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COVER PHOTO

Photomicrograph of quartz-mica-graphite variety of Condrey Mountain Schist, discussed in article beginning on page 125. This photo, taken under plane-polarized light, shows incipient development of crenulation cleavage typical of later stages of deformation of Condrey Mountain Schist. Each edge of photo represents about 0.75 cm.

Geologic studies of the La Grande area and Mount Hood now available

The Oregon Department of Geology and Mineral Industries announces the release of two new geologic publications that are part of its geothermal assessment program in the State of Oregon.

Special Paper 6, *The Geology of the La Grande Area, Oregon*, summarizes the results of a recently completed geologic investigation by Warren Barrash, John G. Bond, John D. Kauffman, and Ramesh Venkatakrishnan, Geoscience Research Consultants, under contract to the Department. The 47-page report describes the stratigraphy and structure of the Miocene Columbia River Basalt Group in the general area through which Interstate I-84 (old I-80N) runs between Hilgard and North Union, in eastern Oregon. It includes geologic maps and cross sections of the Hilgard, La Grande SE, Glass Hill, and Craig Mountain 7½-minute quadrangles (scale 1:24,000). Price of Special Paper 6 is $5.00.

Special Paper 8, *Geology and Geochemistry of Mount Hood Volcano*, is the result of a study by Craig White, Department of Geology, University of Oregon, also under contract to the Oregon Department of Geology and Mineral Industries. The 26-page report sells for $2.00 and contains petrologic and geochemical data, including major- and trace-element analyses of Main Stage lavas and post-glacial silicic rocks.

Both papers may be purchased from the Department's Portland, Baker, or Grants Pass offices. They may be ordered by mail from the Portland office. Payment must accompany orders under $20.00. ☐

June OREGON GEOLOGY late

Due to circumstances beyond our control, the June issue of *Oregon Geology* was printed two weeks later than usual. We apologize for any inconvenience this delay may have caused.

CONTENTS

Sheeted dikes of the Wild Rogue Wilderness, Oregon

by Len Ramp, Grants Pass Field Office, Oregon Department of Geology and Mineral Industries, Grants Pass, Oregon 97526, and Floyd Gray, U.S. Geological Survey, Menlo Park, California 94025

INTRODUCTION

The name "ophiolite" is applied to sequences of rocks consisting, in part, from bottom to top, of peridotite, gabbro, dike swarms, basalt (often as pillows), and oceanic sediments. The basaltic dike swarms (sheeted diabase dikes), apparently feeders for the overlying volcanic rocks, form a continuous layer between them and the underlying gabbro (Figure 1). The dikes are thought to have been intruded along a single, narrow fracture, thereby becoming chilled against previously emplaced, solidified dike rock. Ideally, the dikes pinch downward into the gabbro unit, from which they are thought to have been derived. The relation between the dikes and the underlying gabbro constitutes one of the major field and petrogenetic problems of ophiolite genesis. The central question of the gabbro-diabase relationship was succinctly pointed out by Thayer (1977a) in a discussion of the Troodos Complex:

> "If the dikes are chilled against underlying cumulate gabbro, they cannot be derived from it. If they pinch out downward in the gàbbro, as described and postulated, they cannot have come up through it. How then, did they get where they are?"

The great lateral extent of some dike swarms has led geologists to believe that the dikes were formed by repeated injection of magmatic liquid along zones of extreme crustal extension (Moores and Vine, 1971; Kidd and Cann, 1974). Possible sites of such extension zones include island-arc marginal basins, mid-ocean ridges, and stationary hot spots beneath a drifting plate.

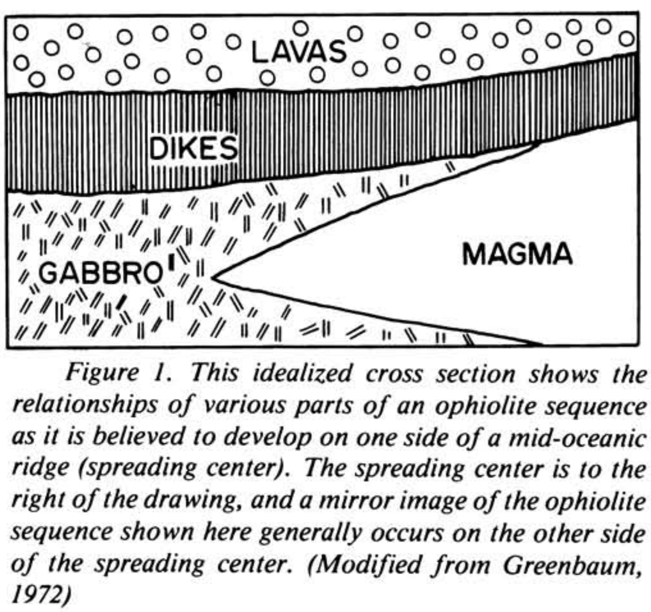


Figure 1. This idealized cross section shows the relationships of various parts of an ophiolite sequence as it is believed to develop on one side of a mid-oceanic ridge (spreading center). The spreading center is to the right of the drawing, and a mirror image of the ophiolite sequence shown here generally occurs on the other side of the spreading center. (Modified from Greenbaum, 1972)

This article discusses dike swarms recently recognized in the Wild Rogue Wilderness, southwestern Oregon.

LOCATION

The recently designated Wild Rogue Wilderness is an elongate area extending from near Agness to the Eden Valley Road just north of Mount Bolivar near the Coos, Curry, and Douglas County boundaries. The area is about 31 km (19 mi) long and from 2 to 8 km (1.3 to 5 mi) wide. Elevations range from about 46 m (150 ft) near the Rogue River at the southern end of the area to 1,316 m (4,319 ft) on top of Mount Bolivar. The area includes about 19 km (12 mi) of the Rogue River from Marial downstream to Big Bend near Illahe (Figure 2; detail on Figure 5).

A study of this wilderness is being conducted jointly by the U.S. Geological Survey, the Oregon Department of Geology and Mineral Industries, and the U.S. Bureau of Mines. The Wild Rogue Wilderness project, a part of a multidisciplinary land-resource study of the Medford 2° quadrangle, emphasizes evaluation of potential mineral resources and their relation to regional geology. Field mapping in the steep, rugged area began in June 1979 and should be completed during the 1980 field season. This article outlines some recent discoveries of the past field season and suggests possible avenues of future research.

PREVIOUS WORK

Previous studies of the area include those by Diller (1914), Butler and Mitchell (1916), Wells (1955), Wells and Peck (1961), Baldwin and Rud (1972), Kent (1972), Purdom (1977), and Ramp and others (1977). Earlier geologic mapping in this area was done at smaller scales than that of the present investigation, and the dikes were grouped along with the volcanic rocks as greenschist-facies metamorphic volcanic rocks, including basalt, andesitic to siliceous tuffs and flows, occasional pillow lavas, tuffaceous sediments, and chert locally intruded by diabasic and gabbroic dikes then considered part of the Rogue Formation. A few areas of similar rocks were mapped about 32 km (20 mi) to the southwest in the vicinity of Saddle Mountain and Gray Butte by Ramp and others (1977, p. 6) and were described as Rogue Formation volcanic rocks intruded by abundant diabasic and gabbroic dikes.

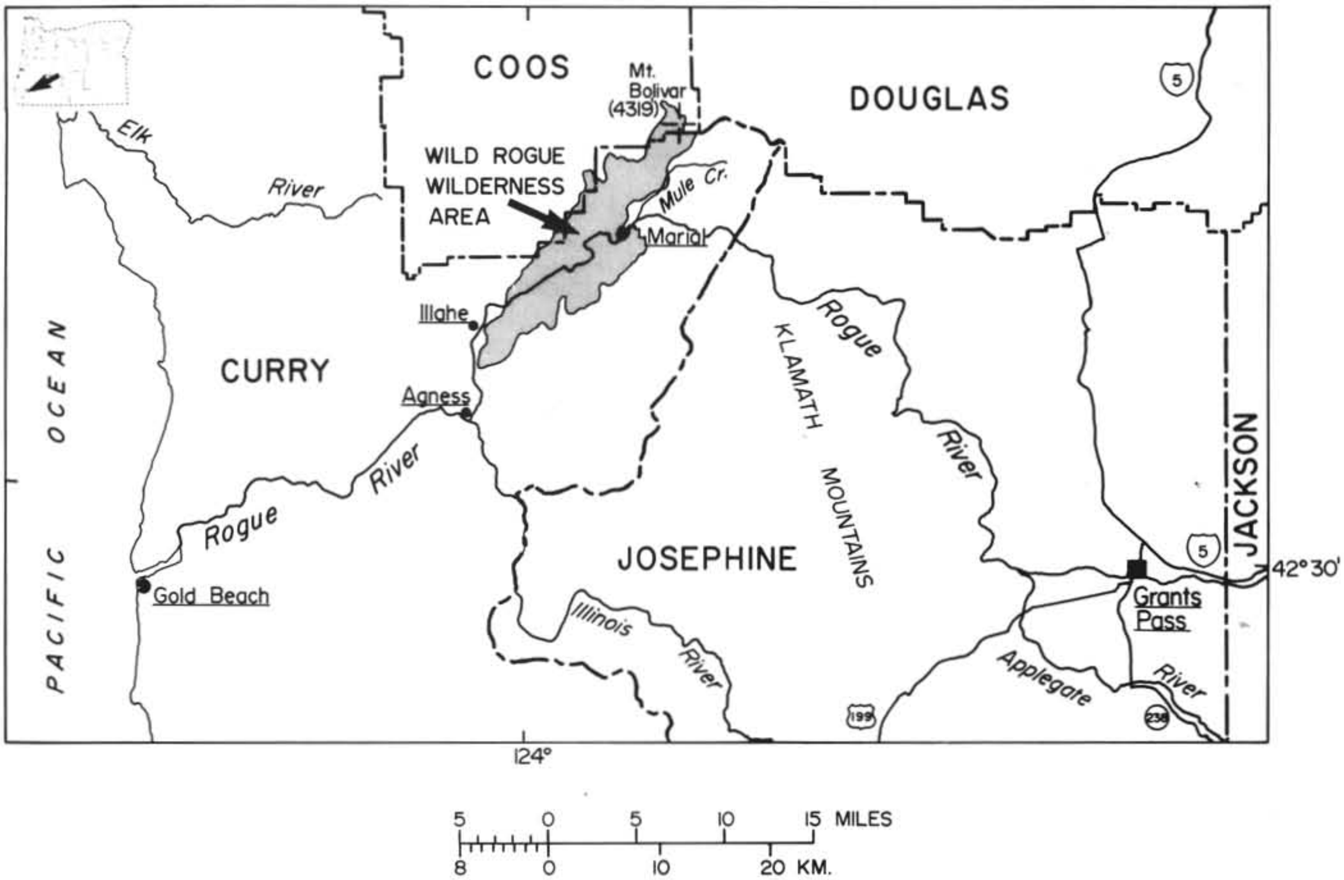
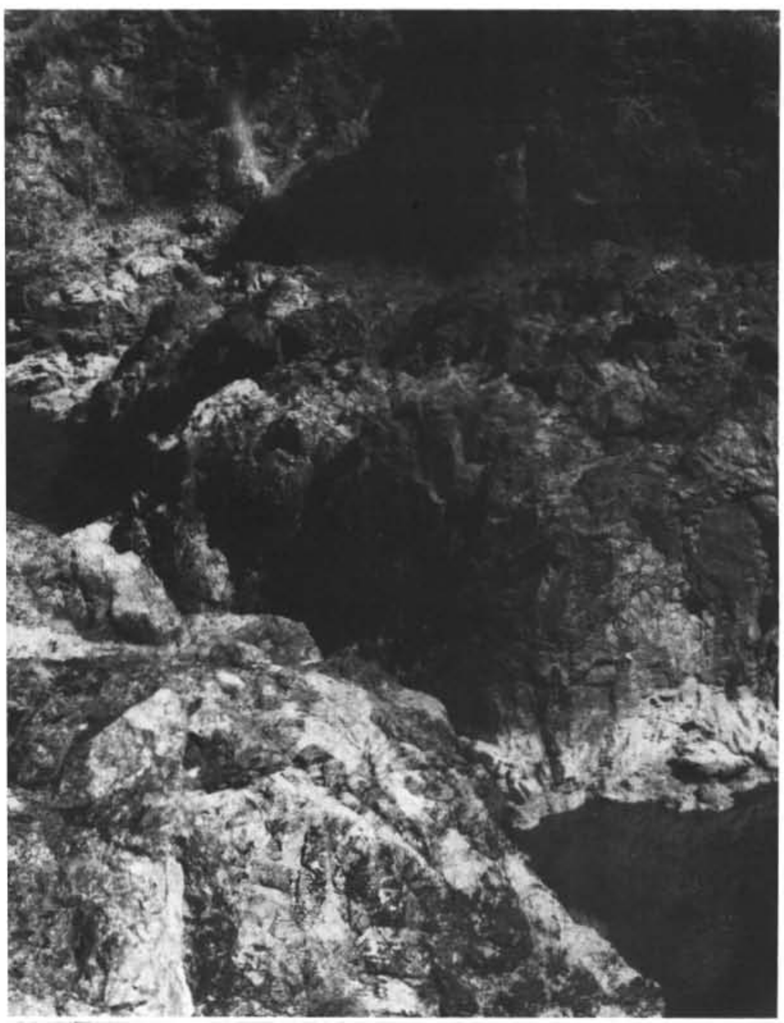


Figure 2. Locality map of the Wild Rogue Wilderness area, southwestern Oregon.



DISCUSSION

The recognition of the extensive sheeted dike unit described in this article is of particular interest to those attempting to construct a model of the tectonic environment of the northern Klamath Mountains of southwestern Oregon. The sheeted dikes are best exposed in Mule Creek Canyon of the Rogue River in the vicinity of Inspiration Point (Figure 3), where they crop out continuously from about 0.5 km (0.3 mi) upstream to 0.8 km (0.5 mi) downstream from the mouth of Stair Creek. The dikes are also well exposed in Mule Creek, on the ridge extending south from Saddle Peaks, and on the south slope and top of Mount Bolivar (Figure 4).

The section of sheeted dikes exposed along the Rogue River in the vicinity of Inspiration Point forms a mappable unit that trends N. 10°-15° E. and is approximately 600 m (2,000 ft) thick (Figure 5). To the northwest, the dikes mapped along the river are faulted against a sequence of silicious tuffs intruded in places by quartz diorite. The fault exposed in the river bank trends approximately N. 55° E. and dips 75° S.E. The southeastern boundary of the dike complex is best exposed in Stair Creek about 180 m (590 ft) upstream from its mouth. At this point the dike unit is in fault

Figure 3. Mule Creek Canyon on the Rogue River near Inspiration Point.

Figure 4. South flank of Mount Bolivar. Dikes trend from the lower right of the photograph to the upper left. Some of the dikes display dark pyrite staining.

contact with the younger marine shale and graywacke of the Jurassic and Cretaceous Dothan Formation (D. Jones, personal communication, 1979).

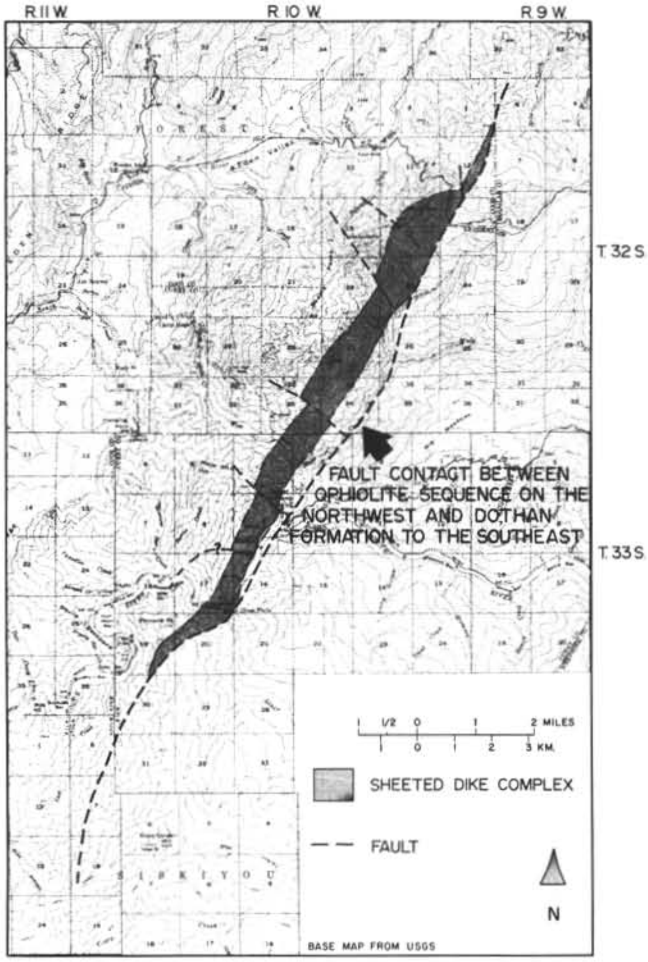
The highly recrystallized and tightly contorted (drag-folded) rocks of both formations suggest that faulting occurred at considerable depth. The dike rocks within about 75 m (250 ft) of the fault have been altered to a chlorite-epidote schist. The juxtaposed sedimentary rock is a highly indurated argillite. The foliation in the schist strikes about N. 20°-50° E. and dips steeply about 75°-85° S.E. Movement along this fault was predominantly vertical, although the orientation of drag folds indicates that some lateral displacement also occurred.

Where relatively undisturbed by faulting, the sheeted dikes strike approximately N. 40°-70° W. and dip nearly vertically. The unit consists of multiple, subparallel dikes with an average thickness of about 1 m (3 ft) but varying from 10 cm (4 in) to 2 m (6 ft). The dikes are composed of medium-grained, occasionally porphyritic rocks containing gray, subophitically intergrown plagioclase and pyroxene. Many of the dikes exposed in the upper Mule Creek drainage are notably porphyritic (Figure 6). A rare, greenish-black, coarse-grained, porphyritic, olivine-bearing dike is exposed near Stair Creek Falls (Purdom, 1977, p. 49). Younger dikes intruding older dikes display chilled margins on one or both sides, and the number of chilled margins is greater on the north side than on the south by a ratio of 3:2.

Most of the dikes measured along the Rogue River strike approximately N. 40°-70° W. and dip steeply to the north, but some rotation of the dikes apparently occurred near the Dothan fault contact, where strike measurements of N. 10°-15° E. with a vertical dip were recorded.

Many of the sheeted units are 100 percent dikes, but screens of gabbroic country rock constitute up to 50 percent of the unit near its eastern margin where mapped along the river. An area about 75 m (250 ft) wide near the mouth of Stair Creek has an estimated 40 percent of gabbro screen, but the percentage of screen decreases to the northwest (Figure 7). Slivers and lenses of gabbro caught up in the dike swarm display a foliation with a fairly constant orientation (Figures 8 and 9). This foliation appears to be a metamorphic fabric, although it may be an inherited cumulate layering. The pieces of gabbroic rock (screen) appear to be slabs of country rock broken and intruded by the dikes.

Preliminary mapping in the vicinity of Mount Bolivar (on the ridge, SW ¼ sec. 14) indicates several irregularly spaced groups of diabase dikes intruding the gabbroic rocks. A similar relation can be seen about 3.2 km



↑ *Figure 5. Preliminary map showing the extent of the sheeted dike unit in the study area. (Mapped by the authors in 1979)*

(2 mi) to the northeast along a logging road (NE ¼ sec. 12). Although more detailed mapping will be required to further characterize the complex, the sheeted dike unit in the Wild Rogue Wilderness was apparently emplaced tectonically along with the incomplete ophiolite sequence. Further study of the critical dike-gabbro contact zone may provide useful insight into the petrogenesis of this part of the ophiolite suite.

Preliminary mapping has outlined a zone of coarse, agglomeritic, plagioclase-rich basalt flows that may represent the initial volcanic expression of the dikes. In one area along Bolivar Creek, the dikes are in close proximity to a very coarse-grained agglomerate consisting of rock fragments as large as 0.5 m (1.5 ft) in diameter and plagioclase phenocrysts in a sparse, fine-grained matrix. The size of the fragments and ratio of fragments to matrix decreases to the north until the fragments disappear. Extensive volcanic rocks lie northwest of the dikes and appear to interfinger with dike rocks only in the vicinity of Diamond Peak and Mount Bolivar.

The age of the dikes is uncertain, but if they are cogenetic with the rocks of the Rogue Formation, which are interpreted as island-arc volcanic rocks, they would also be of early Late Jurassic age. Specimens from some of the dikes appear fresh enough for isotopic age dating, and further sampling for this purpose is intended.

Sheeted dikes somewhat similar to those in the Wild Rogue Wilderness have been described in eastern Oregon by Thayer (1977b, p. 96) and in nearby Del Norte County, Calif., by G. D. Harper (written communication, 1979).

Mineralization in the sheeted dike unit consists of abundant disseminated pyrite in a few of the dikes and occasional, small quartz veins that crosscut the formation and contain minor amounts of gold associated with pyrite. The pyritic dikes show up as brown bands on weathered surfaces (Figure 4). Some mineralization in the area is concentrated near the contact between the dikes and the volcanic rocks, where a zone of leached volcanic rock contains abundant pyrite and chalcopyrite along with minor (or occasional) sphalerite. In some of the volcanic rocks, for example, in the upper Mule Creek drainage, a few prospect cuts and adits are found in a zone of quartz-diorite-impregnated bedded tuff to the northwest of the sheeted dikes. This area appears to be a favorable location for mineralization. The Mule Mountain gold mine located on top of the ridge about 800 m (0.5 mi) north of Inspiration Point is in this zone.

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← *Figure 6. Dark-colored andesite porphyry dike with chilled margins penetrates older, light-colored diabasic dike.*

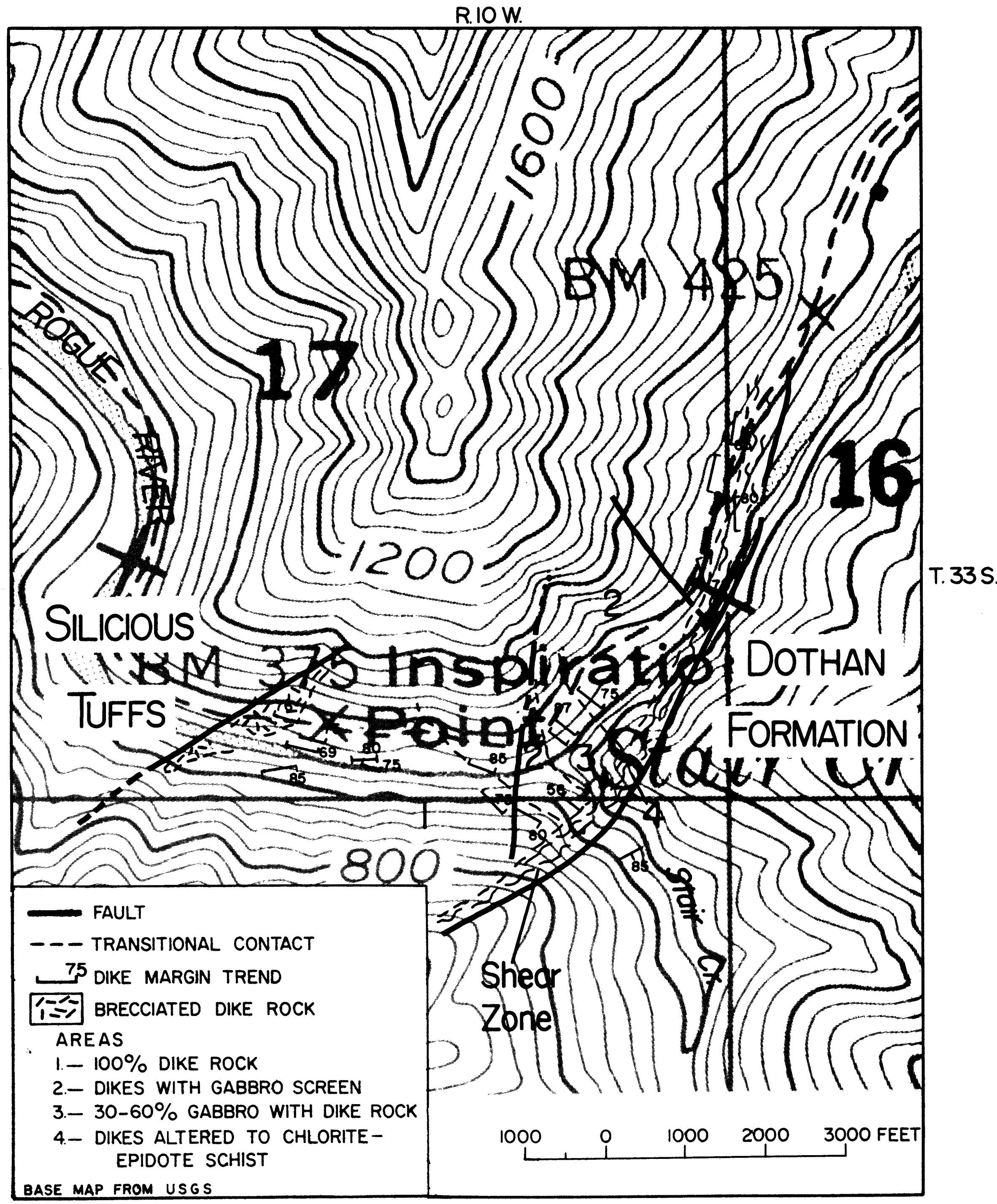

Figure 7. Preliminary geologic map of the sheeted dike sequence in the Inspiration Point area, Mule Creek Canyon.

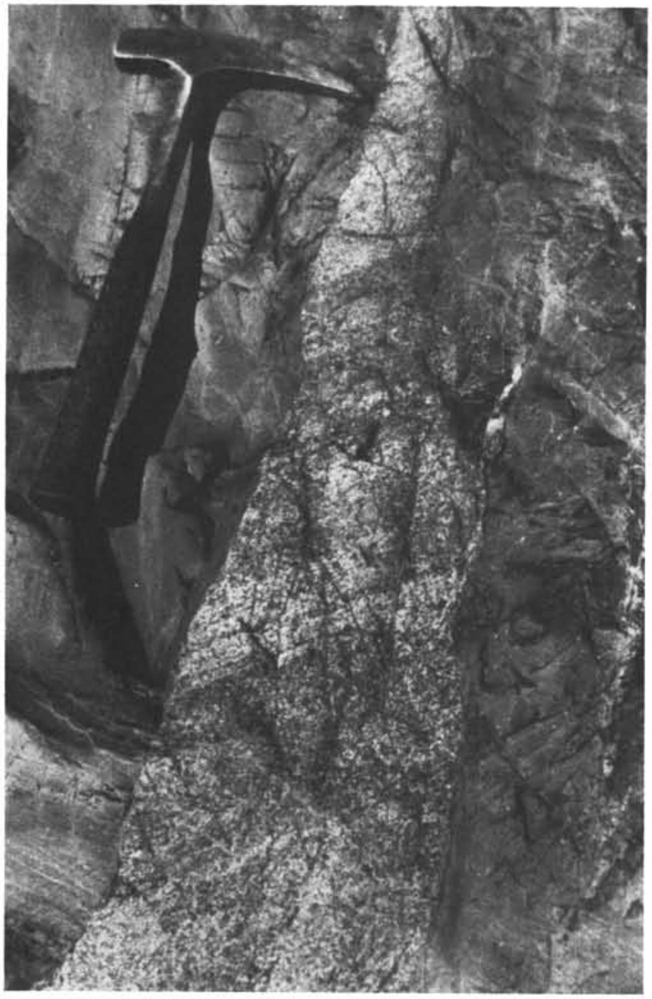

Figure 8. Gabbro screen surrounded on both sides by dikes with chilled margins against the gabbro. Note foliation (bands of light and dark minerals) in gabbro.

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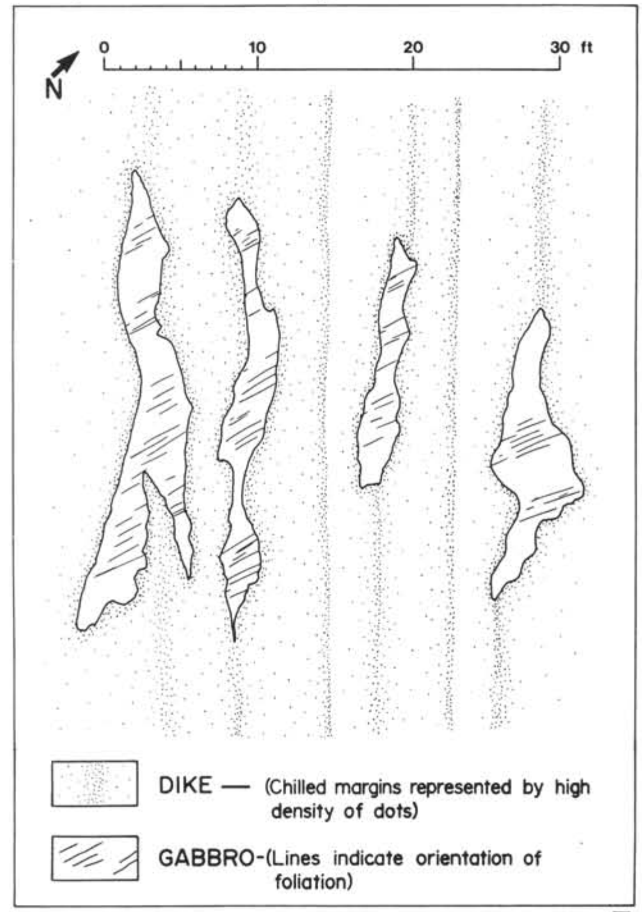
Figure 9. Sketch of outcrop showing typical relationship between dikes and gabbro.



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Geology of the Condrey Mountain Schist, northern Klamath Mountains, California and Oregon

by M. M. Donato and R. G. Coleman, U.S. Geological Survey, Menlo Park, Calif. 94025, and M. A. Kays, Department of Geology, University of Oregon, Eugene, Oreg. 97403

This paper is intended as a companion piece to the "Geologic Field Trip Guide through the North-Central Klamath Mountains," by M. A. Kays and M. L. Ferns, which appeared in *Oregon Geology*, v. 42, no. 2, February 1980. The two papers represent the material for Field Trip 4 of the March 1980 GSA Cordilleran Meeting and were announced under the title "Geologic Summary for a Field Trip Guide through the North-Central Klamath Mountains" in *Geologic Field Trips in Western Oregon and Southwestern Washington*, Oregon Department of Geology and Mineral Industries Bulletin 101, 1980, p. 77. —Ed.

REGIONAL GEOLOGY

The Condrey Mountain Schist is exposed through a structural window in the so-called western Paleozoic and Triassic belt of the Klamath Mountains of southern Oregon and northern California (Figure 1). On the eastern and southern margins, a low-angle folded thrust fault separates the schist from overlying garnet amphibolite-facies rocks of the western Paleozoic and Triassic belt. On the west, the contact with ultramafic rocks of the Seiad Complex appears to be a high-angle fault. The structurally overlying rocks of the western Paleozoic and Triassic belt, known in Oregon as the Applegate Group, form a diverse assemblage of amphibolite-facies metavolcanic, metasedimentary, and ultramafic rocks intruded by granitic to dioritic plutonic rocks. These rocks are described in detail by Hotz (1979). Evidence for the age of the western Paleozoic and Triassic belt comes from limestone bodies containing fossils of Paleozoic, Triassic, and Jurassic age (Elliott, 1971; Irwin, 1972). The recent recognition of Triassic and Jurassic radiolarians in some cherts of the western Paleozoic and Triassic belt suggests that at least some of the limestones may be blocks in a mélange (Irwin and others, 1977). Based on isotopic measurements of hornblende separates, the age of metamorphism of the amphibolitic rocks that overlie the schist is reported by Kays and others (1977) to be 144 ± 3 m.y.

In lithology and metamorphic grade, the Condrey Mountain Schist presents a strong contrast to the rocks that structurally overlie it. It consists predominantly of black graphitic quartz-mica schist, here referred to as "blackschist," but contains considerable amounts of interlayered chlorite-actinolite schist, a "greenschist," that may be tuffaceous in origin. The greenschist locally contains abundant glaucophane or crossite; lawsonite is not present in any of these rocks. The schist, though strongly deformed and thoroughly recrystallized, is markedly lower in grade than rocks of the overlying belt.

The age of metamorphism of the Condrey Mountain Schist has been determined by several investigators. Lanphere and others (1968) and Suppe and Armstrong (1972) reported isotopic ages of 141 m.y. and 155 ± 3 m.y., respectively, based on muscovite and whole-rock analyses. These ages suggest that the two plates have at least overlapping histories of crystallization. Yet the correlation of the schist with other rocks in the Klamath Mountains has proved to be difficult. On the basis of lithologic similarity and structural and metamorphic evidence, Klein (1977) suggested that the schist is equivalent to the Galice Formation to the west. Overlap of the Galice Formation's Oxfordian to Kimmeridgian age with the apparent metamorphic age of the Condrey Mountain Schist complicates any proposed correlation. Clearly, refinement of the Galice's stratigraphy and age as well as a better notion of structural relations in the overlying plate is needed.

LITHOLOGIES

The dominant rock type in the Condrey Mountain Schist is graphitic quartz-mica schist, "blackschist" (Figure 1). Alternating, thin (millimeter-sized), micaceous and quartzose layers impart a strong schistosity to the rock. Pyrite cubes measuring up to 1 cm on a side are abundant, and many show quartz-pressure shadows. Most of the blackschist is compositionally monotonous, but amounts of quartz, feldspar, and mica vary locally. Rare, but distinctive thin cherty layers occur within the blackschist. The apparent ease with which the blackschist deforms is shown by disharmonic folding in some outcrops. Because incompetency of the blackschist results in shearing of folds, most outcrops display only strong schistosity modified by small-scale crenulations. Rarely, intrafolial folds are observed.

The mineral assemblage in the blackschist is quartz, muscovite, carbonaceous material, chlorite, albite, and pyrite (commonly altered to iron oxides). Accessory minerals include tourmaline, sphene, and clinozoisite.

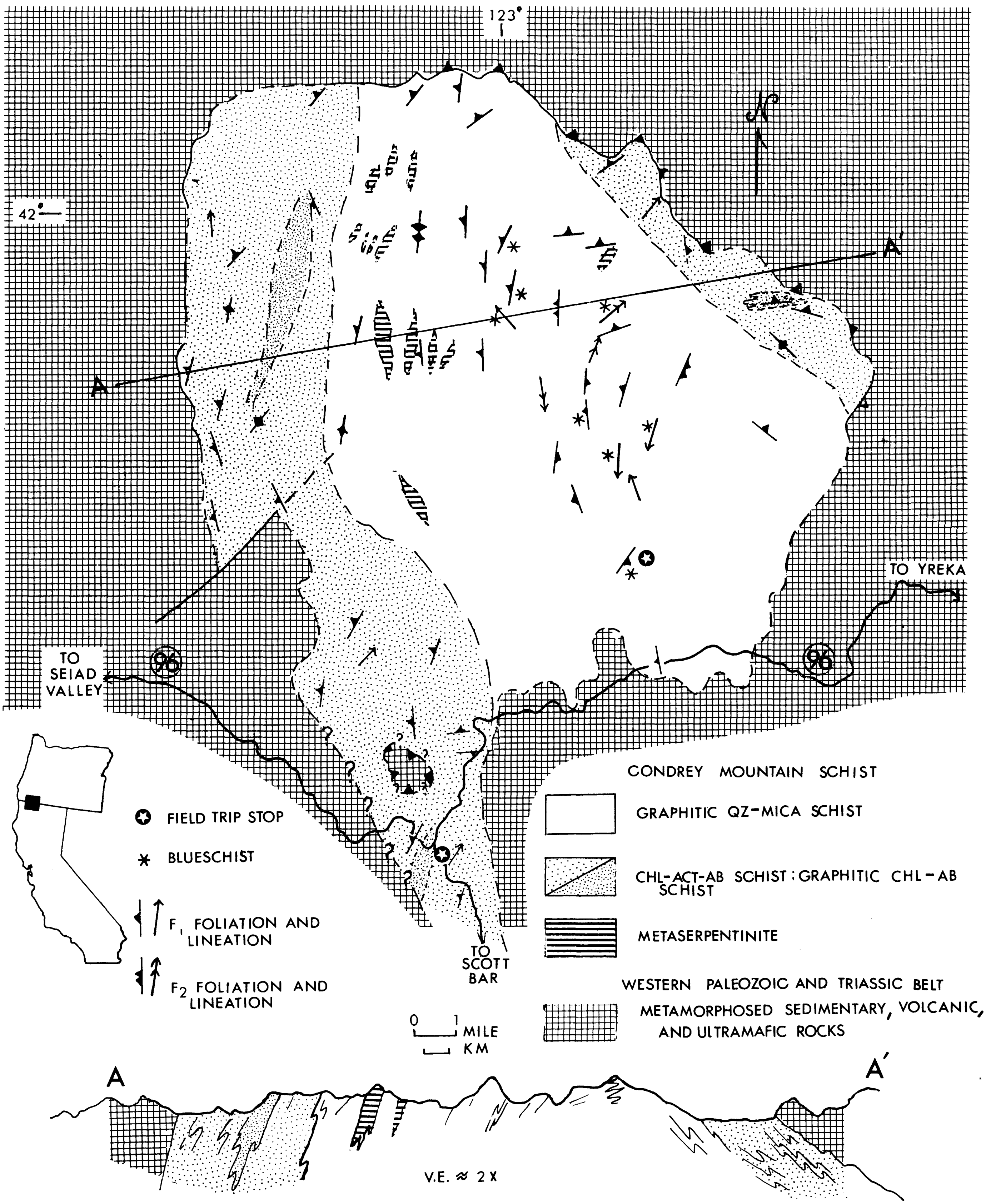

Figure 1. Geologic sketch map and cross section of the Condrey Mountain Schist. Based on mapping by Engelhardt (1966), Hotz (1967), and Donato and Coleman (1979).

Late-growing stilpnomelane and chlorite pseudomorphs after garnet have been observed in several thin sections. Metacherts contain quartz, riebeckite, garnet, stilpnomelane, and albite.

Conformably interlayered and infolded greenschist is mainly chlorite, albite, actinolite, epidote, and white mica, with minor garnet, stilpnomelane, calcite, and sphene occurring locally. Fine-scale compositional banding visible in some outcrops may reflect primary layering, possibly in a tuffaceous deposit. Compositional variations occur on a scale ranging from millimeters to meters or tens of meters. A graphite- and chlorite-rich variety forms a mappable subdivision of greenschist and is shown in Figure 1.

In several localities, greenschist is interlayered with schist containing crossite or glaucophane as the predominant mineral. We refer to these schists as "blueschist," although they lack the diagnostic blueschist-facies mineral lawsonite. The assemblage is sodic amphibole (crossite and, at some places, glaucophane, by their optical properties), chlorite and epidote (both iron-rich), white mica, albite, garnet, and stilpnomelane. The only mineralogical difference between the greenschists and blueschists is indeed the composition of the amphibole.

Blueschist layers range in thickness and extent from a few centimeters to tens of meters, as seen at a local quarry excavated in blueschist with interlayered greenschist (shown as field trip stop in Figure 1; also stop 6, field trip guide in February 1980 *Oregon Geology*). The presence of these fine-scale intercalations of blueschist and greenschist implies that the dominant factor controlling the mineral assemblage is local layer composition rather than large pressure differences. These schists probably formed under higher than normal greenschist-facies pressures.

Volumetrically minor, but nonetheless significant, is the metaserpentinite that occurs as concordant lenses or pods within the blackschist and greenschist. Most are massive antigorite-magnetite-brucite rocks, but talc-magnesite schist and microgabbro (clinozoisite-actinolite-albite-garnet) are found. Some lenses have rodingite selvages containing nephrite. We are uncertain whether the rocks were serpentinized prior to, or concurrently with, metamorphism. It is clear from their metamorphic assemblages, however, that these rocks have shared the same history of recrystallization as the

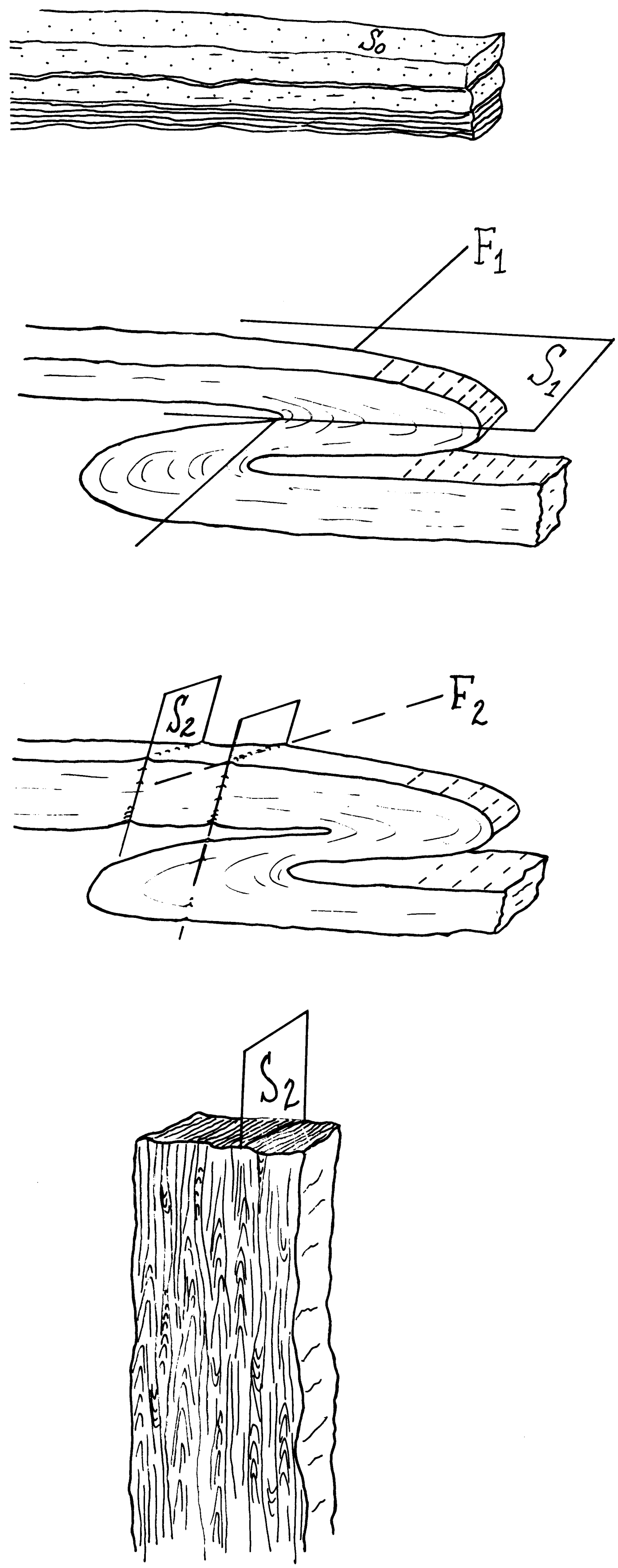

Figure 2. Sequence of events summarizing the deformational history of the Condrey Mountain Schist. F_1 *and* F_2 *indicate axes of folds resulting from deformational episodes.* S_1 *and* S_2 *indicate schistosity. In the most extreme stage,* S_2 *schistosity completely transposes* S_1*, leaving only rootless intrafolial folds as evidence of* S_1*. Common in the easily deformed blackschist.*

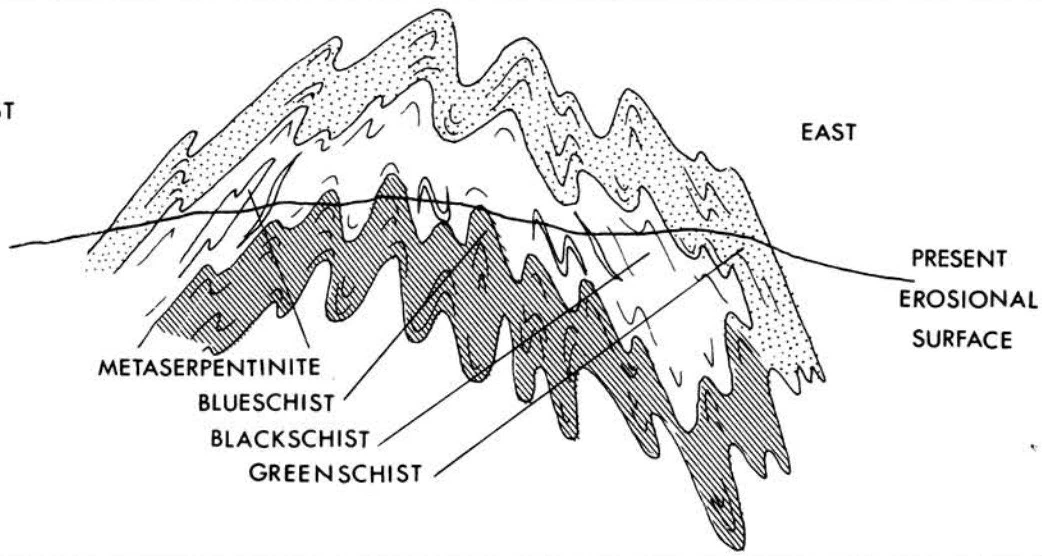

Figure 3. Schematic cross section of the Condrey Mountain Schist. This interpretation of the structure and metamorphism calls upon a nappe-like configuration to produce the observed distribution of lithologic types. Greenschist envelops blackschist on a gross scale. Structurally lower blueschist is exposed in the central zone of the window. In this figure, the "nappe" is drawn overturned toward the east, but present structural information is not sufficient to distinguish between an eastward- and westward-thrust "nappe."

surrounding schist. Their ultimate origin is a mystery. They could be slivers of serpentinite tectonically incorporated early in the history of the Condrey Mountain Schist. Hotz (1979) has interpreted these rocks as remnants of serpentinite occurring between the Condrey Mountain Schist and the overriding plate that were infolded with the schist. If they are, we might expect to see remnants of rocks other than serpentinite, such as amphibolite or other schists found in the upper plate. Another possibility is that the metaserpentinite bodies represent sedimentary serpentinite deposited near a fracture zone on the ocean floor.

A leucocratic igneous body within the Condrey Mountain Schist is exposed in outcrops and roadcuts along the Scott River. It is composed primarily of twinned plagioclase, quartz, chlorite, and white mica and displays a gneissic fabric, thus appearing to have intruded the protolith of the Condrey Mountain Schist before or during metamorphism. Hotz (1979) describes a similar intrusive body near the West Fork of Beaver Creek.

STRUCTURAL GEOLOGY

The Condrey Mountain Schist has a complex deformational history that is yet to be completely understood. Structural information gathered in the course of geologic mapping has led to the following interpretation, summarized in Figure 2.

The schist has undergone two major deformational events: (1) The first event produced isoclinal recumbent folds (fold axes represented by F_1 in Figure 2) whose sense of vergence has not been established. This folding was concurrent with greenschist- to blueschist-facies metamorphism that produced mineral lineations parallel to fold axes. (2) A second period of folding produced north-south-trending crenulations (fold axes represented by F_2 in Figure 2) and associated steeply dipping cleavage, but only minor recrystallization. Deformation seems to indicate an east-west compression of the schist. Later kink folds and associated quartz veins cross the crenulation at a high angle.

The extremely rare occurrence of what may be refolded isoclinal folds within the foliation plane suggests that there may have been two episodes of isoclinal folding prior to the north-south crenulation event. Alternatively, these folds may be single folds "rolled over" upon themselves during a single event. At the present time, we favor the single-fold interpretation because petrographic evidence for two periods of isoclinal folding is lacking.

INTERPRETATION

A late north-south folding is recorded in both the Condrey Mountain Schist and the overlying western Paleozoic and Triassic rocks. The two contrasting units may have been tectonically juxtaposed prior to this event. The structural geology of the overlying plate has not yet been thoroughly investigated. The contrasts in grade (garnet amphibolite vs. greenschist-blueschist) and in lithology (mélange-like oceanic lithosphere vs. deep-water sediments grading upward to island arc [?] volcanic rocks) between the schist and the overlying plate indicate that thrusting brought together units of two differing regimes—an upper, hot oceanic slab and a lower, cooler, predominantly sedimentary sequence of rocks. It is possible that thrusting of the hot upper slab over the lower cooler slab was the event recorded in the Condrey Mountain Schist as F_1. The fact that blueschist seems to be restricted to structurally lower parts of the lower plate (Figure 3) suggests that these rocks were not only insulated from the overlying hotter slab but also metamorphosed at greater depth. Concurrently, upper levels of the lower plate were heated by the hot oceanic slab, thereby producing greenschist assemblages. Rare blue cores in actinolite seem to support a model involving low pressure-temperature conditions followed by increasing temperature. We can speculate that thrusting and metamorphism were related to incipient subduction of these rocks, but hard evidence for this is lacking.

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Three companies high bidders for Oregon geothermal parcels

Bids totaling more than a million dollars have been received by the Bureau of Land Management for geothermal rights on 12 parcels of Federal land in southeast Oregon.

Anadarko Production Co., Chevron U.S.A., Inc., and Getty Oil Company are the high bidders and upon the issuance of leases will have the right to develop the geothermal resources. Anadarko was high bidder on three parcels, Chevron on two, and Getty on seven. All of the lands are located in the Alvord or Crump Geyser Known Geothermal Resource Areas.

Sixty-four parcels were offered by the Federal government, with 52 receiving no bids. The geothermal leases cover a 10-year period.

Bidding details are as follows:

Parcel	Acreage	Area	Company	Amount
4	2,563	Alvord	Getty	$ 30,117.37
5	2,566	Alvord	Getty	60,953.43
6	2,360	Alvord	Getty	60,770.00
28	1,830	Alvord	Getty	61,751.70
29	2,542	Alvord	Getty	44,478.35
33	2,400	Alvord	Anadarko	149,664.00
34	2,560	Alvord	Anadarko	397,516.80
35	40	Alvord	Getty	630.00
36	2,520	Alvord	Anadarko	227,379.60
37	2,560	Alvord	Getty	44,802.28
59	2,568	Crump	Chevron	5,785.00
60	81	Crump	Chevron	1,057.00
				$1,084,905.53

□

Chemical analyses of Mount St. Helens pumice and ash

Analyses performed June 4, 1980, by Karl C. Wozniak, Scott S. Hughes, and Edward M. Taylor, Analytical Laboratory, Department of Geology, Oregon State University, Corvallis, Oregon

We are printing these analyses because we believe they may be of interest to the general public and to more specialized groups such as public health officials. Samples were submitted for analysis as indicated. The assistance of Peter W. Lipman, James G. Moore, and Donald A. Swanson, U.S. Geological Survey, and Diane Bender, Washington State University, in obtaining these samples is greatly appreciated.

The samples were analyzed by X-ray fluorescence, except for the oxides of sodium and magnesium, which were analyzed by atomic absorption spectrophotometry.

	1	2	3	4	5	6	7	8
SiO_2	64.3	64.1	64.6	67.7	64.1	64.1	64.2	64.3
Al_2O_3	18.2	17.9	17.8	17.1	18.0	17.5	18.0	18.0
FeO*	4.2	4.2	3.7	3.2	4.2	4.1	4.3	4.0
CaO	4.8	4.8	4.8	4.0	4.8	4.6	4.9	4.7
MgO	2.0	2.0	2.0	0.5	2.0	1.9	1.9	1.8
K_2O	1.45	1.45	1.60	1.85	1.45	1.45	1.45	1.50
Na_2O	4.8	4.8	4.7	5.0	4.7	4.8	4.8	4.7
TiO_2	0.60	0.60	0.70	0.55	0.65	0.60	0.65	0.60
	100.35	99.85	99.90	99.90	99.90	99.05	100.20	99.60

1. Pumice lapilli deposited May 18, 1980, on west fork of Pine Creek at 4,000-ft elevation. Collected May 19 by P. Lipman, J. Moore, and D. Swanson, USGS.**
2. Duplicate analysis of no. 1.**
3. Ash fall, Pullman, Washington. Collected 2:30-3:30 p.m., May 18, by D. Bender, WSU.**
4. Ash fall, Pullman. Collected 12:30-8:00 a.m., May 19, by D. Bender, WSU.**
5. Light-tan pumice lapilli from ash flow erupted May 18. Collected May 21 one mile south of site of Spirit Lake Lodge by P. Lipman, J. Moore, and D. Swanson, USGS.
6. Gray pumice lapilli from blast deposit of May 18. Collected May 24 at crest of ridge between forks of Castle Creek by P. Lipman, J. Moore, and D. Swanson, USGS.
7. Light-tan pumice lapilli from ash flow erupted May 25. Collected May 26 two miles south of site of Spirit Lake Lodge at 3,600-ft elevation by P. Lipman, J. Moore, and D. Swanson, USGS.
8. Light- to dark-gray banded pumice lapilli from ash flow erupted May 25. Same locality as no. 7.

* Total iron content reported as FeO. H_2O-free.
** Previously reported May 21, 1980.

NOTES

Pumices differ chiefly in color due to variations in density (inflation, vesicularity). All are hypersthene-bearing dacites close to the average chemical composition of dacites from other High Cascade volcanoes. The principal crystalline constituent is plagioclase feldspar (10-15 weight percent) with subordinate hypersthene, amphibole, magnetite, and rock fragments. None of the quartz that has so often been reported was found, other than as minute traces in rock fragments. More than 80 percent of the pumice is fresh dacite glass. Variation in chemical composition of the ash-fall deposits is attributable to early fallout of crystals and consequent concentration of glass shards in finer grained deposits farther removed from the volcano. □

Geologic map of southern Washington Cascades now available

The Earth Sciences Department of Portland State University (PSU) announces the publication of a new geologic map (scale 1:125,000) and cross sections of the Cascade Range of southern Washington. The map covers 4,050 sq mi and includes the area between lat. 45°31′ and 47°15′ N. and between long. 120°45′ and 122°22.5′ W.

Based on mapping done through May 1978 by Paul Hammond, Earth Sciences Department, PSU, the two-color, two-sheet map has over 200 map units and shows the extent of glaciation, landslides, alteration zones, mineral and hot springs, and sites of heat-flow holes. Accompanying the map is a 25-page text.

The prepaid cost of the map, including surface mailing, is $18.00 (add $1.00 for mailing outside the conterminous United States). Checks or money orders are payable to Geology Fund, Department of Earth Sciences, PSU; orders should be sent to Department of Earth Sciences, PSU, PO Box 751, Portland, OR 97207. □

GSA offers employment opportunities booklet

A forum on future employment opportunities in the geological sciences was held during the Annual Meeting of the Geological Society of America (GSA) at San Diego, California, on November 4, 1979. The forum was sponsored by the GSA Employment Service as a pilot program to aid persons new to the job market in selecting prospective employers and in determining career goals. Speakers at the forum also provided tips for successful interviews and presented salary survey figures.

A booklet summarizing presentations at the forum is now in print. For a free copy of "Future Employment Opportunities in the Geological Sciences," write to The Geological Society of America, Membership Department, P.O. Box 9140, 3300 Penrose Place, Boulder, Colorado 80301. □

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