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Geologic Map of the Anacortes South and La Conner 7.5-minute Quadrangles, Skagit and Island Counties, Washington

by

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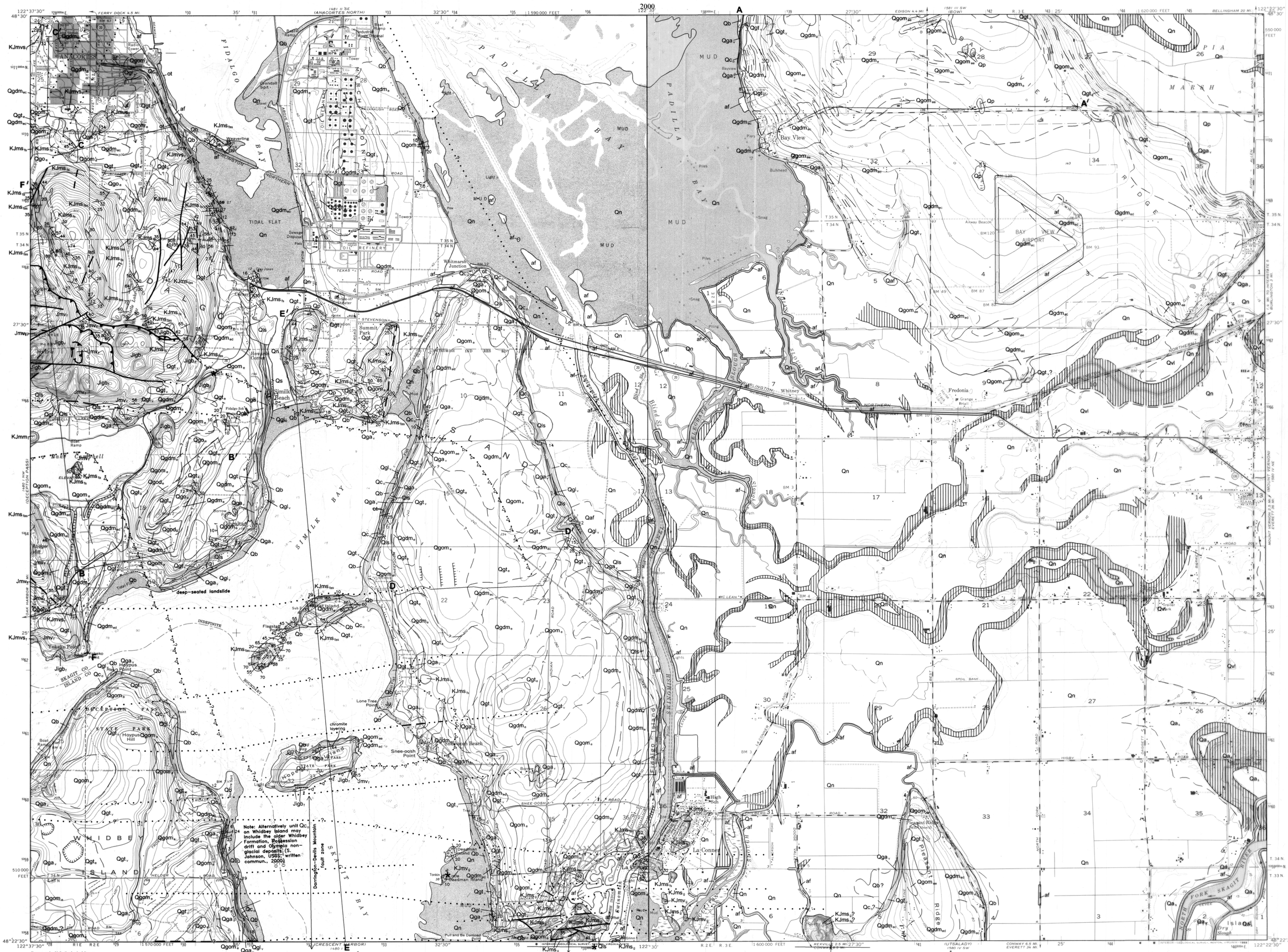
PLATE 1
OPEN FILE REPORT 2000-6
GEOLOGIC MAP OF THE ANACORTES SOUTH AND
LA CONNER 7.5-MINUTE QUADRANGLES,
SKAGIT AND ISLAND COUNTIES, WASHINGTON

Anacortes South Quadrangle

La Conner Quadrangle



GEOLOGIC UNITS

af Artificial fill

QUATERNARY SEDIMENTARY AND VOLCANIC DEPOSITS

NONGLACIAL DEPOSITS

(low-density deposits generally described as loose or soft)

Qs Undivided surficial deposits (Holocene to Pleistocene) (cross sections only)

Qb Beach deposits (Holocene)--Moderately to well-sorted sand and gravel along shorelines; typically well-rounded; locally includes wave-worn shell fragments. Beach deposits are mapped to the ~5 ft contour along most of the shoreline

Qn Nearshore deposits (Holocene)--Mostly estuarine or tidal flat deposits composed of fine sand, silt, and clay; locally includes flood overbank deposits and marsh or peat deposits. Varies from massive silt or silt with organic or peaty mats and layers to rare, thinly bedded fine sand, silt, and clay deposits

Qa_s Alluvium of the Skagit River valley, undivided (Holocene)--Generally well-sorted and well-stratified fluvial deposits of sand with overbank silt and clay; contains lesser sandy gravel, cobble gravel and gravel

Qvl Lahar runout deposits (Holocene)--Pumiceous or vesicular dacite-clast-bearing, moderately to well-sorted, very fine to coarse volcanic sand, gravelly sand, sandy gravel, and lesser cobble gravel (see Plate 3)

Qp Peat (Holocene)--Poorly stratified to unstratified, brown to black, fibrous to woody peat and muck of bogs and swamps in abandoned channels, kettles, and shallow oxbow lakes or depressions

Qaf Alluvial fan deposits (Holocene to latest Pleistocene)--Poorly sorted to locally stratified diamicton consisting of clayey silty sandy gravel and gravelly sandy silt

Qls Landslide deposits, undivided (Holocene to latest Pleistocene)--Poorly sorted, unstratified, cohesive diamicton consisting of angular to rounded boulders, cobbles, and gravel in a sand, silt, and (or) clay matrix

GLACIAL DEPOSITS, FRASER GLACIATION (PLEISTOCENE)

Everson Interstade

(low-density deposits generally described as loose or soft)

$Qgdm_e$ Glaciomarine drift--Clayey silt, silty clay, clay, and clay-rich diamicton; locally contains lenses and layers of sandy or gravelly outwash

Locally divided into:

$Qgdm_{ec}$ Fine glaciomarine sediment--Mostly clayey silt, silty clay, and clay; massive to rarely rhythmically bedded or varved with lesser sand and silt interbeds; rare or no gravel (dropstones)

$Qgdm_{ed}$ Diamicton--Mostly silty sandy clay with scattered gravel (dropstones) or clayey silty sandy gravel

Qgo_e Terrestrial recessional outwash--Sand, sandy gravel, gravelly sand, and sandy cobble gravel with rare interlayered silt; massive to crudely bedded on a scale of centimeters to a meter; commonly has low-amplitude foreset beds (1 m high), pebble imbrication, truncation surfaces (scoured bedding)

$Qgom_e$ Glaciomarine outwash--Sand, sandy gravel, and gravel with minor interlayered silt and silty sand; rare diamicton; occurs below the glaciomarine limit of 360-400 ft elevation and locally interlayered with glaciomarine drift

Locally divided into:

$Qgod_e$ Deltaic glaciomarine outwash--Sandy gravel, gravelly sand, and silty sand with lesser sandy cobbly gravel and rare interlayered silt; very commonly displays planar high-amplitude foreset beds with tens of meters of vertical extent

Qgt_e Ablation or flow till--Clayey silty sandy gravel diamicton to silty sandy gravel with boulder diamicton; includes moderately to poorly sorted, bouldery, cobbly, sandy gravel deposits locally with silt; massive, moderately dense, and cohesive; small outcrops at several locations mostly near the glaciomarine limit of 360-400 ft. Probably deposited by several near-ice mechanisms; association of moderately to poorly sorted coarse-grained deposits, morainal ridges or kettle topography, and nearby Everson outwash deposits probably delineates ice recessional grounding positions at the close of the last glaciation

$Qgom_{ee}$ Emergence (beach) deposits--Mostly sand, sandy gravel, and gravel; massive, laminated, or rarely ripple cross-bedded; occurs predominantly as topographic benches interpreted as wave-cut terraces (strandline symbol); also occurs as thin sand and sandy gravel emergence deposits related to temporary reworking of older glacial deposits during the rebound at the close of the last glaciation

Vashon Stade

(moderate- to high-density deposits generally described as compact, hard or stiff)

Qgt_v Till (Pleistocene)--Nonstratified, dense to very dense diamicton consisting of clay, silt, sand, and gravel in various proportions, with scattered cobbles and boulders; rare lenses of sand or gravel indicate some redeposition by subglacial meltwater processes during deposition

Qga_v Advance outwash (Pleistocene)--Moderately to well-sorted and -stratified, moderately to highly compacted medium to coarse sand, pebbly sand, and sandy gravel, with minor amounts of fine silty sand or sandy silt, and clay interbeds with scattered lenses and layers of pebble-cobble gravel

Qgl_v Silt and clay deposits (Pleistocene)--Very thinly to thickly bedded clay, clayey silt, silt, and silty sand with local dropstones; commonly contains rhythmite (varve?) bedding; also includes interlayers of sand, sandy gravel, and silt; shells reported in water well logs from this unit (for example, Plate 3, cross section B, wells 29, 30, and 58). Generally underlies Vashon advance outwash and probably consists of early, distal Vashon Stade glacial and earlier nonglacial deposits. S. Johnson (USGS, written commun., 2000) indicates that this unit could locally include older units such as the interglacial Whidbey Formation and (or) glaciomarine drift of the Possession Glaciation

NONGLACIAL DEPOSITS, OLYMPIA NONGLACIAL INTERVAL

(moderate- to high-density deposits generally described as compact, hard or stiff)

Qc_o Olympia nonglacial deposits (Pleistocene)--Compositionally heterogeneous unit composed of sand, gravelly sand, organic-rich sand, silty sand, silt, silty clay, and peat with lesser cobble gravel and gravel, as well as rare diamicton of probable mass-flow origin; peat and logs are common; may locally include outwash sand of the Possession Glaciation and nonglacial sediments of the older Whidbey Formation (S. Johnson, USGS, written commun., 2000)

GLACIAL DEPOSITS, POSSESSION GLACIATION

(moderate- to high-density deposits generally described as compact or stiff)

ot Possession till (Pleistocene)--Clay, silt, sand, and gravel in various proportions, with scattered cobbles and boulders. Rare small outcroppings at the base of several marine bluffs. We do not assign a formal geologic symbol to this unit to emphasize the tentative nature of this correlation with Possession Glaciation

LOW-GRADE METAMORPHIC ROCKS OF THE SAN JUAN THRUST SYSTEM AND DARRINGTON-DEVILS MOUNTAIN FAULT ZONE

METAMORPHIC ROCKS OF THE FIDALGO COMPLEX

Metasedimentary and metavolcanic rocks

Fidalgo Complex metasedimentary rocks (Jurassic to Cretaceous)--Includes metamorphosed siltstone, volcanic lithic to volcanic arkosic sandstone and graywacke, with much lesser conglomerate, diamictite, chert, radiolarite, shale (claystone), and rare breccia; locally siliceous to intermediate metavolcanic rocks are interbedded with the metasedimentary rocks. We have divided a metasedimentary rock package with extremely rare metavolcanic interbeds (units that include KJms) into three protolith units in an effort to map the proportions of metasiltstone (meta-argillite), rare metashale (fine-grained metasedimentary), metasandstone, metagraywacke, and rare metaconglomerate (coarse-grained metasedimentary) in different parts of the study area

$KJmvs_f$ Fidalgo Complex interbedded heterogeneous metavolcanic greenstone and metasedimentary rocks (Jurassic to Cretaceous)--Thinly to very thickly bedded metasandstone with lesser metasiltstone, metaconglomerate with rare thin metagraywacke and metachert layers; metasandstone and metasiltstone are compositionally similar to the metasedimentary rocks described above but probably contain a higher percentage of volcanic lithic grains. Metasedimentary rocks with interbedded andesitic to dacite metavolcanic rocks (greenstones)

$KJms_{fs}$, $KJms_{fas}$, $KJms_{fa}$ Fidalgo Complex metasedimentary rocks (Jurassic to Cretaceous)--Metasiltstone, metagraywacke, and metasandstone with lesser metaconglomerate and metachert and rare crystal metatuff beds; thin, sporatic, discontinuous metatuffaceous interbeds of intermediate to siliceous crystal tuff

Divided into:

$KJms_{fs}$ <10% interbedded fine-grained metasedimentary rocks; locally contains metaconglomerate, metadiamictite, and minor thin to very thin beds of plagioclase-quartz phyric, dacitic, andesitic, and possibly rhyolitic crystal tuff

$KJms_{fas}$ 10-90% interbedded fine-grained metasedimentary rocks

$KJms_{fa}$ >90% interbedded fine-grained metasedimentary rocks

$KJmm_f$ Fidalgo Complex pelagic argillite (Jurassic to Cretaceous)--Radiolarians in an aphanitic matrix; mapped by Gusey (1978) directly west of Lake Campbell

Meta-igneous rocks

Jmv_f Fidalgo Complex metavolcanic greenstone (Jurassic)--Mostly includes massive meta-andesite and metadacite; probable metabasalt less common on Fidalgo Island; (see splite of Brown and others, 1979); dacite dikes occur on Mount Erie
******* dike

$Jigb_f$ Fidalgo Complex meta-intrusive rocks of Mount Erie (Jurassic)--Mostly massive hornblende metagabbro, hornblende metadiorite, or quartz diorite, with rare melanocratic amphibole-rich layers and tonalitic to trondhjemitic, leucocratic layers or veins; gabbroic dikes, mapped only on Hope Island

Ju_f Fidalgo Complex ultramafite of Hope Island (Jurassic)--Serpentinite, harzburgite, and dunite mostly on and east of Hope Island; rare serpentinite pods on Fidalgo Island
★ Serpentine pods and outcroppings too small to show at map scale

METAMORPHIC ROCKS OF THE GOAT ISLAND TERRANE

The Goat Island terrane is composed of heterogeneous metamorphic rocks of poorly known regional terrane affinity. These rocks occur as imbricate slices in the Darrington-Devils Mountain fault zone of Tabor (1994) and Johnson and others (in progress)

$KJms_g$ Metasedimentary rocks (Jurassic to Cretaceous)--Metasandstone with lesser metagraywacke, metasiltstone (locally with a phyllitic appearance), metaconglomerate, and lesser metachert; Whetten and others (1988) mapped minor metaclastsone (metashale) Hopkins (1962) mapped minor, very poorly sorted metaconglomerate/breccia (metadiamictite)

$KJmv_g$ Metabasaltic greenstone (Jurassic to Cretaceous)--Vesicular metabasaltic greenstone with pillows and massive metabasaltic greenstone; pods of serpentinite and silica-carbonate rocks are associated with the metabasalts on Deadman Island, common in the Goat Island terrane directly south of the study area
metavolcanic rocks with pillows

GEOLOGIC SYMBOLS

Contact--Dashed where inferred; dotted where concealed; queried where location uncertain

High-angle fault--Dashed where inferred; dotted where concealed; U, upthrown block; D, downthrown block; arrows indicate relative apparent strike-slip motion

Thrust fault--Dashed where inferred; dotted where concealed; sawteeth on upper plate

Overturned fold

Syncline

Anticline

Holocene to latest Pleistocene fluvial terrace--Hachures on scarp side

Bar and swale topography in Skagit River alluvium (lateral accretion surfaces of meandering river point bars) visible on the NW-1996 aerial photographs

Abandoned fluvial or tidal channels visible on 1:12,000-scale NW-1996 aerial photographs

Subtle glacial micro-topography observed on aerial photographs of Whidby Island; probably represent ice-contact recessional ridges

Wave-cut marine terrace or strandline formed during the Everson Interstade of the Fraser Glaciation

★ Ultramafite pods in the Ficalgo Comples and Goat Island terrane

******* Fidalgo Complex dikes (includes metadacite dikes on Fidalgo Island and metagabbroic dikes on Hope Island)

Strike and dip of bedding (may be combined with other symbols)

Plate 4 (Map A) — This Plate

Inclined (glacial deposits only; f, adjacent to symbol indicates foreset bedding)

1 Inclined (upright bedding or bedding top ambiguous)

2 Vertical

3 Inclined bedding parallel to tectonic foliation

4 Overturned

Trend and plunge of minor fold axes (may be combined with other symbols)

5 Overturned F1 fold axis

6 F1 fold axis; arrow indicates the direction of plunge

Strike and dip of tectonic foliation (may be combined with other symbols)

Penetrative to semi-penetrative to S1 cleavage and (or) D1 semi-brittle to ductile Riedel fracture planes. In the Goat Island terrane, undivided foliations are predominantly penetrative cleavages. In the Fidalgo Complex, cleavages are locally divided into:

7 inclined

8 vertical

Low to moderate strain S1 cleavage and (or) D1 semi-brittle to ductile Riedel fracture planes; sites mostly display spaced semi-penetrative to very locally penetrative cleavages and (or) spaced to intensely developed fracture planes; associated vein development typically only moderately conspicuous; associated lineations are subtle to moderately developed slickenlines or undivided lineations; locally grades into higher strain foliations (below), particularly near thrust faults; where metasandstone layers are present, S1 cleavage is locally axial planar to F1 folds

9 inclined

10 vertical

Moderate to very high strain S1 cleavage; sites mostly display a semi-penetrative to penetrative protomylonitic to mylonitic cleavage; S-C mylonites locally observed; associated vein development typically conspicuous and very commonly pervades the outcrop; associated stretching lineations (below) are moderately well-developed to distinct; locally grade into lower strain foliations and fractures (above), with increased distance from thrust faults; where metasandstone layers are present, S1 cleavage developed in the metasiltstone is typically axial planar to F1 folds and boudinaged F1 folds of metasandstone

11 horizontal

12 inclined

13 vertical

Semi-penetrative to penetrative S1 axial plane foliation to F1 folds

14 inclined

15 vertical

16 Thin (meter-scale to tens of meters) mylonitic inhomogeneous shear zone (typically near D1 thrust zones), inclined

Strike and dip of fractures and joints (may be combined with other symbols)

Plate 4 (Map B)

Penetrative to semi-penetrative cataclastic foliation associated with high-angle fault zones (commonly slickensided fracture planes)

17 inclined

18 vertical

Areas of pervasive brittle to semi-ductile shear deformation adjacent to fault zones

Joint, undifferentiated

19 inclined

20 vertical

Plate 4 (Map A)

Subsidiary minor fault or slickensided fracture plane

21 inclined

22 vertical

Minor fault (commonly with gouge zone)

23 inclined

24 vertical

Plate 4 (Map B)

Metamorphic veins (includes asbestos-fiber extensional veins in serpentinite) (see above)

25 inclined

26 vertical

Trend and plunge of tectonic lineations associated with high-angle post-metamorphic faults and fault zones

Slickenline on slickensided fracture, fault, or cataclastic to mylonitic foliation; arrow indicates direction of plunge

27 inclined

28 horizontal

Trend and plunge of tectonic lineations mainly associated with moderately to shallow-dipping metamorphic foliations

Plate 4 (Map A)

Lineation, undifferentiated (mostly stretching lineations and crenulation lineations; rare pencil lineations, slickenlines, and boudins are included); arrow indicates direction of plunge

29 inclined

30 horizontal

Stretching lineation; arrow indicates direction of plunge

31 horizontal

32 inclined

33 inclined L1 stretching lineation

34 horizontal L1 stretching lineation