PRELIMINARY GEOLOGIC MAP OF THE

CLEAR LAKE NE QUADRANGLE, SKAGIT COUNTY, WASHINGTON

By

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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 other 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, was not sufficiently accurate for the mapping objectives. Therefore, the mapping was done on aerial photographs (photography in 1974; scale approximately 1:24,000) and compiled on the Clear Lake NE orthophotoquad, the northeast one-fourth of the Clear Lake 15-minute topographic map.

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 northeast 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

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REFERENCES CITED

Brown, E. H., 1977, the Fidalgo ophiolite, in Brown, E. H., and Ellis, R. C., eds., Geological excursions in the Pacific Northwest: Western Washington University, p. 309-320.

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

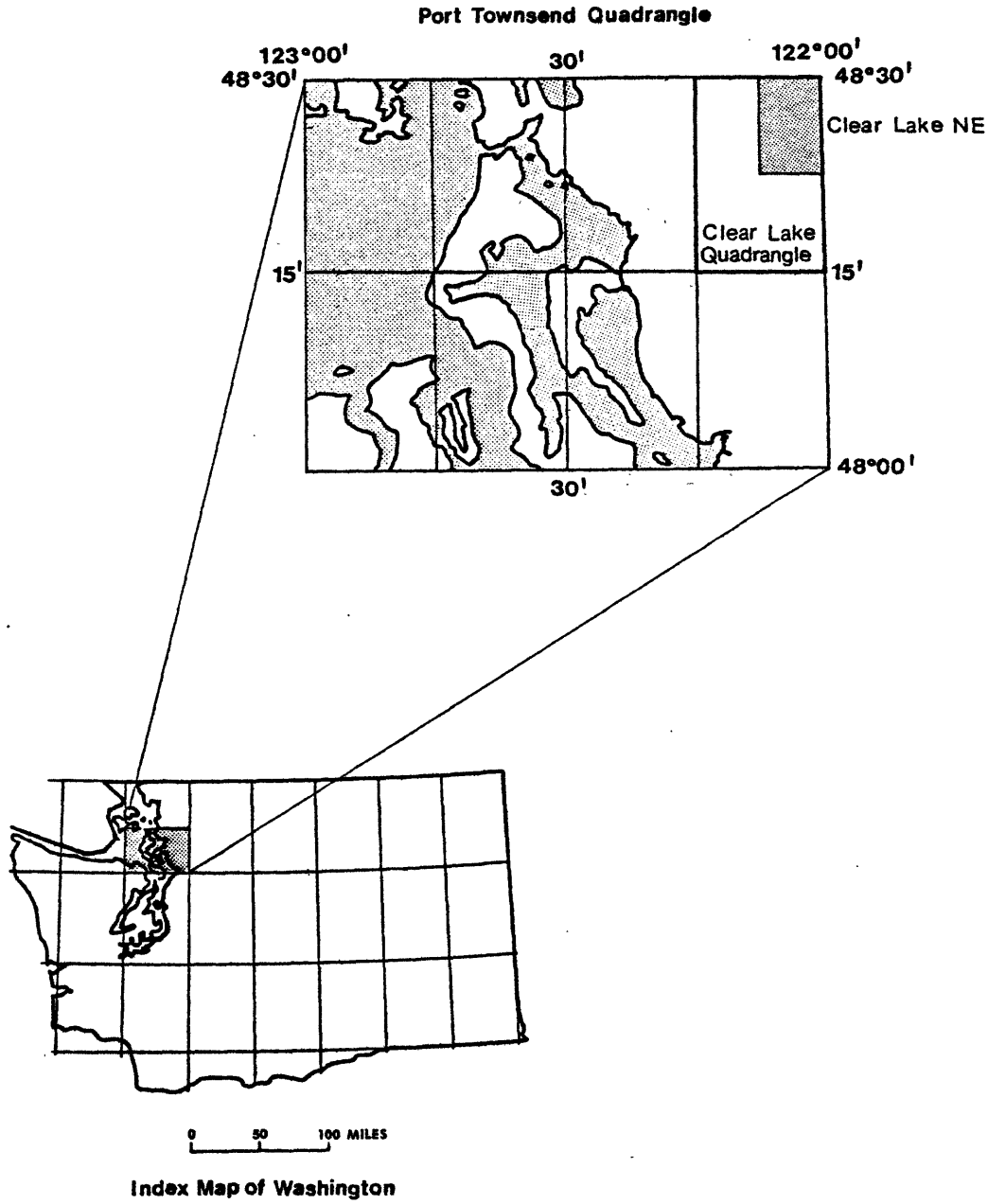
Griggs, P. H., 1970, Palynological interpretation of the type section Chuckanut Formation, Northwestern Washington: Geological Society of America Special Paper 127, p. 169-212.

Heller, P. L., 1979, Map showing surficial geology of parts of the lower Skagit and Baker valleys, North Cascades, Washington: U.S. Geological Survey Open-file Report 79-964, scale 1:62,500.

Loveseth, T. P., 1975, The Devil's Mountain fault zone, northwestern Washington: Seattle, University of Washington M.S. thesis, 29 p.

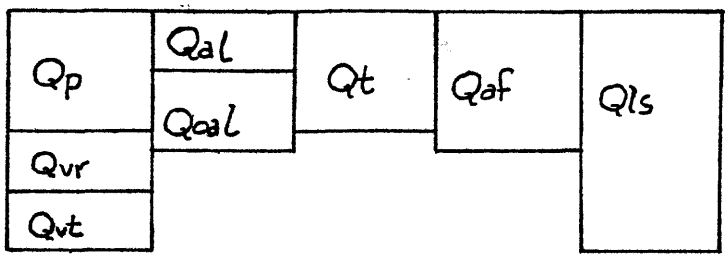
Misch, Peter, 1966, Tectonic evolution of the Northern Cascades of Washington State - A west-Cordilleran case history: Canadian Institute of Mining and Metallurgy, Spec. Vol. 8, p. 101-148.

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 NE Orthophoto (1:24,000) quadrangles.

CORRELATION OF MAP UNITS

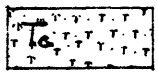


Holocene

Pleistocene

QUATERNARY

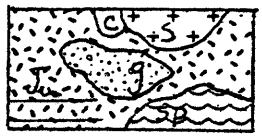
-unconformity-



Eocene

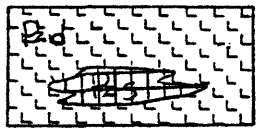
TERTIARY

-fault-



JURASSIC

-fault-



PALEOZOIC

DESCRIPTION OF MAP UNITS

Qal — ALLUVIUM - Late Holocene sand, gravel, and silt generally occurring along the Skagit River and its tributaries. Deposits are well sorted and stratified, and the material is subrounded to rounded. Includes low terraces lying 2-6 meters above the modern flood plain.

Qt — TALUS - Angular boulders and finer material derived as rockfall and small rockslides from bedrock cliffs: generally unvegetated.

Qp — PEAT - Fibrous to woody peat and muck deposits. Includes many shallow ponds and bogs near Table Mountain and in other upland areas. Tephra from Mount Mazama (∿6900 BP) is present as a layer, 20 to 50 mm thick, in some bogs.

Qaf — ALLUVIAL FAN - Latest Pleistocene to Holocene cobbles, sand, and boulders deposited by Gilligan and Loretta Creeks. Deposits consist of poorly to moderately sorted and stratified alluvium and debris flows. Clasts are angular to subangular. Interfingered with recessional outwash, older alluvium, and alluvium.

Qoal — OLDER ALLUVIUM - Latest Pleistocene to middle(?)-Holocene well-sorted and stratified sand and silt with minor gravel, occurring south of the Skagit River. Clasts are subrounded and rounded. Includes several prominent terraces lying as much as 30 meters above the present flood plain.

Qls — LANDSLIDE -Pleistocene and Holocene landslide deposits, generally occurring downslope from source-area scars which resemble cirques. The boundaries of the landslides with other bedrock and surficial units are drawn principally from interpretation of aerial photographs. Deposits are compact, poorly sorted, and stratified and consist of angular boulders and cobbles in a matrix of finer material. Most landslides include transported unconsolidated material and blocks of locally derived bedrock. Unit includes isolated areas of bedrock and undisturbed glacial deposits.

Qvr — RECESSIONAL OUTWASH - Late Pleistocene sand, cobbles, and boulders; includes fine sand and silt. Deposits are poorly to well sorted and stratified and consist of subangular to rounded clasts. Forms terraces lying as much as 60 m above modern channels to the south of the Skagit River and along Day Creek. Heller (1979) reports similar terraces to the north of the Skagit River. Recessional outwash interfingers with alluvial fans near the mountain front.

Qvt — TILL - Late Pleistocene nonsorted, nonstratified, compact till consisting of angular to subrounded gravel and boulders in a matrix of sand and silt. Till mantles much of the upland area, particularly in the southern part of the map area. The prominent west- and northwest-trending ridges and troughs south of Table Mountain are formed largely of bedrock. Trains of large glacial erratics extend east and southeast from many bedrock knobs. The linear topography thus records local ice-flow direction as well as probable structural control by local bedrock.

Tc — CHUCKANUT FORMATION - Fine- to medium-grained sandstone and siltstone, well bedded and locally finely laminated, with abundant plant debris suggestive of quiet-water fluvial deposition. Although age of Chuckanut is believed to be Late Cretaceous and Early Tertiary on the basis of fossil plants (Griggs, 1970), Chuckanut-type rocks in map area are probably Eocene on the basis of Early to Middle Eocene ages of detrital zircon from sandstone in the Coal Mountain area (east of map area) determined by the fission-track method (C. W. Naeser, oral commun., 1979). Unit is folded and an exposure in Loretta Creek (NW-1/4 sec. 35, T. 34 N., R. 6 E.) shows a fault contact with rocks of the Shuksan thrust plate along a high-angle northwest-trending fault.

Ju — UNDIFFERENTIATED ROCKS OF THE HAYSTACK THRUST PLATE - A tectonic mixture without discernable stratigraphic order including the lithologies listed below and assigned by Loveseth (1975) to the "Rocks of Table Mountain." Nearly concordant Jurassic U-Pb ages were obtained from two silicic metaplutonic rocks (Whetten, Zartman, Blakely, and Jones, in press). One dated rock is from Sorenson Creek drainage in northern part of map area (SW-14 sec. 6, T. 34 N., R 6 E); the other is from northeast of Lake Cavanaugh outside the map area. Whetten and others (in press) correlated rocks of Haystack thrust plate with Fidalgo ophiolite (Brown, 1977; Brown, Bradshaw and Mustoe, 1979) in San Juan Islands on basis of aeromagnetic properties, age, and lithology. Rocks of the Haystack plate are more strongly metamorphosed in the map area than in the San Juan Islands; aragonite, epidote, and actinolite are locally present in greenstone, and most sedimentary rocks are slightly to moderately foliated. Rocks of the Haystack plate overlie rocks of the Shuksan unit along the Haystack thrust fault. Time of thrusting is believed to be Late Cretaceous, and the Haystack thrust is probably one of a family of middle Cretaceous thrusts known to occur in western cascade Range (Misch, 1966; Whetten and others, in press). Unit Ju designates

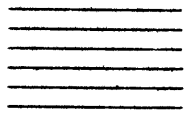
bedrock areas of the Haystack plate that are a) composed of several lithologies, b) poorly exposed, or c) not examined during the mapping.

g — GREENSTONE - Generally massive and nonfoliated but locally weakly to moderately foliated. Pillow and pillow breccia structures commonly preserved. Unit includes scattered metaplutonic rocks ranging from quartz diorite to pyroxenite.

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

c — METACHERT - White to gray, recrystallized, and generally nonfoliated.

Sp — SERPENTINITE - Widespread within Haystack plate. It commonly separates blocks of different lithologies. Locally altered to silica-carbonate rock, particularly near faults. Some serpentinite may have been remobilized and intruded subsequent to thrusting; large body in the Table Mountain-Little Haystack Mountain area occurs along the high-angle fault mapped near Morgan Creek.

 — TRANSITION ZONE - Rocks of the lower part of the Haystack plate on west side of Day Creek drainage are characterized by an increase in degree of foliation, flattening of sand grains, and destruction of primary structures as the underlying Shuksan unit is approached. The metamorphic character and degree of foliation in the Haystack plate, which are generally less well developed than in Shuksan unit, resemble that of the Shuksan near the Haystack thrust. Apparent similarity of Haystack and Shuksan protoliths accentuates this convergence in appearance. All other contacts between Haystack plate and Shuksan unit rocks are interpreted as high-angle faults that post-date thrusting. No transition zone rocks occur near these contacts. On ridge between Campbell and Carry Creeks, Haystack plate rocks show similarities to the Transition zone, but the zone terminates eastward (out of the map area) in rocks of normal Haystack, not Shuksan, type. This suggests a high-angle fault, down-dropping the eastern block.

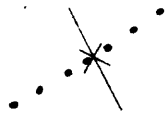
Pzd — ROCKS OF THE SHUKSAN UNIT, PREDOMINANTLY DARRINGTON PHYLLITE OF MISCH (1966) - Metamorphism of rocks of the Shuksan unit is of blueschist facies and has a probable minimum age of Late Permian-Early Triassic (Misch, 1966). The age of the protolith is unknown, but it is presumed to be Paleozoic (Misch, 1966). The phyllite contains metasandstone composed of flattened sand grains

or thin lamellae of quartz and plagioclase, separated by fine graphitic material. The finer grained portions of the phyllite are usually graphitic and typically contain abudant quartz veins that parallel foliation and are commonly folded with axial planes parallel to foliation. At least one isoclinal folding event, with development of a strong axial plane foliation was succeeded by development of a steeply dipping spaced crenulation cleavage. This cleavage is axial planar to a variety of folds, all small-scale, and in places transposes the earlier foliation. As a result of the intersection of the cleavage with the earlier foliation surface, a crenulation lineation is developed on that foliation surface. Later folding and broad kinking seem local and lack an associated cleavage.

Pzs — SHUKSAN GREENSCHIST OF MISCH (1966) - The Shuksan Greenschist is usually a homogeneous, fine-grained, light-green rock, which only locally exhibits a schistosity defined by coarse-grained micas or metamorphic banding and usually occurs as layers parallel to foliation up to several meters thick within the phyllite.

▲ Outcrop of nonfoliated greenstone (g) or serpentinite (sp). Symbol denotes outcrops within mapped greenstone and serpentinite areas, and isolated outcrops in areas of Quaternary sediments.

Contact



Axis of syncline - concealed

High angle fault, dip-slip or strike-slip - dashed where inferred, dotted where concealed

Haystack thrust fault, saw teeth on upper plate - dashed where inferred, dotted where concealed.

Strike and dip of beds

Strike and dip of foliation

Vertical foliation

Bearing and plunge of lineation

Horizontal lineation

Strike and dip of fracture cleavage

Sample locality for U-Pb date on zircon from quartz diorite (160-170 m.y.); Whetten and others, (in press).