UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAP OF THE CLEAR LAKE SE QUADRANGLE, SKAGIT COUNTY, WASHINGTON

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INTRODUCTION

The U.S. Geological Survey is engaged in a program of regional geologic mapping at a scale of 1:100,000. In order to delineate map units and geologic structures adequately in areas of unusual geologic complexity, mapping is sometimes done at larger scales. This map is one of those larger scale maps, prepared as an intermediate step in compiling the geology of the Port Townsend quadrangle at a scale of 1:100,000 (see index map).

The use of the orthophoto base for this map is a compromise resulting from the need for a suitable large scale and the lack of base maps of adequate accuracy. The original plan for intermediate mapping in the northeastern part of the Port Townsend quadrangle area included using the Clear Lake 15-minute topographic quadrangle (scale 1:62,500) as a base. That map, derived from a 1941 plane-table survey, is not sufficiently accurate for the mapping objectives. We mapped on aerial photographs (photography in 1976; scale approximately 1:24,000) and compiled on the Clear Lake SE orthophotoquad, the southeast one-fourth of the Clear Lake 15-minute topographic map. We supplemented our field mapping on the 1976 photographs with aerial photographs taken in 1941 (scale approximately 1:40,000); interpretation of these photographs aided us in mapping geologic structures and deposits now obscured by dense vegetation. This map is the third geologic map produced at a 1:24,000 scale from Clear Lake orthophotoquad maps (see Whetten, Dethier, and Carroll, 1979; 1980).

In addition to the geologic map on an orthophoto base, three other maps are included in this report: (a) an index map, (b) a geologic map showing only geologic units and structures, and (c) a copy of the southeast quarter of the Clear Lake 15-minute topographic map showing generalized bedrock units and structures, for the convenience of the reader in locating map features that are not apparent on the orthophoto base.

ACKNOWLEDGMENTS

Sally Safioles assisted in the field and Kathy Lombardo drafted the map.

REFERENCES

Bechtel, Inc., 1979, Report of geologic investigations in 1978-79: Report for Puget Sound Power and Light Co., v. 3, Appendix F.

Brown, E. H., Bradshaw, J. Y., and Mustoe, G. E., 1979, Plagiogranite and keratophyre in ophiolite on Fidalgo Island, Washington: Geological Society of America Bulletin, Part I, v. 90, p. 493-507.

Danner, W. R., 1957, A stratigraphic reconnaissance in the northwestern Cascade Mountains and San Juan Islands of Washington State: Seattle, University of Washington, Ph.D. thesis, 562 p.

_____1966, Limestone resources of western Washington: Washington Division of Mines and Geology Bulletin 52, 474 p.

Lovseth, T. P., 1974, The Devils Mountain fault zone, northwestern Washington: Seattle, University of Washington, M.S. thesis, 29 p.

Marcus, K. L., 1980, An Eocene-Oligocene age basin in the northern Puget Sound of Washington: Geological Society of America Abstract with Programs, v. 12, p. 117.

Vance, J. A., 1977, The stratigraphy and structure of Orcas Island, San Juan Islands, in Brown, E. H., and Ellis, R. C., eds., Geological excursions in the Pacific Northwest: Bellingham, Western Washington University, p. 170-203.

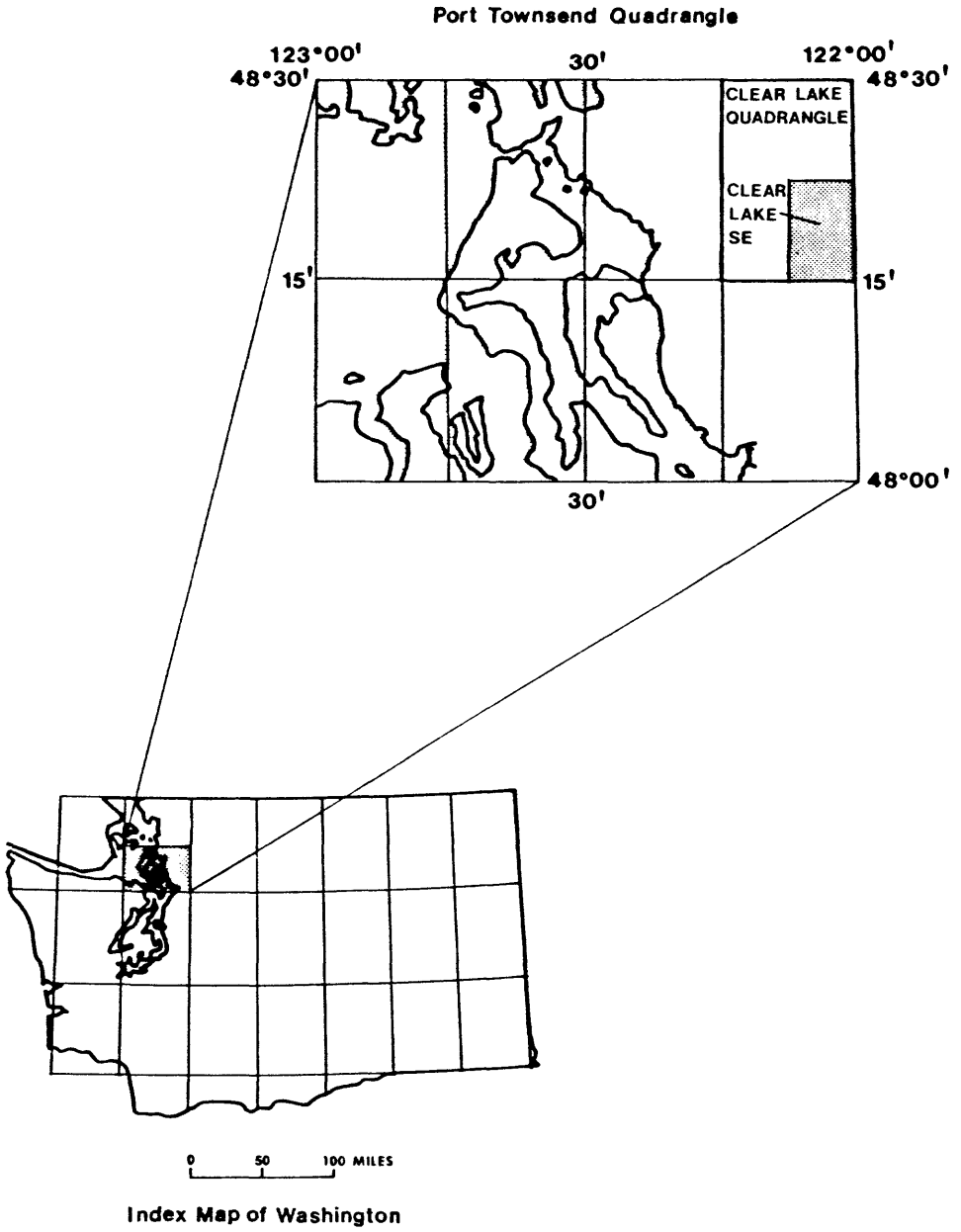
Whetten, J. T., 1978, The Devils Mountain fault: A major Tertiary structure in northwest Washington: Geological Society of America Abstracts with Programs, v. 10, p. 153.

Whetten, J. T., Dethier, D. P., and Carroll, P. R., 1979, Preliminary geologic map of the Clear Lake NE quadrangle, Skagit County, Washington: U.S. Geological Survey Open-File Report 79-1468, scale 1:24,000.

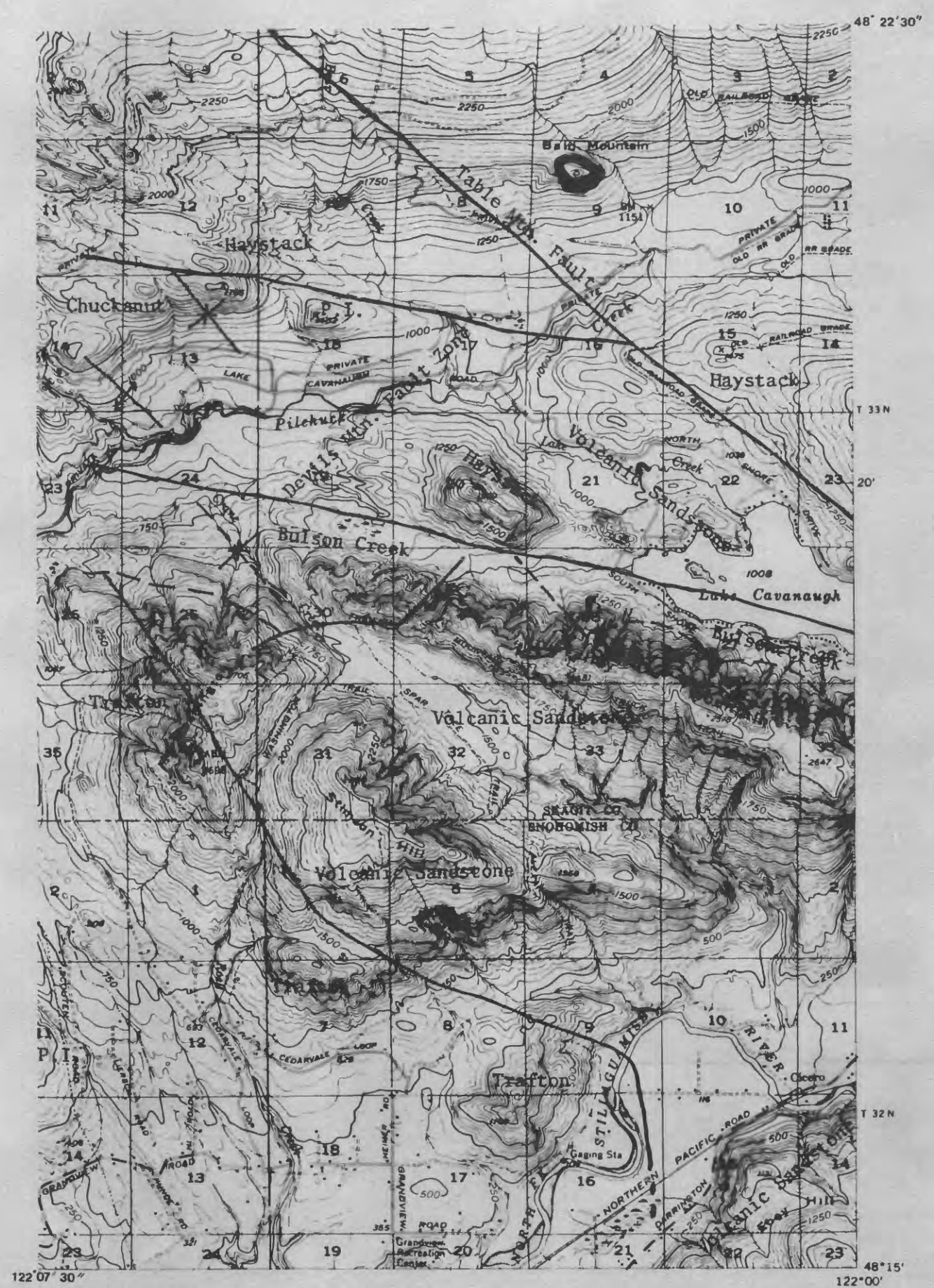
Whetten, J. T., Dethier, D. P., and Carroll, P. R., 1980, Preliminary geologic map of the Clear Lake NW quadrangle, Skagit County, Washington: U.S. Geological Survey Open-File Report 80-247, scale 1:24,000.

Whetten, J. T., Jones, D. L., Cowan, D. S., and Zartman, R. E., 1978, Ages of Mesozoic terranes in the San Juan Islands, Washington, in Howell, D. G., and McDougall, K. A., eds., Mesozoic paleogeography of the Western United States: Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 117-132.

Whetten, J. T., Zartman, R. E., Blakely, R. J., and Jones, D. L., Allochthonous Jurassic ophiolite in northwest Washington: Geological Society of America Bulletin, in press.

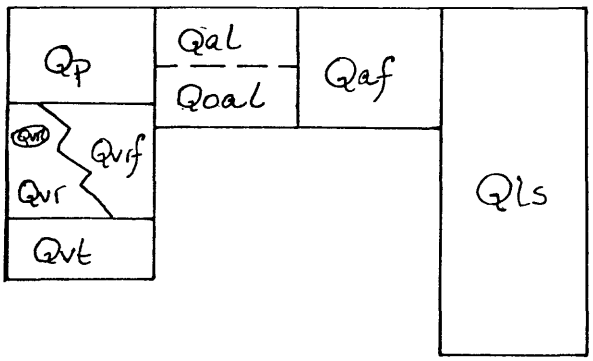


Index map showing locations of Port Townsend (1:100,000), Clear Lake (1:62,500) and Clear Lake Orthophoto (1:24,000) quadrangles.



Southeast quarter of the Clear Lake 15 minute topographic quadrangle (1:62,500) showing geographic names, faults, folds, contacts, and principal bedrock units. (Bulson Creek = Bulson Creek unit, Chuckanut = Chuckanut Formation and Tertiary rhyolite, Haystack = Haystack unit, Volcanic Sandstone = Volcanic Sandstone-Greenstone unit, Trafton = Trafton unit, P.I. = Paleozoic Intrusive unit). Bulson Creek depositional contact indicated by dashed line.

CORRELATION OF MAP UNITS

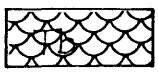


Holocene

Pleistocene

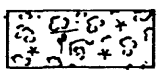
QUATERNARY

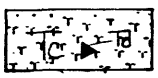
– unconformity –



Oligocene-Eocene

– fault –



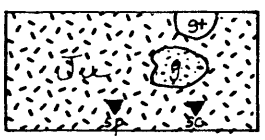


Eocene

TERTIARY

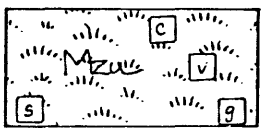
– fault –

probably also unconformity



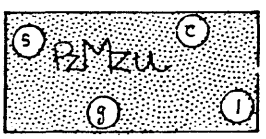
JURASSIC

– fault –



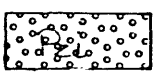
MESOZOIC

– fault –



MESOZOIC-PALEOZOIC

– fault –



PALEOZOIC

DESCRIPTION OF MAP UNITS

Qal — ALLUVIUM - Holocene gravel and sand, and isolated silt deposits occurring along the North Fk. Stillaguamish River, its tributaries and Pilchuck Creek. Sediment is well-sorted and stratified, and clasts are subrounded to rounded. Alluvium mapped along Pilchuck Creek and the Stillaguamish tributaries contains less fine material than the Stillaguamish alluvium. Unit included low terraces 2-6 meters above the modern flood plain.

Qp — PEAT - Fibrous to woody peat and muck deposits. Includes deposits in many shallow ponds and bogs near Lake Cavanaugh, and north and west of Mt. Washington. Tephra from Mount Mazama (∿6900 yrs BP) is present as a layer, 20 to 50 mm thick, in some bogs.

Qaf — ALLUVIAL FAN - Latest Pleistocene and Holocene cobbles, sand, and boulders deposited on the north side of Frailey Mountain and in other areas where upland streams spill out onto valley floors. Deposits consist of poorly to moderately sorted and stratified alluvium, and sediment deposited by debris flows. Clasts are angular to subangular. Overlies recessional deposits.

Qoal — OLDER ALLUVIUM - Latest Pleistocene and Holocene gravel, sand, and silt deposits occurring north of the North Fk. of the Stillaguamish River. Deposits are generally well-sorted and stratified, and clasts are subrounded and rounded. Includes minor (<1%) amounts of material derived from Glacier Peak. Forms terraces 5-15 meters above the present flood plain.

Qls — LANDSLIDE - Pleistocene and Holocene landslide deposits, generally occurring downslope from source-area scars which resemble small glacial cirques. Deposits are compact, poorly sorted, nonstratified, and consist of angular boulders and cobbles in a matrix of finer material. The boundaries of the landslides with other bedrock and surficial units are drawn principally from interpretation of aerial photographs. Most landslides include transported unconsolidated material and blocks of locally derived bedrock. Unit includes isolated areas of bedrock, recessional fan deposits, and undisturbed glacial till too small to be shown at a scale of 1:24,000.

RECESSIONAL DEPOSITS

Qvr — RECESSIONAL OUTWASH - Late Pleistocene sand and gravel containing fine sand and silt in some areas. Deposits are poorly to well-sorted, stratified, and consist of subangular to rounded clasts. Forms terraces as much as 80 m above modern channels near the North Fk. Stillaguamish River. Includes extensive areas of stratified silt and fine sand exposed near Pilchuck Creek.

Qvrf — ALLUVIAL FAN - Extensive alluvial fans are exposed on the slopes of Frailey Mountain and Mt. Washington. Deposits consist of poorly to moderately sorted and stratified alluvium, and sediment deposited by debris flows. Clasts are angular to subangular. Fan deposits overlie and interfinger with recessional outwash on the south side of Frailey Mountain and on the north side of Mt. Washington.

Qvrl — LAHARS - Terraces composed of lahars and alluvium rich in volcanic gravel and sand lie 20-45 m above and one or two km north of the North Fk. Stillaguamish River. The volcanic debris originated on the upper slopes of Glacier Peak and flowed down the North Fk. Stillaguamish River more than 11,700 YBP (J. Beget, U.S. Geological Survey, personal communication, 1979).

Qvt — TILL - Late Pleistocene nonsorted, nonstratified, compact till consisting of angular to subrounded cobbles and boulders in a matrix of sand, silt and clay. Till mantles much of the upland area. The prominent northwest-trending ridges and troughs north of Pilchuck Creek and west of Mt. Washington are formed largely of bedrock which is discontinuously mantled with till; unit includes isolated bedrock outcrops.

Tb — BULSON CREEK UNIT OF LOVSETH (1975) - Conglomerate, lithic sandstone, and siltstone; outcrops are predominately poorly-bedded conglomerate with minor sandstone lenses. Bulson Creek sediment was derived from underlying Mzu and PzMzu units and deposited in fluvial and alluvial fan environments. Lovseth (1975) and Marcus (1980) report Late Eocene to Early Oligocene shallow-water marine fossils in the unit west of the map area. Bulson Creek unconformably overlies Mzu and PzMzu on the north side of Frailey Mountain and is truncated by the Devils Mountain fault.

Tr — RHYOLITE - Ash-flow tuffs and flows, locally brecciated, with minor andesite flows (Lovseth, 1975). Lovseth (1975) obtained a fission-track age of 41.5 ± 3.4 m.y. (Late Eocene) on zircon from rhyolite from the Hendricks quarry south of Big Lake. The unit appears to be interbedded with unit Tc on the northwest edge of the map.

Td — BASALT DIKE - Dark, homogeneous fine-grained rock occurring as thick, well-jointed bodies. K-Ar whole rock ages obtained by Bechtel (1979) are 41.2 ± 1.8 m.y., 49.9 ± 2.2 m.y., and 46.4 ± 2.2 m.y.

Tc — CHUCKANUT FORMATION - Fine - to coarse-grained feldspathic sandstone, siltstone, and coal, massively bedded to finely laminated, with abundant plant debris suggestive of quiet-water to fluvial deposition. Chuckanut-type rocks in map area are Eocene or younger on the basis of Early to Middle Eocene fission-track ages of detrital zircons from sandstone from Coal Mountain (NE of map area) (C. W. Naeser, oral communication, 1979), and Early to Middle Eocene (Bechtel, 1979) dikes that intrude the unit.

Ju — UNDIFFERENTIATED ROCKS OF THE HAYSTACK UNIT - A tectonic mixture without discernable stratigraphic order including greenstone and metaplutonic rock, sedimentary rock, serpentinite, and silica-carbonate rock, and assigned by Lovseth (1975) to the "Rocks of Table Mountain." Nearly concordant Jurassic U-Pb ages (160-170 m.y.) were obtained from two quartz diorite bodies (Whetten, Zartman, Blakely, and Jones, in press). One dated locality occurs within the map area (SW¼ sec. 20, T. 33 N., R. 6 E.); the other locality is in the Clear Lake NE quadrangle. Whetten and others (in press) correlated rocks of Haystack unit with the Fidalgo ophiolite (Brown, Bradshaw and Mustoe, 1979) in the San Juan Islands on the basis of aeromagnetic properties, age, and lithology. Rocks of the Haystack Unit are more strongly metamorphosed in the map area that in the San Juan Islands; aragonite, epidote, and actinolite are present in greenstone, and most sedimentary rocks are moderately to strongly foliated. Rocks of the Haystack unit are in fault contact with Tertiary and pre-Tertiary units along the Devils Mountain fault zone and the Table Mountain fault. Unit Ju designates bedrock areas of the Haystack plate that are a) composed of several lithologies, b) poorly exposed, or c) not examined during the mapping. The Haystack unit is divided into:

g/(g) — GREENSTONE - Generally massive and non-foliated but locally weakly to moderately foliated. Pillow and pillow breccia structures commonly preserved. Unit includes metaplutonic rocks ranging from gabbro to quartz diorite shown on map as (g).

s — METASEDIMENTARY ROCK - Slate, argillite, and metagraywacke, moderately to strongly foliated, with relict bedding locally preserved.

sp — SERPENTINITE - Serpentinite commonly separates blocks of different lithologies. Green to black outcrops vary from strongly foliated to massive.

sc — SILICA - CARBONATE ROCK - Brownish weathering, commonly occurs along faults.

Mzu — UNDIFFERENTIATED ROCKS OF THE VOLCANIC SANDSTONE-GREENSTONE UNIT - A tectonic mixture consisting predominately of medium-grained sandstone and greenstone with minor amounts of fine-grained sandstone, siltstone, argillite, and chert. The unit, assigned by Danner (1957) to the Olo Mountain unit and, in part, by Lovseth (1975) to the "Rocks of Frailey Mountain," lithologically resembles the Upper Jurassic to Lower Cretaceous Constitution unit in the San Juan Islands (Vance, 1977; Whetten and others, 1978) and is considered Mesozoic on the basis of this correlation. The lithologies suggest derivation from a volcanic arc terrane. The lithologies listed below are indicated for each outcrop in order of decreasing abundance of each lithology.

[v] VOLCANIC SANDSTONE - Massive, light bluish-gray medium-grained sandstone, with shale chips and nearly euhedral feldspar phenoclasts commonly visible. Unit is highly fractured and extensively veined with thin veinlets of prehnite, but is generally non-foliated.

[g] GREENSTONE - Ranges from massive, non-foliated flows and pillow lava to thin tuffs interbedded with [v], [s], and [c]. Unit comprises about 40% of the rocks exposed on the Frailey Mountain road. By itself, this unit cannot be distinguished from other greenstone units in the map area.

[s] SILTSTONE, ARGILLITE, FINE-GRAINED SANDSTONE - Brown to black fine-grained sedimentary rocks, commonly associated with [c]; may or may not show incipient foliation.

[c] CHERT - Generally very thin-bedded, black to gray lenticular beds associated with [s]. Thick-bedded red radiolarian chert occurs on the NW side of Mount Washington; similar chert N of Lake Cavanaugh is also assigned to this unit.

PzMzu UNDIFFERENTIATED ROCKS OF THE TRAFTON UNIT OF DANNER (1957, 1966) - A chaotically deformed tectonic mixture of chert, argillite, greenstone, and limestone. Danner (1957, 1966) has identified Permian Tethyan fusulinids in limestone pods, and D. L. Jones (oral commun., 1977-79) has identified radiolaria in chert ranging from mid-Paleozoic to Jurassic. No fossils have been identified from within the map area. The lithologies listed below are indicated for each outcrop in order of decreasing abundance of each lithology:

(c) CHERT - Black to gray ribbon chert commonly associated with (s), intensely crumpled and broken by folding and faulting.

(s) ARGILLITE AND SILTSTONE - Black, non-foliated to incipiently foliated, occurs in association with (c) and (g). Unit includes minor fine-grained sandstone.

(g) GREENSTONE - Predominantly green tuff associated with (c) and (s), but also including pillow lava, and massive flows. By itself, unit is undistinguishable from other greenstone units in map area.

(l) LIMESTONE - Fault-bounded blocks of gray limestone. Some areas have been extensively quarried (Danner, 1966).

Pzi COARSE-GRAINED INTRUSIVE ROCK - Mapped at two localities: the outcrop in the SW corner of the map is pyroxene gabbro; the hill NW of Lake Cavanaugh (sec. 18, T. 33 N., R. 6 E) ranges from weakly foliated hornblende-biotite quartz diorite to fine-grained quartz-amphibole gneiss with plagioclase porphyroblasts. The origin of the more foliated rock is not known. Similar quartz diorite associated with PzMzu outside of map area was dated as mid-Paleozoic (R. E. Zartman, written commun., 1978).

DESCRIPTION OF FAULTS

The northwest-trending fault cutting across the northeast corner of the map is inferred to be the extension of the Table Mountain fault mapped in the Clear Lake NE and NW quadrangles.

The Devils Mountain fault is an east-trending fault zone bounded by two relatively well-defined parallel faults. The pre-Tertiary rocks in the fault zone are a mixture of megablocks and breccias derived from the terranes on either side of the fault zone. Numerous concealed faults are inferred to bound the blocks, but the faults are not shown on the map because there is little to constrain their location or orientation. The Chuckanut Formation occurs as a relatively coherent unit within the fault zone on the west side of the map. It is bounded on the north and south by faults, but the contact on the east could be a fault or an unconformity.

An apparently sinuous contact separates the Trafton unit from the Volcanic-Sandstone-Greenstone unit in the southern part of the map. If the lithologic correlations suggested in this report are correct (see "Description of Map Units") this contact may be one of the east-dipping Cretaceous thrust faults mapped in the San Juan Islands (Whetten and others, 1978) offset to the east by movement on the Devils Mountain fault. Alternatively, the contact could be a high angle fault. The contact is not exposed in the map area.

MAP SYMBOLS

Outcrop visited by us but consisting of non-foliated rock. Symbol occasionally used for other rocks where foliation or bedding could not be measured. Symbol denotes outcrops within large areas mapped as bedrock, and isolated outcrops in areas of Quaternary sediments.

Contact - dotted where concealed

Fault - dashed where inferred, dotted where concealed.

Strike and dip of beds. Bedding tops generally not known.

Strike and dip of foliation.

Vertical foliation.

Inferred axis of anticline, dotted where concealed.

Inferred axis of syncline, dotted where concealed.

Sample locality for U-Pb date on zircon from quartz diorite.