DESCRIPTION OF MAP UNITS

[Numbers in brackets refer to locations on figure 4, in pamphlet.]

SURFICIAL DEPOSITS

Mf **MANMADE FILL AND MODIFIED LAND (HOLOCENE)**—Gravel or diamicton as fill, or extensively graded natural deposits

Qe **EOLIAN DEPOSITS (HOLOCENE)—**Well-sorted loose sand deflated from Columbia River floodplain that is now drowned behind dams

Qb **BOG DEPOSITS (HOLOCENE)**—Peat and alluvium. Poorly drained and at least intermittently wet. Grades into unit **Qa**

Qt **TALUS DEPOSITS (HOLOCENE)**—Nonsorted angular boulder gravel to boulder diamicton. At lower altitudes only arbitrarily distinguished from unit **Oa**. At higher altitudes in western part of quadrangle includes Holocene moraines, rock glaciers, and protalus ramparts

LANDSLIDE DEPOSITS —Consist of:

Qlsi **Incipient blockslides (Holocene)**—Large nonrotated mass of bedrock extensively crevassed as a result of slight movement toward nearby free faces. Crevasse -arrow symbol (not in digital coverage) shows direction of movement

Qls **Landslides (Holocene and Pleistocene)**—Diamicton of angular clasts of bedrock and surficial deposits derived from upslope. Locally includes rotated blockslides. Arrows (not in digital coverage) denote downslope direction

Qs **ALLUVIUM (HOLOCENE AND PLEISTOCENE)**—Moderately sorted cobble gravel along rivers grading to poorly sorted gravelly sand on small-tributary fans; as mapped, includes some material in fans similar to unit **Qt**

Ql **LOESS (HOLOCENE AND PLEISTOCENE)**—Slightly compacted well-sorted silt. In places below edge of Columbia Plateau grades into unit **Qe**

Qr **REGOLITH (HOLOCENE AND PLEISTOCENE)**—Slightly compacted to loose silt, diamictite, and soils. Extensive and thick on upland surfaces north and northwest of Columbia River. Includes considerable loess and weathering debris. Mostly mapped on basis of gentle ridgetop topography; contacts approximate

GLACIAL DRIFT AND RELATED DEPOSITS

Qgd **GLACIAL DRIFT (PLEISTOCENE)**—Ranges from till in uplands and upvalley areas to gravelly outwash on broad valley floors. In lower Chelan Valley and in large valleys of Wenatchee drainage east of Lake Wenatchee, outwash gravel is interbedded with till and minor lacustrine sediment; in these areas gravel fraction is cognate with unit **Qtg**. Mostly last-glacial deposit, but in some places passes upslope into older, weathered drift. Conspicuous, large, sharp-crested moraines distinguished by dot-dash pattern

Qtg **TERRACE GRAVEL (PLEISTOCENE)**—Moderately sorted cobble to pebble gravel. Largely but not entirely inwash and outwash fill, the latter grading upvalley to moraines within unit **Qgd**. No subsequent incision of drainage network since accumulation

Qbs **BEDDED SILT (PLEISTOCENE)**—Ranges from very fine sand to clay, distinctly interbedded; commonly contains ice-rafted dropstones. Polygenetic lacustrine deposits

DEPOSITS OF CATASTROPHIC FLOODS IN THE COLUMBIA RIVER VALLEY

Qfg **FLOOD GRAVEL (PLEISTOCENE)**—Similar to unit **Qtg** but contains large boulders and rarely has associated fields of large boulders, giant current dunes, fosses behind bedrock protuberances, and scabland on adjacent bedrock

OTHER DEPOSITS

QTup **GRAVEL AND DIAMICTITE OF UPLAND AREAS (PLEISTOCENE, PLIOCENE, AND MIOCENE?)**—Moderately sorted river gravel to poorly sorted diamicton or diamictite sparsely capping ridges or upland erosion surface. Considerable incision of drainage network since deposition. May possibly include some deposits of Holocene age

Tbl **CONGLOMERATE OF BRAYS LANDING (PLIOCENE AND MIOCENE?)**—Moderately sorted pebble conglomerate of diverse rock types, all from Columbia River drainage. Columbia River has incised 240 m below the surface of the deposit

TERTIARY BEDROCK

Tbm **ANDESITE AND DACITE OF BURCH MOUNTAIN (MIOCENE)**—Gray to dark-gray and black pyroxene and hornblende-pyroxene andesite and dacite. Some rocks with minor hypersthene, zoned labradorite, and conspicuous apatite needles. Porphyritic and glomeroporphyritic, holocrystalline, cryptocrystalline to aphanitic. Occurs as plugs and dikes

Tsp **ANDESITE OF SUGARLOAF PEAK [18] (MIOCENE)**—Hypersthene-clinopyroxene andesite;porphyritic holocrystalline aphanitic with zoned labradorite. Well-developed vertical columnar joints

Te **ELLENSBURG FORMATION (MIOCENE)**—Micaceous feldspathic sandstone, and very minor pebble conglomerate and dark mudstone. Weakly indurated. Interbedded with the Grande Ronde Basalt and underlies the Priest Rapids Member of the Wanapum Basalt

COLUMBIA RIVER BASALT GROUP (MIOCENE)

YAKIMA BASALT SUBGROUP— In this area, consists of:

WANAPUM BASALT

Twp Priest Rapids Member—Fine- to medium-grained basalt flow with sparse plagio- clase and olivine phenocrysts less than 8 mm long. Intergranular to intersertal groundmass texture. Reversed magnetic polarity. Occurs only on the Waterville Plateau, where it is equivalent to the White Hill Basalt of Waters (1969)

GRANDE RONDE BASALT—Fine- to medium-grained basalt flows. Nonporphyritic. Groundmass textures dominantly intersertal, with small clots of plagioclase and clinopyroxene. Complexly jointed. Pillows, hyaloclastites, and invasive flows common. As mapped, locally includes thin sedimentary deposits of the Ellensburg Formation. Many flows display jointing patterns including typical basal colonnade, central entablature, and in some flows, upper colonnade, all thoroughly described in nearby areas by Mackin (1961, p. 9-12), Swanson (1967, P. 10831086), and Diery and McKee (1969, p. 52-54). Jointing patterns in much of the area are considerably affected by interaction of flows with water and sediment. Divided herein on basis of magnetic polarity and locally distinctive outcrop characteristics into:

Tgn_2 Flows of normal magnetic polarity—Locally divided into:

Tgb Basalt of Beaver Creek—Youngest flow in unit. Well-developed colonnade; pillowed base in places

Tgk Basalt of Keane Ranch—Several invasive flows and associated hyaloclastite and peperite. Consists of flows of at least three different chemical compositions

Tgr_2 Flows of reversed magnetic polarity—Locally divided into:

Tgh Invasive flow of Hammond—Equivalent to the Hammond sill of Hoyt (1961)

VOLCANIC ROCKS OF CHIKAMIN CREEK (OLIGOCENE)—Divided into:

Tcr Rhyolite—White, orange brown to gray where fresh, generally earthy or finely granular due to spherulitic devitrification. Contains microphenocrysts of quartz and highly skeletal resorbed garnet. Grades downward into unit **Tcrt**

Tcrt Rhyolite tuff and breccia—Gray to brown crystal lithic vitreous tuff and breccia rich in fragments of gneiss and schist. Devitrified shards and eutaxitic structure. Crude bedding and local columnar joints

Tw WENATCHEE FORMATION (OLIGOCENE)—Sandstone, shale, and conglomerate. Near Burch Mountain, poorly sorted, buff- weathering sandstone with interbeds of gray clayey (tuffaceous?) shale, quartz sandstone, and conglomerate rich in vein quartz and volcanic porphyritic pebbles. East of the Columbia River, reddish to variegated (tuffaceous?) claystone and quartz pebble and cobble-rich sandstone and conglomerate

Tbp **PORPHYRITIC DACITE OF BASALT PEAK [71 (EOCENE)**—Biotite**-** hornblende plagiociase porphyry with numerous euhedral phenocrysts in a holocrystalline aphanitic matrix. Plagiociase highly zoned from labradorite to andesine (Willis, 1950, p. 115). Rocks commonly highly altered to montmorillonoids and calcite

Tc **CHUMSTICK FORMATION (EOCENE)**—Sandstone, shale, and conglomerate. White to buff- gray, medium- to coarse-grained, micaceous, feldspathic to lithofeldspathic sandstone. Composition averages 35 to 40 percent quartz, 45 to 50 percent feldspar, and 10 to 15 percent lithic clasts of which 90 percent are volcanic rock; also includes lesser amounts of interbedded pebbly sandstone, conglomerate, and minor shale. Sedimentary structures include graded, crossbedded and channeled sandstone, and imbricate pebbles in conglomerate. Unit descriptions adapted from Gresens and others (1981), Whetten and Laravie (1976), and Whetten and Waitt (1978). Locally interfingers with units **Tcc, Tcn, Tcmf**, and **Tcrf**. Locally divided into:

Tcsu Tuffaceous sandstone, upper—Light-colored resistant tuffaceous sandstone, Extensively zeolitized and weathered to slabs subparallel to bedding. Ranges from 1 to 3 m thick

Tcpt Pumiceous tuff—Pumiceous, vitric tuff; ridge-forming; about 2 to 3 m thick

Tcct Coarse-grained tuff—Contains pumice; probably water-laid and reworked. Zeolitized. Thickness ranges from 2 to 4 m. Equivalent to the zeolite tuff as used by Gresens and others (1977, p. 104)

Tcsl Tuffaceous sandstone, lower—Light-colored resistant tuffaceous sandstone. Extensively zeolitized and weathered to slabs subparallel to bedding. Ranges from 1 to 3 m thick

Tcft Very fine-grained tuff—Vitric tuff; poorly exposed

Tcte Tuff of Eagle Creek—Coarse -grained tuff containing pumice and carbonized wood; probably deposited as an ash flow. Thickness ranges from 4 to 14 m. Equivalent to the tuff of Eagle Creek as mapped by Gresens and others (1977, p. 104)

Tctb Tuff (b)—Vitric coarse-grained, pumiceous. Thickness variable up to 3 m. Equivalent to the tuff of Cashmere (b) (Tabor and others, 1982a)

Tcta Tuff (a)—Crystal vitric, dense, fine-grained; 2 to 4 m thick. Equivalent to the tuff of Cashmere (a) (Tabor and others, 1982a)

Tcc Conglomerate and conglomeratic sandstone—On east side of Chiwaukum graben, angular to rounded pebbles, cobbles, and boulders of gneiss, vein quartz, and volcanic rocks in weakly cemented matrix of white to buff-gray medium to coarse-grained feldspathic sandstone. On west side, clasts are tonalite, granodiorite, fine-grained schist, and serpentinite as well as volcanic rocks

Tcn Nahahum Canyon Member—Olive-brown carbonaceous, micaceous, finely laminated lacustrine shale interbedded with laminated sandstone turbidites and rocks similar to undivided part (Tc) of the Chumstick Formation

Tcmf Monolithologic fanglomerate breccia—Well-cemented angular clasts of tonalite, poorly sorted with no visible bedding. Largest clast seen was 7 m across. Matrix consists of sand, granules, and pebble-sized fragments derived from tonalite

Tcrf Redbed fanglomerate—Angular to subrounded clasts of biotite gneiss and vein quartz in a matrix of reddish sandstone. Exposed mostly near the gneissic core of the Eagle Creek anticline

DUNCAN HILL PLUTON (EOCENE)—Consists of:

Tdhg Biotite and hornblende-biotite granodiorite—Light-colored, pinkish-weathering granodiorite with interstitial perthite and quartz. CI = 6-18 (Cater, 1982). Subidiomorphic granular texture

Tdhb Biotite granite—Mostly light-yellow- to deep-pink- and red-weathering, locally microlitic, biotite granite with subhedral to euhedral crystals of oligoclase, perthite, and corroded quartz, crowded in a mesostasis of micrographic feldspar and quartz. CI = 4-5 (Cater, 1982). As mapped, may include some granodiorite on lower elevations of Stormy and Baldy Mountains [26, 27]. Modal and chemical analyses of units **Tdhg** and **Tdhb** are in Cater (1982)

Tgd **GRANITE PORPHYRY DIKE SWARM (EOCENE)**—Biotite and hornblende-biotite granite porphyry, characteristically with 2-5-mm phenocrysts of corroded quartz, subhedral oligoclase, and K-feldspar in a micrographic or very fine grained granular matrix. Dikes range from 1 to 5 m thick and have a northeast- southwest trend. Locally, especially near the Duncan Hill pluton and north of Antilon Lake [30], dikes constitute over 80 percent of terrane

Tr **RHYOLITE DIKE SWARM (EOCENE)**—Predominantly white to yellow or brown rhyolite with small phenocrysts of plagiociase and (or) quartz in devitrified earthy to spherulitic matrix. Common in swarm are dikes of hornblende diorite and of aphyric to slightly plagioclase porphyritic brown-colored andesite(?). Dikes trend northwest-south east near the Columbia River and northeast-southwest west of Lake Chelan. In the area south of Baidy Mountain [26] dikes of units **Tr** and **Tgd** are particularly abundant

Tcrd **CLOSELY SPACED RHYOLITE DIKES AND LARGER BODIES (EOCENE)**—Rocks similar to those of unit **Tr**

Td **DIABASE (EOCENE)**—Clinopyroxene diabase with some K-feldspar and partially altered to montmorillonoids and limonite. Intrudes diorite and gabbro (**Kmsd**) of the Mount Stuart batholith on the west side of Icicle Valley. Unmapped diabase dikes intrude the hornblende schist, amphibolite, biotite schist, and granofels unit (**KJih**) of the Ingalls Tectonic Complex on floor of Icicle Valley

PRE-TERTIARY BEDROCK

MOUNT STUART BATHOLITH (LATE CRETACEOUS)—Consists of:

Kmsh Tonalite of Harding Mountain [23]—Fine- to medium-grained biotite-hornblende tonalite, commonly with crystalloblastic patches of actinolitic hornblende and biotite. CI=12-18. Hypidiomorphic granular, rich in intergranular quartz. Locally cumulate layering of hornblende and plagioclase. Outcrops tend to be highly jointed and disintegrate into 10 to 20-cm blocks in extensive talus

Kmst Tonalite and granodiorite—Predominantly medium- grained hypidiomorphic granular hornblende-biotite tonalite and subordinate granodiorite. CI=15-40. Hornblende locally uralitic around relict clinopyroxene; K-feldspar late and replaces plagioclase with some myrmekite developed. Massive to gneissic near margins and in area of Arrowhead Mountain [13]. See Erickson (1977) for modal and chemical analyses

Kmsd Diorite and gabbro—Medium-grained hornblende diorite and gabbro with variable amounts of hypersthene and (or) augite. Hypidiomorphic granular to pseudo-ophitic with mostly hornblende filling in and around plagioclase. Locally foliated. Cummingtonite replaces pyroxene in many rocks (Pongsapich, 1974, p. 22; Erickson, 1977, p. 189). CI=25-75. Mapped unit includes some mafic tonalite. Contact with unit Kmst gradational and locally very irregular

Kmsc Contact complex—Mostly interlayered very fine grained garnet-biotite schist, and hornblende schist with massive to foliated light-colored biotite tonalite, schistose biotite metaporphyry, and minor ultramafite. North of Fall Creek [22] consists of lit-par-lit injection complex of hornblende-biotite tonalite and light-colored tonalite in biotite schist

Kmsg Metagabbro and metadiorite—Medium -grained biotite-hornblende metagabbro and metadiorite and minor metatonalite characterized by uralitic hornblende and actinolitic hornblende mat between subhedral to euhedral well-aligned plagioclase prisms. Some rocks with mosaic of granoblastic plagioclase between clots of mafic minerals. Erickson (1977, p. 189) reports olivine in gabbro on west end of Nason

Ridge. Gabbro at Big Jim Mountain [21] and west end of McCue Ridge [16] is well layered, locally with graded bedding. Locally, includes hornblendite and ultramafite

Kmsx Mixed metagabbro and schist—Metagabbro, biotite schist, amphibolite and ultramafite mixed on an outcrop scale

TEN PEAK PLUTON (LATE CRETACEOUS)—Consists of:

Ktpt Hornblende-biotite and biotite-hornblende tonalite gneiss and tonalite—Medium grained hypidiomorphic to crystalloblastic with interstitial quartz, broken and healed sodic andesine with relict euhedral oscillatory zoning and rare synnuesis twins. Hornblende commonly euhdral. Euhedral epidote and clinozoisite locally with pseudomyrmekitic intergrowths of quartz. Common sphene, allenite; rare garnet. Epidote at least in part appears to be a primary igneous mineral (Zen and Hammarstrom, 1984) CI = 20-40. Plagiociase porphyroclasts filled with euhedral epidote minerals and some muscovite. Commonly mylonitic especially along margins where flaser and augen gneiss prevail. Modal and chemical analyses are in Cater (1982)

Ktpi Interlayered and mixed light- and dark-colored biotite-hornblende tonalite gneiss and tonalite flaser gneiss—Light layers similar to those of unit Ktpt, dark layers grade into gneissic hornblendite; mylonitic textures common

Kdf **DIRTY FACE PLUTON (LATE CRETACEOUS)**—Dark biotite-hornblende quartz diorite gneiss and flaser gneiss; crystalloblastic and blastomylonitic with greenish-brown subhedral to anhedral hornblende and oligoclase-andesine with very faint relict euhedral oscillatory zoning. Biotite has partially replaced hornblende. Many rocks altered to zoisite, chlorite, and sericite. Grades to amphibolite Nason terrane

Nason terrane

CHIWAUKUM SCHIST (LATE CRETACEOUS)—Divided into:

Kcb Biotite schist—Mostly fine- to medium-grained, well-laminated graphitic garnet biotite-quartz schist. Locally with cordierite, staurolite, or kyanite; rare sillimanite close to the contact with the Mount Stuart batholith (Plummer, 1980, pt. 2, p. 1644). Contains very minor schistose amphibolite. Commonly isoclinally folded on outcrop and microscopic scale with contorted quartz segregations and veins. Some areas of brecciation. Locally thick veins of quartz and local dikes and sills of foliated light-colored tonalite and granodiorite. Grades into unit **Kca**

Kcp Poikiloblastic mica schist—Silvery gray-weathering, black and green graphitic sodic plagiociase-porphyroblastic chlorite-muscovite schist. Chlorite has partially replaced biotite in many rocks, but in some the two minerals appear to be in equilibrium. Albite and oligoclase micropoikiloblasts with included graphite, chlorite, and epidote minerals showing helicitic rotation and preserving isoclinal fold traces are characteristic. Grades into unit **Kca**

Kca Biotite schist and amphibolite—Mostly fine- to medium-grained well-laminated mica schist similar to unit Kcb but with rare to abundant schistose amphibolite, fine-grained hornblende gneiss, and less common calc-silicate schist and marble. Cut by dikes and sills of light-colored biotite tonalite and pegmatite

Kcm Marble—Coarsely crystalline white marble with gray streaks. Locally associated with calc-silicate granofels and schist. Also occurs as small lenses in unit **Kbgn**. *=pod too small to show at map scale

BANDED GNEISS (LATE CRETACEOUS)—Divided into:

Kbgn Gneiss, schist, and amphibolite—Interlayered heterogeneous light-colored tonalite to granodiorite gneiss, mica schist, and amphibolite similar to unit Kca. Contacts between gneiss and schist sharp in places and gradational in others along and across strike. Crosscutting sills, dikes and irregular bodies of light-colored, fine-grained to pegmatitic tonalite and gneiss. Some granodiorite pegmatite. Locally migmatitic. Minor garnet hornblendite, talc-tremolite rock and marble. Good descriptions in Rosenburg (1961, p. 38-54) and Van Diver (1964, p. 51-67). Most outcrops of this unit are composed of 10 percent or more light-colored gneiss. Percentage estimate of the amount of light-colored gneiss is shown by dot pattern (see explanation of symbols)

Kbg Biotite granodiorite gneiss—Homogeneous, light-colored, medium-grained biotite granodiorite gneiss with accessory sphene, allanite, and locally garnet. Relict euhedral oscillatory zoning in plagiociase and interstitial K- feldspar and quartz. Textures mostly granoblastic, but locally blastomylonitic, Contacts with schist are characteristically parallel or interlayered, locally crosscutting

Kbwu Light-colored gneiss of Wenatchee Ridge and ultramafite—Ultramafite pods similar to unit Ku; many altered to talc-tremolite rock

Kbw Light-colored gneiss of Wenatchee Ridge—Heterogeneous fine-grained to pegmatitic tonalite and granodiorite gneiss. Similar to gneisses in unit Kbgn but with only 1-5 percent schist and amphibolite

Ku ULTRAMAFITE (LATE CRETACEOUS)—Serpentinized peridotite and metaperidotite. x = pod too small to show at map scale

Kscm SCHIST OF CROOK MOUNTAIN (LATE CRETACEOUS)—Fine-grained phyllitic graphitic chlorite-muscovite schist, hornblende-clinozoisite schist, and rare graphitic muscovite-quartz schist (metaporphyry), and garnet amphibolite. Locally with albite porphyroblasts including folded S-planes revealed by graphite traces. In general characterized by greenschist facies mineralogy. Grades into the poikiloblastic mica schist unit (Kcp) to south

Ingalls terrane

INGALLS TECTONIC COMPLEX (EARLY CRETACEOUS OR LATE JURASSIC)—Divided into:

KJih Hornblende schist, amphibolite, biotite schist, and granofels—North of Harding Mountain, hornfels with relict structures and textures indicating that the protolith was a mixture of mafic volcanic breccia, volcanic conglomerate, argillaceous sediment, chert, pillow basalt, and gabbro cut by dacitic dikes. Locally, schistose amphibolite and biotite schist. At Windy Pass [11], amphibolite, biotite schist, calc-silicate granofels, metaquartzite, tonalite gneiss, and imbricated metaperidotite. Miller (1980b, p. 313-388) describes the Windy Pass and Harding

Mountain rocks in detail. East of the Stuart Range [24] very fine grained granoblastic amphibolite and garnet-biotite schist grades eastward into unit **KJip**. Includes small pods of serpentinite

KJip Phyllite—Very fine-grained black mica-quartz phyllite, minor greenstone and light colored greenstone

KJia Amphibolite—Similar to amphibolite in unit **KJih**. Grades eastward into unit **KJih**

KJig Greenstone—Includes minor phyllite

KJis Foliated and massive serpentinite, serpentinized peridotite, metaserpentinite, an metaperidotite—Near the Mount Stuart batholith ultramafic rocks are commonly thermally metamorphosed to talc-tremolite and anthophyllite bearing rocks, with metamorphic forsterite. Characteristically the rocks weather orange and are blocky jointed (Miller, 1975, p. 33; Frost, 1973). x = pod too small to show at map scale

KJid Diorite and gabbro—Metamorphosed pyroxene diorite and gabbro; uralitic, cataclastic, and altered to chlorite

Mad River terrane

HETEROGENEOUS SCHIST AND GNEISS (LATE CRETACEOUS)—Divided into:

Khs Heterogeneous schist—Mostly quartzitic schist, micaceous quartzite, fine-grained schistose amphibolite, amphibolite, hornblende-biotite schist, biotite schist, calc-silicate schist, marble, and rare biotite porphyroblastic gneiss, augen gneiss, and pyroxene-biotite gneiss. Rare graphite in the gneiss with kyanite. Some layers of biotite gneiss similar to the Swakane Biotite Gneiss. Includes small bodies of light-colored gneiss similar to unit Khlg. Scattered pods and lenses of ultramafite and talc rock. Isoclinally folded on outcrop scale; locally cut by aplitic to pegmatitic dikes and sills. Good description of the heterogeneous schist unit north of the quadrangle in Crowder (1959, p. 835- 838)

Khlg Light-colored gneiss—Mostly biotite gneiss with hornblende-biotite gneiss and muscovite-biotite gneiss; sphene and locally garnet. CI= 5-10. Two to thirty percent K-feldspar including some microcline that has partially replaced quartz, plagiociase, and micas. Heteroblastic, granitoid rock with uneven distribution of minerals. Cut by numerous light-colored tonalite dikes and sills

Khu Ultramafite—Larger bodies and masses along the Entiat fault are serpentine and serpentinized metaperidotite; smaller bodies and pods elsewhere are mostly talc schist and tremolite-talc rock, commonly highly foliate. X = pod too small to show at map scale

Khm Marble, calc-silicate schist with minor amphibolite, and micaceous quartzite—Along Entiat and Mad Rivers, a zone characterized by numerous marble beds and pods; some marble beds, with minor schist interbeds, up to 60 m thick (Danner, 1966, p.411). *= pod too small to show at map scale

ROCKS OF THE NAPEEQUA RIVER AREA (LATE CRETACEOUS)—Consist of:

Kns Schist and gneissic amphibolite—Micaceous quartzite, mica schist, garnet-biotite schist, and gneissic amphibolite. On Mount David [2] mostly micaceous quartzite; on Chiwawa Ridge mostly gneissic amphibolite and zoisite amphibolite gneiss similar to rocks in unit Knmg. Abundant metaporphyritic dikes

Knmb Mafic breccia-Mostly massive to gneissose mafic amphibolite with areas of breccia wherein angular clasts of massive, fine-grained hornblendite and amphibolite are set in a uniform amphibolite matrix with slightly different texture and grain size and spotted with small plagioclase porphyroblasts. Scattered rounded clasts of fine-grained quartzofeldspathic rock and rare marble. Breccias grade into migmatitic amphibolite and hornblende gneiss. Locally coarse hornblende-plagioclase pegmatite. Chemical analyses of a hornblendite clast and amphibolite (diorite) matrix of breccia are given in Ort and Tabor (1985, RWT 465A and B, Table 1 and 2)

Kmng Metagabbro, metadiorite, and metadiorite gneiss—Fine -grained crystalloblastic massive to gneissic with pale-brown subhedral hornblende zoned to actinolitic hornblende in matrix of zoisite, rare clinozoisite, muscovite, biotite, and oligoclase. In a few rocks subhedral plagioclase is mostly replaced by zoisite. Locally sheared out to hornblende-zoisite flaser gneiss and hornblende-zoisite schist. In western part of less deformed block near Roaring Creek [6] (shown without shearing symbol) interlayered zoisite rock (meta-anorthosite?) and metadiorite gneiss. Older, northwest-trending foliation crosscut by younger, east-west trending foliation and shears. Grades into blastomylonitic rocks on south and includes hornblende and hornblende-zoisite schist presumably derived from the metadiorite by marginal shearing

Knba Blastomylonitic amphibolite schist—Strongly foliated, very fine grained schistose amphibolite, chlorite-actinolite-clinozoisite schist, and zoisite -muscovite schist. Outcrops display many slickensides and are cut by chloritic shears. Schistose amphibolite grades into gneissic metagabbro and metadiorite. Unit includes granodiorite metaporphyry (premetamorphic dikes?) and talc schist

Knsp Serpentinized metaperidotite and metaperidotite; x = pod too small to show at map scale

Swakane terrane

Ksg **SWAKANE BIOTITE GNEISS AND AMPHIBOLITE AND HORNBLENDE SCHIST (LATE CRETACEOUS)**—Fine-to medium-grained biotite-oligoclase -quartz gneiss with very uniform schistose fabric and planar cleavage. Locally thin layers rich in mica. Commonly granoblastic and locally strongly mylonitic with varying amounts of muscovite and garnet and small amounts of sphene, zircon, apatite, and magnetite (Waters, 1932, p. 615). Small spindles of elongate mica aggregates define lineation. Very rare amphibolite, hornblende schist, and calc silicate schist. Light-colored tonalite, alaskite, and granite pegmatite dikes and sills common locally, especially on the axial zone of the broad antiform in the type area (Waters, 1932, p. 617 621, fig. 3). Locally divided into:

Ksga Amphibolite and hornblende schist—Thin fairly continuous layers locally gradational into the biotite gneiss. Includes calc-silicate schist and marble

Chelan Mountains terrane

Kpg **HORNBLENDE GABBRO AND QUARTZ GABBRO (LATE CRETACEOUS)**—Fine-to medium -grained hypidiomorphic granular to pseudosubophitic; clinopyroxene relicts in yellow- brown euhedral hornblende zoned to actinolitic hornblende. Plagioclase strongly euhedrally zoned from labradorite to albite. Rock is characteristically rich in apatite. Locally grades to hornblende quartz diorite. Commonly highly altered to chlorite, epidote, sphene, sericite, and K-feldspar. Also occurs as numerous unmapped dikes throughout the Chelan Complex

CHELAN COMPLEX OF HOPSON AND MATTINSON (1971) (LATE CRETACEOUS)— Divided into:

ENTIAT PLUTON—Consists of:

Kceg Fine-grained two-pyroxene gabbro—Least metamorphosed rocks contain unzoned subhedral andesine- labradorite in a tight knit mosaic with clinopyroxene, hypersthene, and rare intergranular quartz. In some rocks plagiociase prisms are strongly aligned. Pyroxene gabbro grades into fine-grained biotite- hornblende tonalite with green hornblende in fine-grained aggregates and poikiloblasts, surrounding rare relicts of hypersthene and clinopyroxene. Quartz in continuous mesostasis partially replaces plagioclase and mafic minerals. Includes some fine-grained hypersthene-bearing biotite-hornblende tonalite. Grades into unit **Kcet**

Kcet Hornblende-biotite and biotite-hornblende tonalite and tonalite gneiss—Ranges from a uniform tonalite to quartz diorite and rare granodiorite with pronounced lineation and rare mafic-rich layering to strongly schistose flaser gneiss, the latter located mostly along the western margin. Massive tonalite mostly medium-grained hypidiomorphic to xenomorphic granular with crystalloblastic aggregates of hornblende and biotite. Cl = 10-45, meters across. South end of pluton cut by mylonite zones and locally partially altered to chlorite, sericite, calcite, sphene, epidote and rare prehnite. For further descriptions and chemical analyses see Cater (1982, p.23-31) and Waters (1938, p. 769)

Kcbg **BANDED MIGMATITIC TONALITE GNEISS AND MAFIC AMPHIBOLITE—**Streaky, swirled and irregular light- and dark-colored biotite-hornblende tonalite gneiss including and grading into hornblende schist, hornblende-biotite schist, mafic amphibolite, hornblende- diorite pegmatite, and hornblendite. Highly variable in composition and texture. Heteroblastic to xenomorphic granular with unzoned andesine and green hornblende. Anastomosing dikes of fine-grained to pegmatitic-hornblende tonalite, diorite, and gabbro reported by Cater and Wright (1967)

Kchg **BANDED HORNBLENDE AND BIOTITE GNEISS—**Well-layered heterogeneous hornblende gneiss, biotite gneiss, gneissic amphibolite, hornblende-biotite gneiss, and light-colored biotite gneiss. Granoblastic with porphyroblasts of hornblende and plagiociase. Light-colored biotite gneiss in creases to the east. Gneiss commonly streaky with elongate aggregates and layers of mafic minerals. Foliation locally folded and swirled

Kcmi **MIGMATITE**—Heterogeneous hornblende tonalite and biotite tonalite and tonalite gneiss, much like unit Kct, mixed with mafic to feldspathic amphibolite, gneissic amphibolite, and blastoporphyritic feldspar gneiss. Microdiorite, a fine-grained granoblastic to xenomorphic hornblende, biotite, and plagiociase rock, is an important constituent and forms dikes and irregular bodies gradational to amphibolite (Hopson, 1955, p. 80-107). The migmatite is criss-crossed by small light-colored tonalitic to alaskitic dikes, sills, and irregular bodies, mostly with sharp contacts (Hopson, 1955, p. 80-93). Less common rocks in the migmatite are hornblende schist, biotite schist, and marble. Migmatite grades into gneissic to massive tonalite (Kct) commonly rich in mafic schlieren

Kca **AMPHIBOLITE AND HORNBLENDITE MIGMATITE**—Similar to unit **Kcmi** but with pods and lenses of hornblendite and dark amphibolite ranging from centimeters to several hundred meters across

Kcag **MIGMATITIC BIOTITE ALASKITE GNEISS—Heterogeneous,** light-colored gneiss ranging from fine-grained alaskite to pegmatite with abundant medium grained alaskite gneiss. Contains minor muscovite, epidote, apatite, and sphene. Heteroblastic, seriate with 5- 30 percent late K-feldspar replacing plagioclase and quartz. Swirled foliation. Gneissic amphibolite inclusions common. Occurs as replacement masses and sharply bounded dikes and irregular bodies

Kct **TONALITE**—Hornblende-biotite and biotite tonalite, with minor epidote, allanite, and sphene. Medium to coarse grained, locally with large poikiloblastic biotite plates. CI usually about 3-5 but varies locally up to 15. Subidiomorphic granular and xenomorphic to crystalloblastic gneissic. Euhedral oscillatory normal zoning in oligoclase-andesine varies from sharp and pronounced to faint and partially destroyed by secondary twinning. Epidote is poikiloblastic, partially replacing plagioclase. Rock is commonly strongly gneissic in outcrop and rich in mafic schlieren; grades into migmatite. Locally the tonalite is cut by even lighter colored tonalite dikes

Kcmt **MAFIC TONALITE**—Biotite-hornblende tonalite with CI=20-35. Subidiomorphic granular to crystalloblastic gneissose. Faint relict euhedral oscillatory zoning in plagioclase. Locally poikiloblastic hornblende prisms are well aligned. Rock is altered to epidote, chlorite, and prehnite

Kcga **HORNBLENDE TONALITE GNEISS OF ANTOINE CREEK**—Medium -grained heteroblastic gneiss with prominent lineation formed by elongate crystalloblasts and aggregates of hornblende with minor biotite strung out between partially crushed and recrystallized plagioclase. Some plagioclase has faint euhedral oscillatory zoning. Late cataclasis and chlorite-epidote alteration common

Kta **AMPHIBOLITE AND SCHIST OF TWENTYFIVE MILE CREEK (LATE CRETACEOUS)**—Fine-grained amphibolite, calc-silicate schist, biotite schist, siliceous biotite schist, and marble; well-layered, commonly iron stained. Locally cut by numerous light-colored tonalite dikes and sills. Commonly cut by micro shears and altered to chlorite, epidote, and sericite. Locally divided into:

Ktam **Marble**—Coarsely crystalline, white marble (Shown only with asterisk)