

TERRANES OF THE WESTERN PALEOZOIC AND TRIASSIC BELT IN THE SOUTHERN KLAMATH MOUNTAINS, CALIFORNIA

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Abstract.—The western Paleozoic and Triassic belt of the Klamath Mountains is herein subdivided from west to east into the Rattlesnake Creek, Hayfork, and North Fork terranes, further emphasizing the previously known composite nature of the province. The Rattlesnake Creek terrane is dominantly ophiolitic, includes appreciable soda granite, is structurally incompetent, and contains many deposits of chromite and manganiferous chert. The Hayfork terrane is in large part andesitic, includes the syenodioritic Ironside Mountain batholith, is relatively competent, and contains lode-gold deposits. The North Fork terrane is also ophiolitic, but metalliferous deposits similar to those of the Rattlesnake Creek terrane seem nearly absent. All three terranes include lenses of Permian limestone, but the Rattlesnake Creek terrane also includes Triassic limestone. The lithologies of the terranes suggest that the Rattlesnake Creek and North Fork terranes are tectonic slices of oceanic crust and that the Hayfork terrane originated as an island arc.

The western Paleozoic and Triassic belt is the most extensive of several concentric lithic belts that constitute the Klamath Mountains of northwestern California and southwestern Oregon (fig. 1). It was defined during a reconnaissance of the northern Coast Ranges and Klamath Mountains of California in the 1950's (Irwin, 1960) and at that time was recognized as a catchall for a variety of formations that vary widely not only in lithology but also in probable age. Reexamination of some parts of the southern Klamath Mountains during the past decade has led to the presently proposed subdivision of the western Paleozoic and Triassic belt. This report is preliminary in the sense that its principal theme is based largely on geologic mapping still in progress.

The western Paleozoic and Triassic belt in the southern Klamath Mountains is herein subdivided into three concentric subbelts of rocks that are referred to, from west to east, as the Rattlesnake Creek, Hayfork, and North Fork terranes (fig. 2). The term "terrane" as used herein refers to an association of geologic features, such as stratigraphic formations, intrusive rocks, mineral deposits, and tectonic history, some or all of which lend a distinguishing character to a particular tract of rocks and which differ from those of an adjacent terrane.

The concentric distribution of the three terranes is parallel to that of other lithic belts of the Klamath Mountains

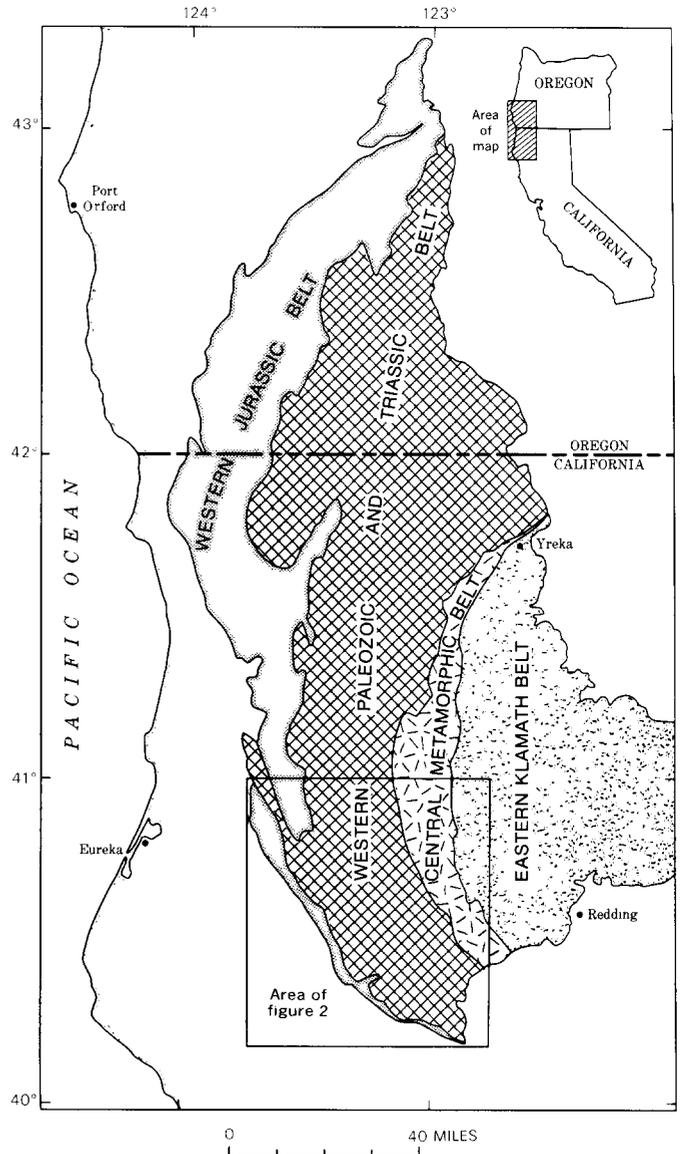


Figure 1.—Generalized map showing the lithic belts of the Klamath Mountains province of California and Oregon.

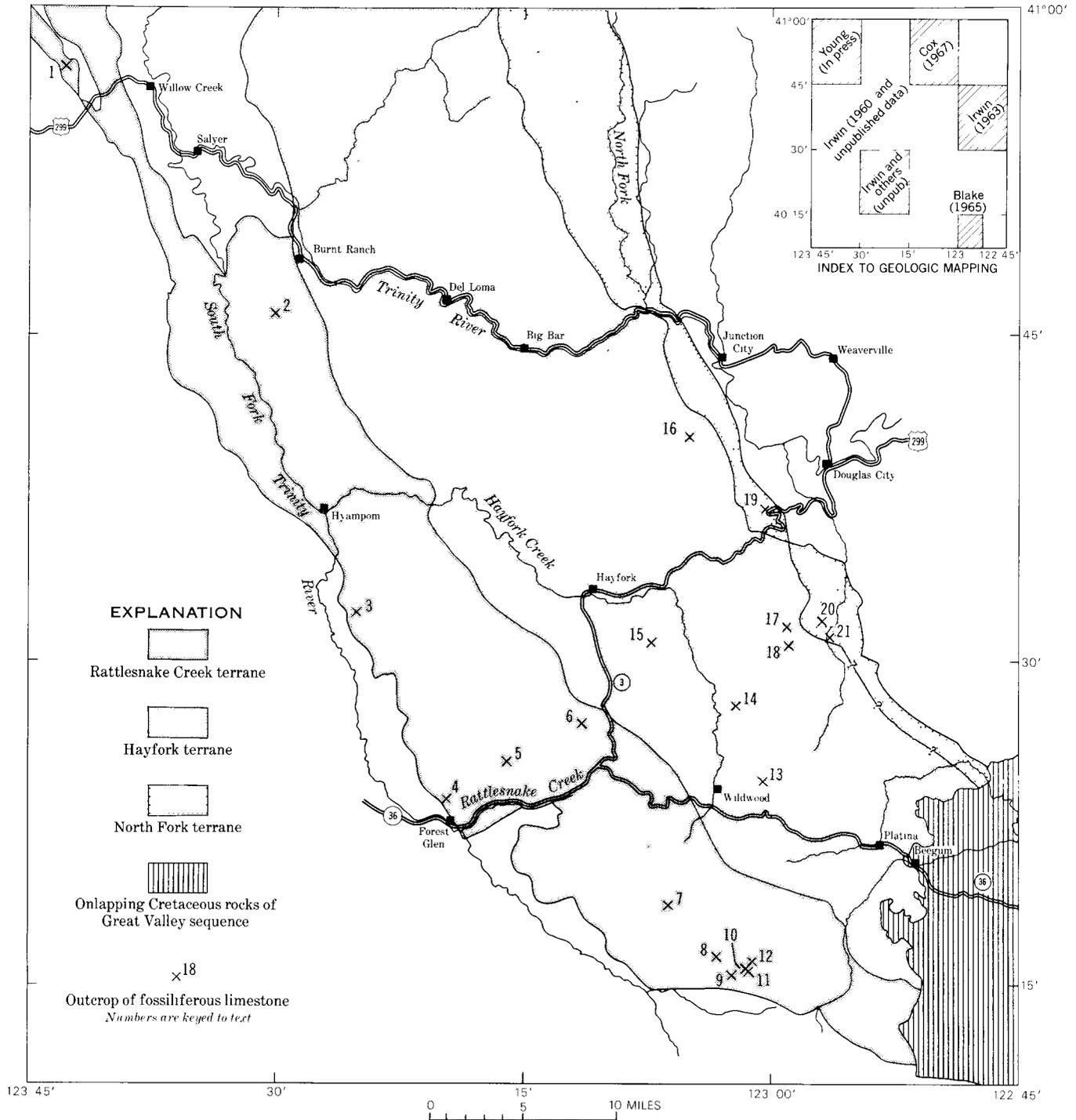


Figure 2.—Distribution of the Rattlesnake Creek, Hayfork, and North Fork terranes in the southern Klamath Mountains, Calif., showing fossiliferous limestone localities.

province, and in this respect the proposed subdivision of the western Paleozoic and Triassic belt further emphasizes the highly composite nature of the province as it is crossed from west to east. The Rattlesnake Creek terrane is bordered on the west for nearly its entire length by metasedimentary Galice

Formation of the western Jurassic belt. In the northern part it is separated from the Hayfork terrane by the Galice Formation and terminates a few miles north of the area shown in figure 2 (see fig. 1). The North Fork terrane is bordered along its eastern side in the southern Klamath Mountains by the Salmon

Hornblende Schist (Devonian or older Paleozoic) of the central metamorphic belt. The southernmost extent of the North Fork terrane has not been mapped, and is inferred as shown on figure 2. The terranes of the western Paleozoic and Triassic belt are overlapped with great unconformity by Cretaceous strata of the Great Valley sequence at the south end of the Klamath Mountains province.

RATTLESNAKE CREEK TERRANE

The Rattlesnake Creek terrane is named after Rattlesnake Creek, which crosscuts much of that terrane in the Pickett Peak and Dubakella Mountain quadrangles. The terrane consists predominantly of serpentinitized ultramafic rocks, gabbro, diabase, pillow lavas and other mafic volcanic rocks, phyllite, thin-bedded radiolarian chert, discontinuous lenses of limestone, and locally interbedded sandstone and pebble conglomerate. The rocks generally are metamorphosed to low greenschist facies, and the strata are considerably disarranged by folding and faulting. The prevailing character of the terrane is that of a dismembered ophiolite suite. Leucocratic silicic igneous rocks are conspicuous in the eastern part of the terrane and probably include both soda granite and soda rhyolite; their structural and temporal relations to the rocks of more ophiolitic aspect are not clear. Plutons that range from hornblende diorite to biotite-hornblende-quartz diorite are sparsely scattered throughout the terrane. The Rattlesnake Creek terrane is one of structurally incompetent rocks, as indicated by an abundance of landslide features.

HAYFORK TERRANE

The Hayfork terrane is named after the town of Hayfork, which lies within the broad belt of that terrane in the Hayfork quadrangle. The terrane appears from reconnaissance to consist mainly of a layered structural sequence of three formations, and of syenodiorite of the Ironside Mountain batholith. The lowest formation of the sequence consists of distinctive augite-andesite metavolcanic rocks and locally attains a thickness of several thousand feet. It is succeeded upward by a formation consisting of slaty argillite, sandstone, pebble conglomerate, and thin-bedded chert, with sparse lenses of limestone and limestone breccia generally in the upper part of the formation. The third and uppermost formation consists of mafic volcanic rocks, thin-bedded chert, phyllite, quartzite, siliceous leucocratic volcanic rocks, and occasional lenses of limestone. Ultramafic rocks, so conspicuous in the Rattlesnake Creek terrane, occur at only a few places in the Hayfork terrane. The rocks of the Hayfork terrane generally are competent to sustain steep hillsides, and, in contrast to the Rattlesnake Creek terrane, landslides are a relatively minor feature of the landscape. In this regard, the syenodiorite and augite andesite are particularly outstanding, as they tend to form steep-walled canyons where cut by Hayfork Creek and the Trinity River.

NORTH FORK TERRANE

The North Fork terrane is named after the North Fork of the Trinity River, which flows through much of that terrane in the Helena quadrangle. It occupies a narrower belt in the southern Klamath Mountains than either the Rattlesnake Creek or Hayfork terranes. Serpentinite, gabbro, and diabase form a practically continuous selvage along the western side of the belt of the North Fork terrane, and these are succeeded to the east by pillow lavas, greenstone, mafic volcanoclastic rocks, thin-bedded radiolarian chert, limestone lenses, chert-limestone breccia, phyllite, and locally sandstone and pebble conglomerate. The lithic assemblage is dominantly that of an ophiolite suite, although an undisturbed normal lithostratigraphic ophiolite sequence has not been seen.

LIMESTONE AND FOSSILS

Limestone crops out sparsely in all three terranes of the western Paleozoic and Triassic belt. Traces of fossils are found in many of the limestone bodies, but fossils suitably preserved for precise age determination are found only in a few of them. The limestone occurs as deformed lenses and pods that commonly are 10 to 20 feet thick and are traceable for a few hundred feet. A few are as much as 200 feet thick and traceable for several hundred to several thousand feet. All are to some degree tectonically deformed and recrystallized. See table 1 for data on the fossiliferous limestone localities shown in figure 2.

The earliest significant search for fossils in limestone of the western Paleozoic and Triassic belt was carried out during a brief yet remarkably perceptive reconnaissance in 1902 by J. S. Diller in company with T. W. Stanton. On the basis of a meager collection of fossils, Diller (1903) concluded that the limestone bodies form a "southwestern Devonian belt" and a "southwestern Carboniferous belt." Limestone bodies of his "southwestern Devonian belt" are in the Rattlesnake Creek terrane; those of his "southwestern Carboniferous belt" are in the Hayfork and North Fork terranes.

The Devonian age for limestones of the Rattlesnake Creek terrane tends to be discounted by more recent study. Diller's designation of a Devonian age for these limestone lenses was based mainly on a collection of ammonites at one locality near White Rock, and on a coral-like fossil he found at localities 1, 3, 4, 6, and 7 (fig. 2) and which was referred to the genus *Chaetetes*. Reexamination of the original collection of ammonites, and additional collections from presumably the same locality (locality 10) near White Rock, show the ammonites to be Late Triassic (Karnian) rather than Devonian (Silberling and Irwin, 1962). In addition, the fossils that were referred to *Chaetetes* are not now considered determinable in age.

Limestone lenses in the Rattlesnake Creek terrane have been searched intensively for fossils during the past decade by the writer and others, but remarkably few have yielded diagnostic

Table 1.—Fossiliferous limestone localities in the western Paleozoic and Triassic belt of the southern Klamath Mountains, Calif.

Map No. (fig. 2)	Field No. or notation	Location ¹	Source data
Rattlesnake Creek terrane			
1. . . .	Three Forks Creek.	T. 7 N., R. 4 E.	Diller (1903, p. 346).
2. . . .	WC.	NW¼ sec. 34, T. 5 N., R. 6 E.	Young (unpub. data.), and this report.
3. . . .	D-711.	NW¼ sec. 29(?), T. 2 N., R. 7 E.	Diller (1903).
4. . . .	D-709, 709a, 710, I-71-7.	W½ sec. 12, T. 29 N., R. 7 E.	Diller (1903), and this report.
5. . . .	P-1358.	Center E. edge sec. 33, T. 30 N., R. 8 E.	This report.
6. . . .	D-707.	1½ miles southwest of Peanut.	Diller (1903).
7. . . .	D-703, 706, I-68-30.	NE¼ sec. 4, T. 28 N., R. 11 W.	Do.
8. . . .	61-1.	SW¼ sec. 13, T. 28 N., R. 11 W.	This report.
9. . . .	I-68-37.	SW¼ sec. 19, T. 28 N., R. 10 W.	Do.
10. . . .	D-705.	Center E½ sec. 19, T. 28 N., R. 10 W.	Diller (1903), and Silberling and Irwin (1962).
11. . . .	D-704.	Center W½ sec. 20, T. 28 N., R. 10 W.	Diller (1903).
12. . . .	I-68-33.	Center NW¼ sec. 20, T. 28 N., R. 10 W.	This report.
Hayfork terrane			
13. . . .	D-702, 61-7, I-68-29.	SE¼ sec. 32, T. 30 N., R. 10 W.	Diller (1903), Irwin (1960), and this report.
14. . . .	D-701.	Center W½ sec. 7, T. 30 N., R. 10 W.	Diller (1903).
15. . . .	I-68-32, I-70-18.	NW¼ of NW¼ sec. 28 (projected), T. 31 N., R. 11 W.	This report, and Merriam (1972).
16. . . .	I-70-32.	NW¼ sec. 35 (projected), T. 33 N., R. 11 W.	This report.
17. . . .	W-318.	SE¼ of NW¼ of NW¼ sec. 22, T. 31 N., R. 10 W.	Do.
18. . . .	T-63.	SE¼ of NW¼ sec. 27, T. 31 N., R. 10 W.	Do.
North Fork terrane			
19. . . .	W-57-28c	Center sec. 21, T. 32 N., R. 10 W.	Irwin (1960).
20. . . .	T-11.	SW¼ of SW¼ sec. 13, T. 31 N., R. 10 W.	This report.
21. . . .	W-324, T-9. . . .	Center S½ sec. 24, T. 31 N., R. 10 W.	Do.

¹Land net is from Willow Creek (ed. 1952), Hyampom (ed. 1951), Pickett Peak (ed. 1954), Dubakella Mtn (ed. 1954), Hayfork (ed. 1951), and Weaverville (ed. 1950) 15-minute quadrangles.

fossils. Limestone collected by N. J. Silberling and the writer at locality 8 was examined by R. C. Douglass, who stated (written commun., 1963) that it contains the small fusulinid *Staffella* that elsewhere in the United States is found in deposits ranging from Middle Pennsylvanian into Permian. Limestone collected by the writer at locality 5 was examined by B. L. Mamet, who stated (written commun., 1970) that it

contains good *Tetrataxis* and some apterinellid "ghosts," and that the possible age is early Carboniferous to Permian. Mamet also examined limestone collected by J. C. Young and R. H. Raschen at locality 2 and stated (written commun., 1970) that the limestone contains apterinellids, nodosariids, and *Pachyphloia* sp. and is undoubtedly Permian in age. The only suggestion of a Devonian age for limestone of the Rattlesnake Creek terrane is the presence of rugose corals at locality 12. The corals were examined by C. W. Merriam, who reported (written commun., 1968):

[the] coral, although well preserved, is much deformed. It is a *Billingsastraea*-like thamnastraceoid colonial genus lacking outer wall, differing from *Billingsastraea* in possessing much thickened tapering septa. The nearest form structurally known to me is a specimen collected from the Kennett limestone. For the present I would consider it to be of possible Devonian age. The dissepiments and character of septa would appear to eliminate the possibility of Mesozoic, in spite of the proximity of Triassic beds***.

In the Hayfork terrane, fossils of determinable age have been found in limestone at several widely spaced localities. The southernmost locality (loc. 13, fig. 2) is at Hall City Cave near Wildwood, where an ammonite collected by Diller was identified as Permian in age by J. P. Smith (Diller, 1903). On later examination the ammonite was considered to indicate a middle or Late Permian age (Miller and others, 1957). From the same locality, limestone collected by D. P. Cox was examined by L. G. Henbest, who identified foraminifers including *Staffella*, *Ozawainella*, or possibly *Eoverbeekina* (written commun., 1956). The foraminiferal assemblage was considered by Henbest to be neither older than Middle Pennsylvanian nor younger than middle Permian, and most likely Permian (see Irwin, 1960, p. 26). Additional material (61-7) from the Hall City Cave locality, collected by N. J. Silberling and the writer, is reported by R. C. Douglass (written commun., 1970) to contain broken and deformed specimens of a fusulinid probably referable to the genus *Cuniculinella*, as described by Skinner and Wilde (1965) in zone F of the Wolfcampian part of the McCloud Limestone.

The most prolific fauna of the Hayfork terrane has come from collections made by D. L. Jones and the writer at the Mueller mine area (loc. 15) about 10 miles northwest of Hall City Cave and 3 miles southeast of Hayfork. There the limestone occurs as abundant subrounded to subangular pebbles and cobbles in conglomerate. The stratigraphic position of the conglomerate is not precisely known but is at the approximate boundary between the argillite-chert formation and the overlying formation. The limestone fragments clearly are transported, as some are seen to contain fossils that are truncated at the boundary of the fragment, and as some adjacent fragments contain different faunas. One fragment (I-70-18A) examined by R. C. Douglass (written commun., 1970) contained ostracodes, bryozoans, gastropods, some small foraminifers including an undetermined textularid and *Tetrataxis* sp., *Pseudofusulinella* sp., and fragments of a

fusulinid with schwagerinid wall structure; this fragment is no older than Late Pennsylvanian and no younger than Early Permian. Another (I-70-18B) contained the smaller foraminifer *Climacammina* sp. and the fusulinids *Pseudofusulinella* sp. and *Schwagerina* sp., and is of Early Permian age (R. C. Douglass, written commun., 1970). Still another contained abundant specimens of *Staffella* sp., and although the range of the genus is from earliest Pennsylvanian into the Permian, the specimens suggest an Early Pennsylvanian age (R. C. Douglass, written commun., 1970). A collection of silicified gastropods (I-70-18), etched from a large fragment by C. W. Merriam, was examined by E. L. Yochelson, who stated (written commun., 1970) that the collection is similar though far superior to those from the McCloud Limestone and is almost certainly Wolfcampian (Early Permian) in age. A single fragment consisting mainly of a well-preserved rugose coral is the only evidence to suggest that limestone of widely different ages may be mixed in the Mueller mine area. The coral most nearly resembles but differs somewhat from *Shastaphyllum schucherti*, which is found in the Gazelle Formation (Silurian) of the eastern Klamath Mountains (Merriam, 1972).

Ten miles north-northeast of the Mueller mine, tectonically stretched fusulinids are abundant in one of several limestone lenses near the crest of a ridge that divides the upper reaches of Dutch and Soldier Creeks (loc. 16). The fossiliferous limestone is at an altitude of 4,050 feet just east of a gap in the ridge, about 1,900 feet east-northeast of hill 4688 (Hayfork 15 minute quadrangle). According to R. C. Douglass (written commun., 1970), the fusulinids have a schwagerinid wall and tight fluting, at least in the lower part of the chambers, and although they cannot be identified generically, an Early Permian age assignment is reasonable.

A conspicuous limestone mass caps the ridge between the upper fork of the East Fork of Hayfork Creek in southwestern Weaverville quadrangle (see Irwin, 1963) and is associated with mafic volcanic rocks and chert of the Hayfork terrane. A sample collected from the southern end of the limestone mass (loc. 18) was examined by B. L. Mamet, who stated (written commun., 1970) that it contains *Cribrogenerina* sp., dasyclad algae, *Macroporella?* sp., miliolids, and paleotextulariids, and that the age is undoubtedly Permian. A short distance north of the main limestone mass, float from small limestone lenses in the volcanic rock (loc. 17) also was examined by Mamet, who reported (written commun., 1970) that it contains *Tetrataxis*, *Pachyphloia*, apterinellids, cornuspirids, nodosariids, cf. *Protonodosaria* sp., and paleotextulariids, and that it is undoubtedly Permian in age.

In the North Fork terrane, fossils of determinable age have been found at three localities (loc. 19, 20, and 21, fig. 2). Limestone from locality 19 is reported by L. G. Henbest (see Irwin, 1960, p. 26) to contain fusulinids that indicate a Late Pennsylvanian or Early Permian age. Abundant microfossils occur in a small (2 by 6 foot) limestone lens (loc. 21) in volcanic rocks, exposed in Browns Creek about 200 feet

upstream from the mouth of Maupin Gulch. According to R. C. Douglass (written commun., 1961), the microfossils include textularid foraminifers and *Schwagerina* spp. He stated that

two species of *Schwagerina* are probably represented, one elongate form with axial filling, and the other more robust and without axial filling. The species are all distorted and are not easily compared with previously described species. Their general stage of evolution suggests Lower Permian age, McCloud equivalent. Neither of the forms present are considered to be as old as the fusulinids [from loc. 19].

A nearby limestone lens, about 30 feet upstream, is much more coarsely crystalline and contains unusually large crinoid stems. In Johnson Gulch, about a mile from its mouth, fossiliferous limestone float (loc. 20) was found in an area of dominantly volcanic rocks. According to B. L. Mamet (written commun., 1970), the limestone float contains endothyrid ghosts referable to *Endothyra* of the group *E. prisca*, and is lower Carboniferous to Permian in age.

Although the data are sparse, the known distribution of fossils in the report area suggests that the chaetetids and fusulinids are almost mutually exclusive in occurrence (fig. 3). The limestone lenses that contain chaetetids (loc. 1, 3, 4, 6, and 7, fig. 2) were early recognized to closely follow the South Fork of the Trinity River (Diller, 1903). All the known

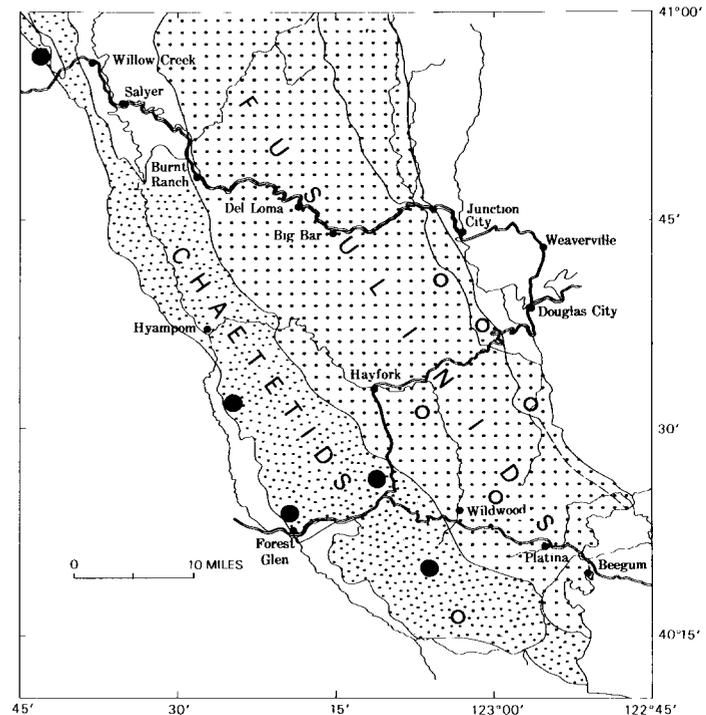


Figure 3.—Apparent distribution of chaetetids and fusulinids in the western Paleozoic and Triassic belt of the southern Klamath Mountains. Chaetetid localities indicated by solid circles, fusulinid localities by open circles.

chaetetid-bearing limestone lenses are in the Rattlesnake Creek terrane. Fusulinid localities (loc. 13, 15, 16, 19, and 21) are comparably abundant in the Hayfork and North Fork terranes, and only one (loc. 8) is known in the Rattlesnake Creek terrane. The virtual restriction of the chaetetid and fusulinid faunas to specific terranes enhances the subdivisions of the western Paleozoic and Triassic belt that are based primarily on lithologic differences. However, the significance of the faunal distribution cannot be assessed until the age of the chaetetid-bearing limestone is known.

METALLIFEROUS DEPOSITS

Deposits of chromite, manganese, and lode gold occur in the western Paleozoic and Triassic belt. Each of these mineral commodities tends to be restricted to a single terrane rather than being randomly distributed throughout all three. Most of the reported deposits of chromite and manganese in the report area are in the Rattlesnake Creek terrane. The lode-gold deposits are restricted to the Hayfork terrane.

The chromite deposits occur in the ultramafic rocks, generally as pods, segregation layers, and disseminated grains. In the area of this report, the locations of 51 chromite prospects (fig. 4) were reported by Wells and Hawkes (1965, pl. 19). Most are in the Rattlesnake Creek terrane, 10 are shown in the Hayfork terrane, and only one is in the North Fork terrane. Those shown in the Hayfork terrane are located with questionable accuracy, according to Wells and Hawkes, and it is likely that most if not all of those would be seen to lie in the Rattlesnake Creek terrane if accurately located. The preponderance of chromite prospects in the Rattlesnake Creek terrane is reasonable, as that terrane has the greatest area of outcrop of ultramafic rock. However, ultramafic rock also crops out over a considerable area in the North Fork terrane, and a disparity between the great number of chromite prospects located in the Rattlesnake Creek terrane and the single prospect located in the North Fork terrane is obvious. The ratio of area of ultramafic rock in the Rattlesnake Creek terrane to that in the North Fork terrane is perhaps 3 or 4 to 1, in contrast to a ratio of nearly 40 or 50 to 1 in number of prospects located. A similar disproportion in numbers of chromite prospects relative to area of outcrop of ultramafic rocks was noted by Wells and Hawkes (1965, p. 178) for the Trinity Alps area of the central Klamath Mountains. Present data are insufficient to determine whether a lack of chromite prospects indicates a difference in composition of the ultramafic magma, insufficient concentration of chromite to be of commercial interest, or failure of prospectors to locate such deposits—although Wells and Hawkes (1965) seemed to reject the last possibility.

The manganese deposits of the western Paleozoic and Triassic belt occur in lenses of thin-bedded radiolarian chert and are probably syngenetic with the chert. The primary ore minerals, rhodochrosite and bementite, are mostly meta-

morphosed to rhodonite and spessartite (Trask and others, 1943). Tephroite, an orthosilicate of manganese, probably also is widely present (Hewett and others, 1961). Most of the manganese deposits occur in lenses of chert that are reddish or purplish in color, rather than in those that are shades of gray. In the vicinity of ore bodies, fracture surfaces of surficially exposed chert commonly are stained black by manganese oxides. Of 38 deposits known in the report area (fig. 5), all are in the Rattlesnake Creek terrane except for three in the Hayfork terrane; surprisingly, none is reported in radiolarian chert of the North Fork terrane.

Gold-bearing quartz veins have been prospected and mined at various places along the length of the western Paleozoic and Triassic belt. Lode-gold mines and prospects in the report area (fig. 5) are restricted to the Hayfork terrane. Two additional prospects (Yellow Surprise and Watson) mentioned by Averill (1933) and O'Brien (1965) are not shown, as they are near terrane boundaries and as location data are insufficient to determine within which terrane they actually occur. The lode-gold deposits of the Hayfork terrane commonly occur in the chert-argillite unit that overlies the augite andesite. The distribution of placer gold reflects that of the lode deposits, although somewhat more disperse. Considerable placer gold has been mined from creeks that drain the Hayfork terrane, but little has been obtained where the drainage is confined to the Rattlesnake Creek terrane. Some creeks in the North Fork terrane have been productive, but most of that gold probably came from veins in the Devonian metamorphic rocks to the east.

CONCLUSIONS

As earlier subdivided (Irwin, 1960), the Klamath Mountains province was considered to consist of four concentric lithic belts separated by east-dipping thrust faults. Each of the presently proposed subdivisions (terranes) of the western Paleozoic and Triassic belt is considered to be as important a structural element as any of the original lithic belts, and thus the number of recognized major structural elements is increased to six. The name "western Paleozoic and Triassic belt" will be obsolete when the undivided part of the belt remaining in the central and northern Klamath Mountains is subdivided. It is noteworthy that although the total span in age represented by rocks of the three terranes is not known, evidence for a Permian age is found in all three terranes, but evidence for a Triassic age is found only in the Rattlesnake Creek terrane. This relationship follows the previously recognized pattern of the thrust plates of the Klamath Mountains tending to be successively younger to the west (oceanward).

Although the three terranes are at least in part the same age (Permian), they are markedly different in lithology and other parameters. The ophiolitic aspect of the Rattlesnake Creek and North Fork terranes may suggest that they formed as oceanic

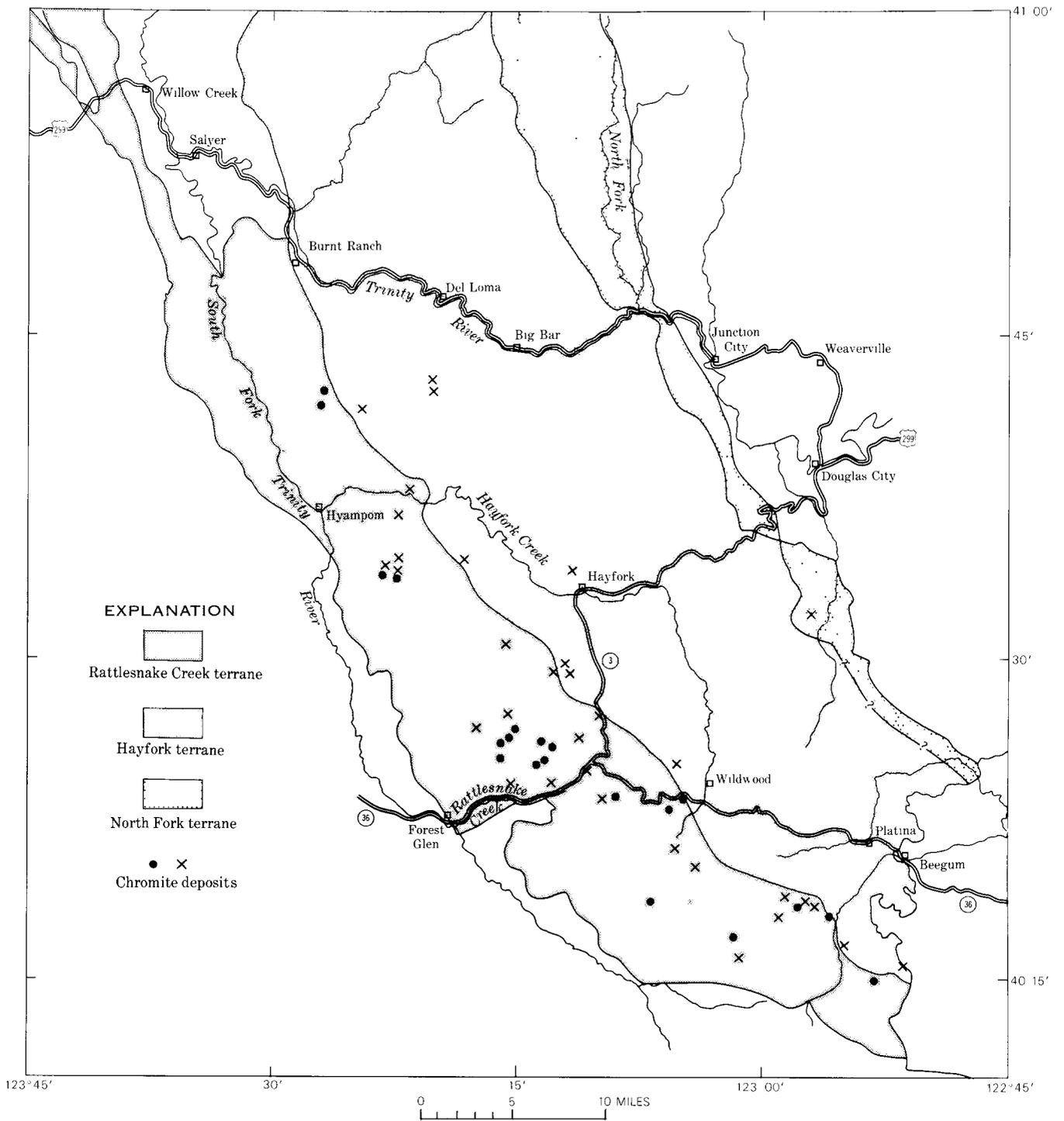


Figure 4.—Relation of chromite deposits to terranes of the western Paleozoic and Triassic belt in the southern Klamath Mountains. Distribution of chromite deposits is adapted from Wells and Hawkes (1965, pl. 19). Solid circles, deposits considered by Wells and Hawkes to be accurately located; crosses, deposits that may not be accurately located.

crust. The andesitic character of much of the Hayfork terrane suggests possible origin as an island arc. The apparent juxtaposition of the terranes is most readily explained by considering them to have been widely separated when formed, and subsequently to have been telescoped together along

east-dipping thrust faults. In the context of the seafloor-spreading hypothesis, the various terranes may represent skimmed-off fragments of crust that successively have accreted to the western edge of North America along subduction zones, perhaps in the general style described by Hamilton (1969).

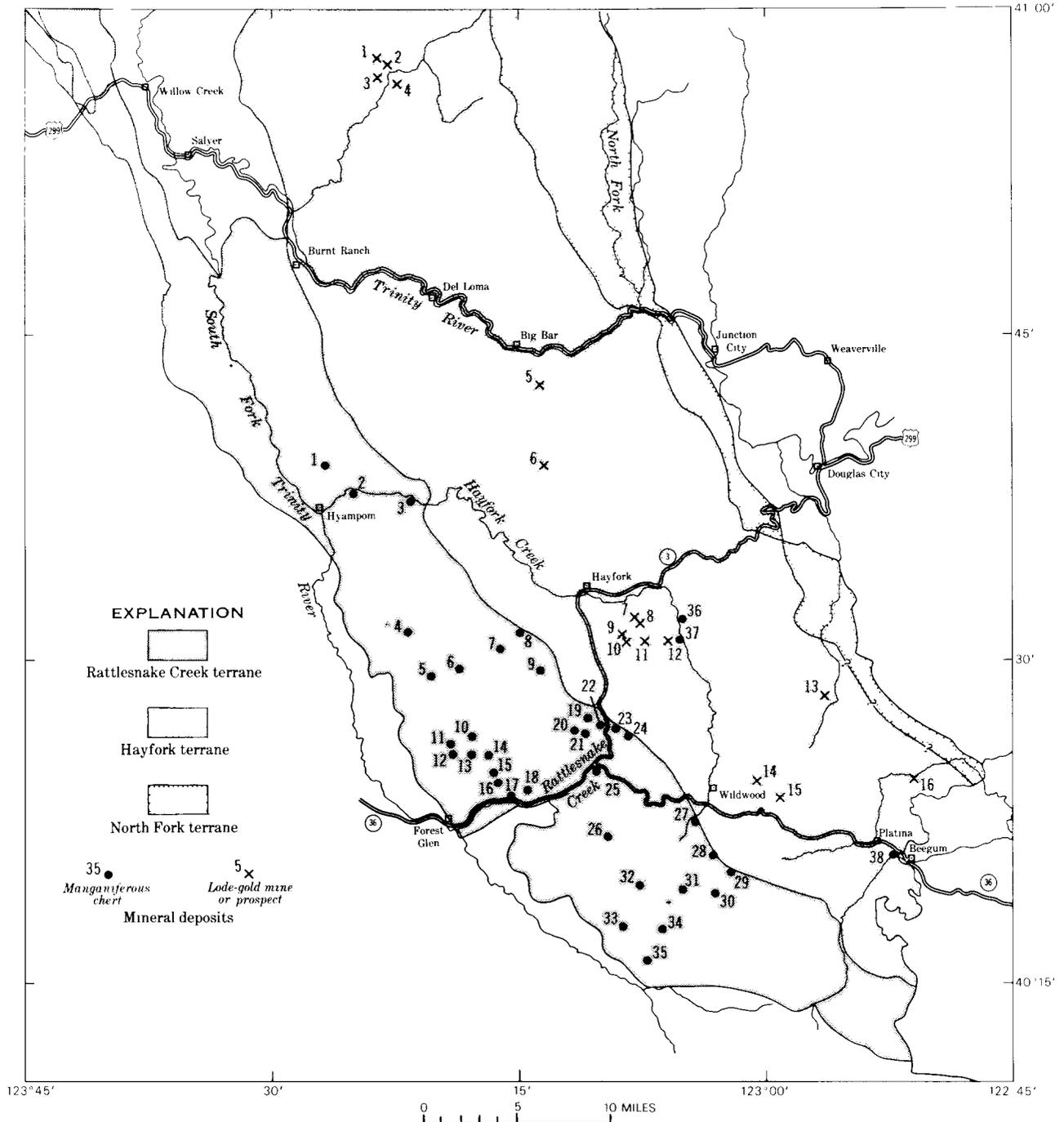


Figure 5.—Relation of manganiferous chert and lode-gold mines and prospects to the terranes of the western Paleozoic and Triassic belt in the southern Klamath Mountains. Data for manganiferous chert localities are from Trask and others (1950), with additions. Data for lode-gold mines and prospects are from Averill (1933, 1941) and O'Brien (1965), with additions. List of mines and prospects below: manganese, first 38; lode gold, second 16.

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|--------------------------------------|--|-------------------------------|------------------------------|------------------------|----------------|
| 1—Big Rock | 10—Four Point | 19—No name | 29—Victor | 37—Last Hope and Woods | 8—Layman |
| 2—Name unknown | 11—Arrowhead, Black Susan, Gool, and Whitman | 20—No name | 30—Goat Camp | 38—Nicol | 9—Kellogg |
| 3—American Manganese No. 1 and No. 2 | 12—Cedar Springs | 21—No name | 31—Sylvester-Wilson and Weed | | 10—Farmer |
| 4—Snow Camp | 13—Last Chance | 22—Dry Lake | 32—Black Hawk and Jewett | 1—Index | 11—Mueller |
| 5—No name | 14—Jaybird | 23—Salt Creek | 33—Murphy-Bramlette | 2—Slake Shack | 12—Scorpion |
| 6—No name | 15—Munson | 24—Salt Creek No. 2 and No. 3 | 34—Lucky Bill | 3—Hazel D | 13—Chancelulla |
| 7—Carr, Carrie, and Louella | 16—Big Buck and The Manganese | 25—Manganese Queen | 35—Spider | 4—Beartooth | 14—Hall City |
| 8—Two Sugar Pines | 17—Lucky Star | 26—High Lead | 36—Reichert and Cliff | 5—Poor Boy | 15—Midas |
| 9—Plummer Peak | 18—Rattlesnake | 27—Foss | | 6—Kattmeier | 16—Bell Cow |
| | | 28—Skaggs | | 7—Kelly | |

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