OPEN-FILE REPORT O-91-03

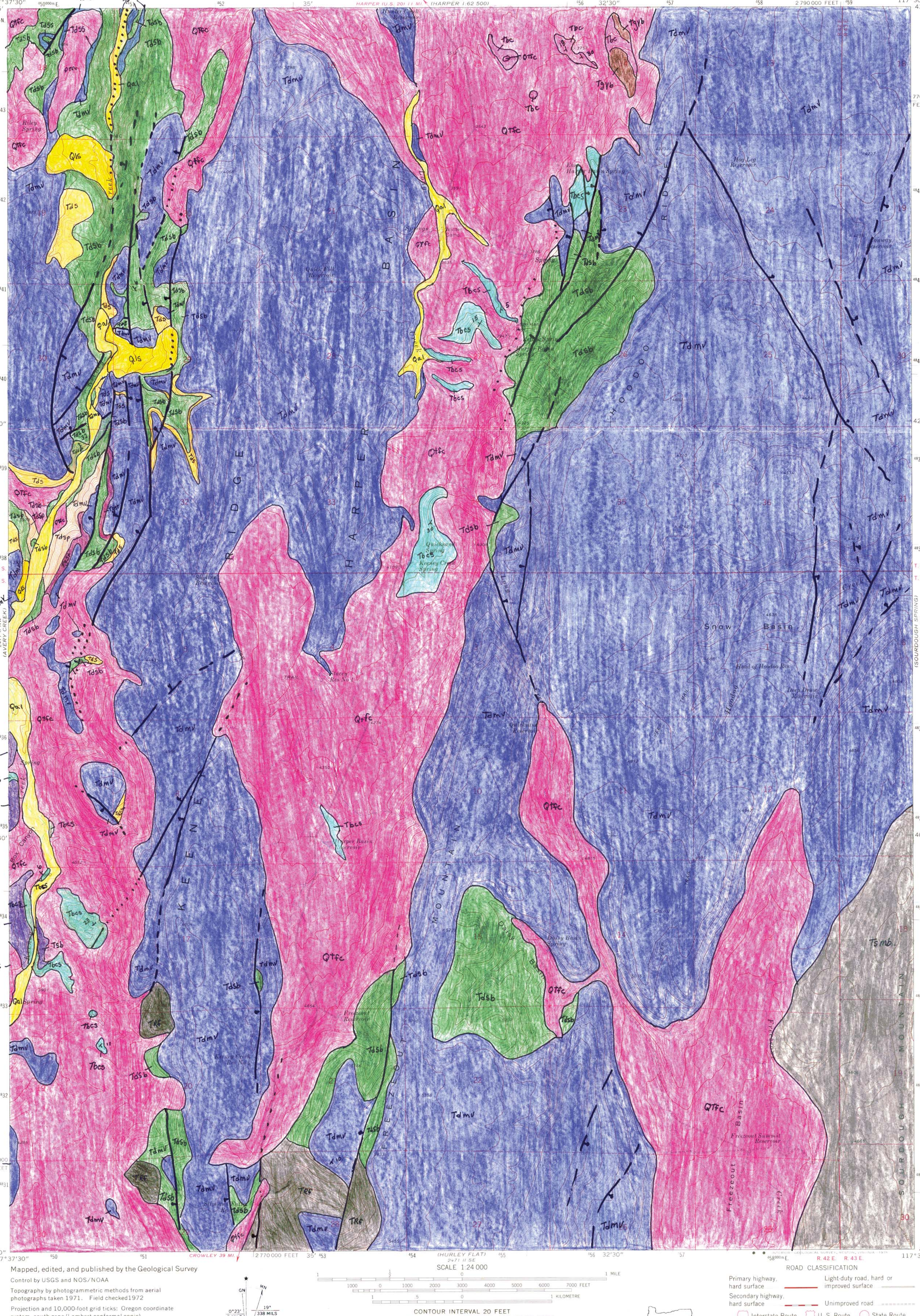
PRELIMINARY GEOLOGIC MAP OF THE KEENEY RIDGE QUADRANGLE
MALHEUR COUNTY, OREGON

1991

BY MARK L. FERNS/J. P. O'BRIEN

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

KEENEY RIDGE QUADRANGLE
OREGON—MALHEUR CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



Mapped, edited, and published by the Geological Survey

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1971. Field checked 1972

Projection and 10,000-foot grid ticks: Oregon coordinate system, south zone (Lambert conformal conic)
1000-metre Universal Transverse Mercator grid ticks, zone 11, shown in blue. 1927 North American datum

Fine red dashed lines indicate selected fence lines

OREGON DEPARTMENT OF GEOLOGY
AND MINERAL INDUSTRIES

Field work conducted 1990

Funded jointly by the Oregon Department of Geology and Mineral Industries, the Oregon State Lottery, and the U. S. Geological Survey COGEOMAP Program.

ROAD CLASSIFICATION

Primary highway, hard surface
Light-duty road, hard or improved surface
Secondary highway, hard surface
Unimproved road
Interstate Route
U. S. Route
State Route

KEENEY RIDGE, OREG.
N4337.5—W11730/7.5

1972

AMS 2471 II NE—SERIES V892

OPEN-FILE REPORT O-91-3
PRELIMINARY GEOLOGY MAP OF THE KEENEY RIDGE QUADRANGLE MALHEUR COUNTY, OREGON

By Mark L. Ferns and James P. O'Brien
Oregon Department of Geology and Mineral Industries

1991

This unpublished Open-File Report has not been reviewed and may not meet all Oregon Department of Geology and Mineral Industries' standards.

Field work conducted in 1990
Map Scale: 1:24,000

Funding Statement: Funded jointly by the Oregon Department of Geology and Mineral Industries, the Oregon State Lottery and the U. S. Geological Survey COGEOMAP Program as part of a cooperative effort to map the west half of the 1° by 2° Boise sheet, eastern, Oregon.

Qal Alluvium (Holocene and Pleistocene?) Unconsolidated and generally poorly-sorted deposits of gravel, sand, and silt along modern streams and flood plains.

QTfc Colluvial and alluvial fan deposits (Holocene, Pleistocene, and Pliocene?) Mainly alluvial fan and slope deposits of unconsolidated, coarse gravel and silt. Colluvial deposits include scree and talus along ridgeslopes and thick accumulations of windblown silt (loess) and sand. QTfc along the west flanks of Keeney and Hoodoo Ridge is mostly made up of basalt talus from unit Tdmv that has buried unconsolidated arkosic sands and coarse volcanic-clast gravels. Surfaces east of Keeney Ridge are covered with unconsolidated gravels with rounded clasts of aphyric black obsidian. The unconsolidated gravels are interpreted as partially eroded alluvial fan deposits of Late Pliocene age.

Tgyb Olivine basalt (upper Miocene) Bluish-black to black olivine basalt flows and orange palagonite breccias. Thickens northward into the Harper quadrangle where it unconformably overlies units Tbc and Tbcs (Ferns and O'Brien, 1991a). Includes hyalo-ophitic and subophitic flows with olivine and plagioclase phenocrysts. Chemically tholeiitic olivine basalts (Ferns and O'Brien, 1991a). Comprises the uppermost basalt flows in the Grassy Mountain Formation of Kittleman and others (1965, 1967).

Tsb Shumuray Ranch Basalt (upper Miocene) Dark black to gray-black olivine basalt flow that unconformably overlies unit Tbcs west of Keeney Creek. The flow can be traced westward into the Avery Creek quadrangle, where it forms an extensive cap. Petrographically an olivine basalt with ophitic clinopyroxene and 5% iddingsitized olivine phenocrysts as large as 3 mm. Chemically a tholeiitic olivine basalt (Sample 7, Table 1). Correlative to the Shumuray Ranch Basalt of Kittleman and others (1965, 1967), from which Fiebelkorn and others (1983) report a K/Ar date of 12.4 Ma.

Bully Creek Formation: (upper Miocene) Tuffaceous siltstones, tuff, diatomite, and fine-grained arkosic sandstones. Herein divided into:

Tbc mainly tuffaceous siltstones, tuff, and diatomite; and

Tbcs mainly fine-grained arkosic sandstones. Correlation with Bully Creek Formation of Kittleman and others (1965, 1967) based on stratigraphic position beneath Tgyb flow in the north end of the quadrangle. Considered by Weeden, 1963 and Kittleman and others (1965) to be part of the sedimentary interbeds in their Grassy Mountain Formation.

Tbc Tuffaceous sedimentary rocks (upper Miocene) Mainly massively bedded, pale yellowish-white tuffaceous siltstone with interbedded gray to grayish-white tuff and white diatomite. Includes laminated pinkish-red shales with root fragments. Thickens northward into the Harper quadrangle (Ferns and O'Brien, 1991a). Conformably overlies fine-grained arkose sandstones of unit Tbcs.

Tbcs Arkosic sandstones and siltstones (upper Miocene) Mainly fine-grained, white arkosic sandstone with interbedded white to pale yellow claystone. Includes cross-bedded fluviatile arkosic sandstone along Keeney Creek. Generally poorly consolidated to friable, but includes highly indurated, silicified arkose south of East Harper Spring.

Tsmb Olivine basalt flow (upper Miocene) A single, vesicular, gray, hyalophitic olivine basalt flow forming the crest of Sourdough Mountain in the southeast corner of the quadrangle. Texturally an ophitic basalt with about 2% plagioclase phenocrysts that are up to 4 mm long and altered olivine phenocrysts as much as 1mm in diameter. Groundmass consists of plagioclase and opaque microlites in ophitic clinopyroxene and glass. Chemically a tholeiitic olivine basalt (Sample 10, Table 1). According to Cummings (written communication, 1991), the flow, which covers a minimum of 45 km2 and is 35 meters thick, erupted from a vent immediately east of the quadrangle boundary, in sec. 19, T. 22 S., R. 44 E. Included in the Grassy Mountain Formation by Kittleman and others (1967).

Tdmv

Basaltic andesites (middle to upper Miocene) Mainly dark blackish-blue, plagioclase- and hypersthene-phyric basaltic andesite flows which commonly weather red. Variable number of flows exposed in the section, which thins rapidly to the south and west. Aggregate thickness ranges from about 40 feet on the west side of Freezeout Mountain in sec. 21, T. 22 S., R. 42 E., where two flows are exposed; to over 400 feet on Long Creek. Upper flows are hyalophitic with plagioclase, hypersthene and occasional olivine phenocrysts set in a groundmass comprised of smaller plagioclase laths in a glass containing abundant disseminated fine opaques. Plagioclase phenocrysts as large as 6 mm in length make up as much as 15% of selected samples. Mainly basaltic andesites (Samples 2, 3, 5, & 11, Table 1) with about 54% SiO_2 and 16.5% Al_2O_3. Unconformably overlies flows and breccias of Tdsb on the east and west flanks of Freezeout Mountain. According to Cummings (written communication, 1991), Tdmv unconformably overlies tuffaceous and arkosic sandstones correlative with unit Tgs of Ferns and Ramp (1989) in the Sourdough Springs quadrangle to the east. Equivalent to the Tui flows of Storm (1975) and the Tdmv flows of Brooks (1990) and Ferns and O'Brien (1991a). Forms main tops of Freezeout Mountain and Keeney Ridge and makes up the bulk of the Grassy Mountain Formation as mapped by Kittleman and others (1965).

Tds

Tuffaceous sedimentary rocks (middle Miocene?) Mainly white to yellowish-white tuffaceous siltstones and white tuff. Comprises an approximately 100 foot thick section of tuffs and siltstones which conformably overlies tuff breccias of unit Tdsb. Previously mapped as a sedimentary interbed in the Grassy Mountain Formation by Kittleman and others (1965) but herein considered to be laterally continuous with tuffaceous sediments in the upper part of the Drip Springs Formation.

Tdsp

Mafic tuff breccias (middle Miocene) Mainly white to light gray, bedded, matrix-supported lapilli tuffs and breccias that are well indurated and weather to form conspicuous outcrops. Clasts range from basalt boulders 2 feet in diameter to white pumice lapilli. Unit thickens to the west into the Avery Creek quadrangle. Grades laterally eastward into tuffaceous siltstones of unit Tds.

Tdsb Basalt and basaltic andesite (middle Miocene) Mainly fine-grained, aphyric, platy-jointed olivine basalt, basaltic andesite, and andesite flows. Grades laterally from mainly aphyric basalt flows with arkosic sandstone interbeds in the northwest end of the quadrangle to aphyric andesite flows with poorly consolidated volcanic-clast conglomerate and breccia interbeds. Includes slightly indurated accumulations of red scoria and volcanic bombs at Daisy Basin that dip radially outward from an andesite high that may be a local vent area. Includes trachytic andesites with 4 mm long plagioclase and 1 mm diameter clinopyroxene phenocrysts, pilotaxitic andesites with orthopyroxene microphenocrysts, and ophitic basalts with large plagioclase and altered olivine phenocrysts. Includes calc-alkaline basalts (Samples 1, 4, & 6, Table 1) and basaltic andesites (Samples 8, & 9, Table 1). Mapped as part of the Grassy Mountain Formation by McMurray (1962) and Kittleman and others (1967) but herein considered as part of the Drip Springs Formation.

Tdss Arkosic sandstones and conglomerates (middle Miocene) Mainly white to pale yellow, fine, medium, and coarse-grained massive and cross-bedded arkosic sandstone. Exposed only along the sides of Keeney Creek in the north end of the quadrangle where the unit is interbedded with basalt flows of unit Tdsb. Tdss forms prominent ledges from 2 to 4 feet thick between basalt flows where silicified near Riley Spring Mapped as part of the Drip Springs Formation by McMurray (1962) and unconformably overlies palagonites and tuffs of unit Tds of Ferns and O'Brien (1991a) immediately to the north in the Harper quadrangle.

Trf Sanidine rhyolite (middle Miocene) Light purplish gray, platy, sanidine rhyolite.Varies from platy lithoidal rhyolite to massive rhyolite with variolitic cavities with folded flow-foliation. Commonly consists of about 5% sanidine phenocrysts in a devitrified groundmass of intergrown quartz and feldspar. A high-silica peralkaline rhyolite (Sample 12, Table 1) interpreted as an exogenous rhyolite dome that formed a local highlands around which flows of units Tdsb and Tdmv flowed. Previously mapped as part of the Littlefield Rhyolite by McMurray (1962) and Kittleman and others (1965), but chemically and petrographically distinct from Littlefield Rhyolite flows mapped by Evans (1990) and Ferns and O'Brien (1991b) along the Malheur River, which are plagioclase-phyric and meta-aluminous. Considered by Cummings, (verbal communications, 1990) to be part of a middle Miocene rhyolite dome field related to development of the Mahogany Mountain and Three Fingers Rock calderas to the southeast.

GEOLOGIC HISTORY

The compositionally diverse rhyodacite and rhyolite flows and domes of Dry Creek Buttes (Brooks, 1992) form a topographic highlands whichmake up the oldest rocks exposed in the quadrangle. Together with basaltic andesite and andesite flows (Tdsb), the middle Miocene rhyolite forms the basement upon which younger late Miocene and Pliocene sedimentary and volcanic rocks were deposited. Ferns and others (1993) suggest that both the rhyolites and andesitic rocks are part of a sequence of dominantly calc-alkaline volcanism which accompanied middle Miocene tectonic subsidience in the central part of the Vale 1:100,000 quadrangle.

Local subsidience along north and north-northeast trending faults was accompanied by eruption of mafic and silicic tuffs (Tdsp) from vents to the west. Distinctive plagioclase phyric andesite flows (Tdmv) covered most of the quadrangle following eruption of the tuffs. Down-to-the-west movement along the major northeast striking fault on the west side of Freezeout Mountain produced a north-trending basin in which arkosic sands and gravels (Tbcs) were deposited. These sediments were deposited by streams which flowed northward through the quadrangle, into a lake to the north and now make up the southern extension of the Bully Creek Formation of Kittleman and others (1965, 1967). Thermal waters locally migrated up along the fault and silicified permeable horizons in the coarser sediments.

Subsidience along northward-directed faults continued into the late Miocene, whereupon olivine basalt flows were erupted from vents outside the quadrangle. These flows (Tgyb, Tsb and Tsmb) flowed out across shallow lakes and down tributary streams, forming the rimrock mesas that now dominate much of the landscape in the quadrangle. Down-to-the-west movment along faults in the western half of the quadrangle continued following eruption of the olivine basalts. During the Quaternary, thick alluvial fan and colluvial deposits developed along the west side of Freezeout Mountain. These deposits may have, in part, formed during emptying of the large Pliocene Lake to the north and east (Ferns and others, 1993).

MINERAL RESOURCES

The quadrangle contains one major gold prospect. The Harper Prospect is located in secs. 22 and 23, T. 21 S., R. 42 E., in an area of silicified, iron-stained sandstones of unit Tbcs. Elevated gold concentrations in stream sediment samples from the East Harper Basin area led Robinson and others (1984) to first identify this area as a potential precious metal target. The prospect appears to be a typical sediment-hosted epithermal system, with dense silicified arkoses and elevated trace metal abundances. A sample of a chalcedony vein peripheral to the main area of silicification yielded anomalous amounts of mercury and arsenic (Sample B, Table 2). The property has been drilled with indeterminate success to date.

Another area that may warrant further investigation is a large zone of altered basalt and silicified sandstone that forms the ridge west of Keeney Creek in sec. 18, T. 21 S., R. 42 E.. Alteration extends northward from near Riley Spring into the Harper quadrangle (Ferns and O'Brien, 1991a). Slightly anomalous Au (Sample A, Table 2) was detected in a fault zone in this area.

Another potential resource is silica sand in unit Tbcs. Poorly consolidated arkose sands are exposed at Harper Basin Reservoir in sec. 9, T. 22 S., R. 42 E. and may extend southward beneath QTfc. Similar sands at Basin Creek in the Harper sheet to the north were identified by Geitgey (1990) as sands which might be upgraded by beneficiation.

GROUNDWATER RESOURCES

Unit Tbcs appears to be the main aquifer in the quadrangle. Numerous springs issue at the contact between Tbcs and underlying basalts of unit Tdmv. The quality and quantity of the groundwater resource is not known.

GEOCHEMISTRY

Sample Preperation

Samples for whole-rock analysis (Table 1) were crushed to minus 1/4 inch in a steel-jawed Braun chipmunk crusher and split in a Jones-type splitter in the Oregon Department of Geology and Mineral Industries (DOGAMI) laboratory. A split of about 60 g of each sample was ground to minus 200 mesh in agate grinding media by X-ray Assay Laboratories (XRAL) of Don Mills, Ontario.

For trace element analysis of altered rock samples (Table 2), each sample was crushed to minus 1/4 in and split as above to obtain a nominal 250 g subsample. Each subsample was milled to about minus 200 mesh in chrome-steel media in an Angstrom disc mill in the DOGAMI laboratory. Each milled sample was split to obtain two analytical samples: one for gold and one for the other trace elements to be determined.

Chemical analysis

Whole-rock analysis: X-ray fluorescence analyses were performed by XRAL. XRAL used a fused button for its analyses (1.3 g of sample at 950 C for one hour, fused with 5 g of lithium tetraborate, and melt cast into a button). Loss on ignition (LOI) was determined by weight loss during roasting.

Trace-element analysis: 1. Gold: Bondar-Clegg, Ltd., of North Vancouver, British Columbia, performed the analyses for gold. The method employed was fire assay preconcentration of the gold in a 20 g sample (gold was collected in added silver) with acid dissolution of the resulting bead and a final analyses by a direct current plasma (DCP) emission spectrometer. The detection limit was 1 part per billion (ppb).

2. 14 trace elements --Geochemical Services, Inc., (GSI) of Torrance, California, performed the analyses for 14 other trace elements. The method employed a proprietary acid dissolution/organic extraction on a 5 g sample. The final analysis was by inductively coupled plasma (ICP) emission spectrometry. GSI considers the digestion to provide total metal contents except for gallium and thallium

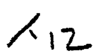
3. 8 trace elements -- The DOGAMI laboratory performed the anlyses for 8 elements: barium, cobalt, chromium, iron, lithium, manganese, nickel, and tungsten. For the first seven elements, a 1 g sample was digested with nitric and hydrofluoric acids, the solution taken to near-dryness with perchloric acid, and the residue redissolved and taken to 100 ml volume with 10% nitric acid. The finish was by flame atomic absorption and (for lithium) flame emission spectrometry. The digestion provides total metal contents except for barium and possibly chromium. Tungsten was determined by a method that gives semi-qunatitative results: 1/4 g of sample fused with potassium pyrosulfate and dissolved with hydrochloric acid, an aliquot treated with stannous chloride and zinc dithiol, the tungsten

extracted into 0.5 ml amyl acetate, and the colored complex visually compared with standards. The detection limit for tungsten was 5 ppm..

MAP SYMBOLS

Contact -- approximately located

Fault contact -- dashed where approximately located, dotted where concealed. Ball and bar on down throw side



Strike and dip of beds

AYB-211 **Location of whole rock sample analyzed in Table 1**

AYB-130 **Location of mineralized sample analyzed in Table 2**

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TABLE 1 MAJOR AND TRACE ELEMENT ANALYSES UNALTERED ROCK SAMPLES KEENEY RIDGE QUADRANGLE 0-91-3

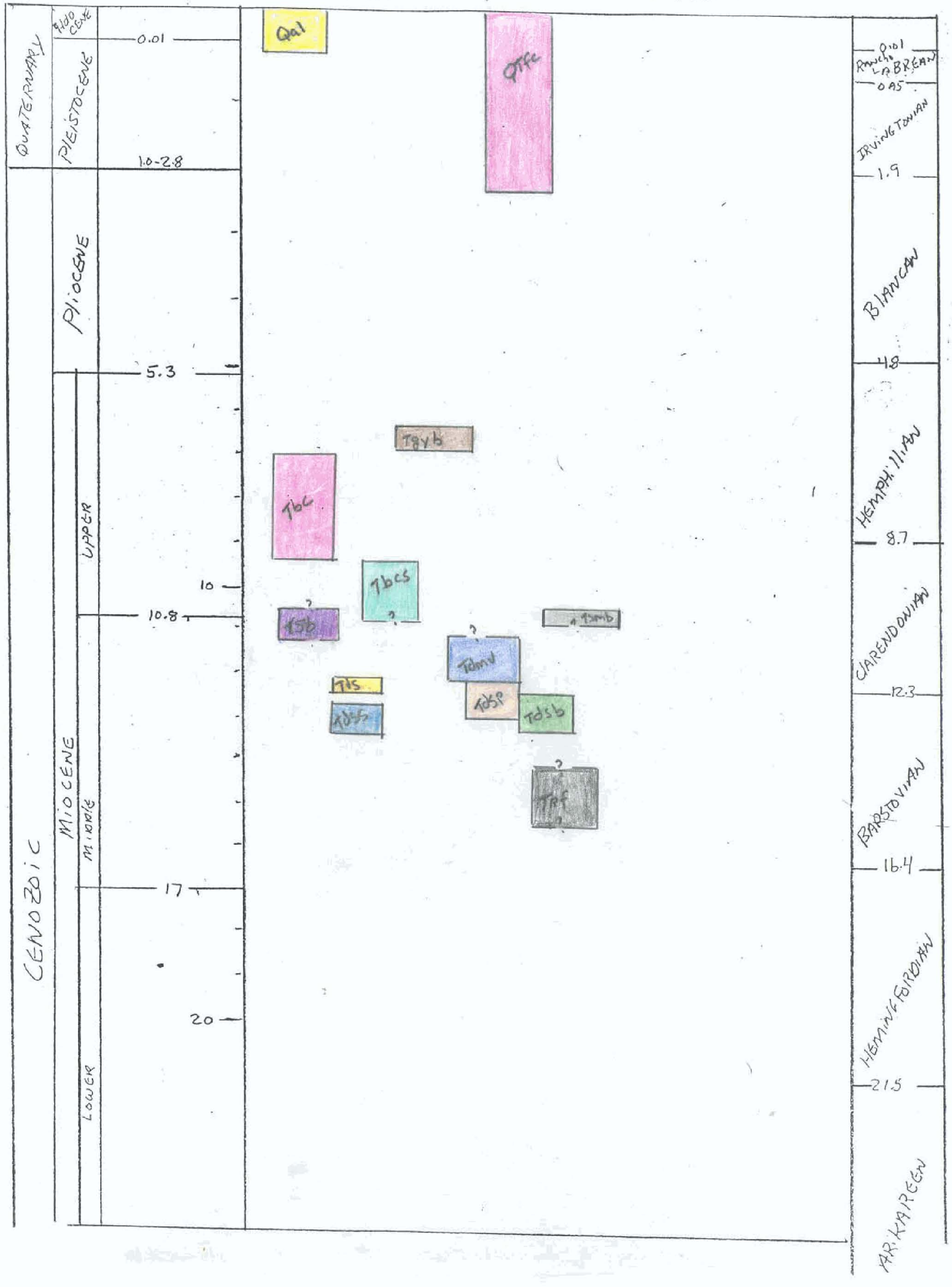
LAB #	Field #	1/4	1/4	Sec.	T.(S.)	R.(E.)	Lithology	Map Unit	SiO2 %	Al2O3 %	TiO2 %	Fe2O3 %	FeO %	MnO %	CaO %	MgO %	K2O %	Na2O %	P2O5 %	Cr ppm	Co ppm	Ni ppm	Cu ppm	Zn ppm	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm	Ba ppm	Li ppm
AYB-211	90-BO-106	NW	NW	20	21	42	Aphyric basalt	Tdsb	51.8	15.5	1.56	3.13	6.99	0.19	8.26	4.55	1.56	3.33	0.63	57	26	75	65	120	45	475	19	180	31	680	12
AYB-212	90-BO-107	SW	NW	20	21	42	Plag-phyric basalt	Tdmv	51.6	16.5	1.20	3.54	4.94	0.17	9.30	5.50	1.12	3.17	0.36	148	27	107	75	93	25	554	<10	130	32	556	10
AYB-213	90-BO-87	NE	NE	27	21	42	Plag-phyric basalt	Tdmv	53.4	16.6	1.11	4.08	3.65	0.14	8.17	4.73	1.56	3.30	0.35	104	26	85	77	95	33	591	32	157	16	841	21
AYB-214	90-BO-86	NW	NW	26	21	42	Aphyric basalt	Tdsb	51.1	15.8	1.84	6.8	3.96	0.16	8.69	4.93	1.10	3.12	0.57	102	26	56	62	115	33	489	20	162	23	676	11
AYB-215	90-BO-100	NE	NE	26	21	42	Plag-phyric basalt	Tdmv	53.8	16.6	1.02	3.15	4.89	0.15	8.47	5.25	1.20	3.25	0.30	120	25	92	71	91	36	546	18	145	16	687	11
AYB-216	90-BO-102	SE	SW	29	21	42	Aphyric basalt	Tdsb	50.3	16.3	1.59	4.2	5.31	0.16	9.09	5.03	1.07	3.15	0.49	106	27	71	52	106	20	532	12	160	31	590	9
AYB-217	90-BO-108	NE	SW	18	22	42	Olivine basalt	Tsb	48.8	16.0	1.87	4.55	6.88	0.19	9.79	6.03	0.93	2.86	0.47	189	33	96	42	113	15	478	19	142	29	636	15
AYB-218	90-BO-85	SW	NE	15	22	42	Aphyric basalt	Tdsb	51.1	16.3	1.60	4.92	5.47	0.18	8.94	5.71	1.17	3.18	0.51	104	29	73	64	111	28	508	12	165	25	618	12
AYB-219	90-BO-83	SW	NE	21	22	42	Aphyric basaltic	Tdsb	54.2	16.5	1.16	4.07	4.44	0.16	7.93	4.52	1.42	3.51	0.36	47	24	54	65	94	27	505	13	173	15	711	11
AYB-220	90-BO-101	NW	NE	24	22	42	Olivine basalt	Tsmb	51.9	15.4	1.24	1.98	6.78	0.16	9.32	6.89	1.34	2.64	0.33	243	29	105	64	78	24	290	29	124	26	849	8
AYB-221	90-BO-89	NE	NE	29	22	42	Plag-phyric basalt	Tdmv	53.3	16.7	1.05	3.99	4.06	0.14	8.74	4.93	1.26	3.28	0.30	124	24	87	71	90	31	570	15	131	12	695	10
AYB-222	90-BO-90	NW	NW	28	22	42	Rhyolite	Trf	75.8	12.3	0.19	1.43	0.1	0.03	0.11	0.13	4.56	4.78	0.04	11	4	6	6	76	114	<10	76	419	42	350	17

Table 2. Trace element analyses of altered rocks samples, Keeney Ridge quadrangle, Oregon.

Laboratoy Number	1/4	1/4	Sec.	T.S.	R.E.	Elev. (ft.)	Lithology	Map Unit	Ag (ppm)	As (ppm)	Au (ppb)	Cu (ppm)	Hg (ppm)	Mo (ppm)	Pb (ppm)
AYB-137	NW	NE	18	21	42	3360	Silicified gouge	Tdsb, Tdss	0.045	80.6	12	8.63	<0.10	5.46	10.6
AYB-138	SW	SW	23	21	42	4160	Chalcedony vein	Tdsb,	0.115	44.7	<1	33.7	0.172	3.98	0.88
AYB-139	NW	SW	34	21	42	4100	Silicified arkose	Tbcs	0.047	20.1	<1	4.75	<0.10	1.58	2.39
AYB-140	NW	SE	18	22	42	3900	Silicified arkose	Tbcs	0.033	1.8	<1	3.41	<0.10	1.66	2.07

Laboratoy Number	Sb (ppm)	Tl (ppm)	Zn (ppm)	Bi (ppm)	Cd (ppm)	Ga (ppm)	Se (ppm)	Te (ppm)	Ba (ppm)	Co (ppm)	Cr (ppm)	Fe (wt %)	Li (ppm)	Mn (ppm)	Ni (ppm)	W (ppm)
AYB-137	0.678	<0.5	16.4	<0.25	<0.10	2.66	<1.0	<0.5	549	4.3	35	1.74	53.8	68	12	<5
AYB-138	1.92	<0.5	3.20	<0.25	<0.10	1.50	<1.0	<0.5	28	1.2	359	1.12	93.0	135	13	<5
AYB-139	1.22	<0.5	9.07	<0.25	<0.10	1.27	<1.0	<0.5	590	5.4	166	2.98	6.8	194	10	<5
AYB-140	0.259	<0.5	6.90	<0.25	<0.10	0.92	<1.0	<0.5	673	4.5	167	0.63	6.8	82	10	<5

TIME ROCK CHART KEENEY RIDGE



MAP SYMBOLS

Contact -- approximately located

Fault contact -- dashed where approximately located, dotted where concealed. Ball and bar on down throw side

Strike and dip of beds

Location of whole rock sample analyzed in Table 1

Location of mineralized sample analyzed in Table 2