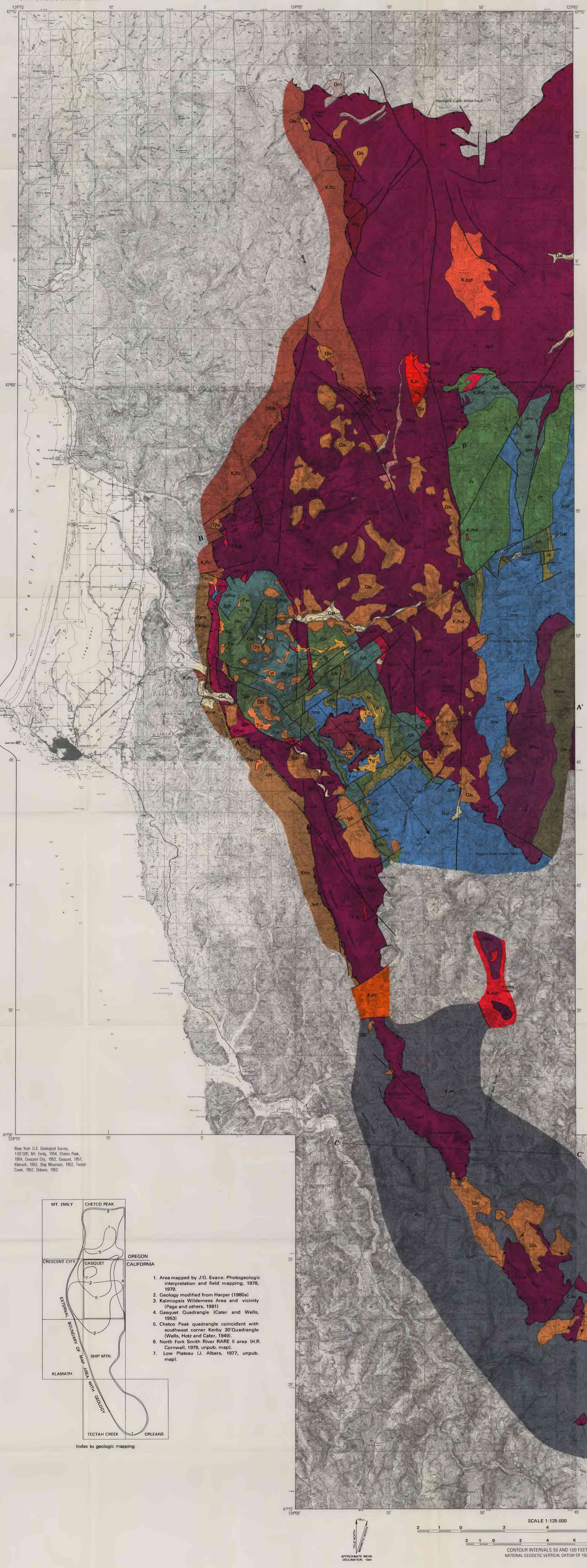
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

BULLETIN 1546
PLATE 1



1. Area mapped by J.G. Evans: Photogeologic interpretation and field mapping, 1978, 1979.
2. Geology modified from Harper (1980a)
3. Kalmiopsis Wilderness Area and vicinity (Page and others, 1981)
4. Gasquet Quadrangle (Cater and Wells, 1953)
5. Chetco Peak quadrangle coincident with southwest corner Kerby 30'Quadrangle (Wells, Hotz and Cater, 1949).
6. North Fork Smith River RARE II area (H.R. Cornwall, 1979, unpub. map).
7. Low Plateau (J. Albers, 1977, unpub. map).

Index to geologic mapping

CORRELATION OF MAP UNITS

Qal, Qls	Holocene	QUATERNARY	
Qm	Pleistocene		
Tw, Tg	Miocene	TERTIARY	
TKqp, TKdk		TERTIARY OR CRETACEOUS	
COAST RANGES BELT			
Kms	CRETACEOUS		
KJfc	CRETACEOUS AND JURASSIC		
KJm	CRETACEOUS AND JURASSIC		
WESTERN JURASSIC BELT			
QKsp		QUATERNARY, TERTIARY, AND CRETACEOUS	
Klc		CRETACEOUS	
KJhd		CRETACEOUS AND JURASSIC	
KJqd, KJgd, KJdi		CRETACEOUS OR JURASSIC	
KJh			
Jms	Upper Jurassic	JURASSIC	
Jp, Jv, Jdc, Jgb, Juc	Josephine ophiolite of Harper (1980b)	JURASSIC	
Jd, Jpd, Jeg	Josephine Peridotite	JURASSIC OR OLDER	
WESTERN PALEOZOIC AND TRIASSIC BELT			
Hg		JURASSIC	
TrPzm, TrPzp	Preston Peak ophiolite	TRIASSIC(?) AND PALEOZOIC	

DESCRIPTION OF MAP UNITS

Qal ALLUVIUM—Raised river terrace gravel deposits and present stream gravels

Qls LANDSLIDE DEPOSITS

Qm GLACIAL MORAINE—Mapped in northern part of Chetco Peak quadrangle

Tw WIMER FORMATION—Includes beds named "Wymer beds" by Diller (1902, p. 31-35) and gravel deposits (Maxson, 1933; Cater and Wells, 1953, p. 104-105; Harper, 1980a). Chiefly clayey silt, minor sand and rare gravel, white to pale brown and poorly consolidated, with irregular reddish-brown veins of iron oxide. Type locality considered the exposures along old Wymer (Wimer) stage road, in sec. 20, T. 17 N., R. 2 E., about 21 km NE of Crescent City, Del Norte Co. Deposition occurred in a very shallow subtidal or intertidal environment (Watkins, 1974, p. 1264). Age is late Miocene on basis of leaf impressions and shell fossils

Tg GRAVEL—Includes minor sand and silt; occurs above 1,900 feet elevation. Cater and Wells (1953, p. 104-105) interpret the deposits as somewhat younger than the Wimer Formation, perhaps as young as early Pliocene. Harper (1980a) interprets the deposits as an eastern fluvial facies of the Wimer Formation

TKqp QUARTZ PORPHYRY—Dikes intrude Josephine Peridotite. A dike 8 km long cuts north-south across a zone of sheared and serpentinized peridotite near the California-Oregon border and is not offset by the numerous northwest-trending faults. The faults are younger than Late Cretaceous emplacement of the peridotite because they cut the thrust at the base of the peridotite. Therefore, the quartz porphyry must be Cretaceous or Tertiary

TKdk DIKES OF UNKNOWN COMPOSITION—Detected from aerial photographs. Age range is the same as for quartz porphyry

COAST RANGES BELT

Kms METASEDIMENTARY ROCKS—A sliver of metasedimentary rocks (slate and metagraywacke) occurs adjacent to west side of Josephine Peridotite from 12 km northeast of Crescent City southward. These rocks have been correlated with the South Fork Mountain Schist (Blake and others, 1967; Harper, 1980a), with which they are continuous, and with the Colebrooke Schist (Dott, 1971) originally named in southwest Oregon. Correlation of the metasedimentary rocks with the South Fork Mountain Schist is favored here. Blake and others (1967) concluded that the South Fork Mountain Schist developed by dynamothermal metamorphism below the South Fork Mountain fault, which is correlated with part of the thrust at the west edge of the Josephine Peridotite. In the Yolla Bolly area, south of the area mapped on plate 1, the age of the protolith of the schist is Early Cretaceous (metagraywacke with *Buchia*): age of metamorphism is dated at 105 ±16 m.y. (Z. E. Peterman and others, in Blake and others, 1967, p. C6), or later than earliest Cretaceous. The schist is believed to have formed during the Late(?) Cretaceous Coast Range orogeny (Irwin, 1964)

KJfc FRANCISCAN COMPLEX—Consists of graywacke, sandstone, shale, chert, and conglomerate below the Josephine Peridotite. These rocks in northern Del Norte County were named the Dothan Formation by Cater and Wells (1953, p. 84-86, pl. 11), by Maxson (1933, p. 130, pl. IV), and by Dott (1971), employing the name first used by Diller (1907, p. 407-411) in Oregon. These rocks were also referred to as the Franciscan Formation by Irwin (1960, p. 27, pl. 1; 1964, p. C3; 1966, p. 27, pl. 1), by Bailey and others, (1964, pl. 1), by Strand (1963), by Bailey and others (1970, fig. 1), and by Blake and others (1967). In California, the Franciscan Complex is equivalent to the Dothan Formation (Hotz, 1969, p. D136). Thickness of the Franciscan Complex is not known. A Late Jurassic and Early Cretaceous age, as suggested by Irwin (1964, p. C3), is supported by two occurrences of pelecypods of the genus *Buchia* (Ramp, 1969; Blake and others, 1967, p. C5)

KJm UNDIFFERENTIATED METASEDIMENTARY ROCKS

WESTERN JURASSIC BELT

QKsp SERPENTINITE—Mapped by Harper (1980a) in a north-south zone about 1 km wide extending from 2.5 km south of the Smith River to 8 km north of the river and in a north-south zone as much as 350 m wide in the French Hill area (after Harper, 1980a, pl. 1). Elsewhere peridotite is serpentinized in vicinity of fault zones (Cater and Wells, 1953, pl. 11). Serpentine probably formed from peridotite as long ago as Cretaceous and is still forming today (Barnes and O'Neill, 1969)

Klc LOWER COON MOUNTAIN PLUTON—Consists chiefly of medium- to coarse-grained olivine clinopyroxenite, plagioclase clinopyroxenite, and rare dunite (Harper, 1980a). The rock has a weakly developed foliation of clinopyroxenite grains and layering of dunite and magnetite. Harper (1980b) concludes that the pluton intruded the metasedimentary rocks overlying the Josephine ophiolite of Harper (1980b). The lower contact of the pluton is now a thrust fault marked by brecciation and serpentinization of the ultramafic rock and brecciation of the metasedimentary rocks of the lower plate. No contact aureole is preserved along the contact. The weak foliation and layering at the north end of the pluton, not far above the thrust, is vertical and, in projection, would be truncated by the thrust. Age of the pluton, as indicated below, is pre-late Early Cretaceous

Jeg A marginal facies of the Lower Coon Mountain pluton recognized by Harper (1980a). It is composed of gabbro, quartz diorite, rare granitic rocks, and locally abundant ultramafic rock like the ones described above. A granodiorite dike yielded a U-Pb date of 100 m.y. (Harper and Saleeby, 1980), or late Early Cretaceous

KJhd HORNBLENDE DIORITE—Dikes intrude Josephine Peridotite, gabbro, and Jurassic metasedimentary rocks (Harper, 1980a; Cater and Wells, 1953, pl. 1; Wells and others, 1949). According to Harper the dikes are metamorphosed to low grade and are locally deformed. They postdate the metasedimentary rocks and probably were intruded before tectonic emplacement of the Josephine Peridotite in Late Cretaceous

KJqd QUARTZ DIORITE—Intrudes Josephine Peridotite and hornblendite. Cretaceous or Jurassic

KJgd GRANODIORITE—Intrudes Josephine Peridotite in southeast Chetco Peak Quadrangle. Cretaceous or Jurassic

KJdi DIORITE(?)—Fault-bounded body exposed along the crest of southern Rattlesnake Mountain. Rock too altered to identify with certainty, but resembles diorite. Cretaceous or Jurassic

KJh HORNBLENDITE—Coarse-grained weakly gneissose hornblende-rich rock. Intrudes Josephine Peridotite in Diamond Creek area. Cretaceous or Jurassic, but older than quartz diorite

Jms METASEDIMENTARY ROCKS—Conformably overlies the Josephine ophiolite of Harper (1980b). Cater and Wells (1953) tentatively assigned these rocks to the Galice Formation, originally named by Diller (1907, p. 403-407). Harper (1980a,b), who did not assign these rocks to a formation, described them as follows. Basal beds comprise a sequence as much as 35 m thick of green radiolarian chert, slate, and, in places, red argillite. Above these beds is a monotonous sequence of interbedded graywacke, slate, rare conglomerate, and rare nodular limestone near the base. Graywackes in the lower few hundred meters contain abundant clasts of volcanic rock, mainly andesite, although felsic and silicic types are present, and subordinate chert, shale, and quartz clasts. Upper graywackes contain abundant clasts of chert and siliceous argillite and subordinate volcanic rock, plagioclase, quartz, and quartz-mica schist clasts. Cross sections of Harper (1980a) suggest that the rock unit is at least 2,500 m thick in the Hurdygurdy Creek-Big Flat area, about 25 km southeast of Crescent City. Age of the unit is Late Jurassic on the basis of pelecypods (*Buchia concentrica* (Sowerby), late Oxfordian to early Kimmeridgian) (D.L. Jones, in Harper, 1980b) which occur in a pebble conglomerate a few hundred meters above the base

JOSEPHINE OPHIOLITE OF HARPER (1980b)

Jp PILLOW LAVA—Spilitic pillow lava and isolated pillow and broken-pillow breccia with rare massive lava lie on the dike complex (Harper, 1980b). A few pillows are sufficiently well preserved to estimate water depth during eruption. Zoned pillows with large irregular marginal vesicles suggest eruption in shallow water (less than 350 m). The unit exhibits pseudostratigraphically controlled mineral and textural zoning, interpreted by Harper to indicate early hydrothermal metamorphism preceding the regional low-grade metamorphism to which the entire Josephine ophiolite has been subjected. The pillow lava is no more than 215 m thick. Age is Late Jurassic

Jv VOLCANIC ROCKS, UNDIVIDED

Jdc DIKE COMPLEX—Dark-to light-green aphanitic to fine-grained mafic dikes averaging 50 cm in width (Harper, 1980a). Chilled margins of dikes are locally well preserved. The cores are generally coarser grained toward the base of the dike. Sheeting in the unit is a result of subparallelism of the dikes. The upper part of the complex is commonly altered to epidosite. This unit is assigned a Late Jurassic age

Jgb GABBRO—Gradational contact with underlying cumulate ultramafic rock. Layered clinopyroxene gabbro locally grades upward into massive gabbro (Harper, 1980b). Medium-grained gabbro is locally intercalated with cumulate ultramafic rock and commonly intruded by diabase dikes. Zircons from a plagio-granite, possibly in the gabbro, yielded a concordant U-Pb age of 157 m.y. (Harper and Saleeby, 1980), or Late Jurassic. This, together with the overlying Late Jurassic metasedimentary rock, dates the section of gabbro through pillow lava as Late Jurassic

Juc CUMULATE ULTRAMAFIC ROCKS—Consists predominantly of medium-grained wehrlite, clinopyroxenite, and dunite, with common interstitial plagioclase and poikilitic textures (Harper, 1980a). Contact between the cumulate ultramafic rock and peridotite is marked by intense serpentinization and shearing. The unit is Jurassic

JOSEPHINE PERIDOTITE—Includes two units:

Jd Dunite. Occurs in harzburgite as layers as much as 30 cm thick and dikes as much as 300 m thick. Three dunite bodies large enough to appear on plate 1 occur 9 km south of the California-Oregon border, at Low Divide, southern Low Plateau, and High Plateau. Dunite bodies less than 15 m across occur at chromite mines and prospects on plate 1. Some dunite may be pre-Middle Jurassic; other dunite may be Late Jurassic

Jpd Peridotite. Predominantly medium- to coarse-grained layered and foliated harzburgite tectonite, with minor dunite, lherzolite, wehrlite, and orthopyroxenite. Serpentinization is moderate to locally intense throughout the peridotite. Wehrlite pods included in peridotite in the Oregon Mountain area probably belong to a sequence of cumulate ultramafic rock overlying the harzburgite tectonite. The Oregon Mountain sequence was not differentiated from the Josephine Peridotite on plate 1. Age of the peridotite is pre-Middle Jurassic on the basis of K-Ar dates of diorite and gabbro dikes intruding the peridotite west of Cave Junction, Oregon (167 to 83 m.y., with a modal concentration near 150 m.y., in Dick, 1973)

Jeg AUGEN GNEISS—Comprises a thrust sliver along the west edge of the Josephine Peridotite in the Chetco Peak quadrangle. Boulders of amphibolite gneiss, presumably from this unit, in the North Fork Smith River, have cataclastic textures. The gneiss may have been brought from a deep crustal environment during emplacement of the peridotite, or the gneiss may be a segment of a formally more extensive dynamothermal metamorphic aureole formed during an early stage of obduction of oceanic crust and mantle. (See Williams and Smyth, 1973, and Jamieson, 1980, for Newfoundland examples.) A Jurassic or older age for the gneiss is suggested by the spacial relation of the gneiss to the Josephine Peridotite

WESTERN PALEOZOIC AND TRIASSIC BELT

Jw WEHRLITE—Predominantly olivine clinopyroxenite, hornblende-olivine clinopyroxenite, and wehrlite with subordinate dunite (Snoke, 1977, fig. 3) intruding metavolcanic and metasedimentary rock. The part of the pluton along the east edge of plate 1 is coarse-grained wehrlite with weakly developed layering and foliation of clinopyroxene. Snoke assigned a Late Jurassic age to the pluton

PRESTON PEAK OPHIOLITE

TrPzm METAVOLCANIC AND METASEDIMENTARY ROCKS—Units listed in ascending order: (a) a lower unit, predominantly massive metabasaltic flows, sills, and dikes with minor mafic metatuff and metatuff breccia, thin-bedded gray to black chert, and siliceous argillite and phyllite and lenses of marble near the top; (b) a unit of siliceous argillite with poorly developed platy cleavage; (c) a unit of polymictic pebble conglomerate and grit, including wacke, siltstone, and argillite; (d) an upper unit of metabasaltic flows, sills, and dikes and subordinate siltstone, argillite, and chert (Snoke, 1977). Assignment of a Permian and Triassic(?) age to the Preston Peak ophiolite by Snoke is based on revised and recent fossil determinations in the western Paleozoic and Triassic belt. Irwin and Galanis (1976) report an Early Jurassic fossil locality in rocks which are a northern extension of these rocks in the Waldo area, Oregon. A pre-Permian age for some of these rocks cannot be ruled out

TrPzp PERIDOTITE—Harzburgite with minor dunite, locally containing podiform chromite. Intensively serpentinized

Contact—Approximately located

Fault—Dotted where concealed

Thrust fault—Dotted where concealed; sawteeth on upper plate

Syncline—Showing direction of plunge

Chromite mines and prospects

Prospect (on Map)

Mine (on Map)

Prospect (on cross-section *B-B'*)

Mine (on cross-section *B-B'*)

Anomalous occurrences of copper, Cu; mercury, Hg; magnetite, mag

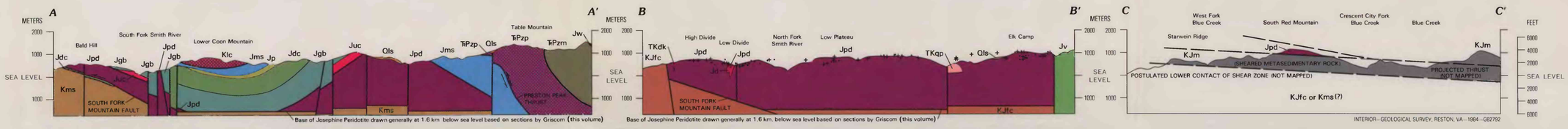
APPROXIMATE MEAN DECLINATION, 1984

SCALE 1:125 000

2 1 0 2 4 6 8 10 MILES

2 1 0 2 4 6 8 10 KILOMETERS

CONTOUR INTERVALS 50 AND 100 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



Base of Josephine Peridotite drawn generally at 1.6 km below sea level based on sections by Griscom (this volume)

Base of Josephine Peridotite drawn generally at 1.6 km below sea level based on sections by Griscom (this volume)

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1984—G82792

RECONNAISSANCE GEOLOGIC MAP OF THE JOSEPHINE PERIDOTITE AND ASSOCIATED ROCKS