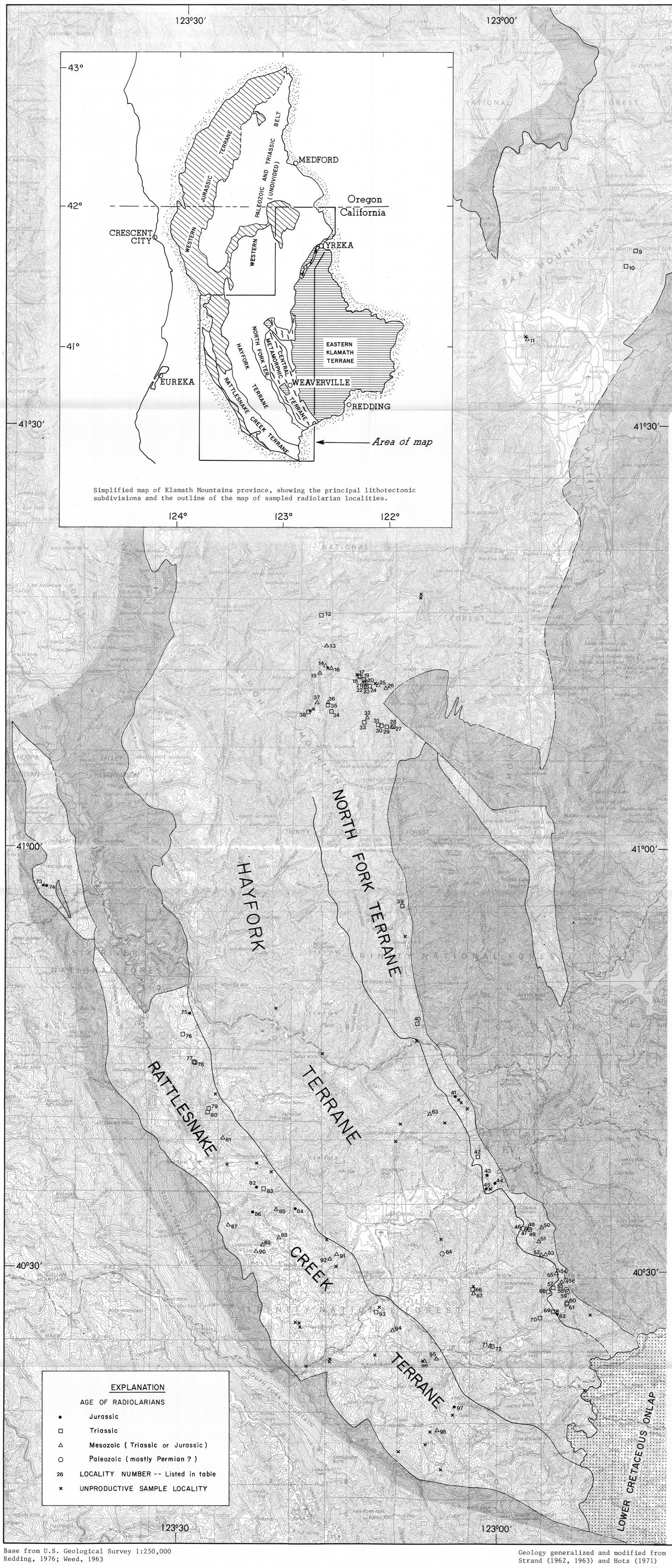

Simplified map of Klamath Mountains province, showing the principal lithotectonic subdivisions and the outline of the map of sampled radiolarian localities.

Base from U.S. Geological Survey 1:250,000
Redding, 1976; Weed, 1963

Geology generalized and modified from
Strand (1962, 1963) and Hotz (1971)

Scale 1:250,000

5 0 5 10 15 20 Statute Miles
5 0 5 10 15 20 25 30 Kilometers
5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS
TRANSVERSE MERCATOR PROJECTION

DISCUSSION

The western Paleozoic and Triassic belt, the largest of several major subdivisions of the Klamath Mountains geologic province, extends 300 km northward from the south end of the province in California to the north end of the province in Oregon (see inset map). The rocks of the belt are mainly sedimentary and volcanic, including tuff, cherty tuff, chert, argillite, limestone, and volcanic flows and breccia. They are of oceanic and island arc facies and are highly disarranged tectonically. The southern part of the belt is subdivided into three tectonostratigraphic terranes---the North Fork, Hayfork, and Rattlesnake Creek terranes. The central and northern parts of the belt are undivided.

Prior to the recent advent of radiolarian biostratigraphy, the age of most of the rocks in the belt was poorly known and was based almost entirely on shelly fossils found in sparsely scattered pods and lenses of limestone. However, datable radiolarians can now be extracted by HF leaching (Pessagno and Newport, 1972) from thin-bedded chert and cherty tuff that occur at many places throughout the belt.

We began sampling the rocks of the western Paleozoic and Triassic belt for radiolarians on a reconnaissance basis in 1976, and during the following years were assisted at various times by T.A. Kaplan, B. Smith, S.A. Monsen, M.C. Astrue, and T.F. Diamond. Much of the laboratory extraction of the radiolarians was done by T.A. Kaplan. Interim results were reported by Irwin, Jones, and Pessagno (1977) and Irwin, Jones, and Kaplan (1978). Some of these early reported radiolarian ages have been modified slightly due to recent refinements in the rapidly evolving science of radiolarian biostratigraphy, particularly for the Triassic part of the section. However, our early conclusion that most of the chert in the belt is Mesozoic has been substantiated by the additional sampling.

The purpose of the present map is to document the age of the chert and tuff of the western Paleozoic and Triassic belt and to make all of our radiolarian age data available in readily usable form. Detailed studies in selected areas of the belt are presently underway in order to refine the ages and structural relations of several important lithologic units.

As shown in table 1, the ages of the chert and tuff of the belt range from Permian to Middle or Late Jurassic. Late Triassic radiolarians are the most common and occur in all three terranes of the southern part of the belt. Jurassic radiolarians occur in both the North Fork and Rattlesnake Creek terranes. The youngest of these are large-horned spindle-shaped forms from locality 41 and are known to occur only in the Upper Jurassic (Tithonian). Radiolarians assigned a Permian or more general Paleozoic age are much less common than those of Mesozoic age. They were found only in the North Fork terrane except for one locality in the Hayfork terrane and for a stream cobble in the undivided part of the belt north of Yreka. Radiolarians clearly older than Permian have not been found in rocks of the western Paleozoic and Triassic belt.

Some of the radiolarian faunas are distinctive. The Permian radiolarian fauna at locality 58, for example, has not been described elsewhere in North America, but is known from Japan. The Triassic radiolarians at locality 83 are similar to those from the the Elkhorn Ridge Argillite at the Vance Creek locality in east-central Oregon and also from the Cache Creek Group of British Columbia. Many of the cherts contain a Late Triassic (upper Karnian to middle Norian) radiolarian faunal assemblage that occurs in similar strata in Baja California, Oregon, Alaska, British Columbia, and Japan. A fauna of Jurassic radiolarians that is characteristic of the North Fork terrane at the latitude of Hayfork, Calif., has also been found at locality 97 in the Rattlesnake Creek terrane and in Franciscan chert from the southern Coast Ranges near Santa Barbara, Calif.

The radiolarian faunas of the three subdivisions of the western Paleozoic and Triassic belt are not different from one another except for age, although differences in the shelly faunas of the subdivisions have been recognized (Irwin, 1972). On the basis of our present knowledge of the ages of the radiolarian cherts and of the gross lithic associations, the cherts of the North Fork terrane span a greater time interval (Permian to Middle or Late Jurassic) than the cherts of the Hayfork or Rattlesnake Creek terranes. Although the data are sparse, the ages of the cherts locally tend to substantiate the distinction between the terranes.

The predeformational relations between the cherts of various ages have not been established. Folding and faulting are so pervasive throughout most of the belt that little of the original stratal continuity is preserved, and the concept that thicknesses of thousands of feet of these complexly deformed strata represent intact stratigraphic sequences is in conflict with the radiolarian data. Because Jurassic radiolarian chert is tectonically interleaved and folded with Triassic and Paleozoic cherts, we conclude that a major disruption of the deep marine environment and the final suturing of the terranes of the western Paleozoic and Triassic belt occurred during Middle or Late Jurassic time.

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LIST OF SAMPLED RADIOLARIAN CHERT LOCALITIES

Map No.	Sample No.	Age	Latitude	Longitude
1	40-80A	Late Triassic [float]	41°51.00'	122°32.50'
2	43-80	Jurassic (North Fork fauna)	41°51.60'	122°33.45'
"	95-80	Early Jurassic (Hettangian to Pliensbachian)	41°51.60'	122°33.45'
3	32-77	Triassic (Ladinian or early Karnian)	41°51.83'	122°33.70'
4	31-77	Late Triassic or Jurassic	41°51.72'	122°33.85'
5	30-77	Early or Middle Jurassic	41°51.66'	122°33.85'
6	44-80A	Jurassic (North Fork fauna)	41°51.30'	122°34.10'
"	92-80	Early Jurassic (Sinemurian to Pliensbachian)	41°51.30'	122°34.10'
7	94-80A	Paleozoic [stream cobble]	41°51.30'	122°34.00'
"	94-80B	Late Triassic (late Karnian? to late middle Norian) [stream cobble]	41°51.30'	122°34.00'
8	93-80	Early Jurassic (Sinemurian or Pliensbachian)	41°51.30'	122°34.00'
9	8-78 (Born)	Triassic	41°54.04'	122°46.93'
10	3-78 (Born)	Triassic	41°52.38'	122°47.86'
X	49-77	NG*	41°36.46'	122°57.62'
11	50-77	Triassic or Jurassic	41°36.19'	122°57.45'
X	44-80B	NG	41°18.03'	123°7.31'
X	46-80	NG	41°17.85'	123°7.45'
12	45-80B & MMD-112-79	Late Triassic (late Karnian? to late middle Norian); conodonts.	41°16.47	123°16.80'
13	18-77	Triassic or Jurassic	41°14.40'	123°17.34'
"	31-80	Mesozoic	41°14.40'	123°17.34'
14	25-80	Mesozoic (Triassic?)	41°12.87'	123°16.70'
X	24-80	NG	41°12.66'	123°16.40'
15	26-80	Mesozoic	41°12.41'	123°16.92'
16	20-80	Mesozoic	41°12.80'	123°15.91'
"	22-80	NG	41°12.77'	123°16.02'
"	23-80	NG	41°12.80'	123°15.98'
X	19-80	NG	41°12.28'	123°13.50'
17	89-80	Middle Triassic (Ladinian)	41°12.13'	123°13.32'
18	90-80	Radiolarians NG; Triassic conodonts	41°12.10'	123°13.30'
19	19-77	Triassic	41°11.90'	123°12.94'
"	91-80	NG	41°11.90'	123°12.94'
20	20-77	Late Triassic	41°11.72'	123°12.82
21	21-77	Late Triassic (late Karnian? to middle Norian)	41°11.67'	123°12.87'
"	18-80A	Late Triassic (late Karnian? to late middle Norian)	41°11.67'	123°12.87'
22	17-80	Samples A, B, C, and D; all Paleozoic	41°11.35'	123°12.89'
"	22-77	Paleozoic radiolarians; middle Permian (Wordian) conodonts	41°11.35'	123°12.89'
23	12-80A	Late Triassic (late Karnian? to late middle Norian)	41°11.36'	123°12.72'
23	12-80B	Middle Triassic (Ladinian)	41°11.37'	123°12.71'
24	13-80A	Late Triassic (late Karnian?)	41°11.40'	123°12.52'
"	13-80C	Late Triassic to Middle Jurassic	41°11.41'	123°12.44'
"	13-80D	Late Triassic or Early Jurassic	41°11.41'	123°12.42'
"	13-80E	Late Triassic (early Karnian? to late middle Norian)	41°11.42'	123°12.40'

LIST OF SAMPLED RADIOLARIAN CHERT LOCALITIES (continued)

Map No.	Sample No.	Age	Latitude	Longitude
X	14-80	NG	41°11.64'	123°11.80'
25	15-80	Mesozoic	41°11.47'	123°11.45'
26	16-80	Mesozoic	41°11.32'	123°10.79'
27	6-80	Middle or Late Triassic (Ladinian to late middle Norian)	41°8.55'	123°9.97'
28	7-80	Mesozoic	41°8.62'	123°10.12'
29	25-77	Radiolarians NG; conodonts	41°8.54'	123°10.70'
"	8-80	Late Triassic (late Karnian? to late middle Norian)	41°8.54'	123°10.70'
30	9-80	Radiolarians scarce; Triassic conodonts	41°8.63'	123°11.15'
31	10-80C	Middle or Late Triassic (Ladinian to late middle Norian)	41°8.68'	123°11.55'
"	24-77	Radiolarians NG; conodonts	41°8.68'	123°11.55'
32	85-80	Mesozoic	41°9.16'	123°12.52'
33	78-80	Triassic or Jurassic	41°9.08'	123°12.62'
"	77-80B	Mesozoic (Triassic?)	41°9.05'	123°12.62'
"	79-80	NG	41°9.03'	123°12.65'
"	80-80	Mesozoic	41°9.04'	123°12.68'
"	81-80	Mesozoic	41°9.02'	123°12.69'
"	82-80	Late Triassic	41°9.02'	123°12.74'
"	83-80	Late Triassic (late Karnian? to late middle Norian)	41°9.02'	123°12.72'
"	84-80	Late Triassic or Early Jurassic	41°9.07'	123°12.60'
34	88-80	Late Triassic (late Karnian? to late middle Norian)	41°9.78'	123°16.23'
35	87-80	Middle Triassic (Ladinian)	41°10.23'	123°16.24'
36	86-80	Mesozoic	41°10.78'	123°16.18'
37	27-80	Mesozoic	41°10.32'	123°17.48'
X	28-80	NG	41°9.88'	123°17.58'
X	29-80	NG	41°9.65'	123°17.90'
38	30-80	Middle Triassic (Ladinian); with conodonts	41°9.67'	123°17.96'
39	65-80	Late Triassic [stream cobble]	40°55.70'	123°9.23'
X	64-80	NG	40°53.54'	123°8.83'
40	63-80	Triassic	40°47.45'	123°7.45'
41	22-81	Middle or Late Jurassic (Bajocian to Tithonian)	40°42.29'	123°4.07'
X	21-81	NG	40°42.10'	123°3.80'
X	20-81	NG	40°41.84'	123°3.59'
X	23-81	NG	40°41.40'	123°2.99'
42	11-76	Late Triassic	40°37.98'	123°1.89'
43	3-76	Early or Middle Jurassic (North Fork fauna)	40°36.66'	123°1.15'
44	10-76A to G	Early or Middle Jurassic (North Fork fauna)	40°36.07'	123°0.29'
45	1-76	Jurassic	40°35.72'	123°1.02'
X	2-76	NG	40°35.66'	123°0.80'
46	72-80	Permian	40°32.88'	122°57.49'
47	73-80	Triassic or Jurassic	40°32.84'	122°57.40'
48	71-80	Mesozoic	40°32.80'	122°57.00'
49	62-80	Triassic	40°32.80'	122°57.00'
50	70-80	Mesozoic	40°32.88'	122°55.85'
51	9-76	Mesozoic	40°31.85'	122°56.10'
52	56-80	Mesozoic	40°30.90'	122°55.90'
53	57-80	Late Triassic or Early Jurassic	40°30.86'	122°55.40'
54	69-80	Mesozoic	40°29.80'	122°54.30'
55	16-81	Mesozoic	40°29.23'	122°53.60'
56	15-81	Late Triassic (late Karnian to late middle Norian)	40°29.05'	122°53.90'
57	55-80	Late Triassic	40°28.68'	122°54.70'
58	58-80	Permian	40°28.44'	122°53.52'
"	67-80B	Permian	40°28.44'	122°53.52'
59	66-80	Permian(?)	40°28.38'	122°53.46'
60	59-80	Paleozoic(?)	40°27.57'	122°53.55'
61	60-80	Permian(?)	40°27.50'	122°53.55'
X	61-80	NG	40°26.98'	122°54.43'
62	14-81	Mesozoic	40°26.80'	122°54.44'
"	12-81	Early Jurassic (Sinemurian or Pliensbachian)	40°26.82'	122°54.40'
"	10-81	Early Jurassic (Sinemurian or Pliensbachian)	40°26.72'	122°54.23'
"	9-81	Early Jurassic (Sinemurian or Pliensbachian)	40°26.72'	122°54.12'
"	8-81	Early Jurassic (late Sinemurian or early Pliensbachian)	40°26.72'	122°54.10'
X	18-81	NG	40°26.43'	122°51.00'
X	17-77	NG	40°48.48'	123°20.90'
X	7-76	NG	40°46.19'	123°7.59'
X	16-77	NG	40°45.20'	123°16.91'
63	14-77	Triassic or Jurassic	40°41.09'	123°6.30'
X	15-77	NG	40°40.40'	123°5.04'
X	36-76	NG	40°40.12'	123°9.02'
X	35-76	NG	40°39.02'	123°9.51'
X	12-76	NG	40°32.00'	123°5.32'
64	26-81	Permian	40°5.13'	123°31.00'
65	68-80	Mesozoic	40°29.65'	122°54.40'
X	86-77	NG	40°28.73'	122°2.26'
66	76-80	Late Triassic (late Karnian to late middle Norian)	40°28.62'	123°2.39'
67	27-81	Mesozoic	40°28.22'	123°2.18'
68	54-80	Middle Triassic (Ladinian)	40°28.35'	122°55.25'
69	85-77	Late Triassic (late Karnian? to middle Norian)	40°26.90'	122°54.75'
X	13-81	NG	40°26.86'	122°54.60'
70	17-81	Middle or Late Triassic (Ladinian or early Karnian)	40°26.50'	122°55.82'
71	82-77	Triassic or Jurassic	40°9.43'	123°00.59'
72	80-77	Triassic radiolarians; Middle or Late Triassic conodonts	40°9.43'	123°00.42'
X	1-79	NG	40°20.82'	122°51.66'
73	52-77	Jurassic	40°57.20'	123°43.00'
74	51-77	Jurassic	40°57.17'	123°43.21'
75	53-77	Jurassic(?)	40°48.21'	123°29.48'
76	54-77	Late Triassic	40°46.60'	123°29.82'
77	55-77	Late Triassic	40°44.70'	123°28.89'
78	56-77	Late Triassic (late Karnian? to middle Norian)	40°44.68'	123°28.92'
X	28-81	NG	40°42.40'	123°26.65'
79	57-77	Late Triassic	40°41.39'	123°27.31'
80	58-77	Mesozoic radiolarians; Late Triassic conodonts	40°40.98'	123°27.25'
81	59-77	Triassic or Jurassic	40°38.94'	123°26.30'
X	14-76	NG	40°37.30'	123°25.47'
"	29-81	NG	40°37.30'	123°25.47'
X	13-76	NG	40°37.43'	123°22.70'
X	15-76	NG	40°36.86'	123°21.30'
82	32-81	Mesozoic (Jurassic?)	40°35.58'	123°27.39'
83	16-76	Middle Triassic (Ladinian) (Vance Creek fauna)	40°35.40'	123°22.08'
84	31-81	Early Jurassic (Pliensbachian) to Middle Jurassic (Bathonian)	40°33.88'	123°19.04'
85	30-81	Mesozoic	40°33.98'	123°20.75'
86	24-81	Mesozoic (Jurassic?)	40°33.94'	123°23.03'
87	33-81	Mesozoic	40°33.03'	123°25.29'
88	17-76	Mesozoic	40°32.24'	123°20.73'
X	6-76	NG	40°32.00'	123°16.23'
89	36-81	Mesozoic	40°31.60'	123°22.16'
90	35-81	Mesozoic	40°31.06'	123°22.60'
91	5-77	Triassic or Jurassic	40°30.87'	123°15.22'
"	4-76	NG	40°30.87'	123°15.22'
92	25-81	Late Triassic (Norian) to Middle Jurassic (Bathonian)	40°30.57'	123°15.74'
X	5-76	NG	40°30.09'	123°15.20'
"	6-77	NG	40°30.09'	123°15.20'
X	22-76	NG	40°27.45'	123°10.90'
93	21-76	Late Triassic (Karnian or Norian)	40°26.86'	123°11.45'
X	18-76	NG	40°26.01'	123°18.87'
X	19-76	NG	40°26.06'	123°18.68'
X	20-76	NG	40°25.68'	123°18.40'
94	37-76	Triassic or Jurassic	40°25.64'	123°9.70'
X	10-77	NG	40°23.00'	123°17.81'
X	2-79	NG	40°23.50'	123°15.80'
X	9-77	NG	40°23.50'	123°16.02'
X	46-77	NG	40°23.85'	123°11.39'
95	39-76	Triassic or Jurassic	40°23.54'	123°5.73'
96	8-77	Triassic or Jurassic	40°23.48'	123°6.88'
X	38-76	NG	40°23.48'	123°6.88'
97	40-76	Early or Middle Jurassic	49°20.20'	123°4.06'
X	44-77	NG	40°19.50'	123°4.26'
98	43-77	Mesozoic(?)	40°18.53'	123°5.51'
X	23-76	NG	40°18.56'	123°6.34'
X	24-76	NG	40°18.5'	123°6.6'
X	45-77	NG	40°16.90'	123°9.15'
X	25-76	NG	40°15.95'	123°5.31'

* NG refers to samples in which radiolarians are present but not extractable by the HF leaching technique.

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MAP SHOWING SAMPLED RADIOLARIAN LOCALITIES IN THE WESTERN PALEOZOIC AND TRIASSIC BELT, KLAMATH MOUNTAINS, CALIFORNIA

By

William P. Irwin, David L. Jones, and Charles D. Blome

1982