UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAP OF THE CLEAR LAKE NW 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 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 NW orthophotoquad, the northwest one-fourth of the Clear Lake 15-minute topographic map. The map joins the northeast one-fourth of the Clear Lake 15-minute map, which was the first geologic map in the area to be produced at a 1:24,000 scale (Whetten, Dethier, and Carroll, 1979).

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.

ACKNOWLEDGEMENTS

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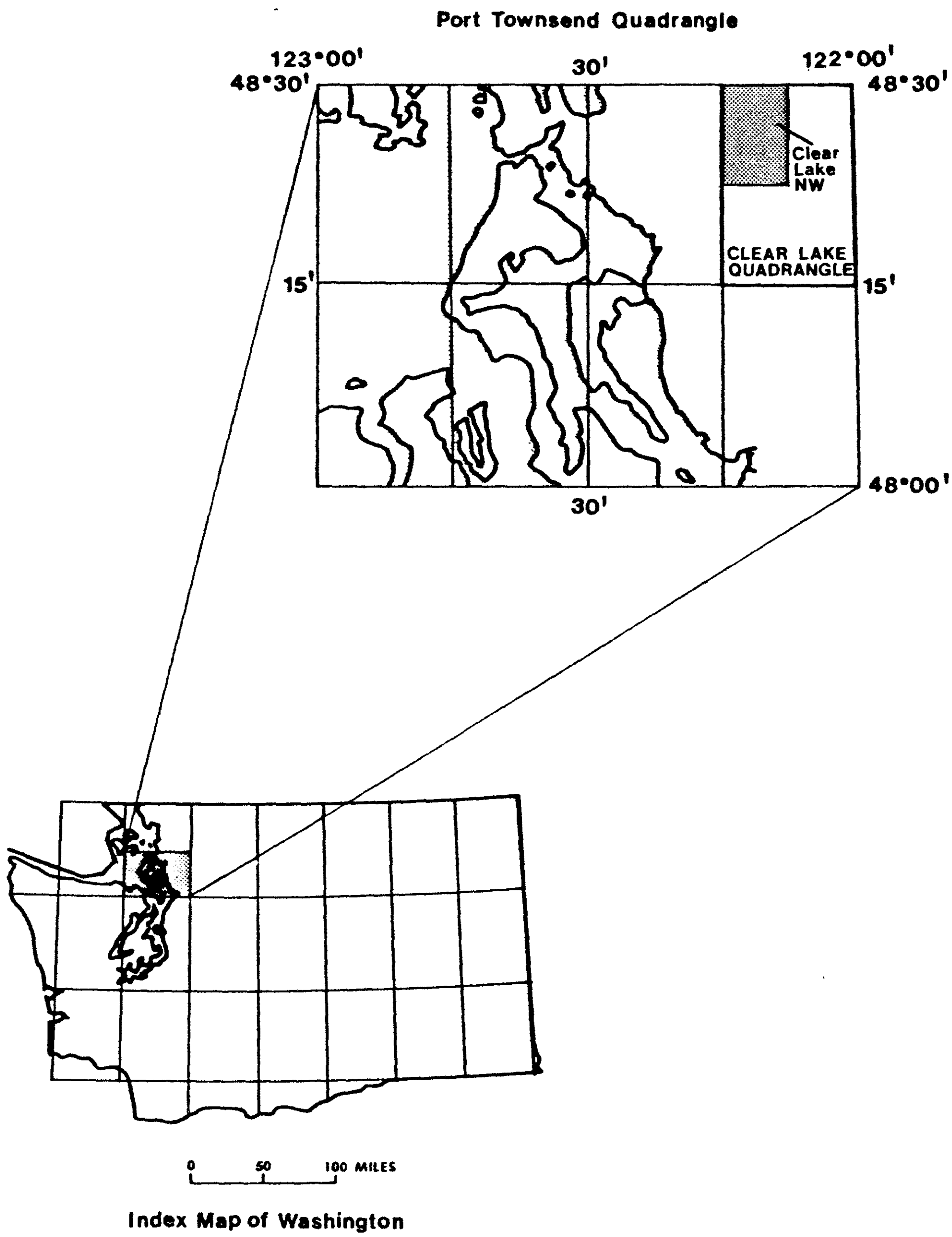
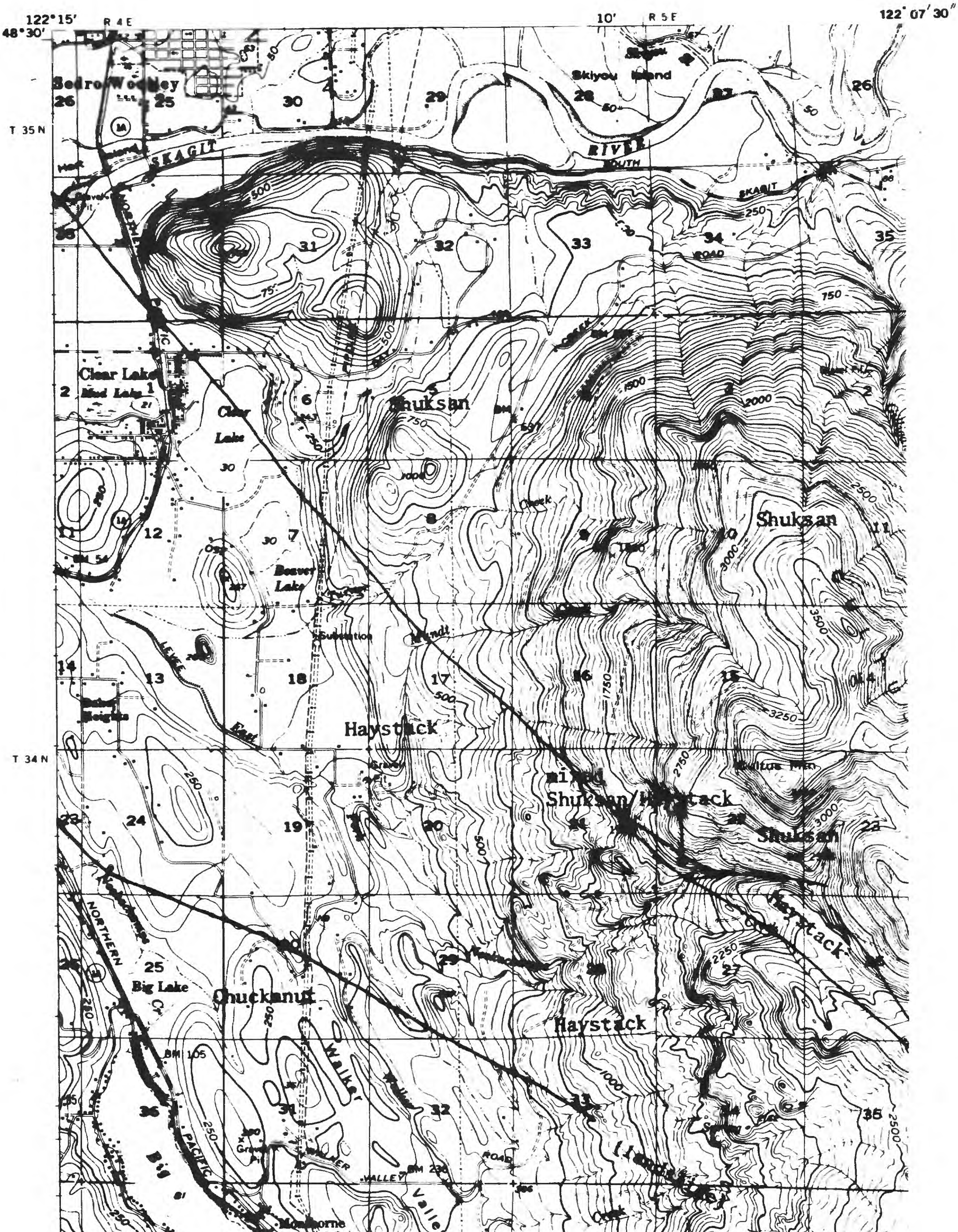
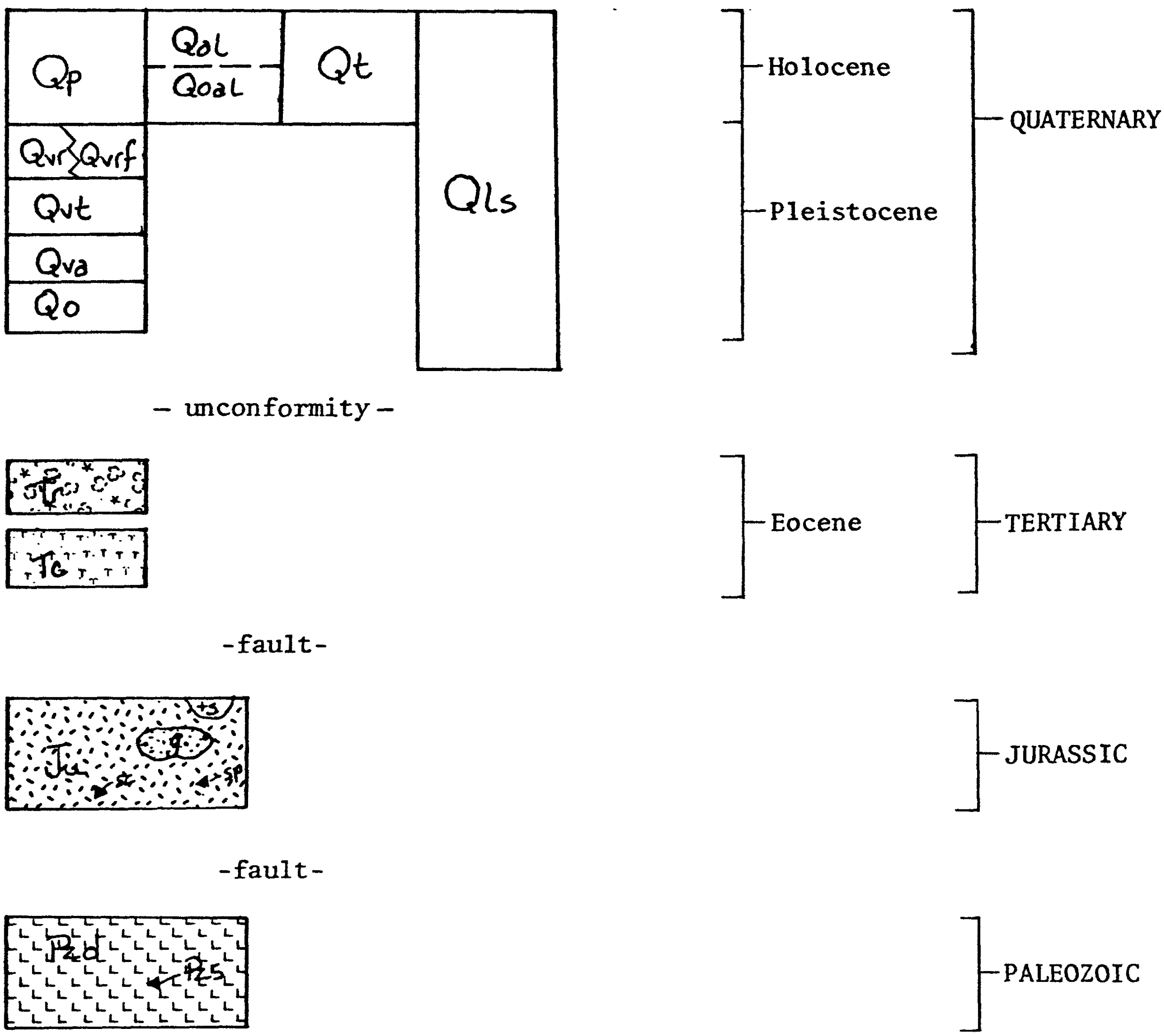


Index map showing locations of Port Townsend (1:100,000), Clear Lake (1:62,500) and Clear Lake NW Orthophoto (1:24,000) quadrangles.



Northwest quarter of the Clear Lake 15 minute topographic quadrangle (1:62,500) showing geographic names, faults, and principal bedrock units. (Haystack=Haystack unit, Shuksan =Shuksan unit, Chuckanut= Chuckanut Formation and Tertiary rhyolite).

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

af — ARTIFICIAL FILL

Qal — ALLUVIUM - Late Holocene gravel and isolated silt deposits occurring along the modern Skagit River and along its former course in the vicinity of Clear and Beaver Lakes. Sediment deposited by the Skagit River is well sorted and stratified, and clasts are subrounded to rounded. Alluvium mapped along tributaries like Gilligan, Mundt, and Nookachamps Creeks is less well sorted and contains abundant subangular clasts. Unit includes low terraces 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 deposits in many shallow ponds and bogs in the Walker Valley and in upland areas. Tephra from Mount Mazama (∿6900 yrs BP) is present as a layer, 20 to 50 mm thick, in some bogs.

Qoal — OLDER ALLUVIUM - Holocene sand, silt, and minor gravel occurring north of the Skagit River near Sedro Woolley. Deposits are generally well-sorted and stratified, and are largely composed of sand, lithic clasts, and pumice derived from Glacier Peak lahars. Clasts are subrounded and rounded. Includes slightly dissected terraces 10 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, nonstratified, and consist of angular boulders and cobbles in a matrix of finer material. Most landslides include transported material and blocks of locally derived bedrock. Unit includes isolated areas of bedrock, recessional fan deposits, and undisturbed glacial till.

Qvr/Qvrf

RECESSIONAL OUTWASH - Late Pleistocene gravel containing areas of fine sand and silt. Deposits are poorly to well-sorted, stratified, and consist of subangular to rounded clasts. Forms terraces as much as 60 m above modern channels near Skagit River. Includes deltaic deposits and stratified silt and sand exposed at elevations up to 75 m where Nookachamps, Mundt, and Turner Creeks enter the Walker Valley. Marine shells collected in a trench exposure at the northwest end of Big Lake were dated at 13,370±70 years BP (USGS#782). Alluvial fans (Qvrf) are exposed on the west slope of Cultus Mountain and at the mouth of Gilligan Creek. The fans overlie and interfinger with horizontally stratified, well-sorted gravel on the slopes of Cultus Mountain, and overlie ice-contact deposits near Nookachamps Creek.

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, particularly in the northern part of the map area. The prominent northwest-trending ridges and troughs east of Big Lake are formed largely of bedrock which is discontinuously mantled with till. A thin (<1 m) cover of silt and fine sand mantles small areas of till between Big Lake and Clear Lake; the unit also includes isolated bedrock outcrops.

Qva

ADVANCE OUTWASH - Late Pleistocene gravel underlying till and exposed in bluffs south of the Skagit River, west of Gilligan Creek. Deposits are well-sorted and moderately well-stratified, and consist of rounded and subrounded clasts. Advance outwash unconformably overlies nonglacial silts and sands in the area south of the Skagit River.

Qo

NONGLACIAL SEDIMENTS - Late Pleistocene nonglacial sediments exposed in bluffs south of the Skagit River, west of Gilligan Creek. Deposits are similar to modern Skagit alluvium and consist of stratified sand, silt, cobbles, and minor amounts of clay and peat. Wood from these deposits was dated at 25,500 ± 350 years BP (USGS #117). These stratified sediments are highly susceptible to landsliding (Heller, 1979). The unit includes isolated bedrock outcrops.

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 south of Big Lake. The nature of the contact with the Chuckanut Formation is unknown.

Tc CHUCKANUT FORMATION - Fine- to coarse-grained sandstone, siltstone, and coal, massively bedded to finely laminated, with abundant plant debris suggestive of quiet-water fluvial deposition. Chuckanut-type rocks in map area are probably Eocene or younger on the basis of Early to Middle Eocene fission-track ages of detrital zircons from sandstone from Coal Mountain (east of map area) (C. W. Naeser, oral commun., 1979). The Chuckanut Formation is in fault contact with older rocks of the Haystack unit along a northwest-trending fault first mapped by Jenkins (1924).

Ju UNDIFFERENTIATED ROCKS OF THE HAYSTACK THRUST PLATE - A tectonic mixture without discernable stratigraphic order including greenstone, metasedimentary rock, serpentinite, and silica-carbonate rock, and assigned by Lovseth (1975) to the "Rocks of Table Mountain." Nearly concordant Jurassic U-Pb ages were obtained from two silicic metaplutonic rocks from nearby areas outside the map area (Whetten, Zartman, Blakely, and Jones, in press). Whetten and others (in press) correlated rocks of Haystack thrust plate with the Fidalgo ophiolite (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 moderately to strongly foliated. Rocks of the Haystack plate overlie rocks of the Shuksan unit along the Haystack thrust fault east of the map area (Whetten and others, 1979), but in the map area the contact is a high angle northwest-trending fault and fault zone. 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. Unit consists of these lithologies:

g — GREENSTONE - Generally massive and nonfoliated but locally weakly to moderately foliated. Pillow and pillow breccia structures commonly preserved. Some greenstone mapped as outcrop may be large landslide blocks or till clasts.

s — METASEDIMENTARY ROCK - Slate, argillite, and metagraywacke, moderately to strongly foliated, with relict bedding locally preserved. In the absence of other lithologies, small, isolated outcrops of this unit can be difficult to distinguish from Darrington Phyllite.

sp — SERPENTINITE - Widespread within Haystack plate. It commonly separates blocks of different lithologies. Green to black outcrops vary from strongly foliated to massive. Also present in Shuksan unit.

sc — SILICA - CARBONATE ROCK - Brownish weathering, commonly occurs along faults. Also present in Shuksan unit.

Pzd — ROCKS OF THE SHUKSAN UNIT, PREDOMINANTLY DARRINGTON PHYLLITE OF MISCH (1966) - Metamorphism of rocks of the Shuksan unit is of blue-schist 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 abundant 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. Occasionally this cleavage is demonstrably 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. The orientation of the actual cleavage plane was measured where possible (when strongly developed) in preference to the lineation, and was the only measurement taken in cases of transposition. Later folding and broad kinking seem local and lack an associated cleavage. Rocks on the ridge west of Gilligan Creek (NW¼sec.11, T. 34 N., R. 5 E.), although mapped as part of the Shuksan unit, show less strongly developed foliation and clast flattening than typical Shuksan rocks and may be transition zone rocks (Whetten and others, 1979) related to the Haystack thrust fault.

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. The greenschist usually occurs as layers parallel to foliation and up to several meters thick within the phyllite. Large outcrops of greenschist are indicated by labeled foliation on outcrop symbol.

DESCRIPTION OF FAULTS

Two northwest-trending faults were mapped in the area; both appear to dip at high angles. The northern fault separates the Shuksan unit from the Haystack unit and is marked by aligned outcrops of silica-carbonate rock southeast of Clear Lake and in Mundt Creek, and adjacent exposures of Darrington Phyllite and greenstone in an unnamed creek south of Mundt Creek. Northwest of Clear Lake this fault is inferred to pass in a straight line beneath Quaternary alluvium of the Skagit River delta, but the actual location of the fault is poorly constrained by the absence of exposed bedrock. To the southeast, the fault appears to splay into a fault zone; the concealed faults that were mapped separate blocks of related lithologies. The zone is probably more complex than is shown. One east-trending fault in Nookachamps Creek is indicated by a solid line; this fault is marked by numerous exposures of silica-carbonate rock, some of which have subhorizontal slickensides. The southern boundary of this fault zone is shown as a concealed fault within the Haystack unit which aligns with a fault-bounded sliver of Darrington Phyllite on the north flank of Table Mountain (see Whetten, Dethier, and Carroll, 1979).

The southern fault separates the Haystack unit from the Chuckanut Formation and Tertiary rhyolite, and was originally mapped by Jenkins (1924). This fault is delineated by isolated outcrops of Chuckanut and greenstone on opposite sides of the fault near the center of the map, and by closely spaced outcrops at Big Rock, approximately 1 km west of the map. To the southeast, the fault is concealed by a large landslide. The contact between Chuckanut and Haystack rocks extends southeast from the landslide as a SSE trending fault, first mapped by Lovseth (1975). It is not known whether the contact is a single fault that bends beneath the landslide or is two different faults.

MAP SYMBOLS

▼ Outcrop visited by us but consisting of non-foliated rock, principally greenstone "g," serpentinite "sp," and silica-carbonate rock "sc." 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

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

Strike and dip of beds

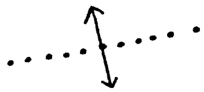

Strike and dip of foliation


Vertical foliation

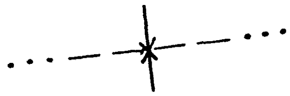

Horizontal foliation

Bearing and plunge of crenulation lineation

Strike and dip of crenulation cleavage



Axis of concealed anticline



Axis of inferred syncline - dotted where concealed