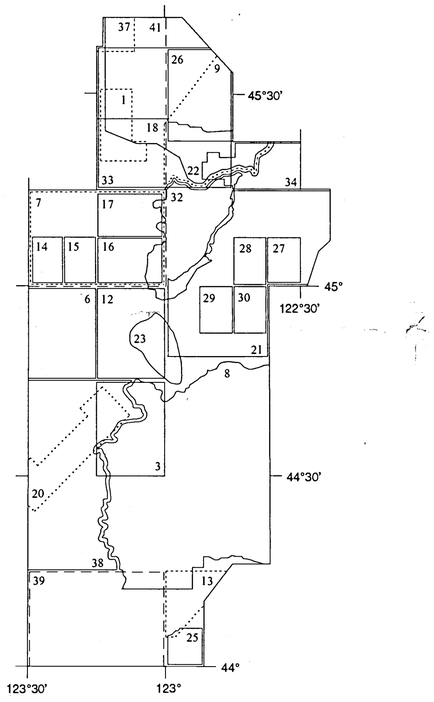
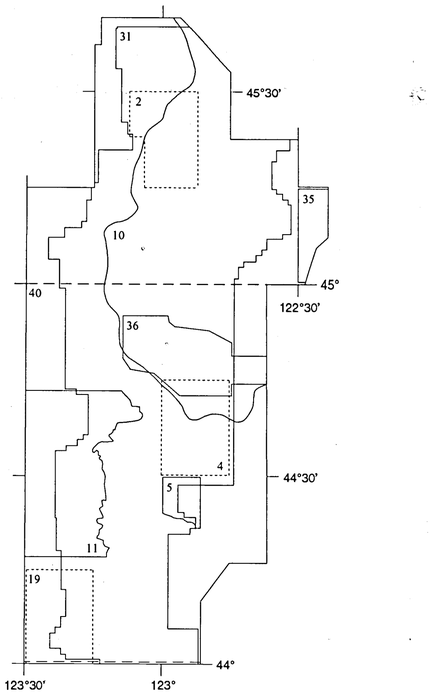


Much data used



Some data used

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DESCRIPTION OF MAP UNITS

Qu — **Undivided nonmarine sediments (Quaternary)**-Unconsolidated gravel, sand, and silt of fluvial and lacustrine origin; includes Linn Gravels and Willamette Silt of Allison (1953), and "Younger deposits" and "Older deposits" of Piper (1942); radiocarbon dates at 36,000 B.P. to present.

Qt — **High terrace gravels (Pleistocene)**-Stratified bench gravel, sand, silt and clay; deeply weathered; includes **Lacomb and Leffler** Gravels of Allison (1953), "Terrace gravels" of Baldwin (1964), "Quaternary upper Terrace" and "Quaternary middle terrace" of Beaulieau (1974), "Terrace deposits" of Piper (1942) and "Higher terrace deposits" of Bela (1979, 1981); "High terrace deposits" of Brownfield (1982a, c), and higher "Terrace alluvium" of Harper (1972); early to middle Pleistocene in age (Allison, 1953).

Qls — **Landslide deposits (Quaternary)**

QPv — **Basalts and basaltic andesites (Pleistocene-Pliocene)**-Olivine basalt and basaltic andesite, and some pyroclastic material of local extent, vents located at Highland Butte; Corresponds to the Boring Lavas; radiometric dates range from 5 Ma to 612±23 Ka (R. Duncan, personal communication to I. Madin, 1990), radiometric date from Oregon City plateau 2.6 Ma (R. Duncan and N. MacLeod, 1985, written communication to F. Swanson); includes basalt, basaltic andesite flows, and basaltic breccia of the Snow Peak volcanics; radiometric dates at 2.8±0.3 Ma and 3.3±0.6 Ma (Verplanck, 1985).

PMf — **Fluvial and lacustrine sediments (Pliocene-Miocene)**-Clay, silt, sand, and gravel. Largely fluvial (A. R. Niem and C. D. Peterson personal communication to I. Madin, 1989), but may contain some lacustrine sediment. Correlates to the Sandy River Mudstone and Troutdale Formation in the Portland area; includes unnamed fluvial sediments on cross sections in the southern Willamette Valley.

PMb — **Basalt (Pliocene-Miocene)**-Basalt of Marks Ridge; radiometric date at 4.5±0.28 Ma (Verplanck, 1985).

Mu — **Undivided volcanic rocks (Miocene)-Sardine Fm.**

Mn — **Tuffaceous nonmarine sediments (Miocene)**-Fine- to coarse-grained tuffaceous siltstone and sandstone, pebble conglomerate, agglomerate, volcanic cobble conglomerate, basaltic andesite flows, and minor interbeds of air-fall tuff (Hampton, 1972; Walker and Duncan, 1989); includes Fern Ridge Tuffs of Thayer (1939), part of Sardine Fm. of Peck et al. (1964).

Mv — **Volcanic rock (Miocene)**- Mudflow breccia, water-laid tuff, and tuff (Hampton, 1972). Corresponds to Rhododendron Formation of Hodge (1933).

Ma — **Andesite (Miocene)**-Capping andesite flows of the Sardine Fm.; also includes basaltic andesite of Washburn and Lone Pine Buttes; K-Ar age at 11.9±0.3 Ma (Verplanck, 1985).

Mb_c — **Columbia River Basalt Group undivided (Miocene)**-Subaerial tholeiitic basalt flows; in places, separated by baked tuffaceous sedimentary rocks; locally deeply weathered to lateritic soil; K-Ar ages range from 14 to 16.5 Ma (Lux, 1982); locally divided into:

Mb_{cw} — **Frenchman Springs Member, Wanapum Basalt**-Thin flows of grey to dark grey, medium-grained, commonly plagioclase-phyric basalt.

Mb_{cg} — **Grande Ronde Basalt**-Flows of dark-gray to black, glassy to mostly aphyric, locally vesicular tholeiitic basalt.

Ms — **Sedimentary rock (Miocene)**-Poorly indurated, friable, fluvial basaltic conglomerate, sandstone, carbonaceous mudstone and coal, interfingered with shallow marine to estuarine mud rock, tuffaceous siltstone and sandstone. Corresponds to the Scappose Formation. Fluvial deposits in the upper portion of the formation are derived from, intercalated with, and invaded by Grande Ronde Basalt flows of the Yakima Basalt. Scappoose unconformably overlies Keasey and Pittsburg Bluff Formations (Van Atta and Kelty, 1985).

MOn_m — **Molalla Formation (Miocene)**-Pumiceous volcanic conglomerate and aquagene tuff with tuffaceous paleosols (Miller and Orr, 1988). Contains early Miocene fossil leaves (Wolfe, personal communication to Peck, 1962); radiometric dates of 15.9±1.0 Ma and 15.0±0.7 Ma determined by Fiebelkorn et al. (1983).

MOs — **Strandline sedimentary rocks (Miocene-Oligocene)**-Marine and nonmarine strata consisting of volcanic conglomerate, arkose, and mudstone, tuffaceous sandstone, burrowed claystone, barnacle limestone, and interbedded coal of nonmarine origin; equivalent to Scotts Mills Formation of Miller and Orr (1986); interfingers with nonmarine sedimentary rocks of Molalla Fm. Dated as upper Oligocene to lower Miocene based on molluscs, barnacles, vertebrate fossils, and echinoderms (Orr and Miller, 1986a, b).

MOu — **Undifferentiated nonmarine sedimentary rocks, basalt flows, and tuff (Miocene-Oligocene)**-Assemblage of basalts and basaltic andesites complexly interstratified with volcaniclastic deposits of basaltic to rhyodacitic composition; includes rhyodacitic to andesitic ash-flow and air-fall tuffs, lapilli tuff and tuff breccia, andesitic to dacitic mudflow deposits, massive to bedded fine- to coarse-grained nonmarine tuffaceous sedimentary rocks, and volcanic conglomerates; included in Little Butte Volcanic Series of Peck et al. (1964); K-Ar ages range from 35 to 22 Ma in the map area with suspect ages older than 35 Ma (Lux, 1982).

MOb — **Basalts and basaltic andesites (Miocene-Oligocene)**-Basalt and basaltic andesite flows and flow breccias; included in Little Butte Volcanic Series of Peck et al. (1964).

MOa — **Porphyritic andesites (Miocene-Oligocene)**-Massive porphyritic andesite; included in Little Butte Volcanic Series of Peck et al. (1964).

MOd — **Dacite and rhyodacite (Miocene-Oligocene)**-Dacite to rhyodacite vent complexes; included in Little Butte Volcanic Series of Peck et al. (1964).

MOt — **Welded to nonwelded ash-flow tuff (Miocene-Oligocene)**-Mostly vitric-crystal and vitric ash-flow tuff (Walker and Duncan, 1982).

OEm — **Marine sedimentary rocks (Oligocene-Eocene)**-Tuffaceous siltstone and sandstone in the south becoming tuffaceous claystone and mudstone to the north; equivalent, in part, to the Eugene, Keasey, and Pittsburg Bluff Formations; also equivalent to Eocene-Oligocene sedimentary rock of Bela (1981); tuffaceous sedimentary rocks of Baldwin et al. (1955), and Illahe Formation of Thayer (1939); foraminiferal assemblages assigned to the Refugian Stage in the south (McKeel, 1985) and the Refugian and upper Narizian Stage in the north (Brownfield and Schlicker, 1981a).

OEb — **Basaltic flows (Oligocene-Eocene)**-Basaltic flows which may be invasive into the undivided Fisher Formation (OEn), and questionable sills which may intrude the undivided Fisher Formation (Walker and Duncan, 1989).

OEn — **Nonmarine sedimentary rock (Oligocene-Eocene)**-Andesitic lapilli tuff and breccia, tuffaceous sandstone and siltstone, and pebble to boulder conglomerate interbedded with flows of andesite, dacite and basalt; equivalent to Fisher Formation of Vokes et al. (1951); interfingers to the northwest with marine strata of the Eugene Formation; fossil leaves indicate late Eocene to Oligocene age (R. Brown in Hoover, 1963); radiometric ages range from 35-40 Ma (Lux, 1982).

Em_s — **Spencer Formation (Eocene)**-Massive to thin-bedded tuffaceous mudstone and siltstone grading eastward to tuffaceous and volcanic rocks, and well sorted, shallow marine, micaceous arkosic sandstone, and siltstone with minor coal; correlative in part to the Nestucca and Cowlitz Formations; foraminiferal fauna assigned to the Narizian Stage (McKeel, 1984,1985); broken into three members on cross-sections:

- Em_{s2}-**(Upper member)**-Tuffaceous mudstone, siltstone, and minor sandstone;
- Em_{s1}-**(Lower member)**-Micaceous arkosic sandstone, siltstone, and minor coal;
- Ev_s-**(Spencer equivalent volcanics)**-Basalt, andesite and tuff; grades into upper member of the Spencer Formation to the west.

Em_n — **Nestucca Formation (Eocene)**-Tuffaceous shale and siltstone and thin-bedded sandstone intercalated with pillow basalt, breccia, and tuff (Baldwin et al., 1955); foraminiferal fauna assigned to upper Narizian Stage (W. Rau, written communication to Wells et al., 1983).

Eb — **Submarine Basalt (Eocene)**-Pillow basalt and submarine basalt breccia and lapilli breccia and intrusive rock (Wells et al., 1983); possibly Tillamook Volcanics or Siletz River Volcanics.

Ev_{wh} — **Basalt of Waverly Heights and associated undifferentiated sediments (Eocene)**-Subaerial basalt and associated sedimentary rock (Beeson, 1989b). Two flows have K-Ar ages of approximately 40 Ma (R. Duncan, personal communication, 1982 to Beeson, 1989).

Em_y — **Yamhill Formation (Eocene)**-Massive to thin-bedded marine siltstone with thin interbeds of arkosic, glauconitic and basaltic sandstone; interfingers with Tillamook Volcanics to the northwest and arc-related(?) volcanics to the southeast; broken into four members on cross sections in the southern Willamette Valley:

- Em_{y1} **(Upper mudstone member)**-Siltstone, mudstone, and minor sandstone; foraminifera indicate deposition at upper to middle bathyal depths (McKeel, 1984, 1985);
- Em_{y2} **("Miller sand" member)**-Tuffaceous to arkosic sandstones and interbedded siltstones becoming more volcanic rich and conglomeratic to the southeast; foraminifera indicate deposition at upper bathyal to inner neritic and nonmarine depths (McKeel, 1984, 1985). Largely restricted to the southern Willamette Valley.
- Em_{y3} **(Lower mudstone member)**-Tuffaceous mudstone and siltstone with minor interbedded sandstone; foraminifera indicate deposition at middle bathyal to outer neritic depths (McKeel, 1985).
- Ev_y **(Yamhill equivalent volcanics)**-Tuff, basalt, dacite and andesite; grades into "Miller Sand" member to the west.

Em_t — **Tyee Formation (Eocene)**-Rythmically interbedded, medium to fine-grained micaceous, feldspathic, lithic or arkosic marine sandstone and micaceous, carbonaceous siltstone of turbidite origin; finer grained distal facies to the north; foraminiferal fauna referred to Ulatisian Stage (Snavely et al., 1969; Molenaar, 1985).

Em_{sr} — **Kings Valley Siltstone Member of the Siletz River Volcanics (Eocene)**-Thin-bedded, tuffaceous, deep marine siltstone and shale; contains thin lenses of basaltic sandstone.

Ev_{sr} — **Siletz River Volcanics (Eocene)**-Submarine pillow lavas, massive flows, tuff breccias and flow breccias of tholeiitic and alkalic basalt and associated sills and dikes, and calcareous sandy tuff; abundant zeolites and calcite veining; upper part of unit contains intercalated tuffaceous shale, siltstone, basaltic sandstone and locally derived basaltic conglomerate; foraminiferal fauna are referred to the Ulatisian and Penutian Stages of Mallory (1959; Snavely et al.,1968; McWilliams, 1980); radiometric ages range from 50.7±3.1 to 58.1±1.5 Ma (Duncan, 1982).

Ti — **Intrusive rocks (Tertiary)**-Sills and dikes of granophyric gabbro and granophyric diorite in the Coast Range south of Sheridan, and aphanitic to coarse grained basalt and diabase in the Coast Range north of Sheridan; basalts, basaltic andesites, and andesites with minor dacite to rhyodacite in the Western Cascades; ages range from Eocene to Miocene in the Coast Range (Wells et al., 1983) and from Oligocene to Pliocene in the Western Cascades (Walker and Duncan, 1989).

GEOLOGIC SYMBOLS

- Inferred geologic contact
- 12 — Strike and dip of bedding
- Fault; dashed where inferred; ball and bar on the downthrown side.
- Thrust fault; sawteeth on upper plate.
- Concealed fault; dashed dots where location is unconstrained; ball and bar on downthrown side.
- Anticline - showing plunge
- Syncline - showing plunge
- Monocline - showing plunge. Abrupt increase of dip in direction of arrows. Dashed where inferred.
- -M- — Aeromagnetic high. Contours enclose areas of high total intensity corresponding in most cases to intrusive bodies mapped or inferred at the surface, or in the shallow subsurface.
- -100 — Structure contour line representing base of Eugene Formation in the southern Willamette Valley (contour interval = 200 m), and top of Columbia River Basalt in the northern Willamette Valley (contour interval = 100 m)
- Location of seismic reflection line
- Soft-sediment subcrop of Eugene-Spencer Formation contact.
- Exploratory petroleum well - labels show the elevation from which depths were measured (usually kelly bushing) over the elevation of the bottom of the well. Formation tops are listed below relative to sea level. All elevations are in meters.
- Water well - Reaches contoured horizon, located to the quarter-quarter section.
- Water well - Constrains altitude of contoured horizon, located to the quarter-quarter section.
- Water well - Reaches contoured horizon, accurately located using Ground Water Report.
- Water well - Constrains altitude of contoured horizon, accurately located using Ground Water Report.
- Radiometric age

PLATE III