STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
1069 State Office Building—1400 S. W. 5th Avenue
PORTLAND 1, OREGON

BULLETIN No. 37

Geology of the Albany Quadrangle, Oregon

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1953

Price 75 Cents

FOREWORD

The accompanying paper is the first of a number of geological quadrangle reports covering central Willamette Valley which the Department hopes to publish. In the late 1930's some of Dr. Allison's students at Oregon State College mapped four central Willamette Valley quadrangles as parts of their masters theses. A small amount of expense money was provided the students by the Department to assist in getting these studies made. Advent of World War II interrupted plans for publication because of dispersal of the student authors and also because of pressure of other Department work. Dr. Allison recently completed the geologic map and report on the Albany quadrangle which make up Bulletin 37, and the Department is glad to publish this bulletin as a contribution to Oregon geology and also to make available a geological map of this important segment of the Willamette Valley.

F. W. Libbey
Director

February 24, 1953

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Illustrations

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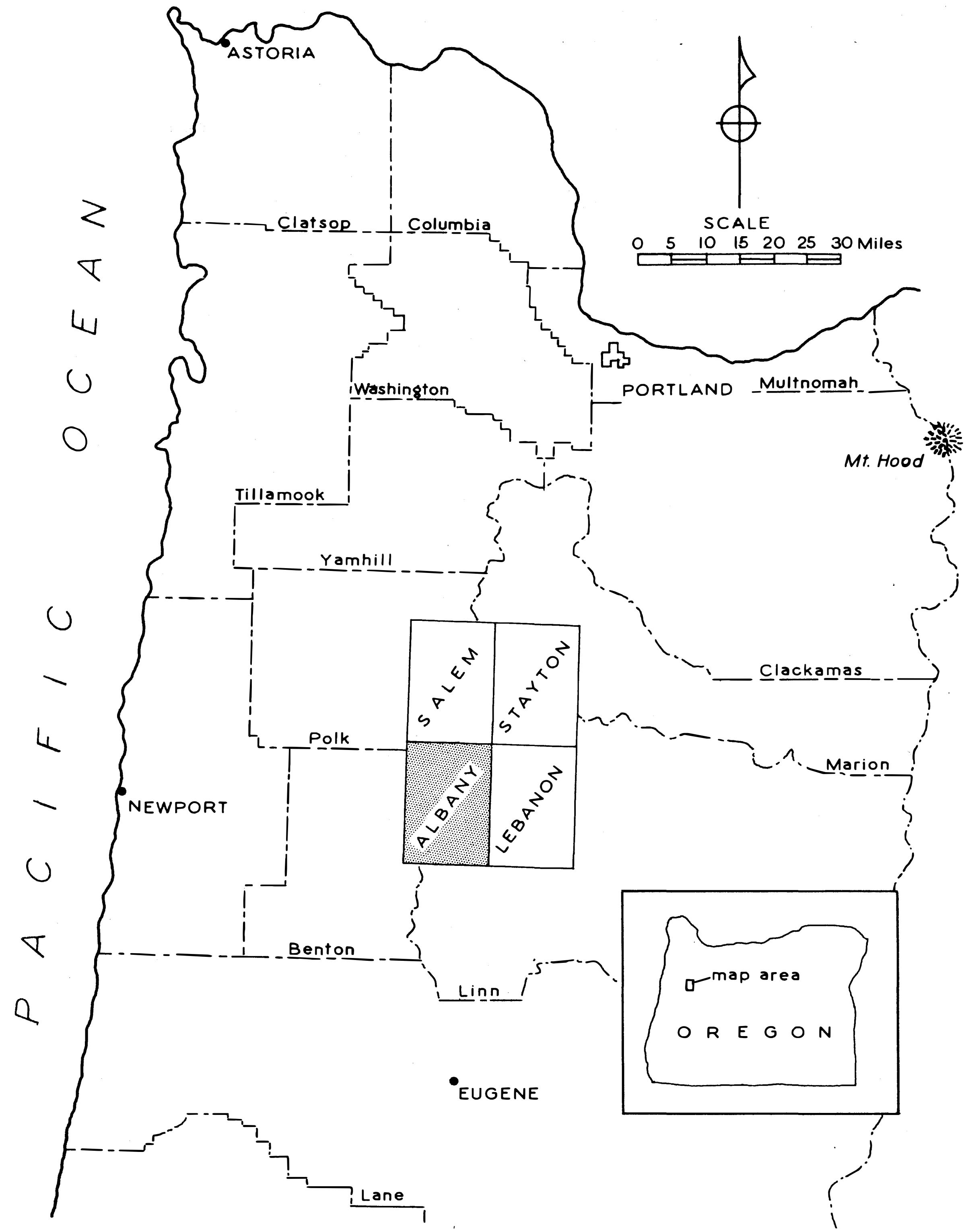

Index map showing location of Albany Quadrangle

GEOLOGY OF THE ALBANY QUADRANGLE, OREGON

By
Ira S. Allison

Introduction

General

The reconnaissance geologic map of the Albany quadrangle (in pocket) is part of a projected series of publications covering selected areas in central Willamette Valley. It is expected that geologic maps of Lebanon, Salem, and Stayton quadrangles will follow. The purpose of the project is twofold, first, to advance the preparation of a geologic map of the State, and second, to show the detailed stratigraphy and structure of particular areas of geologic interest. The Albany quadrangle (see index map) is of special interest because it lies at the east edge of the Coast Range, and contains Eocene volcanics, Eocene and Oligocene marine sediments, and Pleistocene alluvial deposits of four different stages. Stratigraphic names of these alluvial deposits and of the Eocene volcanics are here introduced for the first time.

Work on the Albany quadrangle has been done intermittently over a period of about 15 years. In this project the writer has been assisted at various times by students, especially by Harold Culp, Earl Gould, William Leever, Wallace Lowry, Richard Mathews, Thomas O'Neill, Gordon Shearer, and Harold Wolfe, but the writer accepts full responsibility for the map and this brief description. The State Department of Geology and Mineral Industries furnished funds for mapping part of the area in 1941, and Mr. Ralph S. Mason of the Department staff prepared the map for publication.

Great difficulty was experienced in mapping the area between Albany and Jefferson on account of the number of formations involved, the paucity of exposures, and the difficulty of discerning the structural relations; hence some errors may be present and differences in judgment concerning structural relations may be expected. Most of the mapping, however, is believed to be reasonably accurate. It was done mainly by compass and pace traverses using the Albany topographic quadrangle map as a base.

Previous work

Very little previous work on the quadrangle has been done except reconnaissance by Diller (8, 10), determination of fossils obtained northwest of Albany by Condon (7), Washburne (19), and others (6, 22), and the differentiation of Pleistocene deposits by Allison (3). A selected bibliography is appended.

Geography

Location

The Albany quadrangle is in central Willamette Valley in northwest Oregon where the foot hills of the Coast Range project northeastward into the valley lowland, between latitudes 44°30' and 44° 45' north and longitudes 123° and 123°15' west. The Willamette River follows a crooked course northward across the quadrangle; and the Santiam River, formed by the union of the North Santiam and South Santiam rivers at the east edge of the area south of Jefferson, flows into the Willamette at the north border. Except a small part of Marion County in the northeast corner of the quadrangle, the portion lying east of the Willamette River is in Linn County; that part lying west of the Willamette River is in Benton County. Albany is the principal city.

Accessibility

Most of the area is thickly settled and is easily accessible by a network of roads including the Pacific Highway (US 99E and 99W). The main line and several branches of the Southern Pacific Railway also traverse the area.

Topography

The Albany quadrangle lies in the Willamette Valley lowland province at the east edge of the Coast Range province. The lowland here may be divided into two portions, namely (1) an alluviated valley plain terrace occupying the greater part of the area, mostly 200 to 300 feet above sea level, and (2) an irregular set of bottom lands along the streams, eroded from 5 to 30 feet below the valley plain terrace. The only upland in the quadrangle consists of hills and ridges which project northeastward into the area from the Coast Range and vary in elevation from about 1100 feet above sea level on the west to 300 to 500 feet above sea level near Albany. Coffin Butte and other high hills on the west, which may be regarded as the eastern limit of the Coast Range, owe their greater elevation to their basaltic composition which has resisted erosion more than the tuffaceous sandstones and shales of the lower hills farther east. Knox Butte, Hardscrabble Hill, and Hale Butte, detached remnants of the same group of low hills, have also been protected in part by resistant rocks in their makeup. The flattish summits of the 300- to 500-foot hills may possibly be the result of an ancient erosion surface advanced to late maturity or early old age at that level. The present lowland is the former mature valley of the Willamette River and its tributaries, later aggraded with alluvium. Its topographic age in the present cycle of erosion is youthful.

Stratigraphic Geology

Outline

The rocks of the Albany quadrangle include the Coffin Butte volcanics (basaltic pillow lavas, breccias, and tuffaceous shales) probably of middle Eocene age; unnamed marine tuffaceous sandstones and shales thought to be at least partly equivalent to the Spencer formation of upper Eocene age; the Eugene formation, marine tuffaceous sediments, mostly sandstones, of middle Oligocene age; basaltic and diabasic intrusives (dikes, sills, and plugs) probably of Miocene age; Pleistocene alluvial deposits of the Lacomb, Leffler, Linn, and Willamette stages; and Recent alluvium.

Coffin Butte volcanics

Name and distribution: The name Coffin Butte volcanics is here proposed as a formation name for a volcanic complex of basaltic flows, breccias, tuffs, and tuffaceous shales that make up the eastern edge of the Coast Range in the northwest part of the quadrangle. They extend southwesterly from Coffin Butte on the northeast through Vineyard Hill and other ridges north and northwest of Corvallis to the vicinity of Philomath and Wren, and westward across a large part of northern Benton County, but only a small part of this extensive mass is present within the Albany quadrangle. Coffin Butte, which furnishes the name, gives good exposures of the lava flows as a result of several large cuts and quarries made in 1942 for the extraction of material for use mainly on roads at Camp Adair, and may well be designated the type locality. The breccias and tuffs however are best seen in road cuts on the West Side Highway (US 99W) and on the Tampico-Airlee and Sulphur Springs roads to the west.

Petrographic character: The lavas of the Coffin Butte complex are dark gray to nearly black, fine-grained or partly glassy basaltic rocks characterized by ellipsoidal or pillow structure and a local abundance of zeolites. Except for radial columns in the ellipsoids, columnar jointing is not common. The tops of the flows are generally palagonitic or amygdaloidal, and palagonite also occurs between the ellipsoids, which range in size from about six inches to two or three feet in diameter. Cavities between some of the ellipsoids are beautifully encrusted with chabazite, heulandite, apophyllite, natrolite, analcite, quartz, calcite, and pyrite. The contacts between the flows are uneven, although smoothed in places by thin seams or pockets of dark shale. The flows appear to be thin but numerous. The ellipsoids and the intercalated sediments indicate that the lavas were poured out in the sea, where the reaction with sea water evidently formed the palagonite and the zeolites. The rocks are slightly altered to chlorite, epidote, and serpentine.

Thickness: Coffin Butte rises about 500 feet above the plain to the east. As the flows here have a moderate dip, the stratigraphic thickness in the Butte alone is about 600 feet. The formation as a whole, however, crops out across a belt at least 2 and perhaps 3½ miles wide in the direction perpendicular to the regional strike. If a moderate dip persists uniformly across that belt, the total thickness may be 5,000 to 10,000 feet, or at steeper angles, 10,000 to 15,000 feet. Data at hand are insufficient to decide, but even if there is some repetition by reversal of dip or by obscure faulting, it is clear that the minimum thickness amounts to several thousand feet.

Stratigraphic relations: The stratigraphic relations of the Coffin Butte volcanics are not entirely clear. The greater part of the mass is separated from other solid rocks by valleys occupied by alluvium. Just north of Lewisburg, however, the basalts are exposed within 100 feet of an outcrop of nearly vertical beds of tuffaceous sediments. The contact, easily traceable for a distance of nearly a mile across two low ridges and a shallow ravine, trends about N. 45° E. Although not actually exposed, the contact appears to dip northwesterly at a very high angle; it may be vertical. Whether this portion of the contact is the trace of the upturned original depositional surface or is a subsequent fault is uncertain. A comparatively straight boundary between the Coffin Butte volcanics on the northwest and folded sediments on the southeast also extends many miles southwesterly into the adjacent Corvallis quadrangle. Hence, regardless of the local details, the regional contact is inferred to be a high-angle fault contact, and probably a thrust. The sediments southeast of the inferred fault show pronounced changes in strike and dip within short distances, as if disturbed by such major faulting. Possibly the locus of principal faulting is concealed in the alluviated swale followed by the branch line of the Southern Pacific Railway southwest of Calloway station.

A peculiar relation is exposed in a road cut on Highway US 99W about a mile north of Lewisburg, where a remnant of basalt rests on the beveled edges of nearly vertical beds of tuffaceous shales. The contact slopes southwestward at a low angle and might be considered to be a warped thrust plane. There is, however, little evidence of drag or other modification of the underlying sediments such as one might expect from an important low-angle overthrust. The direction of movement is indeterminate. Hence the fault is thought to be only a minor one, perhaps only a remnant of a former landslide. The underlying siliceous shales probably are merely a sedimentary phase of the Coffin Butte volcanic complex.

Age and correlation: If the foregoing inference on structural relations is correct, the Coffin Butte volcanics and associated sediments are the oldest rocks exposed within the Albany quadrangle. As some of the other marine rocks in the quadrangle yield upper Eocene fossils, the Coffin Butte volcanics are thought to be middle Eocene in age, but paleontological proof is lacking.

Pillow lavas of similar character are associated with the middle Eocene Umpqua formation in western Oregon (9, 20, 21). A thick series of basaltic flows, pillow lavas, flow breccias, and minor amounts of pyroclastics occurs also in the Nestucca Bay, Euchre Mountain, Valsetz, and Dallas quadrangles of northwestern Oregon.

This series, 3000 to 5000 feet thick, named the Siletz River volcanic series by Snavely and Baldwin (15, p. 806), is correlated by them with the Umpqua formation, the correlative of the Capay shale of California. Although other volcanic outbreaks in western Oregon occurred in Eocene time (4, 9, 15, 18, 20, 21) and although exact equivalence of volcanic materials from different centers is not to be expected anyway, the correlation of the Coffin Butte volcanics with the Siletz River volcanic series, not far distant to the northwest, appears reasonable. As the two are disconnected and are not yet known to be exactly contemporaneous, separate names are retained.

The sources of the Coffin Butte lavas have not been identified with certainty but the greater thickness of the lavas farther west and southwest suggests the presence of the vents in that direction.

Upper Eocene marine sediments

Composition: The upper Eocene marine sediments include two unlike facies. One of these is not well exposed but it occurs in Spring Hill and vicinity, in the small hill half a mile southwest of Lewisburg, and elsewhere. It is typically a medium-grained, light-colored, leached or poorly cemented sandstone consisting mainly of volcanic glass, feldspar, quartz, and muscovite in varying proportions. Certain tuffaceous shales of the area are perhaps a part of the same sequence. Its bedding is poorly exposed and hence its structure in places is not clear. Fossils have not been found in it in this area but it is probably marine. In its lithology it resembles the Spencer and Comstock formations in Lane County. Detailed mapping of the intervening area eventually may show its exact relation to these formations. Meanwhile it is regarded tentatively as probably upper Eocene in age. It is not given a formation name as its limits cannot be defined.

The other facies shows a marked change in composition and texture, as it contains large quantities of basic ash, lapilli, and small rock fragments. The two facies may be seen in contact in a hillside road cut about one mile north of Granger, where coarse-grained, brown-weathering, fossiliferous vitric tuff of the second facies, with minor admixture of the earlier micaceous sand at its base, overlies the lighter-colored crystal tuff of the earlier facies. So far as one can tell the contact between the two facies is a conformity. Extremely indurated breccia of lapilli and basalt fragments interbedded with sandy tuff occurs just north of Thornton Lake.

The sediments of upper facies appear to be the product of vigorous volcanic eruptions which supplied a different type of detritus to the Eocene sea than had previously been deposited. That change possibly should be recognized as of formational rank, but in an area of such poor exposures it did not seem feasible to map the two facies separately. Fragments of leaves and carbonized wood are common in this basic tuff. The thickness is not measurable in the area, but according to the width of outcrop it is estimated to be at least 1500 to 2000 feet.

The same succession of facies appears in the Corvallis quadrangle and in the southwestern part of the Salem quadrangle. It is of interest to note that a similar change of lithology occurs in the sequence of Spencer-Comstock-Fisher formations (17) at the type localities west and southwest of Eugene, where light-colored marine tuffaceous sandstones are succeeded by coarse micaceous sandstones and fine conglomerates, and eventually by basaltic tuff, breccia, and coarse conglomerates. This change is thought to reflect the progressively increasing importance of the Calapooya volcanics as sources of sedimentary materials. The same explanation may apply to a lesser degree to the changes in the late Eocene sediments in the Albany quadrangle.

At The Cliff, beside the Santiam River about one mile below Jefferson, a coarse, rather massive tuffaceous sandstone contains irregular layers or lenses of breccia composed of angular pieces of basalt of various sizes. The immediate source of the basalt in the breccia is not apparent; the nearest known basalt, probably in the form of a sill, crops out a mile away in Hale Butte. Several similar nests of breccia are known in the upper Eocene marine sediments of the Dallas quadrangle (4, pp. 26-27), many miles from exposures of basaltic volcanics that may have served as sources. They imply peculiar conditions of sedimentation. Whether the fragments in these local nests of breccia were transported by submarine sliding, by tree rafting, or by some other means is conjectural, but associated contemporaneous deformation structures seen in the Dallas quadrangle suggest sliding. A seemingly necessary condition would be steep slopes on the sea floor bordering islands or peninsulas of Coffin Butte or other volcanics in the late Eocene sea. These breccias, apparently confined to the upper Eocene, deserve detailed study.

Age and correlation: Fossils obtained from the upper facies northeast of Lewisburg, north of Granger, and north of North Albany have been identified by Richard Mathews and include the following:

Brachidontes cowlitzensis (Weaver and Palmer)

Macrocallista cf. conradiana

Nuculana cowlitzensis (Weaver and Palmer)

Pitar californiana (Conrad)

Tellina cf. cowlitzensis (Weaver)

Venericardia hornii clarki (Weaver and Palmer)

Crepidula pileum (Gabb)

Polinices weaveri (Dickerson)

Tivelina cf. vaderensis (Dickerson)

Turritella uvasana stewarti (Merriam)

These fossils, though few in number of species, appear to justify correlation with the Spencer formation of upper Eocene (Cowlitz-Tejon) age in Lane County (17) or with part of the Coaledo formation near Coos Bay (1). The Turritella uvasana stewarti (Merriam), if correctly identified, is especially significant. The similarity of the sequence of lithologic changes, discussed above, appears to strengthen this correlation.

Eugene formation

Distribution: The Oligocene sediments of the quadrangle are referred to the Eugene formation. Marine sediments of known Oligocene age occur on Murder Creek northeast of Albany, about the flanks of Knox Butte, and on the west side of the Santiam River at the confluence of the North and South forks a few miles south of Jefferson. These sediments may possibly occur at other places in the vicinity, as the contact between Oligocene and Eocene was not found and the age of the sediments in Hardscrabble Hill, Hale Butte, and vicinity is uncertain.

No Oligocene fossils have been found in that part of the Albany quadrangle which lies north and west of the Willamette River, but some of the breccia and tuff on the south edge of the hills near Albany may possibly be of Oligocene age.

Petrographic character: The Oligocene sediments are mainly sandstones and siltstones composed of grains of volcanic glass, more or less devitrified, and hence are properly called tuffs. Intercalated locally are thin layers of granule and pebble conglomerate apparently composed of pumiceous lapilli and pieces of basalt or andesite. Individual beds in the tuff range in thickness from a few inches to several feet. On the west side of Knox Butte some of the rock is white or only slightly iron-stained on the outcrop, is thin-bedded and minutely crossbedded, contains leaf and wood fragments, and along thin clayey seams bears marine fossils.

Thickness: The known Oligocene in this quadrangle is not exposed in a continuous measurable section for more than a stratigraphic thickness of about 400 feet but the distribution of the outcrops suggests that the total thickness is many times that figure and probably is comparable with the 2000- to 2500-foot stratigraphic section known in the Salem quadrangle to the north.

Stratigraphic relations: In the Salem quadrangle the Oligocene beds appear to overlie the Eocene with an angular unconformity. In the Albany quadrangle, as well as farther north, the contact has not been located precisely but the north-trending Oligocene seems to cut across the east end of an easterly plunging anticline of Eocene beds and hence appears to be unconformable here also. Known dips of the Eocene beds are somewhat greater than those of the Oligocene, but better evidence of unconformity is probably afforded by the regional relations.

Name, age, and correlation: Fossils have been obtained from these rocks mainly at the junction of the North and South forks of the Santiam River and at Knox Butte. They are fairly numerous but meager in number of species. These fossils indicate that the beds are middle Oligocene in age and comparable to the Eugene (14), Pittsburg Bluff (13), and Illahe (16) formations. As the name Eugene formation has priority, it is used here.

Miocene (?) intrusive rocks

Intrusive rocks thought to be of Miocene age occur on top of Knox Butte, in Hardscrabble Hill, at the foot of the same hill beside the Santiam River, in the west and southwest parts of the hill northeast of Millersburg, near the west end of Hale Butte, in the southeast corner of an unnamed butte about a mile southwest of Hale Butte, in the Eocene sediments about a mile northeast of Lewisburg, in two places near the Luckiamute River at the north edge of the quadrangle, and in small masses at several other places. The two knobs on Hardscrabble Hill are composed of diabase, probably in the form of pipes or plugs, whereas most of the other occurrences are narrow (hence somewhat exaggerated on the map) and of more or less uncertain structural attitudes but at least a few are sills. That on Knox Butte is considered to be a sill as it is characterized by coarse columnar jointing, lacks vesicles or amygdules, and slopes southeasterly with the underlying beds; it may, however, be a remnant of a thick flow.

Most of these rocks cut upper Eocene beds and hence cannot be older than upper Eocene but as the basalt on Knox Butte, whether flow or sill, overlies fossiliferous Oligocene it must be still younger. Although the possibility must be considered that some of these intrusives may be upper Eocene or Oligocene in age, they are here grouped together and tentatively assigned to Miocene time with the thought that they probably are the subsurface expression of the same vulcanism that produced the lavas of the Salem Hills. Regarded in that way they suggest that similar lavas once extended across part of the Albany quadrangle but have been removed by erosion.

Pleistocene alluvial deposits

Lacomb gravels: High-level gravel remnants on hills between Albany and Jefferson, here called the Lacomb gravels, are shown on the map (in pocket). The type locality is at Lacomb, Linn County, Oregon, about 15 miles to the southeast of the quadrangle where remnants of an ancient gravel fan still cover a considerable area. At the suggestion of the author the name Lacomb was applied to these gravels by Felts in his master's thesis on the Lebanon quadrangle, but this is the first publication of the name. Gravels of the Lacomb stage of alluviation originally must have extended across the intervening distance. At Jefferson Cemetery on a hill just east of the limits of the Albany quadrangle the gravels extend to an elevation of 367 feet above sea level. The western slope of the hill near Jefferson is mapped as gravel also, although the contact with the underlying tuffs may belong farther up the slope. One mile south of Hardscrabble Hill the flattish top of the gravel reaches almost to 400 feet above sea level. Its base on the southeast is somewhat below 300 feet, so the thickness is about 100 feet. The pebbles are andesite, rhyolite, basalt, chert, and other rocks apparently derived principally from the Cascade Mountains. They are weathered deeply at the surface to yellow or reddish-brown clay. On account of this advanced degree of weathering, their occurrence as remnants of deposits that have largely disappeared, and their perched positions in relation to other Pleistocene deposits, these Lacomb gravels are thought to be probably of early Pleistocene age.

Leffler gravels: The term "Leffler terraces" was used by Thayer (16) to designate the gravel terrace remnants perched on the south rim of the North Santiam River valley at Leffler in the Stayton quadrangle, which lies immediately northeast of the Albany quadrangle. There this prominent terrace extends from a point near Kingston southwestward into the Lebanon quadrangle and reappears in the northeast part of the Albany quadrangle. It is here proposed to use the name Leffler for the deposits composing the terrace at the type locality and for similar deposits of equivalent age elsewhere in the Willamette Valley and to refer all such deposits to the Leffler stage of alluviation. The name is derived from a Southern Pacific Railway station at the foot of the type terrace.

In the Albany quadrangle two patches of gravel separated by a later ravine north of Jefferson and the terrace in the vicinity of Millersburg north of Murder Creek are classified as Leffler gravels, but some other old gravels, too obscure to map, situated on the low rounded hills just north of Murder Creek northeast of Albany and on the bench north of Knox Butte, may also belong to the Leffler stage. The larger of these two patches near

Jefferson has a nearly flat top just a little more than 300 feet above sea level and is bounded by a 75-foot erosional scarp on the west. The gravel itself is not well exposed there but in road cuts elsewhere it is seen to be pebble gravel of Cascade origin, deeply weathered at the surface to red, brown, or black clays. A cover of silt of the Willamette stage (see p.12) overlies the terrace and in most places conceals the gravel.

The terrace in the vicinity of Millersburg, more or less hidden by such silt and hence of uncertain boundaries (especially on the east), stands mostly from 230 to 250 feet above sea level, or more than 50 feet lower than that north of Jefferson. Whether this lower level is the result of erosion is not known, but presumably this is true unless some error of correlation is involved. The terrace is too high however to match the slope of the later Linn gravels southeast of Albany, and moreover these Linn gravels underlie the adjacent silt-covered plain bordering this terrace on the west between Conser and Dever. The extent of the Leffler gravels in the plain near Millersburg as shown on the map may be too large.

A small patch of weathered basaltic gravel at Adair Village (at the junction of US Highway 99W and Ryals Lane) is correlated uncertainly with the Leffler stage. It may be older. Similar gravel underlies a silt cover a mile to the northeast.

Another gravel remnant on the hill in the SE$\frac{1}{4}$ SE$\frac{1}{4}$ sec. 20, T. 10 S., R. 4 W., also possibly of Leffler age, contains numerous pebbles of sandstone, presumably derived mainly from a different terrain, such as the Eocene sediments nearby. A shallow railroad cut, traversing the eastern half of sec. 20, exposes several feet of sandrock that also includes small pebbles of sandstone or white quartz. The material is strongly crossbedded, appears to be fluviatile in origin, and is apparently flat-lying. It is overlain by a deposit of silt and hence does not show on the map. It is thought to be of Pleistocene age, notwithstanding its different lithology.

Thayer (16) thought that the "Leffler terraces" might be the down-valley equivalent of similar terraces south and east of Lyons and that both may be composed of valley train material from the Mill City glacier of middle Pleistocene age, although he considered that they might be older. According to Allison (3) this correlation is correct and scarcely questionable. The Leffler gravels are interpreted therefore as glaciofluvial outwash deposits corresponding to the Mill City stage of glaciation, probably of Sherwin or Kansan age. Their antiquity is shown by the great depth of oxidation and destruction of the pebbles, by their perched topographic position, and by the amount of destructive erosion the terraces have undergone.

Linn gravels: The term Linn gravels is here used for the first time to designate the gravels of the stage of alluviation next younger than the Leffler gravels. The type section is a cliff about 30 feet high on the left bank of the North Santiam River in sec. 30, T. 9 S., R. 1 W. They are named for Linn County, in the western part of which they are particularly widespread, as between Albany and Lebanon. The type locality is chosen at the edge of the terrace in the Stayton quadrangle not only on account of the excellent exposure there but also because its relation to the older Leffler gravels in the higher terrace about a mile distant is clearly shown. Its relations to the overlying Willamette silts may be seen at Greens Bridge, about 7 miles to the southwest, or better still, in cliffs along the Willamette River at Irish Bend, Ingram Ferry, or Harrisburg in the extreme southwestern part of Linn County. It is here proposed to use the term Linn gravels throughout the Willamette Valley for all deposits of equivalent age, which for convenience may be called the Linn stage.

In the Albany quadrangle the Linn gravels occupy the greater part of the valley-plain lowland south of Albany, where however they are masked by an overlying sheet of silt and hence do not appear on the map. A northwesterly trending strip about 2 miles wide south of Knox Butte has had a similar cover of silt removed and the gravels on the surface have been somewhat reworked. That belt is mapped as an eroded phase of the Linn gravels. As mentioned above, Linn gravels also underlie the plain between Conser and Dever. As the silt cover does not stand up well, exposures of the underlying Linn gravels along the streams and in road cuts are poor.

The Linn gravels in the Albany quadrangle are mainly pebble gravels with moderate amounts of sand and some clay. Most of the pebbles are 1 to 3 inches in diameter and show a fair degree of rounding. The fanlike shape of the deposit southeast of Albany shows that much of it came from the South Santiam River basin but undoubtedly the Willamette and Calapooya rivers from the south and the North Santiam River from the northeast also made large contributions. On the other hand Soap Creek in the northwest part of the quadrangle did not supply much material to build up its valley.

Gravels of the Linn stage extend an unknown but probably short distance below the level of the present streams and to levels from 10 to 30 feet above the streams; hence, though widespread, they are probably not more than a few tens of feet thick.

The top of the gravel is weathered to brown or black clay and the pebbles farther down are softened on the outside so that they can be scratched readily and rattle only dully when rolled. Some of this alteration took place before the deposition of the overlying silt as indicated by a former soil zone buried by the silt.

The large extent of the Linn gravels still remaining, the relatively moderate degree of their weathering, their low topographic position, and their cover of silt all combine to suggest their assignment to a stage of alluviation somewhat earlier than that of the silt but considerably later than the Leffler gravels. They probably belong to the Tahoe (Sierra Nevada of California) or Detroit (North Santiam River valley) glacial stage of early Wisconsin time.

Willamette silts: The name Willamette silts is here proposed to apply to the parallel-bedded sheets of silt and associated materials that cover the greater part of the Willamette Valley lowland. The type section is exposed on the right bank of the Willamette River at Irish Bend in southwestern Linn County, Oregon, where these silts 9 to 13 feet thick overlie deposits of the Linn stage in a 27-foot scarp caused by the undercutting of the river on the outside of the bend. In the Albany quadrangle the Willamette silts form the surface over most of the lowland area except along the present stream courses and along a strip south of Knox Butte where they have been removed by erosion. They are about 15 feet thick at Albany but the amount decreases at higher elevations and finally runs out at about 400 feet above sea level. In the western part of the quadrangle the upper limit of the silts for mapping purposes was set somewhat arbitrarily at 250 to 300 feet above sea level or approximately at the base of steeper slopes of older deposits. In the southeastern part of the quadrangle the Willamette silt is mapped up to an elevation of 300 feet, but gravel of the Linn stage is not far underground there. In the area between Albany and Jefferson the upper reaches of the Willamette silts were deliberately disregarded in order to show on the map more of the older deposits which the silts cover (and obscure); actually the silts extend as high there as elsewhere.

The Willamette silts are composed of quartz, several different feldspars, and a variety of other common minerals, mostly in angular grains or cleavage fragments. Bedding is usually not easily seen as the bulk of the silt seems to have a limited range of particle sizes, but under proper moisture conditions in the field, beds a few inches thick and faint laminations of lesser size can be detected. Included in the silt or lying on the surface are larger particles ranging from chips a fraction of an inch across to boulders several feet in diameter. These coarse pieces are composed of granite, gneiss, quartzite, slate, schist, and various other rocks otherwise foreign to Willamette Valley. These erratics seem to be especially numerous on the hills northwest of Albany. A two-foot angular block of quartzite found near Wells bore glacial striae and grooves on one side. These foreign stones are thought to have been delivered to the Willamette Valley in late Pleistocene time when the lowland was under water to the level of about 400 feet above sea level and surges of glacial water from the Columbia River brought into the valley icebergs carrying stones from eastern Washington to their present positions (2). The silts also came chiefly from the Columbia River. The body of water from which they were deposited, called Willamette Sound by Condon (7) but actually a freshwater lake, was about 200 feet deep in the northern part of this quadrangle. As shorelines are scarcely or not at all discernible about the margins, the water did not persist long at any particular level.

The Willamette silts are weathered to depths of 3 to 6 feet, mostly to Willamette, Amity, and Dayton soils (5, 11). A claypan from a few inches to a foot or more thick has developed in areas of poor drainage, as where earlier clays on the Linn gravels impede movement of subsurface water.

The Willamette silts are the last of the deposits on the valley plain and though waterlaid are clearly of glacial derivation. They are not greatly weathered. Accordingly they are judged to be of late Pleistocene age and to correspond to the last glacial stage, presumably Wisconsin or Tioga, in eastern Washington. Of the two-fold Wisconsin record along the Columbia River, only the first or main depositional phase is known to be represented in the Albany quadrangle.

Fossil bones and teeth of elephants have been reported from the silt within the Albany quadrangle.

Recent alluvium

Recent deposits occupy the stream trenches excavated below the silt-covered valley plain. They consist principally of gravel and sand, and subordinately of silt and clay along the major streams, and of relatively fine materials along the less competent creeks. They bear a characteristic channel-and-bar surface resulting from seasonal floods, especially along the Willamette River. The Recent bottomland soils are generally rich and well drained but subject to damage by floods.

Structural Geology

The prevailing strike of the Eocene rocks of the quadrangle is northeasterly, between N.30°E. and N.60°E., approximately parallel to the trend of the hills, some of which evidently are strike ridges, but there are many exceptions to this northeasterly strike. The dip on the southeast side of the ridge northeast of Lewisburg is easterly or southeasterly at gentle angles, and on the northwest side, northwesterly at somewhat steeper angles. The principal structure in that ridge therefore seems to be an asymmetrical anticline. The greater expanse of the older phase of the Eocene in the vicinity of Spring Hill indicates a structural high in that area and a few easterly dips suggest that the fold plunges in that direction. Variations in the strike and dip suggest that the crest of the fold is probably undulatory or complex and that the above generalization is somewhat oversimplified.

In a general way, the northeasterly plunging anticline of upper Eocene sediments in the Albany quadrangle combines with a plunging syncline in the Salem and Dallas quadrangles lying to the north and northwest to form a crude, incomplete S-pattern of regional distribution of the outcrops. The local strike of the Eocene beds conforms more or less to such an "S."

The supposed fault boundary between the main mass of the Coffin Butte volcanics and the Eocene sediments on the southeast has already been discussed.

Small irregular faults of haphazard orientation and movement appear in the vicinity of the Coffin Butte lavas. These faults are probably incidental to differential compaction and unequal resistance to later folding of the lavas as compared with the associated tuffs. Faults of small throw seen in other parts of the area likewise appear to be unimportant factors in the general structure. Jointing in the sediments is generally abundant and locally oriented with strike and dip.

The Oligocene beds in Knox Butte dip east-southeasterly at an angle of about 9°, and at the confluence of the forks of the Santiam River about S.30°E. at similarly low angles. The upper Eocene sandstone at The Cliff west of Jefferson, however, trends nearly due east. These readings are all in keeping with the picture of moderately tilted Oligocene beds resting unconformably against more strongly folded Eocene beds. Further interpretation is hardly warranted by the meager data.

Economic Geology

Mineral resources of the Albany quadrangle consist chiefly of stone, sand, gravel, clay, and underground water. No metallic ore deposits and no indications of oil or gas are known within the area. Basalt for crushed stone is available at several places in the northern half of the area but the quality of some of it is only fair on account of associated palagonite and zeolites. Coffin Butte was an important source of rock for road base at Camp Adair. Sandstone was formerly quarried north of Albany. Gravel is widespread in the valley lowland, but the Linn and older gravels are usually not of commercial grade; Recent gravel from the Willamette and Santiam rivers is preferred as it is fresher, harder, and cleaner than the others. Clay derived from weathered Willamette silts is burned at Albany to make common red brick and tile. Underground water (12) is obtainable at most places within the quadrangle from various geologic formations in amounts sufficient for domestic purposes but most of the rocks, except Recent deposits on the valley bottoms, are not sufficiently permeable to yield large supplies. Springs are used locally. Water for Camp Adair was pumped from the Willamette River. A few wells have struck connate salt water trapped in the marine sediments at the time they were deposited in the Eocene sea.

Geologic History

The known geologic history of the Albany quadrangle begins with the deposition of the middle (?) Eocene volcanic rocks in an arm of the sea which then covered the area. Some vent, or series of vents, apparently to the west or southwest of the Albany quadrangle, poured forth into the sea great quantities of basic lava and minor quantities of basic volcanic ash and lapilli that now compose the pillow basalts and associated tuffs and breccias of the Coffin Butte volcanics. Sedimentary beds of Umpqua-Tyee age have not been identified within the area.

Studies elsewhere in western Oregon indicate that considerable orogeny with intense folding and faulting took place shortly after middle Eocene deposits had been laid down (1, p. 33), but evidence of such earth movements is lacking here.

The next record is furnished by the late Eocene sediments which presumably were deposited unconformably upon middle Eocene and older rocks. The source of these quartz-feldspar-mica-bearing volcanic tuffs is not known but likely lay somewhere to the east or southeast. After such volcanic ash had accumulated in the sea to a thickness of at least hundreds of feet, particles of volcanic detritus of coarser size and of more basic composition became increasingly abundant in the sedimentary load. As suggested earlier, this change may have foreshadowed the eruptions that later culminated in the Calapooya volcanic series in the Cottage Grove quadrangle.

After this twofold sequence of upper Eocene sediments had been deposited, they too were folded into the S-shape structure described earlier. The asymmetrical anticline northeast of Lewisburg, the inferred fault along its northwest boundary adjacent to the Coffin Butte volcanics, and a number of less important minor folds were likely formed at that time.

The ensuing interval of erosion lasted until the area was again submerged by the sea in middle Oligocene time, when the Eugene formation was laid down upon the eroded edges of the Eocene sediments. The tuffs in this formation attest further volcanic activity as the principal source of sedimentary material, probably from the present site of the Cascade Mountains. After hundreds of feet or more of this material had been deposited in the middle Oligocene sea, the area became land by uplift or by filling and withdrawal of the sea. Further folding also may have occurred, as the Oligocene beds are tilted easterly. Then erosion of this surface set in and continued until Miocene time when magma arose to fill fissures or to squeeze between beds of sediments and thus form dikes and sills. Probably as in the Salem Hills farther north some of it reached the surface and spread out as flows upon mature topography, only to be removed later by erosion.

The later Tertiary history is practically blank. It is likely that further folding, uplift, and erosion took place. The Coast Range was notably uplifted in Pliocene or early Pleistocene time. Eventually the Willamette River and its tributaries carved out the valley lowland about to its present general form. The smoothly rolling upland surface 300 to 500 feet above sea level suggests that erosion had once advanced to a stage of late maturity or early old age before a rejuvenation of a couple of hundred feet caused development of a new surface at a lower level.

The Pleistocene history is a sequence of alternating stages of alluviation and erosion corresponding to glacial and interglacial stages in the Cascade Mountains. The earliest of these is the Lacomb stage of alluviation represented by high-level Lacomb gravels of which only small areas remain. After they were deposited, erosion deepened the lowland somewhat and removed all of the gravel except these perched remnants. The process of filling was repeated at a lower level in the Leffler stage and again erosion removed the bulk of the gravel fill. In the next succeeding stage the rivers deposited the wide sheet of Linn gravels over most of the lowland and pushed the Willamette River against the hills near Albany. The streams had not succeeded in removing much of the Linn gravels, however, before, in late Pleistocene time, the lowland was submerged in fresh water to an elevation about 400 feet above sea level. The Willamette silt and associated ice-borne erratics from the Columbia River were then spread over the earlier deposits below that level to a thickness locally as much as 15 feet. With the disappearance of this body of water erosion was renewed, thereby excavating the present bottom lands or valley trenches below the valley-plain terraces. Erosion, with minor seasonal deposition, continues to the present.

References

1. Allen, John E. and Baldwin, Ewart M., Geology and coal resources of the Coos Bay quadrangle, Oregon: Oregon Dept. Geology and Min. Industries Bull. 27, 157 p., 1944.

2. Allison, Ira S., Glacial erratics in Willamette Valley: Geol. Soc. Am. Bull., vol. 46, p. 615-632, 1935.

3. Allison, Ira S., Pleistocene alluvial stages in northwestern Oregon: Science, n.s., vol. 83, p. 441-443, May 1936.

4. Baldwin, Ewart M., Geology of the Dallas and Valsetz quadrangles, Oregon: Oregon Dept. Geology and Min. Industries Bull. 35, 61 p., 1947.

5. Carpenter, E. J. and Torgerson, E. F., Soil survey of Benton County, Oregon: U.S. Dept. Agriculture, Bur. Soils Field operations (1920), p. 1431-1474 and map, 1924.

6. Clark, W. B., Correlation papers - Eocene: U.S. Geol. Survey Bull. 83, p. 95-110, 1891.

7. Condon, Thomas, Oregon Geology, 187 p., Portland, Oregon, 1910.

8. Diller, J. S., A geological reconnaissance in northwestern Oregon: U.S. Geol. Survey Ann. Rpt. 17, pt. 1, p. 441-520, 1896.

9. Diller, J. S., Description of the Roseburg quadrangle: U.S. Geol. Survey Geol. Atlas, Roseburg folio 49, 1898.

10. Diller, J. S., Guidebook of the western United States, part D, The Shasta Route and Coast Line: U.S. Geol. Survey Bull. 615, 142 p., 1915.

11. Kocher, A. E. and others, Soil survey of Linn County, Oregon: U.S. Dept. Agriculture, Bur. Soils Bull. 25, 72 p. and map, 1924.

12. Piper, A. M., Ground-water resources of the Willamette Valley, Oregon: U.S. Geol. Survey Water-Supply Paper 890, 194 p., 1942.

13. Schenck, H. G., Stratigraphic relations of western Oregon Oligocene formations: Univ. California Dept. Geol. Sci. Bull., vol. 18, no. 1, p. 1-50, 1928.

14. Smith, Warren D., Petroleum possibilities of western Oregon: Econ. Geol., vol. 19, p. 462, 1924.

15. Snavely, P. D., Jr., and Baldwin, E. M., Siletz River volcanic series, northwestern Oregon: Am. Assoc. Petrol. Geol. Bull., vol. 32, p. 805-812, May 1948.

16. Thayer, Thomas P., Geology of the Salem Hills and the North Santiam River basin: Oregon Dept. Geology and Min. Industries Bull. 15, 40 p., 1939.

17. Turner, F. E., Stratigraphy and mollusca od the Eocene of western Oregon: Geol. Soc. Am. Spec. Paper 10, 130 p., 1938.

18. Warren, W. C. and Norbisrath, Hans, Stratigraphy of upper Nehalem River basin, northwestern Oregon: Am. Assoc. Petrol. Geol. Bull., vol. 30, p. 213-237, Feb. 1946.

19. Washburne, C. W., Reconnaissance of the geology and oil prospects of northwestern Oregon: U.S. Geol. Survey Bull 590, 108 p., 1914.

20. Waters, A. C. and Wells, F. G., Quicksilver deposits of southwestern Oregon: U.S. Geol. Survey Bull. 850, 58 p., 1934.

21. Wells, F. G. and Waters, A. C., Basaltic rocks in the Umpqua formation: Geol. Soc. Am. Bull., vol. 46, p. 961-972, June 1935.

22. White, C. A., The occurrence of Cardita planicosta Lamarck in western Oregon: U.S. Geol. Survey Bull. 18, p. 7-9 and plate I, 1885.

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PUBLICATIONS

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of the
ALBANY QUADRANGLE
Oregon

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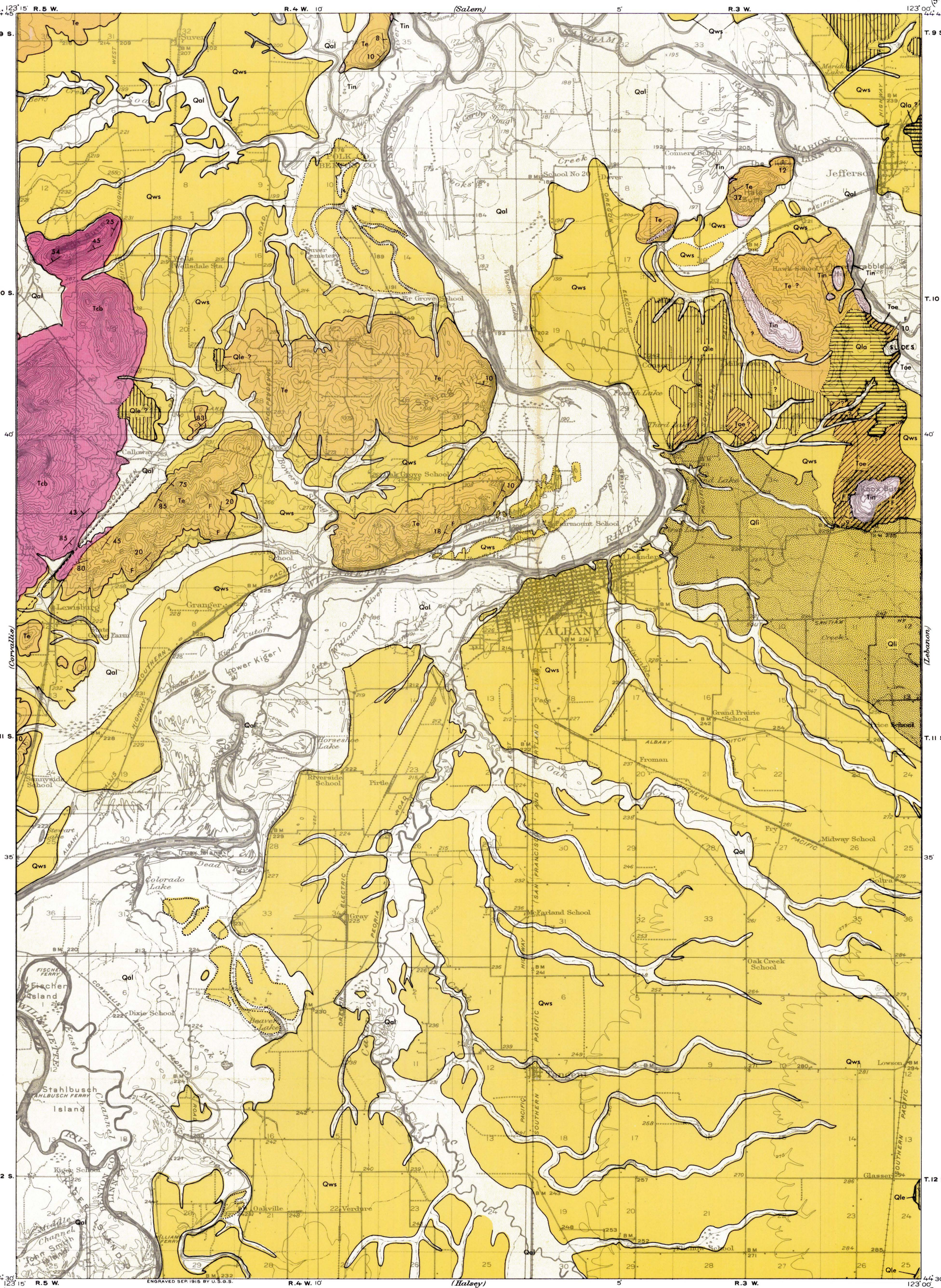

EXPLANATION

QUATERNARY

Qal — Recent alluvium
Gravel, sand, silt, and clay.

Qws — Willamette silt
Silt deposits of "Willamette Sound" lying mostly on Linn gravel; overlapping widely below 300 feet elevation; associated iceberg-rafted erratics extend to about 400 feet; of Wisconsin (Tioga ?) age.

Qli — Linn Gravels
Stratified gravel and sand deposits, widespread but shown only in areas from which later Willamette silt has been eroded; possibly Tahoe in age.

Qle — Leffler gravels
Stratified bench gravels, deeply weathered and partly covered at low elevations by Willamette silt; probably Sherwin or Kansan in age.

Qla — Lacomb gravels
High terrace remnants probably of early Pleistocene age.

UNCONFORMITY

TERTIARY

Tin — Intrusive rocks
Basic dikes, sills, and plugs, probably Miocene in age.

Toe — Oligocene Eugene formation
Tuffaceous sandstone, siltstone, and shale.

Te — Unnamed Eocene
Fossiliferous marine tuffaceous sandstones, shales, and conglomerates; fossils upper Eocene.

Tcb — Coffin Butte volcanics
Basalt flows, basic breccias, tuffs, and tuffaceous shales; pillow structure and zeolites common; probably middle Eocene.

F — Fossil locality

20 — Strike and dip

Inferred Fault

Based upon the Albany
topographic map issued by
The U. S. Geological Survey, 1913.

Geology by
Ira S. Allison

Scale 1/62500

1 ½ 0 1 2 3 4 Miles

TRUE NORTH — MAGNETIC NORTH 22°
APPROXIMATE MEAN DECLINATION 1913.

ALBANY, OREG
N4430—W12300/15

Contour interval 25 feet
Datum is mean sea level

1953