STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
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GEOLOGY AND GOLD DEPOSITS MAP OF THE NORTHEAST QUARTER OF THE BATES QUADRANGLE, BAKER AND GRANT COUNTIES, OREGON

GMS-29

Geology and Gold Deposits Map of the Northeast Quarter of the Bates Quadrangle, Baker and Grant Counties, Oregon

H.C. Brooks and others

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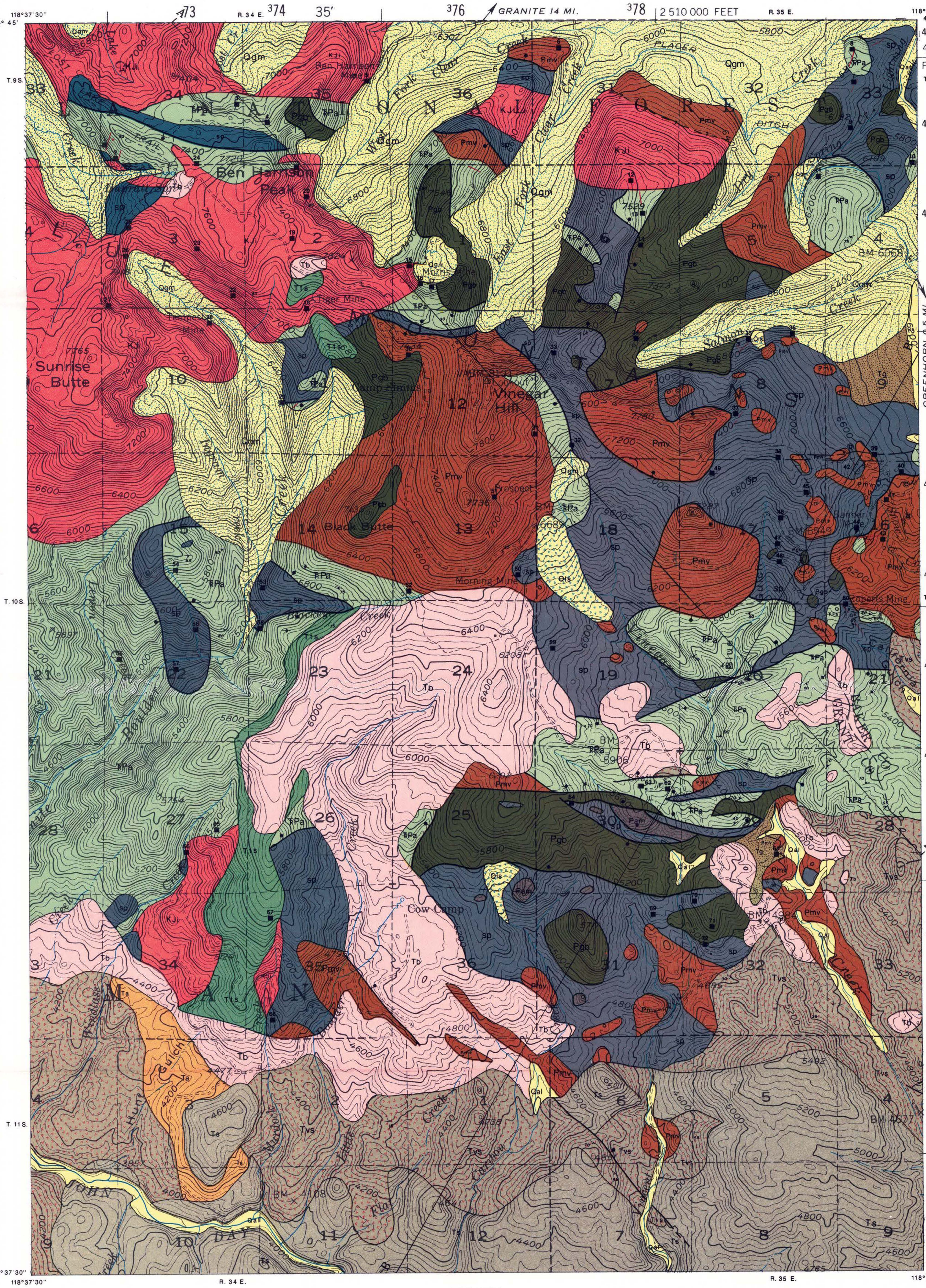
1983



Base Map from U.S.G.S. 15 Series (Topographic) enlarged to 7½' scale

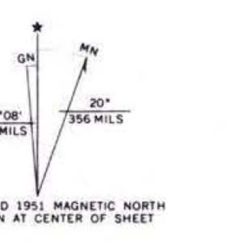
Control by USGS and USC&GS

Topography from aerial photographs by multiplex methods
Aerial photographs taken 1946. Field check 1951

Polyconic projection. 1927 North American datum
10,000-foot grid based on Oregon coordinate system, north zone

1000-meter Universal Transverse Mercator grid ticks, zone 11, shown

Dashed land lines indicate approximate locations



SCALE 1:24 000

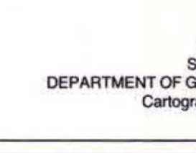
1 MILE — 1000 FEET — 7000 FEET — 1 KILOMETER

CONTOUR INTERVAL 40 FEET

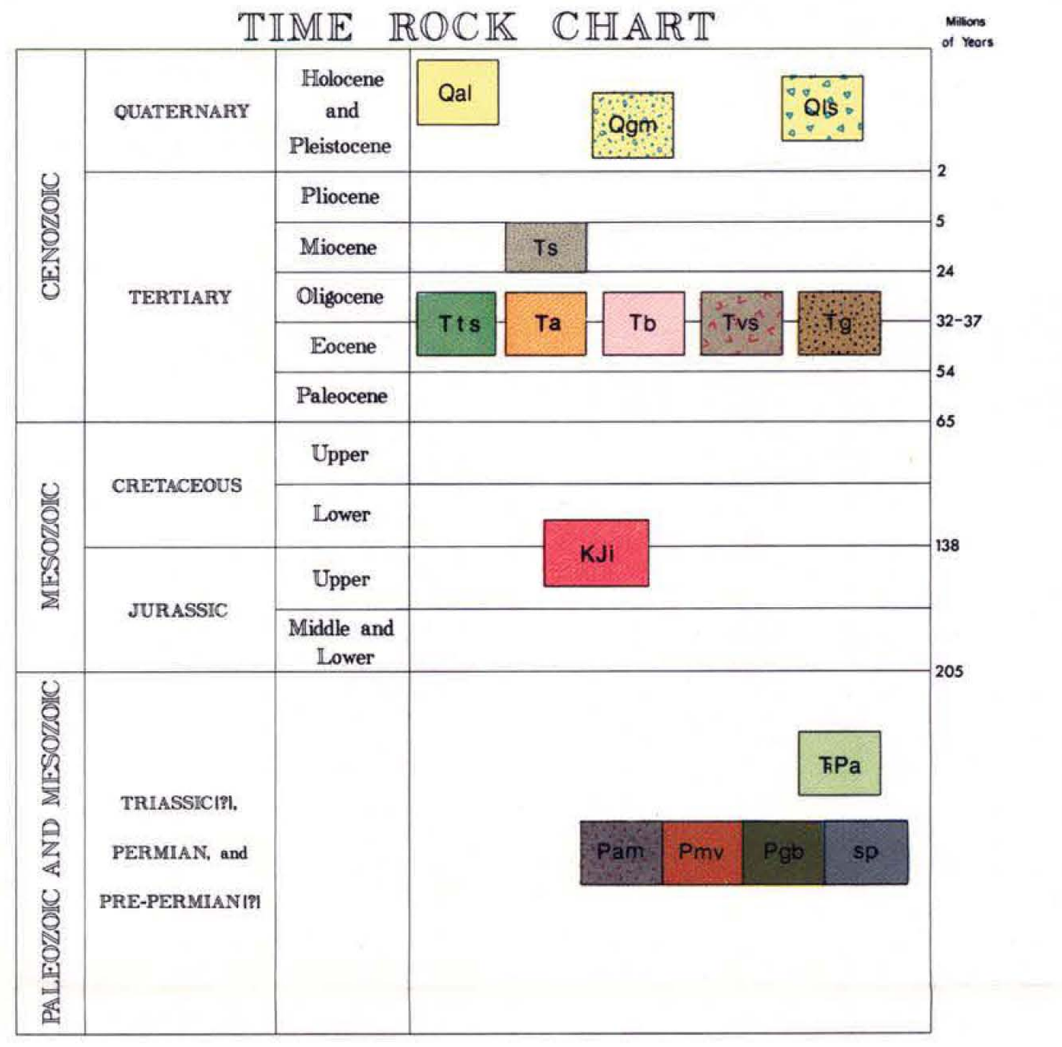
Map prepared by
STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
Cartography by C. A. Schumacher

Geology by H.C. Brooks, M.L. Ferns, G.R. Wheeler, and D.G. Avery

Field work completed in 1982



TIME ROCK CHART



EXPLANATION

Qal — **Alluvium (Holocene and Pleistocene):** *Unconsolidated, poorly sorted fluviatile deposits consisting of gravel, sand, and silt in channels and flood plains of the present drainage system*

Qls — **Landslide debris (Holocene and Pleistocene):** *Unstratified, heterogeneous mixture of soil and angular rock fragments resulting from bedrock failure on oversteepened slopes; typified by hummocky topography*

Qgm — **Glacial deposits (Holocene and Pleistocene):** *Unconsolidated, unsorted accumulations of boulders, cobbles, sand, and silt. Includes lateral moraines developed on upper Granite Boulder Creek*

Ts — **Volcanic and sedimentary rocks (Miocene):** *Predominantly gray to black, locally vesicular aphanitic basalt, basaltic andesite, and andesite flows with minor amounts of interbedded tuffaceous sediments and welded vitric tuff. The flows are predominantly pilotaxitic to hyalopilitic augite-bearing basaltic andesites and andesites correlative with the Strawberry Volcanics of Brown and Thayer (1966). Wheeler (1982) reports a whole-rock K-Ar age of 9.96 m.y. on a sample of this unit from sec. 21, T. 11 S., R. 35 E.*

Tg — **Gravels (Oligocene-Eocene):** *Poorly consolidated deposits of gravel, sand, and clay. Locally overlain by basalt of unit* **Tb**. *Composed mainly of pre-Tertiary rock fragments. Extensively worked for placer gold in some areas*

Ta — **Porphyritic andesite (Oligocene-Eocene):** *Dark-gray to gray porphyritic andesite. Composed predominantly of plagioclase phenocrysts in a holocrystalline groundmass of feldspar and pyroxene with a few medium-grained diorite xenoliths. Locally intrudes rocks of unit* **Tvs** *(Wheeler, 1982). Fragments of similar andesite occur in tuffaceous mudflow deposits a short distance east in sec. 2, T. 10 S., R. 34 E. Wheeler (1982) reports a whole-rock K-Ar age of 40.06 m.y. for this unit, which probably represents a local vent*

Tb — **Basalt and basaltic andesite (Oligocene-Eocene):** *Predominantly black to dark-gray, fine-grained porphyritic holocrystalline olivine basalt flows. The unit includes flows which underlie, interfinger with, and overlie volcaniclastic rocks of unit* **Tvs**. *Unit includes distinctive quartz amygdule basalts south of the Morning Mine (50)*

Tvs — **Volcaniclastic rocks (Oligocene-Eocene):** *Predominantly volcanic mudflow breccia deposits (lahars) with irregularly intercalated tuffaceous boulder conglomerates, bedded tuffs, and tuffaceous sandstones and siltstones. Also includes local lava flows of aphanitic and porphyritic platy andesites. The volcaniclastic deposits typically are poorly consolidated and consist of poorly sorted, subrounded to subangular volcanic rock fragments in a matrix of felsic volcanic ash, sand, and silt. Rock fragments are predominantly porphyritic, dark-gray, light-gray, and brownish-red pyroxene and hornblende andesites with smaller amounts of dacite, rhyodacite, and basalt*

Tts — **Tuffaceous sedimentary rocks (Oligocene-Eocene):** *Predominantly sandstone which generally is deeply weathered and limonite stained. Includes tuffaceous conglomerate and breccia composed of altered volcanic rock fragments. In many exposures the rocks are sericitized and silicified. Disseminated pyrite and limonite after pyrite are common. Rocks of this unit are unconformable on rocks of units* **KJi** *and* **TRPa** *and are overlain by quartz-amygdule basalt of unit* **Tb**. *Age of unit* **Tts** *uncertain. Contains fragments of felsic volcanic rocks believed to be correlative with unit* **Tvs**. *Correlated with Cretaceous rocks in the Quartzburg area to the southwest (sec. 11, T. 12 S., R. 33 E.) by Brown and Thayer (1966) and Wheeler (1981)*

KJi — **Intrusive rocks (Lower Cretaceous-Upper Jurassic):** *Chiefly equigranular and porphyritic hornblende and biotite quartz diorite and granodiorite with small amounts of diorite and norite. These rocks are similar to those of the Bald Mountain Batholith and are therefore assumed to be of about the same age. Many dikes of porphyritic quartz diorite not separately mapped cut sedimentary rocks of unit* **TRPa** *on the slopes of Granite Boulder Creek in secs. 21, 22, 27, and 28, T. 10 S., R. 34 E.*

TRPa — **Clastic sedimentary rocks (Triassic(?)-Permian):** *Predominantly argillite and sandstone with small amounts of conglomerate, chert, and limestone. Coarse-grained rocks include chert-pebble conglomerates; polymictic sedimentary breccias containing fragments of metamorphosed gabbro, diorite, chert, greenstone, and serpentine; and poorly sorted lithic wackes composed of chert, argillite, and sandstone fragments in an argillaceous matrix. Sedimentary rocks of unit* **TRPa** *are in depositional contact with tectonic blocks of gabbro and greenstone and with serpentine in several places, e.g., near the Roberts Mine in sec. 21, T. 10 S., R. 35 E., and at the head of Lost Creek in sec. 34, T. 9 S., R. 34 E. This and the presence of gabbro, greenstone, and serpentine fragments in the sedimentary breccias and conglomerates indicate that disruption of the ophiolite terrane either predated or was underway during deposition of unit* **TRPa**. *Fault blocks of unit* **TRPa** *appear to be incorporated in serpentinite matrix mélange in several places. Mullen (1978) reports Early Permian (Leonardian) conodonts and Early Permian (Wolfcampian) fusulinids from a limestone pod immediately west of the quadrangle boundary on Granite Boulder Creek. The Early Permian age conflicts with earlier correlations, based on lithologic and stratigraphic similarities, between unit* **TRPa** *and rocks of Late Triassic and Jurassic age to the south (Brown and Thayer, 1966; Wheeler, 1976). The Early Permian fossils may be exotic to unit* **TRPa** *and may have been derived by sedimentary reworking of older limestones which had been previously incorporated into the underlying mélange. Thus, the sedimentary rocks could be as young as Late Triassic, and mélange formation may have occurred in the Early or Middle Triassic*

Ophiolite and associated rocks (Triassic(?)-Permian-pre-Permian (?)): *Rock units below unit* **TRPa** *in the Time-Rock Chart are lithologic subdivisions of a structurally chaotic terrane in which the rocks have been so fragmented and displaced by tectonic processes that their original stratigraphic succession is largely indeterminable. The metamorphosed serpentinite, gabbro, and mafic volcanic rocks are interpreted as an ophiolite which theoretically represents ancient oceanic crust. The more silicic volcanic and intrusive rocks may represent younger magmatism perhaps related to island-arc volcanism. The chert and argillaceous rocks are interpreted as representing ocean-floor sedimentation during and after formation of the ophiolite. Theoretically, the development of the ophiolite assemblage involved contemporaneous plutonic, volcanic, and sedimentary processes which extended over a long time interval. Available fossil and radiometric age data indicate that most of the rocks are of Permian age, but older Paleozoic and younger Mesozoic rocks may be included*

Pam — **Epidote-amphibolites:** *Foliated epidote amphibolite derived from gabbro and mafic volcanic rocks. Metamorphic minerals include green hornblende, epidote, albite, and quartz. Rocks of this unit are characterized by a well-developed foliation and tightly crenulated folds*

Pmv — **Metavolcanic rocks:** *Basalt including pillow lavas and dikes, andesitic and dacitic flows and tuffs, volcaniclastic conglomerates and breccias, argillite, and chert all metamorphosed to the greenschist facies. Rocks exposed on Vinegar Hill are mainly fine-grained, green to greenish-gray felsic (andesitic?) flows and tuffs intercalated with chert, siliceous argillite, and basalt. Locally the volcanic rocks are intruded and hornfelsed by small diorite and quartz diorite dikes (unit* **Pgb**), *e.g., near the summit of Vinegar Hill and in the NW¼ sec. 33, T. 9 S., R. 35 E. West of the Little Giant Mine (11), the volcanic rocks include well-preserved amygdaloidal pillow basalts which locally contain relict titanaugite phenocrysts. Similar appearing pillow basalts in the Greenhorn quadrangle to the east contain intercalated limestones with reported Permian conodonts (Mullen, 1978, p. 120). Rocks of unit* **Pmv** *are unconformably overlain by argillite of unit* **TRPa** *on the east side of Vinegar Hill*

Pgb — **Metamorphosed intrusive rocks:** *Predominantly metamorphosed gabbro and diorite with subordinate amounts of pyroxenite, quartz diorite, diabase, and albite granite. Numerous textural variations are present, including large masses of equigranular quartz diorite and diorite on Vinegar Creek in secs. 31 and 32, T. 10 S., R. 35 E., and near the Bi-Metallic Mine (34); coarse-grained pyroxene gabbro near the Belmont Mine (63); and strongly tectonized gabbro and amphibolite adjacent to argillite near the Morris Mine (16). Includes small diabase and porphyry dikes near the Morris Mine (16) and in the NW¼ sec. 31, T. 10 S., R. 35 E. Rocks of several different ages and origins may be included in the unit. Perhaps the pyroxene gabbros, tectonite gabbros, and pyroxenites represent ancient oceanic crust, and the quartz diorites represent a younger subvolcanic sequence. A lead-uranium age of 243 m.y. has been obtained from zircons in a similar-appearing quartz diorite in the Granite quadrangle to the northeast (Brooks and others, 1982b)*

sp — **Serpentine and serpentine-matrix mélange:** *Predominantly green or black serpentinite and serpentine-matrix mélange in which small tectonic blocks and slices of greenstone, gabbro, chert, argillite, and epidote-amphibolite are suspended in a matrix of sheared serpentine. Excellent exposures of serpentinite containing blocks of metamorphosed gabbro, basalt, andesite, dacite, and argillite can be seen in secs. 8, 9, 16, and 17, T. 10 S., R. 35 E., near the head of Snow Creek. Rocks of this unit are unconformably overlain by rocks of unit* **TRPa** *in the Greenhorn quadrangle to the east (Ferns and others, 1983). Similar mélange in the Aldrich Mountains to the southwest is unconformably overlain by Upper Triassic sedimentary rocks (Brown and Thayer, 1966; Dickinson and Thayer, 1978)*

REFERENCES

Brooks, H.C., 1963, Quicksilver in Oregon: Oregon Department of Geology and Mineral Industries Bulletin 55, p. 210.
Brooks, H.C., Ferns, M.L., Coward, R.I., Paul, E.K., and Nunlist, M., 1982a, Geology and gold deposits of the Bourne quadrangle, Baker and Grant Counties, Oregon: Oregon Department of Geology and Mineral Industries Geological Map Series GMS-19.
Brooks, H.C., Ferns, M.L., and Mullen, E.D., 1982b, Geology and gold deposits map of the Granite quadrangle, Grant County, Oregon: Oregon Department of Geology and Mineral Industries Geological Map Series GMS-25.
Brooks, H.C., and Ramp, L., 1968, Gold and silver in Oregon: Oregon Department of Geology and Mineral Industries Bulletin 61, p. 106-123.
Brown, C.E., and Thayer, T.P., 1966, Geologic map of the Canyon City quadrangle, northeastern Oregon: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-447.
Dickinson, W.R., and Thayer, T.P., 1978, Paleogeographic and paleotectonic implications of Mesozoic stratigraphy and structure in the John Day inlier of central Oregon, *in* Howell, D.G., and McDougall, K.A., eds., Mesozoic paleogeography of the western United States: Pacific Coast Paleogeography Symposium 2, Sacramento, Calif., Society of Economic Paleontologists and Mineralogists, Pacific Section, p. 147-161.
Ferns, M.L., Brooks, H.C., and Avery, D.G., 1983, Geology and gold deposits map of the Greenhorn quadrangle, Baker and Grant Counties, Oregon: Oregon Department of Geology and Mineral Industries Geological Map Series GMS-28.
Ferns, M.L., Brooks, H.C., and Ducette, J., 1982, Geology and mineral resources map of the Mt. Ireland quadrangle, Baker and Grant Counties, Oregon: Oregon Department of Geology and Mineral Industries Geological Map Series GMS-22.
Lindgren, W., 1901, The gold belt of the Blue Mountains of Oregon: U.S. Geological Survey Twenty-second Annual Report, pt. 2, p. 551-776.
Mullen, E.D., 1978, Geology of the Greenhorn Mountains, northeastern Oregon: Corvallis, Oreg., Oregon State University master's thesis, 372 p.
Swartley, A.M., 1914, Ore deposits of northeastern Oregon: Oregon Bureau of Mines and Geology, Mineral Resources of Oregon, v. 1, no. 8, p. 229.
Wheeler, G.R., 1976, Geology of the Vinegar Hill area, Grant County, Oregon: Seattle, Wash., University of Washington doctoral dissertation, 94 p.
——— 1981, A major Cretaceous discontinuity in north-central Oregon: Oregon Geology, v. 43, no. 2, p. 15-17.
——— 1982, Problems in the regional stratigraphy of the Strawberry Volcanics: Oregon Geology, v. 44, no. 1, p. 3-7.

MAP SYMBOLS

- Contact — approximately located. Queried where location is questionable
- Fault — bar and ball on downthrown side
- Strike and dip of beds or lava flows
- Strike of vertical bed
- Strike and dip of foliation
- Strike of vertical foliation
- Mine and prospect location — numbers correspond to numbers in Table 1
- Source of rock sample for which chemical data are given in Table 2
- Quartz vein or shear zone, showing dip where known. Dashed where approximately located

MINERAL DEPOSITS

Gold and silver from quartz veins and placer deposits have been the major mineral products of the quadrangle, which includes the western part of the Greenhorn mining district. Small amounts of copper, lead, and zinc have been recovered as byproducts of the gold and silver mining. One mine produced a small amount of mercury. Dollar values of production presented here and in Table 1 are based on metal prices at the time of mining. Known mines and prospects are located on the map by numbers that correspond to those in Table 1. Because of time constraints, mapping traverses were as much as half a mile apart, and it is likely that many small veins and prospect excavations were not observed. The historical information and data on individual mines in the following paragraphs are largely from Lindgren (1901), Swartley (1914), and Brooks and Ramp (1968).

Total value of gold and silver output from the mines in the quadrangle has been about $725,000, with much of the production being in silver. The total placer production is believed to have been relatively small. Over half of the recorded production ($425,000) came from the silver and gold ores at the Ben Harrison Mine (5).

The lode gold and silver production has been from narrow, steeply dipping veins and mineralized shear zones developed mainly by underground workings.

Mineralized quartz veins were discovered in the vicinity of Sunrise Butte and Ben Harrison Peak in the 1870's. At that time the town of Greenhorn was near Dupratt Spring. The veins in this area are characterized by relatively high silver to gold contents of the ores. They occur in quartz diorite and granodiorite (unit **KJi**) and in adjacent hornfelsed host rocks including argillite and sandstones (unit **TRPa**), gabbro (unit **Pgb**), greenstone (unit **Pmv**), and serpentine (unit **sp**). Metallic minerals are mainly pyrite, arsenopyrite, and sphalerite with minor local concentrations of galena, tetrahedrite, silver sulfides, and gold. Most of the veins strike northeasterly. The Ben Harrison Mine (5), which operated intermittently from 1913 to 1937, has a recorded production of about $425,000. The Ben Harrison vein is a north-striking zone of brecciated quartz diorite up to 21 ft in width. The main ore shoot was a lenticular zone of brecciated and silicified quartz diorite with lenses and stringers of argentiferous sulfides, all cemented by late-stage, barren white quartz. The ore minerals include pyrite, arsenopyrite, sphalerite, stibnite, tetrahedrite, pyrargyrite, and stephanite. The ratio of silver to gold varied from 5:1 to 50:1, and the value of gold extracted from the mine approximately equaled the value of silver extracted. In 1917 the mine produced 977 ounces of gold and 22,534 ounces of silver from 4,600 tons of ore.

Among the earlier producers in this area, the Morris Mine (16) is credited with a production of $15,000 in silver and $3,400 in gold in 1891. The Tempest Mine (28) produced about 180 tons of silver-gold ore in the late 1800's. The mine was active with small production in 1980-1982. The main vein at the Tempest consists of a shear zone up to 4 ft wide in which strongly sericitized and kaolinized granodiorite is cut by lenses and stringers of quartz with arsenopyrite, pyrite, sphalerite, and tetrahedrite. The vein strikes N. 35° E. At the Bi-Metallic (34) and Intermountain (14) Mines, vein mineralization in metagabbro and diorite consists of pyrite and silver-bearing tetrahedrite with little other sulfides. Quartz veins with molybdenite locally fill joints and other small fractures in quartz diorite (unit **KJi**) in the Sunrise Butte-Ben Harrison Peak area. Scheelite occurs in quartz stringers and veinlets in hornfelsed argillite at the Thornton prospect (55).

About $250,000 in gold has been produced from small mines near the heads of Snow Creek and Vinegar Creek in T. 10 S., Rs. 34 and 35 E. Some of the better known properties are the Morning (50), Snow Creek (43), and Psyche (46) Mines. Gold occurs in small, locally high-grade lensoid ore shoots in discontinuous fractures in and along the contacts of gabbro, greenstone, and argillite blocks in serpentine. Mineralization characteristically consists of pyrite, chalcopyrite, galena, and free gold in a gangue of white quartz and carbonate. Little information is available for most of these mines. The Psyche (46), Snow Creek (43), Banzette (41), Roberts (60), Morning (50), Diadem (45), Worley (40), and Windsor (47) are all credited with small productions. The Snow Creek Mine (43) is reported to have produced about $52,000 during the period 1902-1905. Mineralization occurs in a fracture zone along a contact between argillite on one side and serpentine and gabbro on the other. The vein strikes from N. 60° W. to W. and dips 50° to 75° S. The vein varies from 2 to 10 ft in width with large amounts of barren white quartz and lenses rich in galena, chalcopyrite, and pyrite. Stringers of drusy chalcedony and carbonate also are present. At the Morning Mine (50), quartz veins with free gold, pyrite, chalcopyrite, and sphalerite occur as fracture fillings in a northeast-trending quartz diorite porphyry dike along the contact between greenstone and serpentine. This deposit was discovered in 1893 and has had a total production of about $20,000; 514 ounces of gold were recovered from ore shipments in 1903 and 1941-1942. Gold to silver ratio was about 1:3.

Mercury

About three flasks of mercury were produced from the Paramount Mine (42) at the head of Snow Creek in the 1940's (Brooks, 1963). Here cinnabar occurs as scattered grains and impregnations in chalcedony veinlets in sheared serpentine. Cinnabar also reportedly is associated with pyrite in an east-trending shear zone in greenstone at the Diadem Mine (45).

Table 1. MINES AND PROSPECTS IN THE NORTHEAST QUARTER OF THE BATES QUADRANGLE

Map no.	Mine or prospect name	Quarter section	Section	Township (South)	Range (East)	Elevation (ft)	Geologic formation	Geologic description	Surface and/or underground workings	Past production	References
1.	Kingston Lode, part of Portland Consolidated	SW	34	9	34	7,080	TRPa, sp	2-ft-wide quartz vein with pyrite, arsenopyrite, galena, and sphalerite in hornfelsed argillite. Strikes N. 15° E.	Two adits totaling about 500 ft	Small	7, 8, 11
2.	Silver King, part of Portland Consolidated	SW	34	9	34	7,200	TRPa, KJi	4-ft-wide quartz vein in hornfelsed argillite strikes N. 15° E.	Two adits totaling about 150 ft	Small	7, 8, 11
3.	Smuggler Group	SE	34	9	34	7,080	TRPa	Quartz vein with sulfides	Shallow shaft	Unknown	12 (9-05-03, 5-26-02)
4.	Smuggler Group	SW	35	9	34	7,400	TRPa	Quartz vein with streaks of pyrite strikes N.	300-ft adit and 30-ft shaft	Unknown	12 (5-26-02, 9-05-03)
5.	Ben Harrison	NE	35	9	34	6,600	KJi	Breccia zone up to 21½ ft wide in granodiorite strikes N. 3° E. and dips 67° E. Sericitized breccia and gouge cemented and partly replaced by quartz. Minerals include calcite, pyrite, stibnite, chalcopyrite, sphalerite, pyrargyrite, and stephanite	More than 4,000 ft of workings in two adits and shaft	Est. $425,000	2, 3, 7, 10
6.	King Tut	NW	31	9	35	6,200	Pmv	Quartz vein with pyrite and tetrahedrite in hornfelsed greenstone strikes N. 10° E., dips 85° W.	Shallow pits and short adits	Small	7
7.	Name unknown	NW	33	9	35	5,880	Pgb, sp	Gossan zone in silicified metagabbro	Shallow pits	None	—
8.	Sterling	NW	33	9	35	5,800	TRPa, sp	30-ft-wide limonitic quartz-argillite breccia zone with drusy quartz strikes N. 30° E.	400-ft adit and shallow prospect pits	None	7
9.	Redstone	SW	33	9	35	5,840	sp	Limonitic shear zone with quartz and talc	Short adit	None	—
10.	Amazon?	SE	33	9	35	5,920	TRPa, sp	In argillite and serpentine	300-ft adit	Unknown	12 (8-14-09)
11.	Little Giant	NE	5	10	35	6,040	TRPa, sp	Zone of crushed argillite up to 20 ft wide with stringers of quartz and botryoidal chalcedony	Over 1,100 ft of workings in two adits	Small	1, 7, 10
12.	Silver Tip Group	NE	6	10	35	7,440	KJi	1-ft-wide quartz vein in quartz diorite strikes N. 40° E.	Open cut on old adit	Unknown	—
13.	Silver Tip Group	NE	6	10	35	7,280	TRPa	4-ft-wide composite quartz vein in hornfelsed argillite strikes N. 15° W.	Open cuts on two old adits total about 600 ft	Unknown	—
14.	Intermountain	SE	6	10	35	7,200	Pgb	10-ft-wide zone of silicified gabbro with quartz stringers, limonite, and copper sulfides strikes N. 20° E.	Old adit and several large new open cuts	Est. $5,000+	1, 7, 10
15.	Morris, Gillam tunnel	SW	1	10	34	7,200	TRPa, KJi	Brecciated quartz veins up to 15 in. in width carrying pyrite, arsenopyrite, sphalerite, galena, and tetrahedrite strike N. 35° E.	125-ft crosscut with drifts	Est. $48,400	1, 2, 3, 7, 8, 10, 11
16.	Morris, Thornburg tunnel	SW	1	10	34	7,200	TRPa, KJi	Three north-trending quartz veins with pyrite, arsenopyrite, sphalerite, galena, and tetrahedrite	400-ft crosscut with drifts	Unknown	1, 2, 3, 7, 8, 10, 11
17.	Pride of Pendleton	SW	1	10	34	7,440	TRPa	In hornfelsed argillite and limestone	Short adit	Unknown	8
18.	Tiger	SW	2	10	34	7,080	KJi	Quartz veinlets with arsenopyrite, pyrite, sphalerite, chalcopyrite, and tetrahedrite	Two short adits	Unknown	7, 8
19.	Name unknown	SW	2	10	34	7,440	KJi	Quartz vein with molybdenite	Trenches and pits	None	—
20.	Silver Bell (Potosi)	NW	2	10	34	7,000	KJi	Three quartz veins with pyrite, arsenopyrite, and tetrahedrite in granodiorite strike N. 20° E.	Two adits totaling 350 ft and a shallow shaft	Est. $4,000	1, 11, 12 (4-26-02; 9-5-03)
21.	Savage (Potosi)	NW	2	10	34	7,120	KJi, TRPa	Quartz vein with massive pyrite, arsenopyrite, galena, and sphalerite in quartz diorite and hornfelsed argillite	75-ft adit	Unknown	1, 12 (4-26-02; 9-5-03)
22.	Silver Hilltop	SE	3	10	34	6,880	KJi	Three northeast-striking quartz veins	Short adit	Unknown	11
23.	Name unknown	SE	3	10	34	7,400	KJi	Quartz vein with molybdenite	Short adit	None	—
24.	Flying Dutchman, Carbonate Group	NE	3	10	34	7,440	KJi	Quartz vein in granodiorite	Shallow trenches	Unknown	—
25.	Carbonate	NW	3	10	34	7,160	KJi, sp	Composite quartz vein with pyrite, sphalerite, and arsenopyrite in hornfelsed ultramafics and granodiorite strikes N. 50° E.	300-ft adit and prospect pits	Small	1, 2, 3, 7
26.	Chloride	SW	3	10	34	7,200	KJi	Quartz vein with arsenopyrite, pyrite, sphalerite, and galena	Short adit	Small	1, 2, 3, 7
27.	Bowman (Molybdenite)	SW	3	10	34	7,400	KJi	Northeast-striking quartz veinlets with molybdenite	Short adits	None	7
28.	Tempest	NE	10	10	34	6,600	KJi	Northeast-striking quartz veins with tetrahedrite, sphalerite, pyrite, and arsenopyrite	Several short adits	Est. 400 tons of silver ore	1, 2, 3, 7, 10
29.	Quick Action (Ornament)	SW	11	10	34	6,240	TRPa, sp	5-ft-wide quartz vein with massive pyrite, chalcopyrite, tetrahedrite, and galena in hornfelsed argillite strikes N. 60° E.	Three adits	Small	1, 2, 3, 7, 10
30.	Name unknown	NW	12	10	34	7,360	Pmv, Pgb	Limonitic zone in silicified metagabbro	Two short adits	None	—
31.	Lucy Group	SE	12	10	34	7,360	Pmv	Limonitic quartz vein with calcite	200-ft adit	None	12 (1-30-04)
32.	Lucy Group (Vinegar Basin)	SW	7	10	35	7,040	sp, TRPa	In serpentine and argillite	100-ft adit	None	8, 12 (1-30-04)
33.	Chrome prospect	NW	7	10	35	7,560	sp	Chromite pod in serpentine	Shallow pit	Unknown	—
34.	Bi-Metallic (Intrinsic)	NE	7	10	35	6,840	Pgb, sp, TRPa	Two quartz veins with pyrite, arsenopyrite, tetrahedrite, chalcopyrite, galena, and sphalerite in metamorphosed quartz diorite, argillite, and serpentine. Some molybdenite disseminated in wall rocks	3,500 ft of crosscuts and drifts on three levels	Small	1, 2, 3, 7, 8, 10, 11
35.	Name unknown	NW	8	10	35	6,640	sp	2-ft-wide limonitic gouge zone with talc and quartz in serpentine strikes N. 75° E.	Short adit	Unknown	—
36.	Name unknown	NE	8	10	35	6,640	sp	Gouge zone in serpentine strikes N. 65° W.	Prospect pits	None	—
37.	Name unknown	SW	8	10	35	7,480	sp	Limonitic gouge zone with quartz and carbonate in serpentine strikes NE.	Prospect pits	None	—
38.	Name unknown	SE	8	10	35	7,000	sp	Limonitic talc-carbonate zone in serpentine	Prospect pits	None	—
39.	Name unknown	SW	9	10	35	6,560	Pmv, sp	Quartz vein in greenstone	Short adit	Unknown	—
40.	Worley (Greenhorn)	NE	16	10	35	6,440	Pmv, sp	Limonitic breccia zone with quartz in greenstone	Four shafts with about 600 ft of workings	Unknown; 3,000 tons of ore reportedly shipped in late 1800's	12 (9-21-01; 6-17-05)
41.	Banzette	NW	16	10	35	6,320	Pmv, sp	Quartz vein with chalcopyrite and galena in talcose serpentine	1,000-ft adit and 100-ft shaft	Est. $5,000	1, 2, 3, 7, 10, 12 (6-17-05)
42.	Paramount (Golden Fleece)	NW	16	10	35	6,600	sp	Limonitic chalcedonic quartz stringers with cinnabar in serpentine strike NW.	300-ft adit and shallow pits	Three flasks of mercury	7, 9
43.	Snow Creek	SW	16	10	35	6,080	sp, Pmv, TRPa	Limonitic gouge zone in serpentine with quartz, talc, carbonate, galena, and chalcopyrite	1,300 ft of drifts, a 1,600-ft crosscut, and a 200-ft shaft	$52,000 between 1902-1905	2, 3, 6, 8, 10, 11, 12 (8-20-04)
44.	Banner	SW	16	10	35	6,360	sp	Quartz vein with dolomite strikes W. and dips S.	190-ft shaft with 600 ft of drifts	None	4, 7, 10
45.	Diadem, Brindle Horse	NE	17	10	35	6,880	sp, Pmv	Quartz vein with free gold, chalcopyrite, and galena with talc and carbonate in serpentine strikes W.	550-ft adit and shallow shaft	$1,800 in 1900	1, 2, 3, 4, 7, 10
46.	Psyche	NE	17	10	35	6,560	sp	Quartz vein with free gold, chalcopyrite, sphalerite, talc, and carbonate strikes NE.	1,400 ft on two adits	Est. $90,000	2, 3, 7, 8, 10, 12 (9-21-01; 4-30-04)
47.	Windsor	SE	17	10	35	6,400	sp	Gouge zone with lenses of chalcopyrite, quartz, carbonate, and talc strikes N. 22° E., dips 52° NW.	300-ft shaft	Small	7, 8
48.	Kit Carson	SE	17	10	35	6,240	sp	Gouge zones with talc and carbonate strike N. 65° E.-N. 65° W., dip 50°-70° N.	Over 500 ft of workings	Small	7, 8
49.	Name unknown	NW	17	10	35	7,040	sp, Pmv	Gouge zone with quartz in serpentine and greenstone	300-ft adit	Unknown	—
50.	Morning	SE	13	10	34	6,480	sp, Pmv, KJi?	Quartz diorite porphyry dike with narrow quartz veins containing pyrite, arsenopyrite, sphalerite, and chalcopyrite strikes N. 45° E., dips 35°-75° NW.	Over 1,300 ft of workings on two levels	Est. $20,000	2, 3, 7, 8, 10
51.	Earl (Richardson Group)	NE	13	10	34	7,200	Pmv	Limonitic gouge zone with quartz and calcite	200-ft adit	Unknown	7
52.	Lucky Strike-Big Elk (Little Doe)	SW	13	10	34	6,400	TRPa	Quartz stringers in argillite	300-ft adit	Unknown	8
53.	Name unknown	SW	14	10	34	5,480	TRPa, sp	Pyritized diorite dike in silicified argillite	100-ft adit	Unknown	—
54.	Lady Bug (Butler)	SW	15	10	34	5,960	TRPa	Massive quartz vein with pyrite, arsenopyrite, and tetrahedrite strikes NE.	Shallow shaft and 300-ft adit	Unknown	7
55.	Thornton prospect	NW	22	10	34	4,960	TRPa, KJi	Scheelite-bearing quartz stringers in hornfelsed argillite and quartz diorite dikes	Short adit and prospect pits	None	11
56.	Eureka-Dio Gracia	NE	22	10	34	5,200	sp, KJi	Silicified porphyritic quartz diorite dike with disseminated chalcopyrite and quartz veinlets in hornfelsed ultramafics	About 1,400 ft on three levels	Small	7
57.	Name unknown	NW	22	10	34	4,960	sp	Talcose gouge zone in hornfelsed ultramafics	Open cuts	None	—
58.	Name unknown	NW	23	10	34	5,280	sp	In hornfelsed ultramafic rocks	Short adit	None	—
59.	Black Jack	NW	19	10	35	6,120	sp	Free gold in narrow quartz and gouge stringers	Open cuts	Small	7
60.	Roberts	NW	21	10	35	5,880	TRPa, sp	Gouge zone along contact between serpentine and gabbro clast conglomerates contains lens of quartz breccia with dolomite, galena, and chalcopyrite and strikes N. 70° W., dips 40° NE.	About 500 ft in four adits	Small; $10,000 from surface pocket	2, 3, 4, 7, 10
61.	Kreiger placer (Baker placer)	SE	29	10	35	5,000	Tg?, Qal	Reworked Tertiary gravels	Several acres mined	Small	7
62.	Mohawk	NE	30	10	35	5,560	TRPa	Quartz veins in sheared tuffaceous argillite	Trenches, shallow shaft	Small	12 (3-24-06)
63.	Belmont	NE	30	10	35	5,520	TRPa	Quartz veinlets in sheared argillite	Two short adits, trenches, shallow shaft	$9,000 from surface pocket in 1905	12 (4-15-05; 6-24-05)
64.	Name unknown	NW	30	10	35	5,900	sp, Pgb, TRPa	Limonitic gouge zone with talc and quartz along contact between gabbro and serpentine strikes NW.	40-ft shaft and 100-ft adit	Unknown	—
65.	Name unknown	SE	27	10	35	5,440	TRPa	Quartz veins in strongly hornfelsed argillite	Short adit and trenches	Unknown	—
66.	Akers prospect	SE	27	10	35	5,040	TRPa	Quartz vein with pyrite, galena, and chalcopyrite in hornfelsed argillite	Short adit	None	—
67.	Name unknown	NW	35	10	34	5,640	Tts	Silicified and sericitized tuffaceous sandstones and conglomerates with some disseminated pyrite	Shallow prospect pits	None	—
68.	Name unknown	SW	35	10	34	4,700	sp, Pmv	3-ft-wide gouge zone with quartz stringers in hornfelsed ultramafic rocks and greenstones strikes W.	Open cut	None	—
69.	Name unknown	NE	31	10	35	5,120	sp, Pgb	Quartz stringers in sheared serpentine	Old adit with new open cuts and trenches	Small	—
70.	Name unknown	NW	32	10	35	5,200	sp, Pgb	Fault zone with sheared serpentine and argillite in metagabbro and diorite	Prospect pit	None	—
71.	Daisy, part of Vincent Creek Gold and Copper	NW	32	10	35	5,280	Pgb	Chloritic gouge zones in limonitic and silicified metamorphosed quartz diorite and gabbro. Chalcopyrite reported	Two shallow shafts, two adits, and a crosscut tunnel totaling about 1,500 ft	Unknown	2, 3, 7, 11
72.	Best, part of Vincent Creek Gold and Copper	NW	32	10	35	5,000	Pgb, sp	Talcose gouge zone in serpentine strikes W.	Open cut and short adit	Unknown	11

REFERENCES

1. Lindgren, W., 1901, The gold belt of the Blue Mountains of Oregon: U.S. Geological Survey Twenty-second Annual Report, pt. 2, p. 551-776.
2. Swartley, A.M., 1914, Ore deposits of northeastern Oregon: Oregon Bureau of Mines and Geology, Mineral Resources of Oregon, v. 1, no. 8, 229 p.
3. Parks, H.M., and Swartley, A.M., 1916, Handbook of the mining industry of Oregon: Oregon Bureau of Mines and Geology, Mineral Resources of Oregon, v. 2, no. 4, 306 p.
4. Hewett, D.F., 1931, Zonal relations of the lodes of the Sumpter quadrangle: Transactions of the American Institute of Mining and Metallurgical Engineers, p. 305-346.
5. Lorain, S.H., 1938, Gold mining and milling in northeastern Oregon: U.S. Bureau of Mines Information Circular 7015, 46 p.
6. Oregon Department of Geology and Mineral Industries, 1939, Oregon metal mines handbook (northeastern Oregon, east half): Oregon Department of Geology and Mineral Industries Bulletin 14-A, 125 p.
7. Oregon Department of Geology and Mineral Industries, 1940, Oregon metal mines handbook (northeastern Oregon, west half): Oregon Department of Geology and Mineral Industries Bulletin 14-B, 157 p.
8. Allen, R.M., Jr., 1948, Geology and mineralization of the Morning Mine and adjacent region, Grant County, Oregon: Oregon Department of Geology and Mineral Industries Bulletin 39, 44 p.
9. Brooks, H.C., 1963, Quicksilver in Oregon: Oregon Department of Geology and Mineral Industries Bulletin 55, p. 210.
10. Brooks, H.C., and Ramp, L., 1968, Gold and silver in Oregon: Oregon Department of Geology and Mineral Industries Bulletin 61, p. 106-123.
11. Oregon Department of Geology and Mineral Industries, Mine-file reports: Unpublished reports and maps filed at the Baker Field Office of the Oregon Department of Geology and Mineral Industries.
12. Blue Mountain American, 1901-1909: Sumpter, Oregon, weekly newspaper.

Table 2. CHEMICAL ANALYSES OF ROCK SAMPLES*

Sample	SiO_2	Al_2O_3	TiO_2	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	¼	Sec.	T. (S.)	R. (E.)	Sample description	Map Unit
A.	48.99	19.75	0.44	3.50	4.01	0.14	11.15	8.54	0.17	3.26	0.04	SW	5	10	35	Diorite	Pgb
B.	50.28	16.36	0.79	4.47	5.12	0.15	9.70	9.14	0.16	3.67	0.15	NE	16	10	35	Metabasalt	Pmv
C.	70.70	14.53	0.35	2.06	2.36	0.09	1.57	2.55	0.60	5.12	0.07	NE	16	10	35	Metadacite	Pmv
D.	45.90	19.31	0.63	4.69	5.37	0.17	12.16	9.20	0.20	2.33	0.03	SW	9	10	35	Metabasalt	Pmv
E.	46.02	15.29	1.74	4.97	5.70	0.13	15.22	4.85	0.38	4.77	0.30	NE	5	10	35	Pillow basalt	Pmv
F.	51.34	18.51	1.21	4.09	4.68	0.14	9.31	6.43	0.50	3.48	0.32	NE	32	10	35	Basalt	Tb

* All analyses by X-ray fluorescence at Washington State University, Pullman, Washington, under the direction of Peter Hooper. Analyses are normalized on a volatile-free basis, and total Fe is expressed as Fe_2O_3/FeO at an arbitrarily fixed ratio. All numbers are in weight percent.

Geologic Cross Sections