore area and could be potential targets in offshore petroleum exploration.

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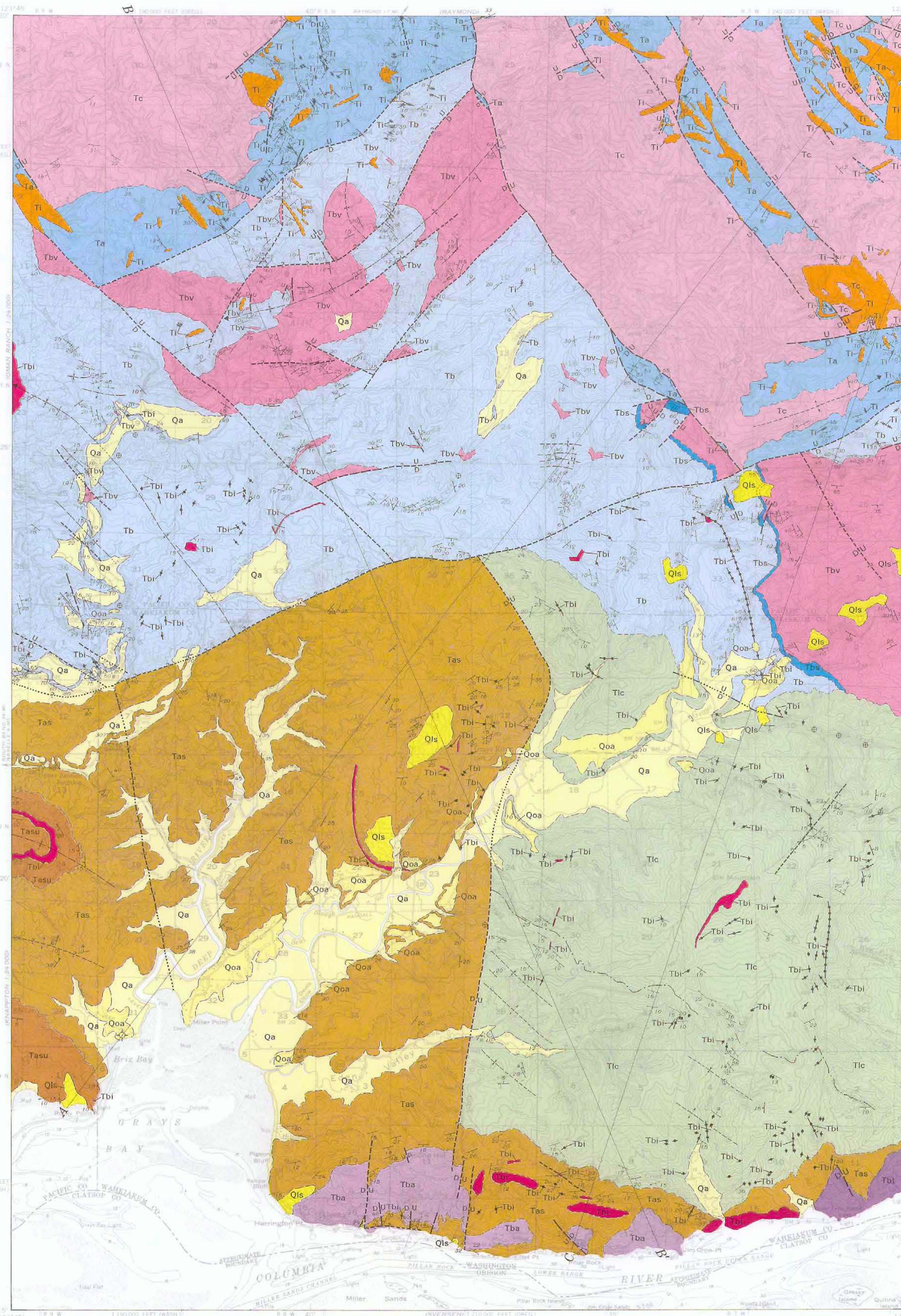


Base by U.S. Geological Survey, 1955

SCALE 1:62 500

1 ½ 0 1 2 3 MILES

1 .5 0 1 2 3 KILOMETERS

CONTOUR INTERVAL 50 FEET
DATUM IS MEAN SEA LEVEL
DEPTH CURVES IN FEET–COLUMBIA RIVER DATUM

WASHINGTON

QUADRANGLE LOCATION

Geology mapped 1963–1966

EXPLANATION

QUATERNARY

Pleistocene(?) and Recent

Qls — Landslide debris

Qa — Alluvium
Gravel, sand and silt

Pleistocene

Qoa — Older alluvium
Gravel, sand, and silt

TERTIARY

Miocene

Tba, Tbt, Tbi — Basalt flows and intrusive rocks
Tba, *basalt of Altoona; basalt breccia, locally pillow lava, slightly porphyritic*
Tbt, *basalt of Three Tree Point; basalt, massive, local breccia and pillow lava, aphanitic*
Tbi, *basaltic intrusive rocks*

Tasu, Tas — Astoria(?) Formation
Tasu, *unnamed unit; siltstone, tuffaceous, with interbedded very fine to very coarse grained sandstone*
Tas, *siltstone to very fine grained sandstone*

Eocene(?), Oligocene, and Miocene

Tlc — Lincoln Creek Formation
Siltstone, tuffaceous; minor glauconitic and basaltic sandstone. Base of upper glauconitic and sandy zone indicated by dots and dashes

Eocene

Tb, Tbs, Tbv — Unit B
Tb, *siltstone, tuffaceous; minor sandstone*
Tbs, *sandstone, friable, massive*
Tbv, *volcanic rocks; aquagene tuff, basalt flows*

Ta — Unit A
Siltstone; feldspathic and volcanic wacke

Tc — Crescent Formation
Pillow basalt; minor siltstone, sandstone, and aquagene tuff

Ti — Intrusive rocks
Basalt and gabbro

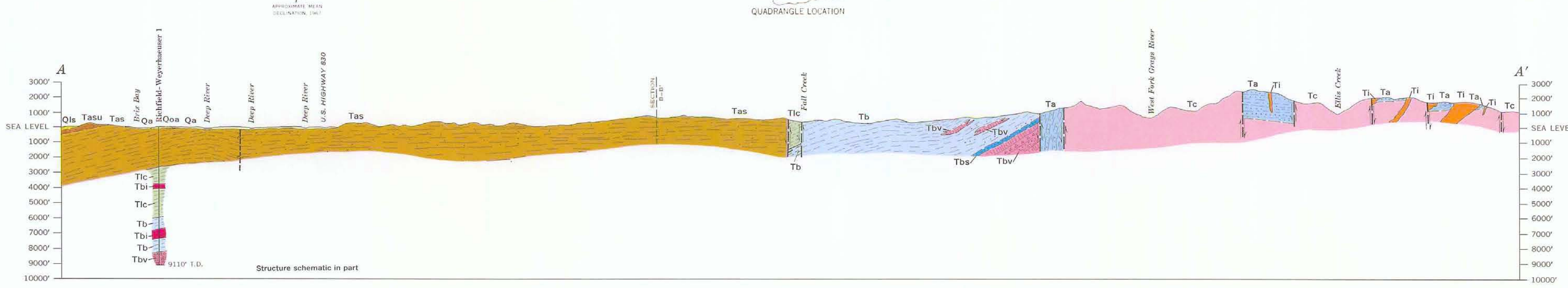
Contact
Approximately located; short dashed where inferred; dotted where concealed

U D
Fault
Approximately located; short dashed where inferred; dotted where concealed; queried where probable or hypothetical; U, *upthrown side;* D, *downthrown side*

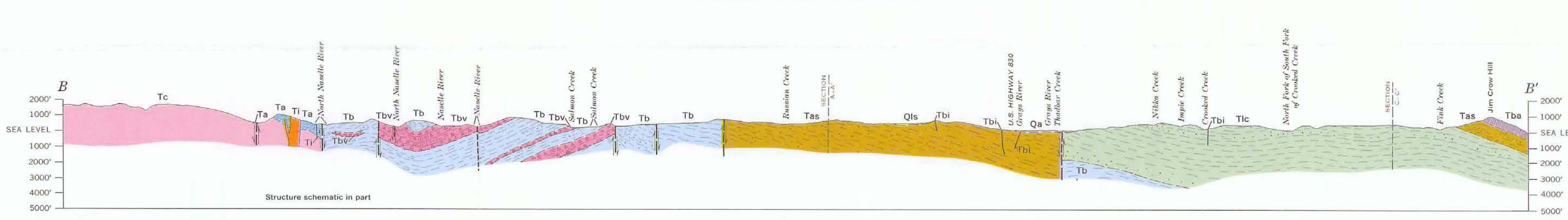
Anticline — Syncline
Folds
Showing trace of axial plane and direction of plunge
Long dashed where approximately located; short dashed where inferred; dotted where concealed

18 — Inclined; 85 — Overturned; Vertical; Horizontal
Strike and dip of beds
Generalized where no numerical value is given

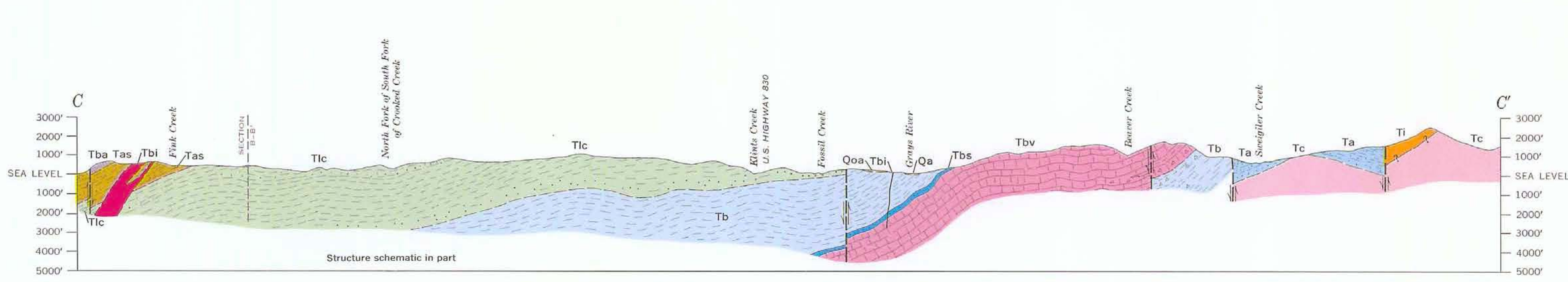
Exploratory test well
Richfield Oil Corp. Weyerhaeuser No. 1
SW¼ Sec. 31, T. 10 N., R. 8 W.



GEOLOGIC SECTION ALONG LINE A—A′



GEOLOGIC SECTION ALONG LINE B—B′



GEOLOGIC SECTION ALONG LINE C—C′

GEOLOGY OF THE GRAYS RIVER QUADRANGLE, WAHKIAKUM AND PACIFIC COUNTIES, WASHINGTON

By
Edward W. Wolfe and Edwin H. McKee
U.S. Geological Survey

1968

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