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Preliminary map of selected post-Nevadan geologic features of the Klamath Mountains and adjacent areas, California and Oregon

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This map of selected post-Nevadan features is in a sense supplementary to Map I-2148 (Geologic map of the Klamath Mountains, compiled by W.P. Irwin, 1994). The map of selected post-Nevadan geologic features is in large part a compilation of the published work of many geologists (see Fig. 1--Index map showing sources of data). The principal new data are the outlines of remnants of old upland surfaces (unit "os" on the map) that are present mainly in a north-trending zone in the western Klamath Mountains and in a sub-parallel zone nearby in the Coast Ranges. The old upland surfaces were drawn mainly by interpretation of standard USGS topographic maps--mostly 1:62,500-scale but in some instances 1:100,000-scale maps. Old upland surfaces in the Coast Ranges west of the Klamath Mountains in Oregon, although present, are not shown.

The principal focus of Map I-2148 concerned the assemblage of terranes that constitute the principal bedrock of the Klamath Mountains. The terranes of the Klamath Mountains variously consist of rocks that range from Cambrian to Late Jurassic and perhaps even earliest Cretaceous age. All of these terranes have been subjected to episodes of metamorphism, plutonism, and tectonism, including a major widespread tectonic event which occurred mainly in Jurassic time and which generally is referred to as the Nevadan orogeny.

On the present map, the terranes that constitute the Klamath Mountains and its outliers are combined as a single composite unit that is referred to as the Klamath terrane. All of the Klamath terrane is thought to have been affected by the Nevadan orogeny. Following the Nevadan orogeny, the composite Klamath terrane was overlain with great unconformity by Cretaceous and Tertiary overlap assemblages of sedimentary and volcanogenic strata at the north end of the Great Valley and along the western margin of the Cascade Ranges. However, much of the overlapping rock has been stripped off the Klamath terrane by erosion so that the total extent of the original coverage by the overlap assemblages is poorly known.

In addition to the Klamath Mountains, the present map includes the portions of the Coast Ranges of California and Oregon that lie to the west. These additional portions consist mainly of terranes of marine Jurassic, Cretaceous, and Tertiary rocks that accreted to North America during Cretaceous and Tertiary times, after the Nevadan orogeny, and also include several tectonic outliers of western Klamath terrane. In Oregon, some terranes of the Coast Ranges share a Tertiary (Eocene) overlap assemblage with the Klamath terranes.

The present map of selected post-Nevadan geologic features was prepared principally for use as an aid in interpreting the tectonic events that shaped the Klamath Mountains and adjacent regions following the Nevadan orogeny. However, there is much disagreement as to the exact timing of the Nevadan orogeny. For the purpose of this map, the portions of the Great Valley sequence (overlap assemblage) that lie depositionally on the Klamath terrane are considered post-Nevadan. The oldest paleontologically dated of these strata represent the

Valanginian stage (131-138 Ma) of the Early Cretaceous. They are highly unconformable on the Klamath terrane, and lack the metamorphism and textural fabric that are commonly attributed to the Nevadan orogeny in the underlying rocks. Southward beyond the Klamath terrane the Great Valley sequence includes strata as old as Tithonian (Late Jurassic). These Upper Jurassic strata lie on the Coast Range ophiolite, but not on the Klamath terrane. Although these strata are older than some plutons of the Klamath terrane (for example, Shasta Bally batholith, 136 Ma), they lack the tectonic overprint attributed to the Nevadan orogeny in the Klamath terrane. The paleogeographic relations of the Coast Range ophiolite and overlying Upper Jurassic strata to the Klamath terrane during the Nevadan orogeny are unclear. The Coast Range ophiolite and its overlying strata are mapped as a separate terrane, the Elder Creek terrane, by Blake and others (1985).

The Klamath terranes, all of which are thought to have been involved to some degree in the Nevadan orogeny, are shown on the present map as a single composite unit. However, the terranes of the Coast Ranges west of the Klamath Mountains accreted to North America during post-Nevadan events. For reasons of cartigraphic clarity, only a few of the Coast Range terranes are shown individually on the main map: The generalized distribution of the various Coast Range terranes is shown on Figure 2. In addition to the Cretaceous and Tertiary overlap assemblages, the main map shows many small patches of marine and nonmarine Tertiary and Quaternary deposits. Most of these small patches are too discontinuous and limited in extent to be useful as overlap units, but they provide important information about the history of uplift of the region.

Evidence of at least several thousand feet of post-Early and post-Late Cretaceous uplift of the Klamath Mountains is provided by the Cretaceous overlap assemblages. Along the southeastern edge of the Klamath Mountains, the basal part of the marine Lower Cretaceous Great Valley sequence rests on Klamath terrane at altitudes ranging from about 1000 to 4800 ft., and the basal marine Upper Cretaceous rests on Klamath terrane near Redding and eastward at altitudes of about 650 to 1600 ft.

Scattered depositional outliers of Lower Cretaceous Great Valley sequence on southern Klamath terrane are at altitudes ranging from 1500 to 4000 ft. At one of these outliers (Glade Creek), rocks representing an Early Cretaceous shoreline (Jones and Irwin, 1971) are now approximately 3200 ft. above present-day sealevel. Along the northeastern edge of the Klamath Mountains, from Yreka to Medford, the Upper Cretaceous marine to nonmarine Hornbrook Formation rests on Klamath terrane at altitudes ranging from about 1400 to 4000 ft.

All of these Cretaceous strata of the overlap assemblage are dominantly marine and are moderately deformed. The outliers of Cretaceous strata are not uniformly distributed, and most of the interior area of the Klamath Mountains is devoid of them. Physiographic surfaces that suggest a relationship to the Cretaceous deposits are not seen.

The presence of old upland surfaces, even-crested ridges, and associated patches of old gravels in the Klamath Mountains was described nearly a century ago by J. S. Diller (1902) of the Geological Survey. He thought these features indicated the former presence of a widespread surface of low relief--the Klamath peneplain--which he believed to have covered most of the Klamath region during Miocene time. The evidence for the age of the surface was the presence of shelly fossils in patches of marine sedimentary strata (Wimer Formation) associated with the remnants of an old upland surface east of Crescent City. Although Diller thought these sediments to be Miocene, they now are considered at least partly earliest Pliocene (John Barron, written comm., 1988) based on marine diatoms found in Wimer Formation during a study of the old upland surfaces east of Crescent City by Stone (1992).

The altitudes of the old upland surfaces generally increase eastward, away from the coastline, and thus are generally higher in the Klamath Mountains than in the Coast Ranges. In the Coast Ranges of California, the old surfaces show an overall increase in altitude southeastward from the Oregon boundary to beyond the latitude of Cape Mendocino, and thus are seen to increase in altitude along the length of major southeast-trending ridges. The altitudes of the old surfaces in the Coast Ranges range from 1000 ft or less just south of the Oregon boundary, and increase to several thousand to rarely as much as 5000 ft in the southern part. In the Klamath Mountains, all the old surface remnants are higher than 2000 ft except for a few near the western boundary of the province just east of Crescent City. In the Klamath Mountains of Oregon the old surfaces reach altitudes of more than 4000 ft., and in California reach an altitude of about 6000 ft at a few places east of the Hoopa Valley.

At some places where the old upland surfaces coincide with exposures of ultramafic rocks of the Klamath Mountains and Coast Ranges, nickeliferous lateritic soils have developed (Fig. 3). These occurrences are mainly in Oregon and to a much lesser extent in California. These soils develop preferentially on relatively unserpentinized harzburgite rather than on highly serpentinized ultramafic rock (Ramp, 1978). They commonly occur on or near the crests of ridges, coincident with remnants of old upland surfaces, generally at altitudes between 2800 and 3600 feet but as high as 4200 feet. Associated landslide patches of nickeliferous laterite are locally present nearby at somewhat lower altitudes. One laterite locality, at Nickel Mountain near Riddle, Oregon, has been mined for its nickel content for several decades (see Fig. 3).

The ages of the various upland surface remnants are not established paleontologically except where patches of Wimer Formation of Miocene and(or) earliest Pliocene age are present east of the Crescent City platform. Many of the sedimentary patches associated with the old surface(s) elsewhere are so thoroughly weathered and decomposed that only the most resistant clasts are preserved, and fossils are not found. Local deep weathering of the bedrock and sedimentary patches along ridge crests, and development of saprolitic and nickeliferous lateritic soils, suggest a long period of exposure of a widespread surface during Pliocene-Pleistocene time. Along the coast between Cape Mendocino and Trinidad Head, several levels of warped marine terraces range in age from 83 to 200+Ka (Carver and Burke, 1992). The oldest of these Pleistocene terraces are at various levels well below the upland surfaces shown on the present map.

Various milestones in the post-Nevadan history of the region are shown on the Correlation of Map Units chart. These include: 1-Development of the South Fork Mountain Schist (Fig. 2) which is a regional metamorphic rind that formed during Early Cretaceous time on accretionary rocks directly beneath a westward overriding upper plate of Klamath terrane; 2-Intrusion by Oligocene alkaline rocks at Mt. Emily, at Fickle Hill, and elsewhere; and 3-Oligocene-mid Miocene movement along the Coastal Belt thrust (R. J. McLaughlin, oral comm., 1996), which moved rocks of the central belt of Franciscan melange westward over Yager Formation.

Also shown on the correlation chart are several stages in the development of early Man (Johanson and Edgar, 1996). Although the evidence for early hominid development has only been found elsewhere in the world, the chronological comparison with Klamath events gives a human perspective to the late Tertiary and Quaternary development of the Klamath Mountains and peripheral regions. Interestingly, the early hominids are thought to have branched off the evolutionary tree they shared with the chimpanzee approximately 6-7 Ma, which is about the time of deposition of the Wimer Formation. This occurred after the last accretionary event in the map area, perhaps excepting the King Range terrane which (according to R. J. McLaughlin, oral comm., 1996) may have accreted during Pliocene-Pleistocene time. Thus the hominids were evolving into Man in Africa and elsewhere during the time the old upland surfaces were forming in the Klamath Mountains and Coast Ranges. However, the earliest firm evidence of Man in western North America is the presence of spear points associated with fossil mammoths found near Clovis, New Mexico, dated at about 11-11.5 Ka (Johanson and Edgar, 1996). The oldest artifacts found in the northern coastal area of California are dated at about 6-7 Ka (Leigh Jordan, Northwestern Information Center, Sonoma State University, oral commun., Jan. 1997).

DESCRIPTION OF MAP UNITS

Qya--Younger alluvium (Quaternary)--Unconsolidated sand and gravel in beds of modern streams, on associated low terraces, and as valley fill; includes dune and beach sands, and estuarine deposits, in some coastal areas. Many small patches along modern streams are not shown.

Qs---Dune and beach sand, where mapped (Quaternary)

Qf---Alluvial fan deposits (Quaternary)--Shown only in Oregon portion of map (Smith and others, 1982)

Qv---Volcanic rocks (Quaternary)--Mainly basaltic and andesitic flows and pyroclastic rocks emanating mainly from Mount Shasta (Wagner and Saucedo, 1987); includes large area of chaotic volcanic landslide debris northwest of Mount Shasta

Qt---Alluvial deposits on low- and intermediate-level terraces associated with modern streams (Quaternary); includes deposits on some wave-cut terraces along the coast

Qth--Alluvial deposits on high-level terraces (Pleistocene and Pliocene?); includes "old channel" and "high bench" gravels of Wells and Walker (1953)

Qg---Glacial deposits (Pleistocene)--Moraines and outwash consisting of unconsolidated glacial debris: deposits in Weed sheet are from Wagner and Saucedo (1987), in Redding sheet from Fraticelli and others (1987), and in the Trinity Alps area from Sharp (1960)

Qby--Battery Formation (Pleistocene)--Unconsolidated sand and shale covering the southern part of the Crescent City platform (Maxson, 1933); locally may be as much as 20 m thick (Back, 1957); contains shells of marine mollusks approximately 100 Ka in age based on amino acid dating (Wehmiller and others, 1977)

Qhc--Hookton Formation (Pleistocene)--Orange-colored shallow-marine and nonmarine shale, sand, and gravel in the Humboldt Bay area; includes marine and continental terrace deposits; contains Rockland ash bed of probable 0.41 Ma age and Loleta ash bed of approximate 0.39 Ma age (Sarna-Wojcick and others, 1991)

Qm---Small marine terrace deposits near Cape Mendocino (Pleistocene)(Strand, 1962)

QToa-Older alluvium (Pleistocene and (or) Pliocene)--Weakly consolidated nonmarine silt, sand, and conglomerate occurring as perched terrace deposits, commonly more than several hundred feet higher than the nearby stream bed, or as deposits associated with remnants of old upland surfaces: locality source data--Irwin and others (1974), and Irwin (1960, 1963, 1974, 1985, and unpub. mapping)

Qrb--Red Bluff Formation (Pleistocene)--Red-colored sandy gravels, 1 to 10 m thick, that lie on a mildly deformed pediment surface that formed 0.45 to 1.08 m.y. ago (Helly and Jaworowski, 1985; Helly and Harwood, 1985)

Qsc--Surpur Creek unit of the Prairie Creek formation (Pleistocene (and Pliocene?))--Fluvial gravels on crests of ridges west of the lower Klamath River in Tectah Creek and Orick quadrangles; probably deposited by the ancient Klamath River (Kelsey and Trexler, 1989)

Qms--Skunk Cabbage unit of Prairie Creek Formation (Pleistocene)--Near-shore marine, light-colored sands with pebbly layers; thickness of unit ranges from a few meters to 50 meters; rests unconformably on Gold Bluffs unit and Redwood Creek schist and now uplifted about 500 meters; youngest beds probably no older than about 700 Ka (Kelsey and Trexler, 1989)

QTgb-Gold Bluffs unit of the Prairie Creek Formation (Pliocene and Pleistocene)--Weakly consolidated sand and gravel, grading upward from shallow marine sand in the lower part to deltaic and fluvial sand and gravel in the upper parts (Kelsey and Trexler, 1989). Marine mollusks in the lower part of the Gold Bluffs unit are similar to those found in the Falor Formation and are thought to constrain the lower age limit to 2-4 Ma (Kelsey and Trexler, 1989

QTf--Falor Formation (Pleistocene and late Pliocene)--Mainly shallow marine sandstone and conglomerate, but upper part may be continental; locally as much as 2460 ft thick and contains abundant molluscan fauna (Manning and Ogle, 1950); contains Huckleberry Ridge ash bed dated at about 2.0 Ma (Sarna-Wojcicki and others, 1991); age range of formation approximately 0.7-2 Ma (Kelsey and Trexler, 1989)

QTw--Wildcat Formation, undivided (Pleistocene to late Miocene)--Ranges from marine glauconitic mudstones in the lower part to nonmarine massive sandstone and conglomerate in the upper part; total section about 12,000 ft thick, with only minor stratigraphic breaks (Ogle, 1953); where divided, consists of units Qc, Pu, Pl, and Mu

Qc---Carlotta Formation (early Pleistocene)--Mainly nonmarine conglomerate, sandstone, and claystone; locally more than 3,300 ft thick; locally contains white volcanic ash beds and thin lignite beds (Ogle, 1953); includes Rio Dell ash bed of probable 1.48 Ma (Sarna-Wojcicki and others, 1991)

Pu---Scotia Bluffs and Rio Dell Formations (late Pliocene)--Rio Dell is mainly massive mudstone and thin beds of fine-grained sandstone, with local volcanic ash beds; mollusks and foraminifers common; contains Rio Dell ash beds of probable 1.48 Ma age, and Bear Gulch ash beds of estimated 1.9 Ma age (Sarna-Wojcicki and others, 1991); Scotia Bluffs Formation is mainly massive fine-grained shallow-marine sandstone, locally as much as 2,100 ft thick, and grades upward into Carlotta Formation (Ogle, 1953)

Pl---Eel River Formation (early Pliocene)--Dark-colored, glauconitic mudstone, siltstone, and sandstone; locally includes minor rhyolitic volcanic ash beds; disconformably overlies Pullen Formation; locally as much as 1,700 ft thick (Ogle, 1953); near base, includes ash equivalent to Putah Tuff (age 3.4 Ma)(Sarna-Wojcicki and others, 1991)

Mu---Pullen Formation (late Miocene)--Diatomaceous mudstone, siltstone, and sandstone; overlies Yager Formation with angular unconformity; lower and middle parts are upper Miocene (Mohnian); upper part may be lower Pliocene; age based mainly on foraminifers (Ogle, 1953)

Tsg--St. George Formation (earliest Pliocene and latest Miocene)-Sandstone and shale containing a shallow marine invertebrate fauna (Maxson, 1933; Moore and Silver, 1968; Back. 1957). Exposed thickness is less than approximately 30 m (Maxson, 1933) but total thickness may be as much as 120 m (Back, 1957). Contains latest Miocene to earliest Pliocene (approx. 5.5-7 Ma) diatoms, (John Barron, oral comm., 1992); probably a near-shore bioturbated storm deposit and a western facies of the Wimer Formation (Stone, 1992)

Tt---Tyee Formation (middle Eocene)--Thick sequence of marine sandstone and siltstone, with minor tuffaceoous interbeds (Walker and MacLeod, 1991)

Tss--Marine sandstone and siltstone (middle Eocene)--Well sorted, partly deltaic, shallow marine deposits (Walker and MacLeod, 1991)

Tsc--Marine deposits ranging from conglomerate to mudstone (early Eocene)(Walker and MacLeod, 1991)

Tsm--Marine sandstone, siltstone, and mudstone (early Eocene and Paleocene?)--Deep sea fan deposit (Walker and MacLeod, 1991)

Teh--Tehama Formation (Pliocene)--Weakly consolidated nonmarine epiclastic sandstone and conglomerate; near base includes Putah Tuff and Nomlaki Tuff Members which are K/Ar dated at 3.4 Ma (Sarna-Wojcicki and other, 1991)

Tus--Tuscan Formation (Pliocene)--Volcanic-derived siltstone, sandstone, conglomerate, and tuff; includes reworked Nomlaki Tuff near base, and, stratigraphically higher, the Ishi Tuff member dated at approximately 2.5 Ma (Sarna-Wojcicki and others. 1991)

Tv---Volcanic rocks (Pliocene)--Basaltic and andesitic flows, breccia, and tuff of the Cascade Range along the eastern side of the Klamath Mountains (Jennings, 1977; Lydon and others, 1960)

Tms--Sedimentary rocks (Miocene)--Nonmarine; two patches along eastern border of province; presumably overlies Montgomery Creek Formation and overlain by Pliocene volcanic rocks (Jennings, 1977)

Tg---Remnant patches of old high-level nonmarine gravels (Pliocene?)--Includes deposits at Gold Basin and York Butte in Oregon considered auriferous gravels of the 1st cycle by Diller (1914)(also see Wells and others, 1948)

Twi--Wimer Formation (earliest Pliocene and late Miocene?)--Weakly consolidated shallow-marine to non-marine siltstone, sandstone and conglomerate; western exposures are marine and eastern are fluvial (Stone, 1992); deposits coincide with an upland erosional surface (Klamath peneplain of Diller, 1902); molluscan fauna indicates late Miocene age (Watkins, 1974), but diatoms indicate probable earliest Pliocene age (Stone, 1992; John Barron, written communication, 1995)

Ti---Alkalic intrusive rocks (Oligocene)--Includes Mt. Emily and associated occurrences (K-Ar dated at 30 Ma) in coastal Oregon (Dott, 1971), several small ocurrences in western Klamaths of Oregon (Smith and others, 1982), small trachytic intrusives near Fickle Hill (dated at 35.3-36.0 Ma by fission-tracks in zircon (Meyer and Naeser, 1970)) and at nearby Quarry Creek in Blue Lake quadrangle (Manning and Ogle, 1950), an alkalic ultramafic diatreme at Coyote Peak dated at about 29 Ma (Morgan and others, 1985), at Blue Creek in Tectah Creek quadrangle (K. R. Aalto, unpub map), and syenite (undated) near mouth of Mad River (Irwin, 1960)

Tw---Weaverville Formation (early Miocene and/or late Oligocene)-Weakly consolidated non-marine sandstone, conglomerate, and tuff; locally contains coal beds; age based on fossil plants (MacGinitie, 1937), palynomorphs (Barnett, 1982), and, in the Hyampom area, a Miocene fossil fish (LeRoy, 1993); flora suggests subtropical to warm temperate climate (Barnett (1982); locality source data from Irwin (1963, 1974, 1985), Fraticelli and others (1987); areas of questionable Tw northwest of Hoopa adapted from Irwin (1960) and Judith Wait (unpub. mapping, 1993)

Tvs--Sedimentary and volcanic rocks (Oligocene and Eocene)--Andesitic and basaltic flows, breccia, tuff, minor rhyolitic tuff, and intercalated sedimentary units of the Cascade Range along the northeastern border of the Klamath Mountains (Smith and others, 1982; Walker and Macleod, 1991)

Ts---Sedimentary rocks (Eocene)--Mainly fluvial sandstone and conglomerate; mostly non-volcanic and derived from the underlying older rocks; unconformably overlies Hornbrook Formation

Tmc--Montgomery Creek Formation (Eocene)--Weakly indurated, thick-bedded arkosic sandstone, conglomerate and shale; nonmarine and mostly fluviatile; locally includes coal beds; approximately 800 m thick; rests unconformably on Late Cretaceous and older rocks along the southeast border of the Klamath Mountains

Ty---Yager Formation (late Eocene to Paleocene) (McLaughlin et al, 1994))--Indurated mudstone and thin-bedded siltstone, with subordinate sandstone and conglomerate; 750 to 3000 ft thick (Ogle, 1953; Evitt and Pierce, 1975); considered a terrane with highly mixed provenance by McLaughlin and others (1994)

TKc--Coastal belt rocks (late Eocene to Late Cretaceous)--Mainly sandstone, argillite, and conglomerate; locally includes basaltic pillow lavas, flow breccias, tuffs, and rare foraminiferal limestone; blocks of blueschist are present in melange along the western border (McLaughlin and others, 1994)

Tkr--King Range terrane (middle Miocene)--Dominantly argillite, sandstone, and minor chert, limestone, and basalt (McLaughlin and others, 1994)

Ku---Late Cretaceous shallow-marine sedimentary rocks of coastal Oregon (Maastrichtian and Campanian)--Includes the Cape Sebastian sandstone of Dott (1971), consisting of more than 800 ft thickness of massive sandstone and conglomerate, and the overlying Hunters Cove Formation of Dott (1971), consisting of at least 700 to 1000 ft thickness of alternating thin sandstone and mudstone (Dott, 1971)

Kl---Marine sedimentary rocks of coastal Oregon (Early Cretaceous)--Includes the Humbug Mountain Conglomerate (Berriasian or Valanginian) which overlies Galice Formation with angular unconformity, and the overlying(?) Rocky Point Formation (Valanginian)(Dott, 1971)

KJm--Myrtle Group (Early Cretaceous and Late Jurassic)--Marine sedimentary rocks; dominantly sandstone, siltstone, and conglomerate; includes Riddle Formation (Tithonian) and Days Creek Formation (Valanginian and Hauterivian)(Imlay and others, 1959); correlative with Great Valley sequence of California

Kh---Hornbrook Formation (Late Cretaceous)--Mudstone, sandstone, and conglomerate; approximately 1,200 m thick; mainly Cenomanian to Maastrichtian age; includes some Early Cretaceous (Albian) in Grave Creek area; shallow and deep marine to non-marine; locally includes minor coal beds; deposited unconformably on Klamath pre-Nevadan rocks (Nilsen, 1984 and 1993)

Kc---Chico (aka Redding) Formation (Late Cretaceous)--Siltstone, sandstone, and conglomerate; shoreline and shallow marine, Turonian and Santonian in age (Sliter and others, 1984); unconformable on pre-Nevadan rocks

Kgv--Great Valley sequence (Early Cretaceous)--Mudstone, sandstone, and conglomerate; dominantly Valanginian to Albian age in map area, but includes minor Late Cretaceous;

includes Tithonian (Later Jurassic) south of Klamath Mountains ; mainly marine, but locally includes non-marine beds in Glade Creek and Big Bar outliers; lies on erosional surface of Shasta Bally batholith (136 Ma, in Lanphere and Jones, 1978) and older Klamath basement rocks

os---Remnants of old upland surfaces in Klamath Mountains and Coast Ranges (Pleistocene to late Miocene)--Presence of remnant surfaces is based mainly on interpretation of 1:62,500- and 1:100,000-scale topographic maps; most remnant surfaces are along the crests of broad linear ridges; on some ridge crests the old surfaces coincide with thin patches of weathered late Miocene, Pliocene, or Pleistocene sedimentary deposits, but are paleontologically dated only where coincident with Wimer Formation; some surfaces coincide with deeply weathered bedrock and patches of saprolitic or lateritic soil (see Fig. 3); many of the remnant surfaces were referred to as part of a widespread "Klamath peneplain" by Diller (1902) and by Maxson (1933); although present, remnant upland surfaces are not mapped west of the Klamath Mountains in Oregon or in the Coast Ranges south of the latitude of Cape Mendocino in California in this report.

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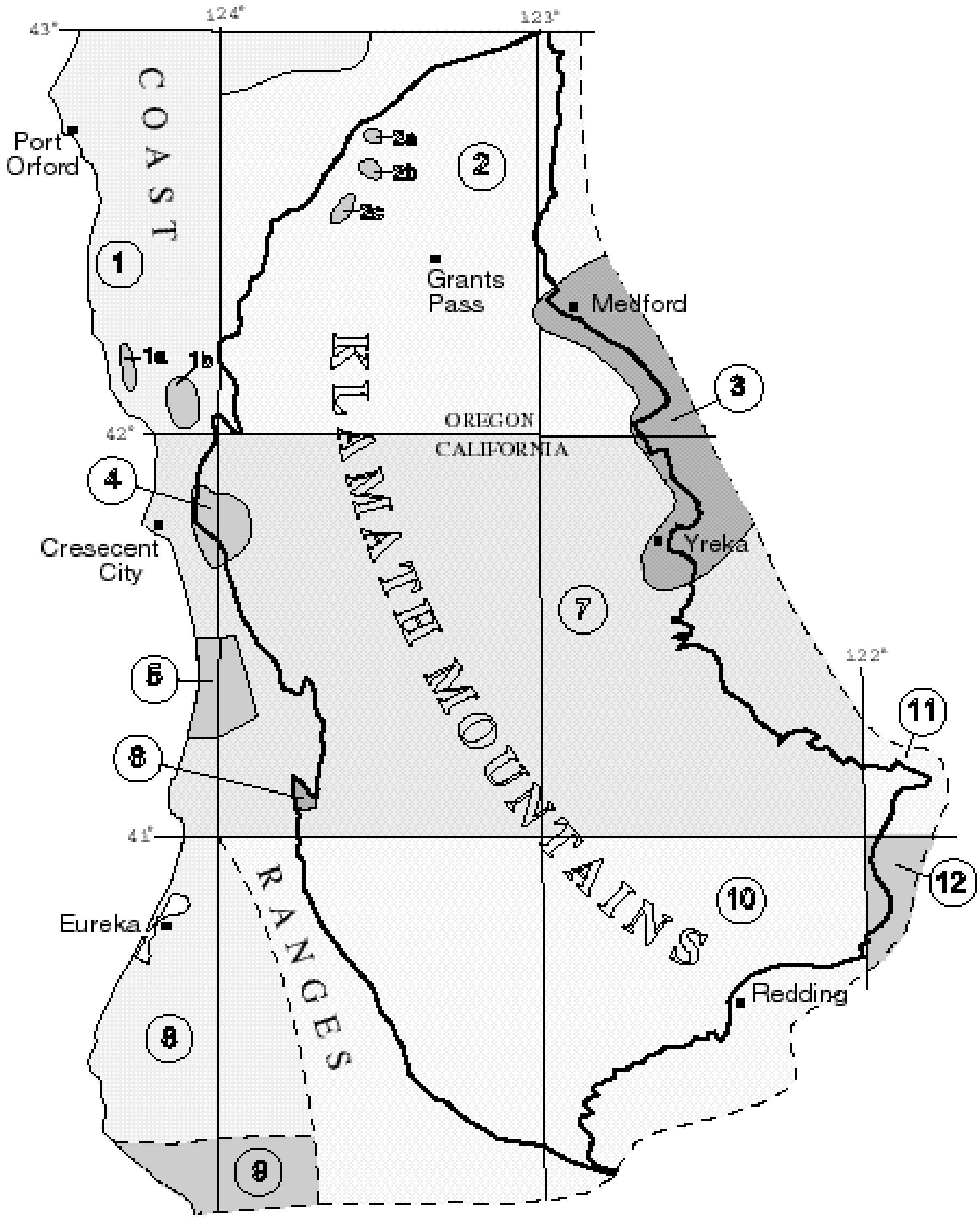

FIGURE 1. Index to sources of data shown on map of selected post-Nevadan geologic featuresof the Klamath Mountains and adjacent areas, California and Oregon. Circled numbers refer to numbered sources on the following page.

Explanation for Figure 1. Numbers correspond to those shown on Index Map.

1-Adapted from Walker and Macleod (1991): Alkaline intrusive rocks shown in sub-areas 1a and 1b are from Dott (1971), and in western Klamath Mountains of Oregon from Smith and others (1982)

2-Adapted mainly from Smith and others (1982): Laterite at Nickel Mountain near Riddle is adapted from Pecora and Hobbs (1941): Highlevel gravels at Gold Basin and other localities in Oregon are from Wells and others (1948), Diller and Kay (1909), and Diller (1914). "Old channel" and "high bench" gravels (Qth) in sub-areas 2a, 2b, and 2c are from Wells and Walker (1953).

3-Distribution of Cretaceous and Tertiary overlap sequences is adapted from Nilsen (1984 and 1993).

4-Wimer Formation and other highlevel deposits are from Cater and Wells (1953), Watkins (1974), Aalto and Harper (1982), Saleeby and others (1982), and Wagner and Saucedo (1987).

5-Prairie Creek Formation and associated terrace deposits are from Kelsey and Trexler (1989), and Harden and others (1981).

6-Questionable Weaverville Formation in Hoopa area is adapted from Irwin (1960) and Judith Wait (unpub. mapping, 1993).

7-Modified from Wagner and Saucedo (1987).

8-Adapted from Strand (1962).

9-Modified from McLaughlin and others (1994).

10-Modified from Fraticelli and others (1987): Some glacial deposits (Qg) are from Sharp (1960).

11-Adapted from Jennings (1977), Sanborn (1960), and M. M. Miller (in Irwin, 1994).

12-Modified from Lydon and others (1960).

All remnant patches of "old surfaces" (os) are interpreted from USGS topographic maps (mostly 15-minute quadrangles) and are unpublished: Old surfaces in the Coast Ranges of Oregon west of the Klamath Mountains are not shown.

Alkaline intrusives in California Coast Ranges are from Blake (1977), Meyer and Naeser (1970), Manning and Ogle (1950), Irwin (1960), and K. R. Aalto (written commun., 1995).

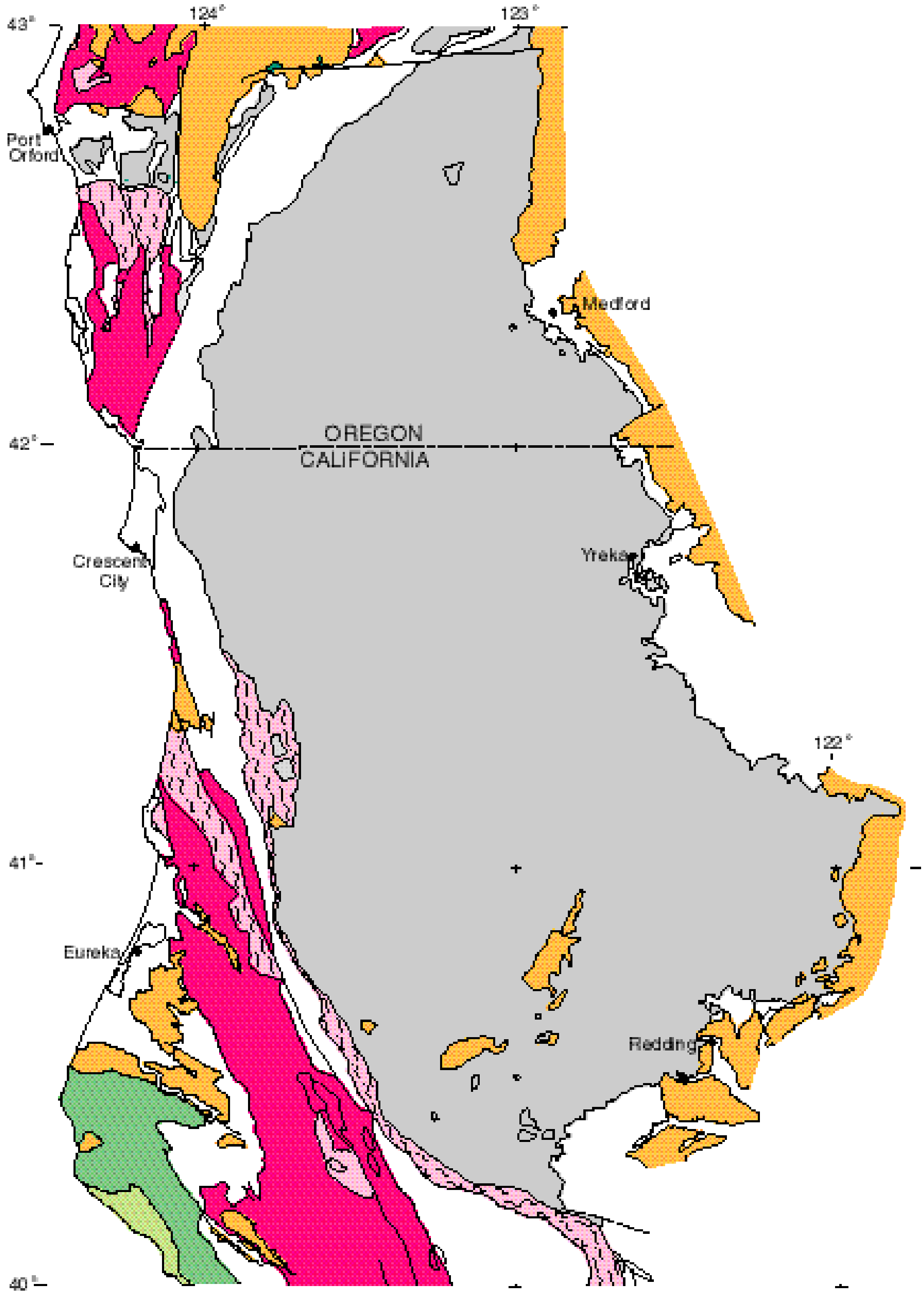

FIGURE 2. Generalized map of the Klamath Mountains and adjacent regions.

EXPLANATION (for Figure 2)

POST-NEVADAN ACCRETED TERRANES

King Range terrane (Late Cretaceous to middle Miocene)

Coastal terrane (Late Cretaceous to late Eocene)

Yager terrane (Paleocene and Eocene)

Gold Beach terrane (Late Jurassic and Cretaceous)

Franciscan melange (and Oregon equivalents)

Yolla Bolly terrane (semi-coherent graywacke)(and Oregon equivalents)

South Fork Mountain Schist and Colebrooke Schist: Early Cretaceous metamorphic age approximately 125 Ma

OVERLAP ASSEMBLAGES

Quaternary

Tertiary

Latest Jurassic and Cretaceous: Includes Great Valley sequence, Myrtle Group, and Hornbrook Formation

PRE-OVERLAP ROCKS

Klamath Mountains composite terrane (Late Jurassic and older)

Coast Range ophiolite (Jurassic) and correlative (?) ophiolitic rocks in Coast Ranges of Oregon

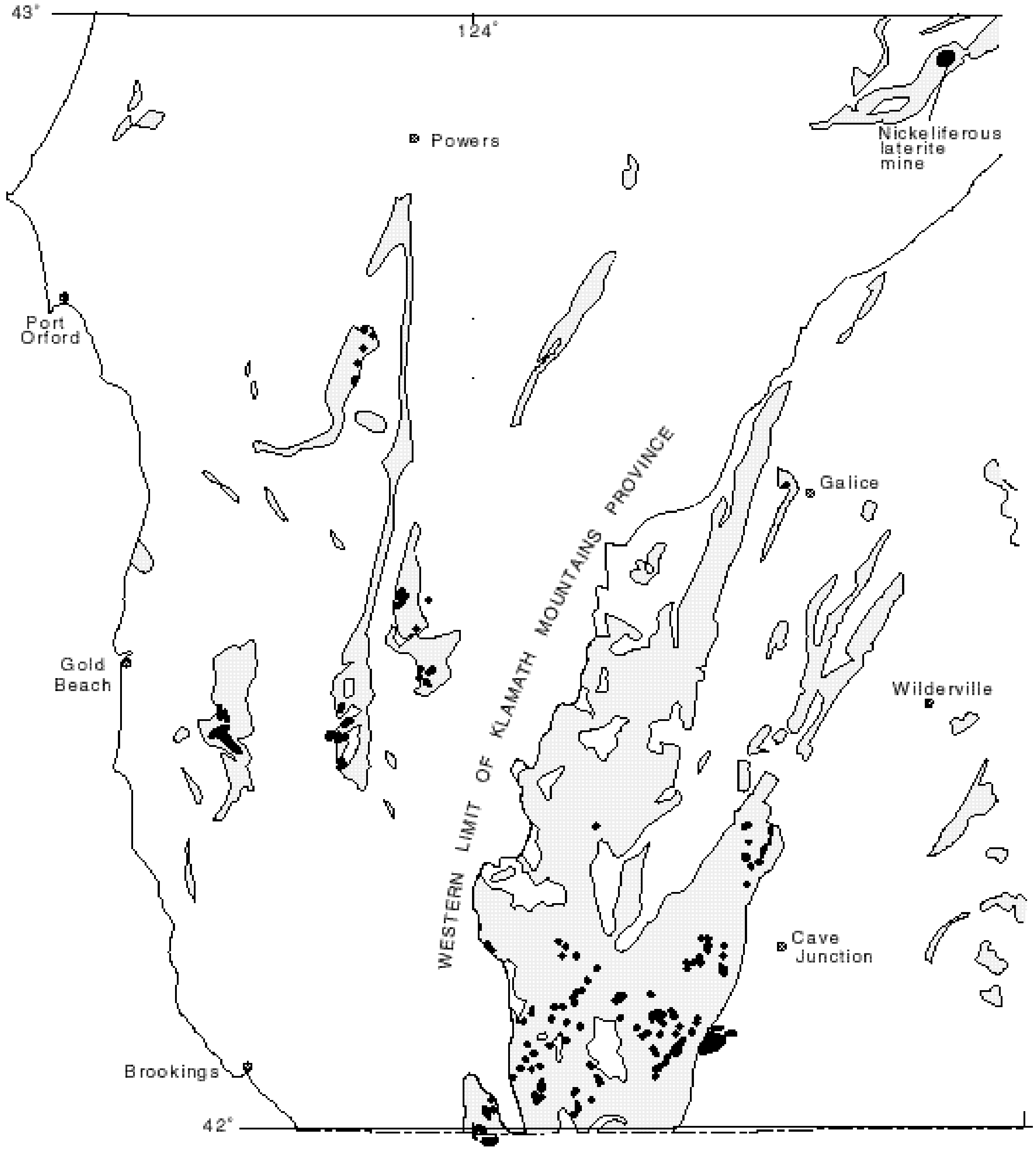

FIGURE 3. Distribution of ultramafic rocks (gray areas) in southwestern Oregon (after Walker and MacLeod, 1991), and associated nickeliferous laterite deposits (black spots)(adapted from Ramp, 1978).