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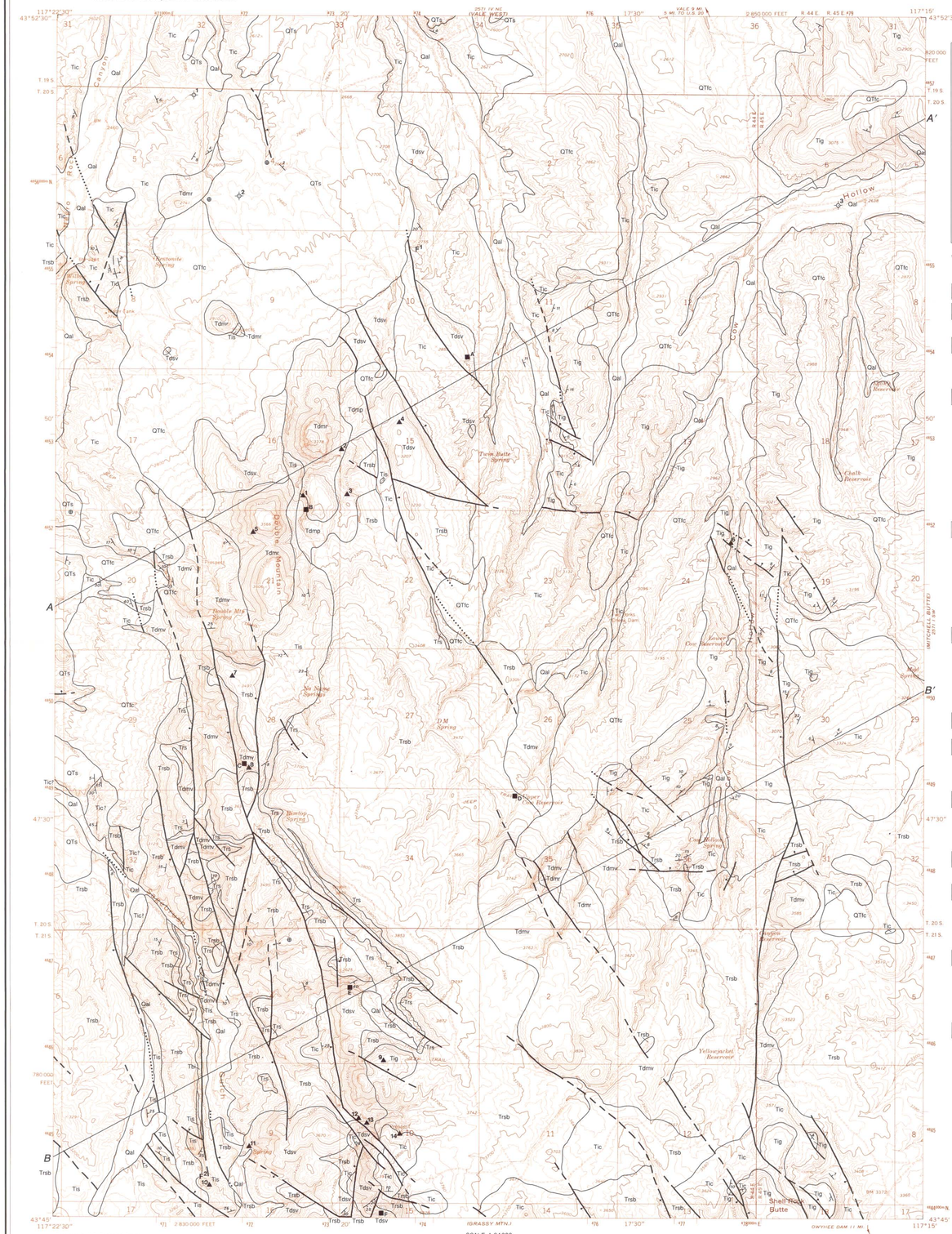
STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
DONALD A. HULL, STATE GEOLOGIST

GEOLOGY AND MINERAL RESOURCES MAP OF THE DOUBLE MOUNTAIN QUADRANGLE, MALHEUR COUNTY, OREGON

1989



Base map by U.S. Geological Survey
Control by USGS and USC&GS
Topography by photogrammetric methods from aerial photographs taken 1966. Field checked 1967
Polyconic projection. 1927 North American datum
10,000-foot grid based on Oregon coordinate system, south zone
1000-meter Universal Transverse Mercator grid ticks, zone 11

UTM GRID AND 1967 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET
(GN, MN, 0°13' 4 MILS, 19° 338 MILS)

SCALE 1:24 000
1 MILE — 7000 FEET
1 KILOMETER

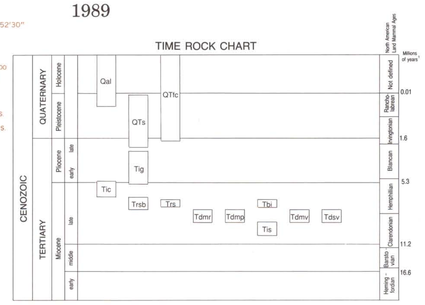
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

QUADRANGLE LOCATION (OREGON)

By Len Ramp and Mark L. Ferns, Oregon Department of Geology and Mineral Industries

Field work conducted in 1988 and 1989. Map reviewed by W.K. Hart, Miami University, Oxford, Ohio, and J.G. Evans, U.S. Geological Survey, Spokane, Washington. The assistance of Michael Cummings, Portland State University, and field assistant Kevin Urbanczyk, Washington State University, is gratefully acknowledged. Prepared in cooperation with the U.S. Geological Survey as part of the COGEOMAP program.

TIME ROCK CHART



[1]Dates from Palmer (1983)

EXPLANATION

Qal — **Alluvium (Pleistocene and Holocene)** — Unconsolidated and generally poorly sorted deposits of gravel, sand, and silt accumulated along modern streams and flood plains

QTfc — **Colluvial and alluvial fan deposits (Pliocene, Pleistocene, and Holocene)** — Mainly alluvial fan and slope deposits consisting of unconsolidated coarse gravels and silts. Colluvial deposits include scree and talus along slopes of ridges and thick accumulations of windblown silt and sand on the tops of benches and ridges and in the broad valleys

QTs — **Terrace gravels and interbedded tuffaceous lacustrine sedimentary rock (Pliocene and Pleistocene)** — Mainly poorly consolidated deposits of nearly horizontally bedded basalt and rhyolite clast conglomerate with thin interbeds of limy silt and sandstone. Fines upward into white, poorly consolidated tuffaceous siltstone and sandstone. Unconformably overlies unit **Tic** along the east side of Negro Rock Creek. Equivalent to the terrace gravels mapped by Doak (1953) and Corcoran and others (1962). Distinguished from unit **Tig** on basis of abundant basalt clasts in the gravels. Maximum thickness of the unit is about 150 ft east of Negro Rock Canyon

Tig — **Tuffaceous conglomerates and sandstones (upper Miocene and Pliocene)** — Mainly tuffaceous arkosic sandstone and siltstone with interbedded lenses of black chert-pebble conglomerate. Includes light-colored, fine-grained tuffaceous fluviatile and deltaic sandstone, conglomerate, siltstone, and mudstone. Includes gypsiferous sandstone along Cow Hollow. Conglomerate lenses range from half an inch to 4 ft in thickness and range from discontinuous lenses to thick cross-bedded sheets. Unit unconformably overlies limestone of unit **Tic**. Correlative with Pliocene arkosic sandstone and chert-pebble conglomerate exposed in the Adrian quadrangle (Ferns, 1989) to the east, which is considered by Kimmel (1982) and Smith and others (1982) to be equivalent to the Glenns Ferry Formation of Malde and Powers (1962). Includes the upper part of the Chalk Butte Formation as defined by Corcoran and others (1962) and the Mitchell Butte Member of the Deer Butte Formation as defined by Kittleman and others (1965). Sandstone and conglomerate form resistant yellowish outcrops near hydrothermal systems where silica and/or carbonate cement has been introduced. Some of these areas, e.g., Shell Rock Butte, were previously considered to be erosional remnants of older, more resistant Deer Butte Formation (Corcoran and others, 1962; Storm, 1975). Limonitic conglomerate containing gypsum is exposed along Cow Hollow near the lower Cow Reservoir. Unit is over 1,600 ft thick in quadrangle, based on gas well log for Mammoth Oil and Gas Company well 1, located in sec. 6, T. 20 S., R. 45 E. (Newton and Corcoran, 1963), which passed from sand, shale, and gravel to limestone and shale interpreted to be part of underlying unit **Tic** at about 1,025 ft

Tic — **Tuffaceous siltstone, sandstone, and limestone (upper Miocene and Pliocene)** — Mainly lacustrine deposits of poorly consolidated, light-gray, fine-grained tuffaceous sandstone, siltstone, and mudstone. Includes thin beds of diatomaceous siltstone, tuff, and pebbly sandstone. Also includes a distinctive 4- to 5-ft-thick bed of massive white limestone with apparent algal structures and abundant gastropod debris near the contact with underlying basalt of unit **Trsb** in Cow Hollow and west of Shell Rock Butte. Interbedded tuffaceous limestone often contains abundant mollusk fossils, with some pelecypods up to 4 in. in length (e.g., along the west bank of Negro Rock Creek in the northwest corner of the quadrangle). Unit is estimated to be about 300 ft thick west of Cow Hollow. Correlative with the lower part of the Chalk Butte Formation of Corcoran and others (1962). Based on stratigraphic position beneath the arkosic sandstone and chert-pebble conglomerate of unit **Tig**, unit **Tic** is believed to be equivalent to lake sediments of late Miocene age exposed west of Adrian (Smith and others, 1982; Ferns, 1989) that are considered correlative with the Chalk Hills Formation of Malde and Powers (1962). Late Miocene age based in part on Hemphillian antilocaprid (pronghuck) jaw fragment from locality F1 in the NW¼NE¼ sec. 10, T. 20 S., R. 44 E. (D.E. Savage, written communication, 1988)

Trsb — **Olivine basalts at Rock Springs (upper Miocene)** — "Snake River-type" olivine basalt flows and interbedded deposits of tuffaceous siltstone and sandstone. Stratigraphically, unit is made up of approximately equal amounts of flows and intraflow sedimentary rock. Flows are thin, dark-black to bluish- and greenish-black amygdaloidal olivine basalts. Texturally, holocrystalline and hyalocrystalline olivine basalt flows contain olivine and plagioclase phenocrysts with ophitic or intergranular clinopyroxene. Chemically distinguished by high TiO_2 (>2.00 percent) and relatively high K_2O (0.60 percent) content. Includes "water-affected basalts"; i.e., outcrops characterized by a tendency to weather to zones of granular soil composed of basalt fragments separated by basal red baked zones or paleosols. About 400 ft of section is exposed in Sagebrush Gulch. Unit is the upper part of the Grassy Mountain Basalt of Bryan (1929). A K-Ar age of 7.4 m.y. is reported for a flow from this unit south of Sagebrush Gulch in the Grassy Mountain quadrangle (Fiebelkorn and others, 1982)

Tbi — **Basalt dike (upper Miocene)** — Holocrystalline olivine basalt dike exposed east of Sagebrush Gulch. Intrudes unit **Tis** and is unconformably overlain by the capping olivine basalt flow of unit **Trsb**

Trs — **Tuffaceous siltstone and sandstone (upper Miocene)** — Arkosic sandstone and tuffaceous siltstone interbedded with unit **Trsb** are mapped separately where well exposed. Upper interbeds are mainly tuffaceous siltstones and include some bentonitic clays. Age is probably Hemphillian (8 to 4 m.y.), based on camel bone fragments identified by D.E. Savage, University of California at Berkeley (written communication, 1988) from the Grassy Mountain quadrangle (Ferns and Ramp, 1989). Correlative with the sedimentary interbeds of the Grassy Mountain Formation of Corcoran and others (1962)

Tdmr — **Rhyolite (upper Miocene)** — Porphyritic and aphyric vitric rhyolite flows and domes. Includes glassy rhyolites with sparse, partially resorbed quartz phenocrysts exposed at and northwest of Double Mountain. Typical phenocryst assemblage includes quartz, plagioclase, sanidine, and biotite. Includes a separately mapped, wide zone of white rhyolitic perlitic glass (unit **Tdmp**) exposed along the eastern flanks of Double Mountain. Domes at Double Mountain are part of a partially eroded late Miocene vent complex with an age of 8.07 ± 0.21 m.y. (Fiebelkorn and others, 1982). Presumably related to basalt and andesite flows of unit **Tdmv** and silicic andesite and dacite flows of unit **Tdsv**. Rhyolite mass south of Upper Cow Reservoir is partially buried by later flows of unit **Tdmv**

Tdmp — **Perlite (upper Miocene)** — Glassy white to gray granular perlite related to rhyolite domes (unit **Tdmr**). The granular-textured perlite is flow foliated and ranges from light grayish white to tan and pink. The perlite contains sparse phenocrysts of quartz, sanidine, and biotite. Chemically a rhyolite (sample B, Table 1)

Tdsv — **Silicic volcanic and volcaniclastic rocks (upper Miocene)** — Mainly glassy, aphyric platy andesite, dacite, and rhyolite flows ranging from dark gray to pink or red. Includes interbedded lithic tuffs and monolithologic breccias composed of aphyric glassy clasts in a green tuffaceous matrix. Dacitic flows on Sagebrush Gulch are hyalopilitic and contain plagioclase, hypersthene, clinopyroxene, and hornblende. Dacite and breccias northeast of Double Mountain are hyalopilitic, with partially resorbed quartz and sanidine phenocrysts. Quartz phenocrysts typically are rimmed by clinopyroxenes. Unit is about 300 ft thick on Sagebrush Gulch, where two thick platy vitric flows are separated by a 100-ft-thick section of lithic tuff. Includes vertically foliated flows northeast of Double Mountain that are capped by flow breccias

Tdmv — **Basalt, basaltic andesite, and andesite (upper Miocene)** — Mainly andesite and basalt flows, flow breccias, and near-vent pyroclastic deposits of scoria and cinders. Includes thick plagioclase-phyric platy andesite flows and lithic breccias with feldspar phenocrysts half an inch long and pilotaxitic basaltic andesite flows with sparse plagioclase and orthopyroxene phenocrysts low in the section east of Sagebrush Gulch. Uppermost part of the unit west of Double Mountain includes olivine basalt flows and interbedded pyroclastic deposits that are intruded by rhyolite domes of unit **Tdmr**. A vent area north of Upper Cow Reservoir is indicated by steeply dipping bedded pyroclastic deposits. Uppermost flows include Snake-River-type olivine tholeiites similar in chemistry to flows of overlying unit **Trsb** (sample C, Table 1). Interpreted by Storm (1975) as being correlative to the unnamed igneous complex of Kittleman and others (1965)

Tis — **Chert-pebble conglomerate and interbedded diatomaceous siltstone (upper Miocene)** — Mainly tuffaceous and arkosic sandstone and siltstone with interbedded conglomerate. Unit locally becomes finer grained upward into pale white and yellow claystone and interbedded diatomaceous siltstone. Uppermost exposures on Sagebrush Gulch are altered yellowish-orange arkosic sandstones with numerous gastropod fossils. Late Miocene age based on Clarendonian mammalian fossils at Poison Springs (Kittleman and others, 1965) in the Sourdough Springs quadrangle to the southwest and camel and horse bones of probable Hemphillian age from locality P2, SW¼SW¼ sec. 9, T. 21 S., R. 44 E. (D.E. Savage, written communication, 1988). Unit is about 200 ft thick in the southwestern part of the quadrangle where separated from flows of overlying unit **Trsb** by an angular unconformity. Presumably equivalent to the thick section of lower Idaho Group sediments identified in the El Paso Natural Gas Federal Spurrier well 1 by Newton and Corcoran (1963)

MINERAL RESOURCES

The major potential mineral resource in the quadrangle is gold. Gold resources may occur in the hot-springs type of epithermal systems hosted in both volcanic and sedimentary rocks. Sedimentary-hosted systems, such as at Shell Rock Butte and east of Sagebrush Gulch, are characterized by resistant caps of red- and yellow-weathering, densely indurated arkosic sandstone and conglomerate. The capping sandstone and conglomerate are flooded by silica and form resistant outcrops that weather to large blocky talus.

The Shell Rock Butte system itself is a late Miocene-early Pliocene system covering an area of about 3 mi^2 in the southeast part of the Double Mountain quadrangle and the northeast part of the adjoining Grassy Mountain quadrangle (Ferns and Ramp, 1989). Shell Rock Butte consists of intensely silicified sandstones and conglomerates and, in the Grassy Mountain quadrangle, includes an underlying, partially exhumed zone of massive and bedded chalcedony along the southeast flank of the butte (Ferns and Ramp, 1989). The chalcedony deposits may be hot-spring sinter that has subsequently been buried by coarser clastic material. Small travertine deposits with late-stage calcite veining locally cap the silicified gravels. Surface samples from the Shell Rock Butte system collected in the Grassy Mountain quadrangle contain as much as 40 ppb gold and significant amounts of arsenic (376 ppm) and molybdenum (290 ppm) (Ferns and Ramp, 1989).

A second area of alteration extends northward from the Grassy Mountain quadrangle into secs. 3, 10, and 15, east of Sagebrush Gulch. Alteration zones include opalite-filled fault breccias, massive lenses and nodules of opalite and chalcedony along bedding planes and intraflow surfaces in flow rocks, and areas of case-hardened yellow siltstone and sandstone.

Precious-metal mineralization may also be associated with the rhyolite domes near Double Mountain. Argillically altered rhyolites crop out near Bentonite Spring. Limonitic fault zones east of Double Mountain (samples 2 and 3, Table 2) are highly anomalous in arsenic (259-312 ppm) and molybdenum (288-408 ppm). The mineralization at Double Mountain may be the surface expression of a deep-seated porphyry molybdenum system. Newton and Corcoran (1963) report altered rhyolite with disseminated pyrite at the bottom of the El Paso Natural Gas well in sec. 5, T. 20 S., R. 44 E. Cuttings from the 7,450-ft interval include a highly altered, fine-grained crystalline igneous rock (monzonite?) cut by cloudy granular quartz veinlets and sulfide seams. Primary mafic minerals are altered to pyrite and chlorite. Some of the cuttings are coated by a black sooty sulfide mineral.

Other potential resources include freshwater limestone, bentonitic clay (Gray and others, 1989), and perlite. Perlite is exposed along the south and east flanks of the northernmost dome at Double Mountain. Perlite is granular in texture and flow foliated. Refractive index of the glass is 1.496. Phenocrysts of quartz, sanidine, and biotite may lower the resource potential of the perlite.

A freshwater limestone bed as much as 5 ft thick occurs near the top of unit **Tic**. A small erosional remnant caps the butte west of Shell Rock Butte in sec. 14. More extensive limestones occur near Cow Hollow Spring. The limestone is light gray and is apparently a relatively high-purity lime (52.0 percent CaO) (Brooks, 1989).

Both natural gas and geothermal energy resources may be indicated in the quadrangle. Three natural gas exploration wells have been drilled in the quadrangle, the deepest being the 7,460-ft-deep hole in sec. 5, T. 20 S., R. 44 E., drilled by El Paso Natural Gas Co. in 1955. Traces of gas were reported in all three wells (Newton and Corcoran, 1963). An odorless inflammable gas is reported at Mud Spring in the NW¼ sec. 29, T. 20 S., R. 45 E. (Washburne, 1909). The reported gas shows may be with unit **Tic**. All three wells penetrated unit **Tic**. Washburne (1909) reports petroliferous sandstones with abundant mollusk fossils in NW¼ sec. 2, T. 20 S., R. 44 E., and to the north in the Vale West quadrangle in sec. 29, T. 19 S., R. 44 E.

The geothermal resource map of Oregon (Oregon Department of Geology and Mineral Industries, 1982) indicates that the northern part of the quadrangle may be underlain at shallow depth (<3,000 ft) by warm waters of sufficient temperature for direct heat applications, with warm water (23 °C) reported from a geothermal test well in sec. 6, T. 20 S., R. 45 E.

MAP SYMBOLS

Contact — Approximately located

Fault contact — Dashed where approximately located; dotted where concealed; ball and bar on downthrown side

Strike and dip of beds

Horizontal beds

Trend of anticlinal fold axis

Location of whole-rock sample analyzed in Table 1

Location of mineralized sample analyzed in Table 2

Fossil locality

Approximate location of drill site in Table 3

GEOCHEMISTRY

Sample preparation

Samples for whole-rock analysis (Table 1) were crushed to minus ¼-in. 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 100 g of each sample was ground to minus 200 mesh in agate grinding media by X-ray Assay Laboratories (XRAL) of Don Mills, Ontario.

Samples for trace-element analysis (Table 2) were crushed to minus ¼-in. and split as indicated above. Each sample split was ground to about minus 200 mesh in chrome-steel grinding media in an Angstrom disc mill in the DOGAMI laboratory. Each minus-200-mesh split was split again to produce two subsamples: one for gold and one for the other trace elements to be determined.

Chemical analysis

Whole-rock analysis: X-ray fluorescence (XRF) analyses were performed by XRAL. XRAL used a fused button for its analyses (1.3 g of sample roasted 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 the 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), acid dissolution of the resulting bead, and a directly coupled plasma (DCP) emission spectrometer finish. The detection limit was 1 part per billion (ppb).

2. *Other trace elements* — Geochemical Services, Inc. (GSI), of Torrance, California, performed the analyses for 15 other trace elements. The method employed a proprietary acid dissolution/organic extraction of a 5-g sample. The finish was by induction coupled plasma (ICP) emission spectrometry. GSI considers the digestion to provide total metal contents except for gallium and thallium. The detection limit for a given element varies slightly as a result of GSI's monitoring process.

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Table 1. Whole-rock analyses, Double Mountain quadrangle, Malheur County, Oregon[1]

Map letter	Field and laboratory no.	1/4	1/4	Sec.	T.(S.)	R.(E.)	UTM coordinates	Elev. (ft)	Lithology	Map unit	SiO_2	Al_2O_3	TiO_2	Fe_2O_3	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	LOI	Total	Cr	Rb	Sr	Y	Zr	Nb	Ba
A	AWB-106	SE	SE	10	20	44	485386N 474860E	2,820	Quartz dacite	Tdsv	64.5	13.9	0.81	5.32	0.11	4.35	2.62	3.06	3.50	0.17	1.93	100.3	84	89	110	39	95	21	150
B	AWB-111	SW	SE	16	20	44	485212N 472730E	3,060	Perlite	Tdmp	72.1	12.7	0.10	0.89	0.05	0.93	0.29	5.27	3.20	0.02	4.47	100.1	16	135	<10	51	80	20	88
C	AWB-107	SE	SW	28	20	44	484920N 472020E	3,380	Olivine basalt	Tdmv	46.0	14.8	2.11	14.3	0.23	8.60	5.71	1.23	2.98	0.58	3.00	99.7	66	45	698	28	68	27	512
D	AWB-110	NW	NW	35	20	44	484882N 475140E	3,440	Olivine basalt	Trsb	46.4	15.3	2.10	14.1	0.22	10.1	6.19	0.60	2.66	0.63	1.23	99.6	106	30	226	33	114	30	294
E	AWB-109	SW	NW	3	21	44	484664N 473180E	3,520	Dacite	Tdsv	68.3	14.9	0.36	2.97	0.06	3.63	1.75	2.38	3.31	0.12	2.77	100.8	52	76	422	<10	115	15	1,430
F	AWB-108	SW	SW	10	21	44	484400N 473820E	3,600	Dacite	Tdsv	67.0	15.0	0.38	3.13	0.10	3.62	1.69	2.89	3.37	0.12	2.77	100.3	47	82	427	23	105	<10	1,450

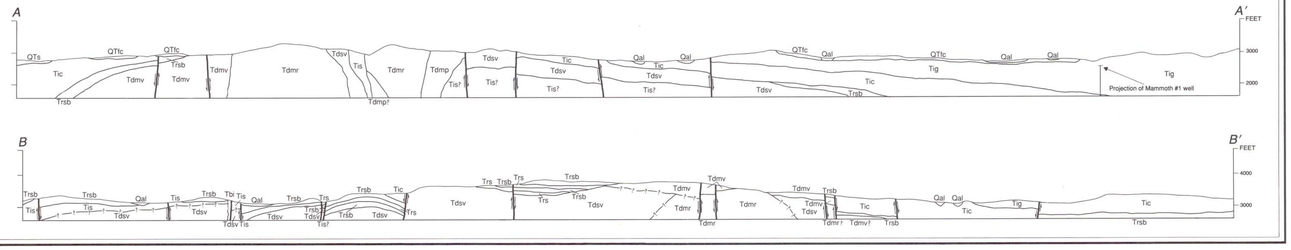
[1]XRF analyses by XRAL.

Table 2. Trace-element analyses, Double Mountain quadrangle, Malheur County, Oregon[1]

Map no.	Laboratory no.	1/4	1/4	Sec.	T. (S.)	R. (E.)	UTM coordinates	Elev. (ft)	Lithology	Map unit	Ag (ppm)	As (ppm)	Au (ppb)	Cu (ppm)	Hg (ppm)	Mo (ppm)	Pb (ppm)	Sb (ppm)	Tl (ppm)	Zn (ppm)	Bi (ppm)	Cd (ppm)	Ga (ppm)	Pd (ppm)	Se (ppm)	Te (ppm)
1	AWB-24	SE	SE	16	20	44	485228N 47274E	3,040	Limonitic breccia	Tdmr	<0.015	5.4	<1	5.50	<0.10	1.20	1.77	<0.25	<0.5	12.8	<0.25	<0.10	<0.5	<0.5	<1.0	<0.5
2	AWB-25	NW	SW	15	20	44	485288N 473716E	3,020	Limonitic breccia	Tdmr	0.07	312	2	23.8	<0.10	408	6.39	0.682	<0.5	29.4	<0.25	0.117	2.70	<0.5	<1.0	<0.5
3	AWB-26	SW	SW	15	20	44	485322N 473020E	3,060	Limonitic breccia	Tdmp	0.038	259	3	36.6	<0.10	288	6.95	0.535	<0.5	32.1	<0.25	<0.10	3.52	<0.5	<1.0	<0.5
4	AWB-27	SE	NW	15	20	44	485322N 473861E	3,160	Limonitic dacite	Tdsv	0.038	23.6	4	34.1	<0.10	17.1	1.65	0.406	<0.5	15.3	<0.25	<0.10	0.91	<0.5	<1.0	<0.5
5	AWB-28	NE	NW	21	20	44	485196N 472165E	3,360	Opalite	Tdmv	<0.015	59.6	3	3.74	<0.10	14.3	2.78	0.697	<0.5	12.3	<0.25	<0.10	0.92	<0.5	<1.0	<0.5
6	AWB-29	NE	NE	24	20	44	485196N 471764E	2,840	Sandstone	Tig	0.122	72.9	2	10.2	<0.10	3.79	3.53	0.69	<0.5	23.2	<0.25	<0.10	0.77	<0.5	<1.0	<0.5
7	AWB-30	NW	NW	28	20	44	485020N 471905E	3,480	Chalcedony	Trsb	<0.015	2.7	1	8.83	<0.10	3.30	0.62	<0.25	<0.5	4.1	<0.25	<0.10	<0.5	<0.5	<1.0	<0.5
8	AWB-31	SE	SW	28	20	44	484916N 472118E	3,400	Argillic breccia with calcite and chalcedony	Tdmv	<0.015	1.7	<1	16.4	<0.10	0.58	0.53	<0.25	<0.5	24.7	<0.25	0.113	1.97	<0.5	<1.0	<0.5
9	AWB-32	SE	SW	3	21	44	484574N 472185E	3,880	Chalcedony and opalite breccia	Tig	0.015	2.0	1	5.69	0.40	2.45	2.33	0.268	<0.5	8.4	<0.25	<0.10	0.52	<0.5	<1.0	<0.5
10	AWB-33	SW	SW	9	21	44	484434N 472000E	3,300	Sandstone	Tig	0.017	40.1	3	6.29	<0.10	0.91	6.51	0.495	<0.5	35.2	<0.25	<0.10	3.81	<0.5	<1.0	<0.5
11	AWB-34	NE	SW	9	21	44	484478N 472085E	3,100	Silicified breccia	Tdsv	0.017	1.1	10	26.2	<0.10	0.6	2.71	0.313	<0.5	23.4	<0.25	<0.10	1.46	<0.5	<1.0	<0.5
12	AWB-35	SW	NW	10	21	44	484508N 471934E	3,460	Jasperoid	Tdsv	<0.015	<1.0	1	18	<0.10	1.19	2.98	0.324	<0.5	20.3	<0.25	<0.10	0.92	<0.5	<1.0	<0.5
13	AWB-36	SW	NW	10	21	44	484504N 473420E	3,520	Jasperoid	Tdsv	<0.015	1.5	1	7.74	0.42	0.59	1.81	0.292	<0.5	8.7	<0.25	<0.10	1.09	<0.5	<1.0	<0.5
14	AWB-37	NE	SW	10	21	44	484488N 473846E	3,740	Jasperoid	Trsb	<0.015	7.0	5	6.38	0.14	4.01	2.52	0.611	<0.5	4.9	<0.25	<0.10	<0.5	<0.5	<1.0	<0.5

[1]Gold analyses by Bondar-Clegg; other trace-element analyses by GSI.

Table 3. Gas exploration wells

Map no.	Name	Depth (ft)	Date drilled
1	El Paso Natural Gas Federal-Spurrier 1	7,470	1955
2	Columbia Oil and Gas	975	1909
3	Mammoth Oil and Gas	1,280	1909

GEOLOGIC CROSS SECTIONS