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STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
DONALD A. HULL, STATE GEOLOGIST

Geologic Map of the Tenmile Quadrangle, Douglas County, Oregon

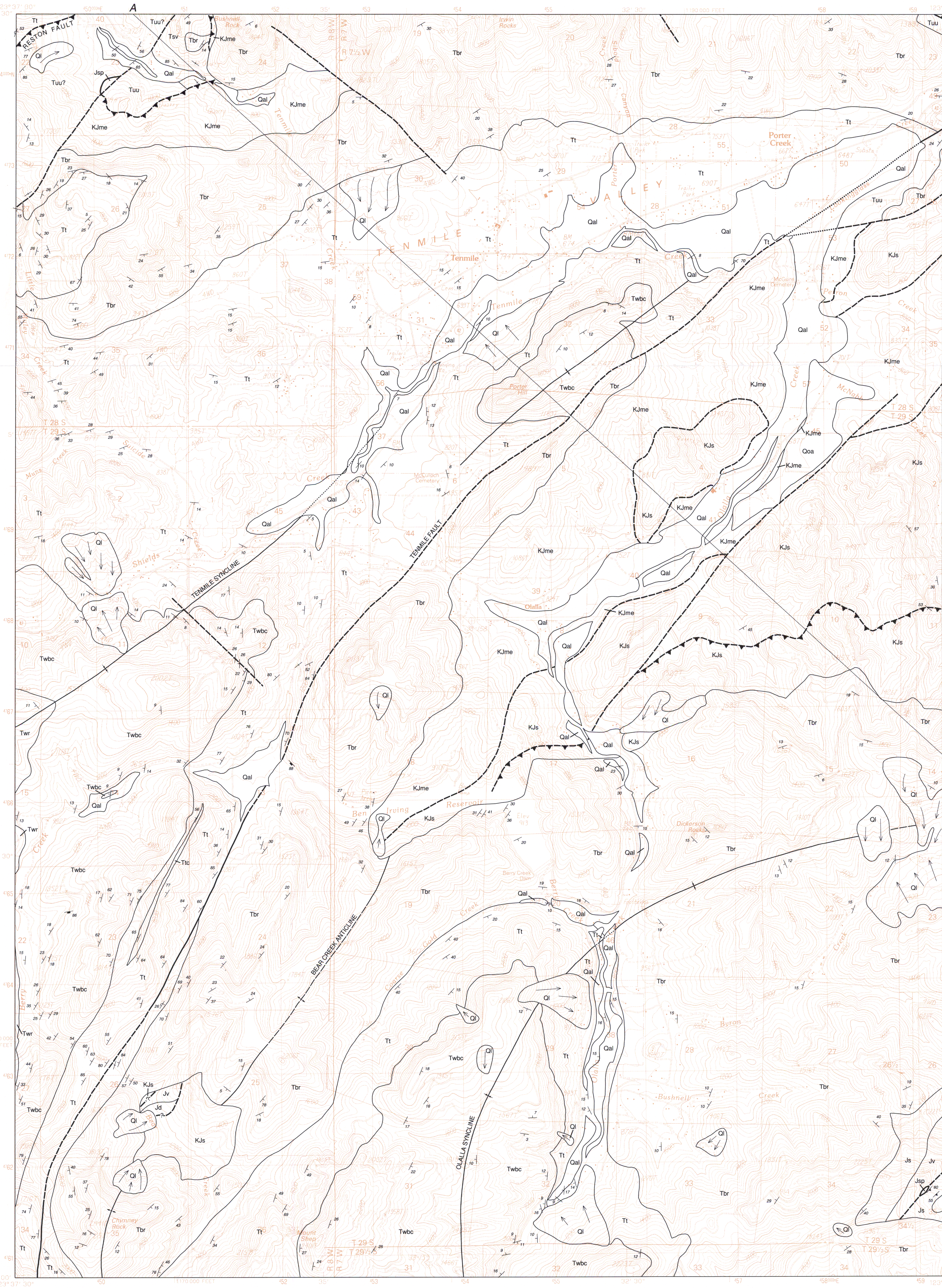
1994

GMS-86

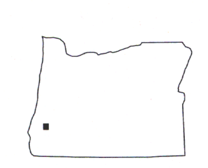
Geologic Map of the Tenmile Quadrangle, Douglas County, Oregon

By T.J. Wiley and G.L. Black

Funded in part by the National Geologic Mapping Program (STATEMAP) administered by the U.S. Geological Survey, Department of the Interior, under assistance award no. 1434-93-A1169.



Base map by U.S. Geological Survey
Control by USGS, NOS/NOAA
Projection: Lambert Conformal Conic
Grid: 1000-meter Universal Transverse Mercator, Zone 10
10,000-foot State Grid Ticks, Oregon, South Zone
1990 magnetic north declination: 18 degrees east
Vertical datum: National Geodetic Vertical Datum of 1929
Horizontal Datum: 1927 North American Datum



SCALE 1:24 000

.5 0 1 2 KILOMETERS

1000 0 7000 FEET

.5 0 1 MILES

CONTOUR INTERVAL 40 FEET

Geology by Thomas J. Wiley and Gerald L. Black,
Oregon Department of Geology and Mineral Industries

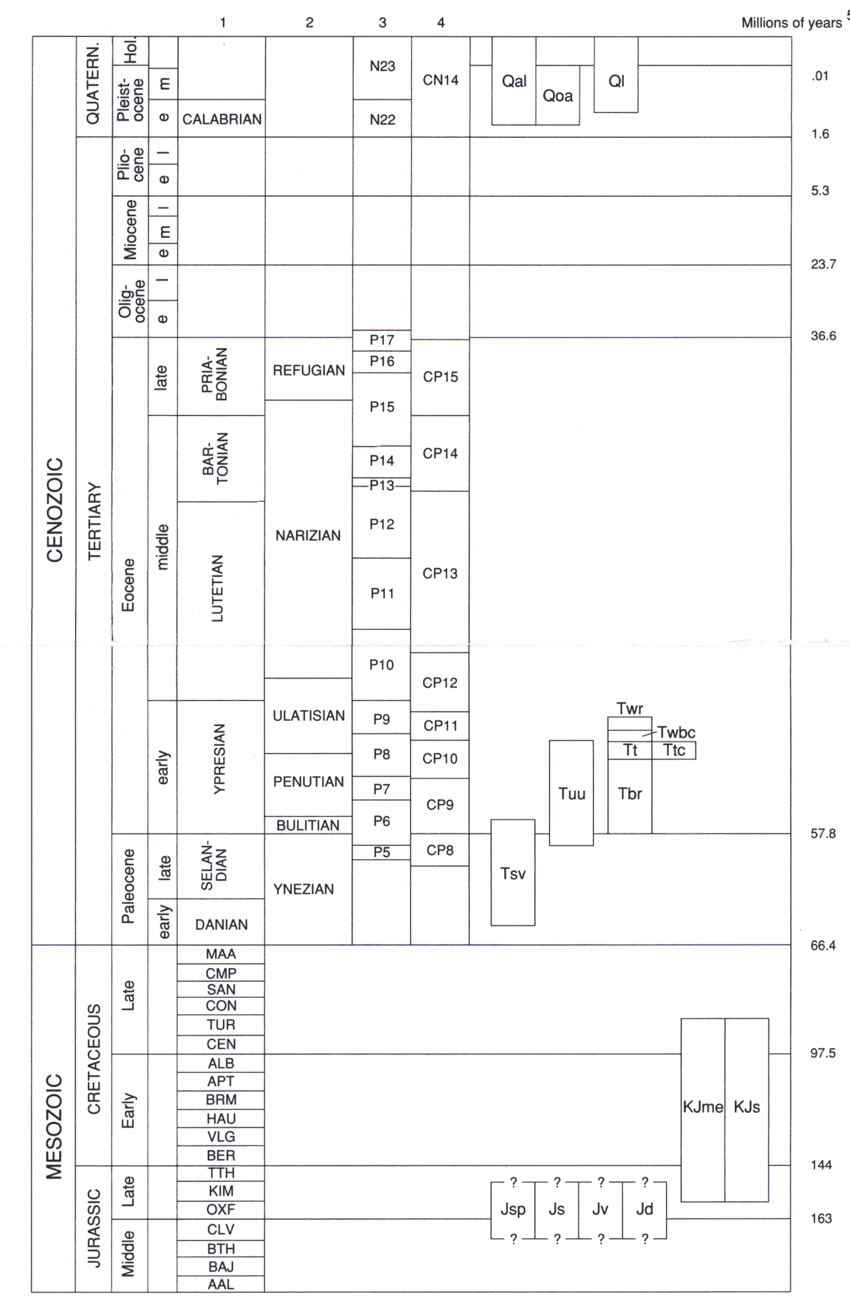
Reviewed by Norman V. Peterson

Field work conducted November 1993 and March 1994

Cartography by Mark E. Neuhaus

The geologic information on this map is available in digital formats.

TIME ROCK CHART



[1] Standard ages
[2] Benthic foraminifer zones from Mallory (1959) and Almgren and others (1988)
[3] Planktonic foraminifer zones from Berggren and others (1985)
[4] Calcareous nannoplankton zones from Berggren and others (1985) and Bukry and Snavely (1988)
[5] Time scale after Palmer (1983)

EXPLANATION OF MAP UNITS

QUATERNARY DEPOSITS

- Qal — Alluvium (Holocene and Pleistocene)
- Qoa — Older Alluvium (Pleistocene)
- Ql — Landslide deposits (Holocene and Pleistocene)

ANGULAR UNCONFORMITY

EOCENE SEDIMENTARY ROCKS

Umpqua Group of Niem and others (1992) is divided into:

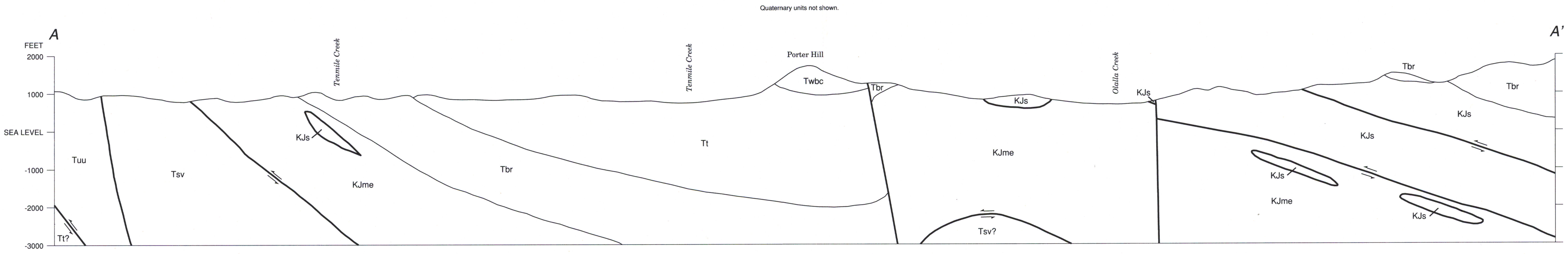
- Tuu — Umpqua Group of Niem and others (1992) undifferentiated (Paleocene? to lower Eocene)
- White Tail Ridge Formation of Niem and others (1992) (lower Eocene; Ulatisian)
- Twr — Remote Member of Niem and others (1992) (lower Eocene)
- Twbc — Berry Creek Member of Niem and others (1992) (lower Eocene)
- Tt — Tenmile Formation of Niem and others (1992) (lower Eocene)
- Ttc — Sandstone and conglomerate (lower Eocene)
- Tbr — Bushnell Rock Formation of Niem and others (1992) (lower Eocene)
- Tsv — Siletz River Volcanics (Paleocene and lower Eocene)
- KJs — Sandstone, siltstone, and mudstone (Jurassic or Cretaceous)
- KJme — Melange (Jurassic or Cretaceous)
- Js — Metasedimentary rock (Jurassic?)
- Jv — Metavolcanic rock (Jurassic?)
- Jd — Diorite (Jurassic?)
- Jsp — Serpentinite (Jurassic?)

MAP SYMBOLS

- Contact
- Fault -- Dashed where inferred; dotted where concealed
- Thrust fault -- Dashed where inferred; teeth on upper plate
- Strike and dip of beds
- Strike of vertical beds
- Syncline -- Dashed where inferred, dotted where concealed
- Anticline -- Dashed where inferred, dotted where concealed
- Direction of landslide movement

GEOLOGIC CROSS SECTION

Quaternary units not shown.



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EXPLANATION OF MAP UNITS

QUATERNARY DEPOSITS

Qal **Alluvium (Holocene and Pleistocene)** — Unconsolidated clay, silt, sand, and gravel deposited in channels and on the flood plains of modern streams. Includes adjacent alluvial fans. Locally divided to show:

Qoa **Older Alluvium (Pleistocene)** — Unconsolidated gravel, sand, silt, and clay deposited on raised terraces. Includes adjacent alluvial fans

Ql **Landslide deposits (Holocene and Pleistocene)** — Fragments of bedrock mixed with gravel, sand, silt, or clay and displaced downslope by gravity sliding. Includes slumps, earth flows, block glides, debris flows, and rock falls. Arrows indicate direction of movement

ANGULAR UNCONFORMITY

EOCENE SEDIMENTARY ROCKS

Umpqua Group of Niem and others (1992) (Paleocene? to lower Eocene) — Divided into:

Tuu **Umpqua Group of Niem and others (1992) undifferentiated (Paleocene? to lower Eocene)** — Sandstone, siltstone, conglomerate, and mudstone. Areas mapped as undifferentiated Umpqua Group are typically small and fault bounded, such that stratigraphic relations are difficult to ascertain; they represent lower, older parts of the group, probably no younger than the Tenmile Formation. In the Tenmile quadrangle, named formations within the Umpqua Group postdate juxtaposition (accretion?) of Siletz River Volcanics with Mesozoic rocks to the south; however, undifferentiated parts of the unit may be older. Small patches of Umpqua Group strata may be mapped as Siletz River Volcanics

White Tail Ridge Formation of Niem and others (1992) (lower Eocene; Ulatisian) — The White Tail Ridge Formation has a thickness of approximately 365 m (1,200 ft) at the type area a few km north of the quadrangle. Divided into:

Twr **Remote Member of Niem and others (1992) (lower Eocene)** — Sandstone, siltstone, mudstone, conglomerate, and coal. Sandstone is typically medium to very coarse grained; it is often crossbedded with lenticular beds interpreted as channel fills. Depositional environment interpreted as fluvial, probably a high-sinuosity bed-load stream. Exposures are limited to the western edge of the quadrangle. Black and Priest (1993) show a thickness of 210 m (700 ft) in the Camas Valley quadrangle to the west

Twbc **Berry Creek Member of Niem and others (1992) (lower Eocene)** — Typically includes sandstone and pebbly sandstone with minor interbedded siltstone and mudstone or massive siltstone. Beds are typically thick bedded, massive, or amalgamated; sedimentary structures include plane lamination and hummocky cross-beds; locally bioturbated. Total thickness is difficult to measure due to incision of the overlying fluvial facies and the possibility of structural repetition; approximately 420 m (1,400 ft) thick near Berry Creek

Tt **Tenmile Formation of Niem and others (1992) (lower Eocene)** — Sandstone, siltstone, mudstone, and conglomerate. Commonly interbedded sandstone, siltstone, and mudstone beds of Mutti and Ricci Lucchi (1972, 1975) turbidite Facies D or massive mudstone of Facies G. In a few places, these beds thicken and coarsen upward into sandstone-dominated Mutti-Ricci Lucchi Facies B and C sequences, some with interbedded, resedimented fine to medium pebble conglomerate. Sandstone is nonmicaceous, medium-grained to granular, lithic arkosic wacke and arenite. Beds are a few centimeters to 1.5 m (1 in. to 4.9 ft) thick; parallel bedding predominates. Coarser beds may display burrows, most commonly in the plane of bedding. Carbonized plant debris is abundant. The lower contact is gradational with the Bushnell Rock Formation. The upper contact is gradational with sandstone and siltstone of the Berry Creek Member of the White Tail Ridge Formation. Thickness is 910 m (3,000 ft). Locally divided to show:

Ttc **Sandstone and conglomerate (lower Eocene)** — Thick, bedded to massive sandstone, pebbly sandstone, and rare conglomerate. Interpreted as Mutti-Ricci Lucchi (1972, 1975) Facies B and C turbidites and other types of sediment gravity flows

Tbr **Bushnell Rock Formation of Niem and others (1992) (lower Eocene)** — Conglomerate with minor sandstone and siltstone. Conglomerate is thick bedded to massive with clasts ranging from pebbles to cobbles and less commonly boulders; angular to subangular clasts are more common near the base, whereas subrounded to well rounded clasts occur throughout the formation. Lithic sandstone is typically coarse to very coarse grained; it occurs as interbeds in the conglomerate and as a band (10-50 m [30-160 ft] thick) along the contact with the overlying Tenmile Formation. From south to north and from bottom to top the Bushnell Rock Formation represents a transition from nonmarine to marine deposition. These facies relationships seem to be telescoped across the Tenmile fault, which suggests left-lateral or thrust offset across that fault. Niem and others (1992) recognize a progression from alluvial fan or bajada to fan delta to shallow- and deep-water marine facies. Peterson (1957) and Baldwin and Perttu (1989) mapped conglomerate of the Myrtle Group (Upper Jurassic and Lower Cretaceous) in the southeastern corner of the quadrangle. Thickness of the Bushnell Rock Formation is variable; greatest thickness in the Tenmile quadrangle is 900 m (3,000 ft) along the axis of the Olalla syncline in the Dickerson Rocks area

Tsv **Siletz River Volcanics (Paleocene and lower Eocene)** — Pillow basalt and associated sedimentary rocks including sandstone, conglomerate, and mudstone; may include mafic dikes. Similar volcanic rocks in nearby areas have radiometric ages ranging from 59 to 62 Ma, and associated sedimentary interbeds have paleontologic ages ranging from Paleocene to lower Eocene. Carayon (1984) reported a K-Ar age of 69 Ma for a basalt sampled near Bushnell Rock. Thickness is unknown

KJs **Sandstone, siltstone, and mudstone (Jurassic or Cretaceous)** — Sandstone is typically lithic arkosic wacke, however composition is variable; locally has a high percentage of biotite. Bouma sequences suggest deposition as turbidites. Conglomerate and mudstone-clast conglomerate occur locally. Intense folding and fracturing have dismembered the unit, so that it is best described as broken formation or dismembered formation. Metamorphosed to zeolite facies. Includes Thrust sheet of Jurassic or Cretaceous Myrtle Group (Imlay and others, 1959) along the contact with the Bushnell Rock Formation. Peterson (1957) mapped two small areas of biotite-bearing sandstone that lie in or adjacent to the melange as a separate unit that he interpreted as deposited on the melange during latest Cretaceous or earliest Tertiary time

KJme **Melange (Jurassic or Cretaceous)** — Blocks of various lithologies including graywacke, chert, serpentinite, greenstone, limestone, and blueschist in a matrix of sheared mudstone. Locally, unit contains small unmapped blocks of biotite-bearing lithic arkosic sandstone with compositions like that of the sandstone in unit **KJs**. East of the quadrangle, a similar melange contains limestone lentils (Diller, 1898) with Cretaceous (Aptian to upper Cenomanian) fossils

Js **Metasedimentary rock (Jurassic?)** — Metamorphosed argillite and sandstone with subordinate amounts of metavolcanic rock and serpentinite

Jv **Metavolcanic rock (Jurassic?)** — Metamorphosed andesite and andesitic to dacitic tuff with subordinate amounts of sandstone, argillite, and siltstone

Jd **Diorite (Jurassic?)** — Diorite and diabase (dikes?) associated with unit Jv

Jsp **Serpentinite (Jurassic?)** — Small pods of serpentinite located along faults

INTRODUCTION

The Tenmile quadrangle is underlain by stratigraphically and structurally complex geology including rocks ranging in age from Jurassic to early Tertiary (early Eocene). The geology can be conveniently divided into six major units that are, from oldest to youngest, (1) Jurassic metasedimentary and metavolcanic rock, (2) Jurassic and Cretaceous melange, (3) broken formation, (4) Siletz River Volcanics, (5) Umpqua Group sedimentary rocks, and (6) surficial deposits. Mesozoic melange, broken formation, and the older mixed metavolcanic and metasedimentary assemblage are interpreted as separated in the subsurface by two low-angle faults. A third low-angle fault, possibly the western extension of the Wildlife Safari fault, is exposed near Bushnell Rock, where it separates basement of Tertiary age (Siletz River Volcanics) from Mesozoic rocks. Bushnell Rock conglomerate laps across this fault at Bushnell Rock but is involved in the faulting in quadrangles to the east (Ray Wells, U.S. Geological Survey, personal communication, 1994). Umpqua Group strata are deformed by steeply dipping reverse or oblique faults including the Reston fault and the Tenmile fault. The Bushnell Rock Formation and the lower part of the Tenmile Formation form a nonmarine to deep marine transgressive sequence. This is overlain by a deep marine to nonmarine regressive sequence that includes the upper part of the Tenmile Formation and the Berry Creek (shallow marine) and Remote (nonmarine) Members of the White Tail Ridge Formation.

STRATIGRAPHIC AND STRUCTURAL NOMENCLATURE

Stratigraphic terms used in this report are those of Niem and others (1992) unless otherwise noted. The reader is also referred to Diller (1898, 1907), Peterson (1957), Harms (1957), Wells and Peck (1961), Baldwin (1974), Molenaar (1985), Baldwin and Perttu (1989), Black (1990), Black and Priest (1993), and Wiley and others (1994).

Two sets of names were applied to the major geologic structures in the Tenmile quadrangle during June of 1957 (Harms, 1957; Peterson, 1957). Several of these names have been revised by subsequent authors, largely on the basis of interpreted continuity with named structures outside the quadrangle. Where more than one name has been used, this map uses the names suggested by Peterson (1957).

STRUCTURAL GEOLOGY

In the Tenmile quadrangle, the oldest rocks make up four distinct packages that are separated by low-angle faults. In general, these packages seem to be progressively older and structurally higher toward the south. From north to south these packages include Paleocene to Eocene Siletz River Volcanics, melange containing Upper Cretaceous and older blocks, broken or dismembered formation, and Jurassic metavolcanic and metasedimentary rock. Umpqua Group sedimentary rocks overlap all four basement packages, although the lower parts of the group seem to be involved in the fault that separates Siletz River Volcanics from melange (Ray Wells, USGS, personal communication, 1994). Umpqua Group strata are generally more deformed than the slightly younger (lower Eocene) Tyee Formation that is present to the west.

Deformation is greatest along faults such as the Reston and Tenmile faults, where Bushnell Rock and Tenmile Formation strata may be folded or overturned in a sense that suggests north vergence along these faults. Evidence for an early Eocene bathymetric high, the Reston high, located just northwest of the quadrangle is discussed by Niem and others (1992) and Wiley and others (1994). The Reston high influenced sediment dispersal patterns during deposition of White Tail Ridge Formation and perhaps earlier. The Reston fault has been mapped as a splay of the Bonanza fault system. The Reston fault, Tenmile fault, and other northeast- to east-trending faults in the area accommodated early Eocene deformation and produced a north- to northwest-verging (current coordinates) fold and thrust belt.

Although structural trends developed in the Umpqua Group are generally not present in the overlying Eocene Tyee Formation, broad east-trending folds do involve the youngest Tyee strata in the Mount Gurney quadrangle to the northwest (Wiley and others, 1994). This deformation seems to be younger than the bulk of Umpqua deformation. We speculate that it may have accompanied the late Eocene (ca. 42-44 Ma) plate-tectonic reorganization recorded by the bend in the Hawaii-Emperor seamount chain and by the onset of arc volcanism in the western Cascades. Miocene uplift of the Oregon Coast Range deformed Tyee strata into a series of open folds and normal and reverse faults. This north- to northeast-trending folding has affected the entire stratigraphic section.

Prominent folds developed in Eocene rocks have trends ranging from north to east. One arcuate fold, the Olalla syncline, trends north along the southern edge of the map and bends eastward to trend east along the eastern edge of the map. The Tenmile syncline (Harms, 1957) has been shown as one of two en-echelon synclines separated by a small anticline, an alternative interpretation could show a single syncline in the vicinity of McCulloch Cemetery.

The Tenmile fault, a name used by both Peterson (1957) and Harms (1957), has been called the southwestern extension of the Wildlife Safari fault (Baldwin and Perttu, 1989; Niem and others, 1990). However, the Wildlife Safari fault, where it crops out in the Roseburg West quadrangle, is a low-angle thrust that separates Siletz River Volcanics from Mesozoic basement, whereas the Tenmile fault in the Tenmile quadrangle is a nearly vertical fault, with Mesozoic rocks present on both sides. Another fault that might represent the western extension of the Wildlife Safari fault is the unnamed thrust that separates Siletz River Volcanics from Mesozoic melange in the northwestern corner of the map.

GEOLOGIC HISTORY

Mesozoic Rocks

Mesozoic rocks are divided into three main assemblages: (1) melange containing blocks of various well-indurated lithologies (including blueschist) in a matrix of sheared mudstone; (2) sandstone, siltstone, and mudstone in locally coherent sequences, interpreted as broken and disrupted formation; and (3) mixed argillite, andesite, tuff, diorite, and minor serpentinite, interpreted as an ophiolite or volcanic-arc sequence. These three assemblages are interpreted to be separated by low-angle faults, although such faults are not well exposed in the field.

Siletz River Volcanics

Siletz River Volcanics (Paleocene to Eocene; Snavely and Baldwin, 1948; Snavely and others, 1968) and Mesozoic rocks in the Tenmile quadrangle are separated by a thrust fault in the Bushnell Rock area.

Potassium-argon ages from five basalt samples in the southern Coast Range vary from 59.2 to 62.1 Ma (Duncan, 1982). These Paleocene dates were measured on basalt not interbedded with sedimentary rock. Turbidites interbedded with basalt yield early Eocene foraminifer ages (Thoms, 1965; Miles, 1977, 1981).

The question of origin of the southern Coast Range basalts has been controversial. They are essentially oceanic in character, though locally they grade upward into subaerial basalt (Snavely and others, 1968). Interbedded sedimentary rocks including conglomerate indicate that the lavas were erupted close to the continental margin (Wells and others, 1984). Several workers have interpreted the basalt as seamounts formed on oceanic crust and subsequently accreted to the continental margin (Snavely and MacLeod, 1974; Dickinson, 1976: Simpson and Cox, 1977; Duncan, 1982). Simpson and Cox (1977) and Duncan (1982) both proposed models in which the basalt was erupted on an oceanic spreading ridge as it moved over the Yellowstone Hotspot. An alternative origin proposed by Wells and others (1984) suggested that the basalt was erupted in a marginal basin during oblique continental-margin rifting, similar to the modern Gulf of California. Work by Pyle and others (1991), however, indicates that the trace-element geochemistry of the Siletz River Volcanics is not compatible with either a spreading ridge or a marginal-basin setting. They suggest that the Yellowstone Hotspot was close by during Paleocene to early Eocene time and that it directly influenced the formation of the Siletz River Volcanics. Thus it seems most likely that the basalt is the result of nearshore volcanic activity influenced by the Yellowstone Hotspot.

Umpqua Group sedimentary rocks and early Eocene deformation

Overlying the Siletz River Volcanics and Mesozoic rocks is a sequence of marine and nonmarine sedimentary rocks assigned to the Umpqua Group. Undifferentiated Umpqua group strata are represented by Mutti-Ricci Lucchi Facies B, C, and D turbidites in the northwest corner of the map. In many areas, a thick conglomerate (Bushnell Rock Formation of Niem and others, 1992) forms the base of the Umpqua Group. At Bushnell Rock, this conglomerate laps across the fault contact between Siletz River Volcanics and Mesozoic melange, providing a minimum age for accretion in models where the volcanic pile originates offshore. Farther east, pre-Tertiary rocks are thrust over the Bushnell Rock Formation, suggesting that deposition is syntectonic (Ray Wells, USGS, personal communication, 1994).

The Tenmile Formation has been interpreted as both lower slope deposits (Heller and Ryberg, 1983; Ryberg, 1984) and upper slope deposits (Molenaar, 1985). The presence of pebbly sandstone and fine pebble conglomerate sequences in this area suggests that some of these rocks represent a somewhat higher energy environment than is typical, perhaps a slope channel.

Strata of the Tenmile Formation and the overlying White Tail Ridge Formation record a transition from outer slope to shelf, nearshore, and subaerial environments. Deformation of the Tenmile Formation seems, therefore, to be coeval with the fall in sea level, suggesting that tectonic uplift drove the regression.

Falling sea level is recorded by the transition from shallow-marine facies of the Berry Creek Member of the White Tail Ridge Formation to fluvial facies of the Remote Member.

Tectonic rotation

The Siletz River Volcanics in the southern Coast Range have been rotated as much as 80° in a clockwise sense since their accretion to the continent, according to Wells and Heller (1988). The same authors note that the overlying Umpqua Group and Tyee Formation have been rotated nearly as much. They suggest that dextral shear associated with oblique subduction along the Oregon continental margin since the middle Eocene (mostly post-middle Miocene) may be responsible for approximately half of the total rotation. The remainder may be due to Basin and Range extension and small-block rotation that began in the late Miocene (Wells and Heller, 1988) and continues through present times.

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