U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES MF-2336
SHEET 5 OF 6, Version 1.0
Pamphlet accompanies map

DESCRIPTION OF MAP UNITS

QUATERNARY AND TERTIARY OVERLAP DEPOSITS

Qal **Alluvial deposits (Holocene and late Pleistocene?)**-Clay, silt, sand, gravel, and boulders, deposited in stream beds, alluvial fans, terraces, flood plains and ponds; and soils formed on deposits. Includes largely Holocene deposits in modern stream channels and on flood plains

Qm **Undeformed marine shoreline and aolian deposits (Holocene and late Pleistocene)**-Gravel and sand deposited in marine terraces, on benches, and on dunes along present shorelines. In northern Eureka quadrangle, near Arcata, includes older late Pleistocene dune sands (Carver and others, 1984)

Qt **Undifferentiated nonmarine terrace deposits (Holocene and Pleistocene)**-Dissected and (or) uplifted gravel, sand, silt, and clay, deposited in fluvial settings. In western Eureka quadrangle (Sheet 1) unit includes minor shallow marine interfingures and warped and tilted beds of late Pleistocene Hookton and Rohnerville Formations of Ogle (1953), in addition to younger late Pleistocene and Holocene fluvial terrace units a few feet to a few tens of feet higher than normal modern high-water level

Qls **Landslide deposits (Holocene and Pleistocene)**-Unsorted clay- to boulder-size debris and broken-rock masses that have moved downslope in debris flows, earth flows, and as more-or-less intact rotational or translational blocks, largely from Pleistocene to present. Only large landslides, occupying tens to hundreds of acres, are depicted here.

QTog **Older alluvium (Pleistocene and (or) Pliocene)**-Weakly consolidated to unconsolidated alluvial sand and gravel in patches as much as 700 feet higher than the present stream level; locally may be related to remnants of old upland surfaces such as preserved along the upper reaches of Plummer, Naufus, and Bear Wallow Creeks in the Pickett Peak area of the Garberville quadrangle (Sheet 3). Also includes alluvium in upland basins to the west of the Eastern belt of the Franciscan Complex, such as Hoaglin and Kettenpom Valleys in the Zenia and Lake Mountain 1:24,000 quadrangles (Sheet 3)

QTw **Marsine and nonmarsine overlap deposits (late Pleistocene to middle Miocene)**-Thin-bedded to massive, weakly lithified siltstone, fine- to medium-grained sandstone, silty to diatomaceous mudstone and locally soft, scaly mudstone. Locally includes lenses of pebble to boulder conglomerate, carbonate concretions, abundant mollusc fossils, woody debris, and horizons of rhyolitic volcanic ash that are greater than 1 meter thick in some areas. Includes the Wildcat Group (Ogle, 1953), the Bear River beds (Haller, 1980), and related outlier Neogene deposits isolated along faults near Briceland, Garberville, Benbow, Piercy, Bridgeville and northeast of Weott. Unit also includes minor fault-bounded blocks along or near the coast between Bear River and the Mattole River that are incorporated into melange of the Coastal terrane; the Neogene False Formation northeast of Eureka (Manning and Ogle, 1950); and equivalent deposits in the offshore area deposited in shelf, slope, and slope basin settings. A few poorly exposed erosional remnants of shallow marine to brackish water strata mapped along high ridge crests overlying the Franciscan Complex in the 1:24,000 Zenia quadrangle are tentatively assigned to this unit. South of this map, unit correlates with valley-fill, perched gravel and shallow marine to nonmarine coal-bearing sedimentary rocks of Quaternary and Tertiary age in the Round Valley area of Covelo 1:100,000 quadrangle (Jayko and others, 1989)

Tv **Volcanic rocks of Fickle Hill (Oligocene)**-Trachytic alkalic volcanic rocks, which intrude rocks of the Central belt of the Franciscan Complex northeast of Arcata. A small sill-like intrusive exposed in a roadcut along Highway 299 north of Arcata on the Eureka quadrangle (Sheet 3), is dated by fission track methods (zircon) at 36.0–0.9 Ma (Meyer and Naeser, 1970). A larger volcanic plug of trachyte intrudes the Central belt at Granite Butte along Fickle Hill ridge, about 5 km south of the Highway 299 facility. Here, zircon is dated at 35.3–2.0 Ma by fission track methods (Meyer and Naeser, 1970)

COAST RANGES PROVINCE

FRANCISCAN COMPLEX

Coastal Belt

Coastal terrane(Pliocene to Late Cretaceous)

Sedimentary, igneous, and metamorphic rocks of the Coastal terrane (Pliocene to Late Cretaceous)-Predominantly sandstone, argillite and minor polymict conglomerate, that forms highly sheared melange and broken formation and is highly folded locally. Sandstone locally is thin-bedded to massive, rhythmically interbedded with argillite, arkosic, rich in felsitic intermediate volcanic detritus; and commonly it is veined with calcite, laumontite, and quartz. Interbedded penetratively sheared sandstone and thin-bedded argillite sequences in the Coastal terrane contains carbonate concretions with fossil planktic foraminifers, dinoflagellates, and spores and pollen, mostly indicative of a middle to late Eocene age (McLaughlin and others, 1994). At one locality south of the map area, low-latitude foraminifers of Late Cretaceous (Maastrichtian to Campanian) age occur in argillite interbedded with basaltic rocks in a melange (McLaughlin and others, 1994). Age of penetrative deformation of Coastal terrane melange is late Eocene and younger. Along the coast between False Cape and Cape Mendocino, and along north fork of the Mattole River near Petrolia, penetrative deformation is very young, due to rapid uplift of the subduction margin. Here, melange blocks with Pliocene bathyal foraminifers and bioclastic debris are incorporated into melange (McLaughlin and others, 1994; Aalto and others, 1995). The Pliocene strata are assigned to Marine and nonmarine overlap deposits (**QTw**).
Sandstone and argillite of the Coastal terrane are divided into 4 subunits based principally on topographic expression on aerial photographs and outcrop data:

co1 **Melange**-Dominantly of highly folded argillite and abundant clayey, penetratively sheared rock that exhibits rounded, lumpy, and irregular, poorly incised topography

co2 **Melange**-Subequal amounts of sheltered sandstone and argillite with much clayey, penetratively sheared rock that exhibits generally irregular topography lacking well-incised sidehill drainages

co3 **Broken sandstone and argillite**-Exhibits sharp-crested topography with a well-incised system of irregular sidehill drainage

co4 **Intact sandstone and argillite**-Exhibits sharp-crested topography with a regular, well-incised system of sidehill drainage
Minor mapped lithologies of the Coastal terrane include:

cob **Basaltic Rocks (Late Cretaceous)**-Pillow flows, tuffs, flow breccias, and intrusives present as rare blocks or as bodies in melange. Basalt is tholeiitic to alkalic in composition

cols **Limestone (Late Cretaceous)**-Pink to red, manganiferous, commonly overlies or is intercalated with basaltic rocks. Contains pelagic foraminifers indicative of deposition at a low paleolatitude and a Late Cretaceous (Maastrichtian to Campanian) age (Blake and others, 1980; McLaughlin and others, 1994). Unit includes exposures at Hackenville, Bear River (northeast of Cape Mendocino), and Parkhurst (northwest of Honeydew)

m **Undivided blueschist (Jurassic?)**-Glaucophane-, lawsonite-, and jadeite-bearing metamorphic rocks, commonly retrograded from rocks of eclogite or amphibolite facies. Occurs as rare blocks in zones of melange adjacent to King Range terrane. Locally blocks are armored with rind of scaly black argillite and actinolite. Blocks are compositionally identical to those in the Franciscan Central belt

Krp *King Range terrane (Miocene to Late Cretaceous)*

Igneous and sedimentary rocks of Point Delgada (Late Cretaceous)-Basaltic pillow flows, sills, flow breccia, tuff, and basaltic sandstone; minor intercalated calcareous red and gray argillite; melange containing rare blueschist blocks; and arkosic metasandstone and argillite (Textural zone 1 of Blake and others, 1967) containing the metamorphic assemblage quartz + albite + chlorite + white mica + pumpellyite. Rocks locally are veined with calcite or with prominent potassic hydrothermal alteration mineral assemblages associated with base- and precious-metal mineralization (McLaughlin and others, 1985; McLaughlin and others, 1982; Beutner and others, 1980; Underwood and others, 1999). Unit is exposed only at Point Delgada. Locally, includes:

sn **Undivided blueschist blocks (Jurassic?)**-Glaucophane-, lawsonite-, and jadeite-bearing metamorphic rocks, commonly retrograded from eclogite or amphibolite. Locally blocks are armored with rind of scaly black argillite and actinolite. Blocks of identical composition occur in Franciscan Central belt

Sandstone and argillite of King Peak (middle Miocene to Paleocene(?)-Arkosic sandstone and calcareous argillite and minor melange, which encloses rare blocks or lenses of red pelagic limestone, red to green manganiferous radiolarian chert, and basalt. The sandstone and argillite occur as thick- to thin-bedded turbidites that are highly folded and (or) penetratively sheared. Sandstone locally contains conspicuous intermediate volcanic detritus. A middle Miocene age for these rocks is suggested by radiolarian chert and cherty to calcareous argillite and benthic and planktic foraminifers in carbonate concretions. Some foraminifers indicate older (Eocene to Paleocene) ages, but are mixed with Miocene faunas and are therefore probably reworked. Sandstone and argillite of King Peak is divided into 3 subunits based principally on topographic expression in aerial photographs and outcrop data:

cm1 **Melange and (or) folded argillite**-Thin-bedded, highly folded, predominantly argillitic sequences. Unit exhibits subdued, irregular topography lacking a well-incised system of sidehill drainages

cm2 **Highly folded broken formation**-Exhibits sharp-crested topography with well incised but irregular sidehill drainages

cm3 **Highly folded, largely unbroken rocks**-Exhibits sharp-crested topography with a regular, well-incised system of sidehill drainages

Where mapped, the sandstone and argillite of King Peak locally includes:

cl **Limestone**-Red to white, locally with planktic or benthic foraminifers; present locally as melange blocks, and as a more extensive lithofacies of thin- to thick-bedded, concretionary and lenticular interbeds in calcareous argillite that in coastal area between Oat and Kinsey Creeks southwest of Hadley Peak (Sheet 2). At mouth of Oat Creek, interbedded limestone and argillite are underlain by a lens of sheared basalt, and red to pink ribbon chert, and limestone

krc **Chert**-Red to green, locally manganiferous, with radiolaria and diatoms of early to middle Miocene age, commonly associated with basalt. Most prominent exposures are in quarries on southwest flank of Queen Peak (Sheet 2)

krb **Basalt**-Tholeiitic and alkalic, present as rare blocks in melange. Blocks derived from pillowed flows, tuffs, and flow breccia, and may be associated with limestone or chert. In places blocks contain minor base metal mineralization. Basalt block near mouth of Cooskie Creek (Sheet 2) is dated by whole-rock K–Ar method at 16.2 – 0.5 Ma (McLaughlin and others, 1985)

Tc *False Cape terrane (Miocene? to Oligocene?)*

Sedimentary rocks of the False Cape terrane (Miocene? to Oligocene?)-Chiefly thin-bedded black argillite, sandstone, and siliceous to dolomitic limestone. Unit also includes minor chloritic cherty tuff and red ferruginous cherty limestone. Rocks are completely folded and thrust fault-bounded and underlie False Cape along the coast between mouths of Oil Creek (Sheet 1) and Bear River (Sheet 2). False Cape terrane is bounded to the north along Russ fault by the Coastal terrane and the Wildcat Group. To the south, terrane is bounded along the Bear River fault by the Bear River beds (Haller, 1980) and Coastal terrane. Calcareous hemipelagites of the False Cape terrane are commonly petrolliferous and emit strong kerosene odor. Locally, sandstones of the terrane contain carbonized plant debris. Diatoms in chert and cherty limestone of the terrane suggest a late Oligocene to early Miocene (+ 20/6 Ma) age (J. Barron, written commun., 1993); indicative of planktonic foraminifers in red ferruginous limestone and planktic zones N4b to N6 of the early Miocene (circa 18-22 Ma) (W.V. Sliter, written commun., 1993; Aalto and others, 1995)

Ysp *Yager terrane (Eocene to Paleocene?)*

Sedimentary rocks of the Yager terrane (Eocene to Paleocene?)-Argillite and arkosic sandstone rhythmically interbedded, this to medium bedded; massive to thickly bedded arkosic sandstone with minor interbeds of argillite; and minor lenses of polymict boulder to pebble conglomerate. Southwest of Garberville, unit highly folded, but locally may be penetratively sheared or broken. Argillite and thin-bedded fine-grained sandstone is commonly calcareous and may have abundant plant debris in places. Sandstone characteristically contains prominent detrital muscovite. Based on fossil dinoflagellates and on spores and pollen from carbonate concretions in argillite, age of terrane is late to middle Eocene. Locally the lower beds of the terrane may be as old as Paleocene (McLaughlin and others, 1994). This Yager terrane is divided into 3 subunits based principally on topographic expression in aerial photographs and outcrop data:

y1 **Sheared and highly folded mudstone**-Includes minor rhythmically interbedded sandstone, locally with lenses of conglomerate. Exhibits irregular topography lacking a well-incised system of sidehill drainages

y2 **Highly folded broken mudstone, sandstone, and conglomeratic sandstone**-Exhibits topography with sharp ridge-crests and well-incised sidehill drainages

y3 **Highly folded, little-broken sandstone, conglomerate, and mudstone**-Exhibits sharp-crested topography with a regular, well-incised system of sidehill drainages

The Yager terrane locally includes:

cgl **Conglomerate**-Polymict, well rounded, consisting largely of recycled clasts. Clasts commonly include abundant hypabyssal volcanic and plutonic rocks of granitic to dioritic composition; and less common metaclastic rocks (including black or green radiolarian chert, quartzite, metasandstone and metaconglomerate)

Central belt

Melange of the Central belt (early Tertiary to Late Cretaceous)-Consists of a matrix of clayey, penetratively sheared argillite and fine-grained sandstone, locally with intercalated green tuff and hard elliptical carbonate concretions armored with scaly black argillite. Includes blocks up to several kilometers across of various lithologies and ages. Age range of the Central belt is based on the paleontologic and isotopic age range of rocks in the melange and on inferred range in age of penetrative shearing, boudinage, and related deformation that occurred during melange formation. Components of the Central belt melange include:

Unnamed Metasandstone and meta-argillite (Late Cretaceous to Late Jurassic)-Arkosic lithic metasandstone and meta-argillite, reconstituted to textural zones 1 to 2A (Jayko and others, 1989) and metamorphosed to pumpellyite and lawsonite grade, with less than 1/2 percent K-feldspar (fig. 5). Unit locally includes cobble- to pebble-size polymict conglomerate or monomict chert-pebble conglomerate. Locally, the metasandstone and meta-argillite depositionally overlie radiolarian chert in composite melange blocks. In some places in blocks metasandstone is imbricated or structurally interleaved with chert and basalt. Fossils from unnamed metasandstone and meta-argillite range in age from Late Cretaceous to Late Jurassic. Carbonate concretions and local, thin, silty, hemipelagic chert beds and lenses in melange matrix contain radiolaria and dinoflagellates ranging in age from Late Jurassic to Early Cretaceous (Tithonian to Aptian or Albian). Some metasandstone and conglomerate in composite blocks depositionally overlie chert with a Late Cretaceous (Cenomanian) radiolarian assemblage. The unnamed metasandstone and meta-argillite is divided into subunits of melange and broken formation based principally on topographic expression in aerial photographs and outcrop data:

cm1 **Melange**-Predominantly penetratively sheared, locally tuffaceous, scaly meta-argillite and less abundant blocks of metasandstone. Exhibits rounded, poorly incised, lumpy and irregular topography

cm2 **Melange**-Subequal amounts of metasandstone and meta-argillite. Exhibits irregular topography that lacks well incised sidehill drainages, but is less lumpy than unit cm1

cb1 **Broken formation**-Consists of bedded to massive, locally folded, rarely conglomeratic metasandstone and meta-argillite, with only minor amounts of highly sheared rocks. Exhibits sharp-crested topography with regular, well-incised sidehill drainages

cb2 **Broken formation**-Very intact, unsheared or little sheared metasandstone. Exhibits very sharp-crested topography with more closely spaced and more regular well-incised sidehill drainages than exhibited by unit cb1

Other metasandstone units of the Central belt include:

cwr **White Rock metasandstone of Jayko and others (1989) (Paleogene and (or) Late Cretaceous)**-Arkosic metasandstone and minor meta-argillite, thick bedded to massive, shattered and sheared; commonly extensively veined with laumontite and calcite; metasandstone has 1 to 25 percent detrital K-feldspar and prominent detrital biotite. Unit occurs slabs and rafts in the Coastal belt several kilometers long, mostly along west side of the Central belt. Unit is named for similar metasandstone described in the Covelo 1:100,000 quadrangle (Jayko and others, 1989) that contains dinoflagellates of late Cretaceous age. Some blocks of the White Rock metasandstone possibly have been tectonically incorporated into the Central belt from the structurally underlying Coastal belt, and thus could be Paleocene or Eocene in age. A carbonate concretion from melange adjacent to the White Rock metasandstone along the western side of the Central belt in the Covelo quadrangle was found to contain Paleocene dinoflagellates (A. Jaylo, oral commun., 1993)

chr **Haman Ridge graywacke of Jayko and others (1989) (Cretaceous?)**-Broken formation, consisting of lithic, typically pumpelly-te-bearing graywacke and meta-argillite; at one locality along Haman Ridge northeast of Lake Mountain, unit is veined with laumontite. The Haman Ridge graywacke lacks K-feldspar and is suggested to be correlative with the Cretaceous (Cenomanian to Albian) English Ridge graywacke in the Covelo 1:100,000 quadrangle (Jayko and others, 1989)

cfs **Fort Seward metasandstone (age unknown)**-Arkosic metasandstone and meta-argillite and minor pebble conglomerate, well bedded with flute casts and fine-scale laminations, and highly folded locally. Metasandstone with prominent biotite and 12 to 22 percent K-feldspar. Unit lacks laumontite vein

Minor isolated blocks or components of composite blocks in melange of the Central belt include:

cls **Limestone (Late to Early Cretaceous)**-Red, pink, gray, or white foraminiferal limestone. Locally manganiferous, containing pelagic low-latitude foraminifers of Late and Early Cretaceous (Cenomanian to Albian) age (Sliter, 1984). Limestone commonly is associated with basaltic rocks and occurs as blocks in melange. Includes limestone localities at Laytonville, Cummings in the Covelo quadrangle south of Sheet 3, east of Harris, near Ft. Seward, and northeast of Ettersburg (Sheet 3)

ch **Chert (Late Cretaceous to Early Jurassic)**-Red or green radiolarian ribbon chert, thin bedded or massive and recrystallized. Radiolaria in chert may range from Late Cretaceous (Cenomanian) at top to Early Jurassic (Pliensbachian) at base, where most complete sections are preserved, but generally only parts of section are found in most locks. Chert locally depositionally overlies basalt flows and locally it is depositionally overlain by Late Cretaceous unnamed metasandstone and argillite unit

bs **Basaltic rocks (Cretaceous and Jurassic)**-Includes pillowed and non-pillowed flows, flow breccias, submarine tuff, and diabase. Basalt commonly is alkalic (high TiO2 content). Basalt may be overlain by radiolarian chert or foraminiferal limestone. Age of locally overlying limestone indicates some basalt to be as young as Middle Cretaceous (Aptian); where overlain by radiolarian chert, basalt is no younger than Early Jurassic. Basalt is metamorphosed to low greenschist grade

sp **Undivided bluechist blocks (Jurassic?)**-Glaucophane-, lawsonite-, and jadeite-bearing metamorphic rocks, commonly retrograded from eclogite or amphibolite, and schistose metasedimentary and fine-grained silicic to mafic metavolcanic rocks. Locally blocks are armored with rind of scaly black metavolcanic rocks, inferred to be derived from western side of Yolla Bolly terrane and translated northward with Central belt

ybl **Melange blocs, lithology unknown**-Delineated from aerial photographs but not identified in the field

Eastern Belt

Pickett Peak terrane (Early Cretaceous or older)

Metasedimentary and metavolcanic rocks of the Pickett Peak terrane (Early Cretaceous or older)-Includes:

ppsm **South Fork Mountain Schist**-Schistose and semischistose lawsonite-bearing metasedimentary and metavolcanic rocks (Irwin and others, 1974). Rb-Sr whole-rock ages suggest metamorphic age of approximately 125–5 Ma (Suppe, 1973; Lanphere and others, 1978; McDowell and others, 1984). Locally includes:

mb **Chinquapin Metabasalt Member (Irwin and others, 1974)**

ppv **Valentine Springs Formation**-Lawsonite-bearing metagraywacke, reconstituted to textural zone 2B to 3A (Blake and others, 1967; Jayko and others, 1989; Worrall, 1981). Includes minor slaty mudstone and scarce metaconglomerate. Along eastern margin of Garberville quadrangle (Sheet 3) also includes:

mv **Metabasalt and minor metachert**-Glaucophane-bearing, local remnants at base of Valentine Springs Formation

Yolla Bolly terrane (Early Cretaceous to Middle Jurassic?)

Metasedimentary and metaigneous rocks of the Yolla Bolly terrane (Early Cretaceous to Middle Jurassic?)-In this area divided into:

ybt **Taliaferro Metamorphic Complex of Suppe and Armstrong (1972) (Early Cretaceous to Middle Jurassic?)**-Schistose jadeite-bearing metagraywacke, crumpled phyllite, metagreenstone, and metachert. Metachert contains Late Jurassic radiolarian fossils. Metamorphic age of unit, based on radiometric dating (Suppe and Armstrong, 1972), is Early Cretaceous

ybc **Chicago Rock melange of Blake and Jayko (1983) (Early Cretaceous to Middle Jurassic)**-Mostly sheared cataclastic meta-argillite, metagraywacke, and metaconglomerate, with abundant blocks of fine-grained greenstone and radiolarian-bearing metachert, scarce serpentinite, and rare blueschist and amphibolite. Metaclastic rocks typically are lawsonite- and pumpellyite-bearing. Locally, scarce Buchias in melange matrix are of Berriasian and Valanginian ages. Where mapped, includes:

gs **Greenstone**-Mafic metavolcanic rocks, metagabbro, and metadiabase, commonly with macroscopic sodic amphibole (crocidolite). Some greenstone occurs in blocks of Eastern belt incorporated into Central belt

ys **Metachert**-Radiolarian from metachert of Chicago Rock melange are flattened and deformed, and have age ranges of Middle Jurassic to Early Cretaceous (Jayko and others, 1989; B. Murchey, oral commun., 1999)

ybs **Metagraywacke of Hammerhorn Ridge (Late Jurassic to Middle Jurassic)**-Dominantly coherent lithic quartzo-feldspathic metagraywacke with lesser amounts of meta-argillite and metaconglomerate; lawsonite- and pumpellyite-bearing, with abundant basal layers of metachert. Basal metachert contains radiolarian assemblages of Tithonian to Bajocian age (fossil locality 81, table 1; Isozaki and Blome, 1994; Baumgartner, 1987). Radiolarian assemblages from other metachert localities (Jayko and others, 1989) have Early Cretaceous-Middle Jurassic age ranges. Assignment of wide age range is due to poor preservation, and true age is most probably restricted to the Jurassic (Isozaki and Blake, 1994). Locally, unit includes scarce fine-grained extrusive greenstone, gabbro intrusives, and scarce tectonically interleaved serpentinite. Unit generally forms sharp-crested, timber-covered topography. Where mapped, includes:

ys **Metachert**

gs **Greenstone**-Including mafic volcanic rocks and gabbro

sp **Serpentinite**-Interleaved locally along faults

ybd **Devils Hole Ridge broken formation of Blake and Jayko (1983) (Early Cretaceous to Middle Jurassic)**-Dominantly lawsonite- and pumpellyite-bearing argillite, metagraywacke, and conglomerate with blocks and lenses of radiolarian chert and rare greenstone. Blocks of Lower Cretaceous age occur locally in upper part of metagraywacke. Unit locally includes:

ys **Radiolarian chert**

ybl **Little Indian Valley argillite of McLaughlin and Ohlin (1984) (Early Cretaceous to Late Jurassic)**-Predominantly thin-bedded argillite and minor lithic metagraywacke, isoclinally folded, with pronounced slaty axial plane cleavage, mapped in the Lassics area of Garberville quadrangle, northeast of Zenia (Sheet 3). Considered to be a translated slab within Central Belt. Unit characteristically lacks high-pressure index minerals, but contains pumpellyite. Type area is 160 km southeast of the Lassics area, near Wilbur Springs, California (McLaughlin and Ohlin, 1984; McLaughlin and others, 1990), where contains Buchias and other fossils of Early Cretacous (Valanginian) to Late Jurassic (Tithonian) age. In map area (Sheet 3) scraps of Buchia were found in talus, on the western slope of Black Lassic (table 1, Loc. 78; see also Kaplan, 1983)

Yolla Bolly terrane, undivided

ybs **Rocks of the Yolla Bolly terrane, undivided**

GREAT VALLEY SEQUENCE AND COAST RANGE OPHIOLITE

Elder Creek(?) terrane

ecms **Mudstone (Early Cretaceous)**-Dark-gray, thin-bedded mudstone, hackly fractured with minor tan, lithic, arkosic siltstone and sandstone and carbonate-rich nodules and veins. Locally an area of mudstone northwest of Black Lassic (Sheet 3) contains carbonate concretions with dinoflagellates of Early Cretaceous (Albian) age (J. L. Clark, written commun., 1986). Rocks are completely down-faulted onto underlying ophiolitic rocks along attenuation faults

Coast Range ophiolite (Middle and Late Jurassic)-Dismembered ophiolite, consisting of:

ecg **Layered gabbro**-Alternating discontinuous layers of plagioclase- and pyroxene-rich gabbro; includes minor intercalations of layered ultramafic rocks (wehrlite, clinopyroxenite, and dunite); rocks typically with cumulate igneous texture; exposed locally in Lassics area (Sheet 3)

ecsp **Serpentinite melange**-Scarce blocks up to 500 m long, of basalt, diabase, gabbro, and ophiolitic breccia in a sheared matrix of serpentinized dunite and minor harzburgite; locally may include small intrusive bodies of diorite and quartz diorite. At Red Lassic, northeast of Zenia (Sheet 3), includes a large block of pillow basalt flows and flow breccia with interleaved chert having Upper Jurassic (Tithonian) radiolarian assemblage (table 1 and fig. 3, Loc. 79; Kaplan, 1983; 1984). Elsewhere, chert associated with blocks in serpentinite melange are Late Jurassic (late Tithonian to Kimmeridgean) in age (McLaughlin and others, 1980)

Del Puerto(?) terrane

Rocks of the Del Puerto(?) terrane-Exposed locally along western margin of Central belt of Franciscan Complex east of Benbow (Sheet 3) and at Bear Buttes northwest of Garberville (Sheet 3). Rocks of this terrane are correlated with a more extensive ophiolite complex and overlying sedimentary rock with island arc affinities 300 km to southeast, in the Del Puerto canyon area, northeast of San Jose, California (McLaughlin and others, 1988a). Includes:

dpms **Mudstone (Late Jurassic)**-Dark green to black, tuffaceous scaly mudstone, highly sheared locally, containing carbonate concretions and nodules with radiolarian faunas of Late Jurassic (late Tithonian) age. Present only locally above ophiolite east of Benbow (Sheet 3)

dpt **Coast Range ophiolite (Middle and Late Jurassic)**-Dismembered ophiolite, consisting of:

dpb **Tuffaceous chert (Late Jurassic)**-Dark-green to brownish-red, tuffaceous radiolarian chert present locally east of Benbow (Sheet 3), below mudstone and above mafic extrusive and intrusive rocks. Contains radiolarian assemblage of Late Jurassic (Kimmeridgean) age

dpd **Basaltic flows and keratophyric tuff (Jurassic?)**-Uralitic and intruded locally by mylonitic quartz keratophyre dike rocks, present locally along west boundary of Central belt of Franciscan Complex near Benbow (Sheet 3)

dpsp **Diabase (Jurassic?)**-Dikes and sills, fine to coarse grained, with ophitic texture, present below basalt flows near Benbow and forms Bear Buttes north of Garberville (Sheet 3). Lower part of diabase unit of Bear Buttes locally includes minor cumulate gabbro. Lower diabase contact considered to be an attenuation fault

dp **Serpentinite melange (Jurassic?)**-Partially to completely serpentinized ultramafic rocks (harzburgite, minor dunite), locally highly sheared, and includes minor masses of cumulate gabbro, diabase or basalt. Present beneath diabase and (or) basalt of the Benbow and Bear Buttes areas (Sheet 3). Contact with overlying ophiolitic rocks probably is an attenuation fault. Unit is partially equivalent to some serpentinite interspersed with and assigned to Central belt of Franciscan Complex

Undivided Serpentinized peridotite (Jurassic?)-Commonly in thin lenticular to tabular masses, intruded along faults and shear zones throughout melange(s) of the Central belt. Some larger serpentinite masses probably are remnants of the Coast Range ophiolite, but here are designated undivided serpentinite unless associated with known outliers of Coast Range ophiolite

KLAMATH MOUNTAINS PROVINCE

Undivided Great Valley Sequence

Sedimentary rocks (Lower Cretaceous)-Sedimentary outliers consisting of well bedded and indurated mudstone, sandstone, and conglomerate. Glade Creek outlier, in central part of the Rattlesnake Creek terrane, contains Valanginian (Early Cretaceous) fossils and shows an upward transition from nonmarine to marine (Jones and Irwin, 1971). The outlier on the Hayfork terrane is mainly conglomerate and coarse sandstone and, although probably Early Cretaceous, is undated paleontologically

GREAT VALLEY SEQUENCE OVERLAP ASSEMBLAGE

Hayfork terrane

Eastern Hayfork subterrane

Melange and broken formation (early? Middle Jurassic)-Includes argillite, thin-bedded chert, mafic and locally silicic volcanic rocks, quartzose sandstone, limestone pods, serpentinite and rare blocks of mica schist and amphibolite. Chert contains Triassic radiolarians and conodonts, and questionably Jurassic radiolarians (Irwin and others, 1982); the limestone locally contains Late Permian fossils of Tethyan faunal affinity (Nestell and others, 1981). Age of serpentinite commonly occurs as slivers along Wilson Point thrust, which separates the Eastern Hayfork subterrane from the structurally underlying Western Hayfork subterrane (Wright, 1982). Includes:

Limestone (mapped locally)

Hayfork Bally Meta-andesite of Irwin (1985), undivided (Middle Jurassic)-Mainly augitic, crystal-lithic tuff and tuff breccia of andesitic to basaltic composition, commonly characterized by euhedral augite and plagioclase in light- to dark-green groundmass; unit locally includes interlayered thin-bedded chert and argillite; K-Ar isotopic age is 168-177 Ma (Fahan, 1982); unit intruded by the pre-accretionary Wildwood and other plutons of the Ironside Mountain plutonic belt (Irwin, 1985) and probably is cogenetic with this plutonism. U-Pb isotopic age of the Chanchelulla Peak pluton, which also intrudes the Hayfork Bally Meta-andesite, is about 169 Ma (Wright and Fahan, 1988) pre-dating timing of subterrane amalgamation. Unit is locally intruded by:

whwg **Wildwood (Chanchelulla Peak of Wright and Fahan, 1988) pluton (Middle Jurassic)**-Mostly dark-colored, medium-grained pyroxene gabbro and diorite forming an outer zone, with a core of clinopyroxenite. U-Pb isotopic age is 169 Ma (Wright and Fahan, 1988). Unit includes:

whwp **Clinopyroxenite**-In core zone of Wildwood pluton, mapped locally at northeastern boundary of Garberville quadrangle

whg **Diorite and gabbro plutons (Middle? Jurassic)**-Undivided small plutons composed of diorite and gabbro. Includes Crooks Creek and Oliphant Creek plutons (Irwin, 1985)

Rattlesnake Creek terrane

Melange (Jurassic and older)-Consisting of sheared and dislocated bodies of serpentinized peridotite, pillow basalt, and other mafic volcanic flows and tuff, thin-bedded chert, argillite, volcanic rocks of intermediate- to silicic composition, dikes and irregular intrusive bodies ranging from gabbro to granite, weakly slaty mudstone, sandstone and conglomerate, minor limestone, and blocks of amphibolite. Melange matrix varies from penetratively sheared metasedimentary rock to mafic volcanic rock and is locally gradational. Unit is also gradational with and may locally include components of other subunits. Chert contains Late Triassic to Middle Jurassic radiolarians and, at one locality, Late Triassic conodonts; limestone contains Middle Triassic corals, late Paleozoic fusulinids, and Late Triassic conodonts and coondont (Irwin, 1985; Irwin and others, 1985; Lakins, 1985). Mapped melange blocks include:

rcls **Limestone**

rcc **Radiolarian chert**

rcss **Volcanic Rocks (Jurassic or Triassic)**-Intermediate to silicic, fine-grained, commonly leucocratic volcanic rocks; locally includes shallow intrusive rocks, which may be equivalent to unit rdic, and minor mafic volcanic rocks

rdic **Intrusive complex (Early Jurassic or Late Triassic)**-Dikes and irregularly shaped bodies, dominantly leucocratic but ranging from gabbro to granite, intruding volcanic rocks equivalent to unit rcss

rcp **Plutonic rocks (Early Jurassic or Late Triassic)**-Medium- to coarse-grained rocks ranging in composition from diorite to granite; includes the Star Mountain and Bear Wallow plutons, which yield U-Pb isotopic dates of about 200 Ma and 193 Ma, respectively (see Wright, 1981)

rcum **Ultramafic rocks (Late Jurassic)**-Mainly sheared, serpentinized harzburgite but locally includes dunite, greenstone, rodingite and other metasomatized rocks of uncertain origin, basaltic volcanic rocks, and blocks of chert and minor limestone; locally, tectonized harzburgite forms bold blocky outcrops on steep canyon walls where cut by Hayfork Creek southwest of Wildwood (Sheet 3). Where mapped, locally includes:

rcpd **Blocky peridotite**-Dominantly tectonized harzburgite moderately serpentinized

Western Klamath terrane

Smith River subterrane

Galice? formation (Late Jurassic)-Mildly slaty to phyllitic argillite, graywacke, and stretched-pebble conglomerate; locally contains interlayers of pyroclastic andesitic kink folds common; unit probably correlative and continuous with the Galice Formation of northwestermost California and southern Oregon, which, north of the Smith River, contains sparse pelecypods of Late Jurassic (Oxfordian-Kimmeridgian) age (Imlay and others, 1959). Fossils were not found in Galice? Formation of map area; unit locally has contact-metamorphosed to hornfels and chiastolite-bearing schist adjacent to plutons. Includes:

srv **Pyroclastic andesite**-Interlayered in metasedimentary rocks, mapped locally

srgb **Glen Creek gabbro-ultramafic complex of Irwin and others (1974)**-Chiefly medium-grained to pegmatitic gabbro and hornblendite, with serpentinized peridotite. Rocks gave a K-Ar isotopic age of about 151 Ma (Irwin and others, 1974) and a U-Pb isotopic age of about 147 Ma (Wright and Fahan, 1988). Includes:

srpd **Serpentinized peridotite** (mapped locally)

MAP SYMBOLS

Contact-Dashed where approximate, dotted where concealed, queried where uncertain

Fault-Dashed where approximate, dotted where concealed, queried where uncertain

Thrust fault-Barbs on upper plate, dashed where approximate, dotted where concealed, queried where uncertain

Trace of the San Andreas fault associated with 1906 earthquake rupture-Dashed where approximate, queried where uncertain

Strike and dip of bedding:

Inclined-Ball denotes top of beds is known from sedimentary features

Vertical-Ball denotes top of beds is known from sedimentary features

Horizontal

Overturned-Ball denotes that top of beds is known from sedimentary features

Approximate-Based on photo interpretation or estimated dip in field

Joint-Strike and dip of joint

Strike and dip of cleavage-Ball denotes that top of flow is known from sedimentary or volcanic features

Shear foliation:

Inclined

Vertical

Folds:

Synclinal or synformal axis-showing direction of plunge

Anticlinal or antiformal axis-showing direction of plunge

Overturned syncline

Landslide-Arrows indicate direction of movement

Melange Blocks:

Serpentinite

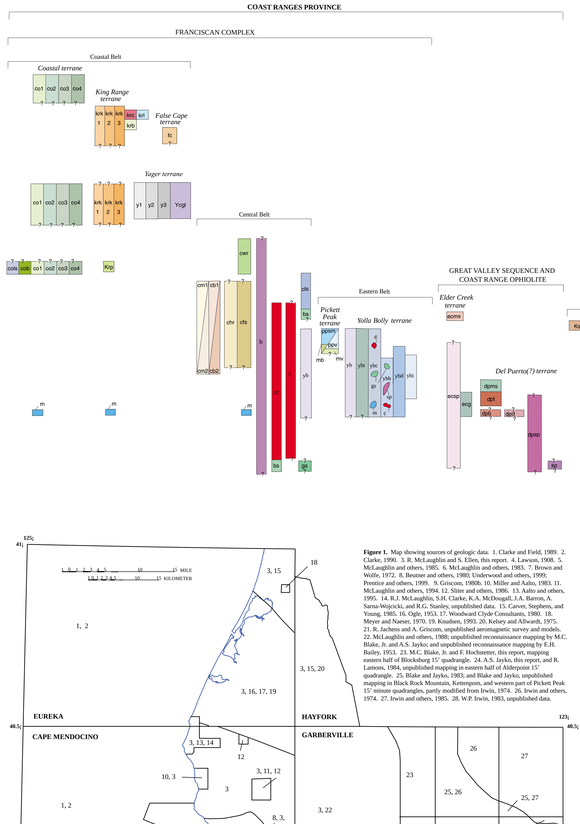
Chert

Blueschist

Greenstone

Fossil locality and number

CORRELATION OF MAP UNITS


COAST RANGES PROVINCE
FRANCISCAN COMPLEX
Coastal Belt
Coastal terrane
co1 co2 co3 co4
King Range terrane
krb krk krk krc krl krb
False Cape terrane
Tc
Yager terrane
y1 y2 y3 Ycgl
Central Belt
cwr
cm1 cb1
cm2 cb2
Krp
Eastern Belt
Pickett Peak terrane
ppsm ppv mv
Yolla Bolly terrane
c ybc ybs ybl
cls ch bs
Elder Creek terrane
ecms
Del Puerto(?) terrane
dpms dpt dpb dpd dpsp dp srpd
GREAT VALLEY SEQUENCE AND COAST RANGE OPHIOLITE
KLAMATH MOUNTAINS PROVINCE
Western Klamath terrane
srs srgb srv
Hayfork terrane
whwg whwp whg
ehsp ehs eh ehls
Rattle Snake Creek terrane
rcls rcss rcc rcp rcum rcpd
QUATERNARY AND TERTIARY OVERLAP DEPOSITS
Qal Qm Qt Qls QTog QTw
KLAMATH MOUNTAINS PROVINCE
Ks
GREAT VALLEY SEQUENCE AND OVERLAP DEPOSITS
Holocene
Pleistocene
Pliocene
Upper
Middle Miocene
Lower